5. ANALYSIS OF RESULTS

The data were analysed using the Statistical Package for the Social Sciences (SPSS) and Excel.

The analysis covered the following aspects:

- Participation in survey
- Characteristics of participants, comparison with the South Australian community and comments by participants on the survey
- Ratings of the scenes of South Australian landscapes
- Overall ratings and regional ratings
- Analysis of tree characteristics
- Development of the predictive model

Statistical assistance and advice was gained from Ms Mary Barnes of CSIRO Division of Mathematics and Information Sciences.

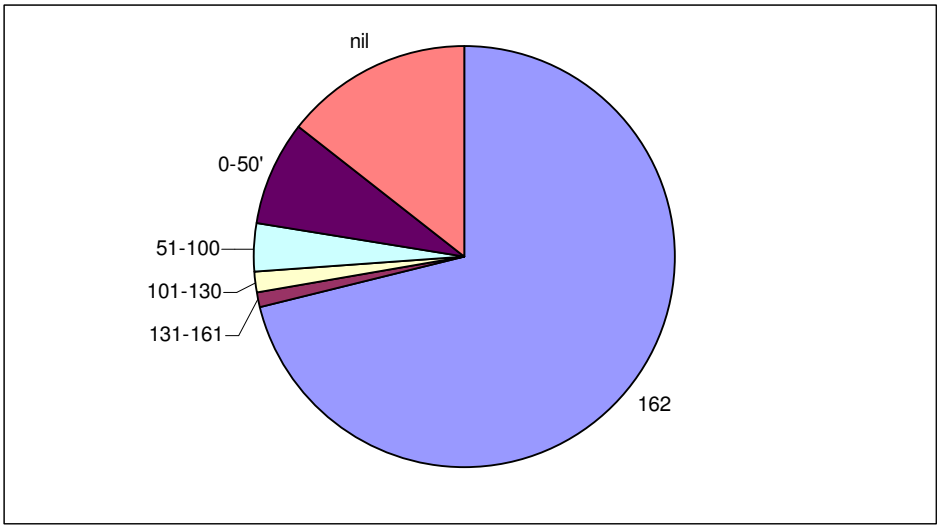
5.1 PARTICIPATION IN SURVEY

Number of Participants

The internet survey commenced on 1 April and ended on 10 May 2004. A total of 619 participated, however not all completed the survey (Table 13, Figure 12). Around 71% completed the survey.

Table 13 Participation in Survey – number of scenes rated

Scenes rated	Frequency	%
162	440	71.1
131 – 161	7	1.1
101 – 130	10	1.6
51 – 100	23	3.7
1 – 50	49	7.9
nil	90	14.5
Total	619	100.0



Note: numbers refer to number of scenes rated

Figure 12 Pie Chart of the Number of Scenes Completed

A large number of 440 participants completed the survey and size of this sample should provide an excellent basis for analysis. This provided a confidence interval of 4.67, i.e. at 95% confidence level, the results will be +/- 4.67[1]. If all 619 responses had been available to be used, it would be +/- 3.94.

Consideration was given to the inclusion of the 17 participants who completed over 100 scenes, including two who completed over 155 out of the 162 total scenes. Their inclusion would improve the confidence interval to 4.58, an increase of only 0.09 (cf 4.67) which was not considered sufficient to warrant their inclusion.

A relatively large proportion of participants commenced the survey but failed to complete it. Ninety participants dropped out after completing the demographic data section but without commencing the ratings of scenes. A further 78 commenced the ratings but dropped out *en route*, mainly in the first third of the survey.

Because provision for comments was provided only on completion of the survey the reasons for the drop-outs can only be speculated. An email from one participant indicated that when he returned after 30 minutes from the computer he found the survey had timed-out, despite the statement that they could use it as long as they required. Some other participants may have been similarly timed-out.

Time to complete survey

The histogram for the completed surveys is positively skewed to the left hand side representing the shorter time periods. The mean is 14.6 minutes (SD 10.1 minutes) (Figure 13).

1. Source: www.surveysystem.com/sscalc.htm#ssneeded

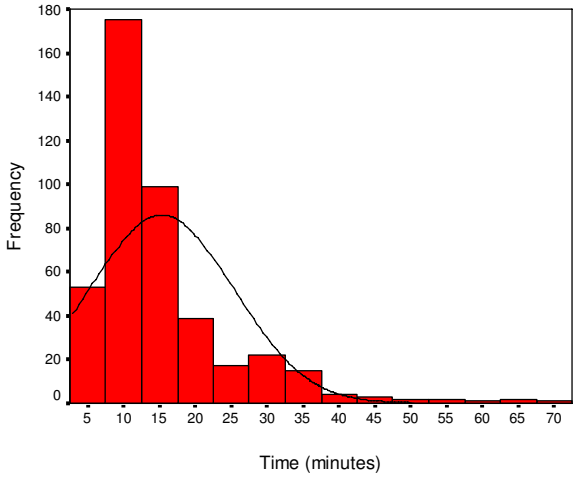


Figure 13 Elapsed times for completed surveys

Participants used either dial up or broadband connections to the Internet, dial up being generally slower to process the scenes than broadband. Broadband was used by 74% and dial-up by 26% of participants. The two connection means were examined to assess whether the elapsed time used to complete the survey differed. Their means were similar: broadband 14.6 minutes (SD 9.6), dial up 15.1 minutes (SD 11.6). The difference was not significant (t = -0.39, df = 366, p = 0.69).

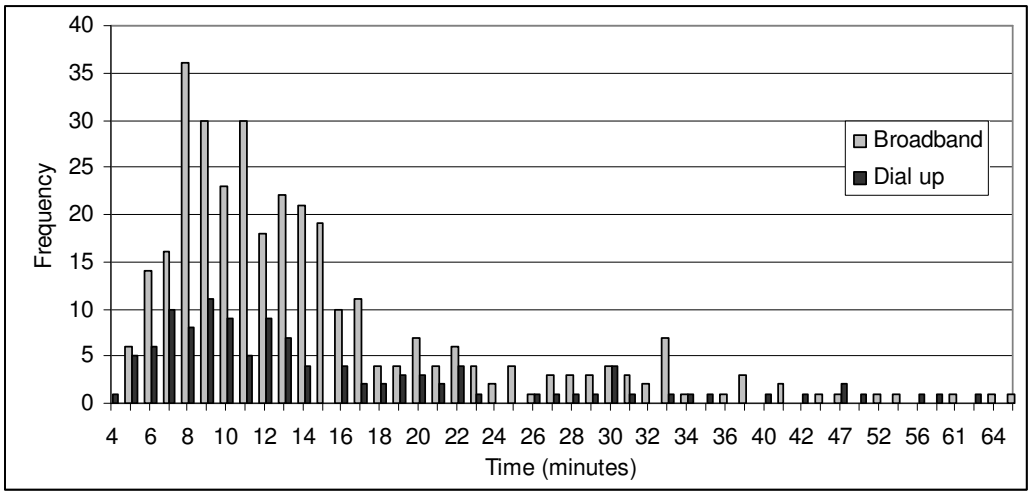


Figure 14 Time taken to complete survey – by Internet connection type

The times taken by the 116 dial up connections and 330 broadband connections are illustrated by Figure 14. The most rapid was 4.4 minutes (on dial up) and there were 11 who completed it in five minutes and 20 who completed it in six minutes. The slowest was 63 minutes on dial up and 70 minutes on broadband.

5.2 PARTICIPANT CHARACTERISTICS

Although the survey was anonymous, participants were asked to provide personal details to enable a comparison with the general population. Comparisons with the

South Australian data are provided based on the 2001 Census (ABS 2002). This summary covers only the responses of those who completed the survey.

Age

Table 18 summarises the age distribution of participants and indicates a slightly greater proportion of middle age and substantially fewer older participants. This may be a consequence of using the Internet for the survey as older people have lower rates of participation (see Table 14).

Table 14 Age Distribution of Participants

Age cohorts	**18 – 24**	**25 – 44**	**45 – 65**	**65+**
South Australian %	16.4%	35.9%	29.7%	18.0%
Survey frequency	54	210	164	11
Survey %	12.3%	47.8%	37.4%	2.5%
Internet access 2002 (ABS, 2004)	84%	73.5%	50%	13%

The distribution of ages in the survey differs significantly from the South Australian community ($\chi^2 = 89.12$, df 3, $p = 0.000$).

Gender

More males than females participated in the survey (Table 15) and about 4.3% more than in the South Australian community.

Table 15 Gender of Participants

	Males	**Females**
South Australian	49.2%	50.7%
Survey frequency	235	204
Survey %	53.5%	46.5%

The survey participants did not differ significantly from the South Australian community ($\chi^2 = 3.08$, df = 1, $p = 0.07$).

Education

Table 16 Educational Attainment of Participants

	No qualification	**Diploma/Certificate**	**Degree**	**Higher degree**
South Australian community	68.1%	21.2%	8.2%	2.5%
Survey frequency	29	80	182	148
Survey %	6.6%	18.2%	41.5%	33.7%
Internet users 2002 (ABS 2004)	48%	56%		88%

Note: Internet users are whole of Australia.

As expected the education level of participants was high, much higher than that of the community, with 75% holding degrees or higher degrees (Table 16). This compares with 10.7% of the community.

The educational level was significantly different from the community ($\chi^2 = 2540$, df = 3, $p = 0.000$). ABS figures indicate that internet use increased with education.

Birthplace

The majority of participants, 81%, were born in Australia, slightly higher than the State figure of 75.4% (Table 17).

Table 17 Birthplace of Participants

	Born in Australia	Not born in Australia
South Australian 2001 Census	75.4%	20.3%
Survey frequency	364	75
Survey	82.9%	17.1%

Note: ABS Census figure totals 95.7%, presumably because of participant failure to identify birthplace

The difference between the survey participants and the South Australian community was not significant (ie $\chi^2 = 0.24$, df = 1, $p = 0.62$).

Comparison of survey participants with South Australian community

The survey participants differed significantly from the South Australian community in respect of their education and their age, however their gender balance and birthplace did not differ significantly. Education is an important component in motivating participation in the survey. The author's past experience with such surveys has been that despite seeking the involvement of a broad range of participants, the better educated tend to be much more willing to participate. The extent to which education affects ratings is not expected to be significant but is examined below. Similarly age is not expected to affect ratings, however this too is examined.

Given that two of the characteristics of the survey participants were statistically significantly different to the South Australia community, the question arises whether their ratings can be validly accepted. To examine this, the ratings were analysed on the basis of each of the participant characteristics. If there was little change across the range of a given characteristic, e.g. education, then it would be apparent that the influence of the characteristic was minimal and acceptable.

Table 18 Ratings by Participant Characteristics

	Factor Categories			
	1	2	3	4
Age	5.55	5.46	5.55	5.73
Gender	5.46	5.53		
Education	5.08	5.80	5.46	5.49
Birthplace	5.52	5.45		

Table 18 summarises the ratings arranged by the characteristics of the participants. The boxplot (Figure 15) reinforce the similarity of the ratings. The ratings range for 5.08 to 5.80, only 0.72 or 7.2% on the 1 – 10 rating scale. Except for three, all are within the range 5.45 to 5.55 which is a range of 0.10 or 1.0%.

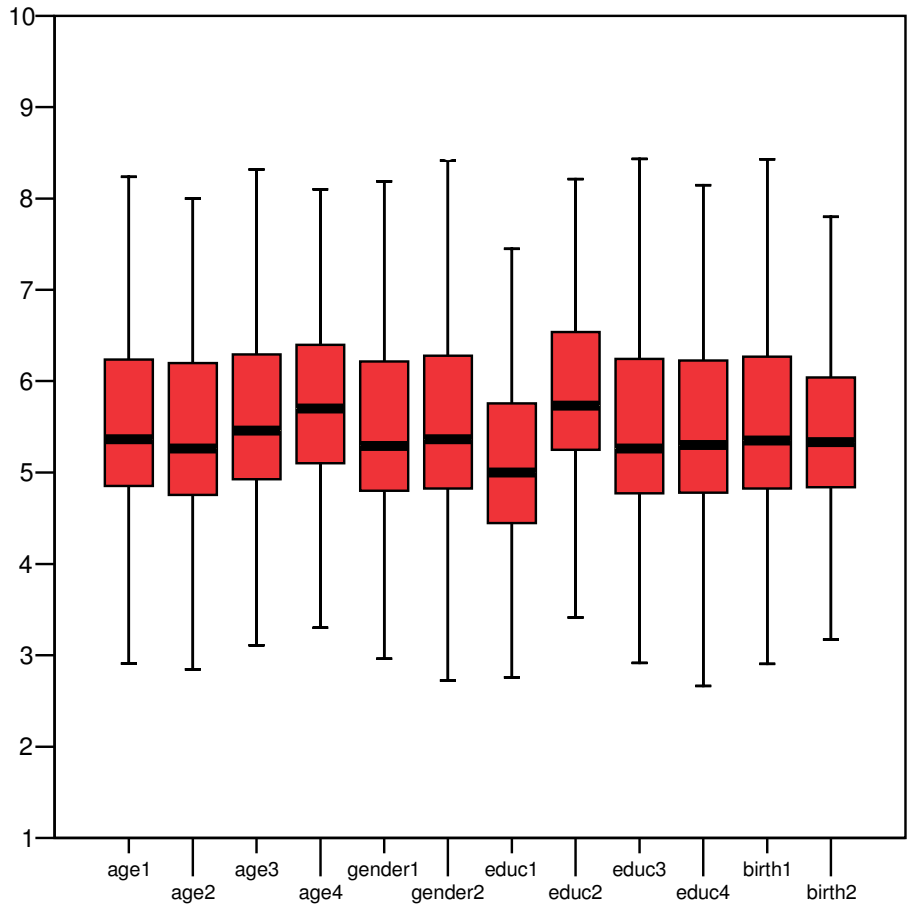


Figure 15 Boxplot of Ratings by Participant Characteristics[2]

The similarity of ratings across the participant characteristics suggests that none should have a major influence of ratings. Thus although the participants differ significantly from the South Australian community, this will have a minimal impact on the findings. The significance of the differences in ratings across the participant characteristics was examined (one-way ANOVA).

- Age F = 1.73, df = 3, 644, p = 0.16
- Gender F = 0.28, df = 1, 322, p = 0.60
- Birthplace F = 0.28, df = 1, 322, p = 0.60
- Education F = 11.55, df = 3, 644, p = 0.000

Only for education were the differences in ratings across the categories of a participant characteristic significant. For age, gender and birthplace the differences in ratings were not significant. This indicates that the differences in the survey participants' age, gender and birthplace compared with the population will have negligible effect on their ratings.

2. The boxplot shows the interquartile range (i.e. 25% - 75%) and the outliers show the highest and lowest values. The line through the box is the median. The boxplot (or box & whiskers plot) illustrates the variance of the data and the relative position of different groups.

Participant Comments

On completion of the survey, participants were provided with an opportunity of commenting on the survey. Unfortunately being at the end it did not enable those who failed to compete the survey to provide comments. The comments in full are included in Appendix 1. The following groups summarises the comments.

Colour of scenes, particularly green, was considered to enhance preferences compared with the bareness of some scenes.

Health of trees important and was linked with the following comment.

Isolation of trees and lack of complete vegetation stratum comprising both tree overstorey and understorey were frequent concerns. Comments:

- Question value of retaining a single tree as opposed to stand of trees with understorey plants
- Monotony of pasture understorey/eucalyptus tree overstorey became less pleasing
- Odd having individual trees in landscape – appealing scene needs complementary objects
- Low graded individual trees & monocultures
- Adverse to dead timber and bare ground
- Magnificence of some trees against barren farm landscape – farmland detracted from overall amenity of scene
- Lack of understorey reduces ratings
- Isolated trees or remnants in agricultural surroundings is depressing given the associated clearance
- Concerned that results may lead to thinking a few trees in a degraded over-grazed landscape is attractive. Isolated Eucalypts unprotected from grazing is a sorry sight – need corridors of natural vegetation protected from agriculture, grazing and pest plants.
- Habitat usefulness should be most important factor in decisions over removal of trees
- Too much emphasis on highly modified landscapes – lots of senescing trees amongst pastures. Need more representation of relatively pristine arid lands, coastal environments and wetter hills & gully environments. Also no urban or near-urban landscapes – Hazelwood Park, Second Creek catchments; also Flinders Chase, Deep Creek.
- Why didn't scenes have good understorey?
- Highlights lack of regrowth in farmed/grazed areas
- Few photos that included natural understorey, healthy or otherwise
- Tree in landscape can only be evaluated through its relationship to the vitality of the landscape – otherwise a cardboard cutout will suffice. Tree health, biotic diversity, age of living organisms, interaction with man form mutually interdependent relationships which make up the whole.
- Ecosystem function more important than amenity value
- Barren ground in desert beautiful but barrenness in agriculture not beautiful
- Tree shapes important with isolated trees
- Hard to see if grasses were native or introduced.
- Dead wood makes landscape appear under severe stress or dying
- Excessively cleared - low ratings
- Loved some of the mature trees in paddocks, but regretted when they were standing alone, with no regrowth nearby
- Looking for a range of ages in the tree scenes and in most of the photos there were single spaced older trees

- Varied strata is much more amenable than isolated large trees or stand of trees within a wheat paddock or a stand with a distinct graze line

Naturalness important. Comments:

- Sand dunes, outback
- Undisturbed landscapes
- Native trees
- Presence of water and sea
- Little introduced species and where no degradation
- Context of trees important – naturalness and sustainability
- Natural scenes more beautiful
- Natural environment more attractive than grassy cow paddocks
- Trees and native vegetation make huge aesthetic difference
- Mountainous landscapes may be healthy ecosystems or weed infested
- Desert shots largely intact ecosystems – should have included some degraded desert images
- Highest ratings to healthy, undisturbed vegetation in natural state; lower score depending on the degree of clearance, considering also health of tree/s
- Coastal or arid zone vegetation if it appeared intact rated highly

Comments on scenes

- Scenic shots more enjoyable - whole landscape rather than single tree in a paddock
- Overall scene or sections of vegetation within scene – which should be basis?
- Rating of health & appearance vs overall landscape
- Judging attractiveness of vegetation or scenery in general
- Familiarity with different landscapes
- Photos are of poor quality and hard to determine what species are present
- Easier to rate if species name included with picture
- Presence of water and or interesting topography biases some scenes (South Australian landscape scenes)

Repetitive scenes

About 11 respondents complained of repetition of scenes. Apart from the first ten Example Landscapes replicating those which follow, no scenes were replicated. The comment indicates that the scenes were perceived to be similar.

Photographs

- Framing of photograph
- Close vs panoramic scenes / Close ups make trees look more impressive / Closeup or distant have different amenity value for same tree / Angle of photograph and close up affect attractiveness / Focal length
- High vantage point enhances scene
- Quality of photograph affects scenic appreciation
- Difficult not to rate picture instead of landscape / Rating of photos rather than scene / photograph's composition/ is amenity value for the tree/trees or the whole landscape?

Length of session

About 11 respondents (out of over 500) found the rating of 162 scenes took too long. Comments included:

- Sameness of photos can make it tedious and therefore lose interest
- Too many photos – tired at end
- Took 45 minutes due to slow internet. Hard to concentrate that long.
- Could it have been edited a little?

- Impatience towards end may affect ratings
- Took three of us 15 – 18 minutes; need to adjust time factor
- Ten minutes! It took me an hour and a quarter
- Took too long – started to lose interest
- Too many photos - gets boring after the first 100.

The similarity of tree scenes was one of the reasons for inclusion of general scenes of the South Australian landscape, to provide relief and context.

Positive comments on the survey included:

- Easy and convenient through the internet survey
- Great way to submit the survey!
- Idea for this kind of survey is great.
- Interesting way to survey
- Survey very interesting
- Thanks … I thought it was an interesting exercise.
- Thanks - nice start to my day! Pleasantly surprised by the content!
- This is an excellent exercise. (It) was quite helpful to me to find which images I felt pleased by
- Thoroughly enjoyable
- There's a lot of psychology in this!
- Great survey
- Cunningly designed test!
- Very good, should have more surveys that are similar
- The idea and design were a great idea

Suggestions for improvements were:

- Would have liked to review choices as there was no way to undo or change responses
- Be useful to be able to review ratings – eg by having thumbnails at the end with ratings under each to get them more consistent.
- The fact that we knew the purpose of the survey – to influence stand alone tree policy – probably impacted results??
- Would like to know natural resources background of respondents
- Need to show number of scenes left
- Instructions indicated no time-out feature but in fact it closed after 20 minutes (this was later remedied)

Assessment of the participant comments

It is evident from the large number of comments concerning the lack of understorey to the isolated trees, the degraded over-grazed fields in which they were situated, the age of the trees and lack of regrowth, together with the comments about the importance of naturalness in ecosystems, that many of the participants have a background in the life sciences, land management and related fields.

Given however that professionals similar to these are likely to be involved in assessing applications for clearance, including of their amenity value, it can be accepted that the results will more closely reflect their preferences.

5.3 RATING OF SOUTH AUSTRALIAN LANDSCAPES

The scenes of scattered and isolated trees were interspersed with scenes of the South Australian landscape to provide a benchmark for ratings and relief from the scenes of trees. These scenes had been rated previously in the author's PhD research and the ratings were compared with the earlier results.

The means for the two data sets were similar: survey mean 5.895, thesis mean 5.93. The correlation coefficient was 0.84 between the two sets of results. The one-way ANOVA indicated the difference between the two sets was not significant ($F = 0.015$, $df = 1, 98$, $p = 0.90$). Figures 16 and 17 show the histograms of distribution for each set.

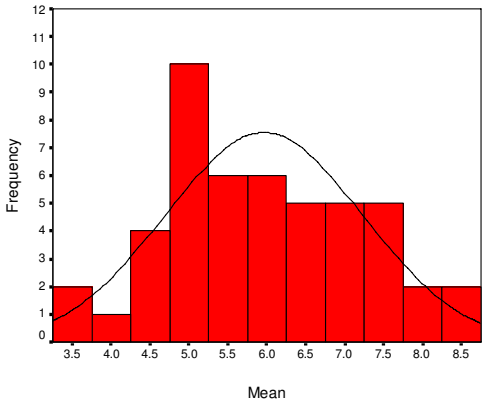


Figure 16 Histogram of Thesis Means

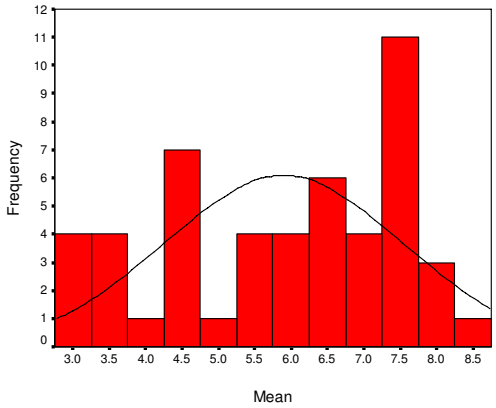


Figure 17 Histogram of Survey Means

Of the 50 scenes, 21 were similar (i.e. +/- 0.5 variation), a further 14 were higher than the earlier ratings (i.e. > +0.5) and 15 were lower (i.e. > -0.5). These are illustrated by Figure 18.

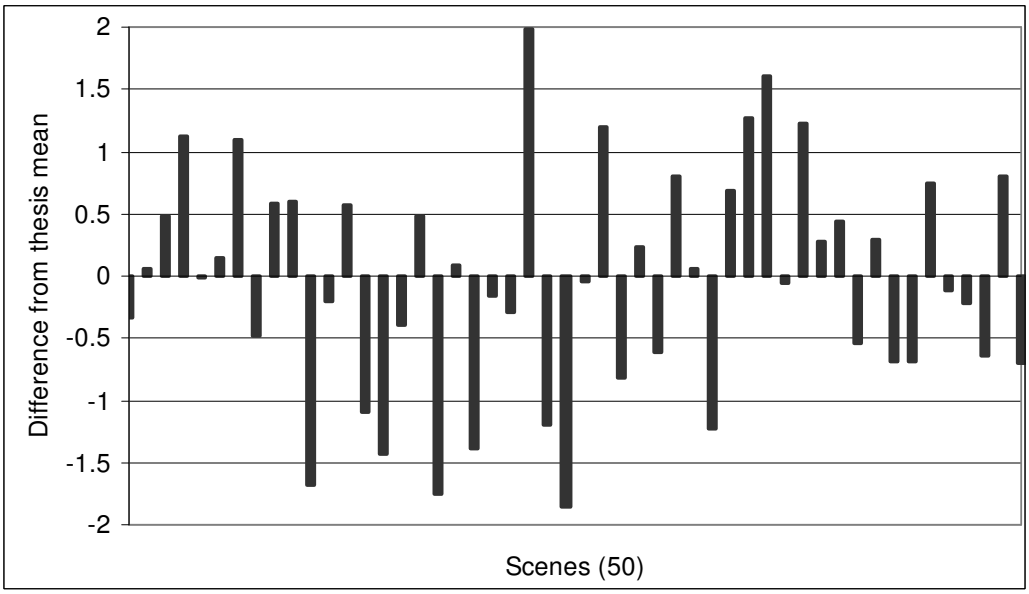


Figure 18 Survey Ratings Compared with Thesis Ratings

Examination of the scenes which rated higher indicated that they were mainly natural scenes, heavily treed or of natural vegetation with the full stratum of vegetation layers. The following are examples of arid vegetation which rated higher than in the thesis survey.


Scene 7. Original rating 6.6 Survey rating 7.7


Scene 39. Original rating 5.4 Survey rating 7.0

Conversely most of the scenes which rated lower were of barren fields planted with cereal. In addition, several natural scenes which appeared overgrazed, degraded or lacking trees also rated poorly.


Scene 12. Original rating 5.4 Survey rating 3.7


Scene 16. Original rating 4.9 Survey rating 3.8

These findings suggest that some participants have been influenced in their ratings of the scenic attractiveness of the scenes by the botanical integrity of the scene. The proportion is unknown but appears high as it has produced these results.

5.4 OVERALL RATINGS AND REGIONAL RATINGS

Overall Findings

The data set for scattered and isolated tree scenes was prepared, removing the 50 benchmark scenes of South Australian landscapes, and all of the ratings containing less than 162 ratings. The data set therefore contained 112 scenes of scattered and isolated trees rated by 438 participants.

Table 19 summarises the statistics of the participant and tree scene data sets and Figures 19 and 20 show the distributions for these two data sets.

Table 19 Distribution Statistics

	Participants	Tree Scenes
Mean	5.33	5.33
Standard Deviation	1.27	0.72
Skewness	-0.05	0.12
Kurtosis	0.15	-0.06

The overall mean rating for the participants was 5.33 (SD 1.27) which is close to the median (5.5) for the 1 – 10 scale. The distribution was only slightly skewed negatively and the kurtosis (peakiness) was low. The distribution was close to a normal distribution as also evidenced by the QQ plot of normality (Figures 20). The ratings were distributed across nearly the entire scale, from 1.8 to 9.9.

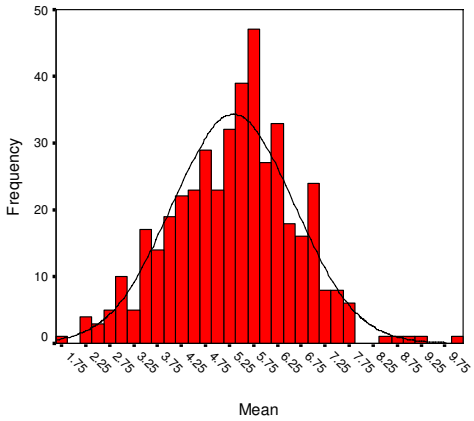


Figure 19 Histogram of Participant Mean Ratings

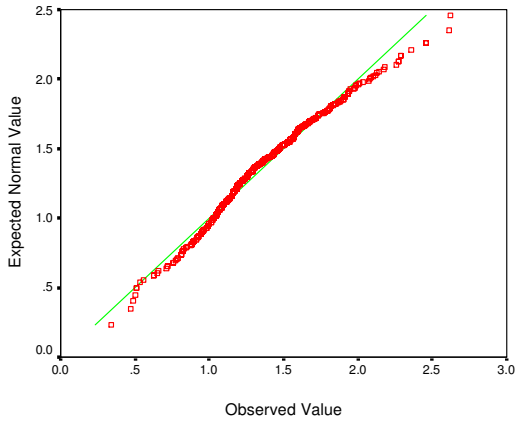


Figure 20 QQ plot of Participant Mean Ratings

The overall mean rating for the ratings of tree scenes was 5.33 (SD 0.72). Figure 21 shows the histogram of the distribution of mean ratings. The distribution was slightly positively skewed and the kurtosis was low. The distribution was close to a normal distribution, as shown by the QQ plot of normality (Figures 22).

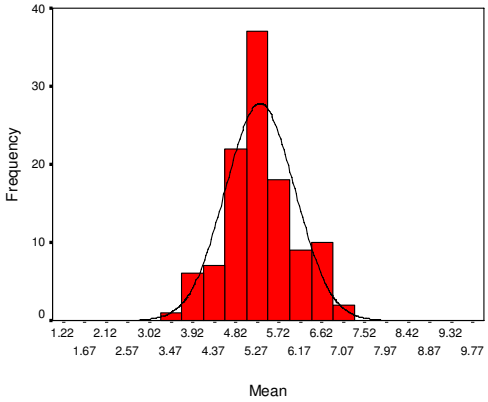


Figure 21 Tree Scene Mean Ratings

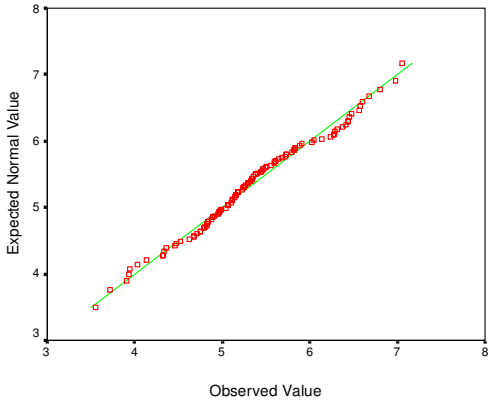


Figure 22 QQ Plot of Tree Scene Mean Ratings

The mean ratings of tree scenes were tightly distributed around the mean, extending from 3.5 to just over 7.

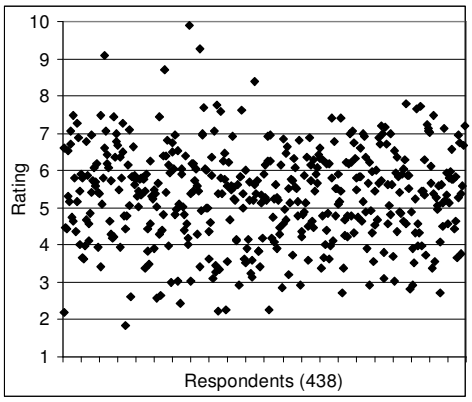


Figure 23 Distribution of Respondent Mean Ratings

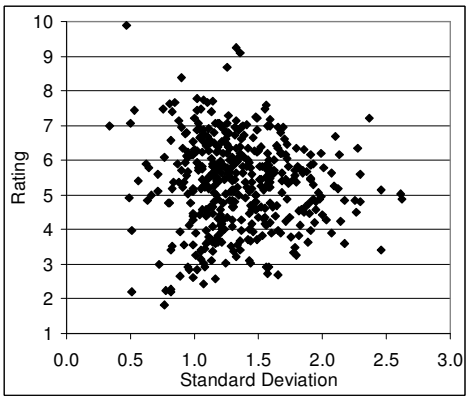


Figure 24 Respondent Mean Ratings vs SDs

Figures 23 and 24 illustrate the distribution of ratings for the respondents and also the relationship between the means and standard deviations. Figures 25 and 26 illustrate the same for the ratings of the tree scenes. The standard deviations were tightly bunched around 1.75.

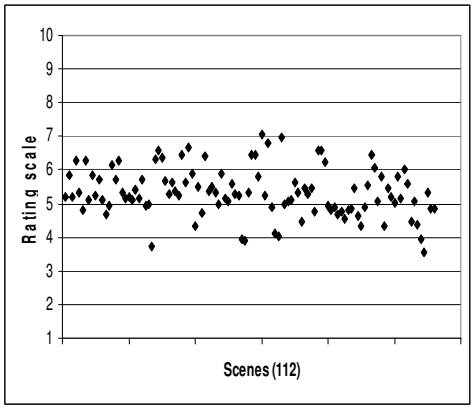


Figure 25 Distribution of Tree Scene Mean Ratings

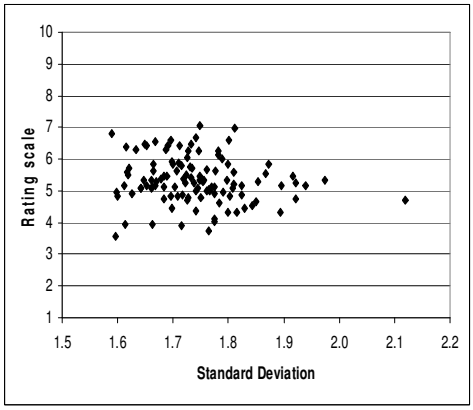


Figure 26 Tree Scene Mean Ratings vs SDs

Figure 27 Ratings of Tree Scenes Arranged in Ascending Order

Figure 27 shows the distribution of tree ratings arranged in ascending order. Overall the distribution had a slight 'S' curve, curving down at the lower ratings and arcing upwards at the top ratings. This suggests a tendency to place a slightly more extreme value on scenes of low or high quality. This phenomenon is common in surveys of this type (Prof. Terry Daniel, Univ. of Arizona, *pers. comm.*).

Regional Ratings

Table 20 indicates the means for the scenes in each of the regions. The range covered was less than 1.5 on the 1 – 10 rating scale, from the highest at the Barossa Valley (5.83) to the lowest at Langhorne Creek (4.41). Figure 31 shows a boxplot for the regional data. The narrow range of the means – only 1.42, reflects the comments by participants of the similarity of the scenes. The one-way ANOVA test indicated that the differences in ratings between the regions were significant (F = 46.53, df 8, 3933, p = 0.000).

Table 20 Regional Means

Region	Mean	SD
Onkaparinga Valley	5.51	1.58
Eden Valley	5.37	1.34
Barossa Valley	5.83	1.35
Clare Valley	5.49	1.25
Mundalla - Bordertown - Frances	5.23	1.29
Padthaway – Naracoorte – Hyman - Wrattonbully	5.30	1.40
Coonawarra – Keppoch - Nangwarry	5.41	1.32
SE Robe	4.63	1.50
Langhorne Ck	4.41	1.31

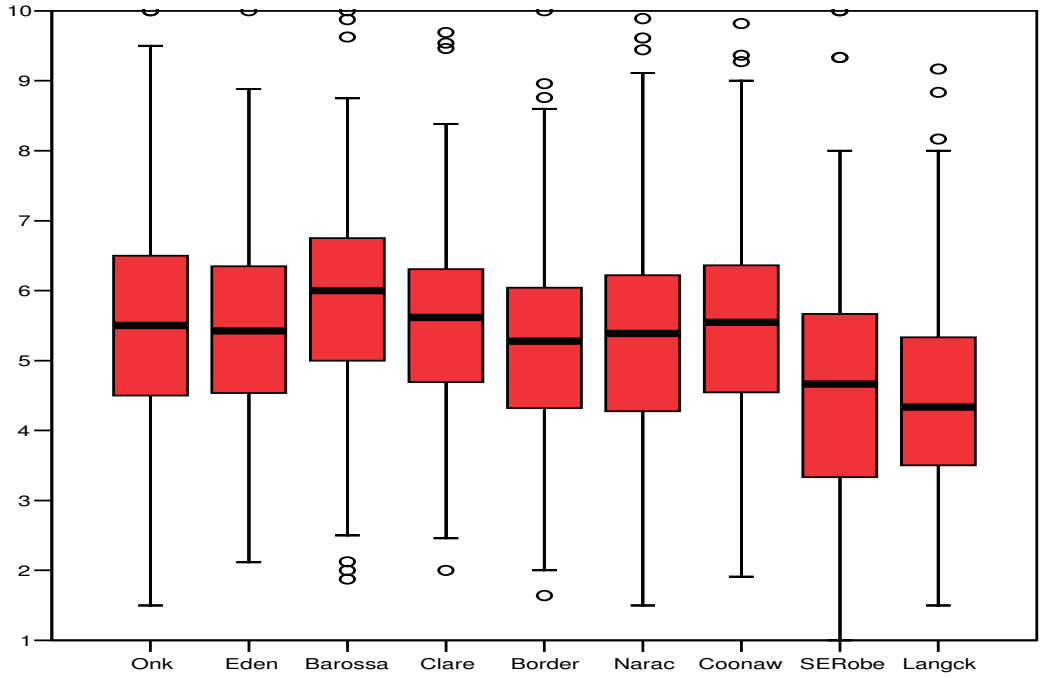


Figure 28 Boxplot of Regional Means

5.5 ANALYSIS OF TREE CHARACTERISTICS

Each of the trees which were subject to the rating survey was classified and these classifications were compared with the ratings obtained. This assists in the identification of factors which have a significant influence on ratings. The test of significance used throughout was the one-way ANOVA where the units of each tree characteristic were entered as the independent factor on which the ratings were dependent.

Height of Trees

Low Scene112

High 94

Medium 47

Very high 84

The height of trees was classified on a four-point scale: low, medium, high and very high. Height had a very positive influence on ratings ($y = 0.26x + 4.58$, $r^2 = 0.79$) and the differences between the categories were significant ($F= 32.21$, $df = 3, 1748$, $p = 0.000$). Table 21 summarises the ratings and Figure 29 is a boxplot of the relationship between height and ratings. Figure 30 exaggerates the vertical axis and shows the trend line.

Table 21 Influence of Tree Height on Ratings

	Low	Medium	High	Very High
Number of scenes	7	51	51	3
Mean	4.67	5.30	5.42	5.49
SD	1.35	1.25	1.31	1.63

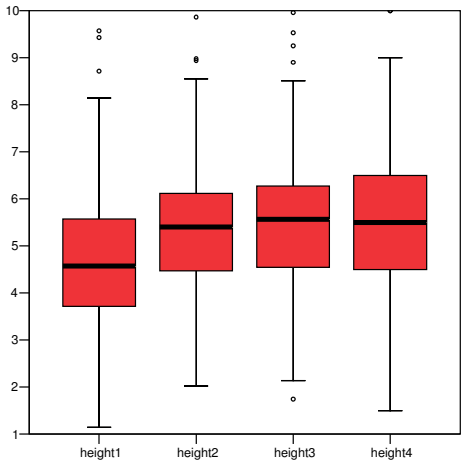


Figure 29 Influence of Tree Height on Ratings

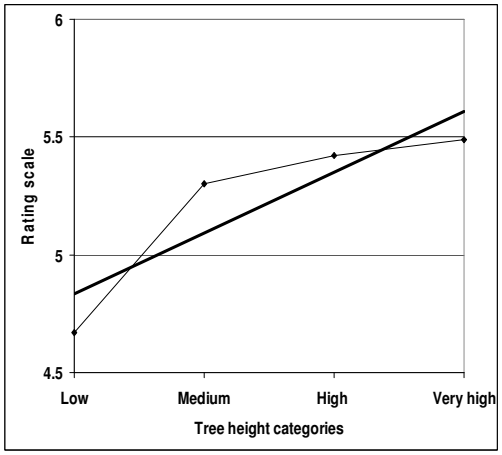


Figure 30 Trend line for Tree Height

Trunk Height

The heights of the tree trunks were similarly classified on a four-point scale, however no tree was classified with a very high trunk so there were three categories.

Low 7

High 11

Medium 37

Table 22 Influence of Trunk Height on Ratings

	Low	Medium	High	Very High
Number of scenes	46	40	26	-
Mean	5.31	5.30	5.39	-
SD	1.28	1.30	1.26	-

Trunk height had a negligible influence on ratings ($y = 0.04x + 5.25$, $r^2 = 0.66$) and the differences between the categories were not significant ($F= 0.68$, $df = 2, 1311$, $p = 0.51$) (Table 22, Figures 31, 32).

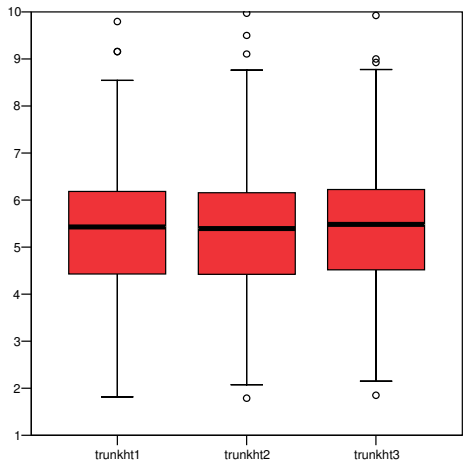


Figure 31 Influence of Trunk Height on Ratings

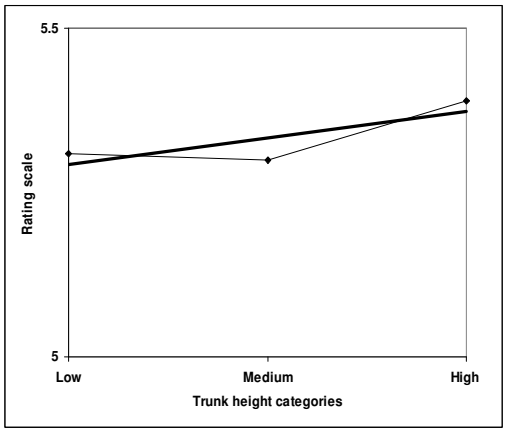


Figure 32 Trend line for Trunk Height

Trunk Diameter

Narrow 66

Thick 78

Medium 82

Very Thick 20

The diameter of tree trunks was assessed on a four-point scale: narrow, medium, thick and very thick.

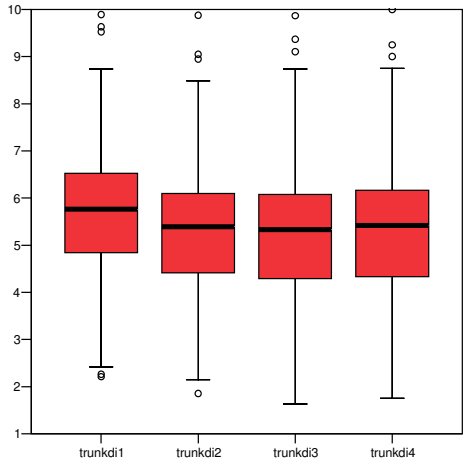


Figure 33 Influence of Trunk Diameter on Ratings

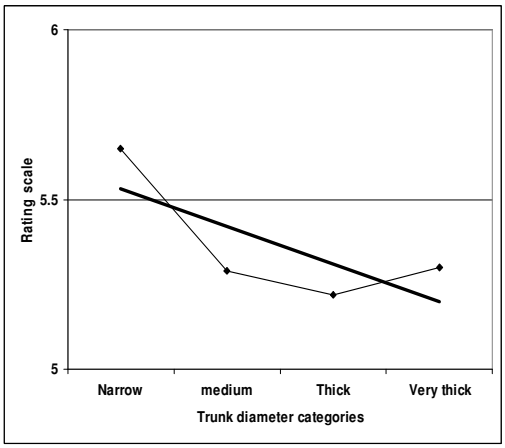


Figure 34 Trend line for Trunk Diameter

Table 23 Influence of Trunk Diameter on Ratings

	Narrow	Medium	Thick	Very Thick
Number of scenes	19	41	40	12
Mean	5.65	5.29	5.22	5.30
SD	1.27	1.27	1.31	1.37

Trunk diameter had a slightly negative influence on ratings ($y = -0.11x + 5.65$, $r^2 = 0.56$) between height and ratings and the differences between the categories were significant ($F= 9.49$, $df = 3, 1748$, $p = 0.000$) (Table 23, Figures 33, 34).

Trunk Verticality

Slight lean 12

Moderate lean 9

The verticality of the trunk was assessed on a four-point scale: vertical (80 - 90°), slight lean (70 - 80°), moderate lean (60 - 70°) and major lean (50 - 60°). There were no grade 4's.

Table 24 Influence of Trunk Verticality on Ratings

	Vertical	Slight lean	Moderate lean	Major lean
Number of scenes	67	38	7	-
Mean	5.22	5.50	5.35	-
SD	1.27	1.29	1.33	-

Verticality had a negligible effect on ratings (y = 0.065 + 5.23, r^2 = 0.22). The differences between the categories were significant (F= 4.83, df = 2, 1311, p = 0.008) (Table 24, Figures 35, 36).

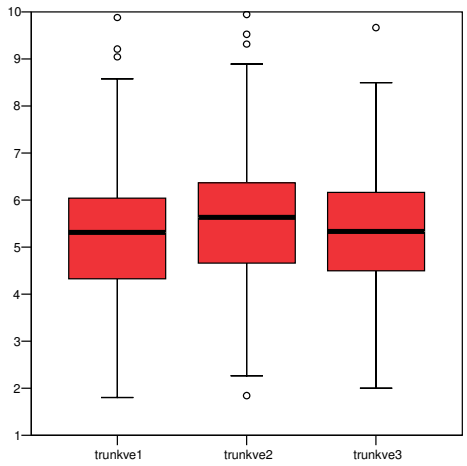


Figure 35 Influence of Trunk Verticality on Ratings

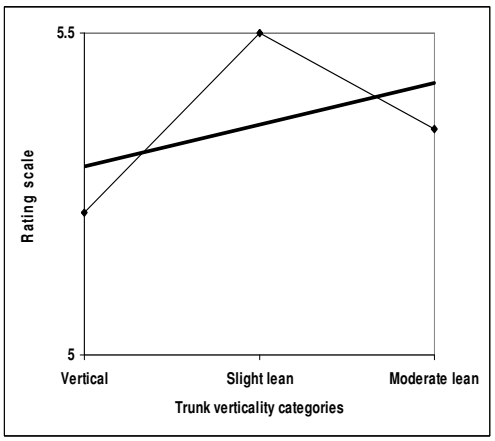


Figure 36 Trend line for Trunk Verticality

Canopy Form

Narrow 1

Wide & high 67

Medium 38

Very wide & very high 102

The form of the leaf canopy was assessed on a four-point scale of its dimensions: narrow, medium, wide and high, and very wide/very high.

Table 25 Influence of Canopy Form on Ratings

	Narrow	Medium	Wide & high	Very wide/very high
Number of scenes	13	34	50	15
Mean	5.40	5.49	5.19	5.40
SD	1.31	1.26	1.29	1.37

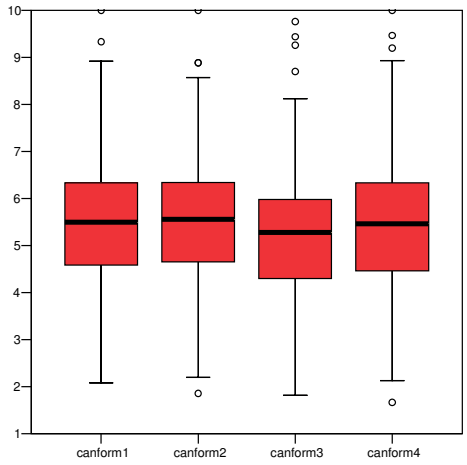


Figure 37 Influence of Canopy Form on Ratings

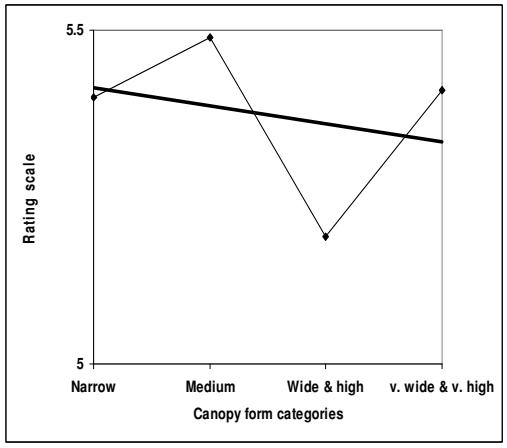


Figure 38 Trend line for Canopy Form

The form of the leaf canopy appeared to have a variable effect on ratings, with the highest ratings being for the narrow and medium categories ($y = -0.03x + 5.44$, $r^2 = 0.07$) which relates to the earlier finding of the preference for trees with narrow trunks. Overall the differences between the categories were significant ($F= 4.30$, $df = 3, 1748$, $p = 0.005$) (Table 25, Figures 37, 38).

Canopy Density

Very open 74

Open 29


Dense 31


Very dense

The density of the leaf canopy was assessed on a four-point scale: very open, open with much light showing through the leaves, dense with some light showing through, and very dense with virtually no light showing through.

Table 26 Influence of Canopy Density on Ratings

	Very open	Open	Dense	Very Dense
Number of scenes	18	60	30	4
Mean	5.04	5.45	5.29	5.26
SD	1.30	1.27	1.32	1.42

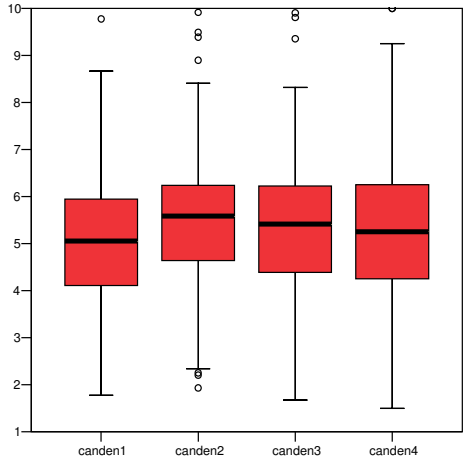


Figure 39 Influence of Canopy Density on Ratings

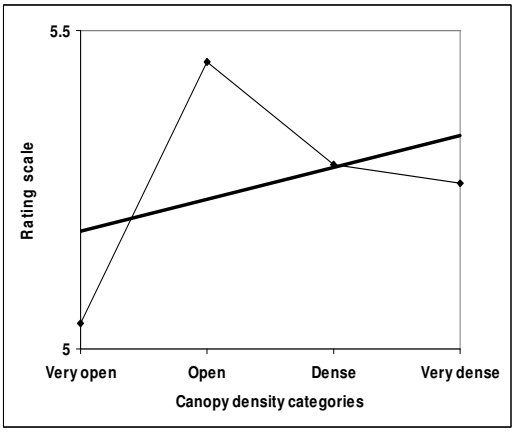


Figure 40 Trend line for Canopy Density

The density of the leaf canopy had a slightly positive effect on ratings ($y = 0.05x + 5.14$, $r^2 = 0.15$). The differences between the categories were significant ($F= 7.01$, $df = 3, 1748$, $p = 0.000$). The peak of ratings for the open category suggests that trees with open canopy with much light showing through the leaves are favoured over denser or more open canopies (Table 26, Figures 39, 40).

Tree Health


Dead 61


Fair 80


Poor 59


Good 88

The health of the tree was assessed on the basis of its leaves and branches. The presence of many dead branches or lerp infected leaves indicated loss of health. Health was assessed on a four-point scale: dead tree, poor (extensive dead limbs), fair (some dead limbs, infected leaves), and good (healthy tree without dead limbs or infected leaves).

Table 27 Influence of Tree Health on Ratings

	Dead	Poor	Fair	Good
Number of scenes	3	11	22	76
Mean	4.78	4.85	5.09	5.49
SD	1.54	1.34	1.33	1.28

The health of the tree had a positive effect on ratings ($y = 0.24x + 4.47$, $r^2 = 0.91$) and the differences between the categories were significant ($F= 23.72$, $df = 3, 1748$, $p = 0.000$). Omitting the three scenes of dead trees in the very poor category, on the basis of the remaining three categories, health had a positive influence on ratings ($y = 0.315x + 4.52$, $r^2 = 0.98$) and the differences were significant ($F= 25.84$, $df = 3, 1311$, $p = 0.000$) (Table 27, Figures 41, 42).

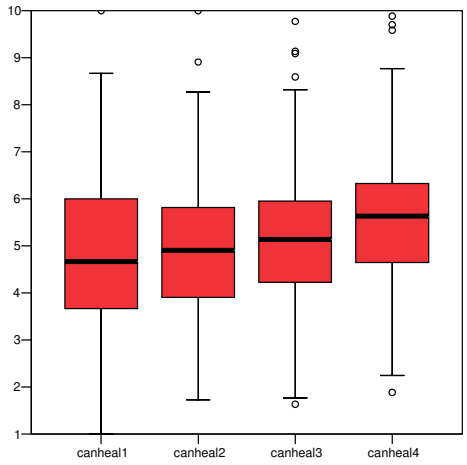


Figure 41 Influence of Tree Health on Ratings

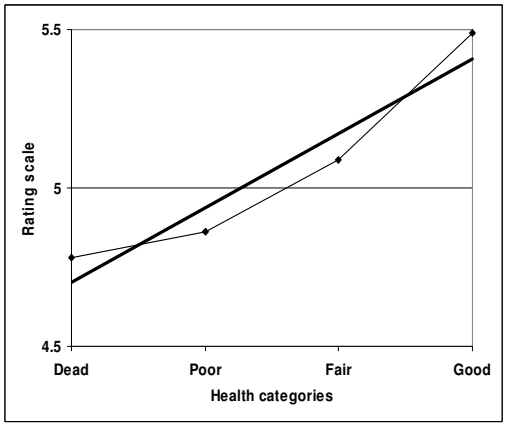


Figure 42 Trend line for Tree Healt

Tree Spacing

Isolated 82

Canopy overlap 47

Open scattered 86

The spacing of trees was assessed on a four-point scale: isolated trees, open scattered trees, trees with overlapping canopy, and close trees with most of their canopy overlapping. While the first three categories met the isolated and scattered trees definition, the fourth category comprised dense stands of trees and no scenes of these were included in the survey.

Table 28 Influence of Tree Spacing on Ratings

	Isolated	Open scattered	Canopy overlap	Close canopy overlap
Number of scenes	28	70	14	-
Mean	4.90	5.32	5.98	-
SD	1.37	1.28	1.30	-

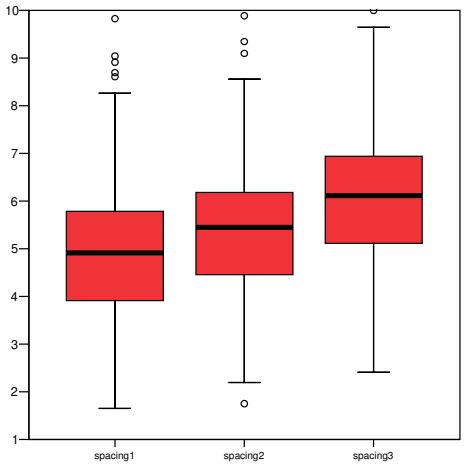


Figure 43 Influence of Tree Spacing on Ratings

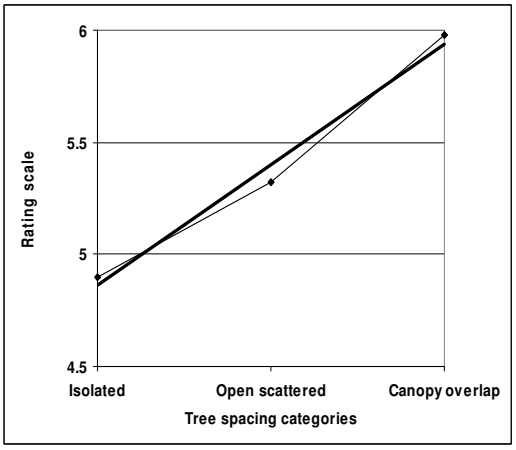


Figure 44 Trend line for Tree Spacing

The spacing of trees had a major effect on ratings ($y = 0.54x + 4.32$, $r^2 = 0.98$). The denser the cover, the higher the rating. The differences between the categories were significant ($F = 75.1$, $df = 2, 1311$, $p = 0.000$) (Table 28, Figures 43, 44).

Number of Trees

Single tree 12

6 – 12 trees 33

2 – 5 trees (ignore background trees) 4

- 12 trees

The number of trees in scenes was assessed on a four-point scale: single, 2 - 5 trees, 6 - 12 trees, and more than 12 trees. The number of trees had a very positive effect on ratings (y = 0.37x + 4.46, r^2 = 0.93). This parallels the findings for tree spacings; the more trees, the higher the rating. The differences between the categories were significant (F= 61.84, df = 3, 1748, p = 0.000) (Table 29, Figures 48, 49).

Table 29 Influence of the Number of Trees on Ratings

	Number of trees			
	1	2 - 5	6 - 12	> 12
Number of scenes	22	46	29	15
Mean	4.80	5.11	5.75	5.83
SD	1.43	1.30	1.30	1.28

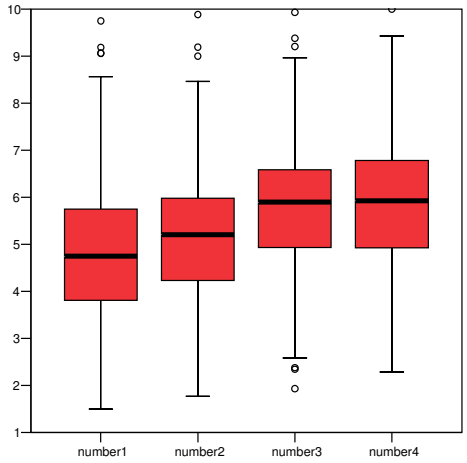


Figure 45 Influence of Number of Trees on Ratings

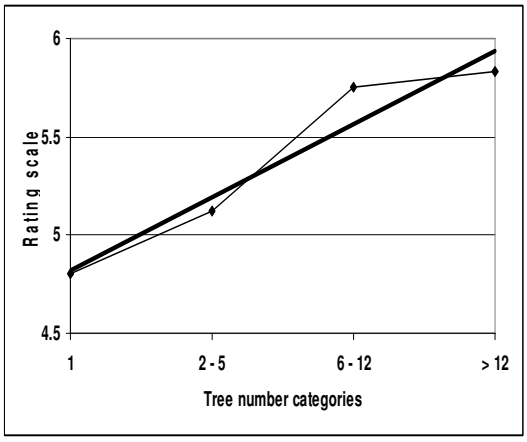


Figure 46 Trend line for Number of Trees

Species

Blue Gum *E. leucoxylon* 48

Pink Gum *E. fasciculosa* 73

Ninety eight of the 112 scenes comprised *E. camaldulensis* (Red Gum) and only fourteen comprised other species There were five scenes with *E. leucoxylon* (Blue Gum), three with *E. fasciculosa* (Pink Gum) and the remaining six with other species. The differences between types of gums were significant (F= 12.2, df =3, 1748, p = 0.000) (Table 30, Figures 47, 48). Because the species characteristic is not ordinal but a categorical number, i.e. there is no trend across the grades because they represent different objects, it is not meaningful to chart a trend line.

Table 30 Influence of Type of Eucalypt on Ratings

	Red Gum	Blue Gum	Pink Gum	Other Species
Number of scenes	98	5	5	4
Mean	5.42	5.02	5.19	4.92
SD	1.27	1.30	1.48	1.27

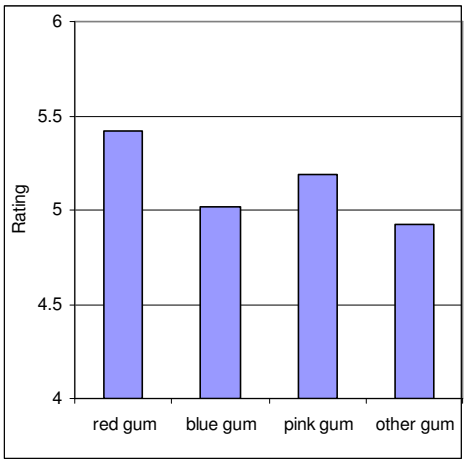


Figure 47 Influence of Type of Eucalypt on Ratings

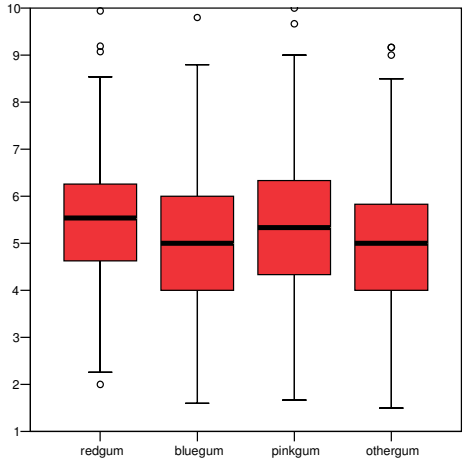


Figure 48 Influence of Type of Eucalypt on Ratings (Box plot)

Terrain

Flat 22

Sloping 39

Hilly 13

The prevailing terrain was assessed on a four-point scale: flat, sloping, hilly, and steep. There were no steep site000s so there were three categories.

Table 31 Influence of Terrain on Ratings

	Flat	Sloping	Hilly	Steep
Number of scenes	89	17	6	-
Mean	5.32	5.51	5.06	-
SD	1.28	1.26	1.46	-

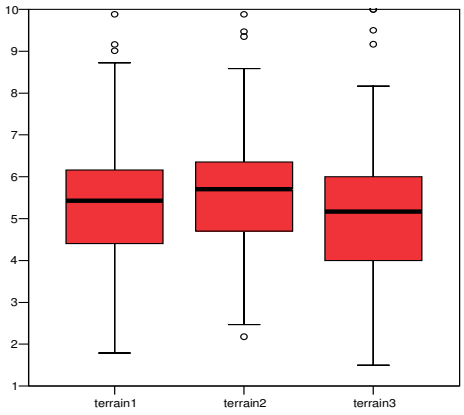


Figure 49 Influence of Terrain on Ratings

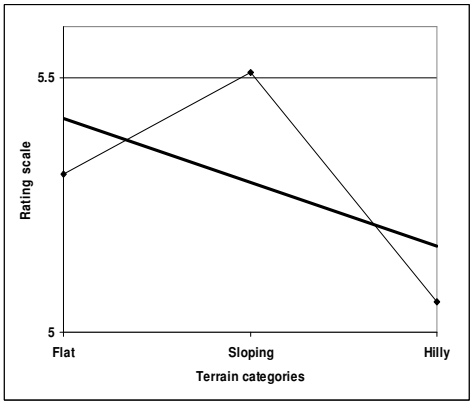


Figure 50 Trend line of Terrain

The terrain had a slightly negative effect on ratings ($y = -0.13x + 5.54$, $r^2 = 0.31$). The differences between the categories were significant ($F= 12.78$, $df =2, 1311$, $p = 0.000$) (Table 31, Figure 49, 50).

Land use

Ninety eight of the scenes comprised pasture, of the remaining fourteen, four were natural sites, nine scenes contained cereals and one scene contained vines. The remaining 98 sites comprised pasture. As all but a handful of sites comprised pastures, this factor was not analysed. The differences due to land use, given the small number of alternative land uses to pasture were considered likely to be obscured by other factors (e.g. spacing, tree height).

Summary of Ratings of Tree Characteristics

Table 32 summarises the mean ratings of the factors examined in this section and these are illustrated by Figure 51. Table 33 summarises the trendline equations and the ANOVA results.

Table 32 Summary of Mean Ratings for Factors

Unit	Height	Trunk height	Trunk diameter	Verticality	Canopy form	Canopy density	Health	Tree spacing	Tree number	Euc. type	Terrain
1	4.67	5.31	5.65	5.22	5.40	5.04	4.78	4.90	4.80	5.42	5.31
2	5.30	5.30	5.29	5.50	5.49	5.45	4.86	5.32	5.12	5.02	5.51
3	5.42	5.39	5.22	5.35	5.19	5.29	5.09	5.98	5.75	5.19	5.06
4	5.49		5.30		5.41	5.26	5.49		5.83	4.92	

Table 33 Summary of the Influence of Factors on Ratings

Factor	Relationship	Significance
Tree height	$y = 0.26x + 4.58$, $r^2 = 0.79$	F= 32.21, df = 3, 1748, p = 0.000
Trunk height	$y = 0.04x + 5.25$, $r^2 = 0.66$	F= 0.68, df = 2, 1311, p = 0.51
Trunk diameter	$y = -0.11x + 5.65$, $r^2 = 0.56$	F= 9.49, df = 3, 1748, p = 0.000
Trunk verticality	$y = 0.065 + 5.23$, $r^2 = 0.22$	F= 4.83, df = 2, 1311, p = 0.008
Canopy form	$y = -0.03x + 5.44$, $r^2 = 0.07$	F= 4.30, df = 3, 1748, p = 0.005
Canopy density	$y = 0.05x + 5.14$, $r^2 = 0.15$	F= 7.01, df = 3, 1748, p = 0.000
Tree health 1	$y = 0.24x + 4.47$, $r^2 = 0.91$	F= 23.72, df = 3, 1748, p = 0.000
Tree health 2	$y = 0.315x + 4.52$, $r^2 = 0.98$	F= 25.84, df = 3, 1311, p = 0.000
Tree spacing	$y = 0.54x + 4.32$, $r^2 = 0.98$	F= 75.10, df = 2, 1311, p = 0.000
Number of trees	$y = 0.37x + 4.46$, $r^2 = 0.93$	F= 61.84, df = 3, 1748, p = 0.000
Species	na	F= 12.20, df = 3, 1748, p = 0.000
Terrain	$y = -0.13x + 5.54$, $r^2 = 0.31$	F= 12.80, df = 2, 1311, p = 0.000

Note: Tree health 2 omitted first category which comprised three scenes containing dead trees

It is evident from these that the most important factors providing a positive influence on ratings are, in order:

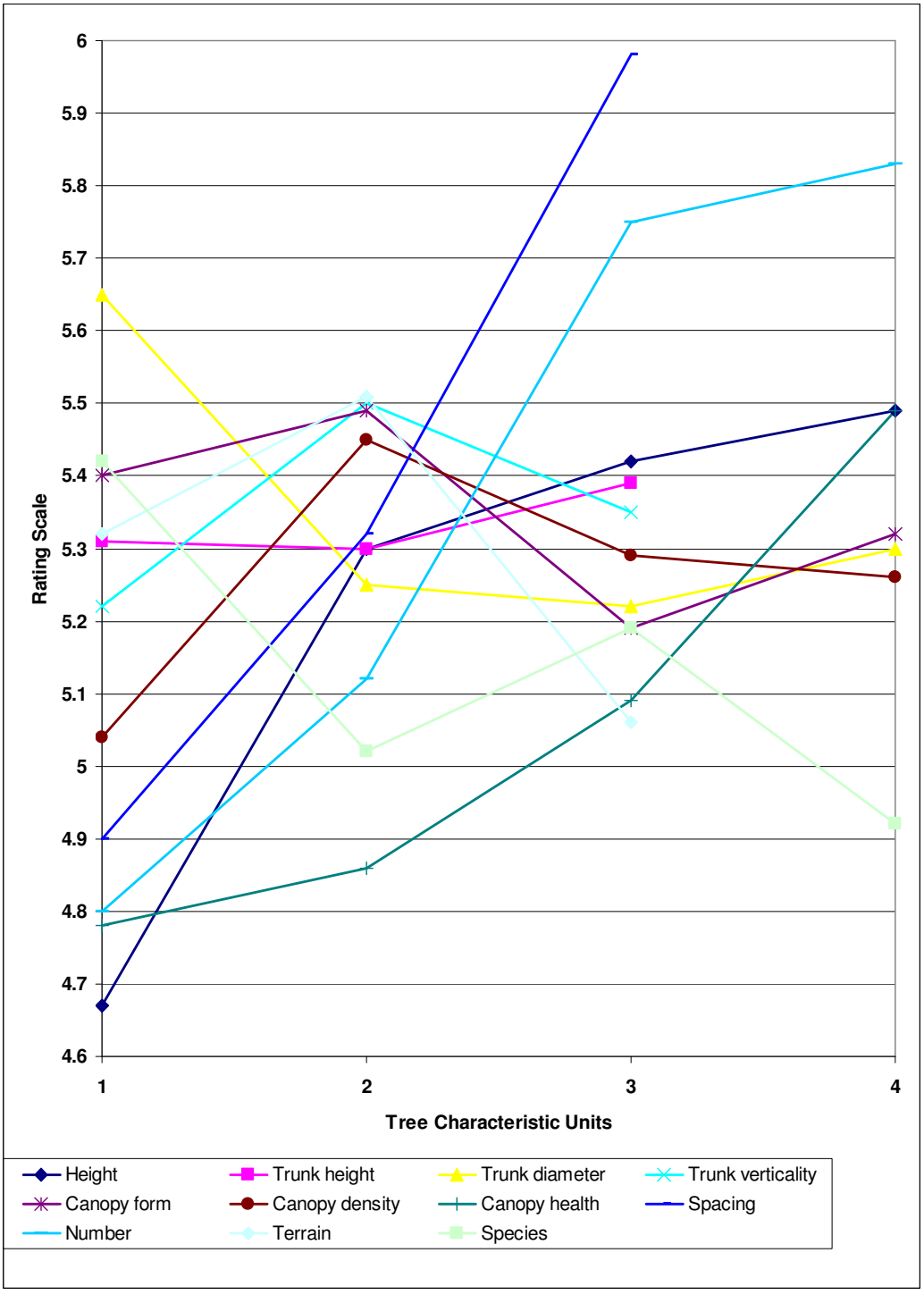
- Spacing of trees – the denser the trees the better
- Health of trees 2 – the healthier the better
- Number of trees – the greater number of trees the better
- Height of trees – the higher the trees the better

These four factors provide steep curves (i.e. high slopes in trend line equations) (Figure 52) whereas for the remaining factors the curves are flat or highly variable. The remaining four factors: canopy form, canopy density, tree verticality and terrain, all peaked at the second unit around a rating of 5.5 and had similar ratings for most of the remaining units. Only trunk diameter was substantially different, peaking at the narrow category and being lower for the remaining units.

Ecological health and landscape quality

The surrogates for ecological health: tree health, tree height, number of trees, denser trees all increased landscape quality. This suggests a relationship between ecological health and landscape quality. However other characteristics which could also be related to ecological health – canopy form and density, tree verticality and trunk diameter did not produce a marked increase in landscape quality. Thus the study

hints at a relationship but further research would be necessary in order to be definitive.



Note: Rating scale is confined to 4.6 – 6

Figure 51 Summary of Factors which Influence Ratings

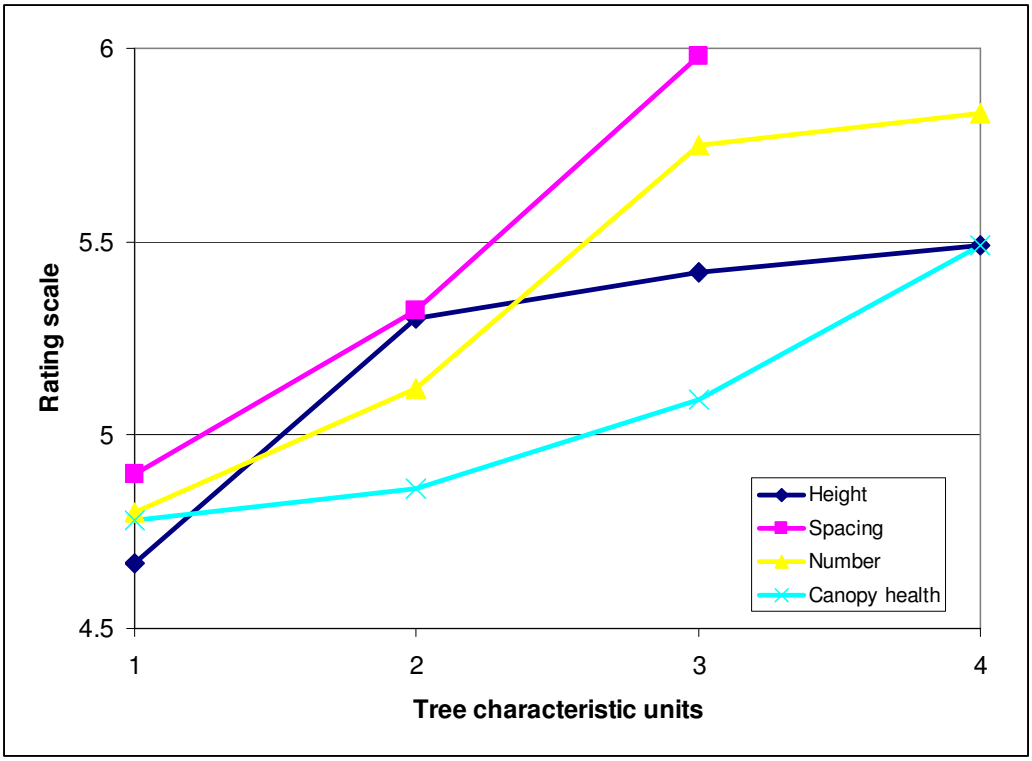


Figure 52 Tree characteristics with highest influence on scenic amenity ratings