LANDOWNER PERCEPTIONS OF SCENIC BEAUTY FOR EASTERN HARDWOOD STANDS
UNDER DIFFERENT MANAGEMENT REGIMES

by

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INTRODUCTION

As the nation's population rises and the supply of non-renewable resources dwindles, the demand for wood and wood products is sure to increase. Wood and/or wood fiber will be needed for everything from housing and fuel to toothpicks and paper for McDonald's hamburger wrappers. In fact, the demand for hardwoods is expected to triple by the year 2030 and the demand for softwoods is projected to be up by two thirds (Slusher,1979).

If available supplies can meet the increased demand then there is no problem. However, by the year 2000 the demand for wood is expected to exceed the supply currently available. Summarizing Dwight Hair's article entitled "Future Timber Requirements - Expectations for Private Lands", Slusher reports there are three options available to increase our national wood supply. They are:

1. to improve the efficiency with which we use the timber harvested
2. to increase net imports
3. to increase the yields of timber from domestic forests

(Slusher,1979)

The first two options may increase the available wood supply to a small degree, but it is the third option which holds the greatest promise, especially as it applies to private non-industrial forest lands. Owning 58 percent of the nation's timberland, private non-industrial forest landowners have the power to at least partially, if not totally, alleviate the projected fiber deficit in the future by managing their lands more intensively (SAF, 1979).

Foresters have been aware of the potential of the nation's non-industrial private forest lands for decades. The "problem" has been to motivate the landowners to manage their holdings intensively enough to produce the wood fiber of which they are capable. So far, state and federal economic incentive programs, various legislative efforts concerning tax laws, and offers of technical assistance have not met with the degree of success desired. The majority of owners of private non-industrial forest land are not actively managing their holdings for timber (Clawson, 1975).

Certainly there are many possible economic reasons for this lack of management. Lack of available capital, reluctance to "tie-up" the funds for the length of time needed to grow timber, or lack of a readily available market offering a high enough price are all plausible, to name just a few reasons. However, non-economic reasons may enter into the landowner's decision-making process as well (Clawson, 1975).

In a survey of southern New England landowners, Kingsley (1976) found that many of them owned and managed their holdings for recreational and aesthetic reasons. In fact, 46 percent of those interviewed felt that the aesthetic pleasures derived from their land were the most important benefits they had received in the past, and 39 percent expected them to be the most important ones in the future. Clearly, aesthetics plays a major role in the minds of many people when deciding what to do with their land--at least in southern New England. Other surveys of a similar nature echo Kingsley's findings to an extent for various other parts of the East (Noyes, 1971; Birch and Kingsley, 1978). Since 92 percent of the nation's hardwood growing stock is east of the Mississippi River and the majority of it is privately held, these findings are of relevance to the timber situation being discussed (USDA-FS, 1980). While aesthetic concerns and timber production are not necessarily mutually exclusive, it is possible that many individuals perceive them to be.

In a survey concerning attitudes toward forest management in general, Willhite and others (1973) reported evidence to support this notion. They found that various nonforestry groups "had a strong distrust of forest industries, as well as foresters, and perceived them as being environmental ravagers, indifferent to aesthetic and other human values." This was ascertained through factor analysis of a questionnaire composed of 115 statements reflecting a wide variety of views concerning forests and forestry. More specifically, Gray (1979) states that "a substantial proportion of private non-industrial forest owners are reluctant to sell timber because of damage from careless logging to residual stands, soil, amenities, and improvements." It appears that a bias against timber harvesting may exist in at least a portion of the nation's private non-industrial forest landowners. Perhaps some of these individuals even mentally equate timber harvesting of any kind with the controversial clearcuts on the Monongahela and Bitterroot National Forests publicized in the early seventies.

Given the probability that many landowners "think" they would react negatively to the aesthetic impacts of timber harvest, the question remains whether this is in fact true. It is important to discover how people actually react to various silvicultural management regimes, in terms of perceived scenic beauty. This information would be helpful to forest managers in choosing the harvesting technique and stategy that would have the least negative aesthetic impact and also in developing information programs to alleviate any misperceptions landowners may have.

LITERATURE REVIEW

Measuring Scenic Preferences

In order to predict the aesthetic consequences of a management action in a given forest stand several problems must first be solved. First, a reliable and valid way of measuring scenic preferences must be found. Secondly, one must identify and quantify the relevant environmental parameters that cause changes in the scenic preference measurement Thirdly, the relationship between the perceived scenic beauty of a site and its environmental characteristics should be empirically valid and intuitively appealing if the predictive model is to be of use to forest managers (Buhyoff and Leuschner, 1978).

Few recent attempts have been made to simultaneously solve the above problems. A pioneering effort in predictive modeling was made by Shafer and others (1969). Using a grid-overlay technique on black and white photographs to obtain areal and perimeter measurements, they were able to relate various landscape features to photo rankings. The model developed was able to predict aesthetic appeal fairly well as is reflected by its ability to explain 60 percent of the variation in the photo rankings. Later studies supported the method's reliability as well (Shafer and Meitz, 1970). However, the predictive equation lacked intuitive appeal. It contained combinatory variables (e.g. perimeter of distant vegetation X area of any kind of water) that were difficult to explain conceptually. Another drawback with the model was that the dependent variable (scenic preference) was ordinal (simple rank) in value. This means that it is impossible to ascertain the magnitude of preference differences caused by various changes in the environment. Magnitude differences are especially helpful in situations which involve choosing between numerous management alternatives.

Other researchers have attempted to solve the aforementioned difficulties by applying well-established psychophysical procedures to the problem.[1] Using the Case III assumptions of the Law of Comparative Judgement (Bock and Jones, 1968), Buhyoff and Reisenman (1979) were able to derive interval scale values of scenic preference for forest stands with varying degrees of insect damage. Application of this method involved showing color slides in all possible pairs via projection on two identical screens and having subjects

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[1] Psychophysics is a quantitative branch of perceptual psychology that deals with the relationship between the physical magnitude of a stimulus and the human perceptual response to the stimulus (Baird and Noma, 1978).

choose which of the two slides they least preferred. Then through scaling procedures based on the proportion of times a given slide is chosen over the others, interval preference scores were obtained. The researchers showed that subjects informed a priori about the presence of insect damage seemed to "cue in" on a "damage dimension" when stating their scenic preferences, whereas uninformed subjects did not. In a further analysis of this data, Buhyoff and Leuschner (1978) were able to etablish a "psychological disutility function" for those who knew they were viewing insect damage. Non-linear in nature, this function related a single variable (insect damage) to the preference and was able to explain 84 percent of the variation in landscape preference. The model was later shown to be replicable and predictively valid (Buhyoff et al.,1980).

Another landscape beauty measurement technique is based on signal detection theory and Thurstone-type scaling models. Daniel and Boster (1976) have developed a methodology whereby Scenic Beauty Estimates (SBE's) can be computed for various landscapes. These researchers believe that scenic preferences are based on an interaction between the human observer and the landscape characteristics. Each observer is seen to possess an "internal judgement criterion" so that even though observers may perceive a given landscape in the same way, their expressed preference scores may differ. In other words, observers may be using the rating scales differently, and their varying criteria may obscure real differences in preference resulting from the landscape.

The ratings given to a landscape, then, are the product of the judgemental criteria being utilized by the observer and his perception of the scenic beauty of the landscape. According to Daniel and Boster (1976), the perception of a landscape can be represented by a distribution of "perceived scenic beauty" values rather than a single value. If two landscapes are perceptually the same, then their distributions will overlap. Thus, the "SBE analysis assesses differences in perceived scenic beauty by comparing an observer's rating distribution for one landscape area against each of several others."(Daniel and Boster, 1976, p. 19)

This comparison of rating distributions can be done graphically by plotting the cumulative probability of the ratings on a one to ten scale for the chosen comparison landscape against the cumulative probability of the ratings for each of the remaining landscapes. The resulting graph is termed a Receiver Operating Characteristic (ROC) curve. Finally, the SBE value is computed as the average distance from the ROC curve for each landscape to the positive diagonal formed by graphing the comparison landscape against itself, multiplied by 100 (to remove the decimal place). (See figure 1). This is the "by observer" procedure.

The "by slide" procedure, which is the one most often used in applied research, more closely resembles Thurstone's categorical scaling model. Here, the cumulative probabilities and resultant z-scores are obtained from all observer ratings for each slide shown. Unlike the "by observer" method, this one does not effectively screen out differences in the internal judgement criteria being used by the subjects, but it does mitigate them more than simple mean ratings would. Thus, an additional assumption of subject homogeneity is inherent (i.e. overall, subjects are using the rating scale in a similar manner.)

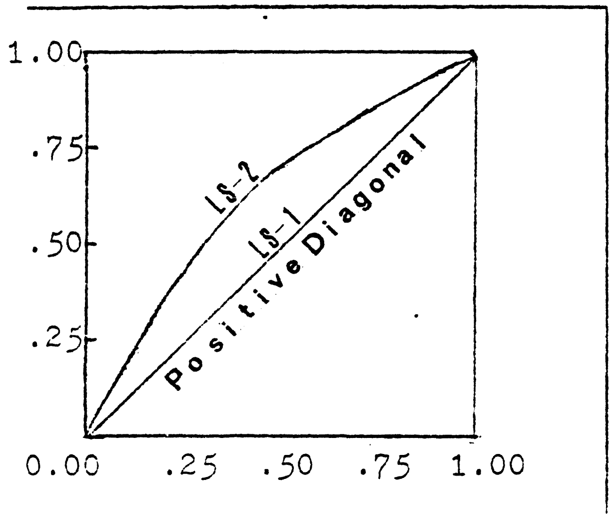
The reliability of the SBE method has been checked in eight separate experiments (Daniel and Boster, 1976). Even though different slides were used for the landscape areas and different panels of observers rated them, the SBE's obtained were very similar. In addition, the SBE method has produced reliable representations of variations in scenic beauty when used in studies involving numerous forest landscapes and 26 separate public interest groups.

The validity of the methodology has also been supported. In terms of content validity, Daniel and Boster (1976) found extremely high correlations between ratings obtained

	LANDSCAPE 1				LANDSCAPE 2			
Rating	f	cf	cp	z	f	cf	cp	z
1	2	30	1.00		1	30	1.00	
2	3	28	.93	1.47	2	29	.97	1.84
3	5	25	.83	.95	3	27	.90	1.28
4	8	20	.67	.44	5	24	.80	.84
5	5	12	.40	-.24	8	19	.63	.33
6	3	7	.23	-.74	5	11	.37	-.33
7	2	4	.13	-1.12	3	6	.20	-.84
8	1	2	.07	-1.47	2	3	.10	-1.24
9	1	1	.03	-1.84	1	1	.03	-1.84
10	0	0	.00	-2.13	0	0	.00	-2.13
			Σz==	-4.68			Σz =	-2.19
			$\bar{z}$ =	-.52			$\bar{z}$ =	-.28

SBE=(-.52)-(-.52)x100 = 0

SBE=(-.28)-(-.52)x100 = 24



f = frequencies
cf = cumulative frequencies
cp = cumulative probabilities
z = Z scores
$\bar{z}$ = mean Zs

FIGURE 1

Hypothetical data for an observer for two landscapes(top) and the resultant ROC curves (bottom).

Taken from Daniel and Boster (1976), pages 19 and 20.

from color slides and those obtained on-site, supporting the contention that the method is measuring what it purports to measure.[2] Convergent validity was also supported in an experiment which compared the rank ordering of slides obtained through a paired comparison routine to the rank ordering derived from the SBE method. The two rank orderings were identical (Daniel and Boster, 1976).

The SBE method also appears to be managerially useful. It has been used successfully to measure the aesthetic effects of various silvicultural treatments in ponderosa pine stands (Schweitzer et al.,1976; Benson and Ullrich, 1981; and Schroeder and Daniel, 1981), to develop a procedure for mapping scenic beauty in forested areas (Daniel et al., 1977), to model landscape preferences with mensurational parameters acting as the predictor variables (Arthur, 1977), and to help evaluate the effects of various educational techniques in altering the public's perception of harvested forest stands (Simpson et al., 1976).

Thus, there are at least two reliable, valid, and managerially useful methods available for assessing scenic beauty -- the paired comparison method based on the Law of Comparative Judgement and the SBE method. For the purposes

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[2] The similarity between judgements made in the field and those made on the basis of color representations has been verified by numerous other studies (Shafer and Richards, 1974; Dunn, 1976, and Schomaker, 1979).

of this research, the latter will be used. The SBE approach is favored due to the inherent restriction as to the number of slides used in the paired comparison methodology. Having to present all possible pairs of slides ((n-1)/2) puts a ceiling on the number of slides allowable in order to prevent subject fatigue.

Studies Related to the Proposed Research

As was previously mentioned, the SBE method has been used successfully in a number of studies dealing with the aesthetic consequences of silvicultural management on forested landscapes. Schweitzer and others (1976) found through a series of experiments that timber harvest generally decreased the scenic preference of an area, with the greatest decrease occurring for areas that had been clearcut. In addition, large amounts of man-made slash seemed to detract from a scene's visual appeal. Benson and Ullrich (1981) reported in a series of follow-up studies that the negative effects seemed to dissipate with time, however, as revegetation and tree growth took place.

Arthur (1977), though not dealing directly with the aesthetic effects of different management actions, aided in laying the groundwork for the proposed research by building predictive models relating physical features of the landscape to scenic beauty. Of particular interest is her linear regression model using measurements commonly obtained on a timber cruise (e.g. trees/acre in a given diameter class and total basal area/ha) as the predictors. With this model, she was able to explain approximately 80 percent of the variation in the SBE's. She also found that the presence of large stems enhanced scenic preference while slash detracted from it. However, the cruise-type measurements used to build the regression equations were estimated from photographs by professional foresters, not actually obtained "in the field", as they usually are when deciding managerial courses of action. Actual management decisions are based on forest feature information from field inventories. Therefore, models predicting the consequences of management actions should be developed from data obtained in a similar way, in order to be readily incorporated into on-going planning efforts.

Schroeder and Daniel (1981) built upon Arthur's research by collecting actual field data to use in model formation. Their forest inventory for each site included information on the trees present by diameter class, the nature of the understory and ground cover, and the nature and distribution of downed wood. This data was collected at the same time that the color photographs for SBE analysis were taken.

Once again the SBE's were regressed onto the timber cruise variables. The resulting models were able to explain 60 percent of the SBE variation once extraneous variables and those not common in forest planning were deleted. The predictor variables found to be important and the values of their coefficients echoed Arthur's (1977) findings, i.e. large stems have a positive effect on perceived scenic beauty and slash a negative one.

All of these studies (Schweitzer et al., 1976; Arthur, 1977; Benson and Ullrich, 1981; and Schroeder and Daniel, 1981) were conducted in the western portion of the United States, though. The tree species and other stand characteristics used to eventually build the predictive models are not found for the most part in the East. Therefore, it is necessary to develop models that deal more specifically with the spatial characteristics of the eastern forests.

While no one has attempted this yet, research has been conducted dealing with the aesthetic appeal of eastern forests. Brush (1979) investigated the visual preferences of Massachusetts landowners for forest scenes. Twenty forest sites were chosen to vary in predominant stem size, height and closure of canopy, stocking density, size of clearings and height of the understory. Efforts were made to choose sites with level terrain and lacking any water or man-made objects.

Three photographs were taken per site and were later made into 8 X 10 color pictures. These were then rated by a group of landowners previously found to own their land for recreational and aesthetic reasons. Forestry students also took part in the rating prodedure.

Among other results, the study found that:

1. landowners could clearly differentiate between the twenty sites in terms of their preferences;
2. more spacious stands were preferred to dense stands that allowed limited visual penetration;
3. stands with large trees were preferred;
4. managed stands generally tended to be preferred to similar unmanaged ones,[3]
5. landowner preferences did not differ significantly from those expressed by the forestry students.[4]

This research effort is in part an extension of Brush's work. Owners of private forest land were again asked to assess the scenic beauty of several forested scenes. However, the scenes were limited to within-stand slides of hardwood sites. These sites represented a range of management alternatives from natural to clearcut. The natural areas

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[3] Rutherford and Shafer (1969) also reported a preference for managed stands over unmanaged ones in their research. However, it should be noted that "managed" refers to thinned stands, not clearcuts.

[4] Daniel and Boster (1976) reported a similar result.

used have not been logged in the past three or four decades, but are not virgin timber stands. Stands that have never been harvested are rare in the East due to extensive logging in the past.

As in Brush's study, the areas were chosen for levelness and lack of unusual features (including water) and man-made objects. Instead of rankings, SBE's were calculated as the measure of preference. The SBE's were then used as the dependent variable in regression analysis relating cruise data to scenic beauty.

In addition, an experiment was done to test for the existence of a bias against the terms used to describe differerent degrees of timber harvest that might affect scenic evaluation.

METHODS

To accomplish the research objectives stated previously, several steps had to be carried out. First, the hardwood sites had to be selected, photosampled, and cruised. Second, slides produced from the photographs taken had to be rated by the landowners and students and then the ratings needed to be converted into SBE's. Finally, predictive models had to be built relating SBE's to the mensurational data obtained. These steps are detailed below.

Data Collection

Data collection occurred in two separate stages. The first involved photosampling the forest sites and gathering the related cruise data. The second stage dealt with obtaining respondent ratings of the slides from stage one and converting them into SBE's. Each stage will be discussed below in detail.

Photosampling and Timber Cruise

The overall areas to be photosampled and cruised were chosen with the aid of U.S. Forest Service personnel in the winter and early spring of 1982. These areas were selected primarily on the basis of their past management in terms of the treatment used and when it was implemented. Stands were located that represented each of the following: (1) recent[5] and older clearcuts, (2) recent and older heavy thins, (3) recent and older light thins, and (4) natural areas. The diversity over time was desired to increase the range of management outcomes represented in the cruise data and in the slides shown to the subject panels.

Also considered in area selection were the area's levelness, lack of man-made structures and roads, lack of water or other unusual features, and proximity to Blacksburg. Sixteen areas were chosen in the Blacksburg and Newcastle districts of the Jefferson National Forest. They were all poor to average sites of oak and hickory typically found in the southern Appalachians.

After full leaf-out in early summer, the areas were photosampled and cruised utilizing variable plots at two and three chain[6] intervals. An average of three plots was taken

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[5] The term "recent" refers to the area having been logged within the past year.

[6] One chain = 66 feet.

per area using an adaptation of the methodology described in Schroeder and Daniel (1981). From each plot center, four photographs were taken at 90 degree intervals after establishing a randomly selected primary bearing.

A Canon 35mm SLR camera with a 50mm lens was set on a tripod over the plot's center at a height approximating an average viewer's eye level (about 5'7"). The camera's focal length throughout the photosampling period was set on infinity.[7] The type of camera lens and film (Kodak Kodachrome ASA 64) also remained constant. Efforts were made to take the photographs at approximately the same time of day to control for shadowing effects and in sunny, clear weather to avoid unusual cloud formations. Photographs were later developed into color slides by Kodak.

At the plot level, the following mensurational data were also obtained:

1. basal areas at plot center and each of the four "corners" (1/2 chain from plot center on the bearings of the four photographs) using a 10 factor prism
2. height and diameter at breast height for each "in" tree from plot center by species

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[7] The extremely dense and close foliage of some of the clearcut areas necessitated focusing the camera at less than infinity in some cases.

3. dead and down and understory tallies on one 33 foot transect from plot center on the primary bearing

The dead and down and understory tallies measured organic matter in a strip one meter wide centered on the primary bearing, and for the understory growth, plants and saplings that were at least 18 inches high were tallied. Overall, photographs and mensurational data were collected on 54 plots.

SBE Computation

From the resulting 216 slides, 102 were chosen for presentation to the respondents. The final slide set was derived by deleting those slides that were found unacceptable to a panel of judges from the School of Forestry and Wildlife Resources because of poor focus, darkness, unusual shadows, dense foliage crowding the immediate foreground, or striking horizon/landform interfaces. This deletion of slides caused the number of plots represented to drop from 54 to 44 and brought the number of treatment categories represented down to six. Only scenes of older lightly thinned areas remained in the final slide set as all recent ones were deleted. Each of the four major treatment categories was, for the most part, equally represented, however.

It is important to note that for analytical purposes the thinned plots were assigned to the light and heavy thin categories after photosampling was completed. Since light and heavy are relative terms in relation to what the stocking density of a stand before harvesting was, plots had been categorized utilizing the subjective judgements of Forest Service personnel. For analysis, however, the plots were assigned to categories based upon the measurements of average basal area obtained from the cruise data. Within the broad "thin" category, 75 square feet per acre was used as the cutoff, with plots whose basal areas were above the value being labeled as "light thin" and those below as "heavy thin". This cutoff value was arbitrarily set using an average hardwood stand in this area of the Appalachians as its basis. For photographic examples of each management category see Appendix A.

The slide set was presented to several subject groups in the fall of 1982. They were:

1. 28 participants in the annual forestry and wildlife bus tour in the Fairfax area
2. 48 participants on a similar bus tour in the Tidewater area
3. 20 participants in a farm group meeting in Floyd county

The majority of these people were owners of private non-industrial forest land who expressed a wide range of reasons for ownership, including both economic and non-economic ones.

A set of standard instructions was read to each group informing them that they would be viewing slides of forested scenes (See Appendix B). No mention was made specifically as to how the slides differed, i.e. in their harvest treatment. In this way, it was hoped to avoid any bias due to negative or positive feelings toward loggers or harvesting in general. The respondents were asked to rate each slide on a scale of one to ten with one indicating very low scenic beauty and ten very high scenic beauty. After being shown five or six training slides to familiarize them with the types of scenes they would be seeing, the subjects were shown each of the 102 slides for eight seconds. All responses were marked by the subjects directly onto op-scan sheets with number 2 pencils.

These sheets were then processed directly by an IBM 370/158 computer. Of the 96 landowners who responded, all but 33 had to be eliminated because of missing ratings or dual answers to a single slide. Possible problems as a result of this will be discussed in the data analysis section. Then, from the remaining 33 sets of ratings, SBE's were calculated using the "by slide" methodology created by Daniel and Boster (1976).

In addition, the slides were shown to approximately 100 students from the introductory psychology subject pool at Virginia Tech.[8] This also took place in the fall of 1982.[9] The students were divided roughly in half. The first group, like the landowners, was uninformed as to the slide content. The second group of students was fully informed as to what they were viewing (See Appendix C). Their instructions prior to seeing the slides explained the various treatments used in the forest stands and their rating sheets contained for each slide a treatment label followed by the rating scale. For example,

SCENIC BEAUTY

1. HEAVY THIN ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

lo hi

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[8] This 3500 member pool of introductory psychology students represents a cross-section of the Va. Tech. population. Previous research has demonstrated that student groups' responses, with the exception of art students, mirror those of the public in terms of aesthetic preference (Daniel and Boster, 1976; Buhyoff et al., 1978; and Buhyoff and Wellman, 1979).

[9] Because Buhyoff and Wellman (1979) demonstrated that a seasonality bias may influence preferences, all photographs were taken in early summer and all slides were viewed in the fall.

Each of their training slides was also verbally identified in terms of previous treatment.

The uninformed student group coded their responses directly onto op-scan sheets as the landowners did. However, the informed students' responses had to be transferred from the rating sheets used onto op-scans. Both sets of ratings were then computer processed.

Subjects were again eliminated because of missing data or dual responses to a single slide. The subject sample was reduced from 46 to 37 for the uninformed group and from 63 to 46 for the informed group. "By slide" SBE analysis followed.

Data Analysis

Variable Computation and Selection

Using the 102 SBE's generated above for the landowner group, a mean SBE value was calculated for each of the 44 plots by averaging the preference scores obtained for slides representing each site. These mean values were then used as measures of the dependent variable in linear regression analysis performed to determine the best model or models for predicting landowner scenic beauty.

The independent variables considered for the analysis are given in Table 1. All but two of the 23 variables list

TABLE 1

Variable Acronyms and Meanings

Acronym		Meaning
HARV	----	type of harvest
HDUN2	----	hardwoods under 2" in diameter
HD2-4	----	hardwoods 2"-4" in diameter
HDGR4	----	hardwoods greater than 4" in diameter
CONUN2	----	conifers under 2" in diameter
DDUN18	----	dead and down under 18" in height
DD18-36	----	dead and down 18"-36" in height
DDGR36	----	dead and down greater than 36" in height
DDAVGHT	----	dead and down average height
DDPCT	----	dead and down percent coverage
AVGBA	----	average basal area
CN4-7	----	conifers 4"-7" dbh
CN8-11	----	conifers 8"-11" dbh
CN12-15	----	coniders 12"-15" dbh
CN16-19	----	conifers 16"-19" dbh
CN20-23	----	conifers 20"-23" dbh
HD4-7	----	hardwoods 4"-7" dbh
HD8-11	----	hardwoods 8"-11" dbh
HD12-15	----	hardwoods 12"-15" dbh
HD16-19	----	hardwoods 16"-19" dbh
HD20-23	----	hardwoods 20"-23" dbh
STEMS	----	number of stems per acre
BAPERST	----	basal area per stem
SBEL	----	scenic beauty estimate--landowners
SBEI	----	scenic beauty estimate--informed students
SBEU	----	scenic beauty estimate--uninformed students

ed were taken directly from the timber cruise data. The exceptions, STEMS and BAPERST, were computed and included because past research found them to be related to preference scores in an urban forest setting (Buhyoff et al., in press). The calculations were made for each plot using the following equations.

STEMS = 62.275(HD4-7 + CN4-7) + 20.487(HD8-11 + CN8-11) + 10.101(HD12-15 + CN12-15) + 6.002(HD16-19 + CN16-19) + 3.973(HD20-23 + CN20-23)[10]

BAPERST = AVGBA/STEMS

In cases where STEMS=0, BAPERST was set at 0.

Several univariate statistics were computed for each variable including its mean, standard deviation, minimum value, and maximum value. For SBEL and the dead and down variables, mean values were also obtained after subdividing the data into the four harvest treatment categories. Pearson's product moment correlation coefficients were calculated between each independent variable and the perceived scenic beauty estimates using SAS (1982). Then, using an a-priori cutoff value of Rho≥|.50| ,variables were chosen to

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[10] Number of stems/acre=Basal Area Factor/BA for a given diameter. To calculate the multiplier for each diameter class the mean BA was used. example. (10/.136) + (10/.196) /2 = 62.275 for the 4"-7" diameter class.

use in model formation. In addition, scatter plots of each variable chosen against SBEL were explored for potential nonlinear relationships.

Correlation Analysis

As was previously mentioned, a large proportion of potential subjects had to be eliminated because of missing ratings or dual responses to a single slide. If the group eliminated is similar to the group retained, in terms of visual preferences, then there is no problem with such a large scale reduction. There were enough subjects left with complete opscans to calculate reliable SBE's. However, if this is not the case, then the models built will not necessarily predict preferences for the entire group adequately.

Since the landowner group is the one of primary interest and the one that was reduced the most, it was chosen as the basis for a test of sample homogeneity. Pearson's product moment correlation coefficient was calculated between the mean ratings of 18 commonly rated slides from both the eliminated and retained subject groups.

In addition, Pearson's product moment correlation coefficients were computed between the landowner SBE's and those from the uninformed students and between the uninformed student SBE's and those from the informed students. The former was calculated to substantiate the assumption that students' scenic preferences for natural landscapes mirror those of the public, or more specifically, the landowners. The latter correlation was obtained to explore the existence of a bias against the terms used to describe timber harvesting that could potentially affect scenic evaluations.

Regression Analysis

In order to look at all the possible regression models simultaneously, SAS's (1982) PROC RSQUARE was used. This procedure printed out multiple R-square and Mallow's C(p) statistics for each possible model. The most promising models were then investigated further. The candidate models were compared using the cumulative PRESS statistic, multiple R-square, s^2, Mallow's C(p), predicted R-square,[11] and the significance of the overall F statistic and regressor coefficients obtained using SAS's (1982) PROC GLM and PROC REG.

The existence of multicollinearity and its effect on each of the final models was explored by examining the variance inflation factors (VIF's). These measure the increase in variability of the regressor coefficients due to collinearities in the data.

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[11] Predicted R-square = 1 - (PRESS/SStot) (Montgomery and Peck,1982)

RESULTS AND DISCUSSION

Correlation Analyses

Pearson's product moment correlation coefficients were calculated for the following data pairs:

1. mean ratings of 18 slides from 33 landowners used and mean ratings of the same 18 slides from the 63 landowners deleted
2. SBE-landowners(SBEL) and SBE-uninformed students(SBEU)
3. SBE-uninformed students(SBEU) and SBE-informed students(SBEI)

The correlations are presented in Table 2. As is obvious, all three data pairs exhibit very strong interrelationships. Using these statistics as a basis, it appears that all of the groups are essentially homogenous, with each rating the landscapes in a very similar manner. Several conclusions can be drawn from this. Firstly, the subjects that were deleted do not appear to have rated the 18 slides differently from those who were included in the analysis. Also, no pattern was evident as to which slides they did not respond to. Thus, it is probable that no significant source of variation

TABLE 2

Correlations Between Different Respondent Groups

DATA PAIRING		CORRELATION[a]	P-VALUE[b]
$\overline{RATE}$ (33 used)[c] and $\overline{RATE}$ (63 deleted)	-----	.967	.0001
SBEL and SBEU	-----	.930	.0001
SBEU and SBEI	-----	.949	.0001

a Pearson's Product Moment·Correlation Coefficient
b Ho: Rho=0; N=44
c Mean ratings for landowners for 18 commonly rated slides

in terms of scenic evaluation, was lost by the large sample size reduction. Secondly, support was found for the assumption that student scenic evaluations mirror those of the landowners. Lastly, there appears to be no difference between the SBE's originating from the two student groups. Therefore, this study found no support for the existence of a bias against the terms used to describe timber harvest since the informed students responded similarly to the uninformed students.

This latter conclusion runs counter to Anderson's (1981) results. In a study of the effect of different landscape designation labels on scenic evaluations, she found that the label "commercial timber stand" caused the evaluation of scenes to drop, while labels connoting a greater degree of naturalness increased the evaluations. From this result, one would expect the informed students of this study to have rated at least the clearcut scenes lower and the natural scenes higher than the uninformed students. This was not the case.

One possible explanation for this, was that in many of the scenes shown to the subjects of this study the treatment was blatently obvious, i.e. no label was necessary to identify a clearcut to the respondents. Thus the connotations of the labels were obvious to all, not just to the group who viewed the slides with the labels in reality. In Anderson's study, however, the scenes shown were similar enough so that labels could reasonably be interchanged among slides.

Regression Analysis

Variables were chosen for inclusion in model formation on the basis of past research and their Pearson's product moment correlation coefficients with the landowner SBE's. From the infinite set of possible cruise variables, data were collected on 46 variables chosen to represent the plots' understory (in terms of visual penetration), stocking density, and amount of downed wood. Of these, the set was collapsed to contain the 23 variables presented here. As was previously mentioned, a cutoff of Rho$\geq|.50|$ was used. Six variables were selected on this basis. They were HARV, DD18-36, DDGR36, DDAVGHT, DDPCT, and AVGBA.

Scatter plots of each of the six variables against SBEL were also done to explore their functional relationships with scenic preference. One variable, AVGBA, appeared to be curvilinearly related to SBEL. Therefore, based on the scatter plot and past research (Buhyoff et al., in press), logrithmic and quadratic transforms of AVGBA were considered for inclusion in the predictive models. The full model was:

SBEL = f(DD18-36, DDGR36, DDAVGHT, DDPCT, AVGBA, AVGBAS, HARV)

All possible linear regression models were then computed and compared on the basis of their associated R-square and C(p) statistics. As a result, sixteen models were selected for further analysis. All had R-squares of .65 or above and contained no more than four variables. This latter constraint was implemented because of the limited degrees of freedom (N=44) and the corresponding fear of overfitting the regression.

These sixteen candidate models were further investigated by comparing several statistics indicative of model goodness of fit and predictive validity. Multiple R-square, overall F statistic, and s^2 were calculated to compare fits between models. Mallow's C(p) (which is a measure of the bias-variance tradeoff of model misspecification) was also considered. In addition, the significance of the coefficients was examined.

In relation to predictive validity, the cumulative PRESS statistics and predicted R-squares were compared between models. The former is the summation of squared residuals formed by deleting each observation, one at a time; estimating the regression model without that observation; and then comparing the actual and predicted values. Essentially, the data is split N times and thus, the PRESS is useful as a measure of a model's predictive validity. The latter statistic is an approximate R-square for prediction calculated by 1 - (PRESS/SStot). Table 3 contains the statistics for all model subsets which were considered.

As is clear from the small numbers of astericks in Table 3, the majority of the models contained one or more non-significant coefficients. This indicated that the regressor variables associated with them were not essential in the presence of the other variables.

A family of four models was ultimately selected on the basis of the statistics discussed above. The models were:

1. SBEL = f(DD18-36, DDGR36, DDPCT)
2. SBEL = f(DD18-36, DDGR36, AVGBA)
3. SBEL = f(DD18-36, DDGR36, DDAVGHT)
4. SBEL = f(DD18-36, DDGR36, AVGBAS)

Model 1 is presented in Table 4, model 2 in Table 5, model 3 in Table 6, and model 4 in Table 7.

TABLE 3

Comparative Statistics for 16 Models

MODEL[a]	R^2	OVERALL F	S^2	C(p)	PRESS	R^2pred.
DD18-36 DDGR36 DDPCT AVGBA	.6973	22.458	740.200	3.669	40171.89	.5787
DD18-36 DDGR36 DDPCT HARV	.6966	22.384	741.888	3.755	40169.02	.5788
DD18-36 DDGR36 DDPCT AVGBAS	.6958	22.300	743.896	3.857	40115.66	.5793
DD18-36 DDGR36 DDPCT DDAVGHT	.6956	22.283	744.226	3.874	42023.82	.5593
*DD18-36 DDGR36 DDPCT	.6956	30.472	725.635	1.875	38157.50	.5999
DD18-36 DDGR36 HARV AVGBA	.6775	20.482	788.564	6.131	40338.95	.5770
DD18-36 DDGR36 DDAVGHT AVGBA	.6765	20.386	791.071	6.258	40861.34	.5715
DD18-36 DDGR36 AVGBA AVGBAS	.6733	20.090	798.835	6.653	41340.72	.5665
*DD18-36 DDGR36 AVGBA	.6713	27.227	783.700	4.906	39463.99	.5862
DD18-36 DDGR36 DDAVGHT AVGBAS	.6667	19.500	815.038	7.478	41555.09	.5642
DD18-36 DDGR36 HARV AVGBAS	.6627	19.160	824.754	7.972	42341.24	.5560
*DD18-36 DDGR36 AVGBAS	.6619	26.100	806.118	6.076	40240.69	.5780
DD18-36 DDGR36 DDAVGHT HARV	.6595	18.884	832.569	8.370	42557.51	.5537
*DD18-36 DDGR36 DDAVGHT	.6562	25.455	819.504	6.775	41311.80	.5668
DDGR36 DDPCT HARV AVGBA	.6553	18.536	842.818	8,892	42858.02	.5506
DD18-36 DDGR36 HARV	.6524	25.027	828.638	7.251	41300.60	.5669

a an asterick beside a model denotes that all regression coefficients were significant at or above the .20 level

TABLE 4

ANOVA and Parameter Statistics for Model 1
SBEL = f(DD18-36, DDGR36, DDPCT)

ANOVA statistics

SOURCE	DF	SS	MS	F	pr>F
MODEL	3	66335.083	22111.695	30.47	0.0001
ERROR	40	29025.409	725.635		
TOTAL	43	95360.492			

Multiple R-square = 0.6956
Predicted R-square = 0.5999

Parameter statistics

PARAMETER	ESTIMATE	STD. ERROR	STD. BETA	pr>t
Intercept	62.127	6.518	0.0000	.0001
DD18-36	-9.037	3.227	-0.3423	.0078
DDGR36	-11.200	3.099	-0.3474	.0008
DDPCT	-0.776	0.286	-0.3398	.0099

TABLE 5

ANOVA and Parameter Statistics for Model 2
SBEL = f(DD18-36, DDGR36, AVGBA)

ANOVA statistics

SOURCE	DF	SS	MS	F	pr>F
MODEL	3	64012.505	21337.502	27.23	0.0001
ERROR	40	31347.987	783.700		
TOTAL	43	95360.492			

Multiple R-square = 0.6713
Predicted R-square = 0.5862

Parameter statistics

PARAMETER	ESTIMATE	STD. ERROR	STD. BETA	pr>t
Intercept	27.658	13.632	0.0000	.0492
DD18-36	-11.281	3.095	-0.4272	.0008
DDGR36	-12.384	3.154	-0.3841	.0003
AVGBA	0.284	0.145	0.2267	.0574

TABLE 6

ANOVA and Parameter Statistics for Model 3
SBEL = f(DD18-36, DDGR36, DDAVGHT)

ANOVA statistics

SOURCE	DF	SS	MS	F	pr>F
MODEL	3	62580.319	20860.106	25.455	0.0001
ERROR	40	32780.173	819.504		
TOTAL	43	95360.492			

Multiple R-square = 0.6562
Predicted R-square = 0.5668

Parameter statistics

PARAMETER	ESTIMATE	STD. ERROR	STD. BETA	pr>t
Intercept	61.401	8.850	0.0000	.0001
DD18-36	-13.464	2.761	-0.5100	.0001
DDGR36	-9.930	4.002	-0.3080	.0174
DDAVGHT	-0.826	0.598	-0.1808	.1744

TABLE 7

ANOVA and Parameter Statistics for Model 4
SBEL = f(DD18-36, DDGR36, AVGBAS)

ANOVA statistics

SOURCE	DF	SS	MS	F	pr>F
MODEL	3	63115.786	21038.595	26.10	0.0001
ERROR	40	32244.706	806.118		
TOTAL	43	95360.492			

Multiple R-square = 0.6619
Predicted R-square = 0.5780

Parameter statistics

PARAMETER	ESTIMATE	STD. ERROR	STD. BETA	pr>t
Intercept	36.111	11.344	0.0000	.0028
DD18-36	-12.181	3.023	-0.4613	.0002
DDGR36	-12.344	3.217	-0.3829	.0004
AVGBAS	0.002	0.001	0.1840	.1142

The four regression equations are given below.

$$SBEL=62.127 - 9.037(DD18\text{-}36) - 11.200(DDGR36) - 0.776(DDPCT) \quad (1)$$

$$SBEL=27.658 - 11.281(DD18\text{-}36) - 12.384(DDGR36) + 0.284(AVGBA) \quad (2)$$

$$SBEL=61.401 - 13.464(DD18\text{-}36) - 9.930(DDGR36) - 0.826(DDAVGHT) \quad (3)$$

$$SBEL=36.111 - 12.181(DD18\text{-}36) - 12.344(DDGR36) + 0.002(AVGBAS) \quad (4)$$

As is obvious, all four equations share two variables in common, DD18-36 and DDGR36. In all cases both variables affected scenic beauty adversely, i.e. as the amount of dead and down material that was 18 inches in height or above increased, scenic beauty decreased. This finding supports previous research results (Arthur, 1977; Benson and Ullrich, 1981; and Schroeder and Daniel, 1981). It is clear from the standardized beta coefficients that the dead and down variables are very influential in the regressions.

The other two dead and down variables, DDPCT and DDAVGHT, also affected scenic preferences negatively and are found in models 1 and 3, respectively. The standardized beta coefficients show that they are moderately influential in the regressions as well.

Finally, AVGBA and AVGBAS, found in models 2 and 4, respectively, were positively related to scenic beauty. AVGBA seemed to achieve better results in terms of fit and predictive validity. This conclusion is based on the higher overall F, R^2, and predicted R^2 and lower PRESS and s^2. In addition, the significance of AVGBAS' coefficient was only marginal.

None of the models appeared to suffer, in terms of increased variability in coefficient estimates, from multicollinearity. The variance inflation factors ranged from 1.16 to 2.07 for the variables in the four models.

Analysis of the Variables

Each variable that was considered in this study is presented in Table 8 along with its mean, standard deviation, minimum value and maximum value. Based on the statistics given, all of the variables seem to adequately represent the possible range of values, given that all of the sites from which the data were derived were poor to average in quality. Table 9

TABLE 8

Univariate Analysis of Variables Used in Study

VARIABLE	MEAN	STD. DEV.	MINIMUM	MAXIMUM
HARV	2.38	0.99	1.00	4.00
HDUN2	7.09	5.43	0.00	28.00
HD2-4	0.30	0.51	0.00	2.00
HDGR4	0.14	0.41	0.00	2.00
CONUN2	0.14	0.41	0.00	2.00
DDUN18	6.27	2.62	2.00	12.00
DD18-36	1.43	1.78	0.00	7.00
DDGR36	0.77	1.46	0.00	6.00
DDAVGHT	16.61	10.31	4.00	40.00
DDPCT	25.55	20.63	5.00	85.00
AVGBA	66.20	37.63	0.00	122.00
AVGBAS	5766.66	4310.01	0.00	14884.00
CN4-7	0.09	0.36	0.00	2.00
CN8-11	0.16	0.64	0.00	4.00
CN12-15	0.14	0.51	0.00	3.00
CN16-19	0.07	0.25	0.00	1.00
CN20-23	0.00	0.00	0.00	0.00
HD4-7	1.52	1.65	0.00	7.00
HD8-11	1.93	1.76	0.00	5.00
HD12-15	1.70	2.04	0.00	10.00
HD16-19	0.45	1.00	0.00	4.00
HD20-23	0.11	0.32	0.00	1.00
STEMS	165.51	123.33	0.00	527.97
BAPERST	0.48	0.23	0.18	1.31
SBEL	20.72	47.09	-118.60	86.35
SBEI	13.91	63.55	-158.68	93.26
SBEU	20.54	57.06	-141.68	98.27

contains the Pearson's product moment correlation coefficients between each variable and SBEL. Four of the five variables measuring dead and down organic matter were moderately correlated with scenic beauty. The exception, DDUN18, may have been less influential in determining preferences because the organic matter it measured may have been too close to the ground to be very noticeable in the slides viewed. HARV, AVGBA, and AVGBAS also showed moderately strong relationships with scenic beauty.

Of equal importance are some of the independent variables that did not show a substantial relationship to scenic preference. The measurements that often dominate standard timber inventories, (e.g. numbers of trees in given diameter classes), were not good predictors of scenic beauty scores unlike the results of past research which found the presence of large trees to have a positive affect on scenic beauty (Arthur, 1977; Brush, 1979; Benson and Ullrich, 1981;and Schroeder and Daniel, 1981). In this study, it is entirely possible that there were not enough trees in the larger diameter classes for the relationship to appear. Although AVGBA was positively correlated with scenic beauty, basal area by itself reveals no conclusive information about stocking density. In fact, the larger basal areas found in this study's data were usually due to a large number of

TABLE 9

Correlations of Independent Variables with SBEL

VARIABLE		CORRELATION[a]	P-VALUE[b]
HARV	----------	.528	.0002
HDUN2	----------	.206	.1795
HD2-4	----------	.112	.6616
HDGR4	----------	-.084	.5872
CONUN2	----------	-.055	.7235
DDUN18	----------	-.342	.0230
DD18-36	----------	-.701	.0001
DDGR36	----------	-.607	.0001
DDAVGHT	----------	-.619	.0001
DDPCT	----------	-.721	.0001
AVGBA	----------	.612	.0001
AVGBAS	----------	.577	.0001
CN4-7	----------	.030	.8470
CN8-11	----------	.058	.7095
CN12-15	----------	.016	.9188
CN16-19	----------	.120	.4360
CN20-23	----------	.000	1.0000[c]
HD4-7	----------	.217	.1563
HD8-11	----------	.317	.0363
HD12-15	----------	.390	.0088
HD16-19	----------	.260	.0879
HD20-23	----------	-.027	.8641
STEMS	----------	.365	.0149
BAPERST	----------	.183	.2775

a Pearson's product moment correlation coefficient
b Ho: Rho=0; N=44
c No observations for this variable occurred

small trees (those from 4 to 11 inches dbh) rather than a few large ones.

In order to gain some insight into how the landowners reacted visually to the different harvest intensities, it was helpful to examine the scatter plot of HARV against SBEL (see Appendix D). The fewer trees taken out, the higher the scenic evaluation given seems to have been. Clearcuts were preferred the least, followed in order of increasing preference by heavy thin, light thin and natural. However, it should be noted that the highest three ratings were obtained for sites that were thinned. Also, the lightly thinned areas were rated very similarly to the natural areas.

Further support for these statements is found in the average SBE's calculated for each broad treatment category. They are;

1. Clearcut mean SBEL = -17.972
2. Heavy Thin mean SBEL = 10.688
3. Light Thin mean SBEL = 44.717
4. Natural mean SBEL = 46.97

Once again, the preference scores for the lightly thinned areas appear to be very similar to those for the natural sites.

While this does not directly support the findings of past research which found thinned stands to be preferred to similar unmanaged ones, it does not refute the findings either. It appears from this study that lightly thinned areas are visually preferred equally as well as natural areas.

A possible confounding factor in this study should be noted. As the models derived indicated, the amount and nature of dead and down material was the most influential factor in deciding scenic evaluation. It is possible that the landowners' SBE's are only reflecting the fact that the lightly thinned and natural areas contained less slash than the heavily thinned and clearcut areas did. By looking at the mean values for the dead and down variables after subdividing the data by harvest intensity, it was found that this was indeed possible. The clearcut areas had the most slash, followed by the heavily thinned sites. Then, the lightly thinned and natural areas both contained a similar quantity smaller than that in the first two categories.

CONCLUSIONS

The purpose of the research effort described in the preceeding pages was to quantify the visual preferences of private non-industrial forest landowners for managed and unmanaged hardwood stands and then build predictive models for those preferences based on mensurational data. It was hoped that the models developed would provide a useful management tool for ascertaining the aesthetic impact of various management actions and provide a much needed insight into how this important group of forest landowners reacts visually to different harvest intensities. The regressor variables considered were, for the most part, based on measurements usually available in timber data bases. This was done to allow for easy assimilation of the models developed into management planning. However, the variables found to influence scenic beauty the most are not usually represented in a standard timber cruise.

The amount and height of the dead and down material present in southern Appalachian hardwood stands of poor to average quality seems to be the most important factor in deciding scenic preferences. The obvious management implication to this is to either remove the slash or cut it into smaller, less conspicuous pieces --- if lessening the negative aesthetic impacts of the harvest is a management goal.

This seems too simplistic, though. Does this mean that if the slash is alleviated on a clearcut, for example, the site would be aesthetically acceptable? Only further research can tell. Studies need to be conducted in which the amount of dead and down material is held constant and the amount of standing timber varied. It is entirely possible that the variability of the dead and down matter on the sites of this study, masked the more subtle differences among them. Perhaps if the amount of slash present was low or held constant, variables such as AVGBA would play a more significant role in determining scenic preferences. One way of exploring this statistically, would be to treat either the dead and down percent or average height variable as a covariate and do an analysis of covariance. In this way, it is possible to ascertain whether the dead and down variables are masking the effects of the others or are in fact, the best predictors.

Also explored in the study was the possible existence of a bias against the terms used to describe timber harvesting which would affect scenic evaluations of managed stands. Contrary to Anderson's (1981) study, no evidence to support this idea was found. As was previously mentioned, however, it is possible that all subjects were able to discern the type of management action depicted without the benefit of the treatment labels. This is especially probable in the case of the recently clearcut scenes. Also since students were used to investigate this possible phenomenon, it may be that their biases, or lack of them, are different from those the landowners' might have. This is not to say that the two groups react differently in terms of scenic evaluation given the same viewing context, only that there may be a bias among the landowners against actually implementing the treatments that was not evident in the student panel. Perhaps future research could explore landowner scenic evaluations where they have been asked to view the slides in the context of a harvest regime being done to their land.

This research effort was a preliminary attempt to model preferences for private non-industrial forest landowners in the east. As such, there are numerous ways to expand and refine the efforts detailed here. In addition to the two studies suggested above, the following could be done;

1. explore the relationships between the scenic beauty of southern Appalachian oak/hickory stands to hardwood stands of other species compositions

2. investigate the effects of different degrees of slash removal on scenic beauty
3. study more closely the effects of time on the scenic evaluation of regenerating clearcuts and heavy thins
4. model preferences for hardwood stands encompassing a wider range in basal area and average stem size
5. study the effects on scenic beauty obtained using different contexts of evaluation for the subjects i.e. viewed in terms of recreation or in terms of personal home site

It is hoped that the research effort described here will serve as a beginning toward unlocking the vast reserves of timber being held by private non-industrial forest landowners in the East. Perhaps by furthering our understanding of how they react visually to management actions in hardwood stands we will be closer to discovering a viable compromise between the needs and desires of society for increased timber supplies and those of the landowner for an aisthetically pleasingforest stand.

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Appendix A

PHOTOGRAPHIC EXAMPLES OF EACH HARVEST TREATMENT

RECENT CLEARCUT (top) OLD CLEARCUT (bottom)

RECENT HEAVY THIN (top) OLD HEAVY THIN (bottom)

LIGHT THIN (top) NATURAL (bottom)

Appendix B

INSTRUCTIONS FOR UNINFORMED SUBJECTS

UNINFORMED
SUBJECT RUNNING INSTRUCTIONS

1. Choose the starting time by closing the door and posting a "DO NOT ENTER" sign on the door.

2. (For students only) Pass out the consent forms, read the consent forms, and have the subjects complete the forms.

3. A. (For students) Collect the consent forms and pass out the response sheets, questionnaire[a], and #2 pencils.

   B. (For landowners) Pass out the response sheets, questionnaire, and #2 pencils.

4. Ask if everyone has the above.

5. Read the following instructions:

   I AM GOING TO READ SOME STANDARDIZED INSTRUCTIONS, SO THAT EVERYONE PARTICIPATING IN THESE EXPERIMENTS WILL HAVE THE SOME INFORMATION.

   TODAY, MORE THAN EVER, WISE MANAGEMENT OF OUR WOODED LANDS SUCH AS OUR NATIONAL FORESTS IS VERY IMPORTANT. IN DECIDING HOW BEST TO MANAGE THESE AREAS MANY FACTORS PLAY A ROLE. THE SCENIC BEAUTY OR QUALITY OF AN AREA IS ONE SUCH FACTOR. THIS RESEARCH IS DESIGNED TO DETERMINE YOUR SCENIC PREFERENCES FOR VARIOUS WOODED SCENES. WE GREATLY APPRECIATE YOUR TIME IN THIS EFFORT.

   I AM GOING TO SHOW YOU, ONE AT A TIME, SOME COLOR SLIDES OF SEVERAL WOODED AREAS. EACH SCENE REPRESENTS A LARGER AREA. WE ASK YOU TO THINK ABOUT THE AREA IN WHIC WHICH THE SLIDE WAS TAKEN RATHER THAN ABOUT THE PHOTOGRAPHIC QUALITY OF THE INDIVIDUAL SLIDE. IN SOME OF THE SLIDES THE FOREGROUND MAY APPEAR OUT OF FOCUS. PLEASE DISREGARD THIS AND CONCENTRATE ON THE SCENE AS A WHOLE.

   THE FIRST SLIDES WILL BE SHOWN JUST TO GIVE YOU AN IDEA OF THE KINDS OF AREAS YOU WILL BE EVALUATING. TRY TO IMAGINE HOW YOU WOULD RATE THESE SLIDES, USING THE "RATING RESPONSE SCALE" FROM ONE TO TEN. NOTE THAT THE SCALE RANGES FROM ONE, MEANING YOU JUDGE THE AREA TO BE LOW IN SCENIC QUALITY, TO TEN, INDICATING VERY HIGH SCENIC QUALITY.

a the questionnaire refered to was part of a larger research effort and was not part of this thesis.

THEN, AFTER THESE INITIAL SLIDES, I WILL ANNOUNCE THAT YOU ARE TO BEGIN RATING THE NEXT SET OF SLIDES. YOU SHOULD ASSIGN ONE RATING NUMBER FROM ONE TO TEN TO EACH SLIDE. YOUR RATING SHOULD INDICATE YOUR JUDGEMENT OF THE SCENIC BEAUTY REPRESENTED BY THE SLIDE. PLEASE USE THE FULL RANGE OF NUMBERS IF YOU POSSIBLY CAN AND PLEASE RESPOND TO EACH SLIDE.

(For landowners)
ON THE RESPONSE SHEET PLEASE BE SURE TO COLOR IN YOUR RATING CHOICE COMPLETELY. YOU SHOULD BE UNABLE TO READ THE NUMBER THROUGH THE PENCIL MARKING.

ARE THERE ANY QUESTIONS?
(Answer any questions by repeating instructions, or defering them until after the experiment is over.)

THESE ARE THE PREVIEW SLIDES---DO NOT RATE THESE SLIDES, JUST USE THEM TO GET AN IDEA OF THE RANGE OF AREAS YOU WILL SEE.
(Show last 10 slides in the tray at 8 sec. intervals.)

NOW RATE THE FOLLOWING SLIDES, USING THE ONE TO TEN RATING SCALE. I WILL CALL OUT THE SLIDE NUMBERS TO HELP YOU KEEP TRACK OF WHICH SLIDE IS BEING SHOWN. THERE ARE ABOUT 105 SLIDES ALL TOGETHER.
(Show slides at 8 sec. intervals)

THAT IS ALL THE SLIDES.

. . . . collection of completed forms, etcetera

Appendix C

INSTRUCTIONS FOR INFORMED SUBJECTS

INFORMED
SUBJECT RUNNING INSTRUCTIONS

. . . . introductory statements and instructions

5. Read the following instructions:

I AM GOING TO READ SOME STANDARDIZED INSTRUCTIONS, SO THAT EVERYONE PARTICIPATING IN THESE EXPERIMENTS WILL HAVE THE SAME INFORMATION.

TODAY, MORE THAN EVER, WISE MANAGEMENT OF OUR WOODED LANDS SUCH AS OUR NATIONAL FORESTS IS VERY IMPORTANT. IN DECIDING HOW BEST TO MANAGE THESE AREAS MANY FACTORS PLAY A ROLE. THE SCENIC BEAUTY OR QUALITY OF AN AREA IS ONE SUCH FACTOR. THIS RESEARCH IS DESIGNED TO DETERMINE YOUR SCENIC PREFERENCES FOR VARIOUS WOODED SCENES. THESE SCENES WILL DIFFER IN TERMS OF HOW MANY TREES HAVE BEEN HARVESTED FROM THEM IN THE FAIRLY RECENT PAST. WE GREATLY APPRECIATE YOUR TIME IN THIS EFFORT.

I AM GOING TO SHOW YOU, ONE AT A TIME, SOME COLOR SLIDES OF SEVERAL WOODED AREAS. EACH SCENE REPRESENTS A LARGER AREA. WE ASK YOU TO THINK ABOUT THE AREA IN WHICH THE SLIDE WAS TAKEN RATHER THAN ABOUT THE PHOTOGRAPHIC QUALITY OF THE INDIVIDUAL SLIDE. IN SOME OF THE SLIDES THE FOREGROUND MAY APPEAR OUT OF FOCUS. PLEASE DISREGARD THIS AND CONCENTRATE ON THE SCENE AS A WHOLE.

AS I MENTIONED EARLIER, THE MAJORITY OF THESE SLIDES REPRESENT AREAS THAT HAVE BEEN MANAGED USING DIFFERENT CUTTING OR HARVESTING METHODS. SOME OF THE AREAS HAVE BEEN CLEARCUT. THIS MEANS THAT ALL OF THE TREES HAVE BEEN REMOVED. THERE ARE ALSO SLIDES OF AREAS WHERE ONLY SOME OF THE TREES HAVE BEEN REMOVED. THIS IS CALLED THINNING. IF A LOT OF TREES ARE CUT AND RELATIVELY FEW ARE LEFT TO GROW, THEN THE TREATMENT IS REFERRED TO AS A HEAVY THIN. IF, ON THE OTHER HAND, ONLY A FEW TREES ARE CUT AND MANY ARE LEFT TO GROW, THEN THE TREATMENT IS CALLED A LIGHT THIN. LASTLY, SOME OF THE SLIDES SHOW NATURAL OR UNMANAGED AREAS. THESE FOREST STANDS WERE PROBABLY LOGGED 50 OR SO YEARS AGO BUT HAVE BEEN LEFT ALONE SINCE THEN. IN OTHER WORDS, NO TREES HAVE BEEN CUT RECENTLY FROM THESE AREAS.

PLEASE NOTE THAT ON YOUR RATING SHEET FOR EACH SLIDE THERE APPEARS A TERM DESCRIBING HOW THE AREA YOU'RE VIEWING HAS BEEN MANAGED. THESE TERMS ONCE AGAIN ARE CLEARCUT, HEAVY THIN, LIGHT THIN, AND NATURAL. ARE THERE ANY QUESTIONS ABOUT WHAT THESE TERMS MEAN?

THE FIRST SLIDES WILL BE SHOWN JUST TO GIVE YOU A VISUAL IDEA OF THE KINDS OF AREAS YOU WILL BE EVALUATING. I'LL TELL YOU HOW EACH OF THE AREAS WAS MANAGED. TRY TO IMAGINE HOW YOU WOULD RATE THESE SLIDES, USING THE "RATING RESPONSE SCALE" FROM ONE TO TEN. NOTE THAT THE SCALE RANGES FROM ONE, MEANING YOU JUDGE THE AREA TO BE VERY LOW IN SCENIC QUALITY, TO TEN, INDICATING VERY HIGH SCENIC QUALITY.

THEN, AFTER THESE INITIAL SLIDES, I WILL ANNOUNCE THAT YOU ARE TO BEGIN RATING THE NEXT SET OF SLIDES. YOU SHOULD ASSIGN ONE RATING NUMBER FROM ONE TO TEN TO EACH SLIDE. YOUR RATING SHOULD INDICATER YOUR JUDGEMENT OF THE SCENIC BEAUTY REPRESENTED BY THE SLIDE. PLEASE USE THE FULL RANGE OF NUMBERS IF YOU POSSIBLY CAN AND PLEASE RESPOND TO EACH SLIDE.

ARE THERE ANY QUESTIONS?
(Answer any questions by repeating instruction, or defering them until after the experiment is over.)

THESE ARE THE PREVIEW SLIDES --- DO NOT RATE THESE S SLIDES, JUST USE THEM TO GET AN IDEA OF THE RANGE OF AREAS YOU WILL SEE.
(Show last 10 slides in the tray at 8 sec. intervals.)

NOW RATE THE FOLLOWING SLIDES, USING THE ONE TO TEN RATING SCALE. I WILL CALL OUT THE SLIDE NUMBERS TO HELP YOU KEEP TRACK OF WHICH SLIDE IS BEING SHOWN. THERE ARE ABOUT 105 SLIDES ALL TOGETHER.
(Show slides at 8 sec. intervals.)

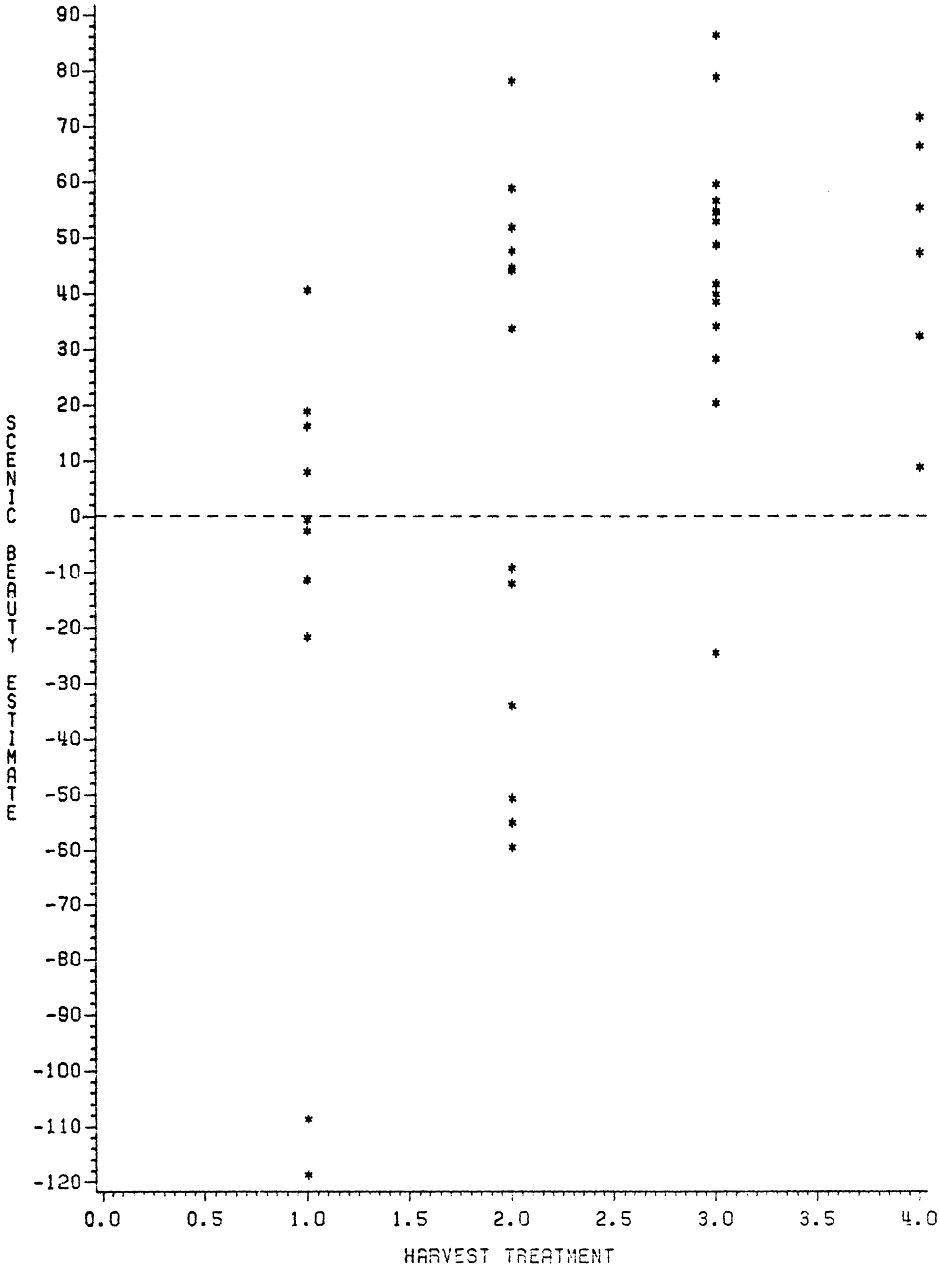
THAT IS ALL THE SLIDES.

. . . . collection of completed forms, etcetera

Appendix D

SCATTER PLOT OF HARV AGAINST SBEL

LANDOWNER SCENIC BEAUTY ESTIMATES BY HARVEST TREATMENT



1 = CLEARCUT 3 = LIGHT THIN
2 = HEAVY THIN 4 = NATURAL

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LANDOWNER PERCEPTIONS OF SCENIC BEAUTY FOR
EASTERN HARDWOOD STANDS
UNDER DIFFERENT MANAGEMENT REGIMES

by

Patricia Lynn Roberts

(ABSTRACT)

A family of four regression models is presented which describes the relationship between perceived aesthetic value and mensurational field data for managed and unmanaged eastern hardwood stands. These models were developed from data collected on 44 plots in selected hardwood stands, ranging in harvest treatment from clearcut to unmanaged. Each of the plots was photosampled and inventoried in the summer of 1982. The mensurational information obtained consisted of basal area, true height and diameter by species, and amounts of understory and dead and down material. The photographs were later developed into color slides.

In the fall of 1982, groups of private non-industrial forest landowners viewed the slides and rated them from one to ten in terms of perceived scenic beauty. The ratings were then transformed into interval scale values, termed

Scenic Beauty Estimates (SBE's), using a psychophysical scaling methodology as explained by Daniel and Boster (1976). Next, the SBE's were regressed onto stand parameters to formulate predictive models. The variables in the full model given below were chosen on the basis of past research and their correlations with SBE.

SBE = f (DD18-36, DDGR36, DDPCT, DDAVGHT, AVGBA, AVGBAS, HARV)

where DD18-36 = dead and down 18-36" in height

DDGR36 = dead and down >36" in height

DDPCT = dead and down percent coverage

DDAVGHT = dead and down average height

AVGBA = average basal area

AVGBAS = average basal area squared

HARV = harvest treatment

From the set of all possible regressions a subset of four were chosen on the basis of several comparative statistics.

Of the variables present in the final models, those representing measures of dead and down material were found to influence scenic preferences to the greatest degree and in a negative way. Average basal area also influences scenic preferences, but to a lesser degree and in a positive fashion. The possibility of the effect of the dead and down variables masking the effects of the other variables is discussed.

Also no support was found for the existence of a bias against the terms used to describe timber harvesting which could affect scenic evaluations.