

VALIDITY OF USING PHOTOGRAPHS TO SIMULATE VISIBLE QUALITIES OF FOREST RECREATION ENVIRONMENTS¹

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Forest recreation managers and researchers interested in conserving and improving the visual quality and recreation opportunities available in forest environments must often resort to simulations as a means of illustrating alternatives for potential users to evaluate. This paper reviews the results of prior research evaluating the validity of using photographic simulations to represent forest environments (i.e. comparing responses obtained in the field to those of photographic representations). The findings of three previously unreported validity tests conducted in northeastern forests are presented. The results indicate that simulations are both effective and appropriate useful to represent in stand conditions. However, simulations that involve a portion of a wider vista may have difficulty establishing the wider context of the scenes.

Introduction

Photographic representations have been used in studies of landscape perceptions and preferences because they offer greater economy, speed, and control than site visits. The use of photographs avoids the costly and time-consuming task of transporting respondents to the scenes, and photographs can be altered to allow for controlled comparisons among alternative conditions.

Studies have repeatedly shown that evaluations done from photographic representations are highly correlated with on-site evaluations of the same areas. However, this body of research is not without its weaknesses, such that a researcher can not always generalize from one study to the next or find guidance for their own research approach. As Zube et al. (1982) point out, there is no theoretical framework that brings coherence to the wide variety in the type of scenes studied, the regions where these studies take place, and the research methods employed. The scope of scenes used in these studies range from forested through open countryside to suburban and urban landscapes. The scale of these scenes ranges from small-scale foreground views to large-scale vistas.

While research in the area of visual qualities of forests exist -- over 100 empirical reports -- most studies have been done in the coniferous forests of the Southwest (Hoffman et al. 1993). A few studies have focused on the northern hardwoods (Brush 1979; Palmer 1990, 1993; Ribe 1990) and only one study looked specifically at slides as a valid and reliable media for representing in-stand forest conditions (Shafer & Richards 1974).

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This paper reviews the literature investigating the validity of photographic media to represent environmental conditions, and summarizes the findings for three new studies that investigate the validity and reliability of photographic media for representing the visible conditions of hardwood forests in the Northeast. The three studies considered middle ground views of clearcutting alternative in the White Mountain National Forest, New Hampshire, the visual effects of slash after an uneven age management harvest cut at Cuyler Hill State Forest, New York, and the impacts of deer pressure on forest regeneration at Fools' Creek in the Alleghany National Forest, Pennsylvania.

Literature Review

A total of 16 studies have been identified that explicitly tested the validity of photographic media to represent the visual quality of the environment. Of these only three took place in northeast. Table 1 summarizes the characteristics of these studies.

Studies Done in the Northeast

The results of Brush's (1979) study of scenic preferences of forested areas in Massachusetts found a correlation of $r = 0.67$ ($p = 0.001$) between those scenic evaluations done from color photographs and those done in the field. The evaluations were completed by two groups of non-forestry students. Both groups used the same five-point scale for their evaluations ranging from very attractive (1) to very unattractive (5). One group of 48 evaluated 10 color photographs; the other group of 48 rated the forest sites in the field from the same view point and in the same direction that the photographs had been taken. Brush notes that some of the variance may be explained by the changes that occurred at the sites during the year that lapsed between the field and photographic evaluations.

The watersheds of the upper East Branch of Brandywine in Chester County and the North Branch of Neshaminy Creek in Bucks County, Pennsylvania were the study sites for Coughlin and Goldstein (1970). Two respondents evaluated 92 in-field points along a road; three to four color slides taken from these same points were used for slide evaluations completed by 11 respondents. All the respondents were affiliates or employees of the Regional Science Research Institute. A seven-point interval scale ranging from 1 = most negative response to 7 = most positive response was used. The authors reported that the mean ratings of the field respondents were significantly correlated ($r = 0.64$, $p < 0.001$) with the mean scenic beauty rating given by the respondents which evaluated slides of each location.

Rabinowitz and Coughlin (1971) used 14 sites on the banks of small streams in the vicinity of Philadelphia. The character of the sites ranged from densely to somewhat less densely developed suburban areas, including open farm country about 20-miles outside the city. The majority of the sites were wooded. Ten suburban housewives completed the in-field evaluations; eight respondents, also suburban housewives, completed the slide evaluations from 39 slides - one to three slides for each of the 14 stream sites. The field group used a two-page questionnaire which included a request for a brief objective description of each site, 14 five-point rating scales (1 = dislike very much, 5 = like very much), and 15 five-point semantic differential scales. The slide group used a one to five point scale for three preference questions regarding the respondents preferences to "live here," "a place to pass through and enjoy the scenery," and "to use this site for recreation". Also, six weeks after the in-field evaluations had been completed the same 10 respondents were asked to complete evaluations from slides of the sites they had visited. The correlations between the in-field and slide evaluations which were completed by the one group were greater than $r = 0.89$ ($p < 0.001$). Results comparing the evaluations of the field and slide-only groups were not reported.

Eight sites representing urban to forested landscapes were used by Shafer and Richards (1974) in their study comparing viewer reactions to outdoor scenes and photographs of those scenes. Three groups of respondents, randomly selected undergraduate photography students at Syracuse University in Syracuse, New

York, evaluated the eight scenes from either in-field, slides, or color photographs. They used 27 bi-polar, seven-step semantic differential scales for the evaluations. These authors concluded that when color slides or photographs adequately depict most of the variation of natural and man-made environments, the adjective-pair measurement of responses to the picture presentations agree with similar in-field responses to the same scenes.

Zube et al. (1975) used an 18-point semantic differential scale, a landscape-feature checklist, scenic quality categories, and preference for use rank order in the evaluation of scenes in the southern half of the Connecticut River Valley. Thirteen sub-groups evaluated scenes which included working farms, village centers, suburban neighborhoods, strip developments, and forests. Five of the groups completed the in-field evaluations; the other eight groups completed the evaluations from panoramic and regular format color photographs. Responses of each sub-group were correlated with those of every other sub-group. Results reported show 82 percent of the correlations at $r = 0.80$ level or higher.

Studies Done Outside the Northeast

Twenty campsites located at five areas within Mt. Jefferson Wilderness Area in Oregon served as study sites for Shelby and Harris's (1985) study of campers' scenic beauty acceptability and camping desirability preferences. The 427 respondents completed evaluations for three to five campsites in the field and from color photographs during their visit using a five point scale with 1 = totally acceptable and 5 = totally unacceptable. They also ranked the sites in order of preference. The authors reported that of the 20 campsites evaluated in-field and from photographs the average scenic beauty acceptability evaluations were significantly different at two sites ($p < 0.05$), and the average camping desirability evaluations were significantly different at five sites. On the sites where disagreement occurred, the evaluations done from photographs were higher than the in-field evaluations. However, for the overall preference rankings, where photograph and in-field rankings agreed for 15 of the 20 sites, the rankings based on photographs were lower than those based on in-field scenes where disagreement occurred.

The respondents in Shuttleworth's (1980) study of scenic beauty evaluations done in the field and from photographs viewed 12 scenes of the University of East Anglia, England. Ninety-three environmental studies students were divided into two groups each of which completed in-field evaluations of six of the 12 scenes. The two groups were then further subdivided -- half of each group evaluated the scenes from black-and-white photographs, the other half from color photographs. They used seven semantic differential landscape scales and rank ordered the scenes for scenic beauty. The results indicate that there were very few significant differences between the evaluations. Black-and-white photographs tended to induce more extreme and more differentiated responses than the color photographs. Evaluations from color photographs agreed more closely to those done in-field than the black-and-white photographs.

Boster and Daniel (1972) used six Ponderosa pine sites in Arizona for their study sites. Five of the sites had received treatments -- uniform stripcut, clearcut, heavy thinning, and conventional logging. The remaining site was a natural, untreated area. The respondents for this study included: 27 Northern Arizona University students who completed scenic beauty evaluations of the six sites in the field, and 30 University of Arizona students and 10 members of the Arizona Water Resource Committee who completed the scenic beauty evaluations from slides of each of the six sites. All the evaluations were done using a 10-point scale with 0 being "I am absolutely certain that I dislike the area represented by the slide/scene" and 9 being "I am absolutely certain that I like the area represented by the slide/scene." Their results show that the mean ratings of the field and slide groups to be statistically indistinguishable with a correlation of $r = 0.99$.

Eleven forested campgrounds in north-central Arizona served as sites for Brown et al.'s (1988) study of campers' scenic beauty preferences. Seven hundred and twenty-seven campers evaluated the scenic beauty of the campsites both in the field and from color photographs. A 10 point scale was used for the evaluations ranging from 1 = very low scenic beauty to 10 = very high scenic beauty. Individual t-tests showed that the ratings done in the field were all significantly higher than the photo-based ratings of the same sites. The correlation between mean ratings done in the field and those completed from the photographs was $r = 0.76$, suggesting that photo-based ratings do provide a reasonably good indication of relative on-site scenic beauty.

Clamp (1975) had 75 volunteer respondents complete scenic beauty evaluations of 170 sites representing a variety of landscapes characteristic of England. (Major urban centers and military property were avoided.) All the respondents completed evaluations in the field and from color slides. A 12-point scale was used for the evaluations ranging from 1 for "very, very attractive" to 12 for "very, very unattractive." The comparison of in-field and slide evaluations resulted in a correlation of $r = 0.80$.

A broad array of landscape types -- residential areas, shopping centers, commercial highway strip, light industrial park, office complex, and grazing land -- were used in scenic beauty evaluations for Craik's (1975) study in Marin County, California. A random county-wide sample of 522 respondents completed descriptive evaluations of the scenes from an auto tour through a site, a color film of a simulated eye-level tour through a scale model of a site, or a black-and-white video of the scale model tour. The evaluations were in the form of a checklist of 240 adjectives frequently used to describe landscape scenes. Respondents were told to read through the list and put an "X" beside each adjective they considered descriptive of the designated landscape. Craik reported correlations of $r = 0.80$ and better for comparisons of adjectives checked to describe each of the presentation formats.

Hull and Stewart (1992) had respondents evaluate 12 scenes in the White River National Forest in Colorado for scenic beauty and recreation satisfaction. Respondents included two groups each of 45 day-hikers and one group of 32 students. The day-hikers completed in-field evaluations during their visit; their photo evaluations of the same scenes were completed both three and nine months later from a booklet of color photographs sent to them by the researchers. The students completed the evaluations from slides of the same scenes twice over a three month period. Correlations between the in-field and photo evaluations of the day-hikers was $r = 0.80$ ($p = 0.05$). Correlations between the in-field groups and the students were reported as $r = 0.85$ ($p < 0.01$). The authors suggest that the differences between in-field and photo-based evaluations seem to be caused, in part, by differences in meaning, novelty, and mood between the in-field and photographic contexts.

Lane et al. (1975) had 66 students complete scenic beauty evaluations in the field and from three simultaneously projected color slides of five sites located in the upper Piedmont area of South Carolina. The five areas included a picnic area on a lake, a hardwood stand on a relatively steep slope, a small lake with a forested shoreline, a picnic area on a small stream in a hardwood stand, and a loblolly pine plantation. The respondents used a nine-point scale ranging from 1 = like extremely to 9 = dislike extremely. Results reported that with the exception of the small lake area, the sites were given a higher scenic beauty preference from the slide evaluations than from the in-field evaluations. The authors suggest that this may be because the slides tend to "glamorize" some sites. For example, roads and parking areas were not evident in the slides, but they were apparent in the field.

Kellomaki and Savolainen (1984) had respondents complete scenic evaluations of 34 forest stands at forestry field stations located near the University of Helsinki. Five groups of respondents completed the evaluations using a seven-point, single adjective scale. The first two groups, comprised of first year

forestry students, evaluated scenes both in the field and from black-and-white photographs. The other three groups -- another group of forestry students and two groups of randomly selected city dwellers -- completed evaluations from only the black-and-white photograph. The correlation between field and photographic ratings done by the two first two groups was $r = 0.94$

($p < 0.01$). A correlation of $r = 0.83$ ($p < 0.01$) was reported when the ratings from the photographs only were compared across all five groups. Kellomaki and Savolainen concluded that black-and-white photographs may be a reliable tool for estimating the scenic value of forest landscapes.

Table 1. Studies that sought to validate the efficacy of photographic media with field evaluations.

	Correlation	Region	Forested Open countryside Urban/suburban	Scenic beauty Other connotative attributes Denotative attributes Specified a use in context	Black and white Color Prints Slides Film or video Panoramic montage	Different field/photo subjects Same field/photo subjects Controlled for field/photo order	Sampling method
Boster & Daniel, 1972	.99	SW	•	•	• •	•	S/C
Brown et al., 1988	.76	SW	•	•	• •	•	U
Brush, 1979	.67	NE	•	•	• •	•	S/U
Clamp, 1975	.80	E	• • •	•	• • •	•	R
Coughlin & Goldstein, 1970	.64	NE	• • •	•	• •	•	S
Craik, 1975	>.80	SW	• •	• •	• • •	•	R
Hull & Stewart, 1992	.80	SE	• •	• •	• • •	• •	S/U
Kellomaki & Savolainen, 1984	.83	E	•	•	• •	• •	S/R
Lane et al., 1975	n/a	SE	•	•	• • •	•	S
Rabinowitz & Coughlin, 1971	.89	NE	• • •	• • • •	• • •	• •	R
Shafer & Richards, 1974	n/a	NE	• • •	• • •	• • •	•	S
Shelby & Harris, 1985	n/a	NW	•	• •	• •	•	U
Shuttleworth, 1980	.89	E	• • •	• • •	• • •	• • •	S
Sorte, 1975	n/a	E	•	• • •	• • • •	•	U
Stewart et al., 1984	.67	SW	• •	• •	• •	•	R
Zube, Pitt & Anderson, 1975	.80	NE	• •	• • •	• •	•	S/R

Notes : Sampling method for respondents: available students (S), civic groups (C), random (R), or users (U).
Region of study: northeast (NE), northwest (NW), southeast (SE), southwest (SW), or Europe (E).

Sorte (1975) looked at evaluations done in-field and from various media types for two urban/suburban row house-type living units in Sweden. The respondents completed evaluations from plan and perspective illustrations, models, color slides and a movie taken of the models, and color slides and a movie of the actual sites. The seven-point semantic scale used for the evaluations were based on pleasantness, enclosedness, complexity, social status, and unity. A review of the means reported shows that the mean evaluation for the model-based slides and movie, and the field-based slides and movie were lower than the mean ratings from the in-field evaluations done at both sites.

Stewart et al. (1984) had seven respondents make $100 \pm$ site visits at various times of the day to evaluate visual air quality. After completing the in-field evaluations, the respondents photographed each of the specified views around Denver, Colorado. Seven point scales were used to evaluate the visual air quality based on clarity, border, and source. In evaluations done from the photographs they had taken, the means of those evaluations across respondents were compared with the corresponding means of evaluations done in the field. For all but two respondents, the mean from photographs was significantly lower ($p < 0.01$) than the mean from the in-field evaluations. The authors suggest that

this may indicate a tendency for visual air quality to look worse in photographs than in the field. Median correlations for each respondent between evaluations of photographs and in-field ranged from $r = 0.51$ to $r = 0.83$.

Study Methods

The materials and data for this paper are drawn from three northeastern hardwood forest sites being studied to better understand major forest management issues.

White Mountain National Forest in New Hampshire

The visual affect of harvesting alternatives were simulated in this study from two vista sites: Sugar Loaf and Welsh Ledge. In all there were 30 simulations representing different sized clearcuts, patterns and intensities. These simulations represented variation in the size of the clearcut openings (approximately 4.5, 12 or 25 acres), the intensity of the cutting (1, 2, 3, 4, or 5 percent of the viewshed), and the placement pattern (scattered or concentrated) of the cutting sites. Also included among these simulations were the photograph of the original view take the previous year and a completely revegetated simulation. Twenty-six different hikers at each site ($n = 52$), used a 10-point bi-polar scale to rate the scenic value of all 32 scenes. The interviews were conducted in the field at the view point. The hikers also rated the actual view and were asked to locate the scene that most resembled the view from among the 32 photographs.

Cuyler Hill State Forest in Central New York

This is a demonstration site for uneven age single-tree selection silviculture. The area was marked according to research guidelines and harvested by a commercial logger in late-August 1993. The last previous harvest was in mid-1970. Two existing data collection points with similar appearance were selected in the treatment area and a third point from a neighboring research stand with similar forest structure was selected as a control site. All three sites were photographed in mid-July. The two treatment sites were rephotographed a week after the harvest. The slash was lopped to the ground at one of these sites and rephotographed. This resulted in the sites representing three different field conditions: uncut, slash, and lopped. Two non-overlapping views were photographed using color 35mm film at all three sites in their uncut condition, at two sites in their slash condition, and one with the slash lopped. All three sites were visited by 12 landscape architecture students during September and the harvested sites by 20 forestry students in October.² Twenty-four bi-polar scales were used to describe various visible forest characteristics, including overall scenic beauty. All participants rated the field sites and twelve photographic slides.

Allegheny National Forest in Western Pennsylvania

Regeneration failure after harvesting in western Pennsylvania forests has become a serious problem due to excessive browsing by the deer population. Fenced plots at Fool's Creek have been established to study the effects of deer density on forest vegetation. There were two controlled densities of 10 and 64 deer per square mile. Within each density, there is an area that has been uncut, thinned to 60 percent stocking, and clearcut in 1968. A third unfenced site was clearcut and remained open to the natural density of greater than 100 deer per square mile. During the second week of September, 1994, a color 35mm slide was taken at each site to represent each management condition, for a total of 7 slides. On 16 October 1994, a group of 27 students and their professors on a biology field trip evaluated all the slides and sites. They used 24 bi-polar scales to describe the forest's visible characteristics, including an overall rating of scenic beauty.

Findings

The data provided for 14 comparisons between ratings in the field and of photographic representations: 2 in White Mountain National Forest, 6 in Cuyler Hill State Forest, and 7 in Allegheny National Forest. The mean ratings for these sites are shown in table 2, along with paired t -test and Pearson correlation coefficients. In 10 cases, the rating in the field was more scenic than of the photograph or slide, in 3 cases it was less scenic, and in 1 they had the same value. A two-tailed sign test indicates a probability of .092 for this or a more extreme distribution. While there is an obvious pattern of higher ratings being made in the field, it does not meet the normal threshold of statistical significance. In only three cases did the t -test indicate that the field and photographic ratings are significantly different at the .05 level. The average correlation between the field and photographic ratings is .388, substantially below those in the literature review.

White Mountain National Forest

This study was originated by the Forest Service because they were unaware of the public's awareness and attitude towards clearcutting on the National Forest. The presence of harvesting activity in the field view was recognized by 96 percent of the respondents at Sugar Loaf and 81 percent at Welsh Ledge. Hikers correctly picked the actual view out of 32 photographs 36 percent of the time at Sugar Loaf and 26 percent of the time at Welsh Ledge. While these levels of recognition are not exceptionally high, it must be remembered that all 32 photographs were quite similar and from exactly the same view point. The binomial test sets the probability of this many hikers at either site identifying one item out of 32 is *very, very* small ($p < .0001$). This result indicates we can have some confidence that observers are able to use subtle distinctions present in a photograph to distinguish a scene.

The ratings of the actual view are much higher than for the photograph. In addition, the Pearson correlation between the field and photo scenic rating is .258 at Sugar Loaf and .241 at Welsh Ledge. These two results indicate a poor correspondence between scenic evaluations made in the field and from the photographs. Probable causes for this are that the previous year when the photos were taken was drier and vegetation was therefore browner. Perhaps more important is that the contextual affect of a breathtaking vista in the field cannot be fully represented by in single photograph. Respondents had trouble limiting their scope of view and wanted to focus on landmarks (e.g. Mount Washington from Sugar Loaf) outside the photograph. This was true even though they were directed where to focus their attention when rating the view in the field.

²The uncut control site could not be visited because access was blocked by a vehicle left in the middle of the road by a thoughtless NYS DEC employee.

Table 2. Means, *t*-tests and correlations for scenic ratings in the field and matching photographs or slides for views at several sites.

Evaluation sites	Mean		<i>t</i> - test		Pearson Correlation	n
	Field	Photo	<i>t</i> -value	p (2-tail)		
White Mountain NF: view point ^a						
Sugar Loaf	6.23	3.54	4.53	.0001	.258	27
Welsh Ledge	7.08	5.71	2.70	.013	.241	24
Cuyler Hill SF: treatment, raters ^b						
Uncut, LA	3.25	3.17	0.24	.815	.245	12
Cut with slash, LA	3.83	4.88	-1.71	.116	.051	12
Cut with lopped slash, LA	3.67	3.21	2.26	.067	.807	12
Uncut, For	--	3.16	--	--	--	20
Cut with slash, For	3.35	3.97	-1.67	.110	.288	20
Cut with lopped slash, For	3.65	3.16	1.59	.127	.449	20
Allegheny NF: density, treatment ^b						
10 d/sm uncut	2.13	1.96	1.16	.257	.781	23
10 d/sm, thinned	2.72	2.56	0.46	.651	.097	25
10 d/sm, clearcut	3.96	3.58	0.89	.380	.196	26
64 d/sm, uncut	2.65	2.00	3.16	.004	.501	26
64 d/sm, thinned	2.66	2.11	1.97	.066	.355	18
64 d/sm, clearcut	4.59	4.59	0.00	1.00	.375	22
Uncontrolled, failed clearcut	2.95	3.05	-0.37	.715	.791	21

^a Rating scale of 1 = low scenic value to 10 = high scenic value.

^b Rating scale of 1 = beautiful to 7 = ugly.

Cuyler Hill State Forest

The results of an analysis of variance shown in Table 3 indicate that there is no significant difference between evaluations made in the field and of slides of the same condition at the same site. Nor did it matter whether the evaluations were made by students trained in forestry (i.e. more oriented toward the benefits of timber productivity) or landscape architecture (i.e. more oriented toward minimal environmental impacts and aesthetic benefits). However the effect of treatment was significant. Tukey's LSD post hoc test indicates that the cut with slash condition was judged significantly more ugly than the uncut ($p = .002$) or lopped ($p = .008$) conditions. The difference between the uncut and lopped conditions was not significant ($p = .251$). The only interaction term to be significant was between treatment and

field/slide. This is probably due to the influence of the landscape architecture students' ratings of the untreated slash condition, which almost reached significance in Table 2.

Two slides were used to represent the three field conditions. A Tukey's LSD indicates there is no significant difference between the slides at the uncut ($p = .537$) and lopped ($p = .691$) sites, it is significant at the cut site with slash ($p = .006$).

Over all, this provides a strong indication that slash has a negative visual affect that can be mitigated by lopping. These results also support the efficacy of slides to evaluate the visual impacts of slash in hardwood forests.

Table 3. Analysis of variance for the effects of field or slide evaluation, slash treatment, respondent background, and their second order interactions on scenic beautiful at Cuyler Hill State Forest.

Source	df	Sums of Squares	Mean Square	F-ratio	Probability
Constant	1	3218.3	3218.2	1606.4	≤ 0.0001
field/slide	1	0.1	0.1	0.1	0.8078
treatment	2	24.6	12.3	6.2	0.0025
For/LA	1	4.6	4.6	2.3	0.1329
treatment*f/s	2	17.5	8.8	4.4	0.0136
For/LA*f/s	1	0.5	0.5	0.2	0.6180
For/LA*trt	2	5.9	2.9	1.5	0.2321
Error	253	506.8	2.0		
Total	262	593.7			

Allegheny National Forest

The results of an analysis of variance in table 4 indicates again that there is no overall difference between the field and slide ratings of scenic beauty. However, the *t*-tests reported in Table 2 indicate that there is a significant difference between the field and photo ratings for the uncut condition at 64 deer per square mile. This difference may be due to season change (Palmer 1990; Palmer & Sena 1993; Buhyoff & Wellman 1979). Slides were taken in mid-September and the field ratings were made mid-October. In the intervening month, the effects of fall had crept onto these sites changing the appearance somewhat. In the words of the proctor: "there was lots of green fern in the pictures and a lot of brown fern in the woods." The average Pearson correlation between the seven field and slide ratings is .516.

The ANOVA also indicates that both silvicultural treatment and deer density do have a significant impact on scenic value. The Tukey's LSD post hoc test indicates that clearcut areas are significantly more ugly than the uncut and thinned conditions. However, uncut and thinned are not significantly different. The results relating to deer density are not as meaningful, since the controlled conditions are not significantly different and the uncontrolled condition had only a clearcut treatment. However, Tukey's LSD for the clearcut condition indicates that the scenic effects of all three deer densities are significantly different

Table 4. Analysis of variance for the effects of field or slide evaluation, treatment, deer density, and their second order interactions on scenic beautiful at the Fool's Creek Deer Management Area.

Source	df	Sums of Squares	Mean Square	F-ratio	Prob
Const	1	3102.0	3102.0	1521.4	≤ 0.0001
field/slide	1	2.6	2.6	1.3	0.261
deer/square mile	2	48.5	24.2	11.9	≤ 0.0001
treatment	2	159.6	79.8	39.1	≤ 0.0001
d/sm*f/s	2.0	1.4	0.7	0.337	0.7144
treatment*f/s	2	0.1	0.1	0.0	0.965
d/sm*treatment	2	11.6	5.8	2.8	0.060
Error	334	681.0	2.0		
Total	345	946.0			

Conclusions

The literature reporting results or methods dependent upon photographic representation of forested environments covers a broad range of subject areas. For example, the interaction between visual quality and recreational experiences, the scenic impact of forest management practices, and the effectiveness of various research methodologies in assessing visual quality. Establishing the reliability and validity of photographic media is clearly necessary for the responsible use of this method. In 1974 Shafer and Richards concluded that:

when color-slide or picture presentations adequately depict most of the natural and man-made environments, the adjective-pair measurement of response to the picture presentations agrees favorably with similarly measured on-site responses to the same scenes.

At the same time, experimental results also suggest that if pictorial presentations include only a portion of the total variation in natural environments, responses to such presentations are significantly different from on-site response patterns to the same conditions.

This advice is reinforced by the literature reviewed and results reported in this paper.

Studies looking at testing the validity and reliability of photographic media cite three main concerns regarding the perceptual distortions that occur when a photo or slide is used as a surrogate display. These limitations include context representation, and attribute perception.

Context Representation

There are obvious differences in context between a photo or slide of a view and the view as seen on-site. The eye can take in a larger field of view than a photo and is able to focus greater attention to objects of interest. The human eye has a 120-degree lateral cone of vision as compared to the 35mm camera lens used in most visual quality research which has a much more limited 65-degree lateral cone of vision.

In the context visible from the vista viewpoints used for the White Mountain study reported here was breathtaking and much more extensive than the focused views in the simulations. They tended to incorporate this context in their judgment, even when directed to evaluate only the area represented in the photograph. This is clear from their responses to an open-ended question to describe what they saw. While the evaluations of the slides may be accurate in and of themselves, it cannot be claimed that they represent the conditions within this larger context.

Attribute Perception

Understanding a site's visual attributes, such as color, lighting, scale, shape, and distances, may not be sufficiently accurate when based on perceptions of a photograph (Shelby & Harris, 1985;

Shuttleworth, 1980). Of course there are additional perceptions that cannot be represented by a visual medium: sounds, smells, tastes, touch, and kinesthetic experience.

A photo or slide is a two-dimensional static image with a very limited depth of field. It is sometimes difficult to photograph the forest because the trees get in the way. It is important view points are not selected for photographic convenience. For instance, care should be taken not to stand in an area that is more open than normal. Care should be taken to obtain maximum depth of field, which may require that a tripod and slower shutter speeds are used. It is also best to take photographs on overcast days with the sun high overhead to reduce the effect of highly contrasting lighting. The image's composition is also a concern. The image should be horizontally accurate and not artistically framed or artificially focused on feature elements. It should become common practice that more than one image be used to represent a site's visual condition. This need is illustrated by the significant difference in ratings for the two slides representing residual slash at Cuyler Hill.

A photograph records the condition of a particular point in time. Palmer (1990) has shown that seasonal change affects scenic evaluation, but that respondents rate the same view differently when it is presented in divergent seasons for evaluation. Researchers must therefore remain cognizant of the importance of changing conditions such as foliage density or color.

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