SCENIC BEAUTY IN SUMMER THE YEAR BEFORE, THE YEAR AFTER, AND 4 YEARS AFTER HARVEST

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Abstract—This study examined the effects of four silvicultural options (clearcut, group selection, shelterwood, and untreated) on the perceived scenic beauty of shortleaf pine-oak (*Pinus echinata*-*Quercus* spp.) stands of national forest land in the Ouachita Mountains of Arkansas. Twelve randomly selected stands were selected and nine were cut in the winter of 1993. Color images of the stands were captured in June 1992, July 1994, and July 1997. Texas A&M University undergraduate students rated the scenic beauty of five images per plot and summer season results are reported here. The visual impact of cutting these stands was severe a year (two growing seasons) after treatment, with intensive treatments yielding the lowest scenic beauty preferences. Four years after treatment, however, no statistical differences were detected among treated and untreated stands. Results are preliminary, but clearly show that the negative visual aspects of harvesting declines with time.

INTRODUCTION

An attractive, healthy, and visually pleasing natural environment is closely related to the success of tourism and recreation-related industries (Mieczkowski 1995). Such environments improve the quality of life for nearby communities and raise their property values (Correll and others 1978, Crompton 1993, Ulrich and others 1991a, 1991b).

Ecosystem management, a paradigm adopted by the U.S. Department of Agriculture, Forest Service, National Forest System, emphasizes the integration of social, economic, and ecological needs at different scales of time and space (Salwasser and Pfister 1994). Society places importance on the public enjoyment of forests, especially their scenic values (Brunson 1991). Because people's first response to the forest is often visual, and their evaluation of place is also visual (Gobster 1993), they judge forest management and policy on a forest's appearance (Hull 1989).

In managing forests, knowledge of the visual impact and speed of recovery from alternative harvest disturbances are critical elements of an appearance-sensitive approach to ecosystem management. Empirical studies have confirmed the validity and reliability of photographs to represent scenes of field conditions (Brown and others 1989, Buhyoff and Wellman 1979, Hoffman and Palmer 1995).

To develop hypotheses about a variety of disturbances, Benson and Ullrich (1981) studied preferences of foreground, or near-stand views of Douglas fir-larch and lodgepole pine forest types in Montana and Wyoming having a range of stand histories and treatments. Viewers rated scenic values lower for stands with severe cutting and burning activities, and rated scenic values higher in stands where time-since-disturbance was 25 to 50 years old. Had Benson and Ullrich (1981) conducted long-term monitoring and controlled experiments at the same location—or in forest types of the Eastern United States—results might have been different.

Rudis and others (1994, 1999) monitored 0.5 acres of experiment-scale (1.6 acres) treatments in shortleaf pine-oak vegetation types of the Ouachita Mountains of Arkansas and found measurable differences in vegetation structure with the type and amount of cutting two growing seasons after harvest. Gramann and Rudis (1994) found the amount of cutting in these same areas negatively associated with scenic values of within-stand views. In operational-scale (about 40 acres) treatments elsewhere in the Ouachita Mountains, the amount of cutting was negatively associated with scenic values within a year of cutting (Barlow and Rudis, in press) and a full year (two growing seasons) after cutting (Li and others, in press), but longer term trends had not been quantified.

OBJECTIVES AND THE STUDY AREA

We monitored change in scenic beauty the summer before, the year (two growing seasons) after, and 4 years after cutting disturbance and compared the effects of different harvest practices. Study locations were part of a 52-stand study region (Baker 1994, Guldin and others 1994, Mersmann and others 1994) in national forests in the Ouachita Mountains of Arkansas. Treated stands were harvested in the winter of 1992-93 and subsequent reproduction treatments occurred in 1994. Silvicultural treatments were randomly assigned to 1 of 13 stands in each quadrant of the study region (Baker 1994). Cost and time constraints limited our study to four treatment conditions and the north, east, and south quadrants of the study region. The conditions and stand references for this study were

(a) Untreated: untreated stands (CON) retained in their natural state, averaging 129 square feet per acre. The north, east, and south stands were 0284-11, 0605-05, 0023-10, respectively

(b) Group selection: pine-hardwood group selection (PHGS): 60 square feet per acre retained (70 square feet per acre removed); openings 0.1 to 2.0 acres.

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Retention of 20 to 45 trees per acre shortleaf pine and 10 to 20 trees per acre hardwoods. The north, east, and south stands were 0046-18, 1124-11, 0035-42, respectively

(c) Shelterwood: pine-hardwood shelterwood (PHSW): 40 square feet per acre retained (90 square feet per acre removed). Retention of 10 to 30 trees per acre shortleaf pines and 10 to 30 trees per acre hardwoods. The north, east, and south stands were 0457-12, 1119-21, 0027-01, respectively

(d) Clearcut: all merchantable trees removed (CC): 0 to 5 square feet per acre of trees retained (129 square feet per acre removed). The north, east, and south stand compartments were 0458-16, 1067-15, 1658-05, respectively.

METHODS

We took about 15 images per stand within a 2-week period. Viewing points were at five to six predetermined locations (depending on the size of the stand) and spaced evenly within each stand (Baker 1994). Equipment used included ASA 400, 35-mm transparency film, push processed to ASA 800, and an f2.8-lens (Olympus XA) camera. Duplicate, overexposed or underexposed images were discarded. This study used about five randomly selected scenes per stand from the remaining images.

We tested scenic beauty at three time periods for four conditions: one untreated (control) and three treatment conditions; and three replicates per condition: one in each of the north, east, and south quadrants of the study region. The season and year for images included a pretreatment summer sample, a year (two growing seasons) after treatment in spring, summer, fall, and winter, and 4 years after treatment in summer, fall, and spring. For brevity, analysis reported here used data only from the summer season; quadrant and season differences are not included.

Rating sessions followed procedures developed by Daniel and Boster (1976) and used rating-analysis software (Brown and others 1990). In each session, raters viewed 80 images, 20 of which were baseline images shown to every group. These baselines were placed in every fourth position of the slide carousel. Raters were shown each scene for 8 seconds, then asked to rate each image on a scale of 1 to 10, where 10 was the highest scenic beauty. The score for an image represented the average scenic beauty rating, called SBE, relative to baseline images shown to all raters (Brown and Daniel 1990). People's perception, represented by SBE, is widely used in visual impact estimation (Brown and Daniel 1990, Ribe 1989). However, one is often cautioned that no true interval exists. Commonly, the resulting ordinal scores are assumed to provide adequate precision and not violate assumptions of standard statistical tests.

We conducted two sets of three rating sessions. Each session consisted of about 5 warm-up images, 20 baseline images, and 80 images stratified by stand and by 4 points-in-time. The first set was from summer 1994, fall 1994, winter 1995, and spring 1995. The second set was from summer 1992, summer 1997, fall 1997, and spring 1998. The total set was 480 images. The baseline images were from four seasons in 1994 and 1995 from another national forest region in the Ouachita Mountains (Winona Ranger District); Gritter (1997) also used these images. Thirty-one students at Texas A&M University viewed a portion of the images and asked to rate scenes as part of a classroom assignment. Respondents were students taking undergraduate courses in parks and diverse populations; methods of park, tourism, and recreation research; and management of tourism and recreation enterprises. Students were predominantly from the Southeastern United States, and majored in agricultural development, architecture, or recreation, park, and tourism sciences.

We used standardized SBE scores, called SBEz, to assure a uniform scale among different raters (Brown and Daniel 1990) and used nonbaseline image SBEz values for subsequent calculations. For ease of interpretation, we converted ratings to rankings for conducting an analysis of variance by year and treatment, calculation of averages, and F- and t-tests of significance at the 0.05 probability level. Statistical software employed SAS's General Linear Model (SAS Institute, Inc. 1990). By year, significant tests among treatments by year used the Tukey-Kramer option to account for multiple comparisons (SAS Institute, Inc. 1990).

RESULTS AND CONCLUSIONS

A visual inspection of color images suggests that overt evidence of disturbance was negatively associated with scenic beauty estimates. (A subset of images in various seasons and related SBEz values are included in the appendix.) The amount of sky in the scene changed dramatically in treated stands, with distant views apparent in areas that were extensively cut. Evidence of cutting disturbance was apparent in the year following treatment, but evidence was not readily visible after 4 years.

Quantitatively, our results showed significant differences in scenic beauty preferences among forest management activities that varied by year (table 1). The chief difference was

Table 1—Analysis of variance in summer scenic beauty ranking by year and treatment, Ouachita-Ozark National Forests

Source	Degrees of freedom	Mean square variance	F value	P (larger F)
Treatment	3	4,428.49	2.08	0.105
Year	2	5,067.44	2.38	0.096
Year by treatment	6	16,430.42	7.71	< 0.001
Residual	167	2,131.29		

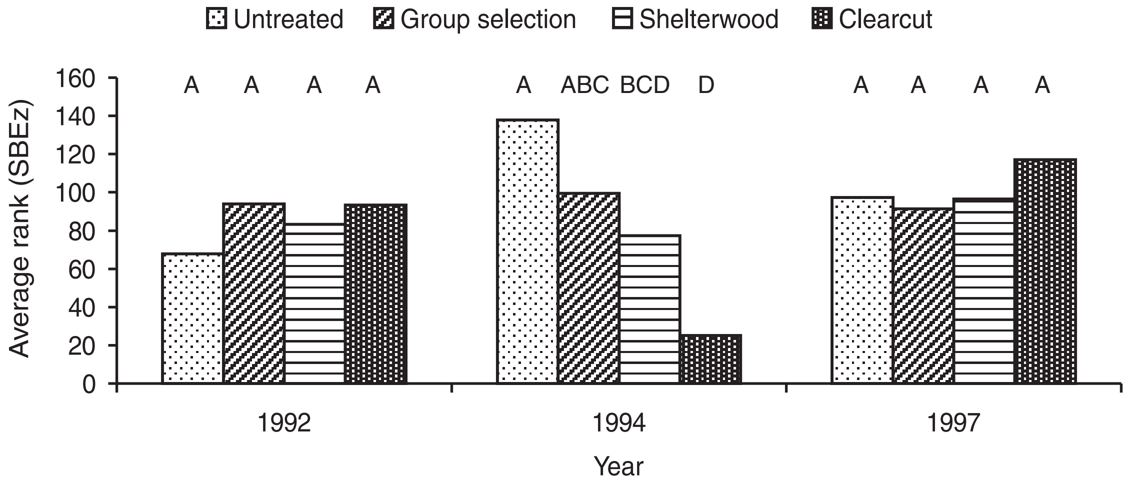

Figure 1—Average rank (standardized scenic beauty estimates) in summer scenic beauty the year before (1992), the year after (1994), and 4 years after harvest (1997) by type of harvest, Ouachita-Ozark National Forest. By year, averages among harvest treatment with the same letter are not significantly different.

in the year after treatment, with more intensive treatments yielding lower scenic beauty (fig. 1). Before treatment and 4 years after treatment, we did not detect significant differences. Failure to detect significant differences in summer between untreated stands and group selection suggests this treatment may be the least offensive of the other treatments. A year after treatment, differences in scenic beauty between group selection and shelterwood were not significant. Analyses that account for quadrant differences and preference ratings from additional images taken in other seasons may reveal other fine-scaled differences. Nevertheless, results to date corroborate a common understanding that, with time, the negative visual aspects of harvests are indistinguishable from untreated stands.

Benson and Ullrich's (1981) hypothesis for Douglas fir-larch and lodgepole pine forests was that the vegetation change in the years following treatment reduces the negative aspects of harvest disturbance. Our results for the summer season in shortleaf pine-oak forest types in Arkansas show definitively that scenic beauty is indistinguishable from untreated stands 4 years after harvest. This contrasts with data in Benson and Ullrich's (1981) report on scenic preferences, which suggested recoveries of lodgepole pine at 3 to 10 years, and Douglas fir-larch at 23 to 30 years at one site and 6 to 18 years at three other sites. Apart from methodological differences between the two studies, our study's shorter recovery time may be due to the more humid and longer growing period for vegetative growth in Arkansas compared with Montana and Wyoming.

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APPENDIX

The following is a subset of the study's digitally-archived images with identifying codes by treatment, stand, and vantage point. References under each image are the season and time period: 1992 = year before treatment; 1994, 1995 = year after treatment; 1997, 1998 = 4 years after treatment; and standardized scenic beauty estimate (SBEz). SBEz scores ranged from -170 to +270 for views from all seasons. For summer views, we also list the ranking of SBEz, where 1 = lowest and 179 = highest. (A seven-digit compact disk/image code is included for archival purposes.)

Untreated (Control), Stand 0284-11, Point 3

Summer (1992) SBEz = 0.06
Rank = 88 CD 2608-069

Winter (1995) SBEz = -62.88
CD 1634-084

Summer (1994) SBEz = 87.87
Rank = 143 CD 0015-022

Fall (1997) SBEz = 68.56
CD 4233-076

Summer (1997) SBEz = -24.89
Rank = 67 CD 4232-014

Spring (1998) SBEz = -16.07
CD 3171-084

Group Selection, Stand 1124-11, Point 4

Summer (1992) SBEz = 77.68
Rank = 135 CD 2609-069

Fall (1994) SBEz = -51.68
CD 1633-048

Summer (1994) SBEz = 38.12
Rank = 116 CD 2607-018

Winter (1995) SBEz = -116.77
CD 1636-072

Summer (1997) SBEz = -292.97
Rank = 2 CD 4232-031

Fall (1997) SBEz = 11.16
CD 4234-044

Shelterwood, Stand 0027-01

Point 5

Summer (1992) SBEz = -104.99
Rank = 28 CD 2608-010

Summer (1994) SBEz = 4.11
Rank = 91 CD 2607-058

Summer (1997) SBEz = -68.15
Rank = 45 CD 4231-045

Point 2

Winter (1995) SBEz = -189.09
CD 1634-065

Spring (1995) SBEz = 31.63
CD 1613-084

Spring (1998) SBEz = 75.22
CD 4235-91

Clearcut, Stand 0458-16, Point 6

Summer (1992) SBEz = 26.28
Rank = 104 CD 2608-054

Fall (1994) SBEz = -188.28
CD 1561-002

Summer (1994) SBEz = -155.81
Rank = 13 CD 0015-012

Spring (1995) SBEz = 235.67
CD 1613-046

Summer (1997) SBEz = 92.82
Rank = 147 CD 4231-066

Spring (1998) SBEz = 121.39
CD 3171-096