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EFFECTS OF HARDWOOD RETENTION, SEASON OF YEAR, AND LANDFORM ON THE PERCEIVED SCENIC BEAUTY OF FOREST PLOTS IN THE OUACHITA MOUNTAINS

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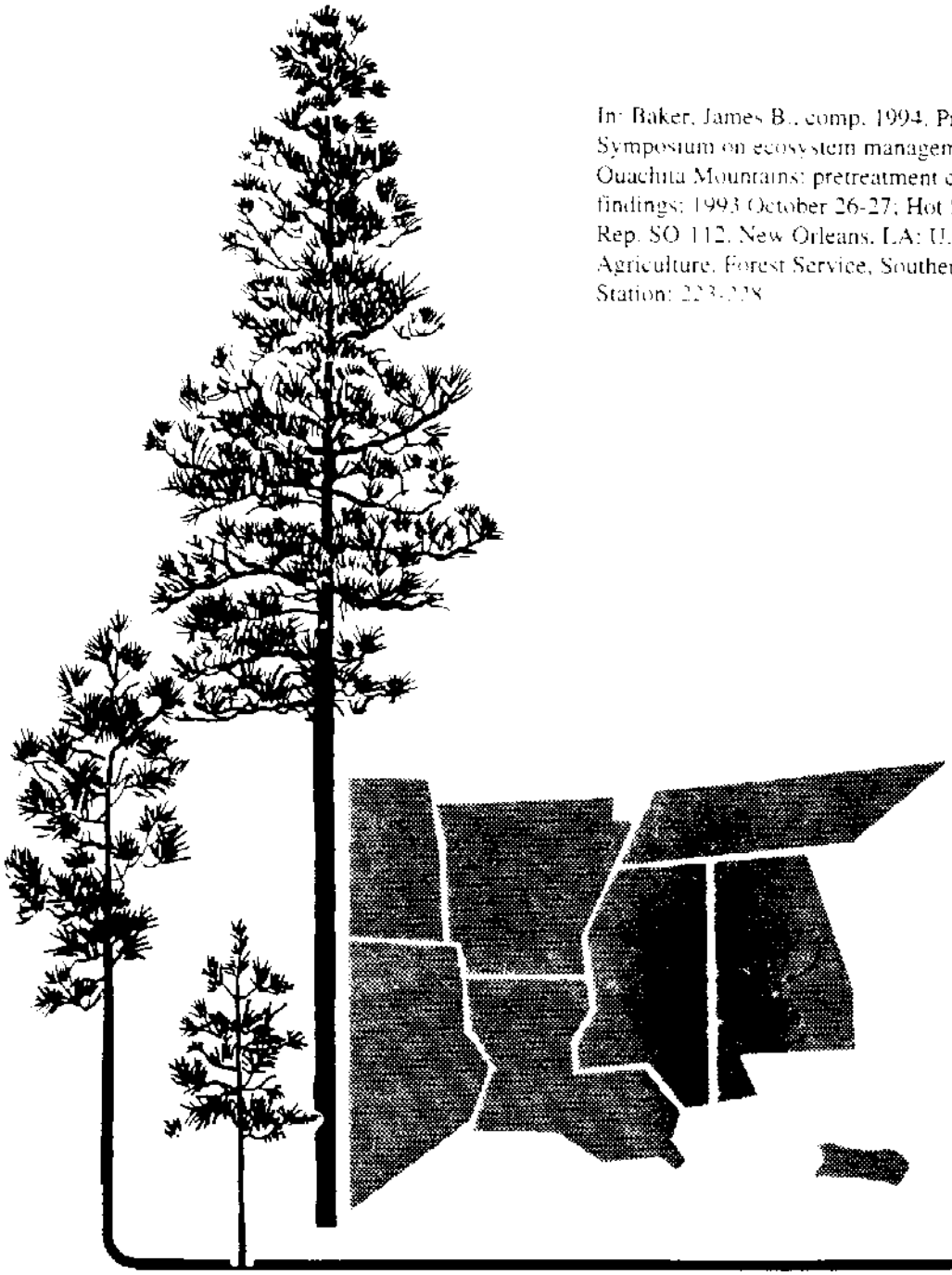

Southern Forest Experiment Station

1994

Effects of Hardwood Retention, Season of Year, and Landform on the Perceived Scenic Beauty of Forest Plots in the Ouachita Mountains[1]

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Victor A. Rudis[2]

ABSTRACT

Results from a study of the within-stand visual effects of alternative reproduction cutting methods on 20 experimental plots in the Ouachita National Forest are presented. Treatments varied in their level of hardwood retention from complete suppression of hardwoods to retention of 30 ft²/acre of basal area. Using color transparency film, plots were photo-sampled two growing seasons after treatments were imposed. The color slides were rated for their scenic beauty by students at Texas A&M University. Results showed that perceived scenic beauty increased with the level of hardwood retention and that summer, fall, and spring views were preferred over those taken during the winter. Ridgetop plots on north-facing slopes were rated as significantly more scenic than plots on gentle-slope north-facing positions.

INTRODUCTION

The within-stand visual-quality impact of alternative reproduction cutting methods carried out on 20 experimental plots located in the Ouachita National Forest, Arkansas is described in this paper. The plots are installed on the Winona Ranger District and consist primarily of second-growth shortleaf pine (*Pinus echinata* Mill.) with a hardwood component dominated by white oak (*Quercus alba* L.) and lesser amounts of post oak (*Q. stellata* Wangenh.), black oak (*Q. velutina* Lam.), blackjack oak (*Q. marilandica* Muenchh.), and southern red oak (*Q. falcata* Michx.) (Shelton and Murphy 1991). Each plot consists of a 0.2-ha division within a 0.65-ha treated area (fig. 1).

The Winona study area was established during the 1988 to 89 dormant season as a "pre-Phase I" plot-level component of the Ouachita/Ozark-St. Francis ecosystem management research program. (Subsequent phases have focused on stand-level and ecosystem-level analyses.) The Winona plots are oriented along an east-west ridge with elevations ranging from 195 to 240 m above sea level. In aggregate, they represent four replications of four treatments, plus four control plots that were not treated (plots 17 to 20, fig. 1). In installing the plots, pine basal area was reduced to 60 ft²/acre in all treated stands. The four experimental treatments included three levels of hardwood retention: a 30 ft²/acre basal area, a 15 ft²/acre basal area, and total hardwood suppression. The treatment with 15 ft²/acre was implemented so that residual hardwoods were retained in either a scattered or grouped spatial arrangement (Shelton and Murphy 1991). Because landform position can affect moisture availability and forest regeneration, the plots were blocked so that each treatment and control is replicated on four landform positions: a gentle-slope north-facing position, a moderate-slope north-facing position, a ridgetop north-facing position, and a ridgetop south-facing position.

METHODS

All 20 Winona plots were photo-sampled two growing seasons (1.5 years) after treatments were imposed. Photo sampling took place during each season of the year, beginning in summer 1990 and ending in spring 1991. Views were photographed with an f-1/2.8 lens and taken from eight surveyed points on each plot's perimeter. The direction of the eight perimeter shots was toward the center of the plot. Ektachrome 35mm color slide film, speed ISO 400, was push-processed to ISO 800 to compensate for the dimly lit conditions that often characterize within-stand views.

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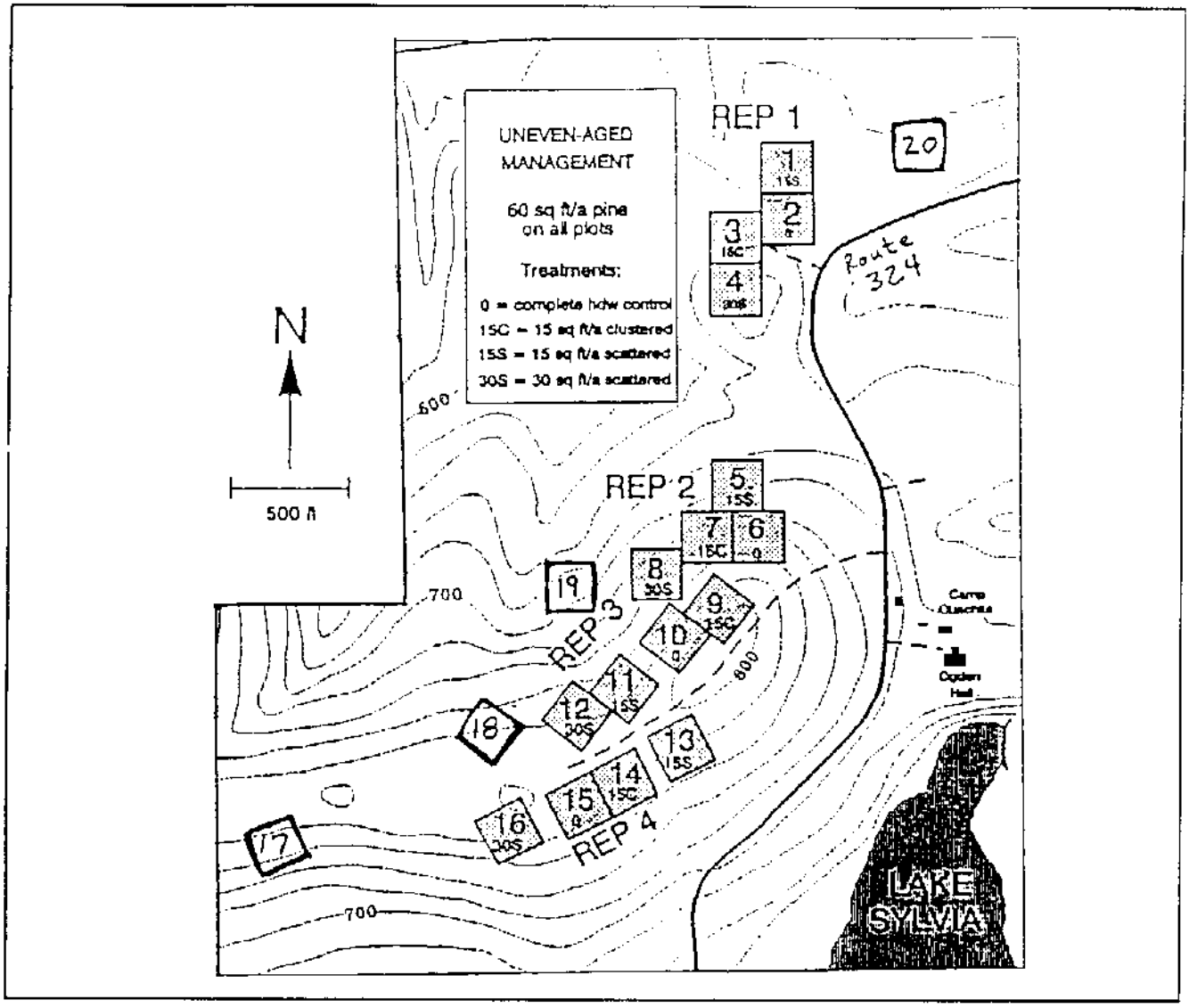

Figure 1.— *Winona plot-level study area.*

During spring 1992, slides from the Winona plots were rated for their scenic beauty by classes at Texas A&M University. Rating sessions followed procedures developed by Daniel and Boster (1976). After viewing 10 "warm-up" slides, students evaluated scenes on a 10-point scale, ranging from "1," which meant "very low in scenic beauty" to "10," which meant "very high in scenic beauty."

Slides used in the rating sessions were selected randomly from the inventory of photos with the constraint that they had to be of acceptable technical quality and not include obvious distractions that might bias judgments (e.g., spectacular lighting effects or the presence of human-made objects in the scene). Scenic-beauty judgments were obtained from three undergraduate and one graduate class. The undergraduate classes were in sociology, business administration, and civil engineering. The graduate class was in computer science. Ratings from students majoring in natural resource management fields were discarded.

Each class rated 100 slides that consisted of 80 unique slides shown only in one rating session and 20 common "baseline" slides, which were shown in each of the four sessions. Baseline slides were interspersed systematically with the remaining 80 slides so that they appeared as every fifth slide shown. Slides remained on the screen for five seconds. In total, 400 scenic-beauty ratings were obtained that covered 340 views. The 20 baseline slides were rated four times.

Each of the rating sessions replicated a four by five by four factorial design. The three factors were season of the year (four levels), treatment (i.e., reproduction cutting method—five levels), and landform position (four levels). Treatments were assigned at random within each landform. The dependent variable was the scenic beauty estimation (SBE) for each slide,

which was calculated from the raw scenic-beauty ratings using the RMRATE software (Brown and Daniel 1990). Data were analyzed using three-way analysis of variance (ANOVA).

Prior to ANOVA, the correlations between the baseline SBE's from each of the rating sessions were examined to determine the agreement between rating groups on the scenic beauty of these 20 slides. The Pearson product-moment correlations ranged from 0.915 to 0.956, with an average correlation of 0.936 for the six pairwise comparisons. This high level of agreement between groups supports the application of ANOVA to the combined ratings of all four groups of judges.

RESULTS AND DISCUSSION

ANOVA results are shown in table 1. To maintain a balanced design, the 20 baseline slides were excluded from the analysis, leaving a total sample of 320 slides. In comparing levels within the three experimental factors, a priori contrasts were specified between complete hardwood suppression and each of the remaining silvicultural treatments and control condition, between winter and each of the remaining seasons, and between the gentle-slope north-facing landform and each of the remaining landform positions. It was hypothesized that plots with complete hardwood suppression would be rated as significantly less scenic than other plots and that summer, fall, and spring scenes would be judged as more scenic than winter views. It also was hypothesized that the lower-elevation landform position would be associated with lower scenic-beauty ratings because the moister conditions that presumably characterized it would produce lusher growth in the understory, which would create a less open and parklike appearance.

Main Effects

Table 1 shows that the simple main effects of treatment, season, and landform were statistically significant, whereas the interaction between treatment and season was insignificant. Because landform was not replicated in the study design, the interaction terms that included this variable were not evaluated. However, the significant effect of the experimental design suggests that landform may interact with other factors to influence scenic-beauty ratings.

Differences in SBE ratings within factors are graphed in figures 2 to 4. In general, a priori contrasts supported the hypotheses concerning the relationship between scenic beauty and silvicultural treatments, seasons of the year, and landform position.

Table 1.— *Analysis of variance of scenic beauty estimations (N = 320)*

Source of variation	*df*	*Mean square*	*F*[*]
Landform	3	3884.0	3.1[†]
Treatment	4	17151.0	13.8[‡]
Season	3	122679.5	98.8[‡]
Treatment by season	12	1403.0	1.1
Experimental design	57	1242.0	1.4[†]
Residual	240	871.4	—
Total	319		

[*] The denominator for the F-test is the residual mean square for the experimental design (871.4) and the experimental-design mean square for the other effects (1242.0).
[†] $P < 0.05$.
[‡] $P < 0.01$.

Treatment

Figure 2 shows that the untreated control plots and those plots retaining 30 ft²/acre of hardwoods in a scattered pattern were rated as significantly more scenic than plots with complete hardwood suppression. Leaving 15 ft²/acre of hardwoods in a grouped pattern also resulted in significantly higher SBE ratings. However, there was no significant difference between the plots with complete hardwood control and the 15 ft²/acre treatment in which hardwoods were left in a scattered configuration. This suggests that retaining residual hardwoods in a grouped pattern, as opposed to a scattered one, may partially mitigate the negative visual impacts of a reproduction cut that maintains only 15 ft²/acre of hardwood basal area.

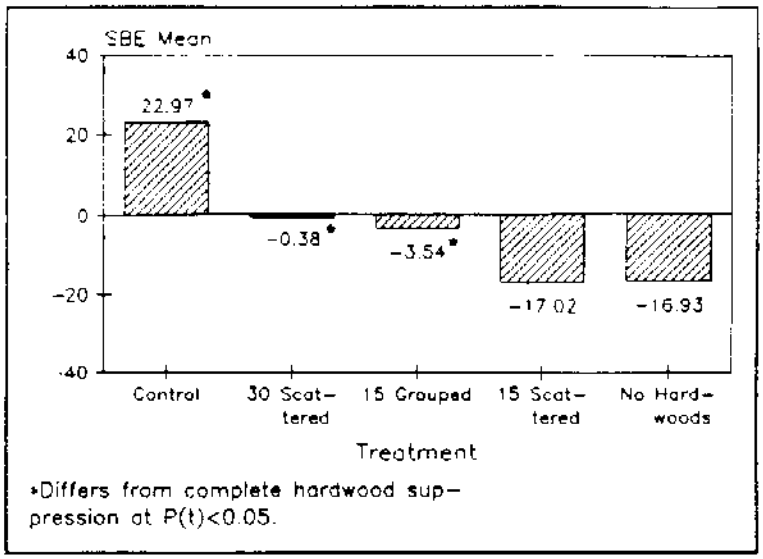

Figure 2.— *Main effect of treatment on scenic beauty estimation.*

Season

Figure 3 shows that summer views were judged as significantly more scenic than winter views. A priori contrasts revealed that fall and spring scenes also received significantly higher ratings than winter views.

The preference for summer, fall, and spring scenes over winter views may be related to seasonal color patterns. Color variation by season is one of the most notable changes in forest vegetation. This variation could have important effects on human preference for forest scenes, even in landscapes dominated by pine. The exact nature of the relationship between silvicultural treatment, forest color, and scenic-beauty judgments is worthy of further investigation.

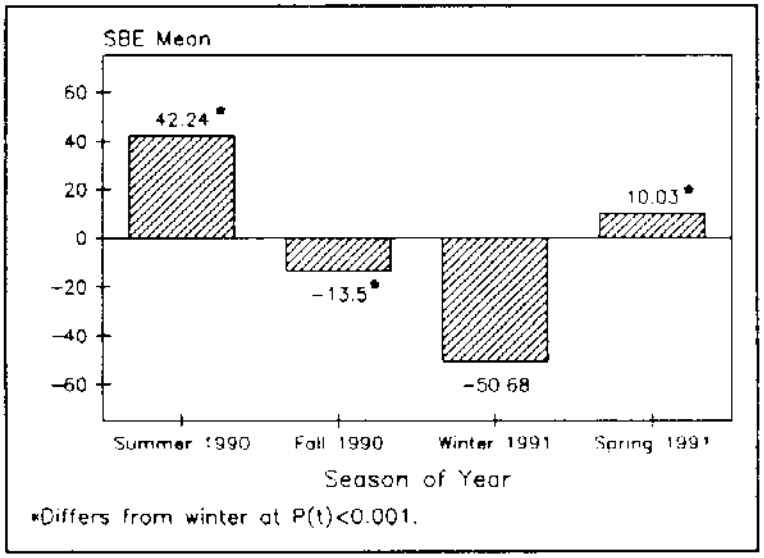

Figure 3.— *Main effect of season of year on scenic beauty estimation.*

Landform Position

Figure 4 shows that ridgetop plots on north-facing slopes were rated as significantly more scenic than plots on gentle-slope north-facing positions. No other significant differences were found for any of the remaining comparisons with the gentle-slope north-facing plots.

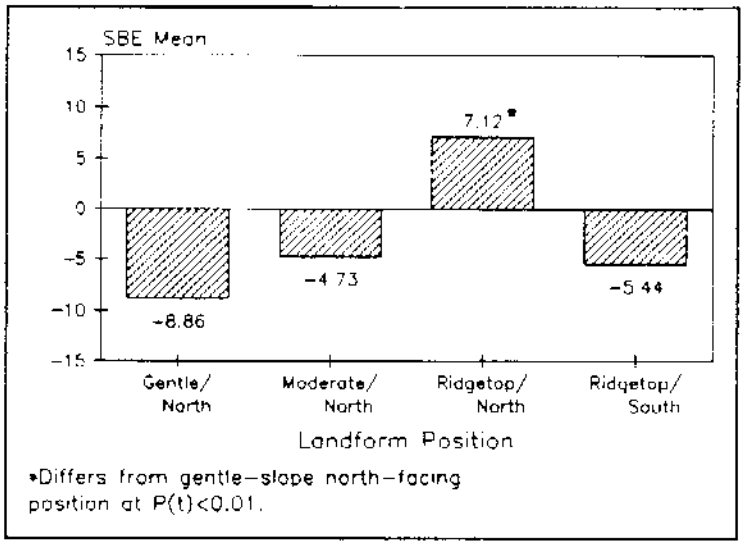

Figure 4.— *Main effect of landform on scenic beauty estimation.*

The relatively low scenic-beauty rating for the lower elevation, north-facing position may be caused by variable response to disturbance. Lower elevation north-facing plots have the highest site index of all the Winona plots (Shelton and Murphy 1991). Thus, compared to other plots, they may have responded more rapidly to disturbance by increased growth of understory foliage and twigs. In summer, low-elevation positions had more foliage and twig screening (Rudis and others 1994). Previous research in southern pine forests showed that vegetative screening in the understory was negatively related to perceived scenic beauty (Ruddell and others 1989).

The landform effect on scenic beauty in the Winona plots also may be an artifact of the preparation work done to achieve hardwood stocking levels appropriate to a treatment. More disturbance may have occurred in the gentle-slope plots than in the higher-elevation positions. The passage of two growing seasons since treatment may not have been long enough for the slash left by these disturbances to become visually unobtrusive. While the effect of slash on visual preference in southern pine forests has not been clearly established (Rudis and others 1988), in other forest types it has been shown to detract from perceived scenic beauty (Brown and Daniel 1984).

CONCLUSIONS

Of the three factors examined, season of the year exhibited the most significant effect on SBE. This finding is important in that most forest scenic-beauty models are based on summer data. As demonstrated by this study, such models should not be generalized uncritically to other seasons of the year.

It seems likely that one source of seasonal differences in scenic-beauty ratings is color variation in forest vegetation. Visual inspection of the Winona slides indicated that summer views, which were the most preferred, were also characterized by higher amounts of green than were winter scenes, which were the least preferred. Future research should investigate more thoroughly the effect of seasonal color change on scenic-beauty ratings as well as the effect of forest management practices on seasonal color patterns.

Two years after treatment, the level of hardwood retention affected scenic-beauty perceptions in the Winona study area. Specifically, untreated plots and plots characterized by 30 ft^2/acre basal area in hardwoods were rated as significantly more scenic than plots with complete hardwood suppression. When remaining hardwoods were left in a grouped pattern rather than a scattered pattern, the negative visual impact of retaining only 15 ft^2/acre basal area in hardwoods was somewhat mitigated. Perhaps, this is because hardwoods growing in clusters present a more parklike appearance to observers than do single trees standing in isolation.

The impact of silvicultural treatment on perceived scenic beauty may change as the Winona plots regenerate. Analyses based on photo sampling taken only two growing seasons after treatment may not predict scenic-beauty effects five or 10 years after treatment. In particular, the impact of silvicultural treatment may become less noticeable in more mature plots as trees increase in size. Followup analyses of the Winona plots should be carried out to determine the long-term impact of hardwood management on scenic beauty in this forest type.

It was not possible to reach a firm conclusion regarding the impact of landform position on scenic quality. The landform effect uncovered in this experiment could be an artifact of differences in disturbance (e.g., downed woody material associated

with establishing treatment basal area) and vegetation response to increased sunlight. The experimental design did not permit an evaluation of the interaction of landform position with either treatment or season. It is possible that the scenic-beauty effect of hardwood-retention level differs significantly between drier ridgetop plots and moister lower-elevation sites, especially during the early stages of forest regeneration. These interaction effects also need to be examined in future research.

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