

Public Preferences for Nontimber Benefits of Loblolly Pine (*Pinus taeda*) Stands Regenerated by Different Site Preparation Methods

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ABSTRACT: *This study assesses public preferences for nontimber benefits of loblolly pine (*Pinus taeda* L.) stands regenerated 1.5 yr earlier using different site preparation treatments at national forest and industrial forestry sites. Treatments tested on the Tuskegee National Forest were none, chainsaw felling, tree injection, and soil-active herbicide. At the industrial site, experimental treatments included chopping and burning, followed by no additional treatment, woody control, herbaceous control, and total control. Both sites were planted with loblolly pine seedlings. Two user surveys employing color photography were conducted to identify the respondents' ratings of the young stands in terms of perceived nontimber benefits, including aesthetics, picnicking, hiking/walking/cycling, camping, hunting, bird watching, wildlife habitat, and biodiversity. The site preparation treatments were rated without consideration of the treatment cost and its distribution. Results indicate that the respondents preferred the minimal or no treatment options at both study sites. The respondents' preferences were significantly affected by their age, education, income, employment status, and living distance from the experimental sites, but not gender. Respondents considered wildlife habitat as the most important benefit and hunting as the least important. Most of the respondents also felt that both national forests and industrial forests should be managed for nontimber as well as timber products. *South. J. Appl. For.* 24(3):145-149.*

Public opinions have increasingly influenced decisions on forest management. The issue of "social acceptability" is emerging as a determinant factor in the management of public as well as private forestlands (Brunson 1996). Meanwhile, public demand for nontimber benefits is rising sharply. This has precipitated forest management conflicts at local, regional, national, and international levels. The most heated conflicts have been focused on public land management, but industrial forests are coming under keener scrutiny by a more suburban population. It is now apparent that the public's preference for desired stand conditions and attributes must be quantified and understood as a basis for discussions aimed at conflict resolution as well as for multiple-use management. Few tools have been devised to aid in mediation of these and future conflicts, and critical attention by forestry researchers is needed in this area.

It is difficult to elicit and quantify the public's preferences for nontimber benefits because an existing market structure does not exist. Surveys have been shown to be effective and efficient in quantifying preferences on an agree-to-disagree scale regarding policies and practices (Zube et al. 1982). Extensive empirical studies have been done on public perceptions of near-view forest scenery during the past three decades, and various findings have been reported (Zube et al. 1982, Ribe 1989). There are two major approaches in measuring scenic preferences: the Scenic Beauty Estimation method (Daniel and Boster 1976) and the Law of Comparative Judgement scaling (Buhyoff et al. 1981, Hull et al. 1984). In both approaches, images and pictures of forest stands were often used to quantify the perceived value of landscape beauty (Benson and Ullrich 1981, Vodaket et al. 1985, Shindler et al. 1993). These studies have covered the preferences of forest conditions (Rudis et al. 1988, Haider 1994), intermediate stand treatments (Brush 1979, Buhyoff et al. 1986, Hull et al. 1987), insect impacts (Buhyoff et al. 1979, 1982, Hollenhorst et al. 1982), and harvest and regeneration methods (Becker 1983, McCool et al. 1986, Pâquet and Bélanger 1997). However, there is limited literature on assessing the impact of site preparation methods on forest stand scenery. Even less is available on the public's perceived preferences on nontimber attributes other than scenery.

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This study examines the public's nontimber preferences for loblolly pine (*Pinus taeda* L.) stands regenerated 15 yr earlier by eight site preparation methods including the one of doing nothing. The stand attributes examined were aesthetics, biodiversity, bird watching, camping, hunting, picnicking, walking/hiking/cycling, and wildlife habitat. These site preparation methods represent a wide spectrum of techniques currently used in the southeastern United States. The perceived preferences were also examined relative to socioeconomic and demographic characteristics of the respondents.

Methods

Experiment Design

Two sets of experimental plots were established 15 yr earlier on two harvested sites in the Tuskegee National Forest and at the Tallassee industrial forestry tract. The two sites in eastern Alabama are about 20 km apart and located on the loam hills of the Hilly Coastal Plain physiographic region. Four different site preparation treatments ranging from extensive to intensive were used at each site. Both experiments were randomized complete block designs with four replications, although only one replication at each site was used in this aspect of the research.

The research site at the Tuskegee National Forest was a 42-yr-old plantation where only pines greater than 10 cm dbh had been harvested. The site preparation methods examined at the Tuskegee site were (1) none, (2) chainsaw felling of all woody plants taller than 60 cm, (3) herbicide tree injection of both hardwoods and pines at least 5 cm dbh using picloram plus 2,4-D, and (4) spot-grid applications of the soil-active herbicide hexazinone. After site preparation, loblolly pine seedlings were planted on all plots using a 2.4 m square spacing in January 1981. Treatment plots at Tuskegee were 0.48 ha. The site index (base 50 yr) averaged 25 m for all plots (Miller et al. 1991).

Fifteen years later, these site preparation methods have yielded different forest stands. The no site preparation method has produced mixed uneven-aged forest stands with one-quarter of the basal area (BA) in hardwoods. The chainsaw felling method has resulted in mixed even-aged stands with about one-half of the BA in hardwoods. The tree injection method has yielded mixed even-aged stands with one quarter of the BA in hardwoods. And the soil-active herbicide has generated mixed uneven-aged stands with mostly loblolly pine (only 5% hardwoods BA).

At the Tallassee industrial forestry site, both pines and hardwoods greater than 10 cm dbh were harvested, followed by roller drum chopping and burning. The four site preparation treatments used were (1) chopping and burning, (2) complete woody competition control leaving herbaceous vegetation after chopping and burning, (3) complete herbaceous plant control leaving woody vegetation after chopping and burning, and (4) total control of both woody and herbaceous competition after chopping and burning. These experimental treatments represent extreme outcomes when operational herbicide applications are completely successful in controlling a target component(s). Loblolly pine seedlings were planted at a 2.7 m square spacing in January 1984.

Treatment plots at Tallassee were 0.1 ha. The site index (base 50 yr) averaged 26 m, very similar to the Tuskegee site.

At age 15, the even-aged plots at the Tallassee industrial plantation site differed significantly in both hardwood component and herbaceous ground cover. Both plots receiving no additional control after chopping and burning and the herbaceous control plots were comparable with about one-quarter of their total BA in hardwoods, similar to the "none" treatment plots on the National Forest study. There was 3% herbaceous ground cover on both of these treatments. Woody control and total control plots had less than 1% of their BA in hardwoods, but 42% and 1% herbaceous cover, respectively. Compared to the chopping and burning (with no additional control) and herbaceous control plots, the pine BA was 31% and 68% greater on the woody control and total control plots, respectively. Thus, these even-aged stands presented wide variations in composition and structure.

User Surveys

Surveys were conducted to identify public preferences for the stands generated by the site preparation methods. Several students trained in survey techniques and general forestry interviewed 200 people for Tuskegee and 255 for Tallassee. These respondents were randomly selected at local schools, gas stations, shopping malls, and streets in Macon, Montgomery, and Lee counties. These counties, ranging from rural to cosmopolitan, are located near the experiment sites. Respondent selection was also based on other factors, including age, gender, race, education, and income, with a goal of choosing interviewees to resemble their distributions in the general population of the three counties as much as possible. Face-to-face interviews were used to ensure interviewees understood questions consistently. The questions centered on: (a) recreational behavior and opinion about public and private forest management, (b) ratings and valuation of the stands regenerated by site preparation treatments, and (c) socioeconomic and demographic characteristics of the respondents.

During the interview, each respondent was shown four enlarged (20 cm by 25 cm) color photographs of the forest stands resulting from the four treatments at each experimental site. One photo for each treatment was used. This approach potentially scarified measuring the variability of the treatment effect, but avoided complexity and potential confusion during the interview, which could have prevented respondents from giving their true preferences. The photos were carefully taken and selected by the researchers to best represent the average effect of the treatment methods. The color photographs used for the interviews were taken at eye level in April 1995 for the Tuskegee site and in April 1998 for the Tallassee site. Both were the beginning of the fifteenth growing season after planting. The respondents were asked to state their preferences by rating the four forest stands using a score ranging from 0 to 10, with 10 for the best. The nontimber benefits considered by the interviewees included aesthetics, picnicking, hiking/walking/cycling, camping, hunting, bird watching, and perceived values for wildlife habitat and biodiversity. The relative importance of these benefits was also surveyed. Interviewees were not told that herbicides had

Table 1. Importance of the nontimber benefits perceived by the respondents to questionnaire administered in southeastern Alabama ($n = 455$).

Nontimber benefit	Importance*	Ranking
Wildlife habitat	6.65	1
Hiking/walking/cycling	6.16	2
Picnicking	6.05	3
Biodiversity	5.90	4
Camping	5.76	5
Aesthetics	5.62	6
Bird watching	5.58	7
Hunting	5.23	8

* Measured by a scale ranging from 0 to 10 with 10 for the most important.

been used in site preparation. In addition, general questions on the management of national forests and industrial forests were presented to the interviewees (Gan et al. 1998). The mean ratings for the treatments were compared using the Tukey's studentized range test. An analysis of variance (ANOVA) was also conducted to examine the effects of the site preparation treatments and socioeconomic and demographic variables on the respondent preferences. Multiple one-way ANOVAs of a single multivariate General Linear Model (GLM) were used.

Results and Discussion

About 60% of the respondents would like both public and private forests to be managed for both timber and nontimber benefits. The respondents considered wildlife habitat as the most important nontimber benefit, followed by hiking/walking/cycling, picnicking, biodiversity, camping, aesthetics, bird watching, and hunting (Table 1). No single benefit dominated others. It seemed that the respondents demanded a variety of nontimber benefits. These diverse demands create a challenge for forest management due to potential conflicts or incompatibility among these nontimber benefits. This at least partially contributes to the current controversies in national forest management in the United States. It also confirms the need to evaluate other nontimber benefits in addition to aesthetic values. Obviously, multiple benefits should be considered to better accommodate the public's desires.

Tuskegee Site

The stand generated by no site preparation was most preferred by the respondents among the four stands for each category of the nontimber benefits (Table 2). No site prepa-

Table 2. Public ratings of nontimber benefits of loblolly pine stands regenerated by four site preparation treatments at the Tuskegee site, Alabama ($n = 200$).

Nontimber benefit	No site preparation	Chainsaw felling	Tree injection	Soil-active herbicide
Aesthetics	6.92 (1)*	5.58 (3)	5.73 (2)	5.51 (4)
Picnicking	5.80 (1)	4.82 (4)	5.60 (2)	5.02 (3)
Hiking/walking/cycling	6.28 (1)	5.60 (4)	6.23 (2)	5.81 (3)
Camping	6.24 (1)	5.34 (4)	6.06 (2)	5.60 (3)
Hunting	6.74 (1)	6.59 (2)	5.97 (3)	5.91 (4)
Bird watching	6.62 (1)	6.43 (2)	6.04 (3)	5.81 (4)
Wildlife habitat	7.03 (1)	6.71 (2)	5.99 (4)	6.12 (3)
Biodiversity	6.17 (1)	5.60 (2)	5.25 (3)	5.21 (4)
All nontimber benefits†	7.12 (1)	6.29 (3)	6.43 (2)	6.14 (4)

* The rating was measured using a scale from 0 to 10 with 10 for the best, and the number inside parentheses represents the ranking of the four stands.

† Included all nontimber benefits perceived by the respondents, not the sum of those listed in the table.

Table 3. Effects of site preparation treatments and socioeconomic characteristics on public preferences for all nontimber benefits of loblolly pine stands regenerated in southeastern Alabama.

Factor	P-value of the preferences for all nontimber benefits	
	Tuskegee site ($n = 200$)	Tailassee site ($n = 255$)
Treatment	0.0290	0.001
Age	0.0087	0.0159
Education	<0.0001	0.0067
Gender	0.1839	0.2446
Annual household income	<0.0001	<0.0001
Employment status	<0.0001	<0.0001
Occupation	0.4749	0.0008
Previous visit to recreational forest	0.5406	0.0091
Living distance from the study site	0.0005	0.0031

ration was superior to other methods in terms of the aesthetic value of the stand. The stand produced by no site preparation was uneven-aged with multiple layers in height, and it had more visual penetration than those resulting from other treatments. This is consistent with the findings from other studies (Hull and Buhyoff 1986, Rudis et al. 1988). Following no site preparation, when all nontimber benefits were considered, tree injection came second, with chainsaw felling and soil-active herbicide rated third and fourth, respectively. The results of the Tukey's studentized range test revealed that there was a statistically significant difference in the respondent preferences for the forest stands generated by the four site preparation methods at the Tuskegee site (Table 3). The stand generated without site preparation was rated significantly higher than that yielded by chainsaw felling, with no significant difference among chainsaw felling, tree injection, and soil-active herbicide.

Results of the ANOVA using the GLM procedure showed that the respondents' age, education, income, employment status, and living distance from the national forest had a significant effect ($\alpha = 0.05$) on their ratings of the site preparation methods; whereas gender, occupation, and previous visits to a recreational forest did not (Table 3). The interactions of site preparation with these socioeconomic and demographic variables were not significant.

Younger and older respondents had higher preference values for nontimber benefits than the group aged between 40 and 60 yr. Education was positively related to the

Table 4. Public ratings of nontimber benefits of loblolly pine stands regenerated by four site preparation treatments at the Tallassee site, Alabama (n = 255).

Nontimber benefit	Chopping and burning	Woody control	Herbaceous control	Total control
Aesthetics	7.38 (1) ^a	7.18 (2)	7.14 (3)	6.53 (4)
Picnicking	6.79 (1)	6.22 (4)	6.26 (3)	6.48 (2)
Hiking/walking/cycling	6.05 (3)	5.92 (4)	6.06 (2)	6.23 (1)
Camping	6.24 (3)	6.24 (3)	6.43 (1)	6.42 (2)
Hunting	6.93 (1)	6.88 (2)	6.84 (3)	4.85 (4)
Bird watching	6.43 (1)	6.24 (3)	6.26 (2)	5.46 (4)
Wildlife habitat	7.27 (1)	1.23 (2)	7.21 (3)	5.46 (4)
Biodiversity	7.26 (1)	7.17 (2)	7.12 (3)	5.64 (4)
All nontimber benefits ^f	6.96 (1)	6.80 (3)	6.89 (2)	5.68 (4)

^a The rating was measured using a scale from 0 to 10 with 10 for the best, and the number inside parentheses represents the ranking of the four stands.

^f Included all nontimber benefits perceived by the respondents, not the sum of those listed in the table.

valuation of nontimber benefits. Respondents with annual income between \$40,000 and \$49,999 gave higher ratings than those in any other income category. Full-time or part-time employees and students ranked nontimber benefits higher than the unemployed and retirees. In addition, respondents who lived 42-120 km away from the forest rated the nontimber benefits lower than those living closer to or farther from the forest.

Tallassee Site

For the Tallassee site, the stand yielded by chopping and burning with no additional site preparation was rated the highest for almost all the nontimber benefits perceived except hiking/walking/cycling and camping. The respondents considered the forest created with total understory control the best for hiking/walking/cycling. This is obviously due to the more open space in this type of stand than those resulting from the other three treatments. The rating for camping in the stands yielded by herbaceous control and total control were generally higher than other two treatments. According to the mean ratings of all nontimber benefits, the absence of additional site preparation after roller drum chopping and burning was the best, followed by stand regenerated by herbaceous control, woody control, and total control (Table 4).

The respondents' preferences for the four stands were significantly different ($\alpha = 0.05$). The stand generated by the total control method was judged inferior to those resulting from the other three treatments. The two surveys revealed the almost identical effects of the respondents' socioeconomic and demographic characteristics on their ratings except those for occupation and previous recreational visits. The Tallassee site survey also showed significant effects on the respondents' ratings by treatment, as well as previous visits to a recreational forest, age, education, income, employment, occupation, and living distance from the experimental site. The respondents who had visited any recreational forest gave a higher rank to all the treatments than those who had not. Education was positively related to the ratings. Those who were employed and homemakers valued nontimber benefits more than retirees or unemployed. The respondents who lived more than 240 km (150 miles) away from the site rated nontimber benefits lower than the rest (Table 3). There was no cross effect between the treatments and the socioeconomic and demographic characteristics of the respondents.

Treatments had different effects on individual nontimber attributes. At the Tuskegee site, treatments had a significant effect only on aesthetic value at the 5% significance level. At the 10% significance level, treatments were also significant on camping and wildlife habitat. At the Tallassee site, treatments had a significant effect on most of the nontimber benefits identified, except picnicking and camping (Table 5).

Conclusions

Our surveys revealed that the majority (about 60%) of the respondents would like both national forests and industrial forests to be managed for timber and nontimber benefits. The public expectation for forest management clearly indicates that both timber and nontimber benefits are important. Over-emphasis on one product at the expense of the other is against public preferences. The issue is how to balance timber and nontimber benefits in forest production. This deserves more debate and research.

This study also identified the public's preferences among nontimber benefits for young stands generated by the eight site preparation methods used for loblolly pine regeneration. Based on the ratings provided by the respondents for nontimber benefits, the stands were judged significantly different. This result shows the long-lasting effects of early stand management treatments, even though they had been treated 15 yr earlier. In general, the respondents preferred no or minimal site preparation to chainsaw felling, tree injection, soil-active herbicide, complete woody control, complete herbaceous control, or total control. The no or minimal site preparation methods dominated chainsaw felling, tree injection, and soil-active her-

Table 5. Effects of site preparation treatments on public preference ratings for specific nontimber benefits of loblolly pine stands regenerated in southeastern Alabama.

Nontimber benefit	p-value	
	Tuskegee site (n = 200)	Tallassee site (n = 255)
Aesthetics	0.0017	0.0002
Picnicking	0.1305	0.1559
Hiking walking/cycling	0.1118	41.000 1
Camping	0.0804	0.6495
Hunting	0.137x	4.000 1
Bird watching	0.234 1	4.000 1
Wildlife habitat	0.0902	<0.0001
Biodiversity	0.1238	<0.0001

bicide in all categories of nontimber benefits. It seems possible to simultaneously meet the diverse public demands for nontimber benefits by choosing a proper site preparation method in this sense. The respondents' age, education, income, employment status, and living distance from the forests had a significant effect on their ratings. Gender did not affect their preferences of the stands regenerated with the treatments. Due to the nature of this type of study, it has its limitation. Usual cautions should apply in generalizing these findings to other stands. Even though the photographs used represented the average effect of the treatments, the variability of the treatment effect was sacrificed by using one photograph for each treatment. The effect of treatments may also vary in other locations due to differences in soil, topographic, and climatic conditions. Moreover, the ratings given by the respondents were only for nontimber benefits. Neither timber value nor site preparation cost was considered by the respondents in rating these treatments.

It is becoming necessary that managers understand what is a socially acceptable forestry practice from nontimber preference perspective and how to achieve publicly desirable future conditions for stands and forest landscapes. Managers must understand what practices result in stands or mixtures of stands that can provide the full array of goods and services requested in a locale or region. Social acceptability or the public's preference of forest management practices is a complex and important issue that deserves extensive studies. The complexity of consumer/user tastes and the nonexistence of a market for nontimber benefits make it extremely difficult to identify the public's preferences of forest management practices in terms of nontimber benefits. Nevertheless, these results provide some insight into the public's preference of young stands yielded by site preparation treatments currently used in the region.

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