A MULTI-ATTRIBUTE-ASSESSMENT OF SITE PREPARATION EFFECTS ON THE SOCIOECONOMICAL AND ECOLOGICAL ATTRIBUTES OF LOBLOLLY PINE (*Pinus taeda*) STANDS

James H. Miller*', Jianbang Gan[2], Stephen H. Kolison[2], Robert S. Boyd[3], Kenneth L. McNabb[4], B. Graeme Lockaby[4]
'Southern Research Station, USDA Forest Service, DeVall Drive, Auburn University, AL 36849
Tel: 334-826-8700, Fax: 334-821-0037, Email: miller@forestry.auburn.edu
*Department of Agricultural Sciences, Tuskegee University
'Department of Botany and Plant Pathology, Auburn University
'School of Forestry, Auburn University

Introduction

The public demands both commodity and non-commodity goods and services from our forests. This requires management options that not only provide fiber, clean water, wildlife habitat, and recreation, but do so in a biologically sustainable manner, resulting in healthy productive forests into perpetuity. A common forest management activity used to enhance fiber production is site preparation. Little is known how site preparation affects recreational quality, soil sustainability, biodiversity, primary productivity, and other indicators of non-commodity productivity and forest sustainability. Management techniques must strike a prudent balance among these diverse and vital multi-attributes. A multidisciplinary team was formed to assess a wide spectrum of site preparation aitematives for the Southeastern U.S. as to their influence on commodity and non-commodity forest values and biological sustainability. Prime indicators for socioeconomic and ecologic attributes were assessed in an integrated approach in an attempt to optimize desirable features.

Materials and Methods

Two sets of experimental plots were established 12 and 15 years earlier on harvested sites having similar soils in eastern Alabama, U.S.A. Four different site preparation treatments were used at each location, ranging from intensive to extensive. These nearby separate studies were both randomized complete block designs, each with four replications. At the Tuskegee National Forest site, only pines >10 cm dbh had been harvested. Site preparation treatments applied 15 years earlier were: (1) none, (2) chainsaw felling of all woody plants >60 cm tall, (3) herbicide tree injection of hardwoods and pines >5cm dbh using picloram plus 2,4-D, and (4) spot-grid applications of the soil-active herbicide (SAH) hexazinone at 1.7 kg ai ha". Loblolly pine seedlings (*Pinus taeda* L.) were then planted at a 2.4 m square spacing. At the Tallassee industrial forestry site, harvesting of both pines and hardwoods >10 cm dbh was followed by roller drum chopping and burning. Loblolly seedlings were planted at a 2.7 m square spacing. Plot treatments at Tallassee were (1) none, (2) complete woody competition control for the first 4 years, (3) complete herbaceous plant control for 4 years, and (4) complete control of all competition for 4 years. Treatment plots at Tuskegee were 0.48 ha with net plots for sampling of 0.24 ha. Treatment plots at Tallassee were 0.1 ha with net plots of 0.037 ha.

At Tuskegee in Year 15, 20 sampling points were established within each net plot using random assignments to a grid. At each point, all plants <1 m tall were identified to species on 9 m^2 plots and

Wagner, RG. and D.G. Thompson (comp.). 1998. Third International Conference on Forest Vegetation Management Popular summaries. Ont. Min. Nat. Resow., Ont For. Res. Inst., For. Res. Info. Pap. No. 141.

their covers estimated in spring, summer, and late-summer visits. At 10 points, 50 m^2 plots were used to sample hardwood and shrub species >1 m tall, with heights and dbh recorded for each stem. Also measured was standing and down coarse woody debris. At a specified distance from each point, soils were sampled to a 60 cm depth and samples combined by plot. On three blocks, at a specified distance from 8 points, 0.5 m^2 traps were used to sample litter fall monthly for 2 years.

At Tallassee after 11 growing seasons, all trees within net plots were measured for height and dhb by species. Shrub numbers and their heights by species were measured on 3 each 27 m^2 plots per net plot. In Year 12, 10 cells (3 m x 3 m, bound by pines on plot corners) were randomly selected for sampling. All 10 cells were used to sample understory plant species by seasons as with the other site. Seven cells were randomly selected and 3 soil samples per cell (21 total per plot) were collected to 60 cm depth and combined by plot. In Years 10 and 11, litter fall was sampled monthly using 6 traps per plot in two blocks. All soil samples were air dried, milled, and C, N, P, K, Ca, Mg, and pH determined. Litter was dried at 70^0 C, ground, and analyzed for N, P, and C.

Timber yields for the unevenaged and evenaged stands at Tuskegee were projected using the SE TWIGS model (Bolton and Meldahl 1990a; 1990b). Timber yields for the evenaged plantations at Tallassee were projected using the North Carolina State University Managed Pine Plantation Growth and Yield Simulator (Hafley and Smith 1991); height-age curves were from Burkhart et al. (1987); and methods for translating these curves for vegetation management treatments followed Lauer et al. (1993). Timber values were calculated using the predicted yields, average monthly wood prices, and a 4 percent discount rate. These values along with published or estimated current treatment costs were used to calculate net present value.

Recreation benefits were evaluated using the Contingent Valuation Method (Cummings et al. 1986; Mitchell and Carson 1989). Recreation was measured using the weighted average of the index values of aesthetics, picnicking, hiking/cycling, camping, hunting, and bird watching. These index values along with their weights were derived from surveys of 400 randomly-selected residents from counties surrounding the study sites. Interviewees were shown enlarged color photographs (25 cm x 20 cm) of the stands to obtain these values, and were not told what treatments were used as site preparation. Site preparation methods were ranked using the multi-attribute assessment approach based on a weighted-additive utility function (Keeney and Raiffa 1976). The original measurements of all indicators were converted to index values ranging from 0 to 10 to overcome the unit differences. All the attributes in this presentation were considered to be equally important.

Results and Discussion

The four site preparation methods used on the Tuskegee site yielded differences in' values for diversity, user preferences, soil sustainability, and biological and economic productivity, 15 years post treatment (Table 1). Results derived from the Tuskegee site will be the focus of this summary. Floristic richness was greatest on the Chainsaw Felling plots and least on plots treated with SAH (α=0.07). A total of 138 taxa were identified. SAH plots had significantly (α=0.05) higher proportion of pine to hardwood basal area compared to the other treatments. SAH plots had significantly lower levels of selected *oak* species in the overstory (*Quercus marilandica* Muenchh. and *Q. margaretta* Ashe). Under-story diversity, according to the Shannon-Wiener Index, was

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significantly greater with Chainsaw Felling (3.0) compared to Check and SAH (both 2.6), while Tree Injection (2.9) was intermediate.

Table 1. Measurements of Prime Attributes for Stands yielded by the Four Site Preparation Methods used 15 Years Earlier on the Tuskegee National Forest.

Attribute	Check	chainsaw Felling	Tree Injection	Soil-Active Herbicide	ANOVA p-values
Total plant species	64	65	63	58	0.0683
Recreation index	6.42	5.70	5.94	5.60	0.8357
Soil C:N ratio	25	22	20	20	0.3632
Annual litterfall ($g\ m^{-2}$)	409	391	383	436	0.6968
Net present value for timber:					
40-year rotation (US$ ha^{-1})	810	514	561	978	0.1323
70-year rotation (US$ ha^{-1})	442	321	306	437	0.0699

An integrated value for recreation indicated that customer preference (from highest to lowest) was Check > Tree Injection > Chainsaw Felling > SAH. Results of this survey are presented more fully in another paper at this conference. Soil C:N ratio was lowest with the SAH (more conducive for N mineralization) and highest with the Check, although not significant at α=0.05. Litterfall levels were highest on the SAH, indicating more leaf area for gross primary productivity. Plots treated with SAH had the highest projected timber value at a 40-year rotation. At a 70-year rotation, the Check yielded slightly higher values than the SAH. The economic optimal rotation age is about 40 years, while the current rotation age used in this National Forest is about 70 years.

Table 2. Index Values (and Rankings) of the Four Site Preparation Methods.

Rotation Length	Check	Chainsaw Felling	Tree Injection	Soil-Active Herbicide
40 years	9.10 (2)	8.44 (4)	8.70 (3)	9.53 (1)
70 years	9.45 (2)	8.84 (4)	8.94 (3)	9.51 (1)

Rankings of the four site preparation methods presented in Table 2, reveal SAH as the best method for both 40-year and a 70-year rotations, followed by the Check and Tree Injection. However, the index values for SAH and Check were almost the same for the 70-year rotation. Chainsaw felling was ranked lowest. Multi-attribute assessments can provide valuable insights into balancing diverse demands and essential attributes. This is only one analysis of a complex matrix of so&economical and. ecological data that can be used to assist in optimizing management. Other attributes, and methods for weighting attribute importance, can and will be explored.

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Poster

Miller, J.H.; Miller, K.V. Forest Plants and Shrubs of the Southeast and Their Wildlife Uses. Southern Weed Science Annual Meeting, Theme: A glance to the past, a vision for the Future, 25-27 January 1999, Greensboro, North Carolina..