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# Photos for Estimating Fuel Loadings Before and After Prescribed Burning in the Upper Coastal Plain of the Southeast

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# Photos for Estimating Fuel Loadings Before and After Prescribed Burning in the Upper Coastal Plain of the Southeast

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**Abstract**

Although prescribed burning is common in the Southeastern United States, most fuel models apply to only western forests. This paper documents a fuel classification system that was developed for plantations of loblolly and longleaf pines for the Upper Coastal Plain region. Multivariate analysis of variance and discriminant function analysis were used to confirm eight discrete fuel groups. A photo series describing these unique fuel complexes is presented to display preburn loading and postburn reductions. This photo series will improve the accuracy of fuel-loading estimates and will provide a measure of the effectiveness of prescribed fires for rough reduction.

**Keywords:** Discriminant function analysis, fuel classification, fuel loading, photo series, planar intersect.

## Introduction

Southeastern foresters and fire managers are facing increasing demands for improved fuel assessments in fire-related operations to ensure the accuracy of prescribed fires and satisfy smoke management guidelines. Prescribed burns in loblolly (*Pinus taeda* L.) and longleaf pine (*P. pallustris* Mill.) plantations are common in the Upper Coastal Plain. These operations have traditionally been 50 to 100 acres in size but burns of several thousand acres are becoming more common.

A detailed fuel classification system that would aid in assessing fuel loading and its influence on fire behavior is lacking. Most fuel appraisals in the region are based on a set of 20 fuel models that was developed for the National Fire Danger Rating System (NFDRS) by Deeming and others (1977) or a revised set of those models developed by Burgan

(1988). Within either set of models, only one (Fire Behavior Fuel Model 9) is applicable to pine plantations of the Upper Coastal Plain. This model is designed to represent all southeastern long-needled pines in the NFDRS. BEHAVE, a computer-based fire prediction application, estimates spread rates and fire intensity for this timber type based on the limited inputs of Fuel Model 9. At best, this idealized representation of the entire Southeast is a broad generalization (Anderson 1982) because Fuel Model 9 is too limited and cannot match all fuels of the South (Shepard 1984). In BEHAVE, computer modules allow for customized models, based on Rothermel's (1972) mathematical model, that more accurately approximate local fuel conditions. Further customizing of a fuel model can help match observed fire behavior with predicted (forecasted) fire behavior. However, data for customized fuel models are limited.

A study was conducted in the Upper Coastal Plain of South Carolina (Scholl 1996) to develop a detailed fuel classification system. Specific objectives were (1) to identify and describe (classify) unique fuel complexes within the fire behavior Fuel Model 9 and (2) to express the classification system with a photo series that allows fire managers to estimate preburn and postburn fuel loads for use in the BEHAVE system.

**Photo Series**

A photo series is a set of photographs showing a range of fuel loads generated from similar timber types and silvicultural practices or other large disturbances (Wade and others 1993). Photo series serve as references for fuel management plans and as training aids for prescribed burning and wildfire suppression. They also provide estimates of available fuel for smoke management plans (Sanders and Van Lear 1988). The photographs help evaluate the effect of prescribed fire by allowing visual comparison of preburn and postburn perspectives in the same area (Ryan and Johnson 1979). Photographs and detailed fuel-loading information provide useful field estimators of fuel loading and reduction that can be shared among fire management personnel.

Photo series are often developed by photographing areas that depict typical loading levels and then applying the planar intersect method (Brown 1974) to measure slash and live fuel quantities. Less time-consuming and expensive than gathering and weighing all material from small sample plots, the planar intersect method is an improvement of the line intersect technique (Canfield 1941, Van Wagner 1968), providing applicability to more fuel conditions by allowing for more varied particle sizes, shapes, and orientations. The planar intersect method is also more accurate because random placement of sampling planes eliminates particle tilt as a source of sampling error. Using quadratic-mean diameters and nonhorizontal particle angles corrects any calculated volume biases (Brown and Roussopoulos 1974).

Photo series are available for fuel complexes throughout the United States such as the Sierra Nevada (Maxwell and Ward 1979), mid-Atlantic (Lynch and Horton 1983), and Lake States (Blank 1982). In the South, fuel models are scarce, except for those discussed in the Southern Forestry Smoke Management Guidebook (Southern Forest Fire Laboratory Staff 1976), or in photo series for the Southern Appalachians (Sanders and Van Lear 1988) and South Carolina Lowlands (Wade and others 1993). Western photo series cannot describe in detail all significant combinations of fuels, silvicultural treatments, degrees of rough, local weather conditions, and topography in a large and varied region like the Southeast. The most accurate fuel information available is taken from local conditions; however, this information is difficult and expensive to collect.

Photo series often show weight of NFDRS woody particle-size classes because loading of these fuels is a primary factor of fire behavior prediction. However, forest-floor and live-fuel weights can be more important when the management goal of burning is hazard reduction and understory control. Larger particle-size classes (>3 inches [in.]) are less important from a reduction standpoint because they are usually not consumed. Values for these fuels assessments must be derived from independent sampling or observations.

## Methods

The study took place on the U.S. Department of Energy, Savannah River Site, which overlaps three Upper Coastal Plain counties of South Carolina: Barnwell, Allendale, and Aiken. The study sites were in four forested compartments, each nearly 1,000 acres, that were slated for winter prescribed fire. These compartments contained stands of loblolly pine, longleaf pine, and hardwood cover types. All four compartments are in red-cockaded woodpecker habitat management zones and are set on a 4-year rotation for prescribed burning. Fire management objectives include hardwood control and wildfire hazard reduction.

Fuels in each compartment were visually assessed along 4 to 6 transects, crossing the entire compartment, noting the absence or presence of characteristics that would define discrete fuel complexes including: quantity of various fuel size classes; condition, type, and arrangement of dead fuels; quantity and type of live fuels; horizontal and vertical arrangement; stand density and condition classes; canopy closure; and composition and depth of forest litter. Afterwards, prevalent compositions of significant fuel characteristics were noted and evaluated, and eight preliminary fuel complexes were selected for statistical testing.

For each complex, 10 plots were established over the 4 compartments. Photo points were located 10 feet (ft) from the beginning of each sample plot at a height of approximately 6 ft. An 8-ft range pole was centered 60 ft from the camera to show perspective. The camera was a programmable Canon AE-1 with a shutter release and a 75-millimeter lens.

Each plot consisted of a 50-ft sampling plane. Quantity of dead and downed woody material was estimated using Brown's (1974) planar intersect technique. This technique was revised using the methods of Sanders (1987) to better estimate southern fuels. Revisions included using quadratic-mean diameters of woody slash fuels for size classes of species on study areas (under 0.25 in., 0.25 to 1.00 in., 1.00 to 3.00 in., and over 3.00 in.) and substituting specific gravities for southern and southeastern forest types (Anderson 1978) for those of western species. No correction factor was used to adjust weight estimates for nonhorizontal particle angles because these data are not available for southern conifers (Sanders 1987).

For each plot, percent cover and average total height were recorded for grasses, herbaceous plants, shrubs, woody regeneration, and vines. These data were used to estimate preburn and postburn fuel loading with biomass equations developed by Scholl (1996). Other measurements included preburn litter, postburn litter, and duff depths to estimate forest floor consumption.

Prescribed burning of the compartments took place on 7 days from January through March 1995. Weather conditions varied slightly throughout the period. All burns were considered winter rough reduction burns. Ignition was by a helicopter equipped with a Premo Mark III delayed aerial ignition device and following a strip headfire firing pattern.

Multivariate analysis of variance determined that the eight preliminary fuel complexes were significantly different from each other, and that distinct fuel groupings could be classified by discriminate function analysis (DFA). Eight discriminate functions were developed, one to describe each fuel category. Variables from each sample plot were used as input to cross validate the classification scheme and incorrectly classified plots were reclassified. Preburn and postburn fuel loadings were averaged and described in the photo series by the categories described by DFA. A more complete description of measurements, burning procedures, and statistical analyses was given by Scholl (1996).

## Results and Discussion

After surveying the study compartments, eight fuel complexes were selected as preliminary categories. Each complex was selected for distinctive qualities as perceived to affect fire behavior. Classification of study plots by DFA indicated that the preliminary fuel groups were different enough to be considered unique fuel categories so the descriptions of fuel complexes remained unchanged. Of the 80 plots sampled, only 10 were reclassified and most of those were reclassified to fuel complexes that were visually similar. For example, one plot was changed from Fuel Complex 1 to Fuel Complex 2. The only distinguishing feature between these two complexes is needle cast suspended by vines. A brief description of each fuel complex is given in the table accompanying each preburn photo.

Observation of fire behavior at each photo plot was impossible due to the large study area, the number of plots in each compartment, and the number of burn days involved. Of the operations that could be observed, most fires had low-to-moderate intensity with flame heights of 2 to 6 ft. For the eight fuel complexes combined, burning decreased forest floor litter depth from 3.05 in. to 1.46 in., resulting in a postburn load of 1.8 tons per acre. Weight of woody fuels decreased by 28 percent for 1-hour fuels, 15 percent for 100-hour fuels, and 3 percent for 1,000-hour fuels. An unexpected result was an increase of 10-hour fuels by 22 percent over preburn levels. This increase may have been caused by the pruning effect of prescribed fire on low limbs or by measurement error. Total live fuel loading for the eight fuel complexes exhibited an average overall reduction of 43 percent of the preburn loading. The most significant reduction in live fuel biomass was that of woody regeneration which was reduced by 61 percent.

Preburn photographs presented in the following pages document the typical range of fuel loading for longleaf and loblolly pine plantations in the Upper Coastal Plain. Postburn photographs indicate the effectiveness of fire in consuming debris under typical burning conditions in winter.

The order of the photographs is based on dominant species (pine versus hardwoods), presence of slash, and stand density. Fuel Complex 2 is identical to Fuel Complex 1 but with the addition of fuel ladders. Fuel Complexes 3, 4, and 5 have similar pine stand characteristics, but with different understory combinations. Fuel Complex 6 is an early-successional staged understory dominated by grass and pine regeneration, whereas Fuel Complex 7 is the only complex consisting of heavy accumulations of slash. Fuel Complex 8 is the only hardwood fuel category.

Fire managers can estimate these characteristics on an area being inventoried by following these steps:

1. Observe each characteristic of the residue by walking through the fuel complex or viewing the residue from an elevated position to observe continuity and distribution.

2. Select a photo that nearly matches, or photos that bracket, the observed characteristic.

3. Obtain the quantitative value for the characteristic being estimated from the table accompanying the selected photo (or interpolate a value between photos).

The photo series characterizes a range of preburn woody slash and live fuel weights ranging from 6 to 16 tons per acre. Total fuel loading for the eight fuel complexes was reduced by an average of 32 percent by prescribed burning. It is important to emphasize that these finalized loadings are averages of several plots and may not be identical to the fuels in the plot pictured. Also, burning operations took place over the course of 3 months and under a range of burning conditions. Fuel reduction will vary by preburn fuel loading and weather conditions at the time of burning.

## Conclusion

The photo series developed in this study, as has been found in other regions of the United States, can provide estimates of preburn and postburn fuel loadings that are fast, easy, inexpensive, and adequate for many management needs. In this study, discriminate function analysis identified eight discrete fuel complexes that are presented in the photo series. Additional research is needed to develop fire behavior models and match observed fire behavior to predicted behavior for each fuel complex. These results would be a meaningful addition to the BEHAVE fire prediction and modeling system. Other uses of this fuel information would be its implementation into smoke dispersion models.

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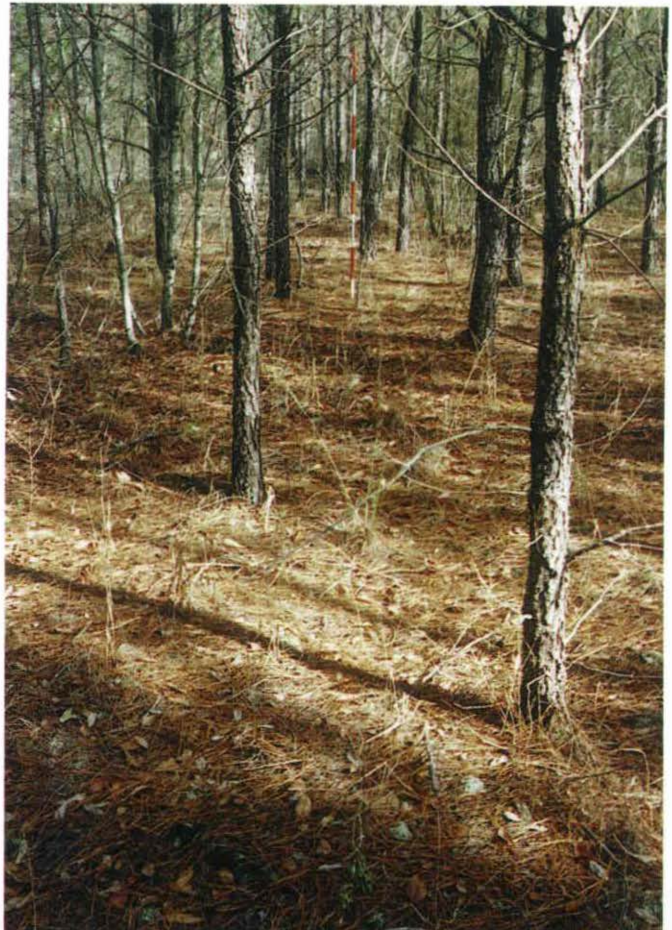
# Photo Series for
# Preburn and Postburn
# Fuel Loadings



**Fuel Complex 1: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 1.000 |
| Branches | | |
| <0.25 | 0.240 | |
| 0.25–1.00 | .813 | |
| 1.00–3.00 | .524 | |
| >3.00 | .000 | |
| Subtotal | 1.576 | |
| Live fuels | | |
| Grasses | .154 | |
| Herbs | .000 | |
| Shrubs | .000 | |
| Woody | .002 | |
| Vines | .002 | |
| Subtotal | .157 | |
| Litter | 4.778 | 2.27 |
| Total | 6.512 | |

Fully stocked immature loblolly pine plantation with no understory development. Tree heights of 30 feet in an 8-foot by 8-foot spacing.

Average diameter at breast height: 6.5 inches
Canopy closure: 90 percent
Age of rough: 4 years

**Fuel Complex 1: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 0.685 |
| Branches | | |
| <0.25 | 0.163 | |
| 0.25–1.00 | 1.067 | |
| 1.00–3.00 | .229 | |
| >3.00 | .000 | |
| Subtotal | 1.459 | |
| Live fuels | | |
| Grasses | .128 | |
| Herbs | .006 | |
| Shrubs | .000 | |
| Woody | .000 | |
| Vines | .006 | |
| Subtotal | .140 | |
| Litter | 1.815 | .806 |
| Total | 3.412 | |

Date of burn: 02/03/95
Days since rain: 5 (0.25 inch)
Ignition technique: Delayed Aerial Ignition Device (Bell 206B)
Period of ignition: 1320 to 1345
Relative humidity: 51 percent
Temperature: 65 °F
Windspeed: 0 to 5 miles per hour

**Fuel Complex 2: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 8.796 |
| Branches | | |
| <0.25 | 0.232 | |
| 0.25–1.00 | .699 | |
| 1.00–3.00 | .182 | |
| >3.00 | .000 | |
| Subtotal | 1.115 | |
| Live fuels | | |
| Grasses | .027 | |
| Herbs | .000 | |
| Shrubs | .098 | |
| Woody | .070 | |
| Vines | .341 | |
| Subtotal | .537 | |
| Litter | 5.103 | 3.900 |
| Total | 6.755 | |

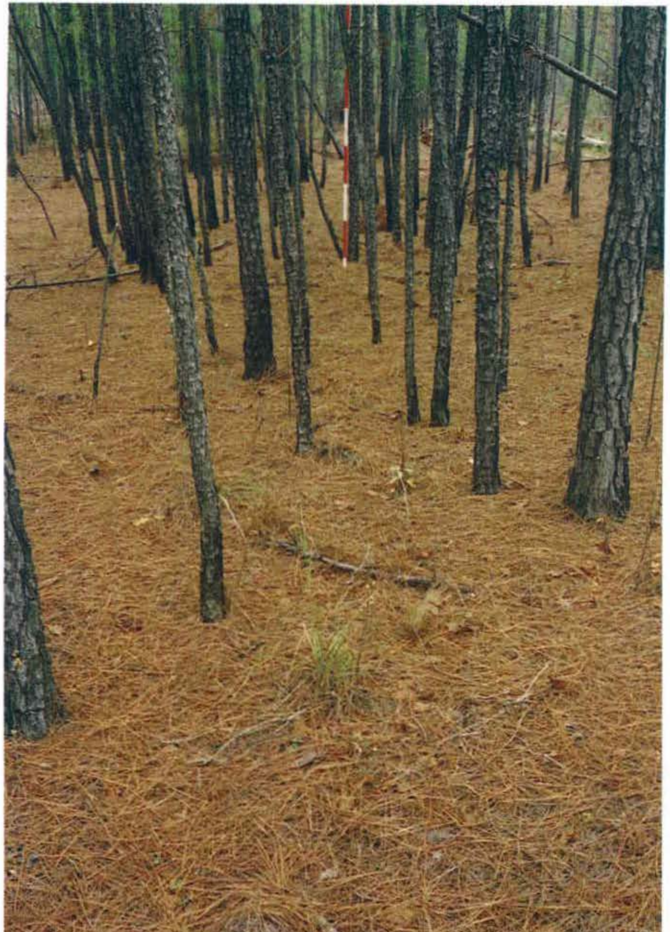
Similar in structure to Fuel Complex 1 but with fuel ladders as high as 12 feet. Composed of excessive needle cast and heavy vines.

Average diameter at breast height: 5.8 inches
Canopy closure: 100 percent
Age of rough: 4 years

**Fuel Complex 2: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 1.015 |
| Branches | | |
| <0.25 | 0.090 | |
| 0.25–1.00 | .883 | |
| 1.00–3.00 | .137 | |
| >3.00 | .000 | |
| Subtotal | 1.110 | |
| Live fuels | | |
| Grasses | .047 | |
| Herbs | .023 | |
| Shrubs | .000 | |
| Woody | .002 | |
| Vines | .136 | |
| Subtotal | .208 | |
| Litter | 1.015 | 3.639 |
| Total | 2.333 | |

Date of burn: 01/10/95
Days since rain: 3 (4.27 inches)
Ignition technique: Delayed Aerial Ignition Device (Bell 206B)
Period of ignition: 1420 to 1605
Relative humidity: 43 percent
Temperature: 61 °F
Windspeed: 0 to 5 miles per hour



**Fuel Complex 3: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 5.484 |
| Branches | | |
| <0.25 | 0.183 | |
| 0.25–1.00 | 1.325 | |
| 1.00–3.00 | 1.830 | |
| >3.00 | 1.515 | |
| Subtotal | 4.853 | |
| Live fuels | | |
| Grasses | .091 | |
| Herbs | .022 | |
| Shrubs | .015 | |
| Woody | .000 | |
| Vines | .005 | |
| Subtotal | .132 | |
| Litter | 5.485 | 3.611 |
| Total | 10.470 | |

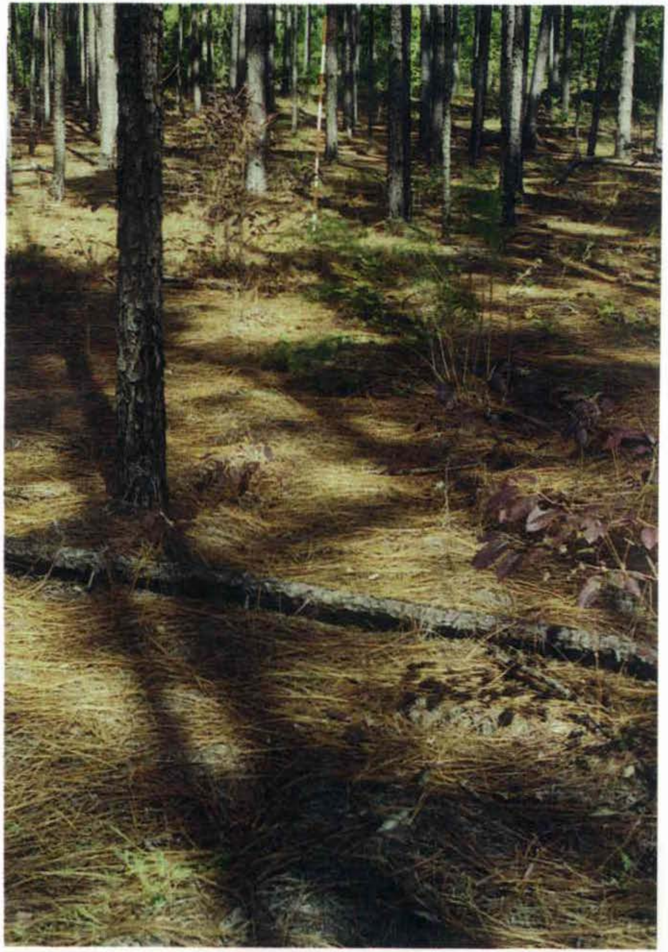
Loblolly pine sawtimber with heavy concentration of pole staged loblolly and longleaf regeneration.

Average diameter at breast height: 13.7 inches
Canopy closure: 80 percent
Age of rough: 4 years

**Fuel Complex 3: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 2.893 |
| Branches | | |
| <0.25 | 0.166 | |
| 0.25–1.00 | 2.281 | |
| 1.00–3.00 | 1.418 | |
| >3.00 | 1.515 | |
| Subtotal | 5.380 | |
| Live fuels | | |
| Grasses | .203 | |
| Herbs | .014 | |
| Shrubs | .000 | |
| Woody | .011 | |
| Vines | .007 | |
| Subtotal | .235 | |
| Litter | 2.893 | 2.407 |
| Total | 8.508 | |

Date of burn: 01/26/95
Days since rain: 3 (0.44 inch)
Ignition technique: Delayed Aerial Ignition Device (Bell 206B) and Drip Torch
Period of ignition: 1215 to 5200
Relative humidity: 34 percent
Temperature: 55 °F
Windspeed: 2 to 4 miles per hour



**Fuel Complex 4: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 1.958 |
| Branches | | |
| <0.25 | 0.105 | |
| 0.25–1.00 | 1.206 | |
| 1.00–3.00 | 1.847 | |
| >3.00 | 2.149 | |
| Subtotal | 5.308 | |
| Live fuels | | |
| Grasses | .060 | |
| Herbs | .013 | |
| Shrubs | .038 | |
| Woody | .017 | |
| Vines | .000 | |
| Subtotal | .129 | |
| Litter | 5.908 | 2.773 |
| Total | 11.346 | |

Closely resembles Fire Behavior Fuel Model 9 in the National Fire Danger Rating System. Loblolly pine sawtimber with a relatively clear understory and light loading of 1-hour, 10-hour, and 100-hour timelag fuels representing long-needled conifer fuel models of the Western United States.

Average diameter at breast height: 11.59 inches
Canopy closure: 70 percent
Age of rough: 4 years

**Fuel Complex 4: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 2.030 |
| Branches | | |
| <0.25 | 0.060 | |
| 0.25–1.00 | 2.047 | |
| 1.00–3.00 | 2.096 | |
| >3.00 | 2.149 | |
| Subtotal | 6.621 | |
| Live fuels | | |
| Grasses | .222 | |
| Herbs | .006 | |
| Shrubs | .017 | |
| Woody | .006 | |
| Vines | .007 | |
| Subtotal | .259 | |
| Litter | 3.024 | 1.314 |
| Total | 9.904 | |

Date of burn: 01/10/95
Days since rain: 3 (4.27 inches)
Ignition technique: Delayed Aerial Ignition Device (Bell 206B)
Period of ignition: 1420 to 1605
Relative humidity: 43 percent
Temperature: 61 °F
Windspeed: 0 to 5 miles per hour

**Fuel Complex 5: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 1.694 |
| Branches | | |
| <0.25 | 0.170 | |
| 0.25–1.00 | 1.214 | |
| 1.00–3.00 | 1.544 | |
| >3.00 | .000 | |
| Subtotal | 2.928 | |
| Live fuels | | |
| Grasses | .234 | |
| Herbs | .063 | |
| Shrubs | .378 | |
| Woody | .344 | |
| Vines | .064 | |
| Subtotal | 1.084 | |
| Litter | 4.491 | 2.735 |
| Total | 8.503 | |

Similar to Fuel Complex 4, but with developed discontinuous understory.

Average diameter at breast height: 14.0 inches
Canopy closure: 60 percent
Age of rough: 4 years

**Fuel Complex 5: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 0.967 |
| Branches | | |
| <0.25 | 0.152 | |
| 0.25–1.00 | 1.722 | |
| 1.00–3.00 | 1.894 | |
| >3.00 | .000 | |
| Subtotal | 3.768 | |
| Live fuels | | |
| Grasses | .288 | |
| Herbs | .055 | |
| Shrubs | .069 | |
| Woody | .092 | |
| Vines | .073 | |
| Subtotal | .578 | |
| Litter | 1.718 | .895 |
| Total | 6.065 | |

Date of burn: 01/26/95
Days since rain: 3 (0.44 inch)
Ignition technique: Delayed Aerial Ignition Device (Bell 206B) and Drip Torch
Period of ignition: 1215 to 5200
Relative humidity: 34 percent
Temperature: 55 °F
Windspeed: 2 to 4 miles per hour

**Fuel Complex 6: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 2.317 |
| Branches | | |
| <0.25 | 0.096 | |
| 0.25–1.00 | .993 | |
| 1.00–3.00 | 2.882 | |
| >3.00 | 1.809 | |
| Subtotal | 5.780 | |
| Live fuels | | |
| Grasses | 1.308 | |
| Herbs | .476 | |
| Shrubs | .105 | |
| Woody | .353 | |
| Vines | .060 | |
| Subtotal | 2.031 | |
| Litter | 2.728 | 2.720 |
| Total | 10.809 | |

Longleaf sawtimber after commercial thinning in open canopies. Forest floor covered in longleaf and loblolly natural regeneration, grasses, and herbaceous material.

Average diameter at breast height: 13.54 inches
Canopy closure: 40 percent
Age of rough: 4 years

**Fuel Complex 6: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 2.208 |
| Branches | | |
| <0.25 | 0.097 | |
| 0.25–1.00 | 1.283 | |
| 1.00–3.00 | 2.316 | |
| >3.00 | 1.809 | |
| Subtotal | 5.506 | |
| Live fuels | | |
| Grasses | 1.013 | |
| Herbs | .208 | |
| Shrubs | .014 | |
| Woody | .161 | |
| Vines | .084 | |
| Subtotal | .148 | |
| Litter | 1.040 | .406 |
| Total | 6.694 | |

Date of burn: 02/03/95
Days since rain: 5 (0.22 inch)
Ignition technique: Delayed Aerial Ignition Device (Bell 206B)
Period of ignition: 1320 to 1345
Relative humidity: 51 percent
Temperature: 65 °F
Windspeed: 0 to 5 miles per hour

**Fuel Complex 7: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 34.200 |
| Branches | | |
| <0.25 | 0.753 | |
| 0.25–1.00 | 2.511 | |
| 1.00–3.00 | 4.272 | |
| >3.00 | 2.700 | |
| Subtotal | 10.236 | |
| Live fuels | | |
| Grasses | .669 | |
| Herbs | .040 | |
| Shrubs | .099 | |
| Woody | .023 | |
| Vines | .013 | |
| Subtotal | .845 | |
| Litter | 4.975 | 3.502 |
| Total | 16.056 | |

Red-cockaded woodpecker management areas in mature longleaf stands after removal of midstory hardwoods.
Abundance of 1-hour, 10-hour, and 100-hour timelag fuels.

Average diameter at breast height: 13.5 inches
Canopy closure: 50 percent
Age of rough: 4 years

**Fuel Complex 7: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 17.000 |
| Branches | | |
| <0.25 | 0.445 | |
| 0.25–1.00 | 2.690 | |
| 1.00–3.00 | 2.724 | |
| >3.00 | 2.464 | |
| Subtotal | 8.323 | |
| Live fuels | | |
| Grasses | .500 | |
| Herbs | .144 | |
| Shrubs | .025 | |
| Woody | .041 | |
| Vines | .006 | |
| Subtotal | .716 | |
| Litter | 1.975 | 1.019 |
| Total | 11.014 | |

Date of burn: 01/26/95
Days since rain: 3 (0.44 inch)
Ignition technique: Delayed Aerial Ignition and Drip Torch
Period of ignition: 1215 to 2200
Relative humidity: 34 percent
Temperature: 55 °F
Windspeed: 2 to 4 miles per hour

**Fuel Complex 8: Preburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 1.200 |
| Branches | | |
| <0.25 | 0.293 | |
| 0.25–1.00 | 1.129 | |
| 1.00–3.00 | 1.153 | |
| >3.00 | .000 | |
| Subtotal | 2.575 | |
| Live fuels | | |
| Grasses | .236 | |
| Herbs | .008 | |
| Shrubs | .130 | |
| Woody | .087 | |
| Vines | .042 | |
| Subtotal | .503 | |
| Litter | 3.105 | 2.880 |
| Total | 6.183 | |

Uneven-aged predominately hardwood stands comprised of oak-hickory cover types.

Average diameter at breast height: 11.3 inches
Canopy closure: 95 percent
Age of rough: unknown

**Fuel Complex 8: Postburn Conditions**

| Fuels | Weight | Depth |
|---|---|---|
| | *Tons/acre* | *Inches* |
| Slash | | 0.750 |
| Branches | | |
| <0.25 | 0.314 | |
| 0.25–1.00 | .662 | |
| 1.00–3.00 | 1.441 | |
| >3.00 | .000 | |
| Subtotal | 2.417 | |
| Live fuels | | |
| Grasses | .306 | |
| Herbs | .000 | |
| Shrubs | .290 | |
| Woody | .005 | |
| Vines | .200 | |
| Subtotal | .801 | |
| Litter | 1.167 | 1.188 |
| Total | 4.385 | |

Date of burn: 02/03/95
Days since rain: 5 (0.22 inch)
Ignition technique: Delayed Aerial Ignition Device (Bell 206b)
Period of ignition: 1320 to 1345
Relative humidity: 51 percent
Temperature: 65 °F
Windspeed: 0 to 5 miles per hour

**Scholl, Eric R.; Waldrop, Thomas A.** 1999. Photos for estimating fuel loadings before and after prescribed burning in the upper coastal plain of the southeast. Gen. Tech. Rep. SRS-26. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 25 p.

Although prescribed burning is common in the Southeastern United States, most fuel models apply to only western forests. This paper documents a fuel classification system that was developed for plantations of loblolly and longleaf pines for the Upper Coastal Plain region. Multivariate analysis of variance and discriminant function analysis were used to confirm eight discrete fuel groups. A photo series describing these unique fuel complexes is presented to display preburn loading and postburn reductions. This photo series will improve the accuracy of fuel-loading estimates and will provide a measure of the effectiveness of prescribed fires for rough reduction.

**Keywords:** Discriminant function analysis, fuel classification, fuel loading, photo series, planar intersect.