

REMNANT FIRE DISTURBED MONTANE LONGLEAF PINE FOREST IN WEST CENTRAL GEORGIA

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Abstract—Fire disturbed ecosystems are characteristic of the Southeastern Coastal Plain of the United States. Less well known are fire disturbed mountainous regions of the Piedmont and Appalachian region that support longleaf pine (*Pinus palustris* P. Mill.) ecosystems. The Pine Mountain Range in the Piedmont of west central Georgia has remnant longleaf pine ecosystems that occupy steep slopes with shallow soils. The montane longleaf ecosystems contain an unusual species composition of coastal plain (*Quercus margaretta* Ashe) and Appalachian (*Vaccinium pallidum* Ait.) species. Landscape scale analysis of vegetation and soils revealed four major ecosystems influenced by topography, soils, and fire history.

INTRODUCTION

Montane longleaf pine (*Pinus palustris* P. Mill.) ecosystems are found in portions of northern Georgia and Alabama. Vegetation surveys have been conducted in areas such as Forest McClellan, AL (Maceina and others 2000) and Rome, GA (Lipps and Deselm 1969), but there have been no attempts to study the interrelationship between forest communities, soils, and landform variables. The objective of the study is to identify ecological land units in the montane longleaf pine forest of west central Georgia based on the discriminating vegetation, soils, and landform features of mature forest communities.

SITES

The study area was Thunder Scout Reservation in Upson County, GA. The 2,200-acre area is owned by the Flint River Council, Boy Scouts of America and is managed for outdoor recreation. Upson County retains only 2,900 acres of montane ecosystems with 50 percent cover of *P. palustris* (Outcalt and Sheffield 1996). The Scout Reservation is within the Pine Mountain Range at the point where it is bisected by the Flint River. The elevation ranges from 61 m at the Flint River to 347 m above sea level. The area is characterized by steep rocky slopes.

PROCEDURES

In the summer of 2003, 15 plots were established in suitable forested sites. The sites were free of recent disturbance with

the exception of fire. Tree, sapling, seedling, and herbaceous strata were sampled in a 20 x 50 m plot following the Carolina Vegetation Survey protocol (Peet and others 1998). Soil samples were collected by horizon from four locations within the plot to determine soil horizon depth and chemical and textural properties. Landform variables sampled included slope gradient, aspect, and landform index (LFI) (McNab 1990).

Ecological land units were delineated through ordination and cluster analysis of presence/absence data. The ordination programs employed were correspondence analysis, detrended correspondence analysis, principal components analysis, and nonmetric multidimensional scaling (McCune and Grace 2002). Cluster analysis was through PC-ORD using Jaccard, Euclidean, and Sorenson (Bray-Curtis) distance measures (McCune and Grace 2002). Environmental variables related to the ecological units were determined through stepwise discriminant analysis ($p=0.10$) and discriminant functions tested through resubstitution (SPSS 1996).

RESULTS AND DISCUSSION

Four landscape ecological land units were identified with a unique species assemblage and soil and landform characteristics (tables 1 and 2). Discriminant functions had a classification success rate of 100 percent, indicating a strong relationship between the ecosystems and environmental variables. Based on the characteristics of each community

Table 1—Mean of diagnostic environmental variables for four communities in the Pine Mountain Region of west central Georgia ($p=0.10$)

Community	Longleaf pine turkey oak goat's rue needle grass	Longleaf pine post oak blackseed flower	Mockernut hickory post oak yellow passion	Chestnut oak sand hickory Christmas fern
Landform index	20.58	11.68	6.44	31.5
A Horizon sand (%)	76.67	73.04	55.00	70.00
B Horizon Ca (%)	0.57	0.40	0.62	0.43
B Horizon P (kg/ha)	23.59	18.69	10.90	35.43
B Horizon Ca (kg/ha)	163.43	389.13	2,505.95	599.25
Elevation (m)	317.00	297.00	329.50	259.00

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Table 2—Community type, habitat, and diagnostic species for the Pine Mountain Region of west central Georgia

Community	Longleaf pine, turkey oak, goat's rue	Longleaf pine, post oak, blackseed needlegrass	Mockernut hickory, post oak, yellow passion flower	Chestnut oak, sand hickory, Christmas fern
Habitat	Steep rocky upper slopes with low Ca	Mountain tops, side slopes with low Ca	Mountain tops, moist slopes with high Ca	Steep slopes bordering ephemeral streams
Diagnostic species	<i>Quercus laevis</i> <i>Tephrosia virginiana</i> <i>Pinus palustris</i> <i>Cnidoscopus stimulosus</i> <i>Quercus margaretta</i> <i>Hypoxis hirsuta</i> <i>Solidago odora</i> <i>Pteridium aquilinum</i>	<i>Quercus stellata</i> <i>Piptochaetium avenaceum</i> <i>Pinus palustris</i> <i>Euphorbia pubentissima</i> <i>Carya tomentosa</i> <i>Baptisia tinctoria</i> <i>Clitoria mariana</i> <i>Ipomoea pandurata</i> <i>Hexastylis shuttleworthii</i>	<i>Carya alba</i> <i>Quercus stellata</i> <i>Passiflora lutea</i> <i>Carya glabra</i> <i>Galium circaezans</i> <i>Ipomoea pandurata</i> <i>Aesculus pavia</i> <i>Lespedeza repens</i> <i>Pteridium aquilinum</i>	<i>Quercus prinus</i> <i>Polystichum acrostichoides</i> <i>Carya pallida</i> <i>Parthenocissus quinquefolia</i> <i>Quercus rubra</i> <i>Quercus nigra</i> <i>Acer rubrum</i> <i>Baptisia tinctoria</i> <i>Solidago odora</i>

identified, it was designated for recreation management as Leave No Trace, Primitive, Semi-primitive, or Group Camping. The management recommendations for each category are:

- (1) Leave No Trace—foot traffic only. Camping is not recommended.
- (2) Primitive—camping is permitted but no permanent structures with the exception of pit toilets and permanent fire pits. The establishment of foot and bike trails is permissible.
- (3) Semi-primitive—the same as Primitive areas but Appalachian Trail type shelters can be constructed
- (4) Group Camping—construction of permanent buildings, campsites, and trails is permissible.

Plant Communities

A longleaf pine-turkey oak (*Quercus laevis* Walt.)-goat's rue [*Tephrosia virginiana* (L.) Pers.] type was found on steep rocky upper slopes with low calcium (Ca). Landform index averaged 20 percent with B-horizon Ca averaging 163 ppm (table 1). The relatively high landform index reflects the upper slope position and steep terrain. Species indicative of this site include *Carya pallida* (Ashe) Engl. & Graebn., *Cnidoscopus stimulosus* (Michx.) Engelm. & Gray, *Quercus margaretta* Ashe, *Q. marilandica* Muenchh., *Prunus umbellata* Ell., *Hypoxis hirsuta* (L.) Coville, *Pteridium aquilinum* (L.) Kuhn, *Hypericum hypericoides* (L.) Crantz, *Vaccinium pallidum*, and *Solidago odora* Ait. (table 2). Sites that support this community are too steep, rocky, and remote for the development of buildings or campsites. This is a Leave No Trace area.

A longleaf pine-post oak (*Quercus stellata* Wangenh.)-blackseed needle grass [*Piptochaetium avenaceum* (L.) Parodi] type was found on mountain tops and side slopes with low Ca. The landform index was lower at 11.68 reflecting positions on mountaintops. B-horizon Ca was slightly higher at 389 ppm (table 1). Species with affinity for these sites include *Carya pallida*, *C. alba* (L.) Nutt. ex Ell., *C. glabra* (P. Mill.) Sweet, *Quercus marilandica*, *Baptisia tinctoria* (L.) R. Br. ex Ait. f., *Clitoria mariana* L., *Euphorbia pubentissima* Michx., *Hypericum hypericoides*, *Hypoxis hirsuta*, *Ipomoea pandurata* (L.) G.F.W. Mey., *Pteridium aquilinum*, *Prunus umbellata* Ell., *Vaccinium pallidum*, *Smilax glauca* Walt., and *Solidago*

odora (table 2). This community is abundant and the sites are relatively flat. This is a Semi-primitive area.

A mockernut hickory (*Carya alba*)-post oak-yellow passion flower (*Passiflora lutea* L.) type was found on mountaintops and moist slopes with high Ca. The landform index was the lowest of the land units at 6.44. This reflects the mountaintop position on the landscape. The B-horizon Ca was very high at 2,505.95 kg/ha due to the parent material underlying the soil (table 1). Species common on this site were *Quercus prinus* L., *Quercus stellata*, *Galium circaezans* Michx., *Ipomoea pandurata*, *Aesculus pavia* L., and *Lespedeza repens* (L.) W. Bart. (table 2). This unusual community is found on relatively flat terrain that can support bike and hiking trails, campsites, and wilderness outposts. However, due to the unusual mix of plant species found on these sites, development should be kept to a minimum. This is a Primitive area.

A chestnut oak (*Quercus prinus*)-sand hickory (*Carya pallida*)-Christmas fern [*Polystichum acrostichoides* (Michx.) Schott] type was found on steep slopes bordering ephemeral streams. Landform index was the highest of the land units at 31.5 reflecting sites in protected valleys bordering streams. The Ca was relatively high at 599.25 kg/ha, reflecting the input and accumulation of Ca from upper slope sites (table 1). Species indicative of this site include *Parthenocissus quinquefolia* (L.) Planch., *Quercus rubra* L., *Quercus nigra* L., *Acer rubrum* L., *Hexastylis shuttleworthii* (Britten & Baker) Small, and *Baptisia tinctoria* (table 2). These sites are too steep to support recreation outside of hiking and bike trials. However, such uses should be kept to a minimum. These sites border streams and intermittent streams and should be protected to prevent erosion onto the streams. This is a Leave No Trace area.

CONCLUSIONS

The montane longleaf pine forests of the Pine Mountain Range represent a unique ecosystem blending coastal and Piedmont/Appalachian species. The presence of longleaf pine on all sites indicates that fire played an historical role in determining plant species distribution. Although the land

units identified are unique and worthy of conservation, total preservation is not required. Recreational activities are compatible with the land units as long as the activities do not increase soil erosion. The steep slopes found in some land units are highly susceptible to erosion.

This study examined the major ecosystems found on Thunder Scout Reservation but did not address some unusual ecosystems such as canebrakes and mountain laurel thickets. Further research is needed to determine the species composition and presence of rare species in these ecosystems.

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