11th North American Forest Soils Conference

Conference Field Trip
Soils and Silviculture in the Ridge and Valley of Virginia

June 24, 2008

Hosted by
College of Natural Resources
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061

VirginiaTech
Invent the Future

Field Trip Agenda

TUESDAY JUNE 24

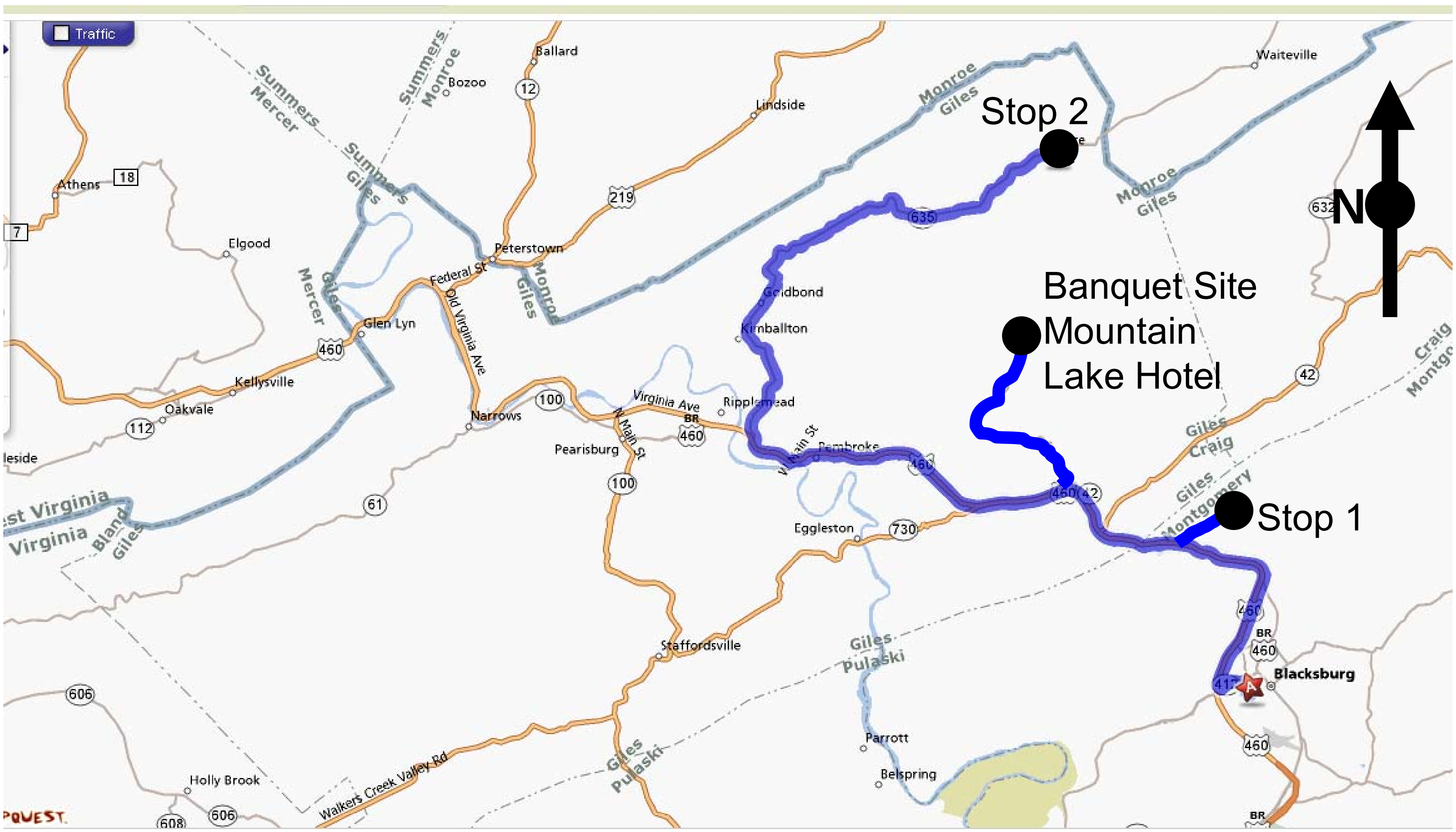
Conference Field Tour – Soils and Silviculture in the Ridge and Valley of Virginia

6:30 - 7:30	Continental Breakfast (Latham Ballroom A)
7:30	Conference Field Trip Depart from Inn at Virginia Tec Parking Lot
7:30 - 8:00	Travel to Jefferson National Forest
8:00 – 11:00	Virginia Tech Southern Appalachian Sustainability and Biodiversity Study in Oak-Hickory Forests on Jefferson National Forest Station 1: Soil Pits – Bailegap Series Tom Bailey, Jefferson National Forest Station 2: Use of GPR to Evaluate Soil Variability Wes Tuttle, NRCS Station 3: Impact of Decomposing Stumps on Soil Fertility Eric Sucre, Virginia Tech Station 4: Comparison of Alternative Silvicultural Systems on Hardwood Regeneration Chad Atwood, Virginia Tech
11:00 – 12:00	Travel to Glenn Alton Recreation Area, Jefferson National Forest
12:00 – 1:00	Lunch at Glenn Alton Welcome by Cindy Schiffer, Eastern Divide District Ranger
1:00 -` 1:15	Gypsy Moth in the Southern Appalachians Ed Leonard, Jefferson National Forest
1:15 – 5:00	Comparison of Appalachian Hardwoods and White Pine Plantation on Jefferson National Forest Station 1: Colluvial Soil Pit – Jefferson Series Appalachian Hardwood Stand Tom Fox, Virginia Tech

	Station 2 Residual Soil Pit – Gilpin Series White Pine Plantation Jim Burger, Virginia Tech
	Station 3: Alluvial Soil Pit – Derroc and Botetourt Series White Pine Plantation Lee Daniels, Virginia Tech
	Station 4: BMPs and Water Quality in Virginia Riparian Hardwood Forest Bill Lakel, Virginia Department of Forestry
	Station 5: GIS Modeling of Site Quality in the Appalachians Claudia Cotton, Virginia Tech
5:00 - 5:45	Travel to Mountain Lake Resort
5:45- 6:30	Reception with Beer and Wine
6:30 – 8:00	Conference Banquet
8:00 – 9:00	Entertainment Traditional Appalachian Music by Mountain Fling
9:00 - 9:30	Return to Skelton Conference Center

North American Forest Soils Conference
Field Tour: Forest Soils and Silviculture in the Ridge and Valley
June 24, 2008

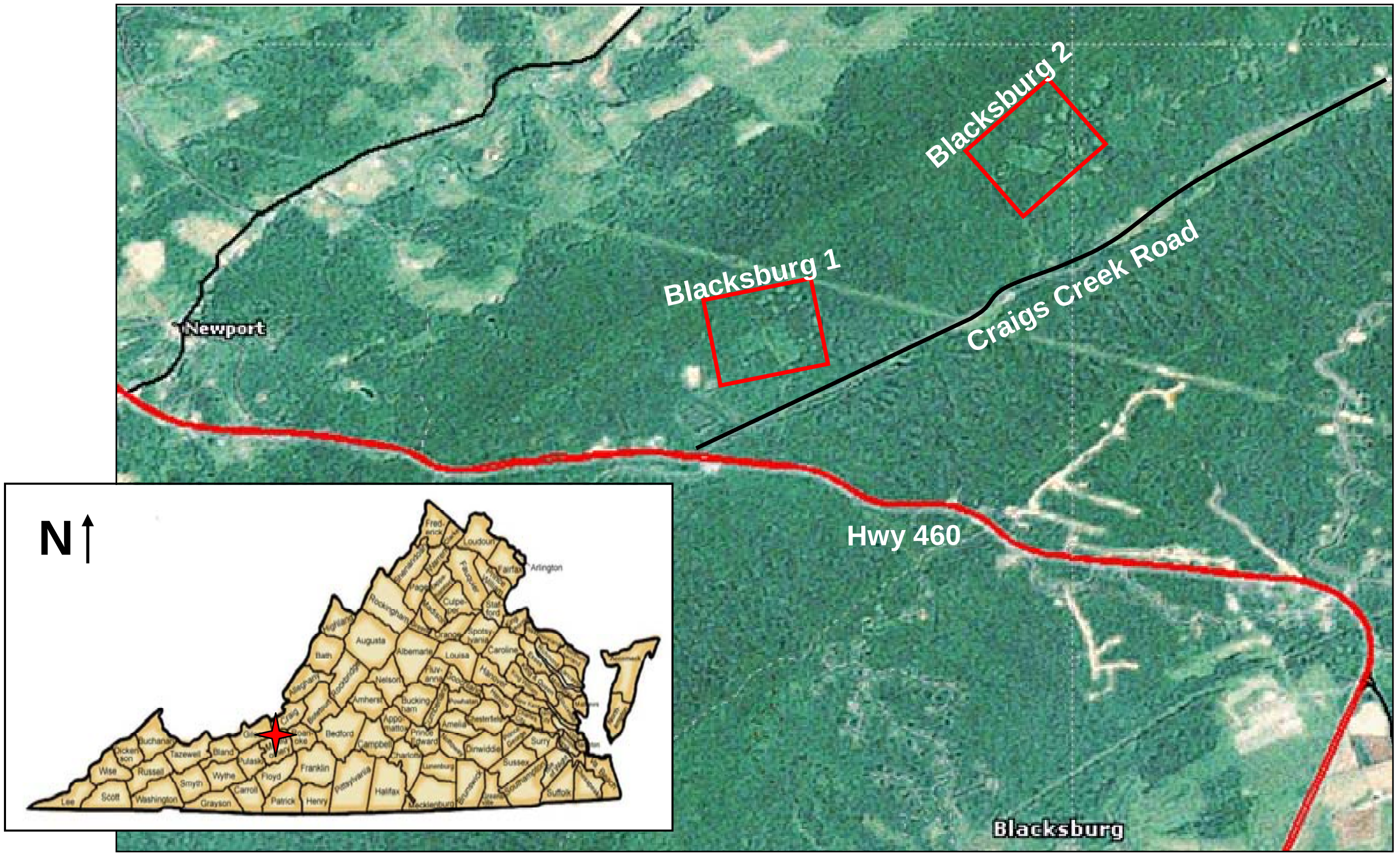
Field Tour Travel Route



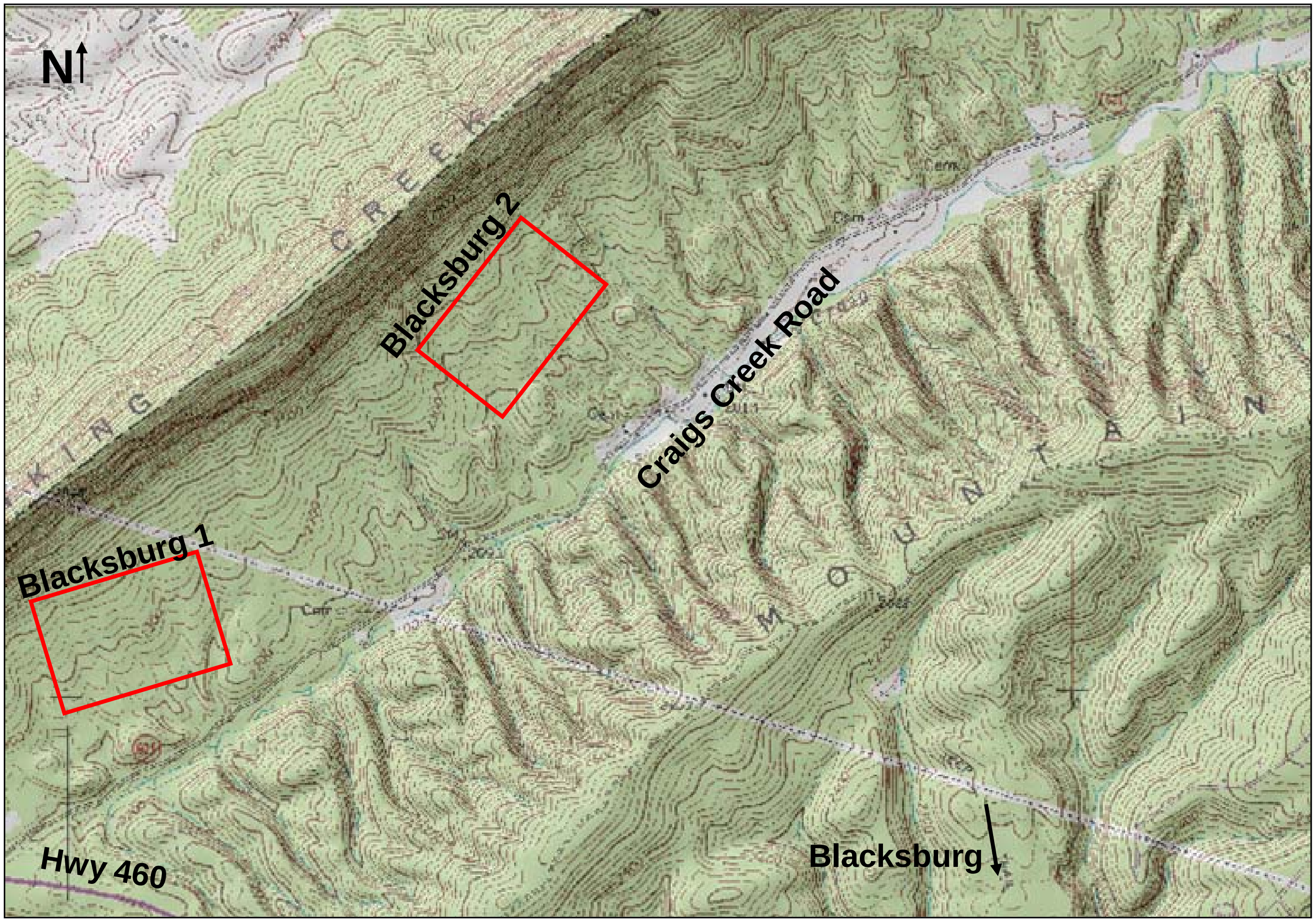
Stop 1

Virginia Tech Southern Appalachian Sustainability and Biodiversity Study in Oak-Hickory Forests

Jefferson National Forest
Montgomery County, Virginia



Aerial view of VT's Diversity Study in Montgomery Co., VA



Topography of Diversity Study Area
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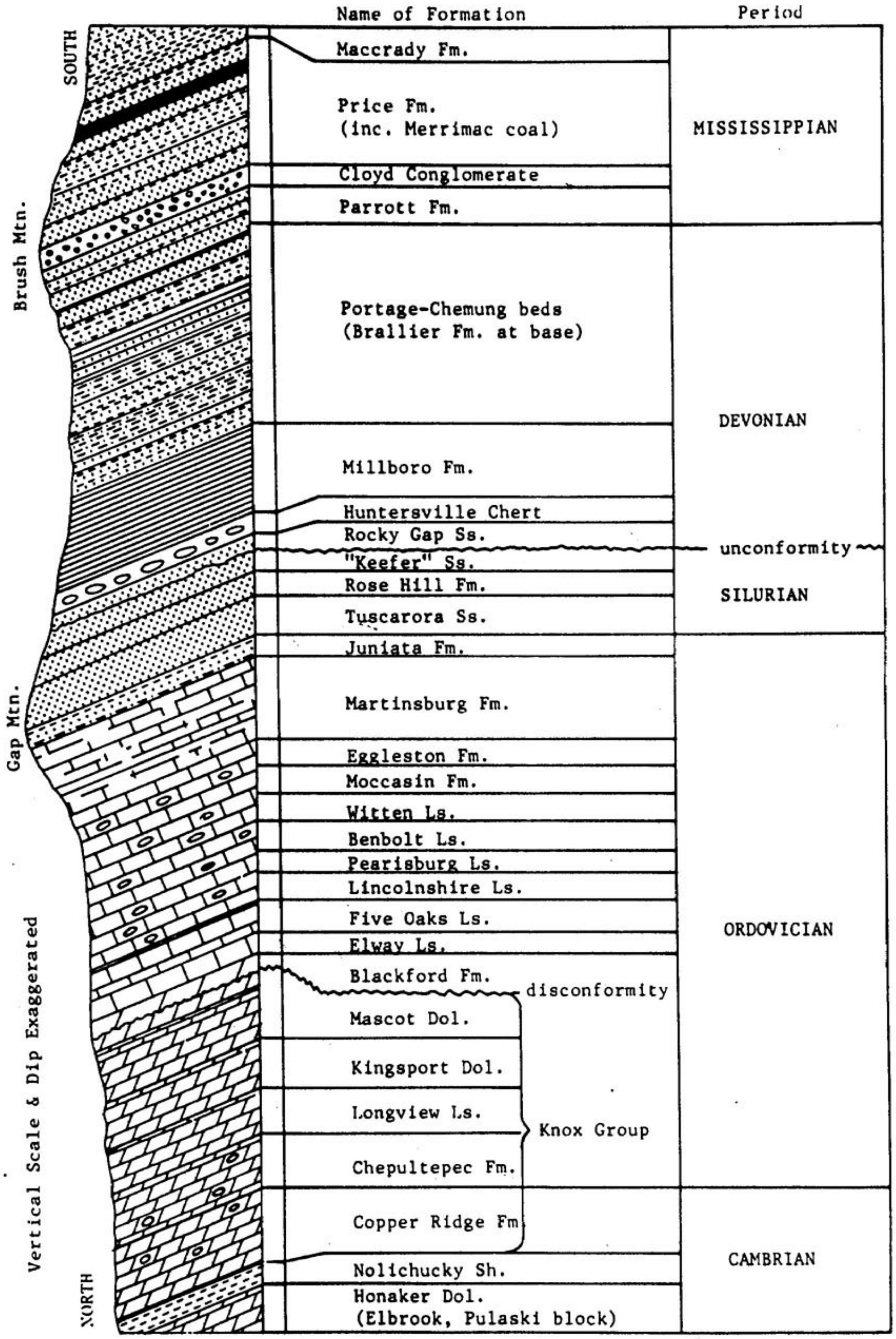
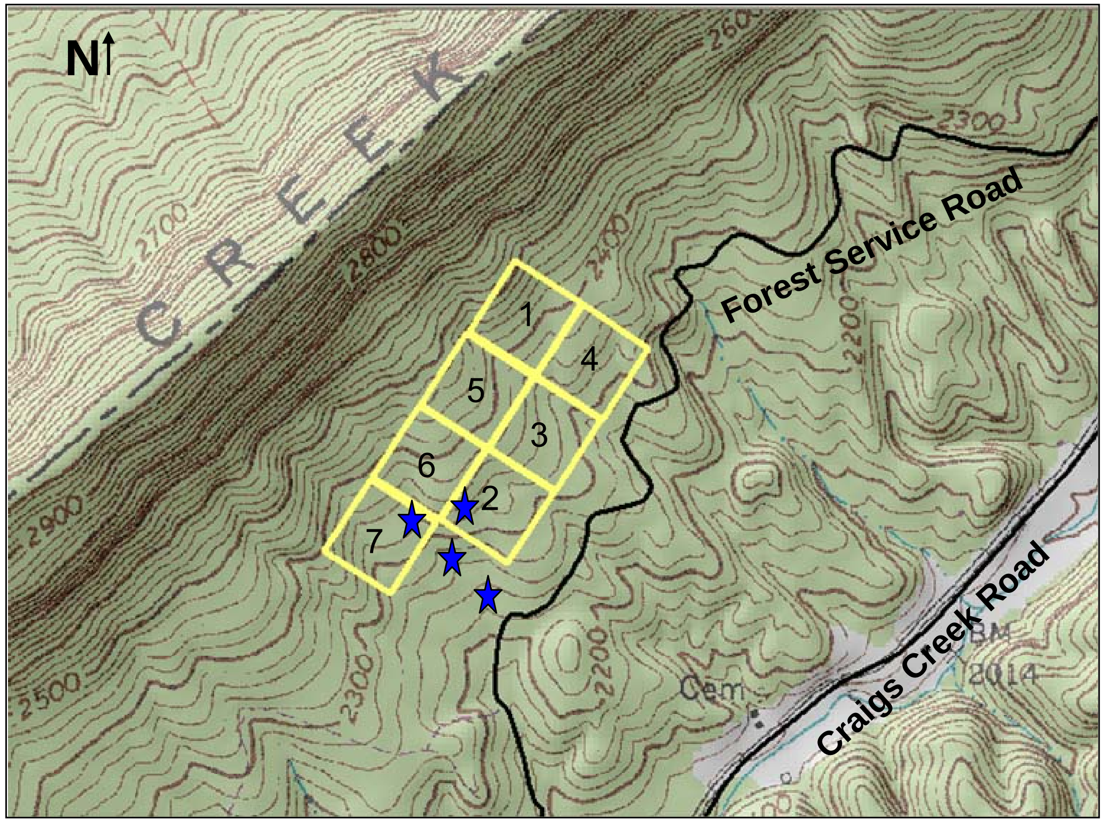


Formations along New River SE. of Saltville fault (NW. limb Blacksburg synclinorium)

Stratigraphic column.

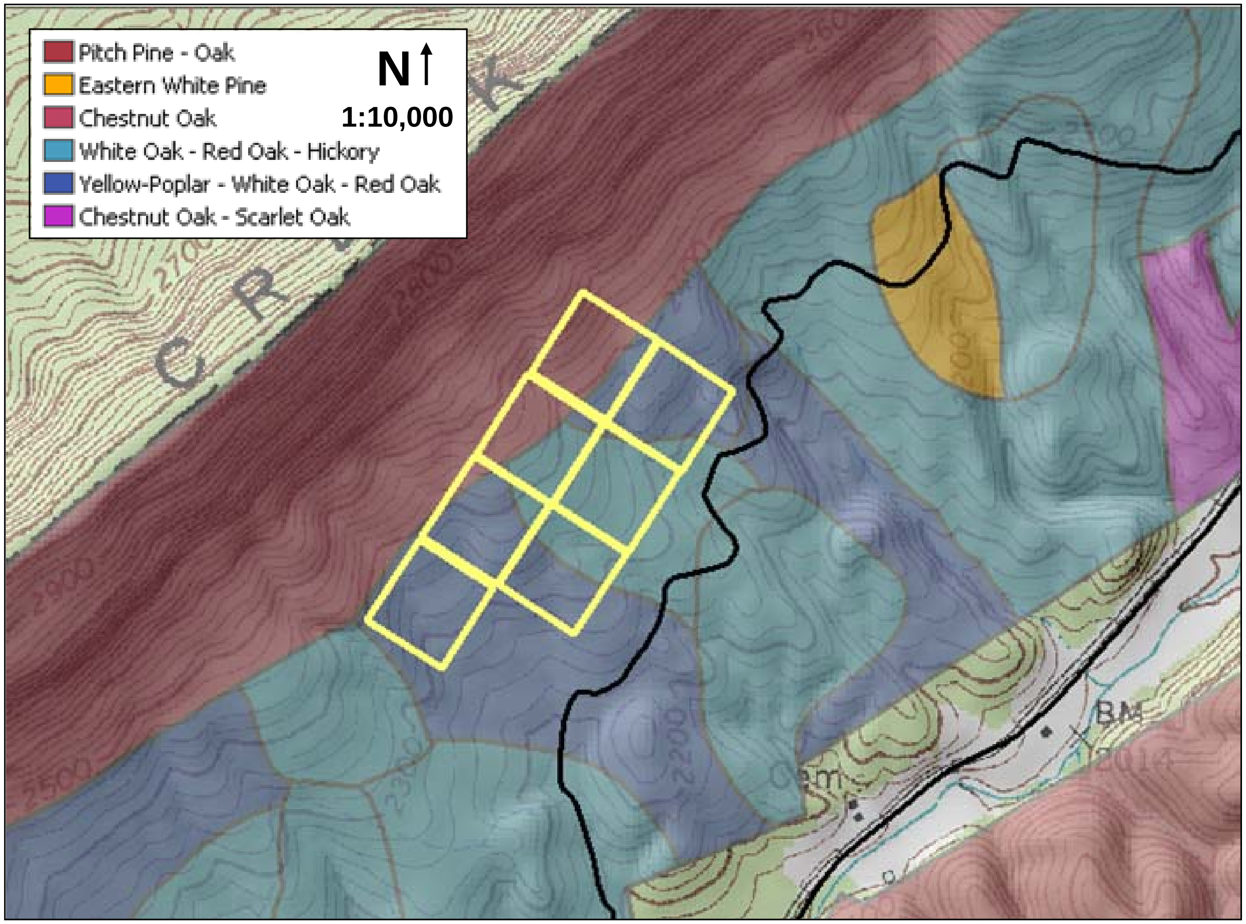


Legend

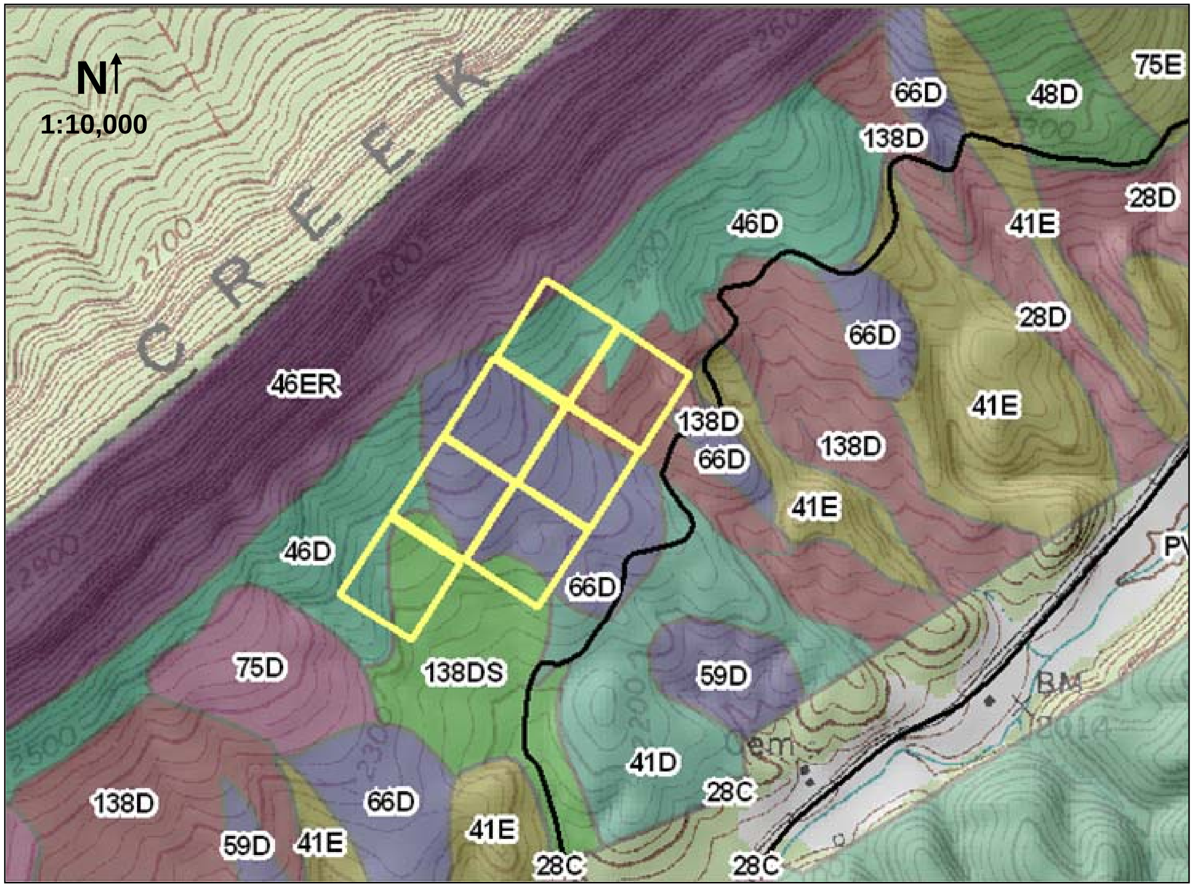
1 - Control
2 - Understory Control
3 - Clearcut
4 - Shelterwood (20-30)
5 - Leave-tree cut
6 - Shelterwood (50-60)
7 - Group Selection
★ NAFSC Field Presentation

Blacksburg 2 Study Layout & NAFSC Field Presentations

1:9,800



USFS Stands and Forest Types in Blacksburg 2 Area



USFS Forest Soils in Blacksburg 2 Area

(Legend on back)

Table 3. Legend for selected USFS Soils of Blacksburg 2 Study Site, Montgomery County, VA.

Map #	Series	Order	Typical Location	Derived from
28C&D	**Shelocta**	Ultisol	Fan deposits in foothills, mtns.	Colluvium of shale and siltstone
41D&E	**Berks**	Inceptisol	Summits, shoulders & backslopes of dissected uplands	Residuum from shale, siltstone, and sandstone
46D	**Dekalb**	Inceptisol	Nearly level to very steep upland slopes and ridges	Regolith from gray and brown acid sandstone
46ER	**Delakb-rock outcrop complex**	Inceptisol	Same as above	Same as above
48D	**Calvin**	Inceptisol	Ridge, hillside	Colluvium of shale and siltstone
59D	**Gilpin**	Ultisol	Gentle slopes to very steep convex dissected uplands	Residuum of horiz. interbedded shale, siltstone, and sandstone
66D	**Bailegap**		Ridge, hill, hillslope	Residuum of sandstone & shale
75D&E	**Lily**	Ultisol	Hillslope, ridge	Residuum of sandstone
94E	**Berks-Weikert complex**	Inceptisol	Mountain sides	Residuum of shale, siltstone, & sandstone
138D&DS	**Oriskany**	Ultisol	Cove, fan deposits	Colluvium of sandstone and shale

Alternative Silvicultural Practices in Appalachian Forest Ecosystems: Implications For Diversity, Resilience and Commercial Production

Thomas R. Fox[1], Carola A. Haas[2], Robert H. Jones[3],

Virginia Polytechnic Institute and State University

[1]Department of Forestry, [2]Department of Fisheries and Wildlife Sciences, [3]Department of Biology

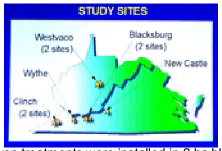
Introduction

The hardwood forests of the Southern Appalachians are some of the most diverse ecosystems in the world. The complex assemblage of flora and fauna in the region is a product of the large variation in habitat types created by differences in geology, elevation, landform, climate and soils in the region. The demands for commodity and non-commodity uses of forests in the Southern Appalachians continue to increase as populations in nearby urban areas expand. Silvicultural practices that include partial harvest rather than clearcutting are emerging as the preferred alternative to balance the competing goals of timber production and preservation of habitat and species diversity in southern hardwood forests. However, little data exist on the impacts of these silvicultural alternatives on timber production, and the diversity of flora and fauna in the Southern Appalachians.

A cooperative project among Virginia Tech, the USDA Forest Service, and Westvaco was established in 1994 to address these issues in a systematic manner using a designed experiment. The study sites provide a template for a wide variety of research on the sustainability of managed Appalachian hardwood forests.

Study Sites and Treatments

The study was initially established at eight locations in Virginia and West Virginia. Two sites are located at the Westvaco Wildlife and Ecosystem Research Forest in WV. Six sites are located on the Jefferson National Forest in VA. One site on the Jefferson National Forest (Wythe) was mothballed due to administrative issues associated with timber harvests.



At each site, seven treatments were installed in 2 ha blocks. The first site was harvested in 1994-95 and the last site was harvested in 1998.

1. **Control:** No silvicultural activity within the stand;
2. **Understory/Midstory Vegetation Control:** Individual stems in the understory and midstory were treated with herbicide to encourage the development of advanced oak regeneration;
3. **Group Selection:** Three openings of approximately 0.25 ha each were made where all stems greater than 5 cm dbh were harvested. Plans call for re-entry every 20 years.
4. **Shelterwood:** 12 to 14 m^2/ha of residual basal area were retained during the initial harvest. Plans call for the overstory removal between age 5 and 10.
5. **Leave Tree:** Approximately 25 to 45 trees/ha totaling 5 m^2/ha of basal area were retained during the initial harvest. These trees will remain throughout the next rotation.
6. **Commercial Clearcut:** Approximately 4 to 7 m^2/ha of residual basal area in low quality stems was left on site during harvest.
7. **Silvicultural Clearcut:** All stems greater than 5 cm were harvested.

Treatments

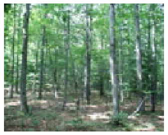
Ongoing Research Activities

Floristic Diversity & Commercial Tree Regeneration

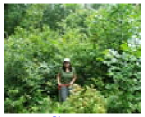
Regeneration of commercially important hardwood species is an important consideration in any silvicultural system. Non-timber species play key roles in Appalachian hardwood forest ecosystems influencing tree regeneration, wildlife habitat quality, and visual aesthetics. Medicinal plants such as mayapple and ginseng have high commercial values and are being extracted in increasing amounts throughout the region. Introduction of invasive exotic species such as ailanthus is changing the composition and structure of these forests.

Detailed studies of plant community response following the various silvicultural treatments are being conducted to address these issues.

Regeneration of commercial hardwoods and the overall floristic diversity increased following silvicultural treatments that disturbed the overstory and increased light reaching the forest floor. The plant community is being monitored through time to assess changes in floristic diversity that occur in these stands as they regenerate and develop.

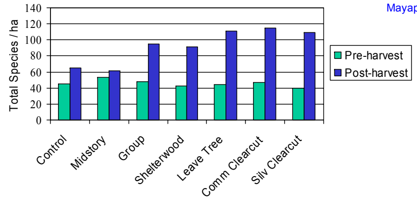

Control

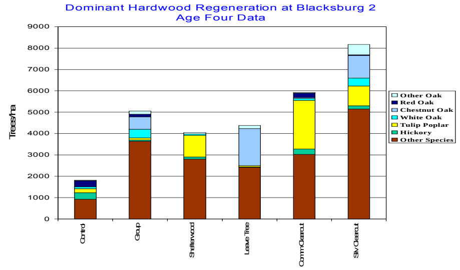

Ginseng


Clearcut
Age 4


Mayapple

Herbaceous Species Richness





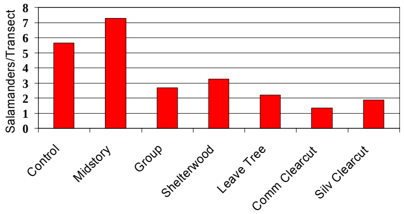
Salamander Populations

Terrestrial salamanders are an important, but relatively poorly studied, component of eastern deciduous forest ecosystems. Therefore, in this study salamander populations were monitored along transects in each treatment using a combination of visual searches and coverboards.


Red-backed Salamander

Large impacts of silvicultural manipulations were found. Salamander populations declined following all harvest treatments, regardless of intensity of overstory removal. These results suggest that partial harvesting practices may have as large an effect on salamander populations as clearcutting. The long-term impact of partial harvesting treatments that require repeated entries in the stand over the rotation may be more severe than clearcutting or leave-tree systems where a single entry is made each rotation.Ongoing work is examining the recovery of salamander populations over time following disturbance

Post-Harvest Salamander Abundance



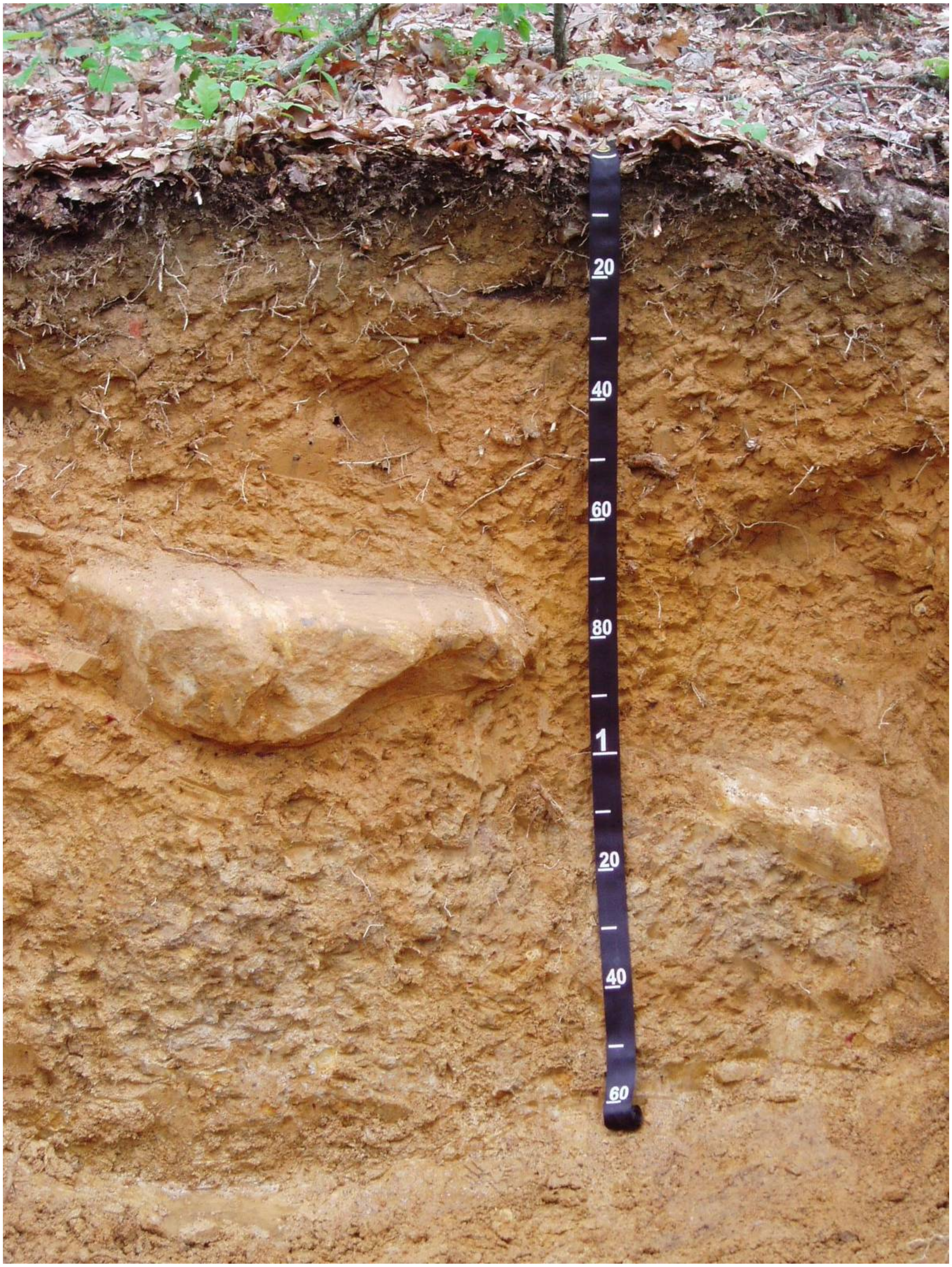
Station 1

Bailegap Soil Profile

Tom Bailey
Soil Scientist
George Washington/Jefferson National Forest
Roanoke, VA

Bailegap Soil
Landscape, Forest Community, and Soil Profile
Jefferson National Forest
Montgomery County, Virginia

Bailegap Soil Profile
Jefferson National Forest
Montgomery County, Virginia



BAILEGAP VA
Established Series
Rev. PLS-DDR-EPE-RP
09/2002

BAILEGAP SERIES

Soils of the Bailegap series are deep and well drained. They are on rounded hills, side slopes or ridge tops and formed in residuum weathered from sandstone, siltstone and interbedded shale in the Appalachian Ridge and Valley area. Permeability is moderate. Slope ranges from 2 to 65 percent. Mean annual precipitation is about 38 to 40 inches and mean annual temperature is about 51 degrees F.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Bailegap flaggy loam, 35 percent slope in a wooded area. (Colors are for moist soil unless otherwise stated.)

0i--0 to 0.5 inches; loose leaves, twigs and partially decomposed organic material.

A--0.5 to 2 inches; brown (7.5YR 4/2) flaggy loam; weak fine granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine vesicular pores; 12 percent gravel and 20 percent flagstones; very strongly acid; abrupt smooth boundary. (1 to 4 thick)

E--2 to 8 inches; reddish brown (5YR 5/3) channery silt loam; weak fine granular structure; friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine vesicular pores; 10 percent gravel and 20 percent channers; very strongly acid; clear wavy boundary. (4 to 12 inches thick)

Bt1--8 to 20 inches; reddish brown (2.5YR 4/4) gravelly silt loam; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; common very fine and fine vesicular pores; 30 percent gravel; few faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2--20 to 29 inches; reddish brown (2.5YR 4/4) angular cobbly silt loam; moderate fine subangular blocky structure; firm, sticky and plastic; few fine and medium roots; few very fine and fine vesicular pores; 15 percent gravel; and 20 percent angular cobblestones; few distinct clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt3--29 to 37 inches; reddish brown (2.5YR 4/4) angular very cobbly silt loam; moderate fine subangular blocky structure; firm, sticky and plastic; few fine and medium roots; few very fine and fine vesicular pores; 30 percent gravel and 30 percent angular cobblestones; few distinct clay films on ped faces; very strongly acid; gradual irregular boundary.

Bt4--37 to 42 inches; reddish brown (2.5YR 4/4) angular very cobbly silt loam; weak fine angular blocky structure; firm, slightly sticky and slightly plastic; few fine and medium roots; few very fine and fine vesicular pores; 40 percent gravel and 40 percent angular cobblestones few distinct clay films on ped faces; very strongly acid; abrupt irregular boundary. (Combine thickness of the Bt horizon range from 20 to 50 inches)

Cr--42 to 58 inches; fractured red sandstone bedrock that crushes to sandy loam; weak fine granular structure in cracks; very strongly acid.

R-- 58 inches; Red sandstone bedrock.

TYPE LOCATION: Giles County, Virginia; on the north side of Big Mountain on Va. Route 804, 2.5 miles South of Va. Route 635.

RANGE IN CHARACTERISTICS: Solum thickness and depth to bedrock ranges from 40 to 60 inches. Rock fragments of sandstone range from 0 to 35 percent in the A, E and upper B horizons. Individual subhorizons in the lower B horizon and the C horizon ranges up to 80 percent. The soil is very strongly acid or strongly acid unless limed.

The A horizon has hue of 10YR to 5YR, value of 3 to 5, and chroma of 2 or 3. It is loam, silt loam, fine sandy loam or sandy loam in the fine earth fraction.

The E horizon has hue of 10YR to 5YR, value of 4 to 6, and chroma of 3 to 6. It is loam, silt loam, fine sandy loam or sandy loam in the fine earth fraction.

The Bt horizon has hue of 7.5YR to 10R, value of 4 to 6, and chroma of 3 to 8. It is silt loam, loam, clay loam, or sandy clay loam in the fine earth fraction.

The C horizon (where present) has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 or 4. It is loam, sandy loam, or loamy sand, in the fine earth fraction.

The Cr has hue of 2.5YR or 5YR, value of 4 to 6 and chroma of 3 or 4. It is saprolite that crushes to loam, sandy loam or loamy sand.

COMPETING SERIES: These are the Jefferson, Lily, Lonewood, Marr, Riney, Sassafras, and Sunnyside series in the same family. Jefferson soils has bedrock deeper than 60 inches. Lonewood soils lack coarse fragments in the solum. Lily and Marr soils have a solum thickness of less than 40 inches. Riney soils do not have hard sandstone rock fragments throughout the solum. Sassafras soils have rock fragments dominated by smooth quartz gravel. Sunnyside soils do not have flagstones or cobblestones in the solum. Apison, Cahaba, Granville, Hartsells and Linker soils have a thermic temperature regime. Brevard, Clymer, Meadowville, Shelocta, Tate and Thurmont soils have mixed mineralogy.

GEOGRAPHIC SETTING: The Bailegap soils are on rounded hills, side slopes, or ridge tops above 1500 feet elevation in the Appalachian Ridge and Valley area. Slope gradient range from 2 to 65 percent. The soils formed in residuum weathered from sandstone, siltstone and interbedded shale. The average annual temperature ranges from 47 to 56 degrees F. Average annual precipitation ranges from 34 to 40 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Clymer and Jefferson series and the Lehew, Nolichucky, Tumbling and Wallen soils. Lehew and Wallen soils have bedrock at depths between 20 and 40 inches and lack argillic horizons. Nolichucky soils have a sola greater than 60 inches thick. Tumbling soils have clayey particle size control sections. Clymer, Lehew and Wallen soils occupy similar landscape positions. The Jefferson, Nolichucky and Tumbling soils occupy side slopes and footslopes at relatively lower landscape positions.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is low to very high. Permeability is moderate.

USE AND VEGETATION: Nearly all areas of these soils are in woodland. Native vegetation consists of dominantly mixed hardwood species.

DISTRIBUTION AND EXTENT: Ridge and Valley and Appalachian Plateau areas of Virginia, Kentucky, Maryland, Pennsylvania, Tennessee, and West Virginia. The series is of small extent.

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Giles County, Virginia; 1980. Name is from Baileys Gap, Virginia.

REMARKS: These soils formerly were included in the Lehew series in Giles County but lab data show that these soils have an argillic horizon and have siliceous mineralogy.

Diagnostic horizons and features recognized in this pedon are:
1. Ochric Epipedon - The zone from 0 to 2 inches (The A horizon). 2. Argillic horizon - The zone from 8 to 42 inches (Bt horizon)

National Cooperative Soil Survey
U.S.A.

Station 2

Contribution of Stumps and Coarse Fragments To Soil Carbon and Nutrient Pools in the Appalachians

Eric Sucre
Graduate Student
Department of Forestry
Virginia Polytechnic Institute and State University
Blacksburg, VA

Contribution of Stumps and Coarse Fragments to Carbon and Nitrogen Pools in the Southern Appalachians

Eric B. Sucre, M. Paige Parrish, & Thomas R. Fox

11th North American Forest Soils Conference:

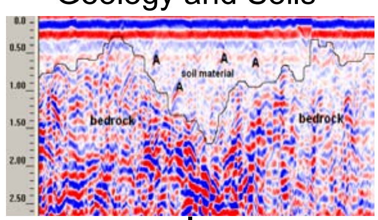
Celebrating 50 years of Research on Properties, Processes and Management of Forest Soils

Virginia Tech 1872

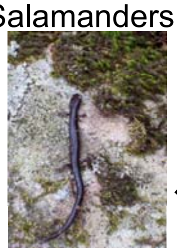
College of Natural Resources
Virginia Polytechnic Institute and State University

Research Scope

Geology and Soils



Salamanders



Soil Resource Heterogeneity in Southern Appalachians

Decomposing Stumps

Introduction

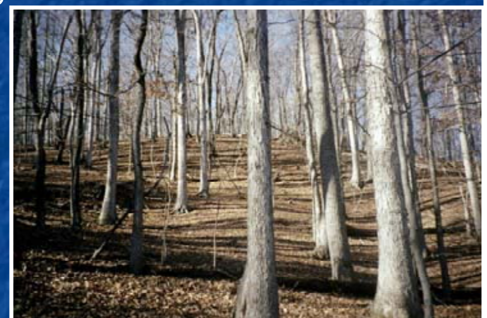
- Southern Appalachian forests & associated soils naturally variable.
- Water availability, soil depth and nutrient availability limit productivity.
- Decomposing stumps increase soil heterogeneity across the landscape.
- Relic stumps provide a favorable microsite for root growth, water retention and enhanced soil fertility.
- Appalachian forest soils contain large amounts of coarse fragments that have an appreciable amount of nutrients accessible by roots.

Research Questions

- What percentage of total soil volume do these microsites comprise on the landscape?
- How do soil chemical & physical properties differ between decomposing stumps and bulk soil?
- How would this affect estimations of soil carbon and nitrogen pools?
- What is the contribution of stumps to water and nutrient availability?

Soil and Site Characteristics

- **Clymer Soil Series (***Coarse-loamy, siliceous, active,mesic Typic Hapludults)*
- **Underlying Geology:** *Sandstone and Shale*
- **Mature 2nd Growth Forest:** *80-100 years old*
- **Medium Site Quality (***White Oak SI_{50} = 60-70ft)*



White Oak/Black Oak Community

Study Design

1) Six 10m x 10m plots randomly established

2) Forest Floor Removed to determine location of stumps

3) All stumps were flagged

4) Stumps were separated based on level of decomposition

Decomposition Classification

- Modified Pyle and Brown's (1998) coarse wood debris classification system with 4 levels of decomposition:
  - Level 1 - Very little to no observable decomposition (i.e. stump is solid and recent)
  - Level 2 - Stump is partially fragmented with bark beginning to flake
  - Level 3 - Stump heavily fragmented and can be pulled out of ground
  - Level 4 - Microdepressional area present, but no aboveground evidence of stump.

1 → Amount of Decomposition → 4

Low — High

Chemical Analysis

- Nitrogen
  - Total N by horizon, stump and roots
  - Extractable NH_4^+ and NO_3^-
  - Potentially Mineralizable N
- Carbon
  - Total C by horizon, stump and roots
  - Microbial Biomass C

Root Properties

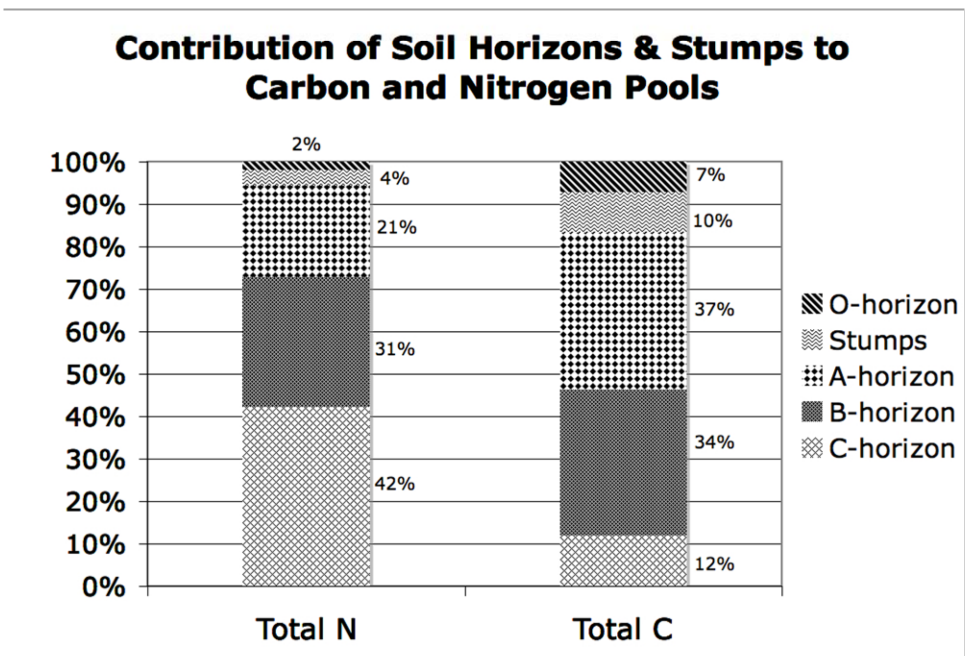
- Total Length and Surface Area of roots by size class:
  - Fines <2mm
  - Coarse > 2mm

Nitrogen and Carbon Concentrations for Soil Horizons and Stumps

	O-horizon	A-horizon	B-horizon	C-horizon	Stumps
Soil Volume (m^3 ha^{-1})	329	1263	5288	5461	151
Total Contribution Soil Volume	2.7%	10.1%	42.3%	43.7%	1.2%
%N	1.2	0.13	0.05	0.06	0.27
%C	50	2.4	0.53	0.20	8.1

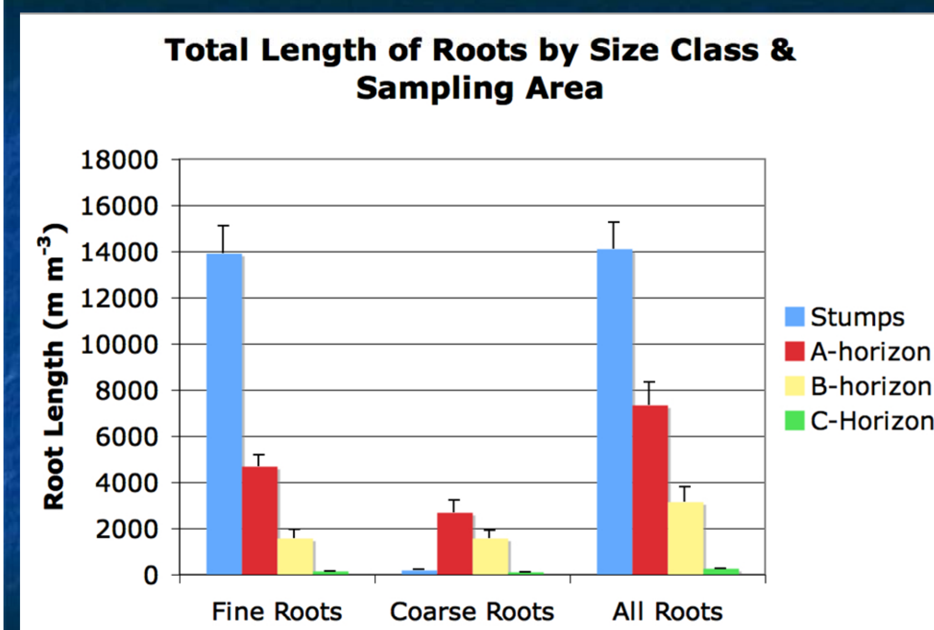
Extractable NH_4^+ and NO_3^-, Potentially Mineralizable N and Microbial Biomass C for Mineral Soil and Stumps

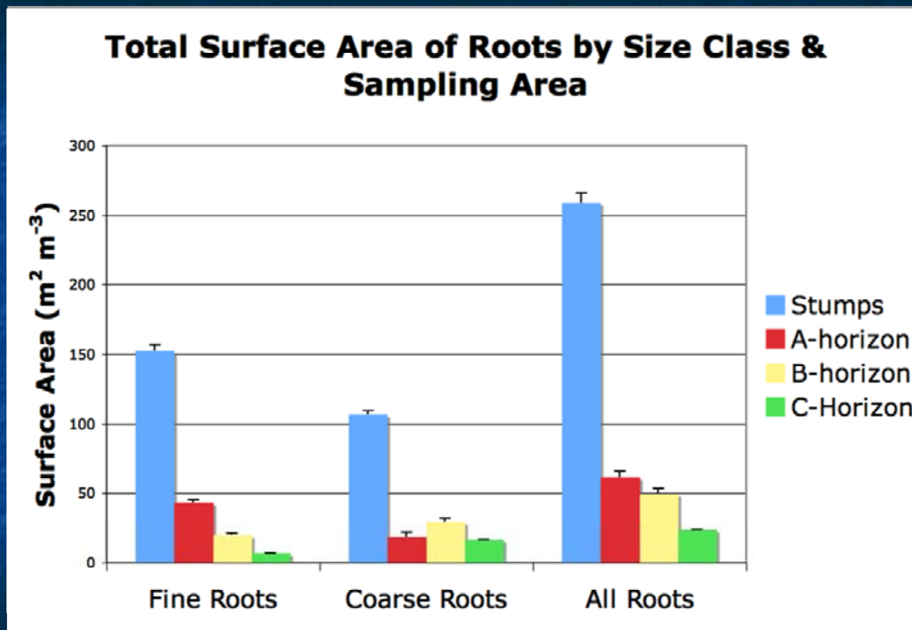
	A-horizon	B-horizon	C-horizon	Stumps
Soil Volume (m^3 ha^{-1})	1263	5288	5461	151
Total Contribution Soil Volume	10.4%	43.5%	44.9%	1.2%
Extractable NH_4^+ (mg kg^{-1})	3.7	3.4	10	16
Extractable NO_3^- (mg kg^{-1})	39	6.8	0.91	2
Potentially Mineralizable N (mg kg^{-1} NH_4^+)	397	60	30	103
Microbial Biomass C mg kg^{-1}	397	60	30	1528



Root Carbon and Nitrogen Concentrations, Total Length, and Surface Area

	A-horizon	B-horizon	C-horizon	Stumps
Soil Volume (m^3 ha^{-1})	1263	5288	5461	151
Total Contribution Soil Volume	10.4%	43.5%	44.9%	1.2%
%N Roots	0.55	0.46	0.54	0.74
%C Roots	39	40	25	48
Mean Roots (g N m^{-3})	112	13	1.25	146
Mean Roots (g C m^{-3})	8684	1407	67	9840
Total Length Fine (m m^{-3})	4676	1580	153	13937
Total Length Coarse (m m^{-3})	2681	1567	107	191
Total Length All Sizes (m m^{-3})	7357	3147	259	14128
Total Surface Area Fines (m^2 m^{-3})	20	7	1	43
Total Surface Area Coarse (m^2 m^{-3})	30	17	1	19
Total Surface Area All Sizes (m^2 m^{-3})	50	24	2	62



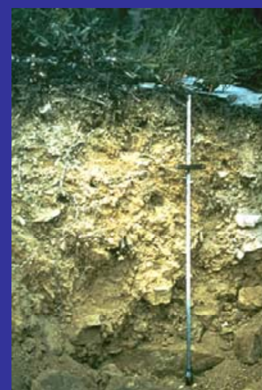


Summary

- Concentrations N, C, NH_4^+, NO_3^-, Microbial Biomass C and potentially mineralizable N markedly higher in stumps than bulk soil.
- Relic Stumps do not constitute significant portion of total soil volume.
- Old stumps have significantly lower bulk density, higher total fine root length and higher absorptive surface area in stump soil vs. bulk soil.

Soils of the Appalachians Frequently Contain Large Amounts of Coarse Fragments

Gilpin Series



Berks Series

Objective

Determine the contribution of coarse fragments to soil carbon and nutrient pools in forest soils of the southern Appalachians

Location of Study Sites for Coarse Fragment Study

Study Site	Soil Series	Taxonomic Classification	Parent Material
BB1	Clymer Berks	Coarse-loamy, siliceous, active, mesic Typic Hapludult Loamy-skeletal, mixed, active, mesic, Typic Dystrudept	Sandstone, shale, siltstone
BB2	Clymer Berks	Coarse-loamy, siliceous, active, mesic Typic Hapludult Loamy-skeletal, mixed, active, mesic, Typic Dystrudept	Sandstone, shale, siltstone
NC	Berks Weikert	Loamy-skeletal, mixed, active, mesic, Typic Dystrudept Loamy-skeletal, mixed, active, mesic Lithic Dystrudept	Sandstone, shale, siltstone
CL1	Muskingum	Fine-loamy, mixed, semiactive, mesic Typic Dystrudept	Siltstone, sandstone, shale
Cl 2	Muskingum	Fine-loamy, mixed, semiactive, mesic Typic Dystrudept	Siltstone, sandstone, shale
WV1	Dekalb Gilpin	Loamy-skeletal, siliceous, active, mesic, Typic Dystrudept Fine-loamy, mixed, active, mesic Typic Hapludult	Sandstone, shale, Graywacke, siltsone
WV 2	Dekalb Gilpin	Loamy-skeletal, siliceous, active, mesic, Typic Dystrudept Fine-loamy, mixed, active, mesic Typic Hapludult	Sandstone, shale, Graywacke, siltsone

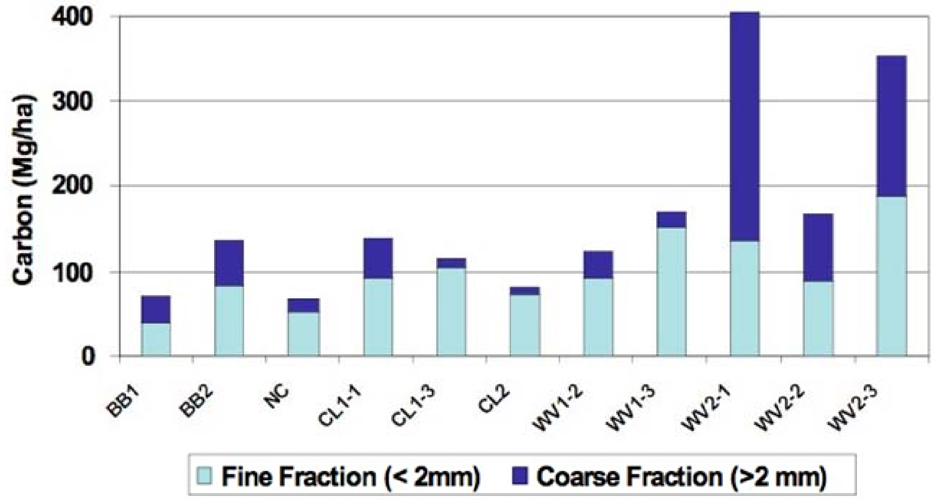
Methods

- Methods
- Soil pits (0.5 m x 0.5 m) excavated to 1 m or bedrock
- Properties determined for each horizon
  - Depth
  - Total Volume
  - Sequential sieving to separate size fractions: 2 mm 2-5 mm, 5-9 mm, 9-19 mm, 19-76 mm, and > 76 mm
  - Weight of fine fractions and coarse fragments by size class
  - Bulk density of fine and coarse fragments by size class

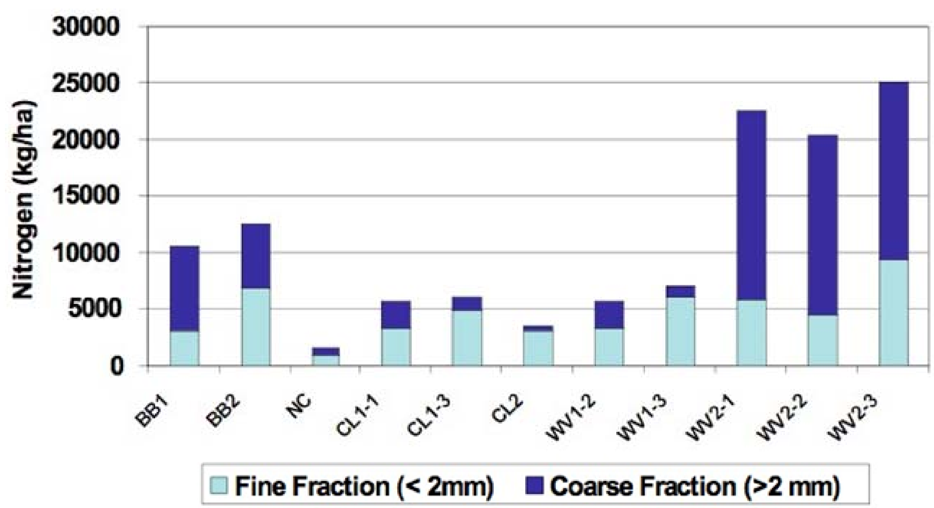
Volume of Coarse Fragments

Location	Surface Soil (A and AB Horizons)	Subsurface Soil (B and C horizons)
BB1	12%	34%
BB2	21%	28%
NC	7%	7%
CL1	7%	34%
CL1	17%	13%
CL2	3%	18%
WV1	26%	23%
WV1	21%	24%
WV2	32%	63%
WV2	13%	48%
WV2	20%	39%

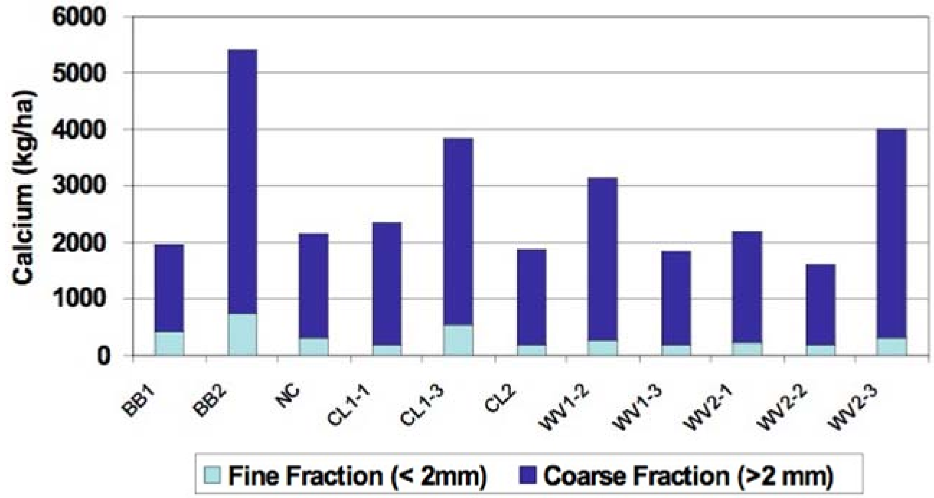
Whole Profile Carbon Content of Forest Soils in the Southern Appalachians



Whole Profile Nitrogen Content of Forest Soils in the Southern Appalachians



Whole Profile Extractable Calcium Content of Forest Soils in the Southern Appalachians



Summary

- Coarse fragments contribute to the total C and N and extractable Ca pools in forest soils in the Appalachians
  - Carbon 9 to 80%
  - Nitrogen 7 to 77%
  - Calcium 77 to 92%
- Implications for nutrient cycling, forest productivity, sustainability and carbon sequestration questions

Conclusions

- Decomposing Stumps and Coarse Fragments contain an appreciable amount of carbon, nitrogen and macronutrients.
- In order to understand nutrient cycling dynamics in forest ecosystems these components should be sampled.

Acknowledgements

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USDA Southern Research Station

CSREES

Virginia Tech

NRCS Natural Resources Conservation Service

Station 3

Use of Ground Penetrating Radar to Determine Properties of Forest Soils

Wes Tuttle
USDA Natural Resource Conservation Service
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Ground Penetrating Radar (GPR)

Ground-penetrating radar is a time scaled system. The system measures the time it takes electromagnetic energy to travel from an antenna to an interface (i.e., soil horizon, stratigraphic layer) and back. To convert travel time into a depth scale requires knowledge of the velocity of pulse propagation. Several methods are available to determine the velocity of propagation. These methods include use of table values, common midpoint calibration, and calibration over a target of known depth. The last method is considered the most direct and accurate method to estimate propagation velocity (Conyers and Goodman, 1997). The procedure involves measuring the two-way travel time to a known reflector that appears on a radar record and calculating the propagation velocity by using the following equation (after Morey, 1974):

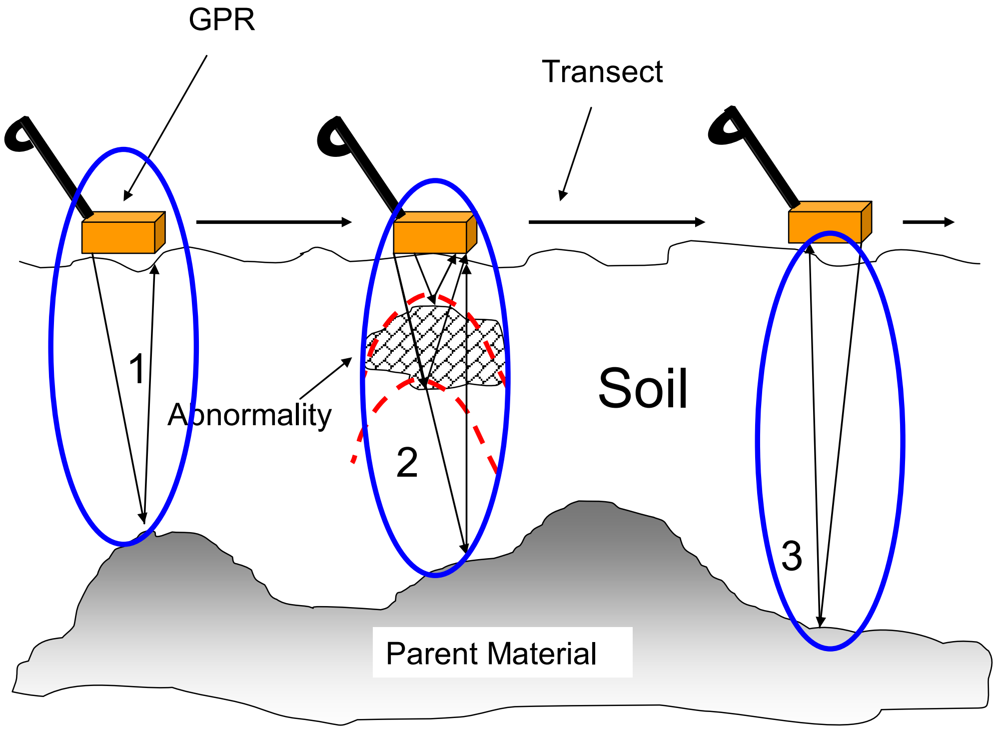
$$V = 2D/T \qquad [1]$$

Equation [1] describes the relationship between the propagation velocity (V), depth (D), and two-way pulse
travel time (T) to a subsurface reflector. During this study, the two-way radar pulse travel time was compared with measured depths to known subsurface interfaces within each study site. Computed propagation velocities were used to scale the radar records.

The performance of ground-penetrating radar (GPR) is dependent upon the electrical conductivity of soils. Soils having high electrical conductivity rapidly attenuate radar energy, restrict penetration depths, and severely limit the effectiveness of GPR. Most GPR service providers have limited knowledge of soils and are unable to foretell the general suitability of the soils within project areas to GPR. Knowledge of the general suitability of soils would help service providers assess the appropriateness of using GPR and the likelihood of achieving acceptable results.

*Photo 1. **Ground-penetrating radar** (GPR) is a geophysical method that uses **radar** pulses to image the subsurface. This non-destructive method uses electromagnetic radiation and detects the reflected signals from subsurface structures. Subsurface features observed in radar records need to be verified with soil borings. A GPR survey is being conducted using a 200 MHz antenna in this photo. Often, additional interpretations can be obtained by utilizing different antennas with different frequencies which consequently affect observation depths and resolution of subsurface features.*

GPR Principles



GPR

◆GPR does not perform well in highly conductive soils (saline, clayey-high shrink swell soils)
◆GPR performs best in coarse textured soils

GPR Applications

◆Depth to bedrock
◆Depth to soil horizons
◆Depth to water table
◆Archaeological investigations
◆Estimates of taxonomic composition
◆Locate buried artifacts
◆Profile geomorphic and stratigraphic features (peat, lake bottoms-assess rates of sedimentation)

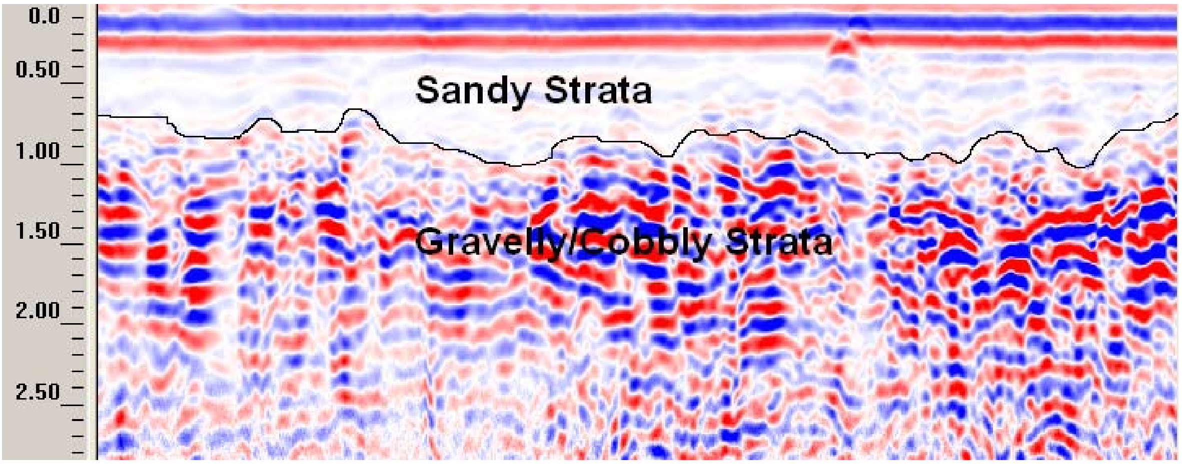


Figure 1. A representative portion of a radar record collected near Glen Alton, VA (Jefferson National Forest). A black line highlights the interface between sandy and gravelly/cobbly strata. Interpreted depths to the interface ranged from approximately 60 cm to 85 cm in this portion of the radar record. Soil borings along the GPR transect revealed gravelly/cobbly strata at a depth of approximately 75 cm. This was consistent with interpreted depths from the radar record. The depth scale is expressed in meters.

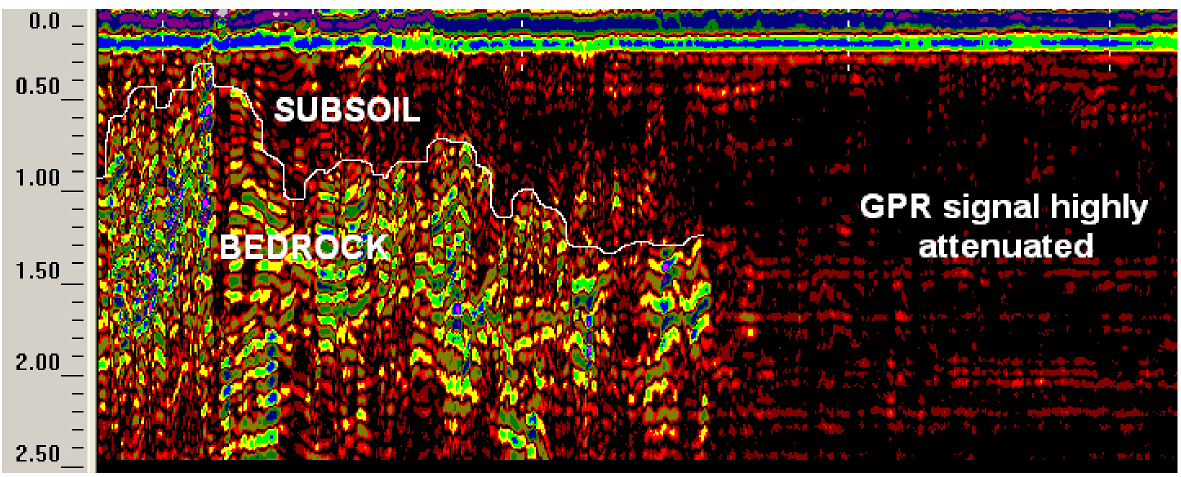


Figure 2. A representative portion of a radar record collected near Glen Alton, VA (Jefferson National Forest). A white line highlights the approximate interface between the subsoil and underlying bedrock. The GPR signal was highly attenuated in the right-hand portion of the radar record. The high amounts of signal attenuation were thought to be attributed to higher amounts of clay and moisture along this portion of the GPR transect. Soils in this highly attenuated portion of the radar transect were situated on a low terrace. Soils in the left-hand portion of the radar record were located on a higher lying landscape position and exhibited residual and colluvial influences from parent material.

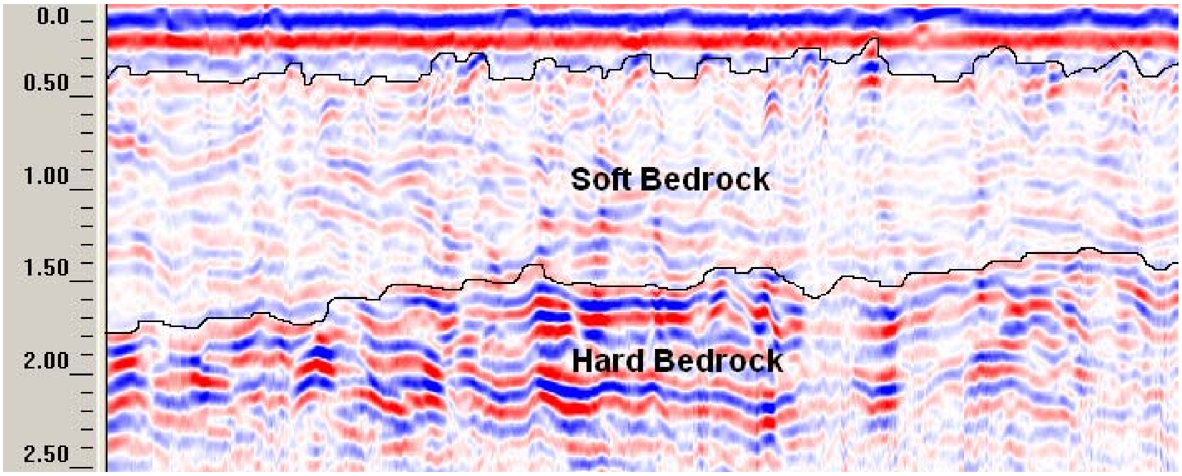
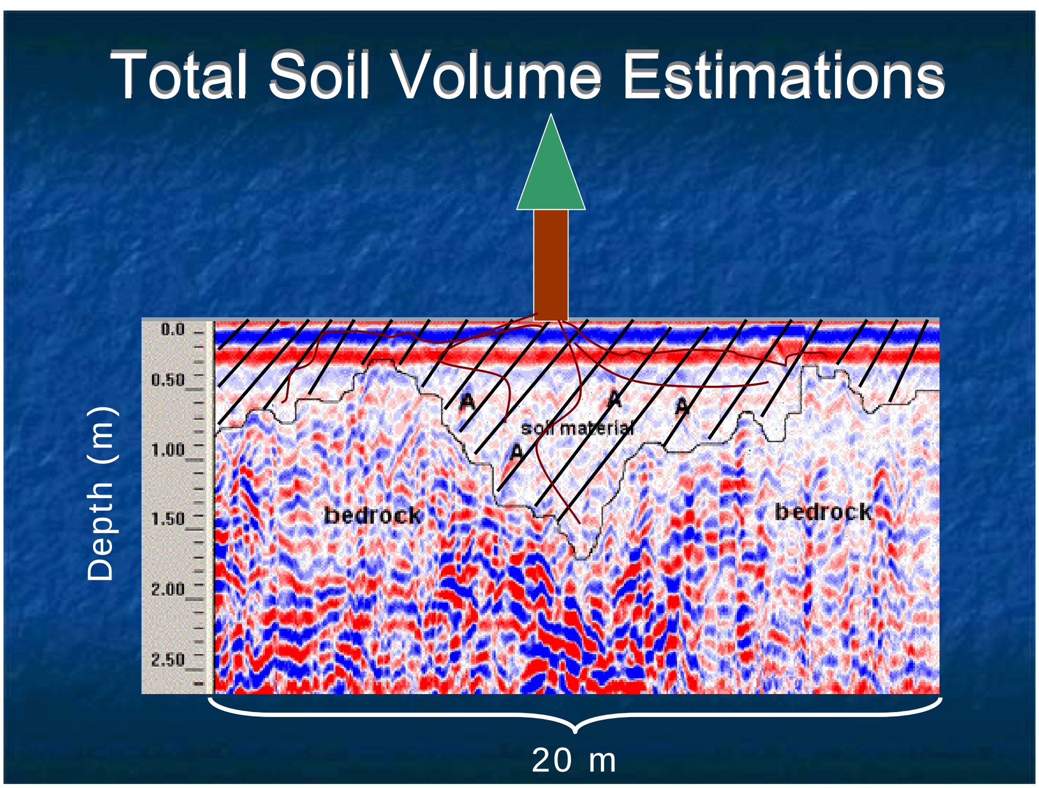


Figure 3. A representative portion of a radar record from an area of Muskingum soils located near Norton, VA (Clinch Mountain, site #2 study area). The black lines indicate the approximate contact between soil material and soft bedrock (upper line) and contact between soft bedrock and hard bedrock (lower line). The contact between soil material and soft bedrock was verified with soil borings. The contact between soft bedrock and hard bedrock was verified in nearby road cuts. The 400 MHz antenna was used in this figure. The depth scale is expressed in meters.



Literature Cited

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Morey, R. M. 1974. Continuous subsurface profiling by impulse radar. p. 212-232. IN: Proceedings, ASCE Engineering Foundation Conference on Subsurface Exploration for Underground Excavations and Heavy Construction, held at Henniker, New Hampshire. Aug. 11-16, 1974.

Station 4

Effects of Alternative Silvicultural Systems on Hardwood Regneration In the Southern Appalachians

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Department of Forestry
Virginia Polytechnic Institute and State University
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North American Forest Soils Conference

Effects of Alternative Silvicultural Treatments on Regeneration in the Southern Appalachians

Chad Atwood
Virginia Tech.
Dept. of Forestry

Thomas R. Fox, Associate Professor Virginia Tech. Dept. of Forestry
David L. Loftis, Research Forester, Southern Research Station

VirginiaTech

Overview

- Project Introduction
- Background/Treatments
- Objectives, Sites, Design, Methods
- Results
- Implications

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Southern Appalachian Silviculture and Biodiversity (SASAB) Project

VIRGINIA TECH FORESTRY

Virginia Tech Biological Sciences

MeadWestvaco

Site quality

- **Has been strongly correlated with species composition and competitiveness after clearcutting in the absence of advance oak regeneration after.**
  - Good sites (SI50 ≥20m) – Oak abundance greatly reduced. Mesic species such as yellow-poplar and black cherry dominate.
  - Fair sites (SI50 = 17-19m) – Oak can retain 25-40% of canopy dominance after 2-3 decades.
  - Poor site (SI50 <17m) – Oak dominates with some pine components in poorly stocked stands.

??? What about Alternative Systems ???

Beck and Hooper 1986, Cook et al. 1998, Blount et al. 1986

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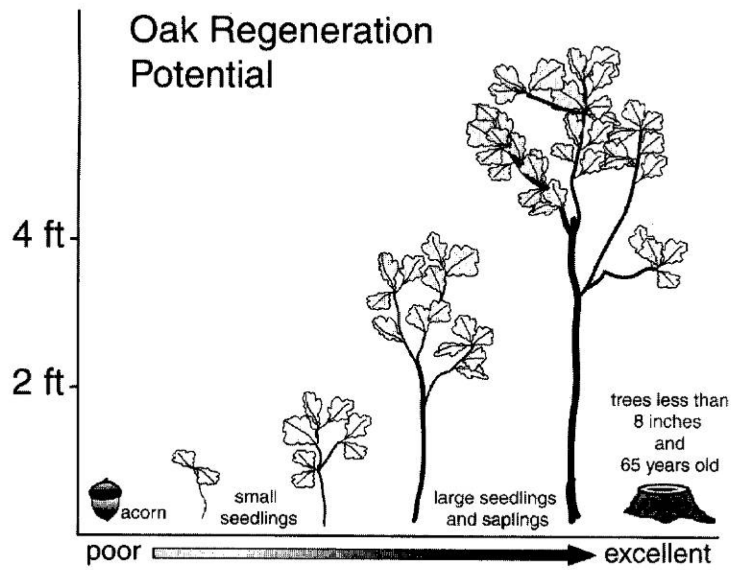

Study Objectives

1. **Quantify any differences in the regeneration among the treatments in terms of height, density, and origin.**
2. **Quantify the impact of clearcut, leave-tree, and shelterwood on stump sprouting percent and vigor.**

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Pre-harvest stand condition

- Even-aged 63-100 yrs.
- 30 m^2/ha
- 1000 stems/ha

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Treatments Evaluated

Treatments (each plot 2 ha in size):

1. Control
2. Shelterwood
3. Group Selection
4. Midstory Control with Herbicides
5. Leave-tree
6. Commercial Clearcut
7. Silvicultural Clearcut

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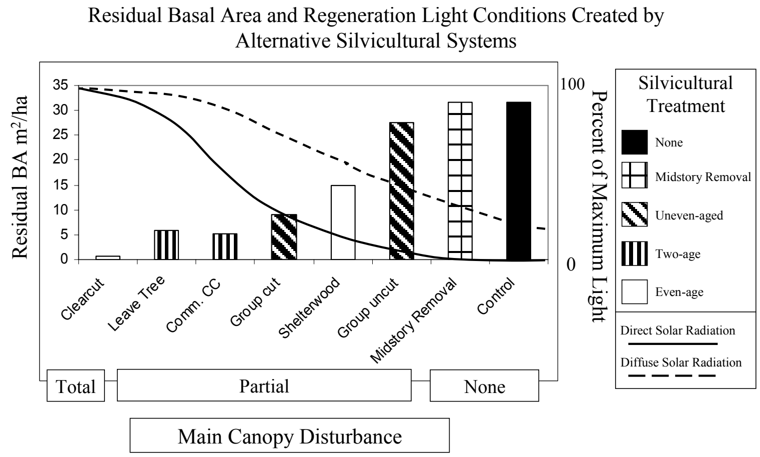
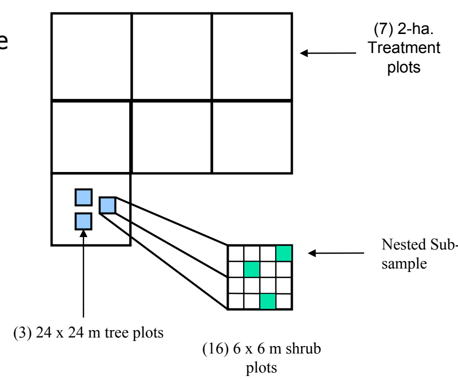
Post harvest conditions



Study and Sampling Design

- Randomized (in) complete block design
- 7 - 2 ha treatment blocks
- 3 - 24 x 24m Tree plots with tagged trees
- 16 - 6 x 6m regeneration plots within each Tree plot

Figure 1. Nested tree and shrub plots



Species groupings

- **Oak group** - chestnut, northern red, scarlet, white, and black oak
- **Maple group** - red and sugar maple
- **Black cherry-yellow-poplar group**
- **Miscellaneous group** - Fraser magnolia, basswood, tree-of-heaven, white ash, green ash, cucumbertree, eastern white pine, mockernut hickory, pignut hickory, and bitternut hickory
- **Midstory group** - striped maple, down serviceberry, sweet birch, American chestnut, flowering dogwood, American beech, hophornbeam, sourwood, pin cherry, black locust, and sassafras

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Results

Analysis of control (CT) and herbicide (HB) regeneration by Species group mean height (m) and density (stems/ha) among treatment

Species group	Treatment	Height (m) Mean±SE		Stems/ha Mean±SE
Oak	CT	0.21 ± 0.013		61.4 ± 18.9
	HB	0.16 ± 0.006		83.5 ± 15.2
Maple	CT	0.17 ± 0.009	A	145.6 ± 31.8
	HB	0.12 ± 0.004	B	176.7 ± 45.6
Black Cherry-Yellow-poplar	CT	0.34 ± 0.076		6.9 ± 1.7
	HB	0.26 ± 0.055		10.9 ± 4.9
Miscellaneous	CT	0.93 ± 0.063	A	20.4 ± 5.3
	HB	0.71 ± 0.052	B	20.3 ± 3.8
Midstory	CT	0.56 ± 0.009	A	72.1 ± 14.0
	HB	0.35 ± 0.015	B	80.8 ± 14.1

Letters represent significant differences between treatments $\alpha < 0.05$.

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Results

Analysis of all of the regeneration by mean height (m) and density (stems/ha) among treatments 9-11 post harvest.

Treatment	Height (m) Mean±SE		Stems/ha Mean±SE	
CC	2.09 ± 0.031	A	6058 ± 521	B
CH	1.60 ± 0.029	C	6532 ± 625	AB
LT	1.75 ± 0.027	B	8218 ± 987	AB
SW	1.35 ± 0.025	D	6290 ± 615	AB
GP	1.68 ± 0.028	BC	7783 ± 840	AB
HB	0.21 ± 0.005	E	9177 ± 1465	A
CT	0.32 ± 0.009	E	8113 ± 1224	AB

Letters represent differences among treatments (α < 0.05).

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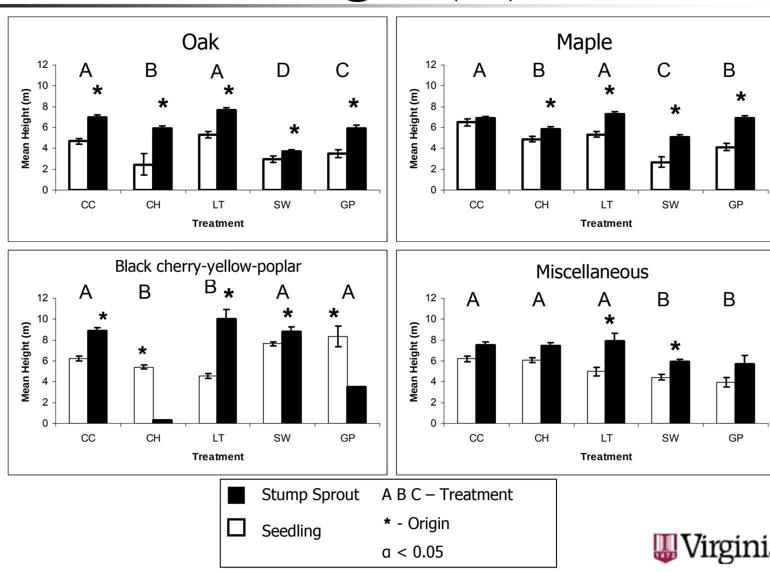
Results – Height (m)



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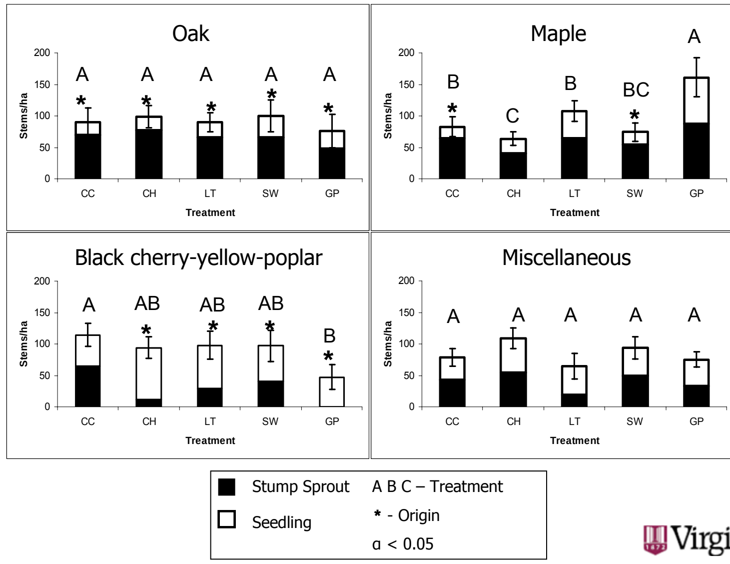
Results- Density (stems/ha)



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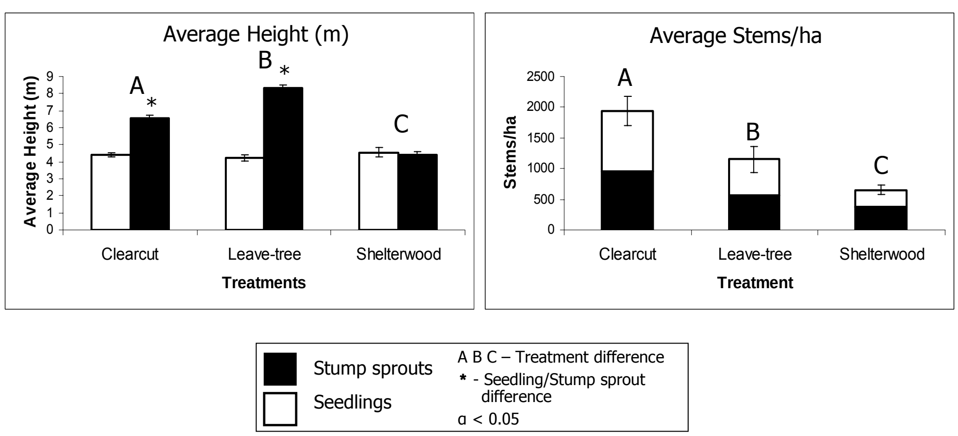
9-11 Year Dominant and Codominant Oak Regeneration



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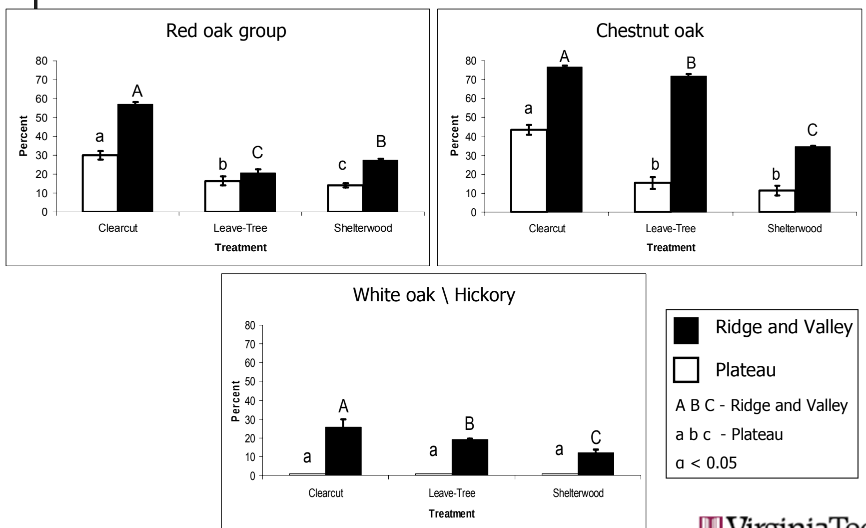
Results – Percent sprouted



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Stump Sprout Investigation:

Species groupings

- **Red oak group** (n = 528) **–** northern red, black, and scarlet oak
- **Chestnut oak** (n = 411)
- **White oak/Hickory** (n = 242) – white oak, mockernut, pignut, and bitternut hickory
- **Red maple** (n = 881)
- **Mixed Mesic** (n = 733) **–** yellow-poplar, black cherry, sugar maple, Fraser magnolia, cucumber tree, basswood, white ash
- **Midstory** (n = 1539) (Including short-lived) **-** Striped maple, American chestnut, serviceberry, dogwood, witch-hazel, deciduous holly, hophornbeam, black gum, sourwood, American beech, black birch

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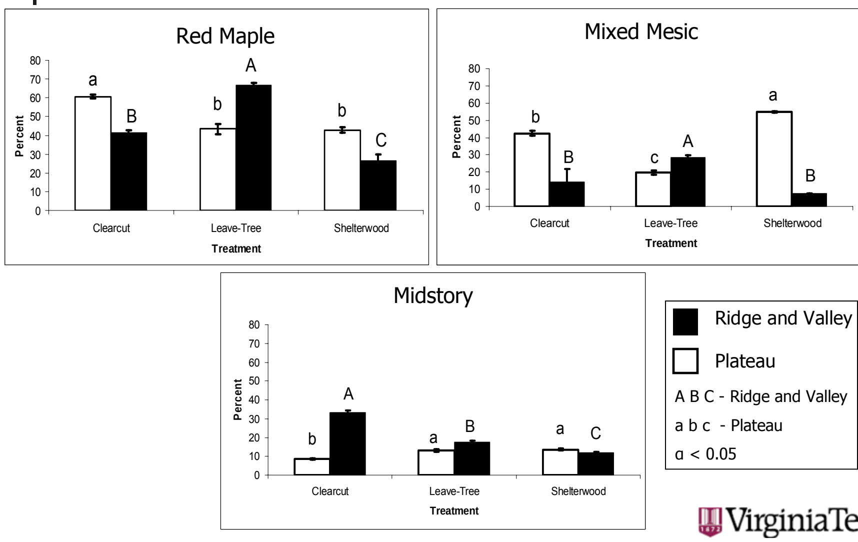
Results – Percent sprouted



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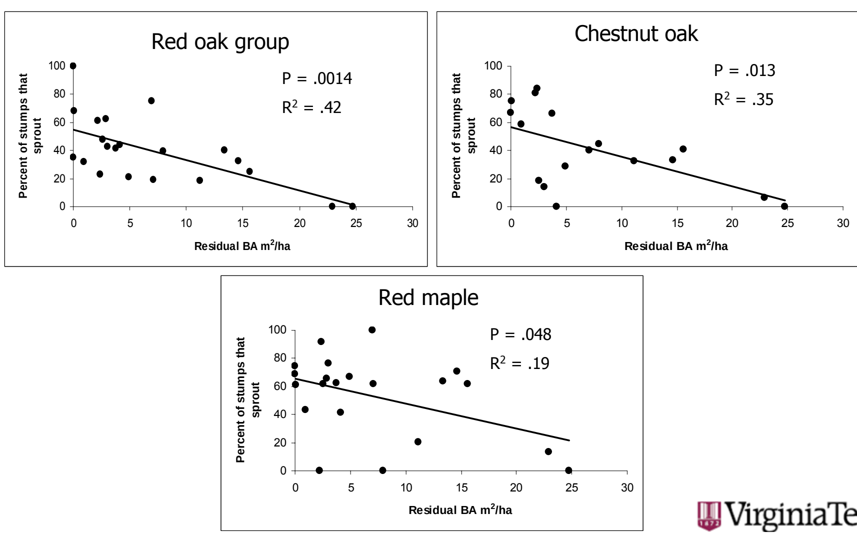
Results – BA regression



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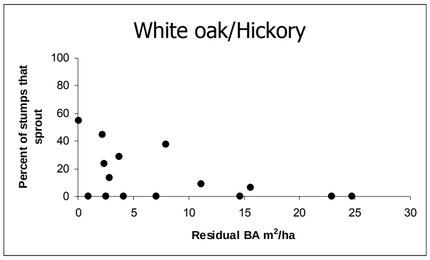
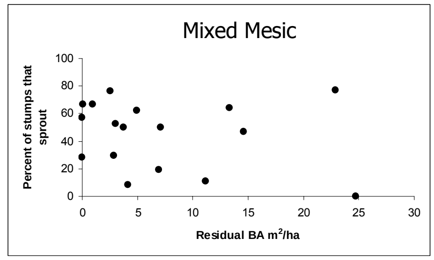
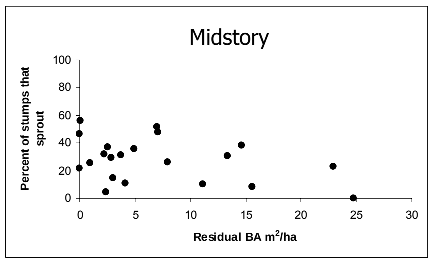
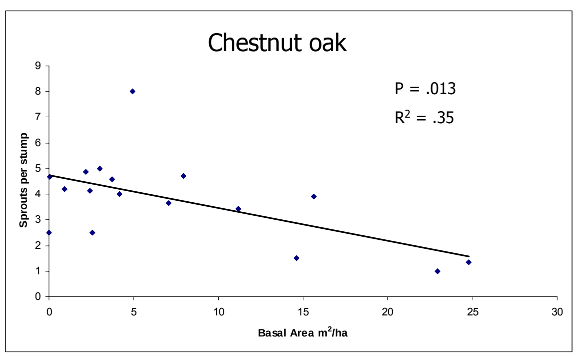
Results – BA regression



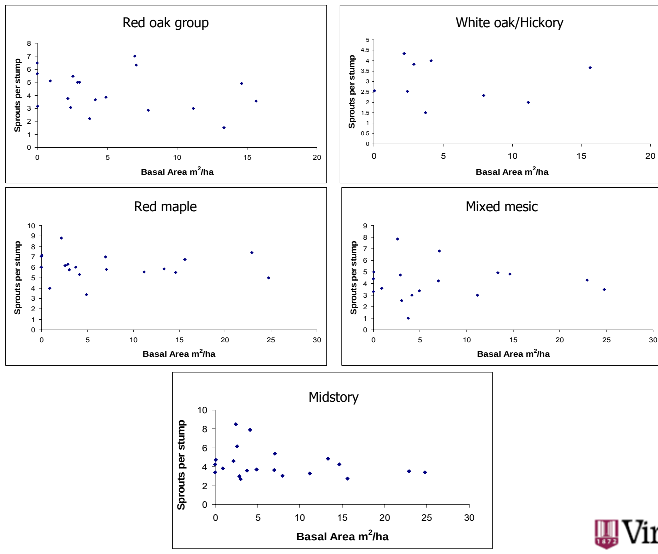




Results – BA regression



Results – BA regression



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Implications of this study

- Alternative silvicultural systems:
  - Reduced overall regeneration mean height but no density differences compared to clearcutting.
  - Altered species composition and competitive abilities.
  - Reduced oaks most reliable, numerous, and competitive form of regeneration.

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Why reduced sprouting

- **What is the control mechanism?**
  - Hormonal control through grafts?
  - Transport of resources?
  - Parasitism of residuals through grafts?

Loehle and Jones 1990 VirginiaTech

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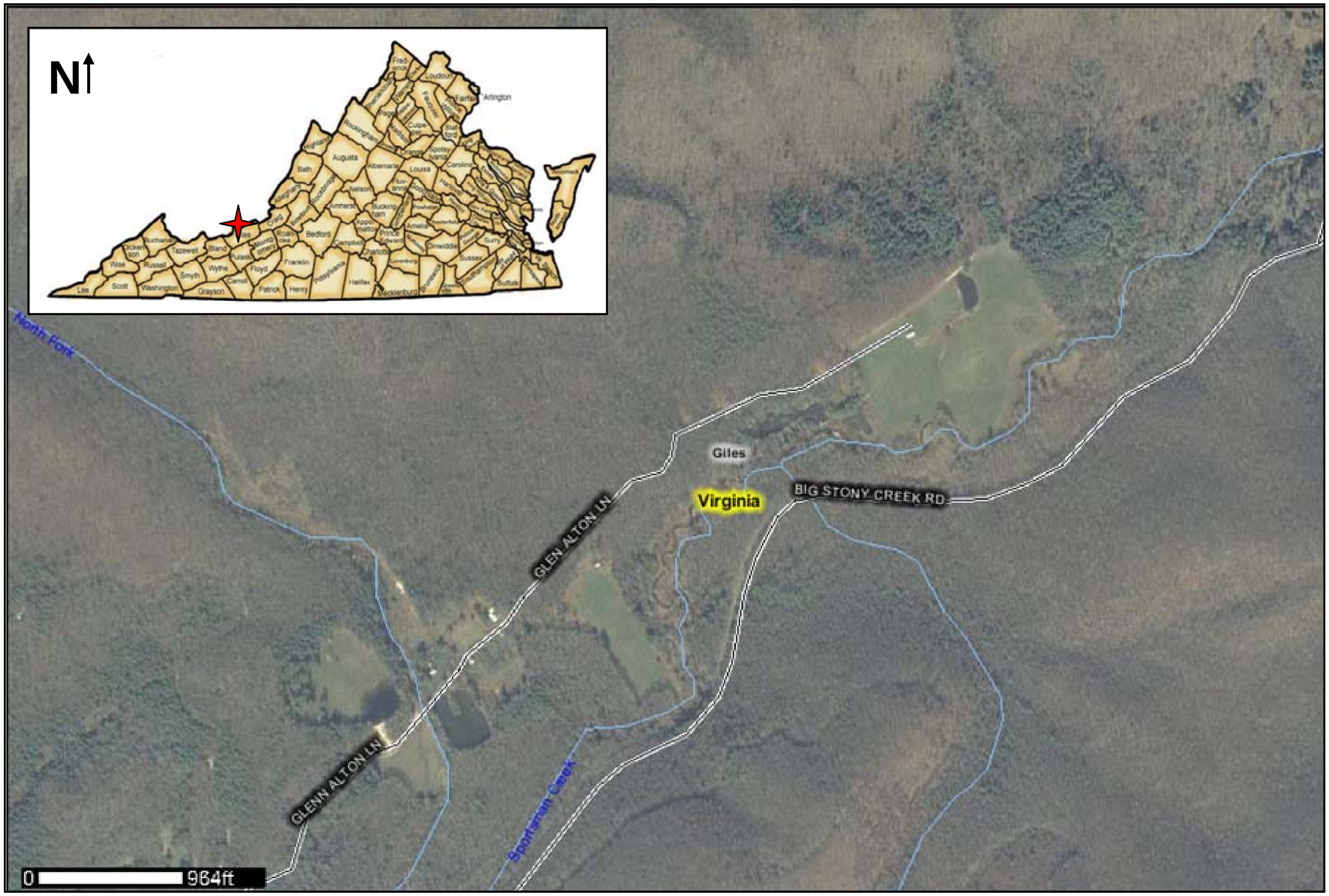
Stop 2

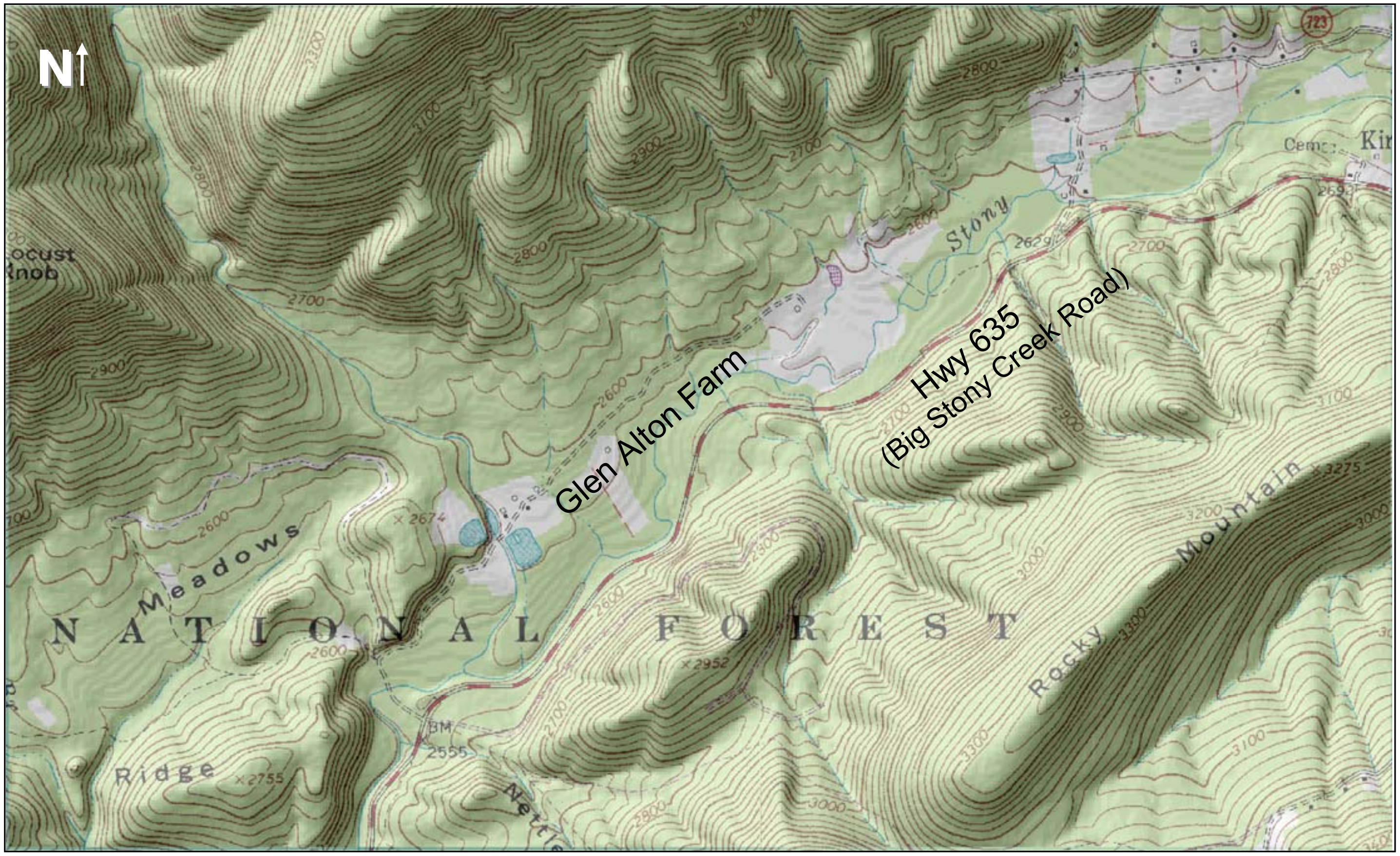
Glenn Alton Recreation Area

Jefferson National Forest
Giles County, Virginia



Aerial view of Glen Alton Farm and surrounding area, Giles County, VA

NAFSC Field Presentations at Glen Alton



Topography of Glen Alton Farm

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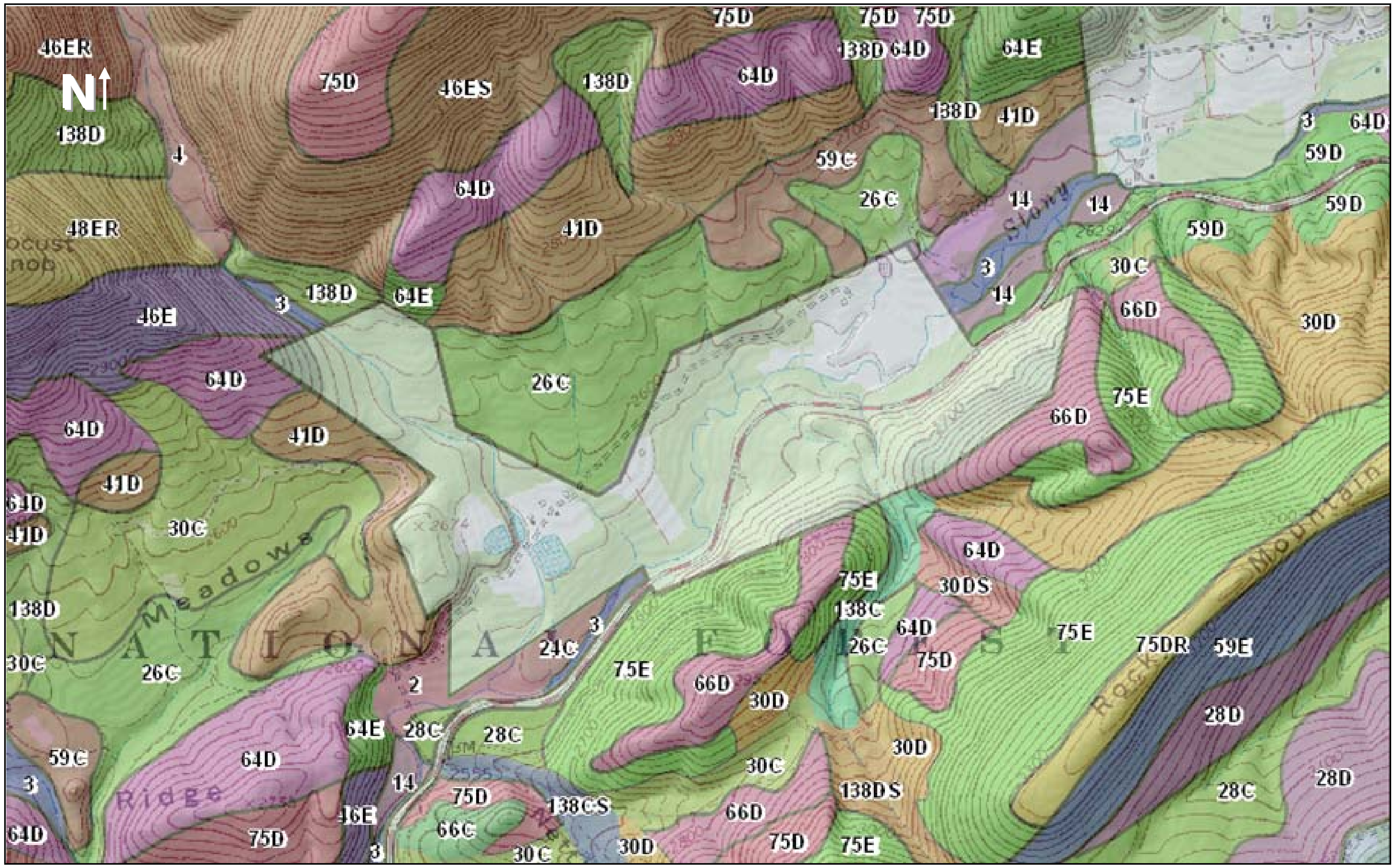


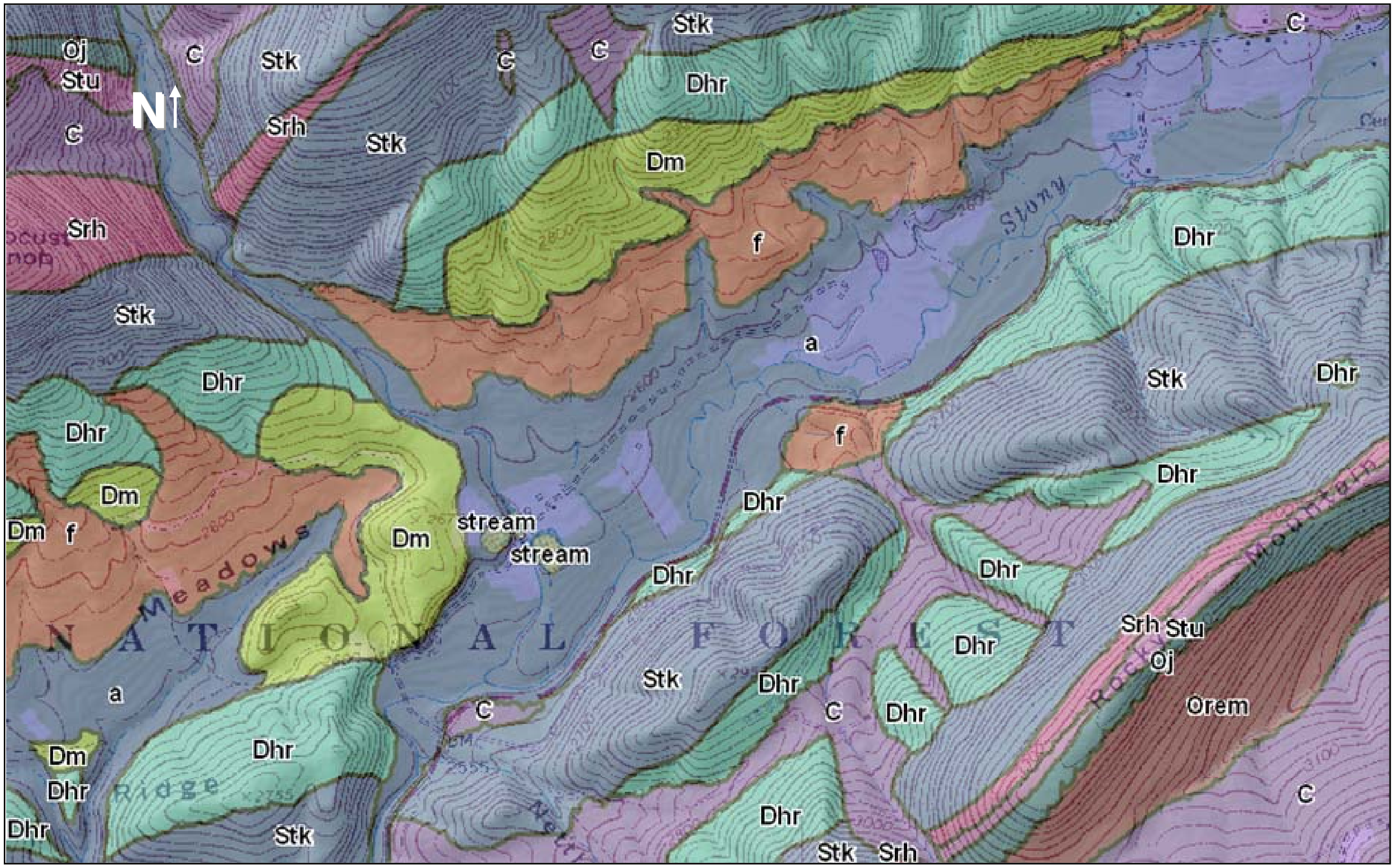
USFS Forest Soils of Glen Alton Farm Area

1:17,658

(Legend on back)

Table 1. Legend for selected USFS Soils of Glen Alton Farm Area in Giles County, VA.

Map #	Series	Order	Typical Location	Derived from
3	**Derroc**	Inceptisol	Floodplains	Alluvium of limestone, shale, quartzite, & sandstone
14	**Boutetourt**	Alfisol	Low stream terraces	Alluvium of limestone, sandstone, quartzite, & shale
26C	**Jefferson**	Ultisol	Mountain sides, footslopes	Colluvium of sandstone, shale & siltstone residuum
41D	**Berks**	Inceptisol	Summits, shoulders and backslopes of dissected uplands	Residuum of shale, siltstone, and sandstone
46ES	**Dekalb**	Inceptisol	Nearly level to very steep upland slopes and ridges	Regolith from gray and brown acid sandstone
59C	**Gilpin**	Ultisol	Gentle slopes to very steep convex dissected uplands	Residuum of horiz. interbedded shale, siltstone, & sandstone
64D	**Brushy**	Ultisol	Mountain summits, shoulders, & sideslopes	Residuum of limestone; subject to colluvial transportation, creep
75D	**Lily**	Ultisol	Upland ridges and hillsides	Residuum of acid sandstone
138D	**Oriskany**	Ultisol	Coves and slightly convex to linear foot slopes; colluvial fans	Colluvium of sandstone, quartzite, and shale;



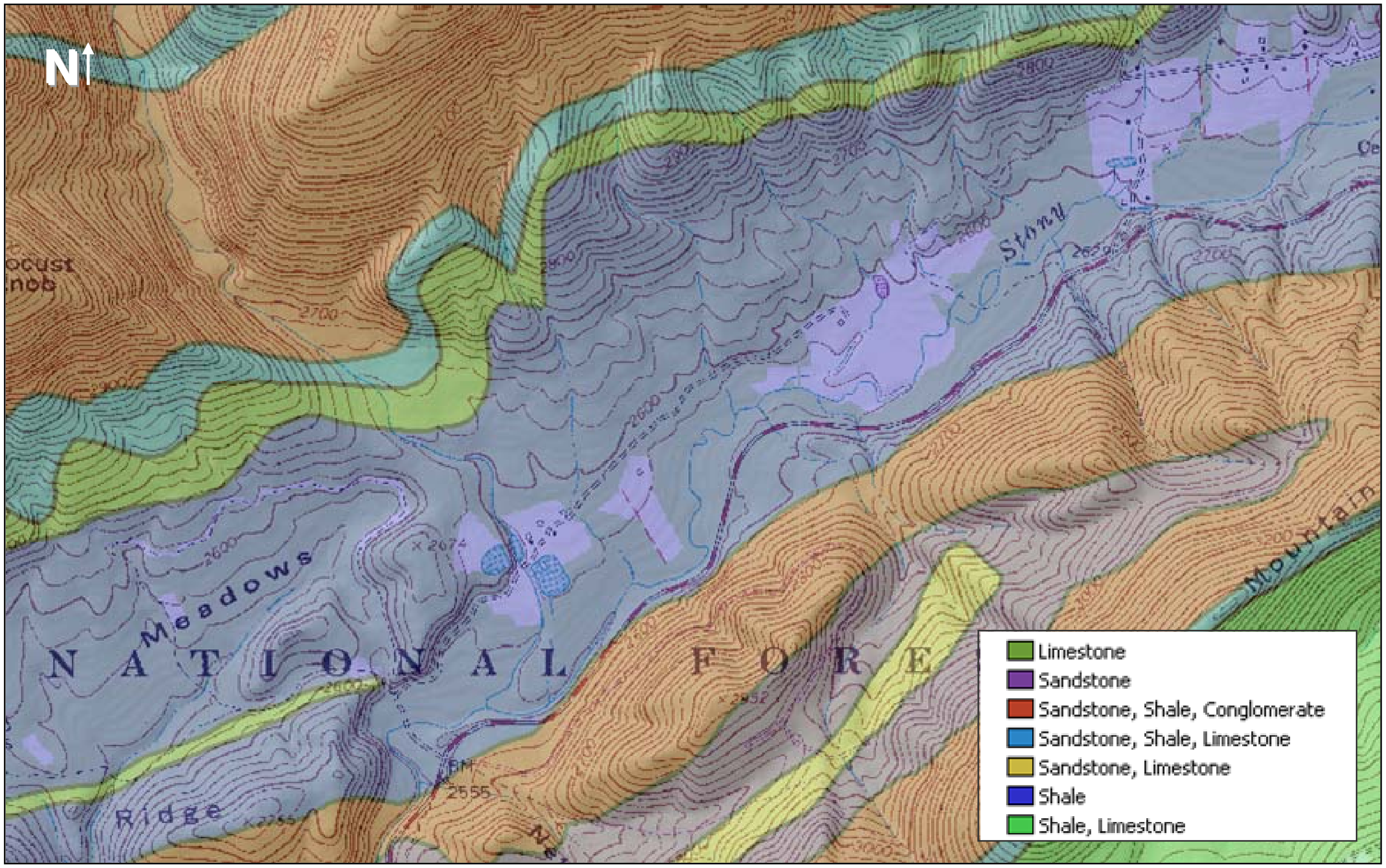
USGS Geology of Glen Alton Farm Area

1:17,658

(Legend on back)

Table 2. Legend for USGS Geology of Glen Alton Farm Area in Giles County, VA.

Symbol	Formation	Description
a	**Alluvium**	Sand, gravel, and clay deposits on floodplains, levees, and channels
C	**Colluvium, undifferentiated**	Boulders, gravel, sand, and silt; includes rockfall, talus, debris train, and blockfield deposits
Dhr	**Huntersville & Rocky Gap Sandstone, undivided**	Huntersville: light gray bedded chert and glauconitic sandstone; Rocky Gap: friable, orange breown, calcareous sandstone; Devonian
Dm	**Millboro, undivided**	Black shale; Devonian
f	**Alluvium**	Sand, gravel, and clay deposits on fan deposits
Oj	**Juniata**	Grayish red sandstone, siltstone, and shale, and gray sandstone; Ordivician
Orem	**Reedsville, Eggleston, and Moccasin, undivided**	Reedsville: thin-bedded limestone gray shale, and calcareous sandstone, fossiliferous ; Ordovician
Srh	**Rose Hill**	Hematitic, cross-bedded sandstone, massive fine-grained sandstone, and olive gray shale; Silurian
Stk	**Tonoloway Limestone & Keefer Sandstone, undivided**	Tonoloway: laminated limestone with thin interbedded calcareous shale and siltstone; Keefer: light gray sandstone with minor shale and siltstone; Silurian
Stu	**Tuscarora**	light gray sandstone and conglomerate with thin shale near the base and top; Silurian



Lithology of Glen Alton Farm Area

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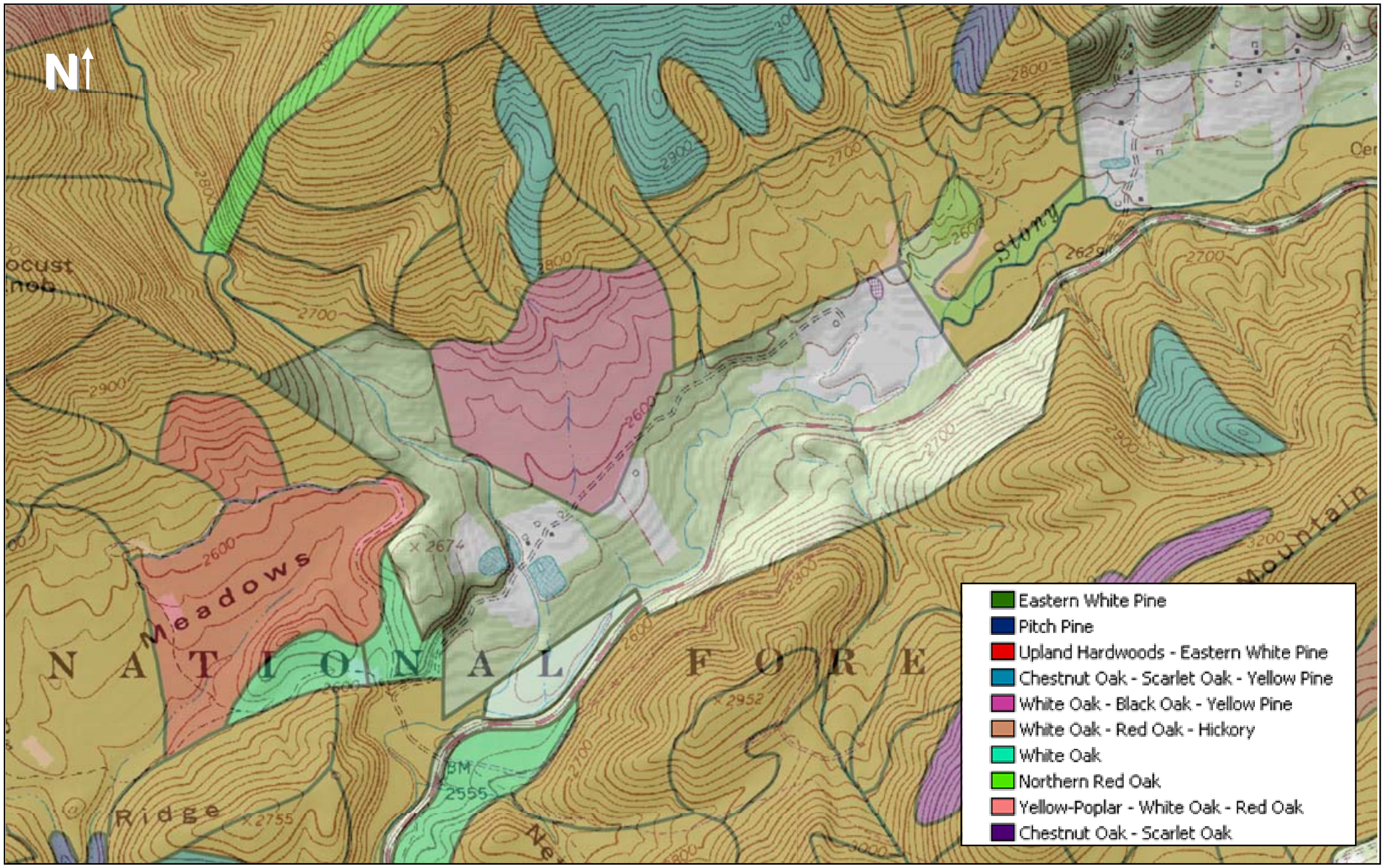

USFS Stands and Forest Types of Glen Alton Farm Area

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Gypsy Moth in Virginia:
Current Status and Silvicultural Treatments

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Gypsy Moth

Gypsy Moth Defoliation

"SLOW THE SPREAD"

A National Program to Contain the Gypsy Moth

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E. Anderson Roberts, and Willard Dickerson

ABSTRACT

Invasions by alien species can cause substantial damage to our forest resources. The gypsy moth (*Lymantria dispar)* represents one example of this problem, and we present here a new strategy for its management that concentrates on containment rather than suppression of outbreaks. The "Slow the Spread" project is a combined federal and state government effort to slow gypsy moth spread by detecting isolated colonies in grids of pheromone-baited traps placed along the expanding population front from Wisconsin to North Carolina. Detected colonies are treated using *Bacillus thuringiensis* or mating disruption. Analyses to date indicate that this project has reduced spread by more than 50 percent.

Keywords: entomology and pathology; integrated pest management; invasive species

The gypsy moth *(Lymantria dispar)* is probably the most destructive forest defoliator in the United States. More than 81 million acres of forests have been defoliated by the gypsy moth since 1924, and more than 12 million acres have been aerially sprayed to control its populations since 1970 (USDA 1995). During gypsy moth outbreaks, many species of hardwoods may be defoliated; repeated defoliation causes decreased growth, dieback, and tree mortality. Outbreaks often occur in forested residential areas where, in addition to problems associated with defoliation, the presence of large number of caterpillars is the source of considerable nuisance to homeowners.

The gypsy moth problem is a prime example of what can happen if alien species become established outside their native range. Gypsy moth is native to Europe and Asia, and it was accidentally introduced into the United States near Boston in the late 1860s. Since then it has gradually spread West and South *(fig. 1)* (Liebhold et al. 1989, 1992). Early eradication attempts failed, as did efforts from 1923 to 1941 to prevent further range expansion via a barrier zone along the Hudson River valley (McManus and McIntyre 1981).

Above: **Plastic laminated pheromone dispensers (circled in yellow) rest on foliage after aerial application. Mating disruption is one of the key elements in the Slow the Spread program.**

Photos across top of page courtesy of Purdue University and Virginia Tech Departments of Entomology

Slow the Spread: How It Works

Because female gypsy moths are unable to fly, natural spread is very limited; Liebhold et al. (1992) estimated that range expansion due to larval dispersal alone is only expected to be about 1¼ miles per year. The higher rate of spread of 13 miles per year that was observed from 1960 to 1990 is most likely the result of introductions that occur when humans accidentally move gypsy moth life stages into the transition or uninfested zones on outdoor household articles, nursery stock, vehicles, and other objects. These life stages found colonies that reproduce and expand over successive years. Eventually these "spot" infestations coalesce with the continuously infested area, which produces a high rate of spread.

These gypsy moth egg masses have become attached to the wheel of a trailer. Accidental conveyance of egg masses can result in isolated colonies establishing themselves ahead of the population front.

Grids of pheromone-baited traps spaced at 2-km intervals are used for detecting isolated colonies in the transition zone, a band 100 kilometers wide spanning the entire length of the generally infested area in the United States *(fig. 3)*. When moth captures in traps indicate a possible colony, a delimiting grid with 0.5-km intertrap distance is set to delineate the boundary of the colony prior to treatment. This ensures aerial treatments are accurately targeted.

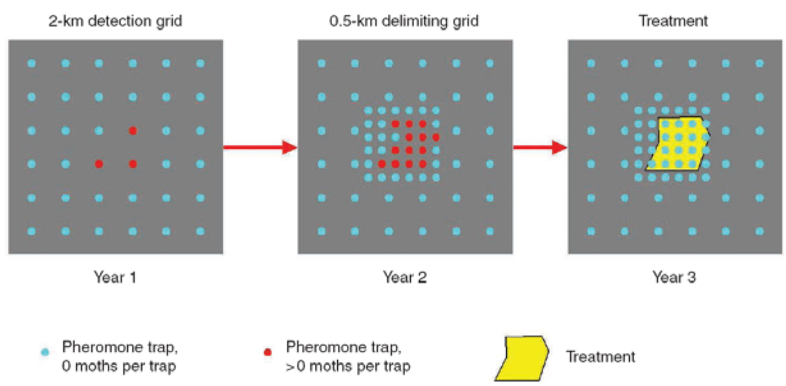
Areas to be delimited or treated are initially determined by a computer algorithm designed to analyze moth capture patterns according to project standards and priorities. Then maps of the recommendations are posted on the Internet, which are used by federal and state representatives to begin planning actions that will be taken in the following year. Plans are discussed, prioritized, and finalized at the project level. The finalized plan of action is then compared to the initial computer recommendations to ensure compliance with project standards.

Widespread use of mating disruption, a noninsecticidal treatment that is specific to the gypsy moth, is one of the key elements in the Slow the Spread project. Mating disruption is based on the application of controlled-release dispensers that emit an insect sex pheromone for several months. The cloud of pheromone emitted by the dispensers interferes with the normal mate-searching behavior of males. As a result, females are not mated and lay nonviable eggs. Plastic laminated flakes (Disrupt II®) impregnated with the gypsy moth synthetic pheromone are used to disrupt mating (Reardon et al. 1998). These flakes are mixed with a sticker and applied from aircraft.

The traditional dose of 30 grams per acre has been demonstrated to suppress mating in low-density populations (Reardon et al. 1998; Sharov et al., in review). Recent experiments indicated that mating can be suppressed at even lower doses of 15, 6, and 3 grams per acre (Reardon et al.1998; Sharov et al., in review). Thus, the recommended dose in the Slow the Spread project was recently reduced to 15 grams per acre. The cost of treatment at this dose is approximately $17 per acre, which compares favorably with alternative treatments such as double applications of *B. thuringiensis* ($26–$28 per acre) or a single application of diflubenzuron ($12–$15 per acre).

Mating disruption is equally efficacious in control of isolated gypsy moth colonies as *B. thuringiensis* treatments (Sharov et al., in review), and the scope of its use in the project has increased dramatically *(fig. 4)*. Target-specific tactics such as mating disruption will continue to be critical in Slow the Spread to protect unique habitats and rare, threatened, or endangered species that occur within the project area.

Figure 3. **Steps in detecting and treating an isolated gypsy moth colony.**



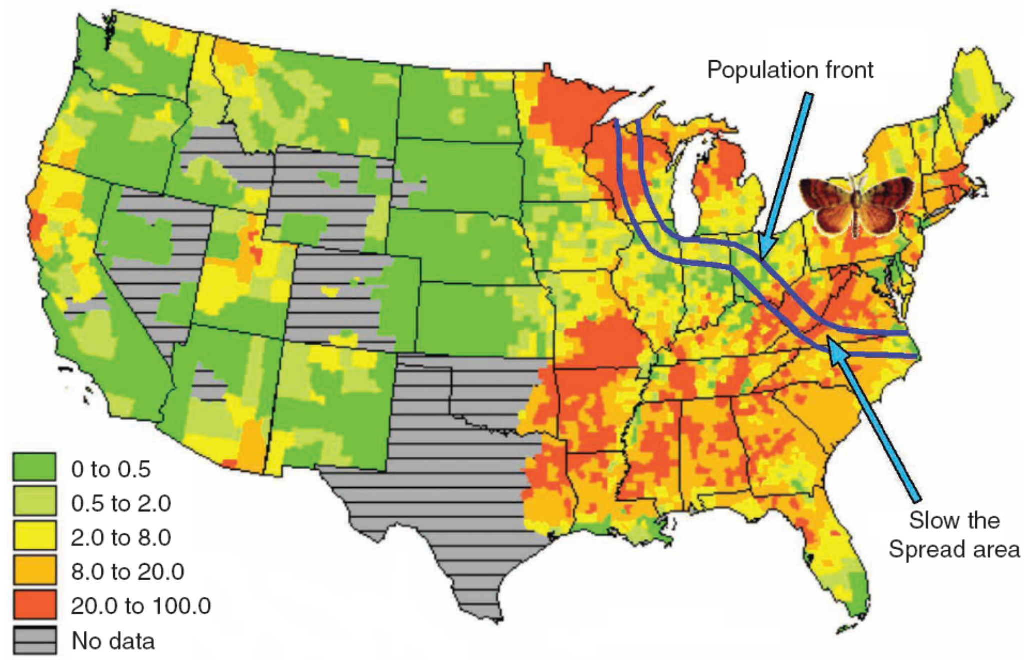


Figure 2. **US distribution of gypsy moth host species in basal area per acre by county (adapted from Liebhold et al. 1997), the current population front, and the location of the Slow the Spread project.**

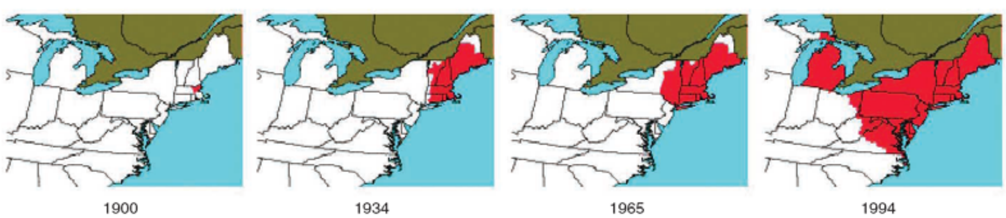


Figure 1. **The dynamics of gypsy moth spread in the United States during the 20th century.**

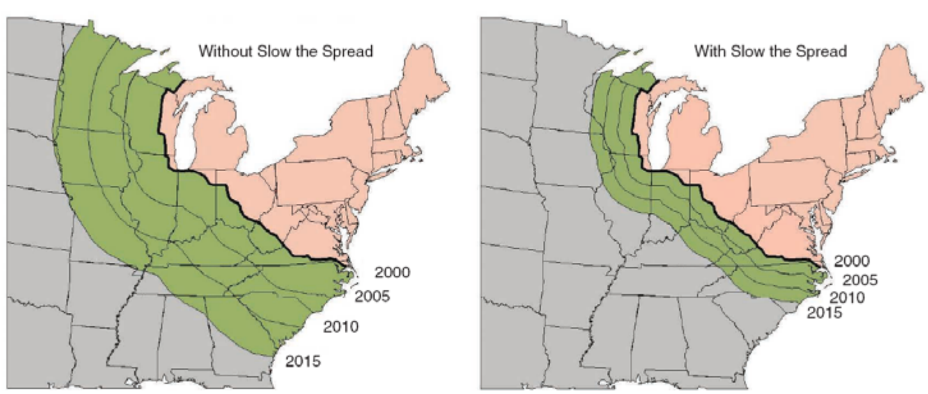


Figure 6. **Projected gypsy moth spread with and without the Slow the Spread project.**

Spraying for gypsy moths to begin this week

Weather permitting, planes will spray Brush and Gap mountains and the Cascades Recreation Area.

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As long as the weather cooperates, approximately 117 acres on Brush and Gap mountains is expected to be aerially sprayed with BTK pesticide to exterminate gypsy moths starting Thursday, as part of Montgomery County's participation in the Virginia Department of Agriculture and Consumer Services' 2008 suppression program.

An additional 137 acres on Poor Mountain is scheduled to be sprayed with Dimilin pesticide next week, according to Montgomery County gypsy moth coordinator Charles Putnam.

"Poor Mountain is going to be at least a week later because the leaves have not developed up there, and we need enough leaf cover to catch the spray as it comes down," Putnam said.

For the spraying be effective, wind speeds must be less than 10 mph and the temperature between 35 and 75 degrees, said Virginia Cooperative Extension agent Barry Robinson.

The optimum rain-free time after spraying occurs is four hours for BTK and one hour for Dimilin, he added.

BTK is a biological insecticide used in the organic food industry to control caterpillars, and Dimilin is a chemical insecticide that is often more effective than BTK.

Extension agents on site Thursday morning will monitor the weather and decide whether to proceed. If the weather is acceptable, a plane releasing droplets of pesticide will fly several hundred feet above the spray sites, Robinson said.

Because both areas are fairly remote and uninhabited, Putnam isn't advising that residents take safety precautions.

"It's up to the individuals and their comfort level," he said. "There's not really considered to be much expectation of any problems at all. These products have been used for decades to do this."

The Montgomery County Board of Supervisors voted to fund the project in January, with the understanding that the county wouldn't likely receive state funding.

The county was given a low priority for funding, in the program's fifth-tier "Type E" category, because the spray areas are so sparsely inhabited.

As expected, the county will fully fund treatments this month, using $8,700 of general fund money, spokeswoman Ruth Richey said.

Meanwhile, the U.S. Forest Service is expected to aerially spray 242 acres in Montgomery County's Boley Field and Brush Mountain areas today with nuclear polyhedrosis virus, a pesticide that targets the gypsy moth species.

On Thursday, the service is expected to spray 1,089 acres in and adjacent to the Cascades Recreation Area in Giles County with BTK pesticide.

<u>Silvicultural Options for Gypsy Moth</u>

1) PreSalvage and SanitationThinning
   Reduce vulnerability by removing oaks with poor crown
2) PreSalvage Harvest
   Utilize reproduction system that favors non-susceptible species
3) Salvage Thinning
   Recover economic value of trees that are killed and reduce susceptibility of residual stand
4) Salvage Harvest
   Recover economic value of trees that are killed and regenerate stand

<u>Gypsy Moth Preferred Species</u>

Oaks Species
Basswood
Sweetgum
Serviceberry
Hornbeam, Hophornbeam
Willow
Apple
Aspen
Birches

Gypsy Moth Resistant Species

Beech
Birch
Black Gum
Black Cherry
Buckeye
Chestnut
Cucumbertree
Elm
Red and Sugar Maple
Sourwood
Hickory
Walnut
Hemlock
Pine

Gypsy Moth "Immune" Species

Yellow-Poplar
Ash
Fir
Sycamore
Black Locust
Dogwood
Holly
Striped Maple
Mountain Laurel
Grap

Station 1

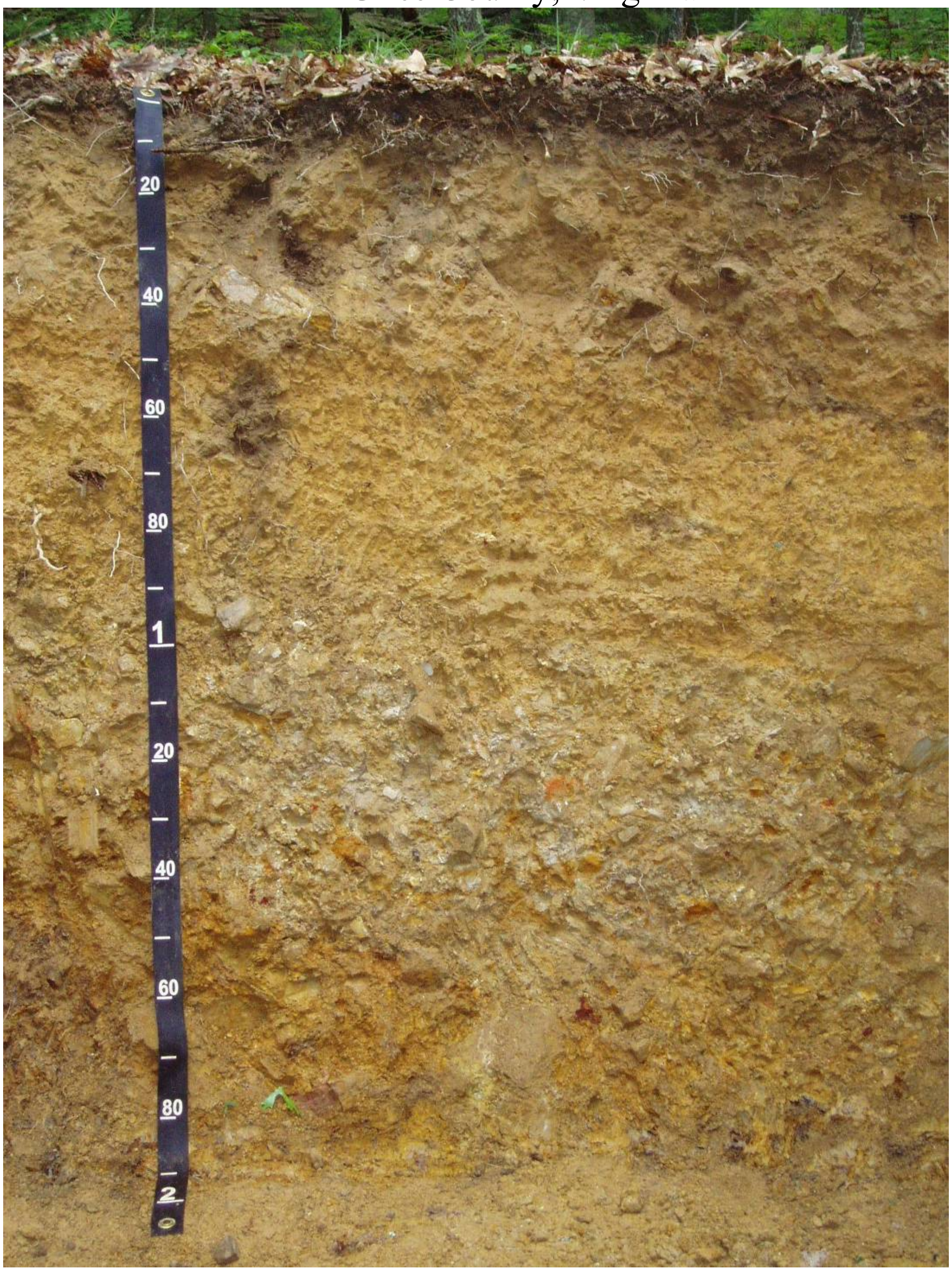
Jeffersonson Soil Profile

Appalachian Hardwood Stand

Tom Fox
Associate Professor
Department of Forestry
Virginia Polytechnic Institute and State University
Blacksburg, VA

Jefferson Soil
Landscape, Forest Community, and Soil Profile
Jefferson National Forest
Giles County, Virginia

Jefferson Soil Series
Jefferson National Forest
Giles County, Virginia



LOCATION JEFFERSON KY+TN VA WV
Established Series
Rev. JMR-HCD
05/2004

JEFFERSON SERIES

The Jefferson series consists of deep, well-drained soils on mountain sides and foot slopes. They formed in colluvium from soils formed in residuum of acid sandstone, shale, and siltstone. Permeability is moderately rapid. The average annual precipitation is about 49 inches, and the average annual temperature is about 57 degrees F. Slopes range from 2 to 75 percent.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Jefferson gravelly silt loam--on a convex 20 percent slope on the lower part of a steep mountain side in woods. (Colors are for moist soils.)

A--0 to 3 inches; dark grayish brown (10YR 4/2) gravelly silt loam; moderate fine granular structure; friable; many very fine roots; 20 percent pebbles; strongly acid; clear wavy boundary.

E--3 to 9 inches; yellowish brown (10YR 5/4) gravelly silt loam; weak fine granular structure; friable; common fine roots; 20 percent pebbles; strongly acid; clear wavy boundary. (4 to 9 inches thick)

BE--9 to 23 inches; yellowish brown (10YR 5/6) silt loam; weak very fine subangular blocky structure; friable; common medium roots; 10 percent pebbles; very strongly acid; gradual wavy boundary. (0 to 14 inches thick)

Bt--23 to 40 inches; yellowish brown (10YR 5/6) gravelly loam; moderate fine subangular blocky structure; friable; few fine roots; many thin clay films on faces of peds; 25 percent pebbles; 25 percent pebbles; strongly acid; gradual wavy boundary. (10 to 30 inches thick)

BC--40 to 75 inches; yellowish brown (10YR 5/6) very gravelly loam; many medium distinct light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; friable; few clay films on faces of peds; few fine roots; 40 percent pebbles; strongly acid; gradual smooth boundary. (24 to 40 inches thick)

TYPE LOCATION: Harlan County, Kentucky; 150 feet north of U.S. Highway 119, near borrow pit, 3 1/2 miles northeast of Harlan, about 1 mile east of Rosspoint.

RANGE IN CHARACTERISTICS: Thickness of the solum is more than 40 inches. Content of rock fragments of sandstone range from 5 to 35 percent to a depth of about 40 inches, and below 40 inches from 20 to 80 percent. Some areas are stony to extremely stony. The soil ranges from stronly to very strongly acid, excep the A horizons which range from very strongly acid to neutral.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1 to 3. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. They are silt loam, loam, fine sandy loam, or sandy loam, or gravelly or cobbly analogs.

The E horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. Texture is similar to the A horizon.

The BE horizon has hue of 10YR, value of 4 to 6, and chroma of 4 to 8. They are silt loam, loam, or sandy loam, or the gravelly or cobbly analogues.

Some pedons have BA horizons similar to the BE horizon.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. Some pedons have mottles in shades of brown, yellow, red, and the lower part shades of gray. It is loam, sandy loam, sandy clay loam, or clay loam, or the gravelly or cobbly analogues.

The BC horizon is in shades of brown, red, or gray, and are usually mottled. It is very gravelly, very channery, extremely gravelly, or extremely channery analogs of sandy loam, fine sandy loam, sandy clay loam, loam, or clay loam.

The C horizon, where present, has color and texture ranges like the BC horizon. Some pedons have a 2C horizon, below a depth of about 50 inches, that are from shaly material with a higher content of clay.

COMPETING SERIES: These are Lily, Lonewood, Marr, Riney, Sassafras, and Sunnyside series. Lily soils have bedrock at less than 40 inches. Lonewood, Marr, and Sassafras soils lack coarse fragments in the solum. Riney and Sunnyside soils have hue redder than 7.5YR in some part of the Bt horizon.

GEOGRAPHIC SETTING: Jefferson soils are on steep mountain sides and foot slopes, often below sandstone escarpments, with slopes ranging from 2 to 75 percent. These soils formed in colluvium from soils formed in residuum of acid sandstone, shale, and siltstone. Near the type location the average annual precipitation is about 49 inches and the average annual temperature is about 57 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are Clymer, Dekalb, Gilpin, Muse, Ramsey, Shelocta, and Whitley series. Clymer soils have mixed mineralogy. Dekalb and Ramsey soils lack argillic horizons. Gilpin soils have bedrock at depths of less than 40 inches. Muse soils are clayey, and Whitley soils are fine-silty. Shelocta soils have mixed mineralogy.

DRAINAGE AND PERMEABILITY: Well drained with rapid or medium runoff, depending on slope. Permeability is moderately rapid.

USE AND VEGETATION: Most areas are in forest but less steep areas are used mainly for pasture and crops. The forest vegetation is chiefly yellow-poplar, upland oaks, Virginia and shortleaf pine, hickory, and laurel.

DISTRIBUTION AND EXTENT: Eastern Kentucky, Tennessee, West Virginia, Georgia, and Virginia. The series is extensive.

MLRA OFFICE RESPONSIBLE: Lexington, Kentucky

SERIES ESTABLISHED: Reconnaissance Survey of Southwestern Pennslyvania; 1909.

REMARKS: Jefferson series formerly included Paleudults. Lab data of representative pedon reveal silt loam texture in the A and E horizons.

Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon: 0 to 9 inches (A,E)

Argillic horizon: 9 to 40 inches (BE, Bt)

ADDITIONAL DATA: Characterization sample S84KY-095-001

National Cooperative Soil Survey
U.S.A.

Station 2

Gilpin Soil Profile

White Pine Plantation

Jim Burger
Garland Gray Professor
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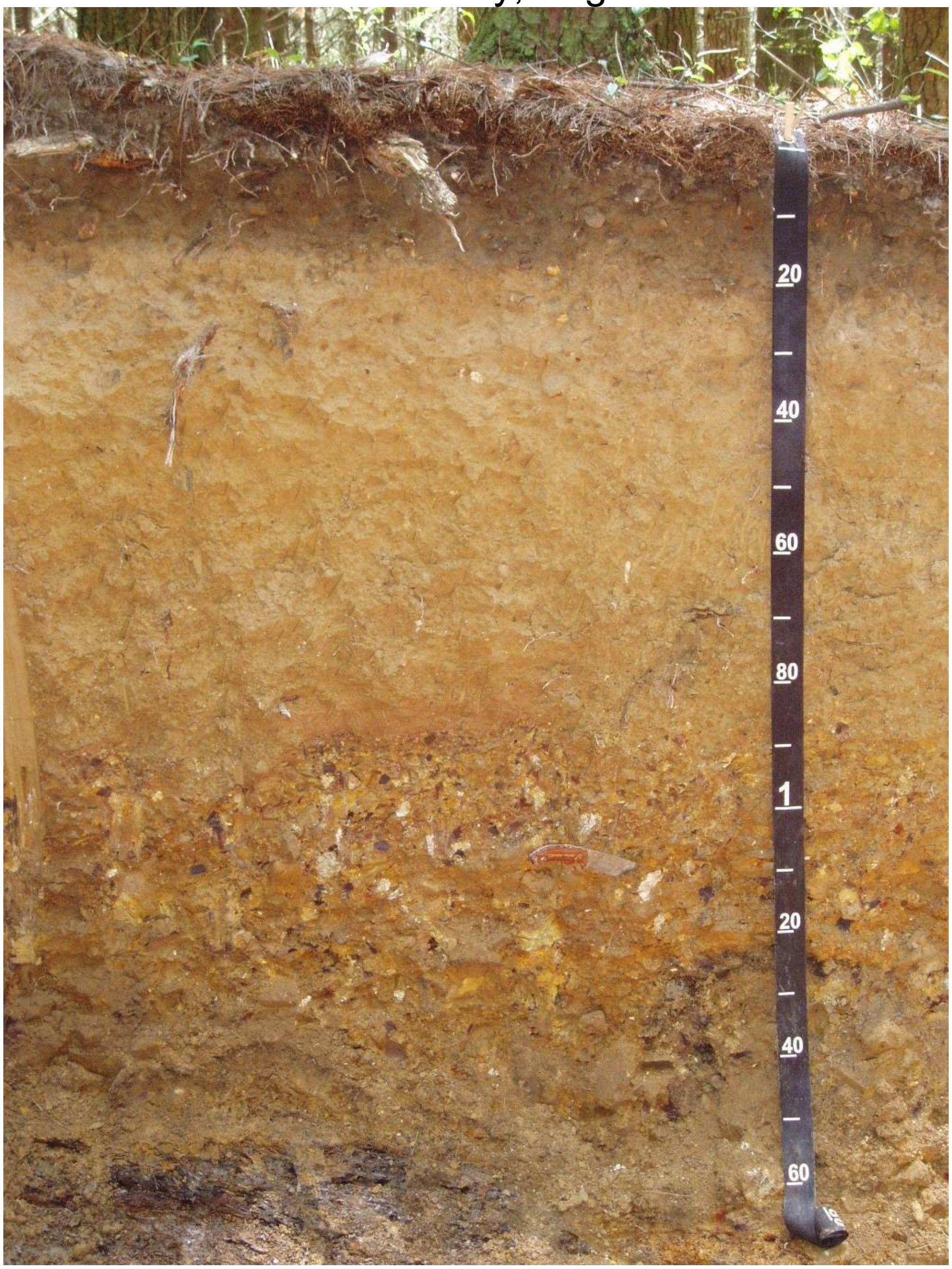
Virginia Polytechnic Institute and State University
Blacksburg, VA

Jefferson Soil
Landscape, Forest Community, and Soil Profile
Jefferson National Forest
Giles County, Virginia

Gilpin Series
Jefferson National Forest
Giles County, Virginia



GILPIN PA+IN KY MD NC NY OH TN VA WV

Established Series
Rev. WRK-LER-AWD-ART
07/2004

GILPIN SERIES

The Gilpin series consists of moderately deep, well drained soils formed in residuum of nearly horizontal interbedded shale, siltstone, and some sandstone of the Allegheny Plateau. They are on gently sloping to steep, convex, dissected uplands. Slope ranges from 0 to 70 percent. Permeability is moderate. Mean annual precipitation is 43 inches, and mean annual air temperature is 51 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Typic Hapludults

TYPICAL PEDON: Gilpin channery silt loam on a 3 percent northwest facing slope in cropland. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 8 inches; dark grayish brown (10YR 4/2) channery silt loam; weak fine granular structure; friable, slightly sticky and slightly plastic; 20 percent rock fragments of subangular siltstone and shale; moderately acid; abrupt smooth boundary.(6 to 10 inches thick)

Bt1--8 to 13 inches; yellowish brown (10YR 5/4) channery silt loam; weak fine and medium subangular blocky structure; friable, slightly sticky and slightly plastic; few distinct clay films on faces of peds and in pores; 25 percent rock fragments of subangular siltstone and shale; moderately acid; gradual wavy boundary.

Bt2--13 to 24 inches; yellowish brown (10YR 5/6) channery silt loam; moderate medium subangular blocky structure; friable, slightly sticky and moderately plastic; few distinct clay films on faces of peds and in pores; 30 percent rock fragments of subangular siltstone and shale; very strongly acid; clear wavy boundary. (Combined thickness of the Bt horizon is 12 to 26 inches.)

C--24 to 30 inches; brown (10YR 5/3) extremely channery loam; massive; friable, slightly sticky and slightly plastic; few faint clay films and common prominent black coatings on fragments; 60 percent rock fragments of subangular siltstone and shale; very strongly acid; clear wavy boundary. (0 to 10 inches thick)

R--30 inches; light olive brown (2.5Y 5/4) fractured, thin bedded, shale and siltstone with silt and clay coatings in fractures; strongly acid.

TYPE LOCATION: Indiana County, Pennsylvania; North Mahoning Township, about l/2 mile southeast of Marchand, on hilltop 500 feet east of Township Road 660. U.S.G.S.

Marion Center Topographic Quadrangle. Lat. 40 degrees, 51 minutes, 18 seconds, N. and Long. 79 degrees, 1 minute, 7 seconds W; NAD 1927.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 18 to 36 inches. Fractured, bedded and rippable bedrock is at depths of 20 to 40 inches. Rock fragments are mostly angular to subangular channers of shale, siltstone and sandstone and comprise 5 to 40 percent of individual horizons of the solum and 30 to 90 percent of the C horizon. The rock fragment content is less than 35 percent, by volume in the upper 20 inches of the argillic horizon. Reaction ranges from strongly to extremely acid throughout unless limed.

The Ap has hue of 10YR or 2.5Y with value of 3 to 5, and chroma of 2 to 4. Dry values are 6 or 7. The A horizon, where present, has hue of 10YR or 2.5Y with value of 2 to 4, and chroma of 1 to 3. Thickness for the A horizon ranges from 2 to 5 inches. The texture of the Ap or A horizon is silt loam or loam in the fine earth fraction.

Some pedons have E, BE, or BA horizons. These horizons range from 0 to 6 inches thick and have hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 5 to 3. Texture is silt loam or loam in the fine earth fraction.

The Bt horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 4 to 8. Colors tend to become redder with depth. Textures are silt loam, loam, clay loam, or silty clay loam in the fine-earth fraction. Clay films on ped faces, pores and on rock fragments are few or common and faint or distinct.

Some pedons have a BC horizon with colors and textures similar to the C horizon.

The C horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 6. Texture is silt loam, loam or silty clay loam in the fine-earth fraction.

Some pedons have a Cr horizon.

The R horizon is horizontal interbedded shale, siltstone or fine grained sandstone.

COMPETING SERIES: The Bedington, Clymer, Edgemont, Edneytown, Gladstone, Joana, Millstone, Pigeonroost, Rayne, Shelocta, Syenite and Wist (T) series are in the same family. Bedington, Clymer, Edgemont, Joanna, Rayne, Shelocta and Wist (T) soils have bedrock at more than 40 inches. Edneytown soils have a Cr horizon at more than 60 inches. Gladstone soils have granitic gneiss bedrock at 60 inches or more. Millstone soils have bedrock deeper than 80 inches. Pigeonroost soils have a Cr horizon within a 20 to 40 inch depth. Syenite soils have coarse fragments of granite in the control section.

The following series were competing under the old classification. They may compete after they are updated to the 9th Edition of Keys to Soil Taxonomy. The Albemarle, Arendtsville, Bucks, Butano, Chester, Elsinboro, Eubanks, Ezel, Freehold, Leedsville, Meadowville, Nixon, Pineville, and Quakertown competed under the old classification.

Of these only Butano soils have bedrock at a depth of 20 to 40 inches. Bertano soils occur in the costal range of mountains of central eastern California with humid mesothermal climate.

GEOGRAPHIC SETTING: Gilpin soils are on nearly level to very steep, convex, dissected uplands with slopes of 0 to 70 percent. They developed in residuum weathered from nearly horizontal, interbedded gray and brown acid siltstone, shale and sandstone. The climate is humid temperate with an average annual rainfall of 36 to 50 inches, average annual air temperatures of 46 to 57 degrees F., and a growing season of 120 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Berks, Blairton, Clymer, Dekalb, Muskingum, Rayne, Shelocta, Upshur, Weikert, Wellston, Westmoreland and Wharton soils. Blairton, Cavode, Ernest and Wharton soils have redoximorphic features in the subsoil. Berks and Muskingum soils do not have argillic horizons. Shelocta, Rayne and Wellston soils are more than 40 inches to rock. Upshur soils have finer textures. Weikert soils have bedrock at 20 inches or less.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff is negligible to high. The permeability is moderate.

USE AND VEGETATION: Gilpin soils are mainly used for cropland and pasture. Wooded areas are in mixed hardwoods, mainly oaks.

DISTRIBUTION AND EXTENT: Pennsylvania, West Virginia, Ohio, Kentucky, Maryland, New York, North Carolina, Tennessee, Virginia and Indiana. The series is of large extent.

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Indiana County, Pennsylvania, 1931.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

a. Ochric epipedon - the zone from the surface of the soil to a depth of 8 inches (Ap horizon).

b. Argillic horizon - the zone from 8 to 24 inches (Bt horizon).

The clay mineralogy is mixed, with illite dominant and kaolinite and vermiculite in lesser quantities.

This series is mapped extensively in many states and MLRA's. Data available indicates CEC of superactive, active, and semiactive. Weighted average supports a CEC of active.

ADDITIONAL DATA: Characterization sample S61PA-32-56 is from Type Location, and was used as the basis for placing this series in the active CEC class. Also available is S61PA-32-54.

National Cooperative Soil Survey
U.S.A.

Station 3

Derroc and Botetourt Soil Profiles

White Pine Plantation

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Professor
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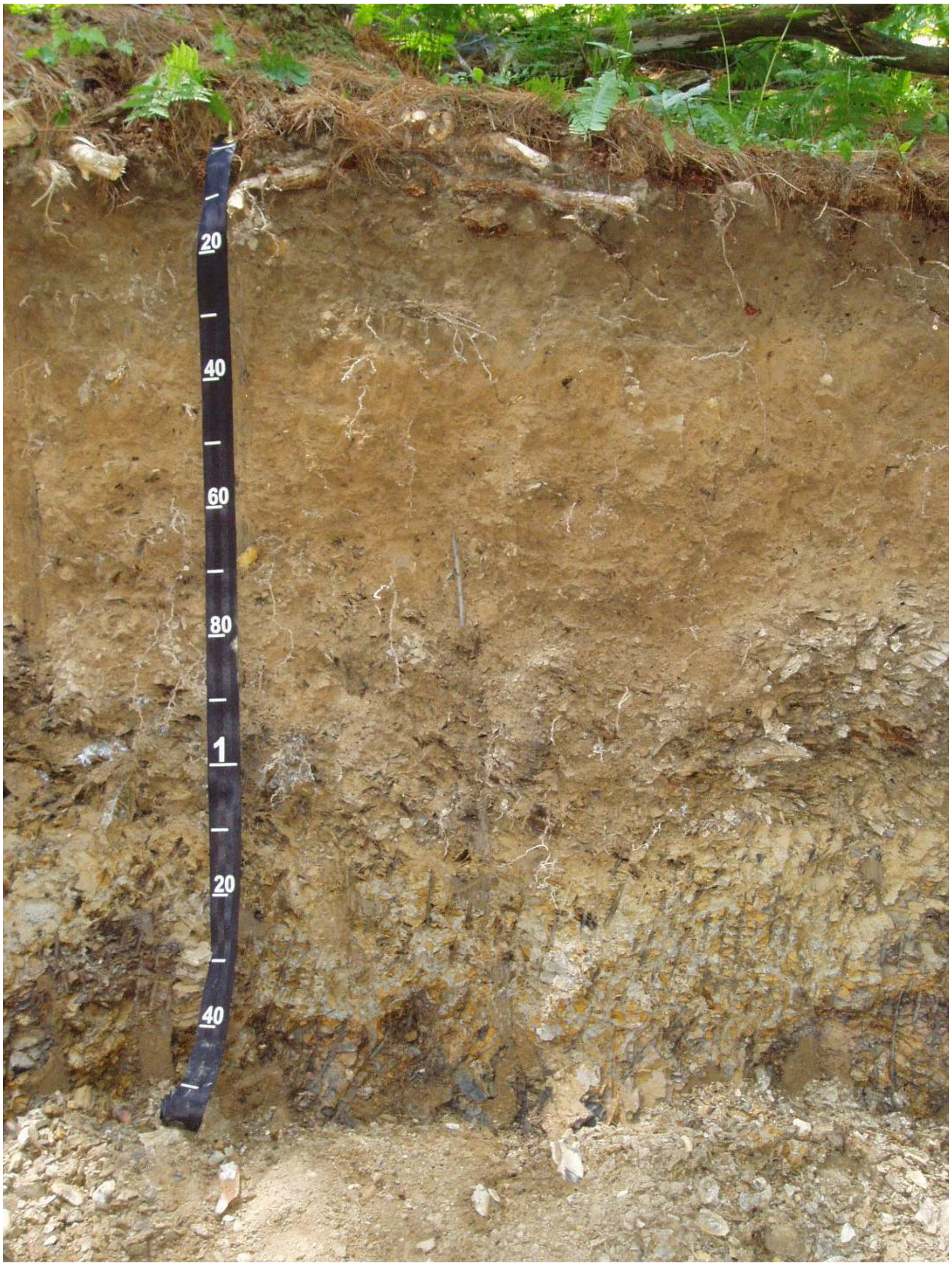
Derroc Soil
Landscape, Forest Community, and Soil Profile
Jefferson National Forest
Giles County, Virginia

Derroc Series
Jefferson National Series
Giles County, Virginia



Established Series
Rev. LWH-WJE-MHC-DGF
05/2004

DERROC SERIES

The Derroc series consists of very deep, well drained soils formed in alluvium derived from limestones, shales, quartzites, and sandstones on flood plains. Permeability is moderately rapid or rapid. Slope ranges from 0 to 5 percent. Mean annual precipitation is about 38 inches, and mean annual air temperature is about 55 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, siliceous, active, mesic Dystric Fluventic Eutrudepts

TYPICAL PEDON: Derroc on a concave 2 percent slope in a forest. (Colors are for moist soil unless otherwise stated)

Oi--3 to 0 inches; loose leaves and twigs and very dark grayish brown (10YR 3/2) organic matter.

A--0 to 3 inches; dark brown (10YR 3/3) cobbly sandy loam; weak fine granular structure; friable, slightly sticky, slightly plastic; many fine and medium roots; few fine pores; 20 percent gravel and cobbles; moderately acid; abrupt smooth boundary. (0 to 9 inches thick)

Bw1--3 to 12 inches; yellowish brown (10YR 5/6) very cobbly sandy loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; many fine and medium roots; few fine pores; 40 percent gravel and cobbles; moderately acid; clear wavy boundary.

Bw2--12 to 37 inches; yellowish brown (10YR 5/6) extremely cobbly sandy loam; weak fine and medium subangular blocky structure; very friable; few fine and medium roots; few organic stains on faces of rock fragments; 65 percent sandstone gravel and cobbles; moderately acid; clear smooth boundary. (Combined thickness of the Bw horizon is 20 to 35 inches)

C1--37 to 46 inches; yellowish brown (10YR 5/6) very cobbly loamy sand; single grained; loose; few fine roots; 40 percent gravel and cobbles; moderately acid; clear wavy boundary.

C2--46 to 65 inches; yellowish brown (10YR 5/6) very cobbly sandy loam; weak medium and coarse subangular blocky structure; friable, slightly sticky, slightly plastic;

few fine roots; common distinct light brownish gray (10YR 6/2) redoximorphic depletions; 40 percent gravel and cobbles; moderately acid.

TYPE LOCATION: Shenandoah County, Virginia; 0.6 mile south of intersection of VA-678 and VA-613, 800 feet west of Passage Creek on the Shenandoah-Warren County line.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 20 to 40 inches. Depth to bedrock is more than 60 inches. Rock fragments range from 5 to 60 percent in the A and Ap horizons and from 30 to 80 percent in the Bw and C horizons with an average of 35 percent or more between depths of 10 and 40 inches. Reaction is moderately acid to neutral throughout.

The A horizon has hue of 7.5YR or 10YR, value of 2 to 4 and chroma of 2 to 4. It is sandy loam, loam, or silt.

Some pedons have an Ap horizon with hue of 7.5YR or 10YR, value of 2 to 5, and chroma of 2 to 6. It is sandy loam, loam or silt loam.

The Bw horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 or 6. It is sandy loam or loam.

Some pedons have a BC horizon with hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 or 6. It is loamy sand, sandy loam, or loam.

The C horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 to 6. It is loamy sand or sandy loam.

COMPETING SERIES: There are no other known series in this family.

GEOGRAPHIC SETTING: Derroc soils formed in alluvium derived from limestones, sandstones, quartzites, and shales on flood plains. Slope gradients range from 0 to 5 percent. Climate is temperate and humid. Mean annual air temperature ranges from 50 to 57 degrees F., mean annual precipitation ranges from 30 to 45 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Alonzville, Berks, Botetourt, Broadway, Caverns, Coursey, Frederick, Gladehill, Groseclose, Gullion, Ingledove, Irongate, Lehew, Moomaw, Newmarc, Nomberville, Shottower, Weikert, and Wolfgap soils. Alonzville, Botetourt, Caverns, Coursey, Ingledove, Newmarc, and Shottower soils contain fewer rock fragments in the subsoil and are on stream terraces. Berks, Lehew, and Weikert soils are shallower to bedrock and are on uplands. Broadway, Gladehill, Gullion, Irongate, Nomberville, and Wolfgap soils contain fewer rock fragments in the subsoil and are on similar landscapes. Frederick and Groseclose soils contain fewer rock fragments in the subsoil, and are on uplands. Moomaw soils have a fragipan and are on stream terraces.

DRAINAGE AND PERMEABILITY: Well drained. The potential for surface runoff potential is negligible. Permeability is moderately rapid or rapid. Derroc soils are subject to flooding.

USE AND VEGETATION: Derroc soils are mainly used for the production of forest products. The remaining areas are cultivated. Pasture, hay, small grain, and corn are the principal crops.

DISTRIBUTION AND EXTENT: MLRA 128. In the Valley and Ridge physiographic province in Virginia, and possibly, West Virginia, Maryland, Kentucky, and Pennsylvania. The area is of moderate extent.

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Shenandoah County, Virginia, 1988.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
1. Ochric epipedon - the zone from 0 to 3 inches. (the A horizon)
2. Cambic horizon - the zone from 3 to 37 inches. (Bw horizon)
3. Fluventic feature - irregular decrease in organic-carbon content.
4. Udic moisture regime.

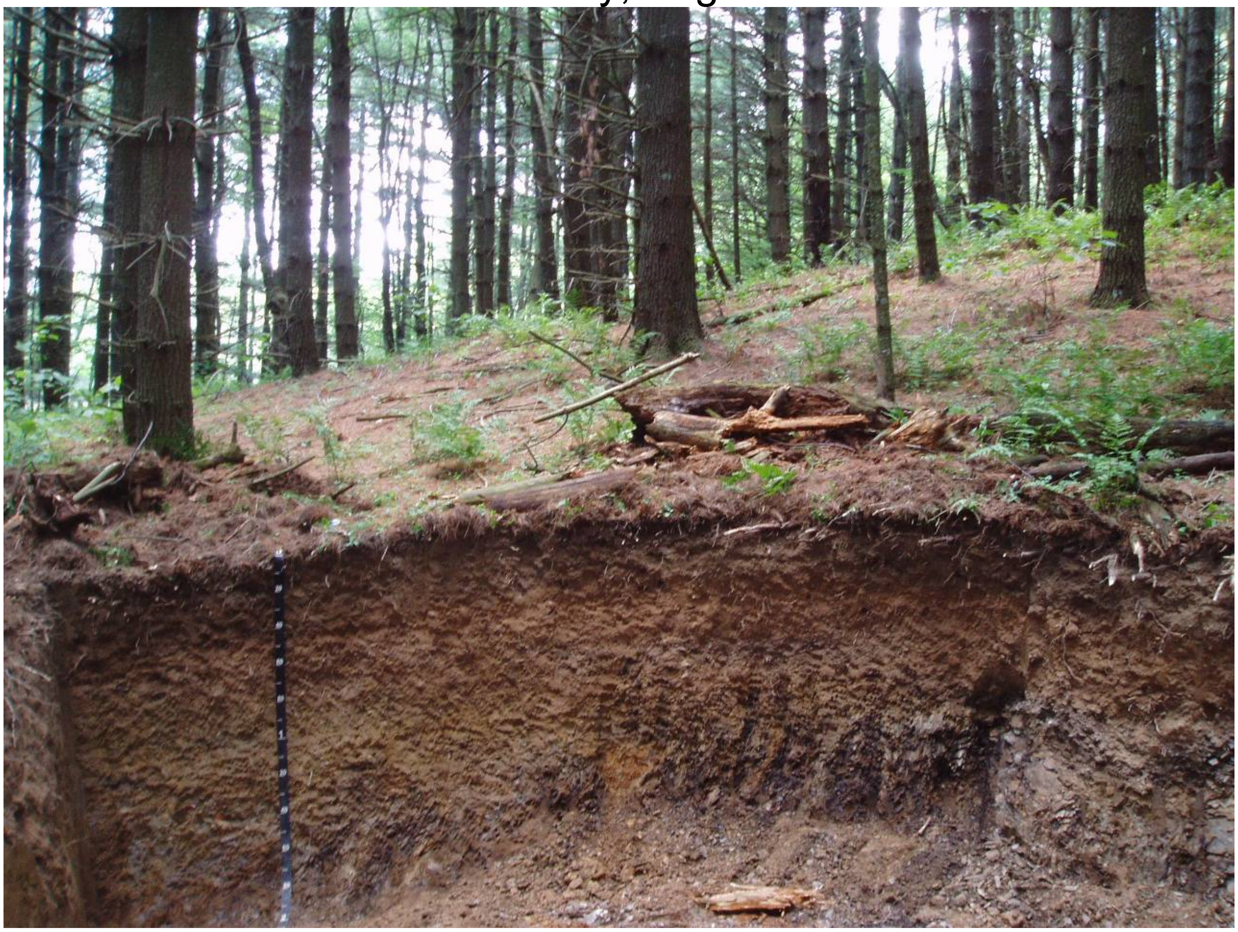
Soils now within the range of the Derroc series were correlated Craigsville in several published soil surveys.

ADDITIONAL DATA: Morphological, chemical, textural, and mineralogical data are reported in:

Edmonds, W. J., D. D. Rector, D. A. Gall, D. R. Hatch, R. S. Joslyn, and J. C. Baker. 1987. Properties and classification of soils derived from stratified alluvium in the Valley and Ridge Province of Virginia. Va. Agric. Exp. Stn. Bull. 85-10.

National Cooperative Soil Survey
U.S.A.

Botetourt Soil
Landscape, Forest Community, and Soil Profile
Jefferson National Forest
Giles County, Virginia



Derroc Series
Jefferson National Series
Giles County, Virginia

Established Series
Rev. RLV-DHE-EPE
06/2003

BOTETOURT SERIES

Soils of the Botetourt series are very deep, moderately well drained, and moderately permeable. They formed in alluvial material derived from limestone, sandstone, quarzite, and shale on low stream terraces and second bottom flood plains in the Southern Appalachian Ridges and Valleys MLRA. Slopes range from 0 to 15 percent. Mean annual precipitation is about 38 inches and mean annual temperature is about 55 degrees F.

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, mesic Ultic Hapludalfs

TYPICAL PEDON: Botetourt loam -- on a southeast facing slope of 2 percent in a fescue and white clover pasture. (Colors are for moist soil, unless otherwise indicated.)

Ap-- 0 to 7 inches; brown (10YR 5/3) loam; moderate medium granular structure; very friable, non sticky and non plastic; many very fine and fine roots; 5 percent rounded gravel; neutral; abrupt smooth boundary. (0 to 10 inches thick)

Bt1-- 7 to 14 inches; brownish yellow (10.YR 6/6) clay loam; few fine faint strong brown (7.5YR 5/8) Fe masses; moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine roots; common distinct clay films on faces of peds; 2 percent rounded gravel; moderately acid; clear smooth boundary.

Bt2-- 14 to 24 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct very pale brown (10YR 7/3) Fe depletions and common medium faint strong brown (7.5YR 5/8) Fe masses; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; few very fine roots; common faint clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3-- 24 to 44 inches; brownish yellow (10YR 6/8) clay loam; many coarse prominent light gray (10YR 7/1) Fe depletions; moderate medium and coarse subangular blocky structure; firm, slightly sticky and slightly plastic; few very fine roots; many faint clay films on faces of peds; strongly acid; clear wavy boundary. (Combined thickness of the Bt horizon ranges from 30 to 60 inches)

BC-- 44 to 53 inches; reddish yellow (7.5YR 6/8) and light gray (N 7/0) loam; weak coarse subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; 2 percent rounded gravel; strongly acid; clear wavy boundary. (0 to 15 inches thick)

C-- 53 to 65 inches; yellowish brown (10YR 5/8), gray (10YR 6/1) and light gray (N 7/0) gravelly sandy clay loam; massive; friable, slightly sticky and slightly plastic; 15 percent rounded gravel and 3 percent cobbles; strongly acid.

TYPE LOCATION: Botetourt County, Virginia; about 3 miles northwest of Fincastle, 1/2 mile southeast of the intersection of VA-606 and VA-666, 500 feet west of the North Fork of Catawba Creek. Elevation 1,180 feet.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches or more. Depth to bedrock is more than 60 inches. Rounded gravel and cobbles of sandstone, chert, and quartzite range from 0 to 15 percent in the A horizon, and 0 to 35 percent in the B horizon and 5 to 50 percent in the C horizon. Reaction ranges from strongly acid through neutral in the A horizon and strongly acid through slightly acid in the B and C horizons.

The Ap horizon has hue of 10YR, value of 4 through 6, and chroma of 2 through 4. It is fine sandy loam, loam, or silt loam.

The BA horizon, where present, has hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 2 through 8. It is loam, silt loam, sandy clay loam, or clay loam.

The Bt horizon has hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 3 through 8. The Bt is loam, clay loam, or sandy clay loam in the fine-earth fraction.

The BC horizon, where present, is multicolored in hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 1 through 8. It is loam, clay loam, or sandy clay loam in the fine-earth fraction.

The C horizon is multicolored in hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 1 through 8. It is sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam in the fine-earth fraction.

COMPETING SERIES: These are the Ingledove and Secesh series in the same family. Ingledove soils do not have gray depletions in the argillic horizon. Secesh soils are well drained and have a lithologic discontinuity in which the lower subsoil has more than 35 percent chert.

GEOGRAPHIC SETTING: Botetourt soils are on second bottoms and low stream terraces along major streams and rivers subject to none to rare flooding. Slope gradients are most commonly 2 to 7 percent slopes, but range from 0 to 15 percent. The soils formed in alluvial materials from limestone, sandstone, siltstone, shale and quartzite of Cambrian, Ordivician, Silurian, and Devonian ages in the Southern Appalachian Ridges and Valleys MLRA. Mean annual precipitation ranges from 30 to 45 inches, and mean annual temperature ranges from 50 to 57 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: In addition to the competing Ingledove soils, are the Berks, Cravens, Carbo, Dekalb, Derroc, Frederick, Gladehill, Irongate, Shottower, and Wolfgap soils. The Berks, Carbo, and Dekalb soils are well drained, more shallow to bedrock, and are on uplands. Caverns soils are well drained and coarse-loamy. Derroc soils are loamy-skeletal and are well drained. The Frederick and Shottower soils are well drained, have redder more clayey subsoils, and are on uplands. The Irongate and Gladehill soils have a mollic epipedon and are on flood plains; in addition, Gladehill soils are well drained.

DRAINAGE AND PERMEABILITY: Moderately well drained. Runoff is very slow to medium. Permeability is moderate.

USE AND VEGETATION: Most areas are used for row crops, hay and pasture. A few areas are in woodland consisting of White oak, yellow-poplar, and Virginia pine.

DISTRIBUTION AND EXTENT: Virginia and possibly West Virginia. The series is of small extent.

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Wythe County, Virginia, 1989.

REMARKS: Botetourt soils have been included in the Wheeling series in the past.

Diagnostic horizons and features recognized in this pedon are:

a. Ochric epipedon, the part from 0 to 7 inches. (Ap horizon)
b. Argillic horizon, the part from 7 to 44 inches. (Bt horizon)
c. Depletions of chroma of 2 or less. (Bt3 horizon)

SIR = VA0311
MLRA = 128, 147
REVISED = 4/2/93, MHC

ADDITIONAL DATA: Laboratory data by Virginia Polytechnic Institute and State University, Blacksburg. (PSA, chemistry and mineralogy)

National Cooperative Soil Survey
U.S.A.

Station 4

BMP Effectiveness in the Appalachians

Riparian Hardwood Stand

Bill Lakel
Virginia Department of Forestry
Charlottesville, VA

Effects of Forestry Streamside Management Zone Characteristics on Soil Erosion and Water Quality.

W. Lakel, W.M. Aust, C.A. Dolloff

Virginia Tech, USFS Coldwater Fisheries Unit

Sponsors

MeadWestvaco

USDA

Virginia Tech

Southern Research Station

National Council for Air and Stream Improvement, Inc. ncasi

Center for Aquatic Technology Transfer CATT

Benefits of Streamside Management Zones

- **Recommended by all state BMP manuals**
- **Research has shown their importance for**
  - **Water quality:**
    - ***trapping sediments/attached nutrients and chemicals.***
    - ***uptake of nutrients.***
    - ***transformation of nutrients.***
    - ***shade for stream.***
    - ***stream bank stabilization.***
  - **Habitat:**
    - ***riparian.***
    - ***stream channel.***

Current Status of SMZs

- **Numerous studies have shown the positive effects of forestry SMZs.**
- **Few studies have actually compared the efficacy of different widths and harvest levels.**
- **Current state BMP guidelines vary from 25 to 200 feet for width.**

Castelle et al. (1994) reviewed research findings regarding widths of riparian buffers that have been found to positively influence water quality indices:

• Sediment	5 – 60 m
• Nutrient removal	5 – 90 m
• Temperature	15 – 30 m
• Species diversity	5 – 110 m

- Clearly, refinement is needed for a variety of sites

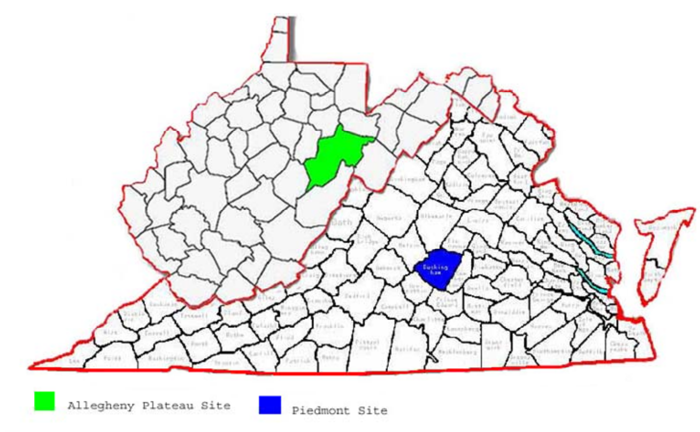
VA SMZ Recommendations

- 50 feet on all perennial and intermittent streams (each side).
- Based on recommendations made by VADCR, USFS and USEPA.
- No specs for ephemeral drains.
- VA BMPs are voluntary but backed by the Virginia Silvicultural Water Quality Law.
- Prohibits pollution due to silvicultural operations.
- Civil penalties are assessed regularly.

Current Research

- To evaluate the effects of different SMZ widths and thinning on indices of water quality (physical, chemical, biological).

Study Sites in Allegheny Plateau and Piedmont



Post Harvest Soil Loss in the SMZs

	Soil Loss (t/ac/yr)	
– 25 ft stringer	+0.3	a
– 50 ft un-thinned	-27.9	a
– 50 ft thinned	+7.0	a
– 100 ft un-thinned	-3.6	a

Post Harvest Nutrients in Water

	Total N(mg/l)	Total P(mg/l)
– 25 ft stringer	0.122 a	0.008 a
– 50 ft un-thinned	0.105 a	0.005 a
– 50 ft thinned	0.115 a	0.007 a
– 100 ft un-thinned	0.108 a	0.004 a

Post Harvest Nitrate and Ammonium in Water

	NO_3 mg/l	NH_4 mg/l
– 25 ft stringer	0.104 a	0.083 a
– 50 ft un-thinned	0.040 a	0.075 a
– 50 ft thinned	0.058 a	0.082 a
– 100 ft un-thinned	0.012 a	0.077 a

Post-Harvest Water Quality Parameters

TRT	DO (mg/l)	Temp Cº
25 ft. stringer	8.6 a	15.5 a
50 ft. un-thinned	8.6 a	15.6 a
50 ft. thinned	9.5 a	15.1 a
100 ft. un-thinned	8.0 a	15.7 a

Post-Harvest Data

TRT	Turbidity (NTU)	TDS (g/l)
25 ft. stringer	13.8 a	61.8 a
50 ft. un-thinned	12.2 a	83.6 a
50 ft. thinned	16.9 a	16.8 a
100 ft. un-thinned	21.7 a	39.5 a

Summary

- **Watershed management history:**
  - **- erosion gullies and stream instability.**
  - **- stream bank erosion is significant.**
- **N and P in water were low and unaffected by SMZ width or harvest level.**
- **SMZ width and thinning did not affect water temperature, DO or TOC.**
- **From a water quality standpoint:**
  - **increasing SMZ widths was not beneficial.**
  - **decreasing SMZ widths (or thinning) was not detrimental.**
  - **forestry SMZ width specs are largely speculative.**
  - **costs to landowners should be considered.**
  - **Several other studies had similar results.**

Best Management Practices (BMPs)

Forestry BMP Guide for Virginia

http://www.dof.virginia.gov/wq/index-bmp-guide.shtml

Best Management Practices (BMPs) are practices developed to reduce nonpoint pollution in response to the Clean Water Act requirements.

Streamside Management Zones (SMZ's)

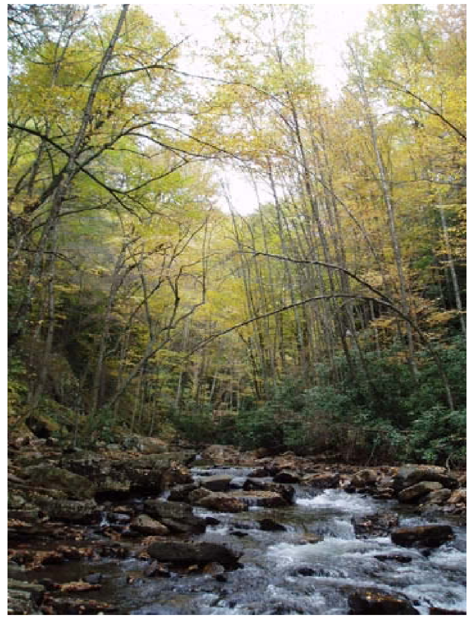
SMZs are areas of forest adjacent to streams designed to protect water quality.

Also called riparian management zones (RMZ) or buffer strips

Streamside Management Zones

1) Filter strip that traps sediment moving in overland flow and prevents it from reaching the stream.

2) Provide shade to stream to maintain Stream temperature



BMPs allow harvest of 50% of the crown cover or Basal Area in an SMZ.

The forest floor should be left undisturbed and intact in the SMZ

- Harvesting limited to cable or winch systems
- Logging decks should be located outside of SMZs
- Skid trails and haul roads should be kept out of SMZs as much as possible.

The size of the SMZ required to protect water quality depends on the type of stream

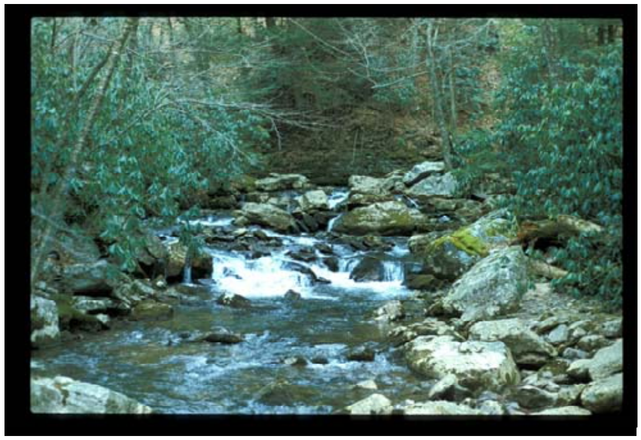
Stream Type	Minimum Widths (each side)
Ephemeral	none
Intermittent	50 ft
Perennial	50 ft

Ephemeral Stream
No SMZ Required

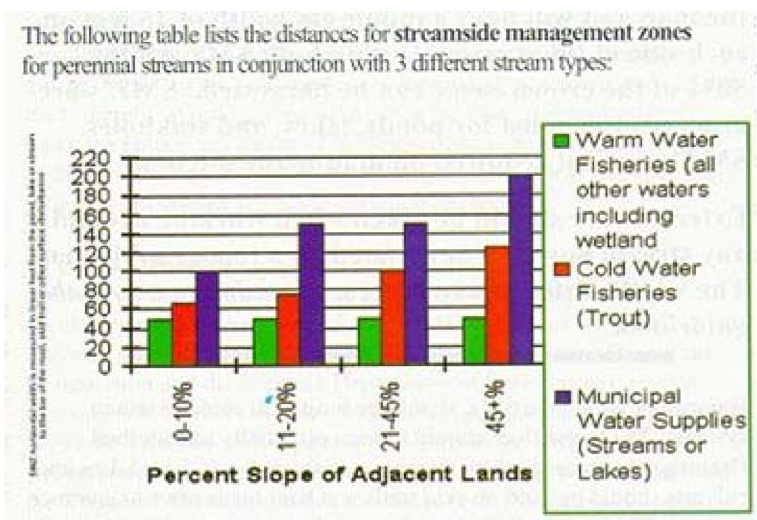
Intermittent Stream
50 ft SMZ Required

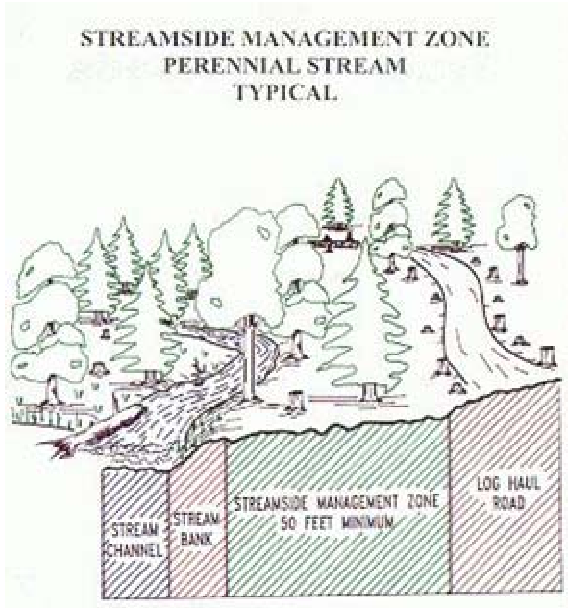
Perennial Stream
50 ft SMZ Required

Cold Water Fisheries
Wider SMZ Required



SMZs for cold water fisheries streams or municipal water supplies are wider and depend on the slope of the adjacent land.




STREAMSIDE MANAGEMENT ZONE
PERENNIAL STREAM
TYPICAL
STREAM CHANNEL
STREAM BANK
STREAMSIDE MANAGEMENT ZONE
50 FEET MINIMUM
LOG HAUL ROAD

Station 5

A GIS Based Approach to Predicting Site Quality in The Southern Appalachians

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Department of Forestry
Virginia Polytechnic Institute and State University
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Predicting & Mapping Forest Productivity with GIS

Claudia Cotton
PhD Student
Virginia Tech Forestry

Significance

Heterogeneous conditions of site quality and potential productivity throughout the southern Appalachians

- Climate
- Topography
- Geology
- Landform
- Soils

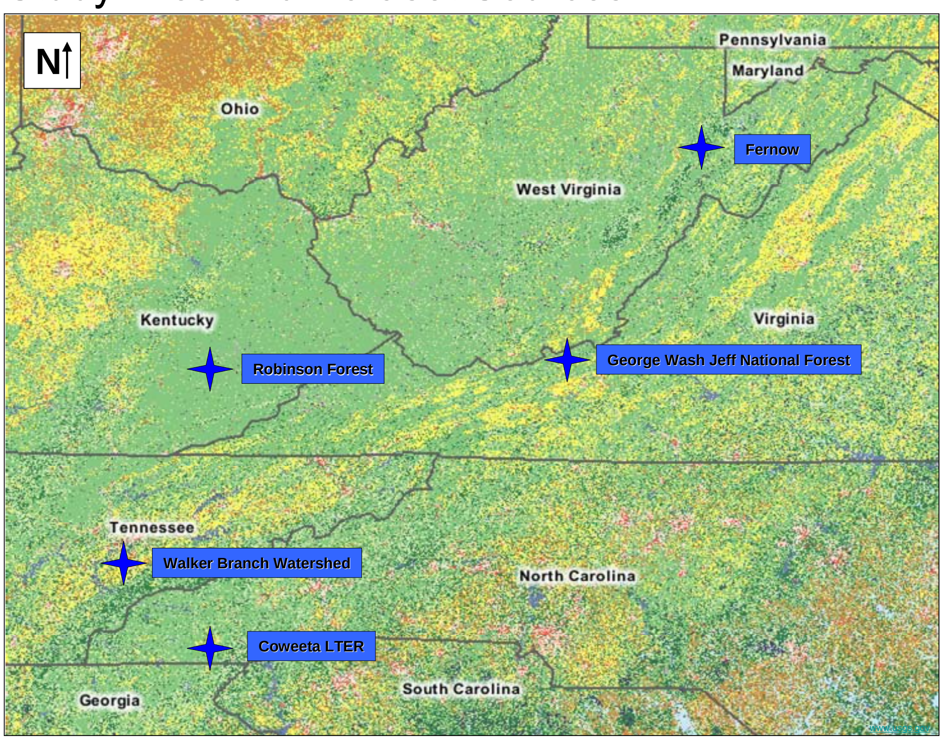
1. How accurate are the existing methods that predict productivity of the upland hardwoods in the southern Appalachians?

2. Can GIS be used to predict forest site quality?

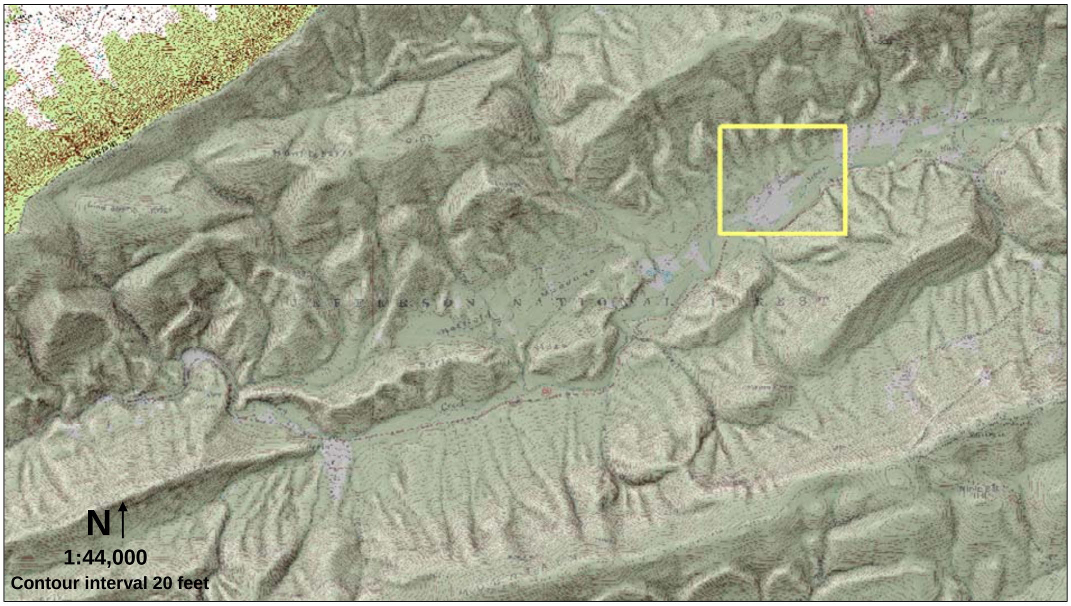
3. Can FIA data be used to validate our predictions?

4. How can we refine our predictions with additional information?

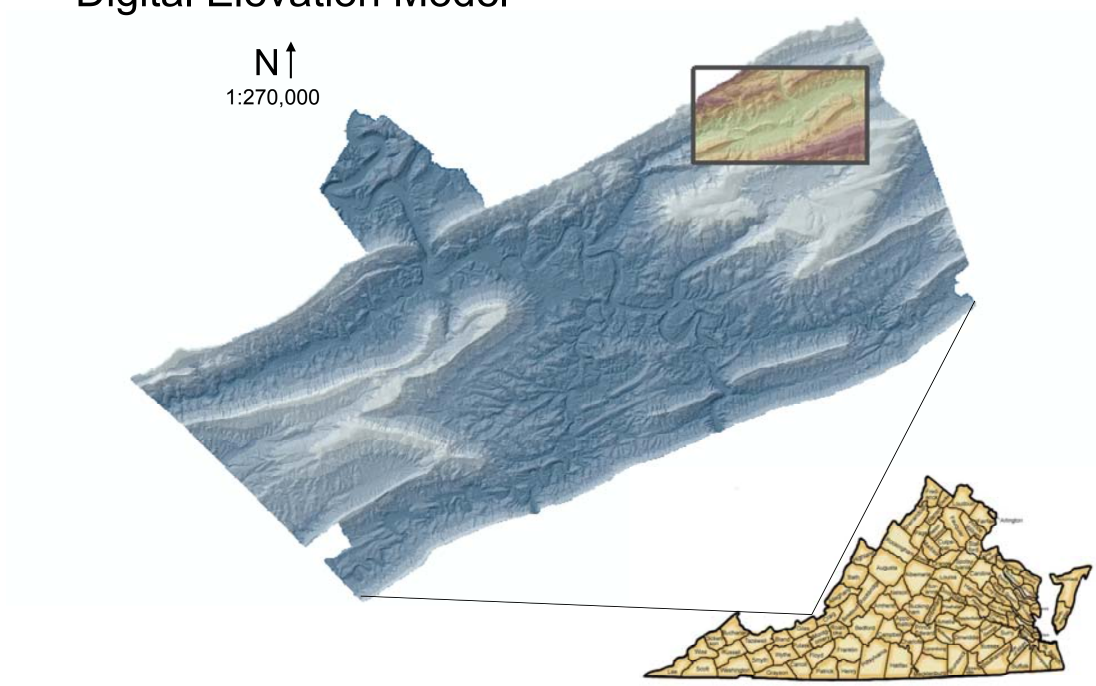
Study Area and Dataset Sources



Topography



Digital Elevation Model



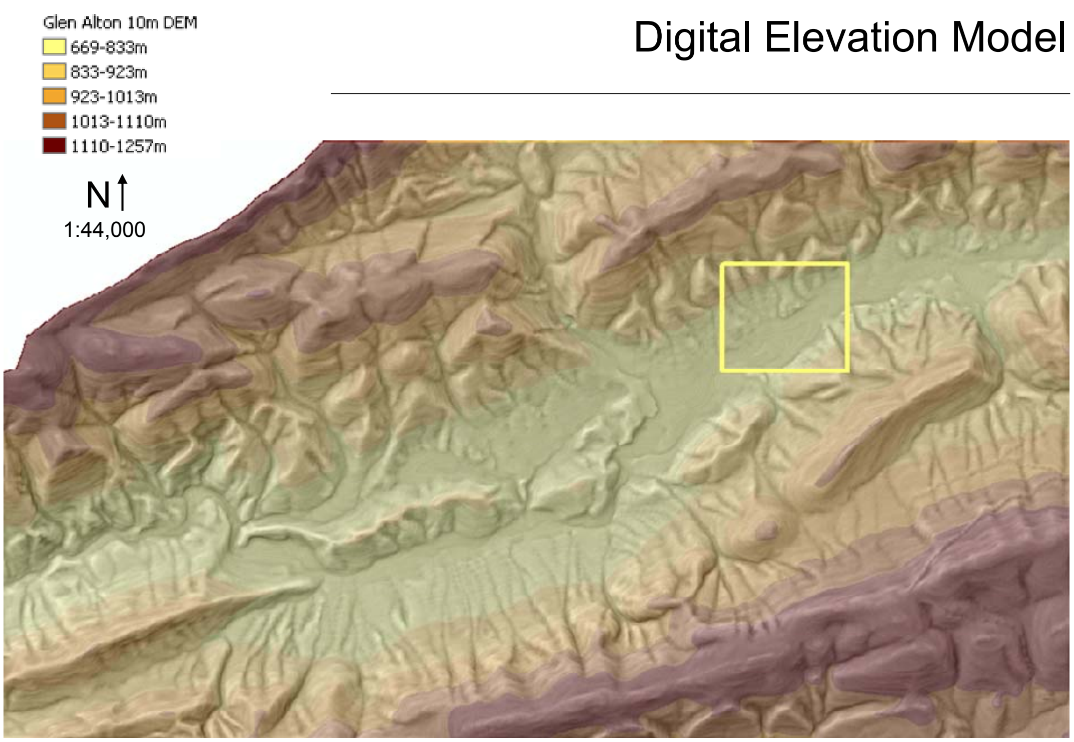
Methods

1. Predict Site Index (or another productivity proxy) using existing methods
   Approach: Landform Index (McNab 93)
   Forest Site Quality Index (Meiners 82)
   Topographic Shape Index (McNab 92)
   Topographic Relative Moisture Index (Parker 82)
   Integrated Moisture Index (Iverson 97)

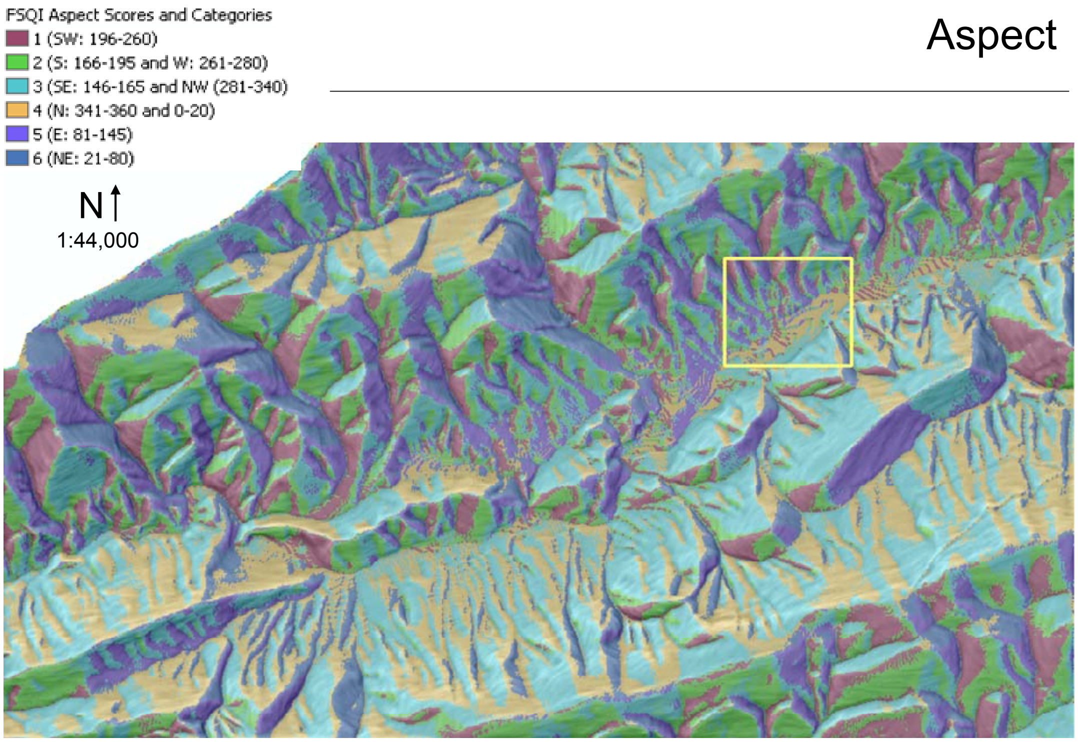
2. Derive environmental variables from Digital Elevation Model
   Approach: Layered GIS

3. Validate with field work or existing datasets
   Approach: FIA data, Cycles 5 (1984), 6 (1990), & 7 (2002)
   Regional research forest datasets

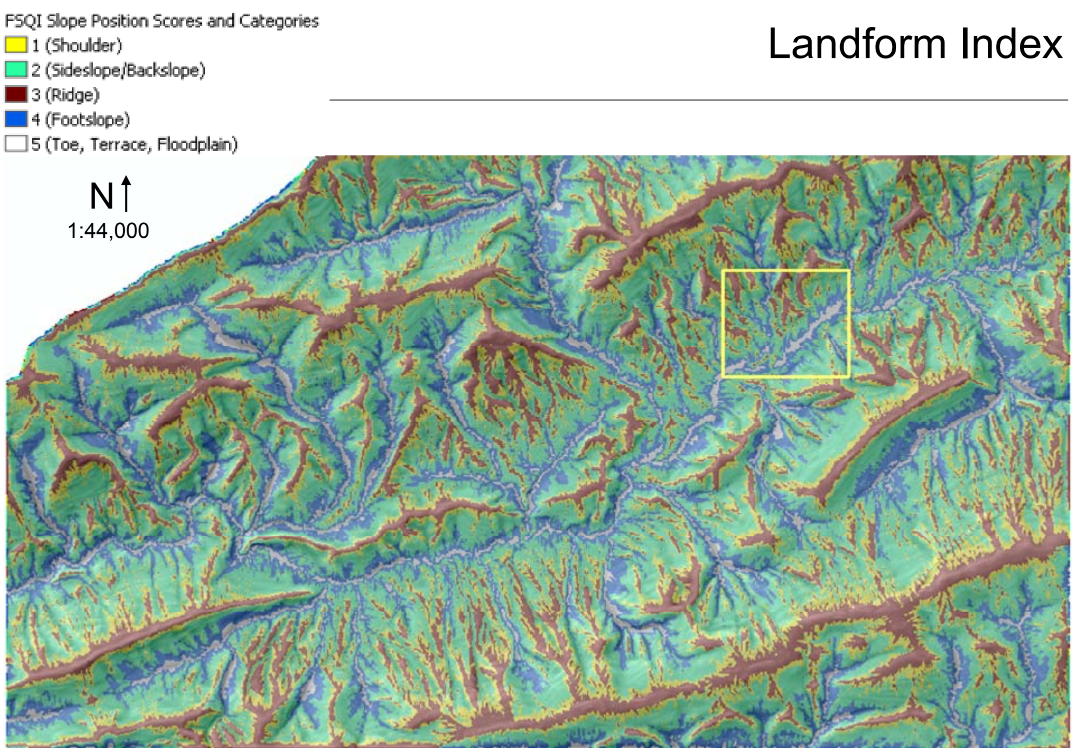
Digital Elevation Model



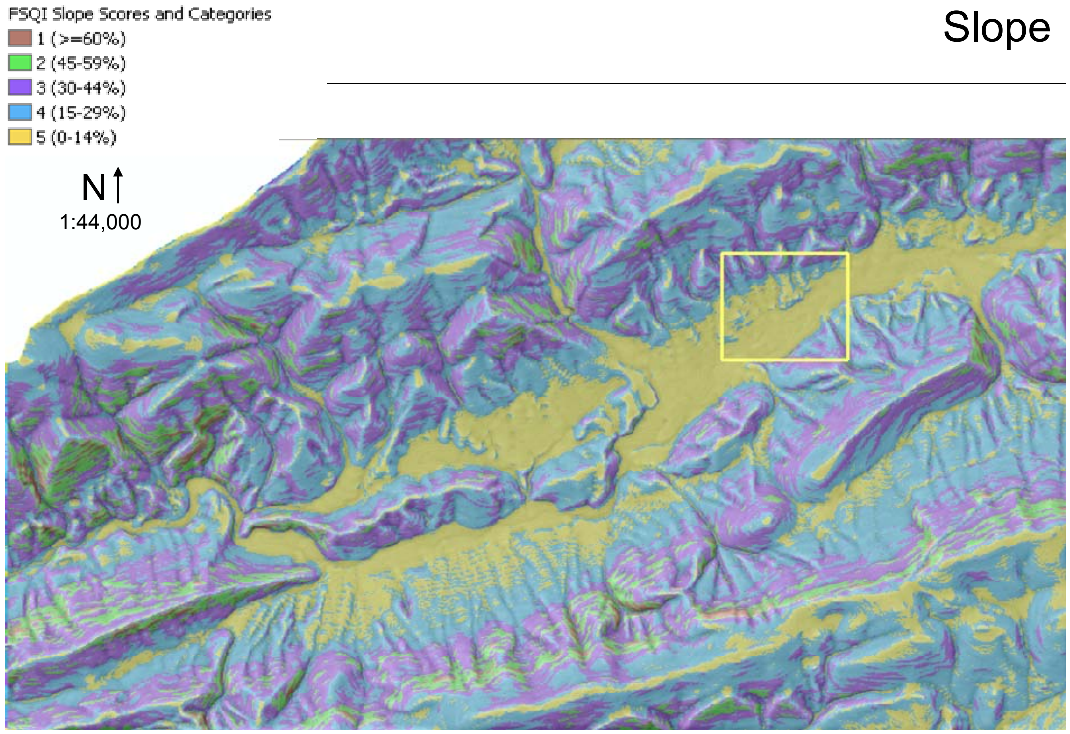
Aspect



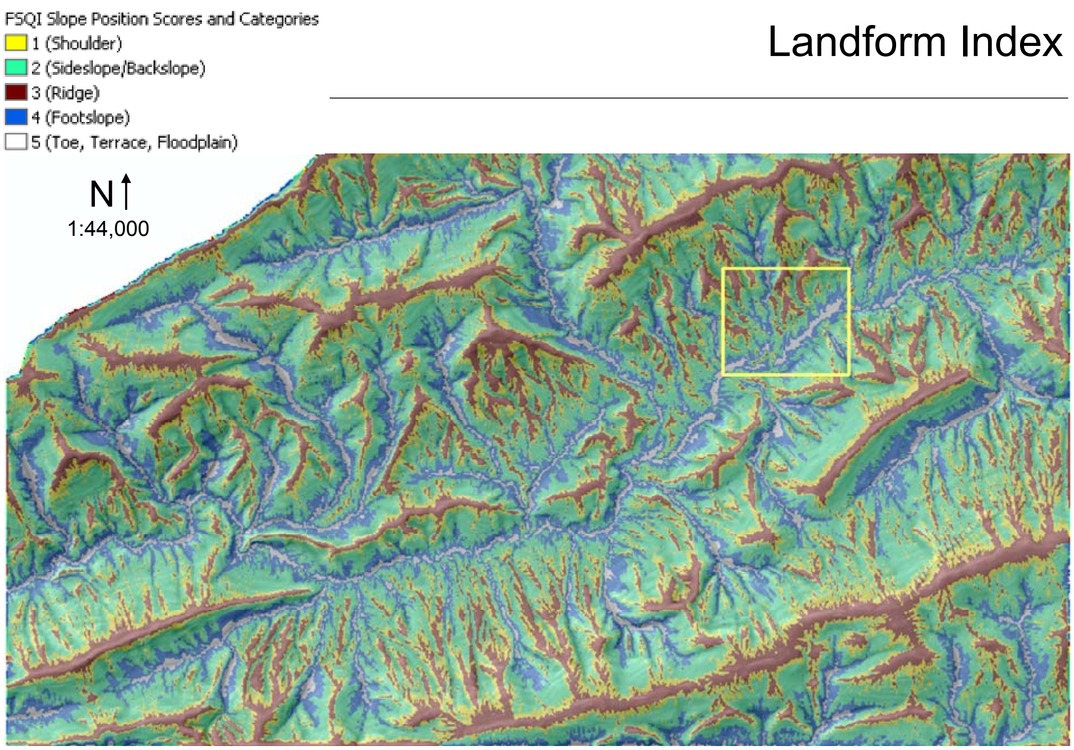
Landform Index

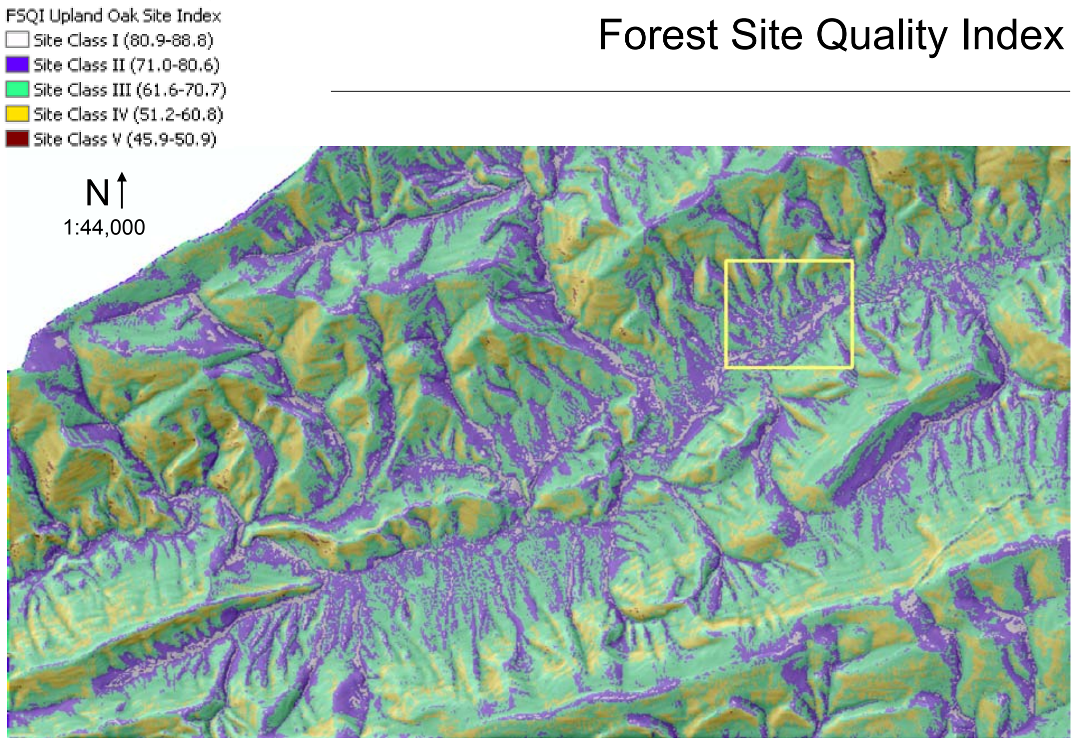


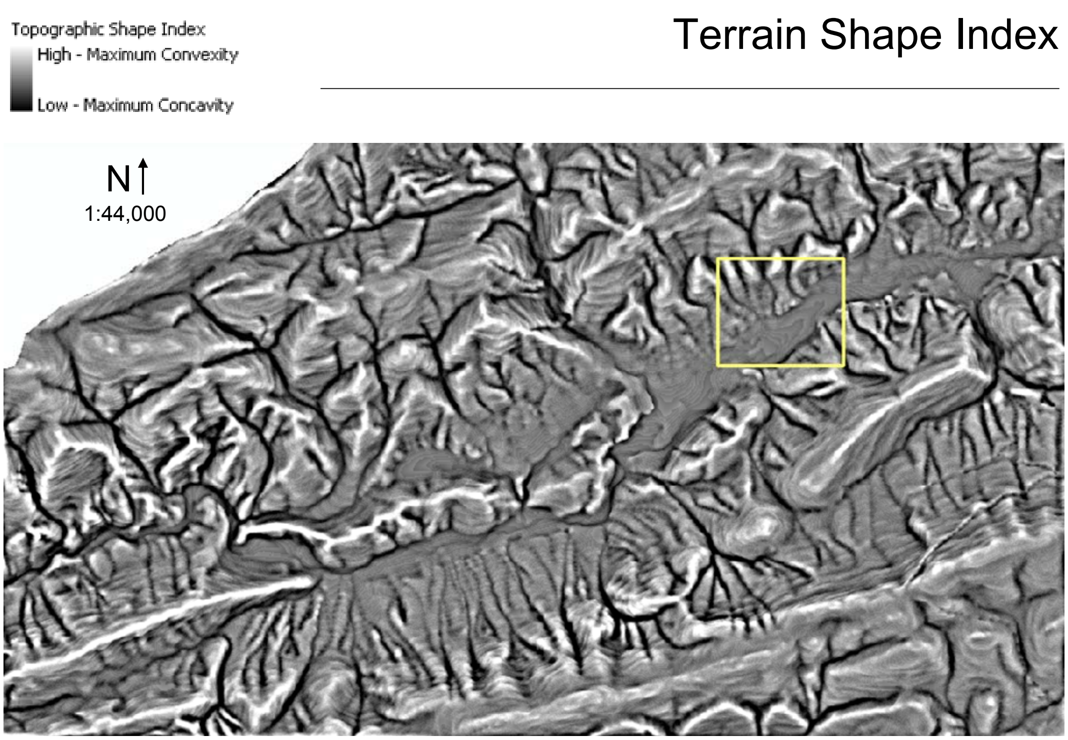
Slope



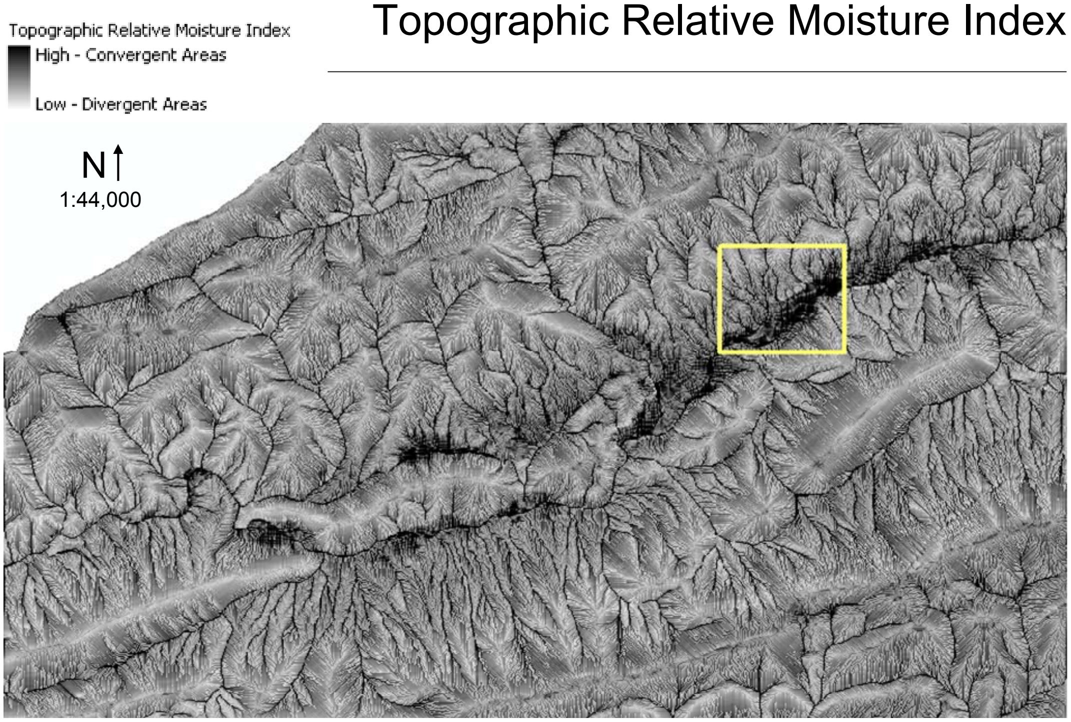
Landform Index



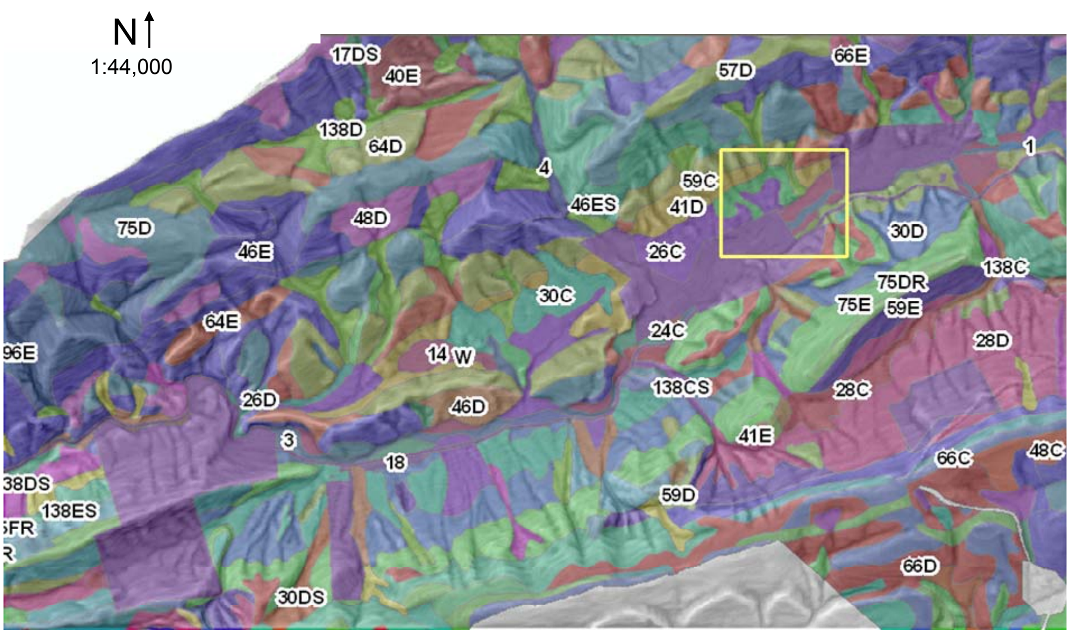

Forest Site Quality Index
FSQI Upland Oak Site Index
Site Class I (80.9-88.8)
Site Class II (71.0-80.6)
Site Class III (61.6-70.7)
Site Class IV (51.2-60.8)
Site Class V (45.9-50.9)
N
1:44,000


Terrain Shape Index
Topographic Shape Index
High - Maximum Convexity
Low - Maximum Concavity
N
1:44,000

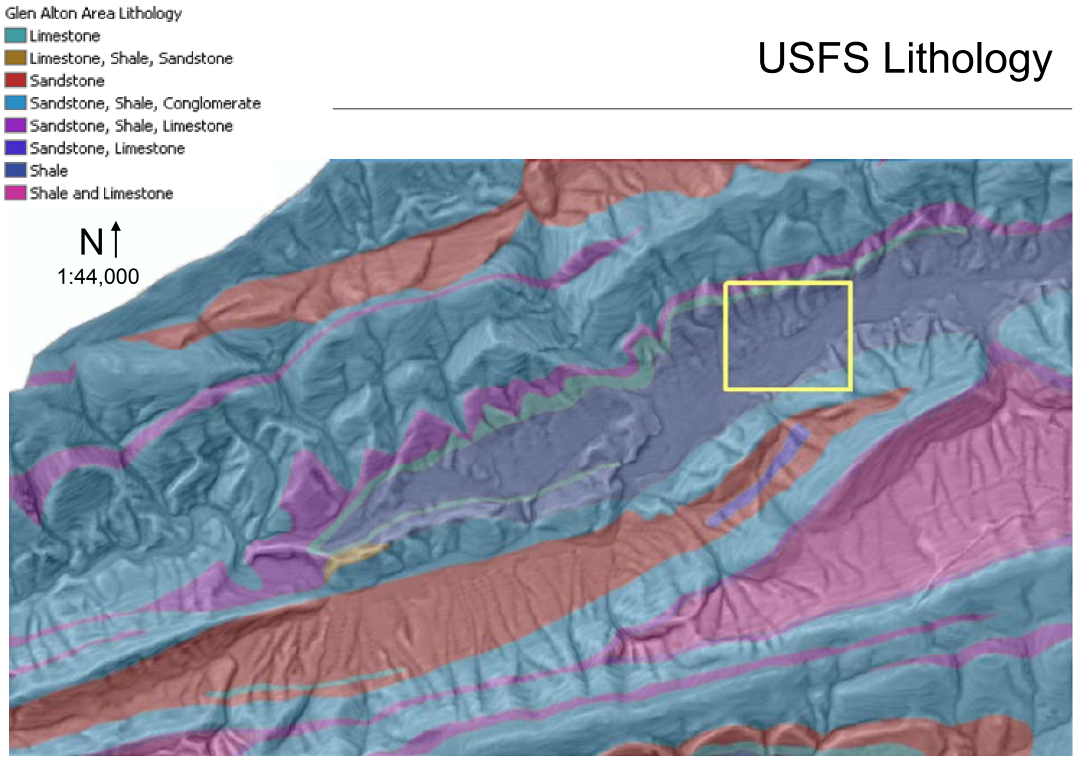
Topographic Relative Moisture Index



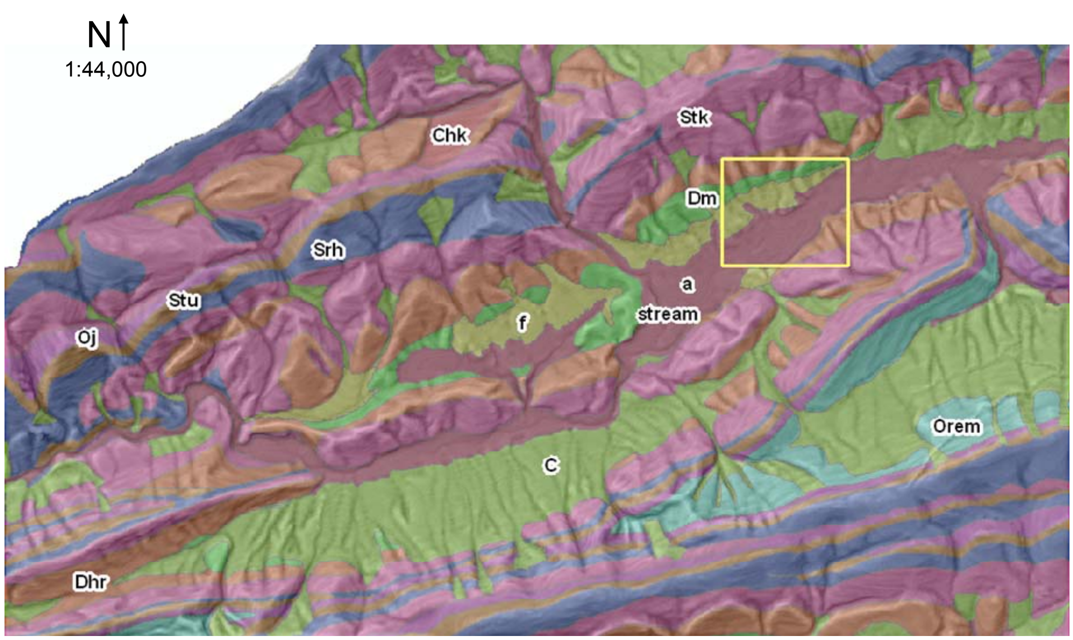
USFS Soils



USFS Lithology



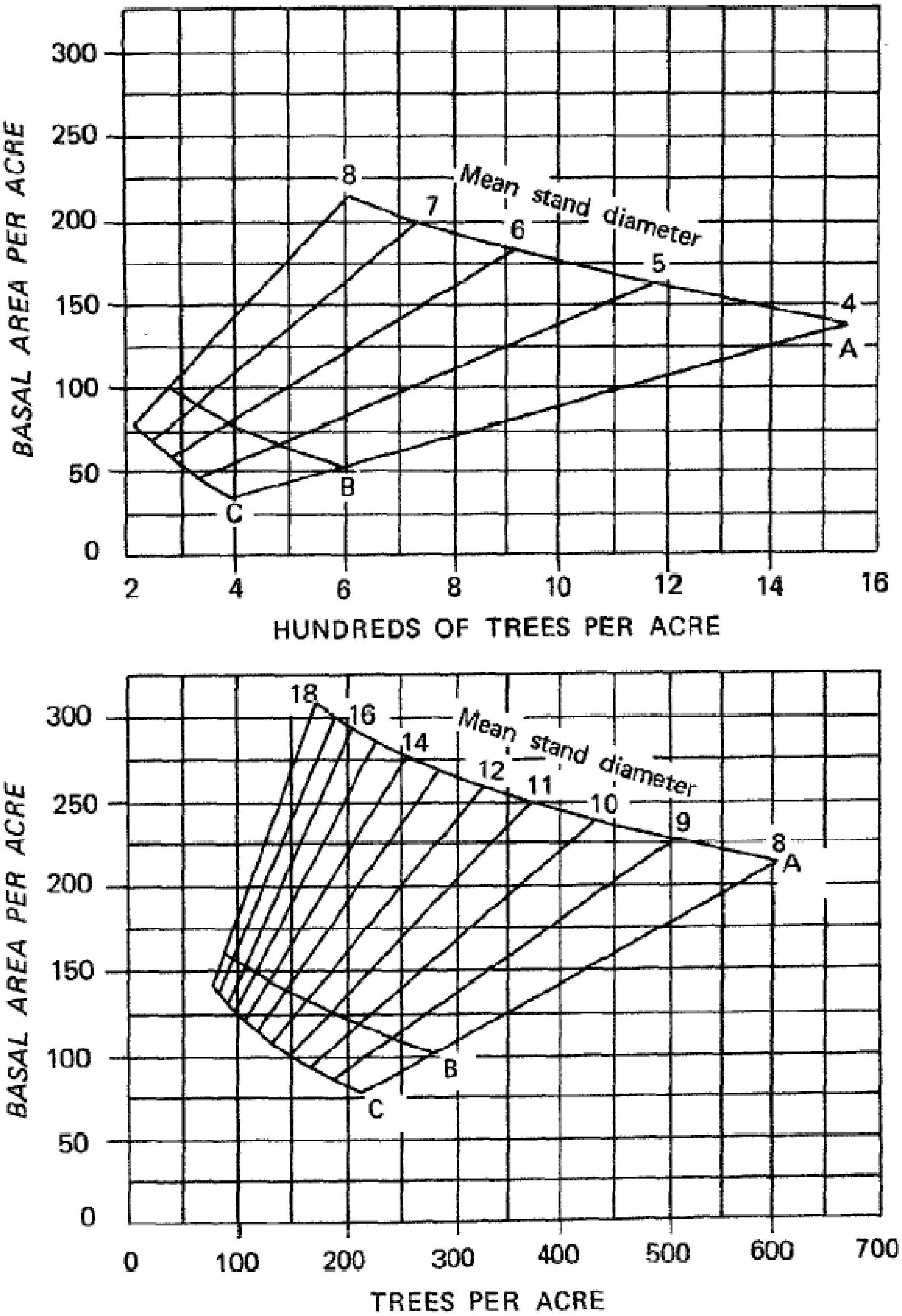
USGS Geologic Formation and Surface Geology



Background Material

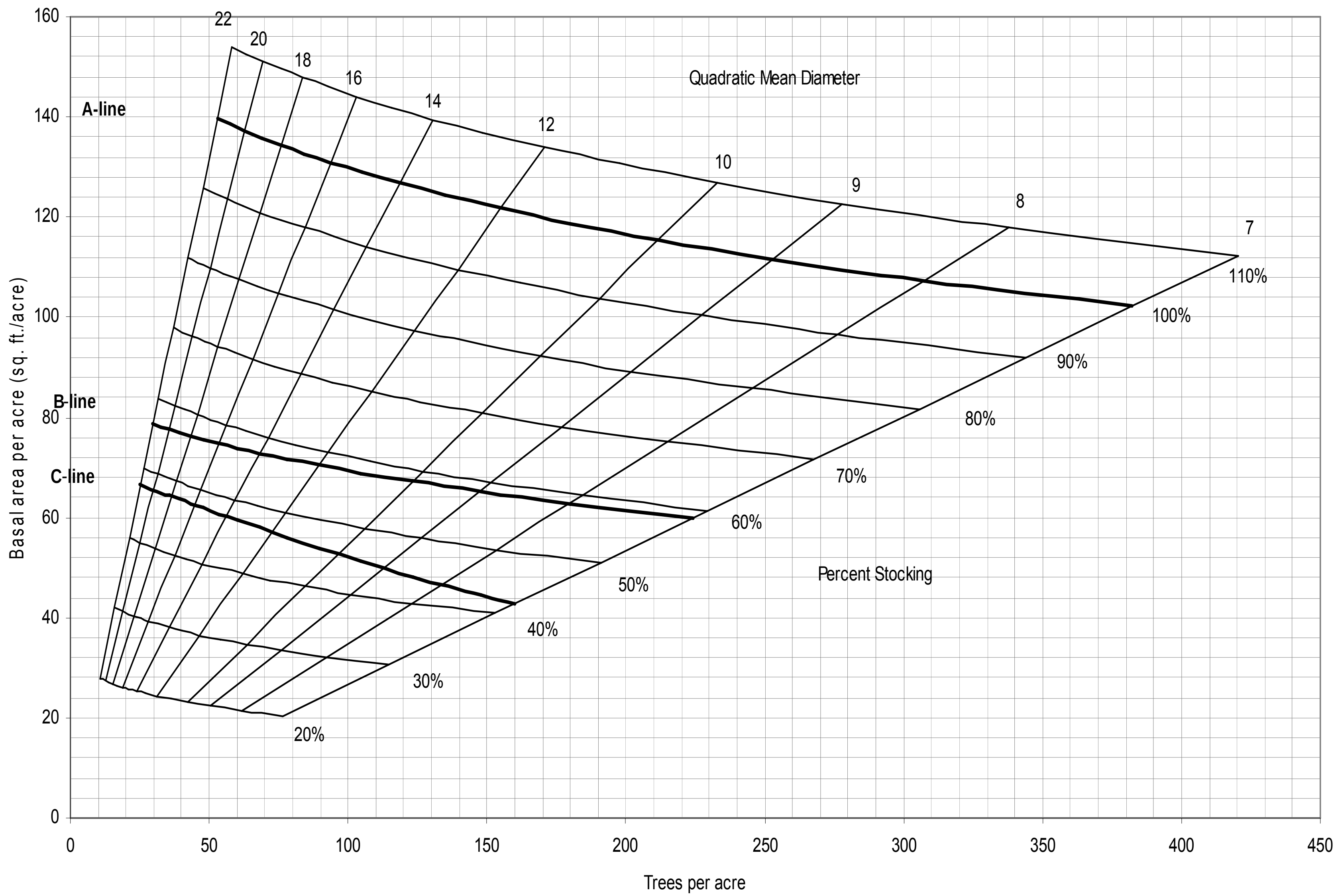
Upland Hardwood and White Pine Silviculture in the Appalachians

Figure 2.—Stocking chart for nearly pure even-aged white pine stands (Philbrook et al. 1973).

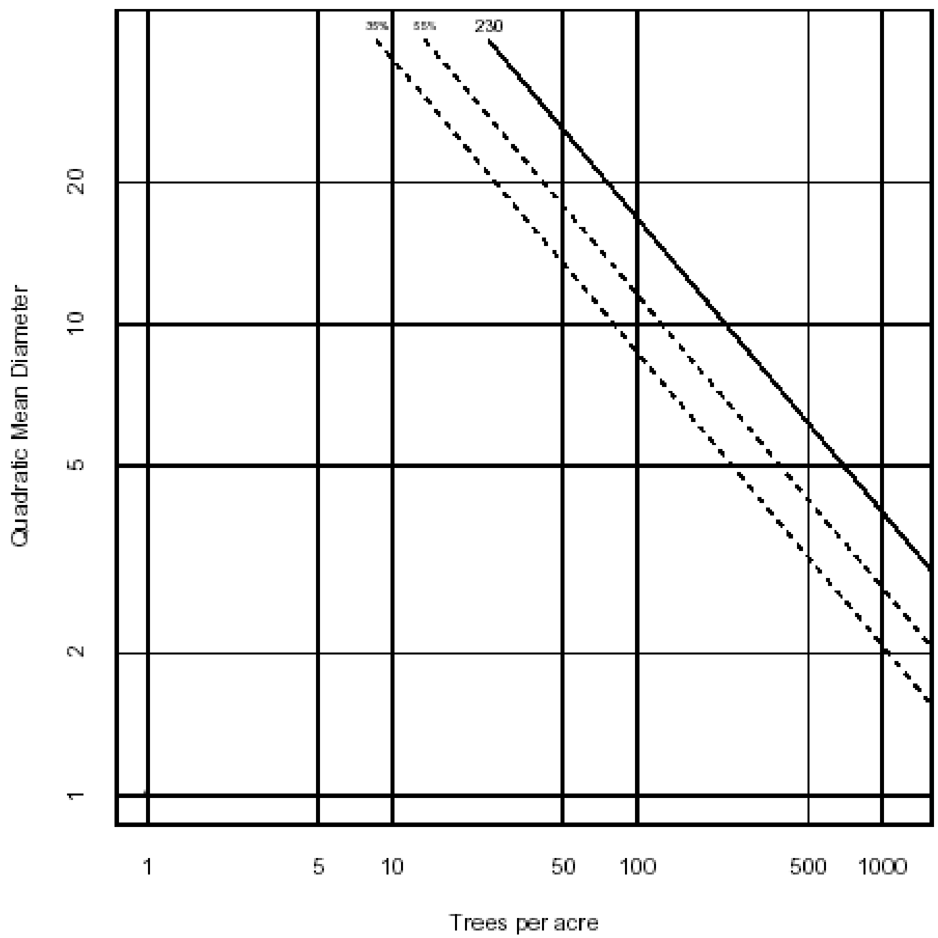


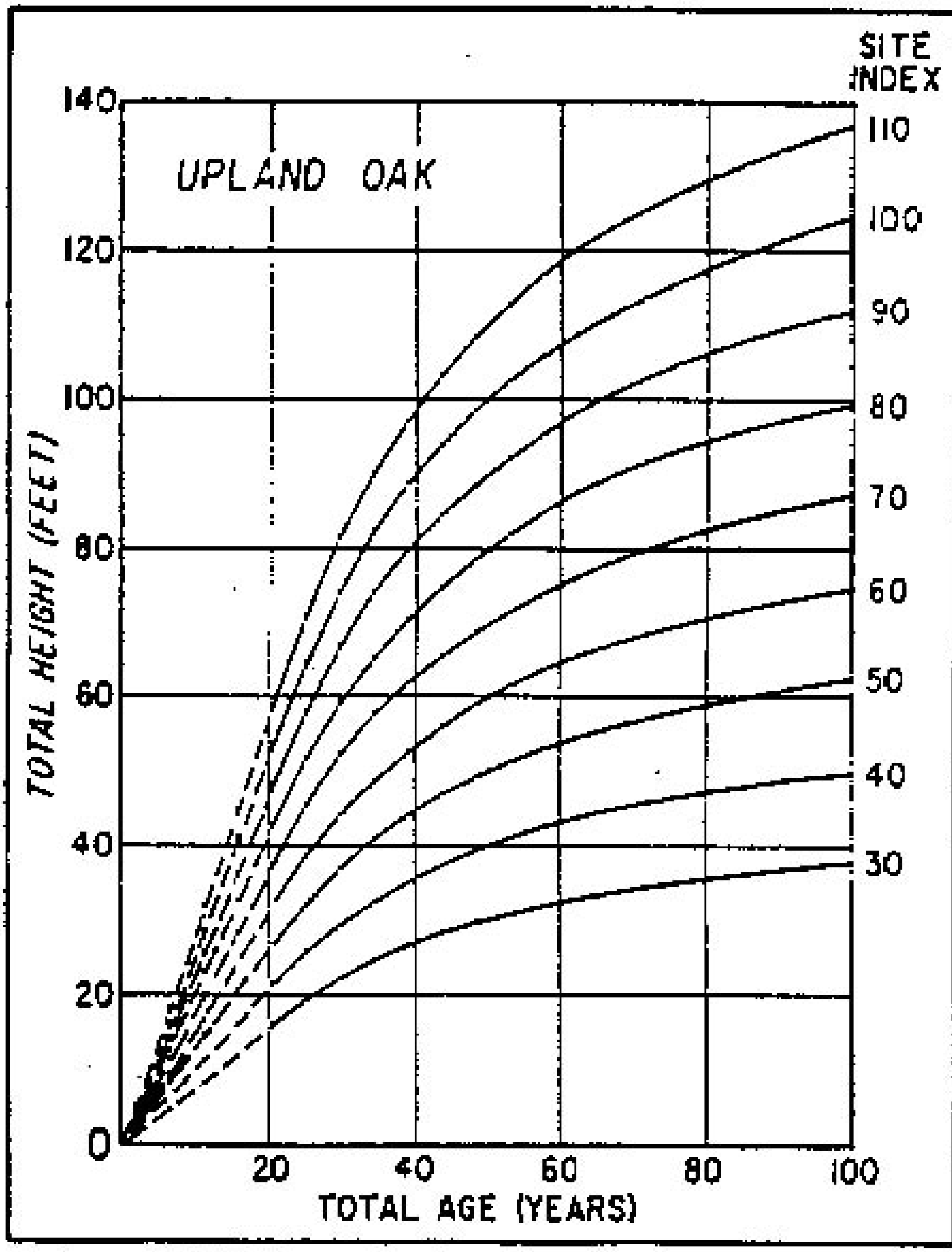
5

Stocking Diagram for Upland Oak

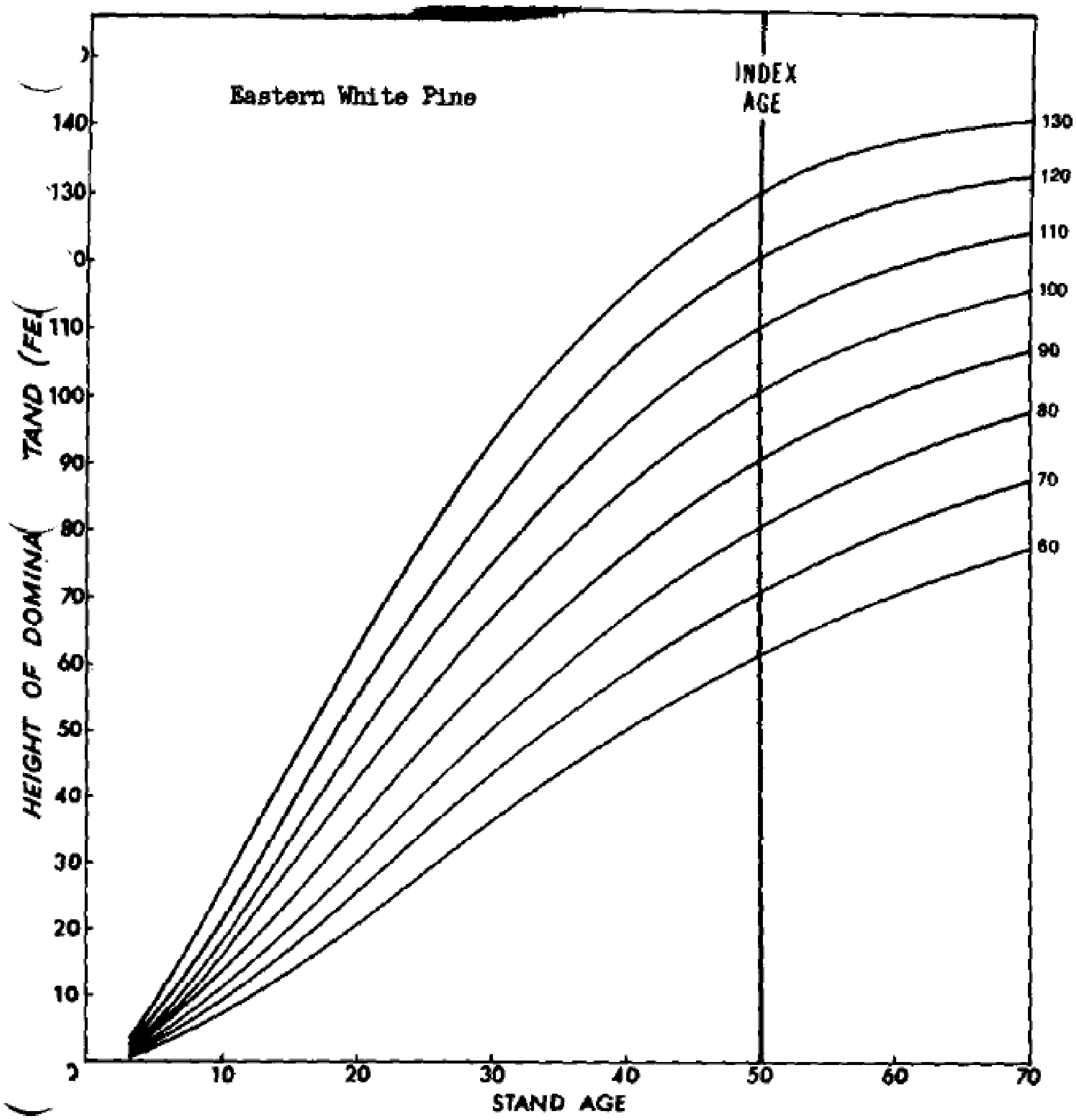


Stand Density Index for Upla nd Oak (Schnur 1937)





Source: USDA Forest Service Research Note No. SE-125. April 1959.



Polymorphic site index curves for natural stands of eastern white pine in the Southern Appalachians.

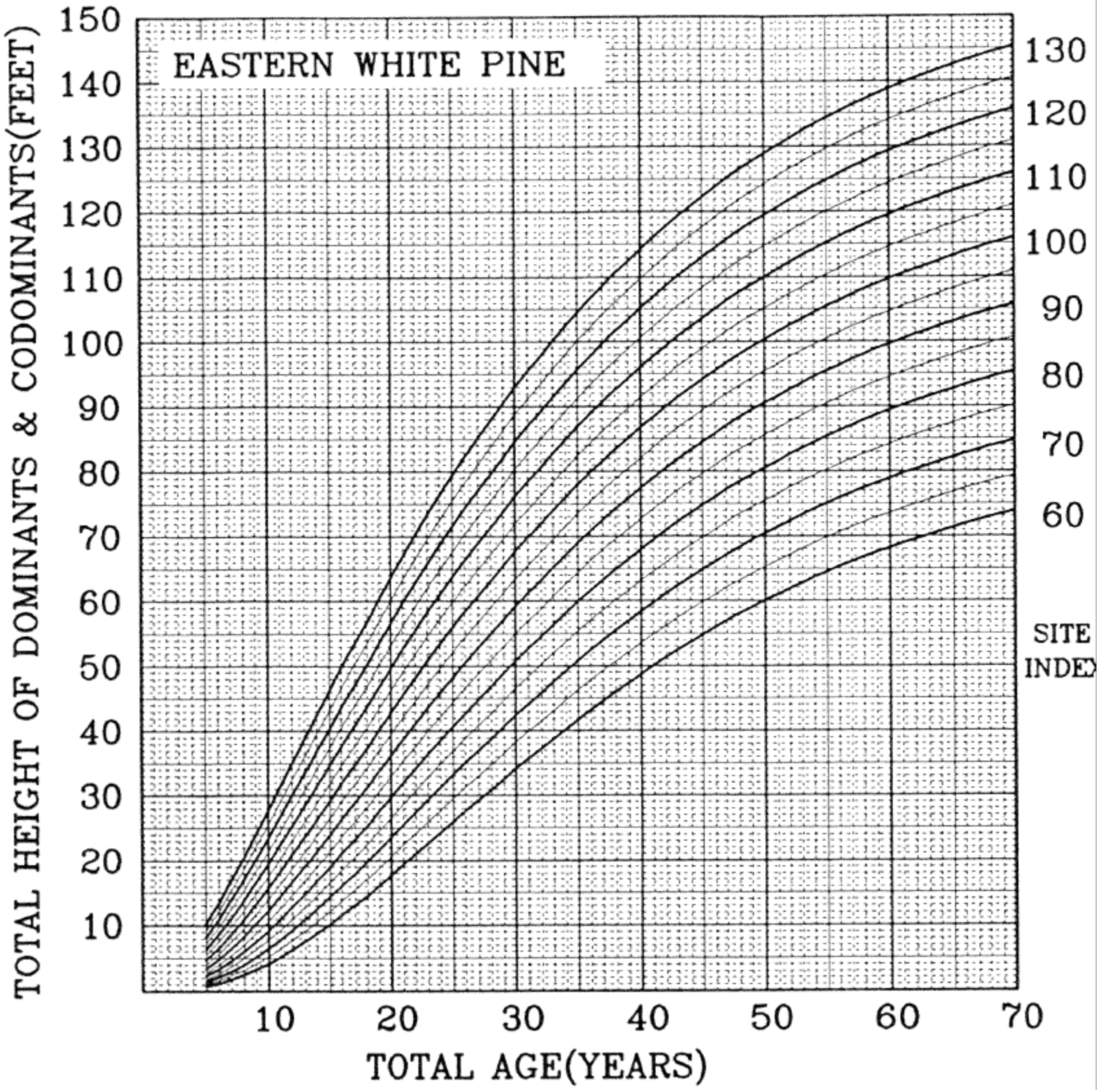


Figure 104.—Eastern white pine (Beck 1971a, 1971b)

Appalachian Mountains of Virginia, Tennessee, North Carolina, and Georgia

42 plots having 3 dominant and codominant trees on each plot

Stem analysis, polymorphic, nonlinear regression

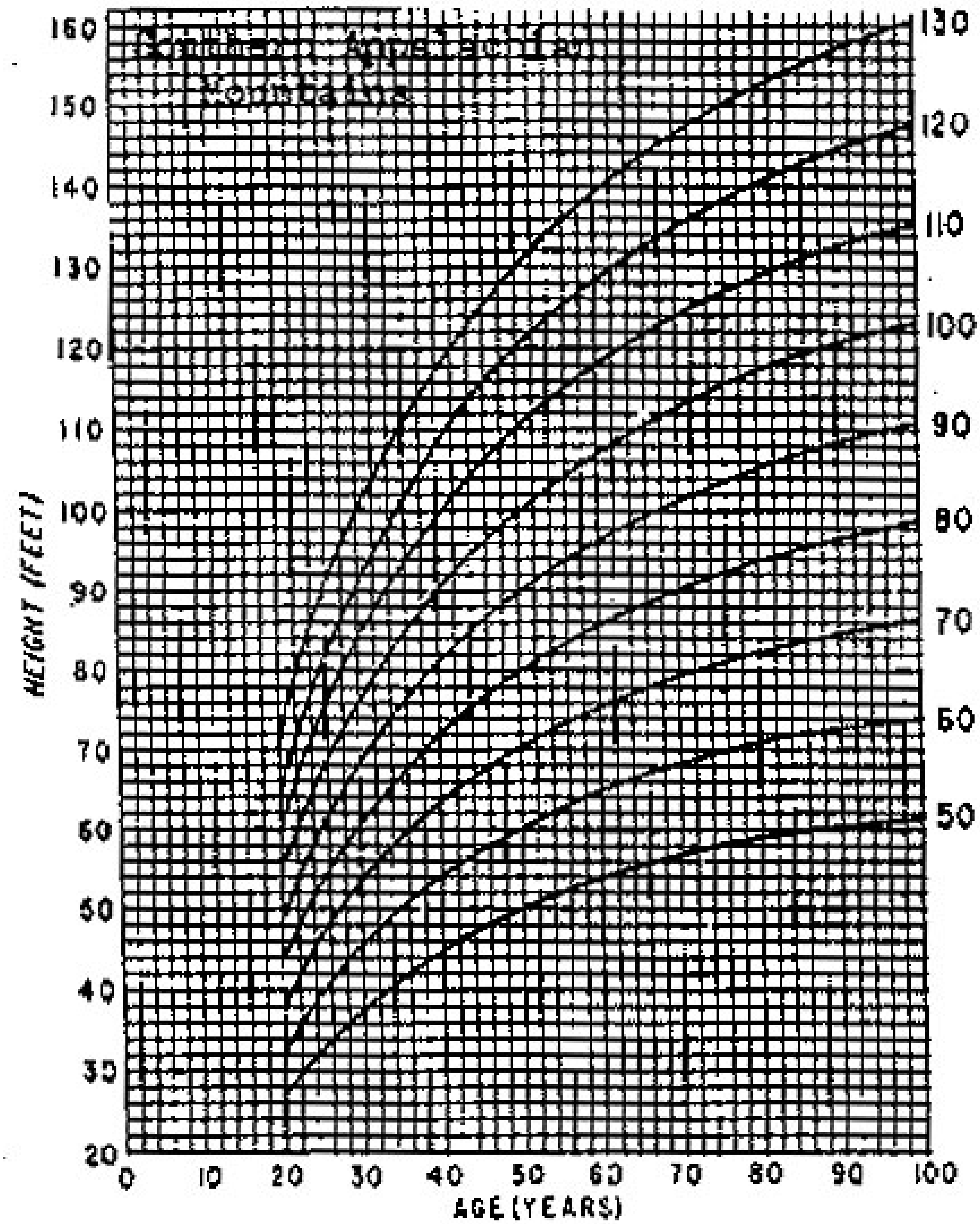
Convert d.b.h. age to total age by adding years according to site index (BH = 0.0):

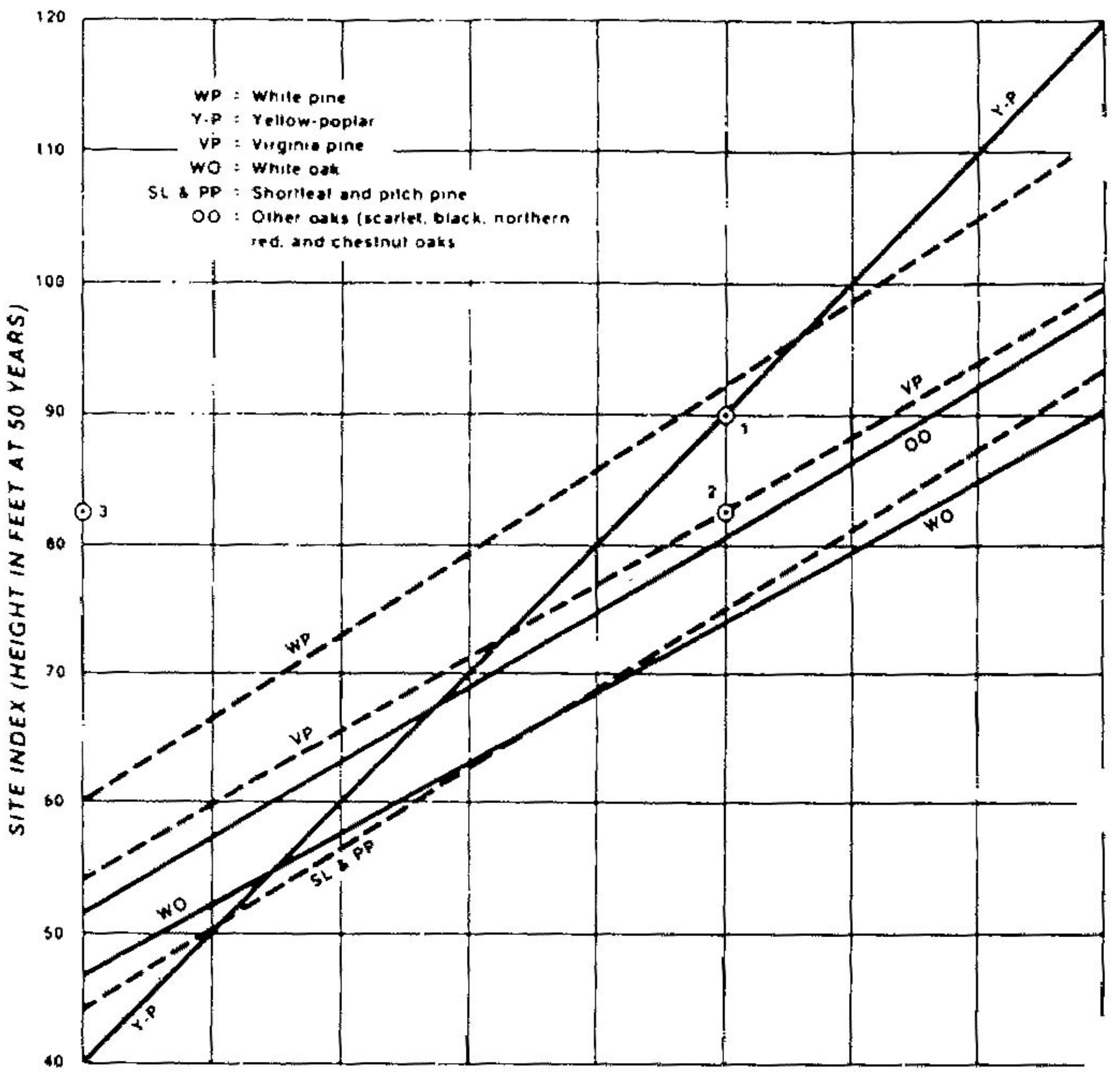
SI:	50-65	66-80	81-95	96-110	111+
Years:	7	6	5	4	3

	b_1	b_2	b_3	b_4	b_5	R^2	SE	Maximum difference
H	3.2425	0.7980	-0.0435	52.0549	-0.7064	0.99	2.24	2.8
SI	0.4732	1.0520	-0.0168	-2.2944	-0.1984	0.99	3.95	9.6

119

Yellow Poplar SI Curves





A SITE INDEX COMPARISON GRAPH FOR 10 SPECIES ON THE SAME LAND IN THE SOUTHERN APPALACHIANS. (DOOLITTLE 1958)

Impact of Site Quality on Growth and Value of Appalachian Hardwoods

Natural Upland Oak Stands (Schnur, 1937)					
	Site Quality Class				
	V	IV	III	II	I
SI (ft)	40	50	60	70	80
SI (% of maximum)	52	62	75	87	100
Bd Ft Vol (% of maximum)	22	38	57	78	100
Value (% of maximum)	10	15	30	60	100

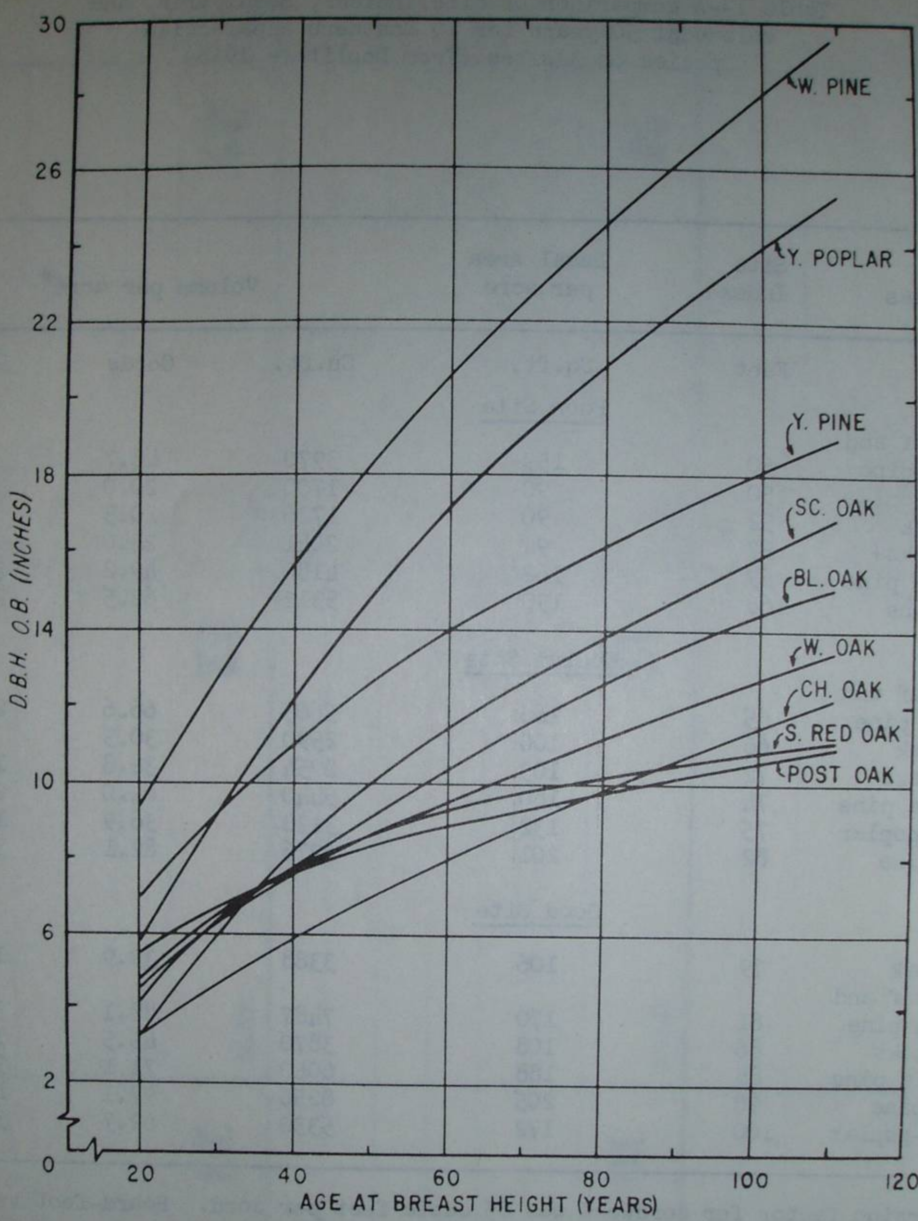


Figure 2--Comparative diameter growth of white pine and associated species. (From Barrett 1933)

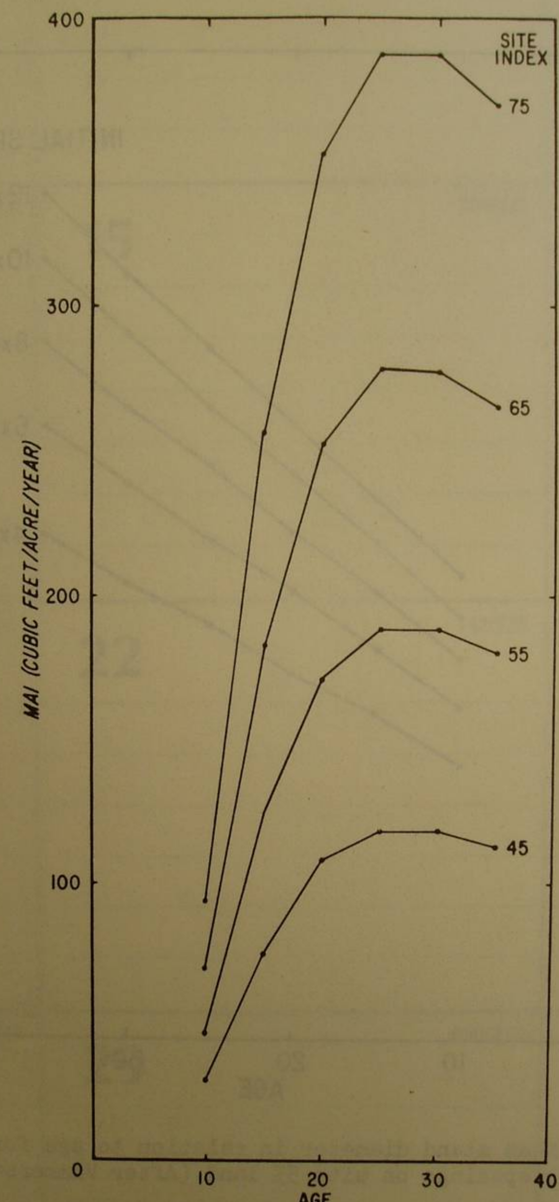


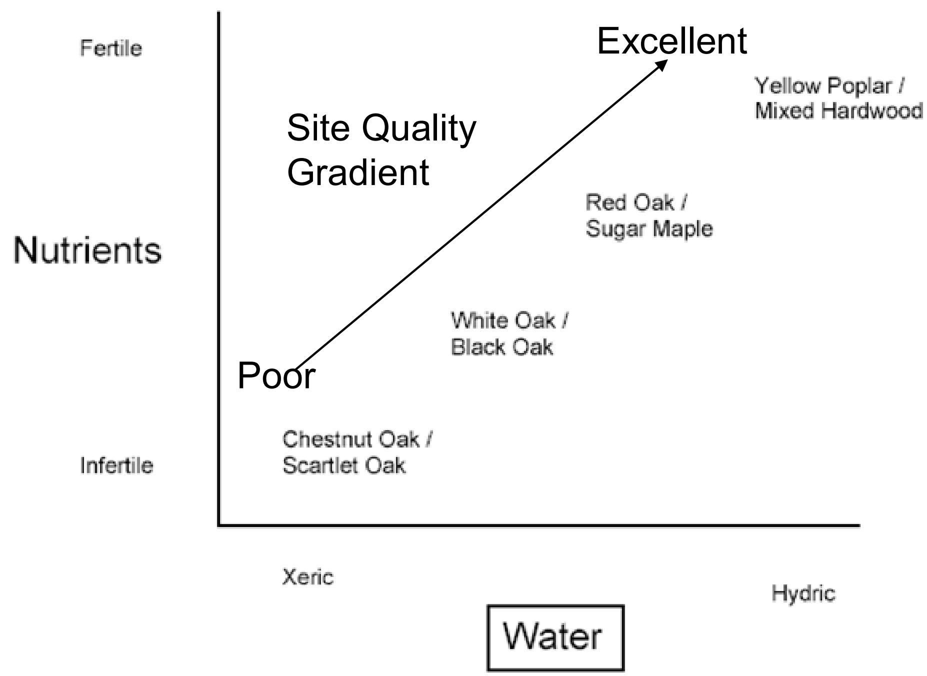
Figure 5--Mean annual increment in cubic-foot volume for white pine plantations by age and site index at 4 by 4 spacing. (After Vimmerstedt 1962)

Comparison of Site Indices, basal area and volume at 50 years for species in the southern Appalachians on three sites (Doolittle 1958)				
	Site Index	Basal Area	Volume	
	(feet)	ft^2/acre	ft^3/acre	Bd. Ft./acre[1]
		Poor Site Quality		
Yellow-Poplar	50	90	1700	3,500
White Oak	52	90	1726	3,860
Other Oak*	57	94	2041	5,385
White Pine	66	190	5312	23,920
Shortleaf Pine	50	159	3970	9,900
		Medium Site Quality		
Yellow-Poplar	75	132	3138	14,510
White Oak	66	100	2590	8,370
Other Oak*	72	103	2954	10,550
White Pine	82	201	6976	35,964
Shortleaf Pine	65	166	5665	22,750
		Good Site Quality		
Yellow-Poplar	100	172	5330	32,150
White Oak	79	106	3388	13,350
Other Oak*	86	108	3870	16,300
White Pine	98	205	8256	45,328
Shortleaf Pine	81	170	7487	36,465

1. Board foot volume are international 1/8 rule

* Other oak includes scarlet, black, chestnut and northern red.

Appalachian Region



Scarlet Oak-Chestnut Oak
White Oak SI < 55
Growth Rate: 32 ft^3/ac/yr
150 BF/ac/yr

White Oak – Black Oak
White Oak SI = 56 – 70
Growth Rate: 50 ft^3/ac/yr
235 BF/ac/yr

Red Oak – Sugar Maple
White Oak SI = 71 – 85
Growth Rate: 65 ft^3/ac/yr
320 BF/ac/yr

Yellow Poplar – Mixed Hardwoods
White Oak SI > 86
Growth Rate: 130 ft^3/ac/yr
650 BF/ac/yr