STUDY OF THE PROPERTIES, CLASSIFICATION, AND WOODLAND SITE QUALITY FOR HIGH ELEVATION SOILS IN WESTERN VIRGINIA

by

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(ABSTRACT)

Initial soil survey efforts in the George Washington National Forest reveal woodland site quality of timber stands to be higher than expected for the soils traditionally mapped in the area. Assessment of soil temperature data indicates the mesic-frigid boundary occurs at approximately 1200 m. This boundary is not absolute, and allows for adjustments as appropriate.

Available climatic data shows precipitation generally increases with increased elevation. This coupled with lower mean monthly air temperatures and decreasing evapotranspiration allows for greater amounts of plant available moisture during the growing season at higher elevations. In some locations at lower elevations, there may be a potential for growth limiting conditions controlled by plant available moisture during the later part of the growing season.

Approximately one-third of the soils sampled are classified as Loamy-skeletal, siliceous, mesic Typic Dystrochrepts. This soil typifies the soils found on summit, shoulder, and side slope landscape positions. The highest elevations have

Typic frigid Dystrochrepts representing the predominance of soils. Frigid soils have higher organic matter content, greater sand content, higher cation exchange properties, and less siliceous minerals in comparison to the mesic soils.

Comparison of the soils above to those occurring below selected elevations revealed an average 5 m greater site index for sites above 1100 m in comparison to all sites below. There are several soil properties that differ between these two groups of comparison. Total soil depth is greater and slope percent is less for soils above 1100 m. Soil organic matter and cation exchange capacity are higher on the sites with higher elevation, while base saturation and pH are lower.

From analysis conducted on the data, aspect may warrant separate map unit phases in mapping. Two properties between the east and west aspect are significantly different; organic matter and soil hydrogen are greater on the east aspect. Increased site index values of between 5 to 10 m on the east aspect, over the west aspect, are apparent for the high elevation sites.

Awareness of differences in productivity of this magnitude is important for management of the forest resource. A difference of 5 to 10 m in site index between two sites may have profound differences in the volume of timber, and, therefore, value of the site. The areas of best productivity need to be separated from those areas of normal productivity. In areas where the sites are accessible, and are under management for timber production, delineation of sites with high woodland site quality is essential since the primary land use is timber production.

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Press on. Nothing in the world can take the place of persistence. Talent will not; nothing in the world is more common than unsuccessful men with talent. Genius will not; unrewarded genius is a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent.

--Calvin Coolidge

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INTRODUCTION

Rationale

Initial soil survey efforts in the Warm Springs Ranger District of the George Washington National Forest reveal woodland site quality to be higher than expected for the soils traditionally mapped and recognized within the area. The principal soils described have morphology within the Berks, Weikert, Gilpin, and Dekalb series, which are currently classified within a mesic temperature regime. A review of climatic data for West Virginia counties bordering the study area indicates precipitation distribution and temperature are considerably different from patterns normally associated with these soil series. The effects on woodland site quality appears to be that cooler temperatures and a more advantageous precipitation pattern may be over-riding what are considered normally "limiting" soil properties such as shallow depths to bedrock and low fertility. The result is a higher woodland site quality than expected for these soil series.

West Virginia has established four new soil series with similar morphology to the Berks, Gilpin, Weikert, and Dekalb, but with a characteristic climate that places them into a frigid temperature classification at the family level. For example, the Mandy series has been established as a frigid counterpart to the Berks soils. In the past, site evaluators had used critical phase criteria where high rainfall had increased timber yields for Dekalb soils.

The questions still to be fully answered are: 1) Are theses high altitude soils better defined by a frigid temperature regime? 2) Are changes in climate enough to over-ride soil properties in influencing woodland site productivity? 3) What is the woodland site quality for prevalent tree species in the survey area?

Currently there is insufficient data to:

1) determine the presence of a frigid temperature regime in this area,

2) prove that climatic factors do indeed over-ride soil properties in influencing woodland productivity, and

3) determine the actual woodland site quality for prevalent tree species in the area as they relate to soil series and their phases.

This study is proposed to gather data to improve the classification, correlation, and interpretation of soils in the study area, similar soils throughout Southwest Virginia, and the region.

Objectives

These are the goals of this study:

1) Soil temperature was measured and considered with climatic data for quantification of temperature and precipitation in the region. This climatic information may result in a different classification, which will affect the correlation and interpretation of the soils in the area and related areas in the

state and region.

2) The evaluation of soil characteristics and properties utilizing field descriptions and laboratory analyses will be made to relate soil influences to woodland site quality.

3) The development of woodland site quality data on major landscape positions in the study area will be made. This data will be used for Forest Service (FS) management programs and to provide woodland interpretative data for state and regional use. The determination of whether aspect is a key factor warranting separate map unit phases in mapping will be a major objective.

Study Area

The area studied lies within the George Washington National Forest along the western border of Virginia in western Allegheny, Bath, and Highland Counties. The approximate southern limit of the study area is in south central Alleghany county near Hematite. The study area extends northeastward, nearly parallel to the mountains, to northern Highland county near Hightown. The Virginia-West Virginia state line forms the western border. In the southern portion of the study area the eastern boundary extends as far east as Clifton Forge; while in the northern portion, the study area extends as far east as Hightown.

The study area is within Major Land Resource Area (MLRA) 128 as shown on current maps. The study area can be located on the Thornwood, Snowy Mountain, Paddy Knob, Minnehana Springs, and Mustoe quadrangles.

Elevations in the proposed study area range from about 670 m (2200 feet) in several valley bottoms to about 1400 m (4600 feet) on Paddy Knob on the Bath-Highland county line. The Laurel Fork area in northwest Highland County may be better recognized as part of the Allegheny Plateau and is not highly dissected, with elevations of 915 to 1100 meters (3000 to 3600 feet). The remainder of the study area is highly dissected with extreme changes in elevation.

LITERATURE REVIEW

Introduction

Modern forest management attempts to maximize yield from a site while minimizing environmental damage. The scientific management of a forest requires knowledge of the maximum productive capacity of the land, in order to set this maximum potential as the ultimate goal of production. Maximum productivity of a site cannot be achieved without reliable predictions of the performance of trees that might be grown there (Broadfoot, 1969). Obtaining an accurate estimate of the potential productive capacity of bare land, or land in immature trees, however, is one of the most difficult problems confronting forest managers. (Van Lear and Hosner, 1967). Development of a forest soil survey helps foresters to determine site quality by providing a summary of information on site factors: climate, soil, and topography. Wilde (1958) describes this indispensable tool as the first and probably the most important step in forest management.

Mader (1964) suggests that a reasonable goal for tree growth prediction should be prediction of growth potential within ±5% in 95% of cases. The ultimate goal Mader suggests is the capacity to identify the exact factors limiting growth, including genetic variation, and the magnitude of response to be expected from changes in these factors.

According to Smalley (1985), the United States Forest Service, in cooperation with several other federal agencies, has begun to develop a comprehensive national land classification system. Tentative agreement was reached in 1979 to use a component system consisting of soil, vegetation, landform, and water. Preliminary testing indicated that additional work on the vegetation component and criteria for using each component is needed. Progress has been made toward standardization and agreement on general principles, but, there continue to be differing opinions as to what type of system is "best" and whether a single system for all lands is desirable or even possible (Larson and Schlatterer, 1984). Broadfoot (1969) concluded from research on southern hardwoods that sites cannot be accurately evaluated for southern hardwood timber production with equations derived over broad areas and complex land patterns. For this reason, Pierpoint (1984) claims it is unrealistic to expect a comprehensive universal classification that will serve all users, beyond providing a broad regional framework for broad land-use planning.

Reasoning such as this has led researchers to investigate regional soil-site-vegetation relationships. The number of soil site studies peaked in the 1960's and then decreased steadily, despite increasing support for forestry research (Stone, 1977). Several reasons for the decline have been identified. First, assumptions about sample selection and statistical manipulation often were not as sound as researchers believed (Broadfoot, 1969). Second, soil-site studies usually yield graphs and equations. These could not be readily used by forest managers, who were more in need of maps and soil inventories. Third, concepts of soil-tree relationships were generally far too simplistic (Stone, 1977).

Stone (1977) states that soil maps and classification systems are essential but must be interpreted in terms of tree response in order to be useful. He criticizes soil survey units as being too broad in definition, giving too little attention to variation in drainage or substrate properties, or allowing too much inclusion of unlike soils in actual mapping practice. Stone proposes that these problems could be largely overcome by higher levels of mapping intensity, control, and interpretation.

The United States Forest Service uses the Basic System of Soil Classification in making and interpreting soil surveys, Soil Taxonomy. Essential criteria for the mapping units are: 1) they must have realistic application to land management; 2) they must be communicable to the user; and 3) they must be based on sound principles that with proper field documentation can be correlated (Aydelott, 1978). Basically, the system separates the landscape into geomorphological parts called landforms. The landforms are further separated into relatively homogenous management units called Ecological Management Units.

The objectives of land classification systems currently in use by the Forest Service are to: 1) identify land units with similar characteristics; 2) increase understanding of ecosystem relationships; 3) increase efficiency of inventory procedures; 4) improve interpretations for management; and 5) facilitate exchange of information and extrapolation of research results (Larson and Schlatterer, 1984). Substantial areas of National Forest land have been mapped utilizing these systems.

Most believe that a hierarchial land classification system would be best. Such a system would allow for aggregation and disaggregation at different levels and could be separated for different properties and management concerns. There is a need to develop a classification system for vegetation that would be taxonomic, and have distinguishable boundaries in a continuous vegetative system. (Larson and Schlatterer, 1984).

Creating a classification system for vegetation and productivity alone has proven to be very difficult. Accounting for all variables affecting vegetative growth and performance seems unreasonable. Pritchett and Fisher (1987) allude to the "great task at hand" because the capacity of a tree species to thrive and compete successfully on a particular site is influenced by both internal (physiological) and external (environmental) factors. The integration of these combined properties determines forest productivity. Of particular concern are the environmental or site factors because tree physiology is difficult to control. External factors largely determine site quality: the inherent capacity of the site to produce plant growth. Site quality is a function of the physiography, climate, soil, and other features of the environment that are not easily altered.

Approaches to Woodland Site Quality Determination

Numerous studies have attempted to correlate vegetation performance and soils, but many have failed to show consistent relationships (Carmean, 1967; Fosberg et al., 1990; Shetron, 1972; Van Lear and Hosner, 1967). The basic concepts of soil and plant sciences state that plants and soils are influenced by like factors. Furthermore, vegetation is related to the whole soil, not to a single soil variable or group of variables (Fosberg et al., 1990).

Factorial Approach

Factorial studies of forest site productivity began in the 1930's. By 1975 about 150 of these regression studies had been conducted throughout the country. Equations and charts derived from such studies are used to evaluate forest site quality in many areas of the United States (Hudson, 1983).

The factorial approach to site evaluation involves measuring tree heights and ages on many plots of varying site quality. Soil and topographic factors believed to affect tree growth are measured on each plot. Tree height is then correlated to age, soil, and topographic factors using linear regression. Equations of the following general form are developed (Hudson, 1983; Meiners, 1982):

Tree height = a + b (Age) + b_1 (soil property 1) + b_2 (soil property 2) + ... + b_n (soil property n)

Most workers calculate some measure of precision, such as a coefficient of determination or standard deviation, to accompany the derived equation. This method of estimation normally explains about 50 to 90 percent of the total height of a tree (Hudson, 1983).

Most studies yield equations that relate site index to soil or topographic factors that affect the soil's moisture-supplying capacity. Variables commonly included in soil-site equations are soil depth, soil texture, available water capacity, depth to mottling, percent slope, slope position, and aspect (Hudson, 1983).

Some researchers believe that only a few factors would satisfactorily explain site differences over a wide range of conditions. Mader (1964) states that the factorial method has been the most successful predictive technique developed. The accuracy of results achieved might be rated as fair. Hudson (1983) cites several researchers on the precision of the factorial approach. Hudson cites Ralston (1964), who optimistically states that the error of individual estimates usually approaches only 10 percent of observed total tree height. Some studies (Carmean, 1965; as referenced by Hudson, 1983) have been able to explain up to 80 percent of the variation in tree height, but few studies approach Ralston's expectation.

Holistic Approach

Another approach to classifying forest sites involves the use of soil series. This has been termed the holistic approach. In this procedure, soil is classified at the series level and then data are collected to determine the average forest productivity of soils in each series. One benefit of the holistic over the factorial approach is illustrated by Pritchett and Fisher (1987), who state that it is essential to consider all factors when assessing site productivity, because more than one factor often limits tree growth on the same site. Also, there are often positive interactions among factors, and in some instances, one factor may substitute or compensate for another factor. One disadvantage to the holistic system is that productivity can vary significantly for a given soil series.

Hudson (1983) states that research results are ambiguous. Most foresters concede that there is usually a measurable correlation; they simply assert that the correlation is too weak to be of any practical use. This view is also expressed by Broerman (1978), who states soil series are not adequate for forest management purposes because more specific site information is needed. Others, more harsh in their appraisal, assert that there is no correlation at all between soil series and forest site quality (Coile, 1959).

Approaches in Determination of Site Quality

Hundreds of soil site studies to date attempt to correlate abiotic environmental factors with tree growth. Researchers take greatly diverse approaches to the problem because soil properties significantly correlated with forest growth in one region may not be significant in another region due to differences in tree species, climate, length of growing season, or other limiting factors.

Ford (1983) states that there are many difficulties in using site surveys to analyze factors that control growth. He suggests that the most important problems are: 1) the selection of variables to include in the analysis; 2) sometimes environmental variables such as elevation and rainfall are themselves correlated; 3) variation in the measurement and assessment of soil conditions; 4) restriction of sites surveyed to a narrow age band; and 5) different relationships may be obtained in different sub-regions of an investigated area.

Most of the land classification systems in use by the Forest Service have the same purpose: to delineate and describe units of land that are more or less homogenous with respect to the relationships among vegetation, soil, and landform. To meet management objectives, the Forest Service in many regions of the United States have created their own site classification system (Larson and Schlatterer, 1984).

Use and Influence of Soils in Determination of Site Quality

On the regional level, climate is believed to be the primary controlling factor of forest growth. Many researchers have focused on soil, because climate is thought to change only a small extent over a large area.

Several advantages exist to using the soils approach to estimate site productivity. First, soil does not change dramatically within short time periods. Second, soil often has a controlling influence on tree growth. Third, measures of site quality based on soil properties are independent of ambient vegetation and can be used to evaluate potential productivity of cutover or nonforested areas (Hudson, 1983). Also, soils are objective rather than subjective, can be aggregated to fit a smaller scale, are suitable for a wide variety of uses, and can be integrated into a geographic information system (Fisher, 1990).

Soil chemical properties and site quality. A wide divergence of opinion concerning the use of chemical analyses to measure soil fertility or nutrient availability in soil-site studies exists (Mader, 1964). Some researchers contend that soil physical conditions are of such overriding importance in site studies that soil fertility should be ignored. This attitude is based on lack of success in most studies that have attempted to relate soil fertility to site quality (Auten, 1945; Coile, 1952; Van Lear and Hosner, 1967). However, in some cases (Mader, 1964) correlation of growth with soil chemical properties has been successful. In a study by Brown and Loewenstein (1978) site index was negatively correlated with elevation, and positively correlated with extractable calcium, exchangeable acidity, cation exchange capacity, organic matter, total nitrogen, soil to rock ratio of the buried soil, and the clay content of ash derived soils.

Auten (1945) collected soil chemical and physical data on the growth of yellow poplar, and concluded that no chemical factor was correlated with site index. Depth of the A horizon and depth of organic matter incorporation was, however, related to site index. Depth of organic matter penetration is an indirect measurement of soil moisture, as well as the depth of soil to "tight" subsoil.

More recently, Mader (1964), working with eastern white pine, found that soil chemical properties accounted for an additional 13% of the variation in site quality not explained by topographic features or soil physical properties. Also a large body of literature exists concerning forest fertilization, a considerable part of which indicates positive response to various nutrients (Mader, 1964).

Brown and Loewenstein (1978) found soil features most closely associated with site index included soil to rock ratio, percent organic matter, and exchangeable acidity. In some of their equations, they used tree age to explain some of the variation; in some instances as much as 71 percent.

Soil physical properties and site quality. The debate between chemical versus physical properties may have arisen partly because a large majority of soil-site studies have evolved to concentrate on measurable physical properties and their relationships to tree growth, rather than on soil chemical properties, for several reasons. First, soil physical properties are readily measured in the field and results are immediately obtained. Second, soil chemical properties often require laboratory analysis and may be expensive. Third, soil physical properties do reflect, in part, the chemical nature of the soil (e.g., texture, depth, color, litter layer type, etc.).

Einspahr and McComb (1951) found soil physical properties had better correlation with forest tree growth than level of soil nutrients. Topographic position, aspect, depth of soil to bedrock, and percent slope were the most important factors affecting growth of oak. The influence of soil depth on growth was greater on southerly slopes than on northerly slopes. Site index increased with decreasing slope, and site index was also greater on northerly than on southerly aspects. A comparison was made of site index in relation to topographic position; plots were classified into upper, middle, and lower slope positions. Differences in site index between lower and middle slopes were significant, but not between the middle and upper slopes.

Brown and Duncan (1990) used stepwise regression to show four significant factors were related to red pine growth: azimuth, distance of site from ridgetop, thickness of the A horizon, and percent clay in the B horizon. Results showed 95% of the trees were estimated to within 15% of their actual height. Regression equations used by Carmean (1967) contained only topographic features and accounted for 75% of the variation of tree height of black oak. If soil physical properties were included with the topographic factors, 84% of the variation was accounted for.

Soil depth controls the volume of soil available to tree roots. This volume influences tree growth by affecting nutrient and moisture supplies, root development, and anchorage against windthrow. Trees growing on shallow soils are generally less well supplied with water and nutrients than trees on deep soils (Pritchett and Fisher, 1987). When a restricting layer such as a claypan, fragipan, or bedrock exist, depth measurements can be used with some precision to predict growth pattern in well drained-soils. Growth normally follows a trend that can be expressed as a reciprocal function of soil depth, with greatest decline in growth found on soils with less than 25 cm of effective depth. Some difficulty in using soil depth to estimate productivity may be encountered when drought, erosion, or poor drainage reduce the available soil volume for root growth (Pritchett and Fisher, 1987).

To determine potential soil productivity for tree growth, the Soil Conservation Service (SCS) relates site index to soil taxonomic units. The SCS has been the principal proponent of evaluating forest site quality, or potential productivity. The Soil Conservation Service uses a holistic approach rather than a factorial approach because the landscape is classified as a whole unit containing most edaphic factors relevant to tree growth (Wiggins, 1978).

Ike and Huppuch (1968) report site quality for several species (yellow-poplar, eastern white pine, and shortleaf pine) is related to soil series in the Georgia Blue Ridge Mountains. In this study, the site index for yellow poplar increased with an increase in elevation, possibly because of increased precipitation. Topographic site characteristics were more strongly correlated with site index of all species in the study than were either chemical or physical soil characteristics. Most reliable were those site features that influence climate and moisture supply, such as elevation, position on slope, aspect, and steepness of slope.

Einspahr and McComb (1951) found soil classification at the series level appears to be a much more precise predictor of tree height growth than several factorial studies conducted in the region. The holistic approach has been criticized because broadly defined soil series used 15 or 20 years ago predicted a wide range of growth, making the soil survey of little value in predicting potential productivity (e.g., Carmean, 1961). Hudson (1983), studying loblolly and slash pines, found statistical measures that indicated tree height was uniform within the soil series evaluated. Within soil series, tree height could be predicted from tree age with average standard deviations of 5.1 feet for loblolly pine and 4.4 feet for slash pine.

One use of the soil survey is the evaluation of a site for tree growth. However, site quality may vary widely within a given series. Some difficulties in using SCS soil series are illustrated by Grigal (1984); first, in the estimation of site productivity, site index is used, but two-thirds of all values are within one standard deviation of the mean. Separating soils by their productivity potential may be difficult; and, second when using site index, one assumes that the polymorphic curve is accurate.

Carmean (1954) concluded that site quality is controlled by the amount of available soil moisture supplied to the tree roots during the growing season in the Douglas-fir region of Washington. Site quality increased with an increase in total annual precipitation and with an increase in depth to the substratum. Site quality increased with an increase in the product of moisture equivalent and gravel content of soil layers above the substratum, thus indicating that the adverse effect of gravel is not as pronounced with fine textured soils. Site quality decreased with an increase in elevation and with an increase in the gravel content and compaction of the soil layers above the substratum.

Coile (1952), in a summary of literature up to 1951, found that aspect, exposure, topography, depth of soil, water table, and other readily measurable site properties were related to site quality. Beck (1971), Carmean (1954, 1967), Ike and Huppuch (1968), Meiners (1982), McClurkin (1963), and Steinbrenner (1975) have also found similar relationships.

Almost certainly, productivity is determined by moisture and nutrient availability during the growing season, aeration, and physical conditions including root-growing space (Broadfoot 1969). Broadfoot claims available moisture is the single most important determinant of productivity. However, available water capacity, presence of a pan, and texture do not accurately indicate how much soil moisture is available during the growing season. Other factors, evapotranspiration, for instance, must be considered simultaneously throughout the growing season.

Pritchett and Fisher (1987) reported that Ralston (1964) and Carmean (1975) reviewed research and found soil factors most correlated with site productivity were soil moisture, nutrients, and aeration. Pritchett and Fisher concur, stating that the recent emphasis on soil fertility factors has not shown better correlation than available water with productivity of many tree species.

Site quality has repeatedly shown better correlation with soil physical and site properties than with chemical properties, fertility level, or indicator species (Coile, 1952; Doolittle, 1957; Einspahr and McComb, 1951; Gysel and Arend, 1953; Trimble and Weitzman, 1956).

Use of Vegetation in Determination of Site Quality

Researchers have not been able to link vegetation to soils or landform in all parts of the United States. Classifying habitat types by plant communities has been quite rare in the southeast because of the high degree of human disturbance. In the southeast, some late successional communities, nearly always hardwoods, have been identified, yet, have had limited use. Vegetation associations have been used in selected areas to predict site productivity; this approach is difficult if native climax vegetation no longer exists (Fosberg et al. 1990). Many western forest plant communities that lead to climax communities have been identified, and thus, estimation of site quality can be made without the presence of a climax community (Cline and Loftus, 1990). Although its strict endorsement is not promoted by forest researchers, classification by vegetation habitat could have the potential to complement other classification systems such as physiographic site classification and soil surveys to provide more comprehensive methods of site quality prediction (Grigal, 1984). The use of ecological concepts (habitat type classification) is stressed as a means of classification, but these are still artificial boundaries imposed by humans.

Use and Influence of Topographic Features in Determination of Site Quality

There is little doubt concerning the relationship between landform and woodland site quality in many parts of the United States; however, the large scale at which woodland site inventories need to be conducted does not suit the woodland manager. The variability of the large scale limits the precision of woodland site quality predictions. Forest managers need an inventory system that will work at the scale stands of timber are managed. For this reason researchers have attempted to find associations between vegetation and other abiotic features such as soils and landscape position. In mountainous or hilly terrain, topographic features are often equally or more important to site quality than soil factors (Doolittle, 1957; Ike and Huppuch, 1968; McNab, 1987, 1989; Rightmeyer and Keys, 1991; and Van Lear, 1991).

Topography exerts an effect on growth through local modification of climate and edaphic variables, particularly moisture, light, and temperature regimes. Associations between site quality and physiography may be evaluated as measurable topographic characteristics such as altitude, aspect, and slope gradient. Alternatively, such associations may be evaluated as discrete geographic position categories, such as ridges, slopes, coves, and bottoms. The former treatment is most appropriate to areas of rugged mountainous terrain, while the latter method is the preferred system to use in regions of moderate relief (Pritchett and Fisher, 1987).

Meiners (1982) reports that oak site quality in the Appalachians can be estimated from (1) aspect, (2) relative position from ridge top to cove, and (3) degree of slope. The soil depth variable was eliminated because of its close relationship with slope position and slope inclination (Trimble and Weitzman, 1956; Doolittle, 1957; Carmean, 1967; Yawney and Trimble, 1968). Similarly, Trimble and Weitzman (1956), also working in the Appalachians, report that aspect or compass direction faced by the plot, position of the plot on the slope, (i.e. distance from the ridgeline), grade or slope percent of the land, and, total soil depth to rock greatly influenced site index. Doolittle (1957) determined that depth of the A horizon, percent sand in the A horizon, and position on slope were the most significant variables influencing site quality, and accounted for 95.7% of the variation. Arend and Julander (1948) working with oak sites in the Arkansas Ozarks show that site index varied with type of parent material, topographic position, soil depth, and aspect.

Gysel and Arend (1953) found productivity of various oak sites sampled (determined from the heights, diameters, and ages) varied considerably with changes in: 1) texture of the subsoil layers, 2) topography as characterized by differences in elevation and steepness of slope, and 3) position on the slopes in rolling and hilly terrain.

In a study conducted in the ridge and valley region of Northeastern West Virginia and Western Maryland, Yawney and Trimble (1968) noted northeast slopes were one to two 3 meter (10 ft.) site index classes above those slopes facing southwest. They also report that site index increased with distance from the ridge top, decreased slope percent, and increased soil depth. Five independent variables accounted for much of the variation in tree height in the Ridge and Valley Region of Maryland and West Virginia: stand age, slope position, aspect, thickness of A + B horizon, and pH of the A_2 horizon.

Climate changes are not only observed on differing aspects, but also at varying elevations. With increased elevation, intensity of radiation increases, air temperature decreases, and precipitation may vary erratically. Elevation greatly influences soil temperature, but Smith et al. (1964) suggest that elevation's influences upon soil temperature is complex.

Local physiography deserves attention, as it may greatly influence the classification of forested soils in hilly or mountainous terrain. These soils may vividly demonstrate the modifying effects of topography on soil water, aeration, and nutrients. Soils on summits receive the least rain water and are susceptible to erosion, thereby decreasing the amount of available nutrients. At lower slope positions, in positions of accumulation, usually foot slope positions, the opposite may be true; runoff water, nutrients from upslope erosion, humus, and soluble salts concentrate (Wilde, 1958). Furthermore, subsurface flow of water benefits trees growing on sites located on lower slope positions (Helvey et al., 1972).

Aspect and Site Quality. The temperature of soils on north facing slopes and south facing slopes are dramatically different (Smith et al., 1964). In the northern hemisphere, south-facing slopes tend to be warmer and have less fluctuations throughout the year than do north-facing slopes.

Sunshine duration and intensity, which differ according to aspect, affect soil microclimate and vegetation. Soil temperature and moisture, that ultimately influence the natural selection of tree species on that site, are especially affected by aspect direction. Soil Conservation Service Staff members measured soil temperature under grass at Waterford, California, on opposing north and south facing slopes, and found the south aspect to be 3.6° C (6.4° F.) warmer (Smith et al., 1964). Soils in local regions also demonstrate differences due to aspect. M. G. Cline (as referenced by Fanning and Fanning, 1989) states that soils in the northern hemisphere average 1.1 to 2.8° C (2 to 5° F.) warmer on south-facing slopes as opposed to north facing-slopes. For example, some soils in Alaska may be Cryochrepts without permafrost on south slopes, while soils on north-facing slopes may be Pergillic Cryaquepts that contain permafrost. Similarly, laterite soils in northern Africa form on south-facing slopes, while on adjacent north facing slopes the soils may not be lateritic.

Birkeland (1984) shows a positive correlation between southwest facing slopes and the presence of E horizons, but points out that the reason for the occurrence of E horizons are not clear. Franzmeier et al. (1969) claims that certain other horizons are also more common to certain aspect directions. In eastern Kentucky and Tennessee, most south facing slopes have argillic horizons, while most north facing slopes have cambic horizons. A study conducted in Washington suggests that one reason for differences in soils and vegetation on differing aspects is the accumulation of snow that can lead to differences in soils on the great group level (Lotspeich and Smith, 1953).

In a small valley in southeastern Ohio, Wolfe and Gilbert (1956) found northeastern slopes had pH ranges from 5.4 to 6.0, while those soils on southwest slopes had pH ranges of about 4.8 to 5.2. They also noted that soils on south facing slopes were thinner and less moist than those on north facing slopes. Cooper (1960) has added that B horizons of soils formed on south facing slopes contained higher amounts of clay, silt, and clay plus silt, and were drier than were soils on northern slopes. North aspect soils seem to have more organic matter and deeper A horizons (Daniels, 1985) than south aspect soils. All these factors contribute to the greater productivity of northern slopes.

Under climatic conditions where low precipitation during the growing season results in plant moisture stresses, the south-facing slopes will be less productive than north-facing slopes because of greater evapotranspiration rates on the southern aspects. Greater evapotranspiration rates result in less available soil moisture, higher plant moisture stress, and reduced rates of plant growth (Auten, 1945; Meiners, 1982).

Hack and Goodlett (1960) introduce a confounding factor into the use of azimuth in the Appalachian Valley and Ridge Province. They found vegetation differences with respect to aspect were readily apparent. However, it was also noticed that each valley trending parallel to the strike of the rocks in a northeastward direction was covered on the northwest-facing or updip side mostly by the yellow pine unit. The opposite, downdip side was covered mostly by the oak unit, which requires more soil moisture. This is the effect of geology, that they suggest is more important than aspect. Seepage through porous rocks create reservoirs of water that may outlast the driest seasons.

Land surface slope, shape, and aspect are shown to influence temperature-related soil properties. Soil temperature is a major influence on soil formation and characteristics. Since vegetation is affected directly and indirectly through the soil medium by temperature, it is logical to incorporate the effects of soil temperature as influenced by slope aspect into soil and vegetative classification systems.

Measurements of latitude and elevation are correlated with air temperature, rainfall, and growing season. These factors may dictate tree species growth and composition more than soil variables alone, and therefore may confound soil-site correlations (Hudson, 1983; Rowe, 1991; Smalley, 1984, 1985). A given soil series can occur throughout several climatic zones, which may cause quantification of tree productivity for the soil series to be inconsistent.

Soil temperature has an important influence on the chemical, physical, and biological processes in the soil. Smith et al. (1964) claim soil temperature is one of the soil's most important properties, because, within limits, it controls the possibilities of plant growth and soil formation. Soil temperature regime can be characterized by: the mean annual soil temperature, average seasonal fluctuation from the mean, and mean warm or cold seasonal soil-temperature gradient within the main root zone; 5 to 102 cm (2 to 40 inch) depth (Smith et al., 1964). Research done by Smith et al. (1964) shows the mean annual air temperature tends to decrease about 1.5° C (2.7° F.) per 305 m (1,000-foot) increase in elevation of the earth's surface. The temperature reduction with elevation is greatest in summer when it averages about 2° C (3.6° F.) per 305 m (1,000 feet). In winter, temperature reduction averages only 1.2° C (2.2° F.) per 305 m (1,000 feet). Kimmins (1987) gives a slightly different mean annual estimate of the rate of change in air temperatures decreasing about 1.1° C (2.0° F) per 305 m (1000 feet) of elevation change. As elevation increases, the difference between air and soil temperature increases because the lower temperatures at higher elevations favors organic matter buildup, buffering the soil from rapid temperature extremes.

Data from mid-latitudes compiled from around the world led Smith et al. (1964) to conclude that if the mean annual air temperature is 8.3° C (47° F.) or higher, and if rainfall is generally adequate in all seasons, level or gently sloping soils have a mean annual temperature about 1.1° C (2° F.) higher than the mean annual air temperature.

Smith et al., (1964) have pointed out that daily temperature fluctuations can have an important effect on surface soil horizons to a depth of about 50 cm (20 inches), particularly in soils of dry climates. For middle and high latitude soils (which can have a climate similar to high elevation soils), a representative daily range on a sunny summer day is 25° C (45° F.).

Vegetative cover can have a significant influence on seasonal fluctuations of soil temperature. Smith et al. (1964) state that the difference in soil temperature between grass, crops, and trees shading or insulating the soil are minor if O horizons are transient or absent. Soils under hardwood stands are more vulnerable to large daily and seasonal temperature fluctuations than those soils under conifer stands. In mid-latitudes, at lower elevations, the temperature of a sod-covered soil 0-30 cm (0-12 inches) is normally close to that of the mean annual air temperature. Trees seem to have little effect on soil temperature or direct insulating ability (Smith et al., 1964).

Significance of Soil Moisture in Determination of Site Quality

Available moisture is probably the single most important determinant of productivity (Broadfoot, 1969). A soil's available water capacity seldom represents the amount of water actually available to plants. Yield for a particular soil cannot be estimated from the knowledge of its average moisture regime (Stone 1977). Yet, there still remains a strong association between moisture and tree growth, as shown by Auten (1945). Studying yellow poplar growth, he found that cool slopes had a significantly higher site index than did warm slopes. Of all site factors, including aspect, slope position, landscape position, aeration, and water infiltration, those influencing available moisture played the largest part in influencing site index.

The available water-holding capacity of a soil is influenced by a number of factors, but it is primarily determined by structure and texture. The use of soil texture as an estimator of water-holding capacity is a standard practice. Estimates of site productivity based on texture effects on water holding capacity is complicated by the influence of texture on soil aeration, nutrient availability, and other soil fertility factors. Stone and gravel content can also modify soil moisture regimes. Moderate amounts of coarse fragments may favor deep penetration of light rains, thus reducing evaporation losses. However, large reduction in effective soil volume by stones decreases moisture retention storage (Meiners, 1982).

Slopes with high convex surfaces have little protection from drying winds, temperature extremes, and are subject to greater erosion and weathering than the more protected lower concave surfaces. Many studies in mountainous regions have found slope position to be the single most useful factor in evaluating growth potential of forest trees, possibly due to its effect on moisture (Meiners, 1982).

The location of a site on a landscape influences growth because of the gain or loss of soil moisture due to gravity and protection from climatic influences. Moisture generally increases with distance from the ridgetop, due to gravitational flow down slope: lower slope positions tend to gain moisture, while upper slopes lose moisture. Soil depth typically increases in a similar manner, increasing from the ridgetop to lower slope. Increased soil depth on lower slopes provides increased soil moisture storage. Additionally, lower slope positions may be protected from winds and long periods of solar radiation, allowing soil moisture to be retained for longer periods.

Coile (1952) estimates that in the pine and hardwood forests of the

Southeast, approximately 0.6 cm (0.25 inches) of precipitation is intercepted by tree crowns and is lost through evaporation. As much or more is absorbed by the unincorporated organic matter (0 horizon). Any individual rain must therefore be in excess of approximately 1.3 cm (0.5 inches) before it will contribute to the moisture supply in the upper mineral soil. Under climatic conditions characterized by periodic precipitation during the growing season, the upper most part of the mineral soil is repeatedly moistened to field capacity and dried to near the wilting point. In contrast, the soil below this zone may be at or near the wilting percentage for longer periods of time because the water retention capacity of the upper zone must be satisfied before water will move, under the force of gravity, to lower depths (Coile, 1952; Wickham, 1975). Coile mentions a confounding factor to soil moisture predictions, subsurface throughflow. Subsurface throughflow can be an important source of soil moisture in steep mountain soils when relatively impervious rock formations approach the surface of the land.

Helvey et al. (1972) after averaging soil moisture records of several years by months, found soil moisture trends in the southern Appalachians closely approximate a sine function, with a maximum in spring and a minimum in fall. This annual trend presumably results because growing and dormant seasons are almost equal in length, and because rainfall, on average, is evenly distributed through the year.

Studying soil moisture in the Valley and Ridge Province of Southwestern Virginia, Wickham (1975), and Meiners (1982) found available soil moisture deficits could seriously decrease or inhibit tree growth from the middle of July to the end of the growing season. Wickham also found soils generally decrease in available moisture with depth. Rainfall is not sufficient to keep the entire soil material moist during southwest Virginia's growing season, a situation further aggravated by steep slopes that hinder infiltration of precipitation.

Soil moisture is dynamic (Buol 1978). Moisture measurements at one time during the year, or even at all times during only one year, are of limited value in evaluating the moisture regime of a site during the lifetime of a tree. Soil moisture dynamics are closely tied to weather conditions. However, different kinds of soils respond differently to any given weather event depending on previous moisture status, vegetation, and surface soil conditions. Meiners (1982) reports soil water potentials on Potts Mountain, Virginia, indicate decreasing moisture availability throughout the growing season. Growth-limiting moisture levels began to occur in late July and continued through October.

Stephenson (1982) focused on the vegetative differences between north- and south-facing slopes near Mountain Lake, Virginia. Density, diversity, and basal area were generally higher for the north slope community; data suggest that these differences can be attributed to a topographic moisture gradient. Statistically significant differences exist for a number of soil characteristics, all seem to be related to a greater accumulation of organic matter on the south slope.

Fralish et al. (1978) found that trees, shrubs, and herbs were distributed along a soil moisture gradient in southern Illinois. The gradient was defined by calculating soil available water capacity (AWC), which integrates texture, bulk density, stoniness, and depth to an impermeable layer. The sequence of stand dominants from soil of low AWC to high AWC is red cedar, post oak, white oak, northern red oak, and sugar maple.

Overstory basal area and composition index are strongly related to AWC and may be an alternative to site index in evaluating site potential. Fralish suggests that available water is the best indicator of site potential and has linked this with vegetation, to be used as an index. This method eliminates tedious multiple soil measurements in areas of rolling or steeply sloping terrain.

Influence of landscape and geologic features on soil moisture. Topographic position on slope is an important factor in moisture regimes, so are geologic structure, soil texture, exposure, and altitude. Hack and Goodlett (1960) studied the headwaters of the Shenandoah River in the Dry River District, George Washington National Forest, Augusta and Rockingham Counties, Virginia. The distribution of the three forest types occurring in their study area coincided with the duration of moisture in the ground through the growing season.

These researchers claim that the orientation of the geologic strata affects some lower slope positions by means of subsurface throughflow. Valley profiles and vegetation composition reflect greater moisture on the northeast, east, and less expectedly, on the southeast exposures, possibly due to geologic subsurface throughflow. The rocks in most of the area dip gently southeastward. Water running down the northwest-facing slopes against the dip enters the many sandstone aquifers, and seeps through the mountain to merge on the opposite side when the slope is inclined with the dip of the rock strata.

Broadfoot (1969) cites research conducted by Turner (1937) which indicated slope to be the most important factor for hardwood growth, since it affects drainage, exposure, depth of soil, and physical structures of soil horizons. Broadfoot (1969) emphasizes that prediction equations must contain variables that consistently express soil moisture and nutrient availability during the growing season, physical conditions including root growing space, and soil aeration.

Smalley (1984) presents a comprehensive forest site classification system for the Cumberland Mountains in north central Tennessee, southeastern Kentucky, and southwestern Virginia. This system is based on physiography, geology, soils, topography, and vegetation. Smalley developed a land classification system where slope gradient, aspect, slope length, and soil moisture are important factors in the delineation of landtypes, the smallest unit in the hierarchy. Thirty landtypes are described and evaluated in terms of productivity and desirability of selected pines and hardwoods for timber production. Each landtype is rated for five soil-related problems that can affect forest management operations.

There may be measurable variation in productivity within a landtype. This problem should be handled by performing sampling based on the desired precision of the productivity information (Smalley, 1985). "Excessive variation in productivity within a landtype may indicate the need to divide the landtype into more homogenous units", states Smalley. These units may be phases, detailed sections of landscape positions (upper third, middle third or lower third) or sites (Wertz and Arnold, 1975; Van Lear, 1991).

Smalley (1985) endorses the use of landscape features in classification systems in mountainous terrain. Smalley supports the use of this approach because soils and soil moisture are closely related to landforms and topography. In rugged terrain, landscape position may have as much as, or even greater, recognizable relationships with tree growth than soil series, and landscape positions can be easily recognized by foresters.

Rowe (1991) states the largest part of the repetitive pattern in natural and semi-natural forests can be traced to the repetitive pattern of landforms. Landform is an essential component of forest ecosystems at whatever scale it is defined; therefore landform merits equal attention as trees, undergrowth, soils, and climate.

Landform represents the most stable surface component of landscape ecosystems, and over long periods of time, becomes the primary correlate of soils and vegetation in areas of similar regional climate (Rowe, 1991; Van Lear, 1991). It is for this reason that landforms, with their associated soils and biota, are the logical basis by which site classification systems should be developed.

Carmean (1967) recognizes the significant influence of soil moisture on site quality and integrates this information into a useable method of site quality determination. Carmean (1967) also states that equations based only on topographic features explain more than 75% of the height variation found in black oak in southern Ohio. This system of site quality evaluation is practical because it can be used with aerial photographs and topographic maps. Exceptional precision is due to correlation, as high as 84%, between topographic and soil features related to oak site quality (Carmean, 1967). For research purposes where the most accurate measure of site productivity is needed, all of the factors contained in the equations should be used. For soil surveys, topographic features and soil drainage are the only criteria necessary to have reasonable prediction quality. Carmean's study was conducted on undisturbed soils, and therefore should be applied only to undisturbed sites.

Forest Site Quality Inventories

The management of forests as a renewable resource is dependent upon an understanding of the basic ecological relationships between forest species and environmental conditions. Forest site quality is the capacity of a site to produce forests, and includes climatic factors, soil factors, and soil biota. These site factors interact in a complex, dynamic ecosystem; their independent effects on forest growth potential are often difficult to quantify (Meiners, 1982).

Pritchett and Fisher (1987) have pointed out two key strategies for developing a woodland site quality inventory system. First, it is often difficult to use regression equations to predict site index accurately when the equations are applied to a large and variable study area. Stratifying or subdividing the area will help to reduce variance, this can be done at the site level. Subdividing the unit of inventory to more specifically defined units will narrow the variability within a mapping unit. The selection of too many variables can cause lack of correlation and hinder usefulness and practicality of the inventory. The inventory must be based around the selection of the least, and most easily measured, soil and site factors that integrate all other factors.

Rightmeyer and Keys (1991) created a site suitability guide for site potential and species recommendations on Southern Appalachian National Forests. Field use of the guide requires measurements of topsoil depth, identification of landform position from a topographic map or on the site, identification of soil texture in the upper 18 inches (45 cm) of soil material and measure of aspect. Solum depth is estimated from field observations or soil survey reports.

Jones and Saviello (1991) created a site quality evaluation guide using soils and topographic criteria in the unglaciated, deeply dissected Allegheny Plateau region of southwestern New York and in northcentral and northwestern Pennsylvania. A different set of decision criteria and site quality weightings is applied for each of four topographic units: plateau tops and side slope, upper slopes, middle slopes, and lower slopes. Decision criteria are all field determinable and include soil texture, soil stoniness, aspect, shade angle, slope shape, and effective rooting depth. Points are awarded so that relative site quality ratings from 40 to 100 are scored. A system of additive factors is used to rate each site. Adding all factors will allow the forester to determine the overall site quality, without the need of vegetative data. Inclusion of the vegetative variables produced equations with predictive ability superior to those with only soil and topographic variables.

Steinbrenner (1975) explains the methods of the forest soils surveys conducted on the Weyerhauser lands in the Pacific Northwest. Topography evidenced by landform is important to interpreting the survey for road construction, equipment use, and productivity. Mapping is based on the correlation between landform and the soil series within a geologic unit. Many soil series are used in this mapping system in order to define more narrowly based management units, and reduce variance within productivity ratings. Soil phases, usually associated with colluvial soils, are used to separate changes in stoniness or total depth.

Storie and Wieslander (1948) created a woodland classification or rating scale for California's forests, using soil depth, permeability, chemical factors such as alkalinity and salinity, soil drainage, and climate, each considered separately, to derive the rating. Once determined, each overall timber site rating is placed into one of five general classes of timber site productivity.

The Storie system was used in only slightly modified form to rate the productivity of soils in Hawaii (Huddleston, 1984). A new factor was introduced: rainfall. Final productivity ratings were grouped into five classes of overall productivity. According to Huddleston (1984) the data suggest that the system was not sensitive to differences in soil productivity, most of the 137 soils rated fell into the two lowest classes, and none fell into the highest class.

The basic concept of the United States forest classification system is a coded legend or key (Aydelott, 1978). The primary component of the key is landform, a natural manageable segment of the landscape. Other components complement the landform and are designed to reflect soil and management differences. The objective of the key is to assist the land manager in identifying natural Ecological Management Units on the landscape. Due to differences in topography, geology, and soils within the region, three sets of guides were developed: one each for the Coastal Plain, Piedmont, and Mountains. In the mountains, ecological management units consist of five components: landform, source of material, texture, water regime, and modifiers. From this criterion site suitability is interpreted for multiple resource uses that have similar management requirements. The guide includes most of the components of an ecological classification system but lacks a correlation with vegetation, and is criticized as too subjective (McNab, 1987).

East of the Mississippi River, ecological classification of National Forest lands is principally based on variations of the Land Systems Inventory (Wertz and Arnold, 1975). These approaches to site classification are various forms of regionalization, whereby geographical areas are successively subdivided into smaller, more detailed homogenous units. According to McNab (1987) vegetation as part of the multicomponent system has been studied and successfully applied in the eastern United States.

Wertz and Arnold (1972) designed a Land Systems Inventory for the Intermountain Region to provide information for integrated environmental studies. Its purpose is to systematically define the land units to useful levels of stratification. The stratification system is composed of seven levels in a hierarchy from broad regional categories to narrowly defined land units: VII Physiographic Province, VI Section, V Subsection, IV Landtype Association, III Landtype, II Landtype Phase, and I Site.

Landtypes are the basic units and building blocks for overall land use study and planning. They are the visually identifiable unit areas resulting from homogenous geomorphic and climatic processes and have defined patterns of soils and vegetation potential. Landtypes delineate permanent elements of an ecosystem and serve as a logical base of reference for which other elements of the ecosystem can be described.

The landtype phase represents the lowest category in the system of land inventory required for land use planning. Their size and composition vary according to the complexity of the local physical environment. Landtype phase identifies uniform land characteristics as they occur within landtypes, generally as specific kinds of soils or soil phases. It is necessary to understand all facets of the environment as they relate to the individual components and their spatial distribution within the unit.

McNab (1987) published a first approximation of a site classification system for the Southern Appalachians similar to that of Smalley's for the interior Uplands. Slope features, such as slope type, slope aspect, slope position, slope shape, and slope gradient are incorporated into the system at different levels to divide the mountainous landscape into increasingly smaller units. McNab suggests that forest managers may use this classification for subdivision of landforms into broad landscape features, for evaluation of stands for species suitability, and estimation of forest productivity.

The structure of McNab's (1987) multifactor classification is a modification of the land systems inventory developed by Wertz and Arnold (1972). Land

Systems Inventory is a method of integrating climate, topography, and geology with physical features of landforms that, when integrated with other components of soil and vegetation, produces a classification with ecological properties (McNab, 1987).

McNab has included ridge and valley as a choice in the highest level of the classification system to make the system useable in western Virginia. Also, McNab (1987) observed that climatic variables have a greater effect on the distribution of forest vegetation than geologic variables and, therefore, enter the hierarchy at a higher level.

A landtype association consists of a group of similar landtypes. For example, a side slope might consist of at least three landtypes: upper, middle, and lower slope positions, all facing in the same direction. Criteria for delineating the landtype include aspect and slope position. Criteria for landtype phase include surface shape and slope gradient. Aspect and slope position are the principal environmental variables affecting species composition and productivity observable at this level (Auten, 1945; Carmean, 1967; Smalley, 1985; McNab, 1987).

The landtype level attempts to account for the influences of solar radiation, an important environmental factor. The effects of solar radiation on soil moisture regimes and associated overstory community types is closely correlated with aspect (McNab, 1987). Landtype phase represents the smallest unit. Landtype phase recognizes the influence of land surface shape as a variable influencing soil moisture supply and nutrient status on a more detailed scale than for landtype. McNab (1987) contends that there is "close correspondence" between this proposed system of forest site classification for the Southern Appalachian Mountains and other systems now in use. Yet, McNab points out: "... links must be established between this proposed system and classification being developed by advocates of site evaluation by use of habit typing and soil survey data".

A Forest Site Quality Index (FSQI) was proposed by Smith and Burkhart (1976) to predict site quality based on three parameters: aspect, slope gradient, and slope position. An ordinal ranking of relative site quality was assigned to each parameter. The FSQI was then defined as the unweighted sum of the ordinal values. The highest ranks were assigned ordinal values that were subjectively rated as best for productivity. The index was found to be highly correlated with site index data of upland oaks in the Allegheny Mountains of West Virginia and Maryland. The index was later found to be highly correlated with mean annual increment of trees on steep slopes in the Ridge and Valley of Virginia (Meiners et al., 1984).

The Forest Site Quality Index first appeared in a multiple use resource management plan. This plan was specifically designed to overlay different landscape, soil, and woodland features, making it possible to have several factors combined to apprize managers of the hazards and limitations of different land uses (Smith and Burkhart, 1976).

Part of the rationale for choosing the specific features used in the FSQI is based upon the belief that available water is a major growth limiting factor in the ridge and valley geomorphic province of the Appalachian region (Wathen, 1977). In this region annual rainfall is normally less than 102 centimeters (40 inches) per year. In mountainous areas where moisture is often limiting to plant growth during the growing season, a classification scheme based on topographic parameters that reflect relative moisture availability would probably be comparable to site index as a measure of site quality (Meiners, 1982). The available water for plant growth on a site is greatly influenced by three easily measured topographic variables: slope percent, slope position, and aspect.

A ranking value was calculated by adding slope position, slope percent, and aspect-weighted values together. The rankings were divided into five broad relative productivity classes based on natural breaks in the frequency distribution of the values. Productivity class I was the most productive and class V was the least productive (Smith and Burkhart, 1976).

Meiners (1982) used the FSQI to validate moisture gradients noticed along a southeast facing slope on Potts Mountain in Craig County, southwest Virginia. A general gradient of increasing soil moisture availability with increasing FSQI was evident for both clearcut and uncut forest stands. Soil water potential and predawn plant water potential exhibited a strong seasonal trend, their directly proportional relationship suggesting that available soil water is probably the critical factor controlling predawn plant water potential. Growth limiting stress levels began in late July and continued through the remainder of the growing season (Meiners, 1982).

The index was later improved by Wathen (1977) and found to be highly correlated with site index data of upland oaks in West Virginia and Maryland. One of the objectives of his study included the correlation of the forest productivity index with site quality. The objectives assumed that (1) water in the form of rainfall is critical in terms of water available to plant growth, (2) the topography of the area had slopes greater than ten percent, and (3) the chemical and physical properties of the soil parent materials were similar.

The aspect ranking was adjusted using insolation values generated. The slope percent ranking was broken down further to better account for site quality differences. The revised forest productivity is highly correlated with site index. The Spearman rank correlation coefficient, based on 66 observations, was significant at the 0.0001 level. This result indicated that high values of the forest productivity index were associated with high values of site index (r^2 was 0.73).

Meiners (1982) states that perhaps the most critical constraint of the FSQI is that chemical and physical properties of the soil parent material within a designated area of measurement must be similar. Meiners proposed three modifications to the FSQI, to expand the usefulness and applicability of the index. First, account for textural differences in soils by stratifying the major textural classes based on their ability to supply water for plant growth during critical periods. Second, add a ranking for land form to account for exposure, protection, and shading, which influence climate and energy partitioning effects. Third, rank elevation to include modifications in climate and energy partitioning along elevational gradients.

In areas like the Valley and Ridge physiographic province where moisture is limiting, and other basic assumptions can be met, the Forest Site Quality Index can be a rapid and easy measure for evaluating relative site quality based on aspect, slope inclination, and slope position (Meiners et al., 1984).

Forest site quality has several determinants in the southern Appalachians. As recognized by many researchers, the most limiting element is soil moisture. Forest site quality inventories which are effective tools for the land manager require a system that will address factors of available moisture at the scale needed by the land use manager.

Regional Setting

The study area lies within the George Washington National Forest. These lands were acquired following passage of the Weeks Law in 1911. This act was designed to protect headwaters of navigable streams and authorized the purchase of lands in the eastern United States that had been deforested by lumbering operations (Hack and Goodlett, 1960).

Climate

The area studied extends, geographically, 100 km north-south; consequently, there may be significant differences in climate between the northern and southern extremes. This region has a humid continental type climate modified considerably by elevation. The winters are moderately cold and the summers are relatively cool. The nearby mountains produce various steering, blocking, and modifying effects on storm and air masses. In winter this flow may cause persistent cloudiness and in many areas snow flurries. The topography modifies the winds, with the air tending to flow parallel to the mountain ridges.

Average daily temperatures are about 35° F. (1.7° C) in January and 70° F. (21.1° C) during July. The length of growing seasons ranges from 5 to 6 months and is related to elevation and latitude (USDA, 1941). Precipitation is correlated with physiography and topography, and ranges from about 32 (81.3 cm) inches in low-elevation intermountain valleys to more than 100 inches (254 cm) (McNab, 1987) in the higher mountains, especially in the southern Blue Ridge in Georgia. Precipitation is dependent primarily on prevailing winds, topography, and the type and paths of the general storms. High precipitation in the southwestern portion of the state represents condensation from moist southerly winds rising over the higher ranges of the Alleghenies (USDA, 1941). The average date of last freeze is May 1, and the date of first fall frost is around October 10. These dates, however, are strongly dependent on elevation.

Several weather stations exist within and near the study area. Climate for each county through which the study area extends is summarized below. This data is from local weather stations which do not, however, reflect the entire range of conditions throughout the county.

Clifton Forge Virginia in central Alleghany County (37° 49'N Lat.; 79° 50'W Lon.) at an elevation of 320 m (1050 feet) has a mean annual precipitation of 99.64 cm (39.23 inches). Precipitation is well distributed throughout the year with the maximum in March and the minimum in November (Weather Disk Associates, 1988).

Hot Springs Virginia in central Bath County (38° 00'N Lat.; 70° 50'W Lon.) at an elevation of 682 m (2238 feet) has a mean annual precipitation of 105.03 cm (41.35 inches) (USDA, 1941). Precipitation is well distributed throughout the year with the maximum in March and the minimum in November (Weather Disc Associates, 1988). Mean annual air temperature at Hot Springs varies slightly from year to year but averages about 10.6° C (51° F.), the growing season is about 157 days (Crockett, 1972). The topography modifies the affect of winds with the air tending to flow parallel to the mountain ridges.

Monterey, located in northern Highland County Virginia, (38° 25'N Lat.; 79° 35'W Lon.) at an elevation of 887 m (2910 feet), has a mean annual precipitation of 102.64 cm (40.41 inches). Precipitation is well distributed throughout the year with the maximum in June and the minimum in November

(Weather Disk Associates, 1988). Mean annual air temperature at Monterey varies slightly from year to year but averages about 9.4° C (49° F.). The growing season is about 143 days. The topography modifies wind direction with the air tending to flow parallel to the mountain ridges (Crockett, 1972).

Geology

The study area lies within the Valley and Ridge province; a belt of folded geologic formations resulting in mountains consisting of limestone valley lowlands separated by interbedded shale and sandstone ridges (Morris and Campbell, 1991). The majority of the sites studied have soils derived either from the Hampshire or the Chemung formations. Some sites occurred on different formations.

The Hampshire formation consists of sandstone and interbedded mudstone, grayish-red or greenish or brownish-gray; fine-grained, locally conglomeratic sandstone with frequent massive sandstone beds (Virginia Division of Mineral Resources, 1993). It is predominantly red to reddish brown arkosic sandstone, generally thin bedded or in thin flags. The sandstone probably predominates. The Hampshire Formation is late Devonian in age and has the largest outcrop area (Butts, 1940). In comparison with the calcareous rock of the valleys that crop out, the Hampshire is a resistant formation. It is relatively nonresistant as compared with the underlying Chemung and overlying Pocono formations (Butts, 1940). This is perhaps because the sandstone beds are flaggy, relatively thin and being arkosic, weather more readily. Many of the thin sandstone beds are permeable (Hack and Goodlett, 1960). The most distinctive characteristic of the Hampshire is its red color (Butts, 1940).

The Devonian aged Chemung formation is composed of shale and sandstone with no sharply marked lithologic change from the one to the other (Butts, 1940). The sandstone is dark-gray and greenish-gray, but to a minor degree reddish and blackish, fine-grained, thin to thick bedded and generally arkosic (Virginia Division of Mineral Resources, 1993). The Chemung is a lumpy, poorly fissile greenish mudrock weathering yellowish. The sandstone is generally coarse, occurring in thicker layers, and occupies the greatest proportion of the whole formation. Most of the shale in the Chemung is green, soft, and poorly fissile and is clayey instead of sandy. The Chemung is abundantly fossiliferous throughout its extent (Butts, 1933). The Chemung formation overlies the Brallier shale, and the Hampshire overlies the Chemung.

The Martinsburg is predominantly black shale with thin layers of impure fossiliferous limestone and sandstone (Virginia Division of Mineral Resources, 1993). Unweathered shale is bluish; weathered shale is yellowish to brownish. This formation is primarily thin-bedded calcareous mudrock, but layers largely composed of very fine quartz sand, and many thin layers of fossiliferous limestone are scattered through the mass (Butts, 1940).

The Juniata formation is composed mainly of bright red shale or mudrock and beds of brown to red sandstone. Siltstone, sandstone, and shale are locally calcareous, grayish-red, locally fossiliferous, with some interbeds of greenish-gray shale (Virginia Division of Mineral Resources, 1993). Its distinctive feature is its red color.

The Brallier shale consists of shale, sandstone, and some siltstone with partly silty, micaceous, greenish-gray, grayish-brown, and medium to dark gray and black shale predominating. The shale is a mixture of silicious, micaceous, thinly laminated slaty rock, and of ordinary argillaceous laminated soft rock (Butts, 1940). The clay shale weathers to a yellowish tint; the siliceous shale is generally stained a manganese-black on weathered surfaces. The sandstone is fine-to very fine-grained, greenish, and has uniform thickness throughout most exposures. Weathered surfaces are yellowish, brownish, or rusty. Locally occurring siltstone is in very thin lenses (Butts, 1940).

The Clinch formation is mostly sandstone, white or gray, and very hard and resistant. The Clinch is mostly quartzarenite and shale. Quartzarenite is very light gray, olive-gray, and brownish-gray, with local grayish-red beds, very fine-grained to very coarse-grained with local conglomerate (Butts, 1940). Shale is light olive-gray to grayish-green; with thin very fine to fine grained sandstone interbeds (Virginia Division of Mineral Resources, 1993).

The Rose Hill formation is a dark grayish-red, fine to coarse grained, hematite cemented quartz sandstone interbedded with red or yellowish-green clay shale, and greenish-gray fine grained sandstone (Virginia Division of Mineral Resources, 1993).

Millboro shale is a black, pyritic, fissile shale in its unweathered condition, but bleaches on weathering to a light gray color (Virginia Division of Mineral Resources, 1993).

The Oriskany is a calcareous sandstone, generally weathering to a friable sandstone, thick bedded, rather coarse-grained in places and at some horizons abundantly fossiliferous and of uniform character throughout (Butts, 1933).

The Keefer sandstone is light-gray, fine grained, medium bedded, and very resistant (Butts, 1940).

Soils

The soils in this study are steeply sloping, high elevation soils, 701 to 1402 m (2300 to 4600 feet), predominantly derived from shale, siltstone, and sandstone. These soils are shallow and have relatively low fertility. Soils on the highest ridges and steep slopes tend to be formed from acid sandstones, those on the lower slopes from acid shales. Dystrochrepts in loamy-skeletal textural classes are common. Available water-holding capacity in many of these soils is low (Morris and Campbell, 1991).

There appears to be a rather well-defined annual soil water balance which reflects the average seasonal soil water in the Southern Appalachian region. In areas where rainfall exceeds evapotranspiration, the annual soil moisture range is characterized by a maximum in spring and a minimum in fall (Helvey and Hewlett, 1962).

Vegetation

Geology, topography, and climate of the Southern Appalachians combine to produce an array of sites. Braun (1950) and others (McNab, 1987) have described this area as unusually rich in species and in the large size attained by many forest species. The study area falls mostly within Braun's (1950) very extensive Oak-Chestnut forest region. This forest region trending in a northeast-southwest direction extends from southern New England and the Hudson River Valley to northern Georgia. Upland oaks are so abundant in most areas they characterize the region (Braun, 1950). In its undisturbed state the Oak-Chestnut forest region covered all of the Blue Ridge Province, and all of the Ridge and Valley Province except its northern end in the Hudson-Champlain Valley, and its southern end from southern Tennessee southward (Braun, 1950).

The name "oak-chestnut" is still used for this region although the Oak-Chestnut association, that characterized it, no longer exists in unmodified form. Various oak, oak-chestnut, and oak-chestnut-tuliptree communities occupy the climax forest. Mixed mesophytic communities, if they occur at all, are generally confined to coves and lower ravine slopes (Braun, 1950).

The relationship between vegetation and physiography was noticed by Braun (1950) when she states that "everywhere the occurrence of oak-chestnut communities seems intimately related to slopes; only rarely do they occupy flats". At higher elevations the regional forests change to a more northern type. On south slopes the chestnut forests may extend to about 1525 m (5000 feet) or higher before giving way to a "northern hardwood" type. On northerly slopes the chestnut changes at about 1370 m (4500 feet) to a "northern hardwood" forest. This in turn grades into the spruce-fir of the highest forest belt (Braun, 1950).

Braun, when studying this forest region in 1950 commented that an earlier classification of forest types (Society of American Foresters, Committee of the Southern Appalachian Section, 1926) was the most usable classification present. Three principal groups, each with a number of forest types, were recognized: (1) the high-altitude northern forests, (2) moist slope and cove forest, and (3) dry slopes and ridge forests. Within each forest group are a number of forest types with varying species composition that require certain environmental regimes of moisture, temperature, and nutrients, allowing them to occupy and dominate a particular site (McNab, 1987).

At higher elevations, and on cool topographic positions, one may find the Northern Hardwood forest type. Braun (1950) states the most important tree species are sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), beech (*Fagus grandifolia*), and painted buckeye (*Aesculus sylvatica*). White ash (*Fraxinus americana*), black cherry (*Prunus serotina*), silverbell (*Halesia carolina*), cucumber (*Magnolia acuminata*), chestnut (*Castanea dentata*), and occasionally American basswood (*Tilia americana*) are accessory species which may be present (Braun, 1950).

Mixed forests are dominated by a large diverse group of mesophytic hardwoods including American beech, sugar maple, red maple (*Acer rubrum*), American basswood, painted buckeye, yellow birch, hemlock (*Tsuga canadensis*), yellow poplar, sometimes called tuliptree (*Liriodendron tulipifera*), and numerous oak (*Quercus spp.*) and ash (*Fraxinus spp.*) species. These sites are often the most mesic habitats in the ravines, coves, gorges, and other sites with well drained loam soils. Oaks prevail on the slopes, and in places, white pine (*Pinus strobus*). White oak (*Quercus alba*) is usually the dominant tree in mesic slope forests, with yellow poplar an important constituent. On drier slopes, chestnut oak (*Quercus prinus*) is dominant in what once was a Chestnut-Chestnut oak community. On upper slopes and well-drained soils within the mountains and plateaus, oak species dominate and intergrade with pine species on ridges and rock outcrops (Braun, 1950). On slopes and ridges with a fire history, shortleaf (*Pinus echinata*) and pitch pine (*Pinus rigida*) may be dominant components of the stand (Gholz and Boring, 1991).

Landform processes have an important affect on vegetational composition and distribution. These processes produce widely different habitats: steep-sided ridges on resistant sandstones; flat or rolling lowland on shales and limestones; and areas of greater moisture on footslopes and along streams (Braun, 1950). Many species associations and communities have developed in response to unlike conditions of different areas. In addition to differences related to northern or southern location, and to the usual factors of slope exposure and steepness, are those brought about by the nature of the rocks and dip of strata influencing soil moisture and development (Braun, 1950).

To better illustrate these points Hack and Goodlett (1960) describe a representative valley. Yellow pine forest grows on noses and on part of the side slopes, oak forest grows on side slopes, and northern hardwood forest grows in the hollows. Data obtained by these researchers showed that local distribution of tree species used to define the yellow pine and northern hardwood forest types is closely related to topography. Some valleys support only two of the three forest types recognized in their study; they lack the northern hardwood forest. This difference is thought to be the result of the valleys having a more southerly or westerly orientation (Hack and Goodlett, 1960).

Hack and Goodlett (1960) state the distribution of species that define the forest type shows a large "coincidence" with other components of the landscape. They state the relation between forest types and vegetation is particularly strong. Observable differences are also apparent between the distribution of forest types and slope orientation, soil texture, and the nature and attitude of the bedrock. For example, Hack and Goodlett explain that the northern hardwood forest extends much farther up the side slopes and occupies the hollows more extensively on the northeast facing slopes than on the southwest facing slopes. Hack and Goodlett believed these differences may be largely related to a common environmental factor: the distribution of moisture in the ground.

MATERIALS AND METHODS

Sampling

A stratified sampling strategy was employed for site selection. Sampling was concentrated in two areas. High elevation areas where unpredictably high site index occurred were chosen and sampled. Surrounding areas, with both high and low elevations, were also sampled to serve as a basis for comparison.

Major landscape positions on landforms, typical for the study area, were selected for sampling to make data useful to the needs of the National Forest management programs. These sites included both residual and colluvial soils in proportions equal to their prevalence in the study area. Sites were also divided between cool and warm aspects.

Fifty-eight sites were sampled for numerous properties. Soil pedons were described for all sites. Woodland data, including dominant and codominant tree species, site index, basal area, and understory composition was recorded. Some site features were recorded as well, including landscape position, slope percent, aspect, and elevation. Samples were gathered by horizon for physical and chemical soil analyses. Samples for mineralogical analyses were gathered from the taxonomic control section.

Temperature Study

The soil temperature study began in November 1990. The temperature study was conducted in the Laurel Fork area and the Ruckman Draft/Paddy Knob areas. Each area has 3 to 5 randomly selected sites. Summit, mid elevation, and lower elevation sites were selected for both cool (north to east) and warm (south to west) aspects. The summit was selected without regard to aspect.

Soil temperature was recorded from thermocouples buried 50 cm (20 in.) in the soil. Soil was removed and separated roughly by horizon. After installation of the thermocouple (*Soiltest*[1], Soil Moisture and Moisture-Temperature Cells, MC-310A), the soil was returned into the pit, in the reverse order from which it was removed, to restore natural soil layering as much as possible. Soil temperature was then recorded monthly near the middle of each month beginning in November 1990, with a *Soiltest*, Soil Moisture-Temperature Meter (MC-300B). Soil temperature was recorded at 13 sites, with three repetitions at each site. The mean of these three values was used to represent the average soil temperature at each site. Three complete years of data were used in estimation of soil temperature. Paddy Knob sites D and E, however, only have one year of data. Soil temperature will continue to be monitored for further refinements.

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[1]Use of brand names does not imply endorsement by Virginia Tech.

Laboratory Methods

Soil chemical analyses and procedures used are standard methods used by the Soil Survey Laboratories of the Soil Conservation Service. The procedure for most analyses can be found in the Soil Survey Laboratory Methods Manual (USDA, Soil Conservation Service, 1992).

The following chemical analyses were conducted on soil from each horizon sampled:

pH determination: 1:1 water:soil (<2mm fraction)

Kjeldahl CEC: using NH_4OAc, pH 7.0 and Kjeldahl distillation

Organic matter: Acid-Dichromate Digestion ($FeSO_4$ Titration)

Exchangeable bases Ca, Mg, and K: NH_4OAc Extraction, and analyzed by atomic absorption spectrophotometry

Exchangeable acidity (H^+): $BaCl_2$-TEA Method, pH 8.0

Exchangeable Al: KCl Extraction as described by McLean (1965)

Cation Exchange Capacity (CEC or NCEC) was determined by the Kjeldahl method as described above. Percent Base Saturation (NBS) is sum of basic cations (Ca, Mg, and K) divided by NCEC, multiplied by 100.

Investigation of soil physical properties is limited to particle size analysis. Particle size analysis was conducted by the pipet method for each soil horizon sampled. The sand fraction was removed by wet sieving and fractionation was done by dry sieving (USDA, Soil Conservation Service, 1992). Size distribution was separated as follows:

Sand:

Very Course: 2.0-1.0 mm

Course: 1.0-0.5 mm

Medium: 0.5-0.25 mm

Fine: 0.25-0.10 mm

Very Fine: 0.10-0.05 mm

Silt: 0.05-0.002 mm

Clay: <0.002 mm.

Mineralogical analyses were conducted by the National Soil Survey Center, Lincoln, Nebraska. Mineralogical analyses included: 15-bar water:clay ratio: to aid in determination of hydraulic properties and moisture retention of the soil; moisture retention at 15-bar for <2 mm soil fraction by pressure-membrane extraction; pH: measured at 1:1 soil:water solution and 1:2 soil:$CaCl_2$ solution to help determine reaction classes in families of Entisols; Elemental Analysis of Al, Fe and K: Hydroflouric Acid (HF) digestion and elemental analysis by atomic absorption for the percent concentration of Al_2O_3, Fe_2O_3 and K_2O for classification purposes; grain counts: counts of the course silt and sand fraction were conducted and reported as percent of total to help classify soil mineralogical families.

Statistical Methods

Means, standard deviations, and other basic statistics were generated by the System for Elementary Statistics (SAS) using PROC UNIVARIATE (SAS, 1990). More complex statistical procedures were also performed by SAS, these are briefly described.

The Wilcoxon Rank Sum Test (also known as the Mann-Whitney Test) is designed to test if the null hypothesis, that two populations are identical, can be rejected. The SAS NPAR1WAY procedure with the Wilcoxon option was used to perform the Wilcoxon Rank Sum test. This technique was employed because the data distribution was not normal for many variables.

An intuitive approach might be to compare the sum of the ranks between the two populations. If the difference is too large or too small, the null hypothesis, no difference between populations, may be rejected if the ranks associated with one sample tend to be larger than the other sample. Two basic assumptions apply; error in the data are random and independent, and the populations are continuous (Upchurch and Edmonds, 1991). The test statistic, T, is the rank sum, calculated by pooling the n_1 observations from Sample 1, and the

n_2 observations from sample 2. The T statistic is calculated from the sum of the ranks corresponding to observations from Sample 1. Ties are assigned the average of the tied observations.

The population location represented by the median, w, is used in the null hypothesis H_O: $w_1 = w_2$, and the alternative H_A: $w_1 \neq w_2$. Reject H_O if $T \geq T_{n1,\, n2,\, 1-y/2}$ or $T \leq T_{n1,\, n2,\, y/2}$. The y percentiles are given by Conover (1980, Table A7). When the sample size exceeds 20, a large sample rank sum test is based on (from Upchurch and Edmonds, 1991):

$$Z = \frac{T - [n_1(n_1 + n_2 + 1)/2]}{[n_1 n_2 (n_1 + n_2 + 1)/12]^{1/2}}$$

where:

Z = cumulative probability of the standard normal distribution
n_1 = sum of the ranks for Sample 1
n_2 = sum of the ranks for Sample 2

$$T = \sum_{i=1}^{n_k} R(X_{ik})$$

where:
$R(X_{ik})$ = the rank of the n_1 observations

The Kruskal-Wallis one-way analysis of variance by ranks was used to compare differences between more than two groups. The SAS NPAR1WAY procedure with the Wilcoxon option was used to perform the Kruskal-Wallis test.

This technique was employed because the data distribution was not normal for many variables. This nonparametric alternative to the one-way analysis of variance was used to test the hypothesis of equal location parameters. The null hypothesis is that the *k* populations have identical distributions. The alternative hypothesis is at least one population has a different central value (Davis, 1986). Observations from *k* samples are pooled and ranked from smallest to largest. The observations are then replaced by their ranks, from 1, assigned to the smallest observation, to *n*, assigned to the largest observation. When two or more observations have the same value, each observation is given the mean for the ranks for which it is tied. For each sample, the sum of the ranks (R_k) are found:

$$R_k=\sum_{i=1}^{n_k} R(X_{ik})$$

where $R(X_{ik})$ represents the rank of the *i*th observation in the *k*th sample (Davis, 1986). Ranks assigned to observations in each of the *k* groups are added separately to give *k* rank sums. The total number of observations, *N*, is:

$$N=\sum_{j=1}^{k} n_k$$

where n_k is the number of observations in the *k*th sample (Davis, 1986). The assumptions are that the observations have been collected randomly, and that the samples are independent of one another. From the sum of the ranks, *H*, the test statistic, can be calculated from:

$$H=\frac{12}{N(N+1)}\sum_{j=1}^{k}\frac{R_j^2}{n_j}-3(N+1)$$

where:

k = the number of groups
n_j = the number of observations in the jth group
N = the number of observations in all groups combined
R_j = the sum of the ranks of the jth group.

When there are three groups with five or fewer observations in each group, the significance of the H statistic is determined from a table of critical values for the Kruskal-Wallis test statistic (see for example, Daniel, 1991, Appendix II Table M). If there are more than five observations in one or more of the groups, H is compared with values for the X^2 (chi-square) distribution with k-1 degrees of freedom, for a predetermined significance level (Daniel, 1991).

When there are three or more groups to compare, and the Kruskal-Wallis test only indicates if at least two groups are different, the next question, then, becomes: which groups are different? A nonparametric procedure described by Hollander and Wolfe (1973), and proposed by Dunn in 1964, that is valid for unequal sample sizes, can be used to compare mean ranks for two groups at a time. The equation is:

$$|R_{.u}-R_{.v}|\geq Z(\alpha/[k(k-1)])[\frac{N(N+1)}{12}]^{1/2}(\frac{1}{n_u}+\frac{1}{n_v})^{1/2}$$

where:

α = predetermined experimentwise error rate
N = the number of observations in all groups combined

$$\bar{R}_{.j}=\frac{R_j}{n_j}$$

where:
Rj = sum of all ranks for treatment j
nj = number of observations in jth group

Z = value from a table of the upper tail probabilities for the standard normal distribution (see, for example, Hollander and Wolfe (1973), Appendix A Table 1)
k = number of groups.

Multiple linear regression was performed on the data using the PROC STEPWISE option in SAS to generate a linear prediction equation. A backward selection technique was used to predict site index (SAS, 1990). Multiple regression can indicate the amount of variation in the data set accounted for by the variables measured. If sufficient variation is accounted for, the prediction equation generated can be used to estimate site index at other sites within the study area with similar properties.

The estimated regression equation for more than one variable using the method of least squares has the form:

$$y=b_o+b_1x_1+...+b_kx_k$$

where:

y = the measurement, or dependent variable
b_o = intercept

b_n = slope of the line
x_n = predictor, or independent variable.

The proportion of the variance explained by the model is indicated by the coefficient of determination, R^2. Values of R^2 near 0 indicates there is little relationship between x and y, while R^2 values near 1 indicates most of the variability in y is explained by the model.

There are many assumptions inherent in this model. First, all variables must be interval or ratio. The independent variable, x, must be known and nonrandom. This indicates that any inferences drawn apply only to the set of gathered data, not a larger collection of X's. Also, the error in the data must be normally distributed. For each set of X values, there is a subpopulation of Y values. The variance of the subpopulation of Y are equal. The Y values are independent (Daniel, 1991).

Some variables considered potentially important were qualitative in nature. Qualitative variables can be constructed into classes for use in the multiple regression equation. The effect of these variables is to shift the position of the regression line and the intercept vertically. Qualitative, "dummy," "categorical," or "indicator" variables were created by the method described by Myers (1990).

Several methods exist for model adequacy testing. Model adequacy testing checks the appropriateness of the variables in the model, and how the variables interact with one another in a statistical framework. Model adequacy checking is used to select appropriate variables for the model, identify the relative effects of the regressor variables and their usefulness in prediction and estimation (Montgomery and Peck, 1992). Some of these model fit testing parameters are generated by SAS (SAS, 1990).

Inspection of the correlation matrix may reveal multicollinearity between variables. If only two variables are correlated together, a correlation of 0.90 or greater indicates variables are linearly dependant. When more than two variables are correlated at once, multicollinearity is much more difficult to detect because the correlation coefficient need not be as large to indicate multicollinearity. The variance inflation factor (VIF) is commonly a useful indicator of linear dependencies, or multicollinearity, between regressor variables. If any of the VIF's exceed 5 or 10, it is usually an indication that the associated regression coefficients are poorly estimated because of multicollinearity. Another commonly used test for model adequacy when model building is Mallows' *Cp* statistic. When creating a model, comparison of the *Cp* statistic between models provides some idea of the adequacy of one model over the other. Generally small values for Mallows' *Cp* statistic are desirable (Montgomery and Peck, 1992).

RESULTS AND DISCUSSION

Temperature Study

Temperature data for three years (November 1990 to November 1993) is available for all sites except for Paddy Knob sites, repetitions D and E, which have only one year of data (November 1992 to November 1993). Soil temperature was compared by aspect. The largest significant mean difference of soil temperature occurred between the north and south aspects ($p=0.032$). The opposing aspect directions that showed the greatest temperature difference was used as criterion to define the two aspects for which soil temperature was determined. The north aspect is defined as the aspect from 270-360 and 0-90°, while the south aspect is 90-270°.

Mean Annual Soil Temperature (MAST) below 8° Celsius (46.4° F) defines a frigid soil temperature regime. Figures 1 and 2 indicate that the mesic-frigid boundary occurs at approximately 1230 m (4032 feet) on the warm (90-270°) aspect, and at approximately 1180 m (3869 feet) on the cool (270-360 and 0-90°) aspect.

The difference between the mesic-frigid boundary is approximately 50 m. This difference may be too small for the level of mapping. An approximate mesic-frigid soil temperature boundary of 1200 m (approximately 3940 feet) may serve the necessary purposes. This is not a rigid delineation. Soil temperature is influenced by slope, aspect, exposure, and other soil and site factors. The delineation of soil temperature should reflect the variation of soil temperature as controlled by soil and site factors. This allows for the mesic-frigid boundary on the south aspect, for example, to rise above 1200 m on spur ridges and summits. Similarly, "cooler" sites in coves, just below 1200 m may be delineated as having a frigid temperature regime.

Across all aspects, an average increase in elevation of 240 meters (787 feet) produced a 1.0° C (1.8° F.) decrease in MAST for the three years of this study. This result is greater than that reported by Smith et al. (1964) who reported a 1.0° C (1.8° F.) decrease in MAST over a 203 m (666 feet) change in elevation. However, Carter and Ciolkosz (1980), studying soil temperature across a transect from northern Pennsylvania to northern West Virginia, reported a 1.0° C (1.8° F.) change in MAST for a 294 m (964 ft.) change in elevation. Shaw (1982) reports a 1.0° C (1.8° F.) change in MAST for a 160 m (525 ft.) change in elevation for the mid Rocky Mountains region of the Western United States.

Figures 1 and 2 show a trend of decreased soil temperature with increased elevation. The relationship between these variables has been shown to be linear (Smith et al., 1964; Carter and Ciolkosz, 1980; Shaw, 1982). Some variation exists in the data. This variation may be accounted for, in part, by several confounding factors. First, a wide range of elevation without temperature measurements affects the confidence of prediction of the soil temperature on the south aspect.

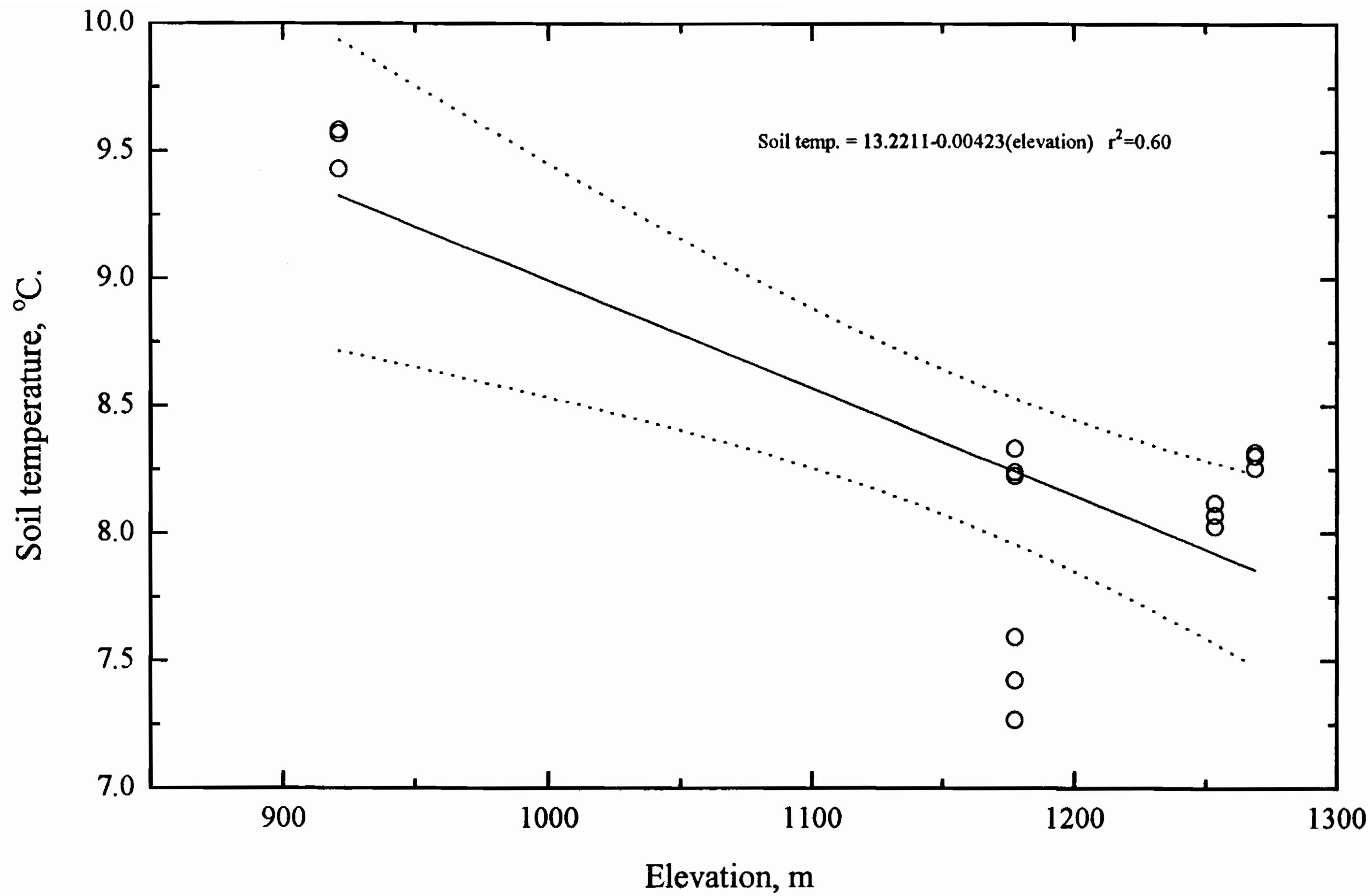

Fig. 1. Relation of soil temperature with elevation on the south aspect (90-270°) with 90% confidence bands in the George Washington National Forest, Virginia.

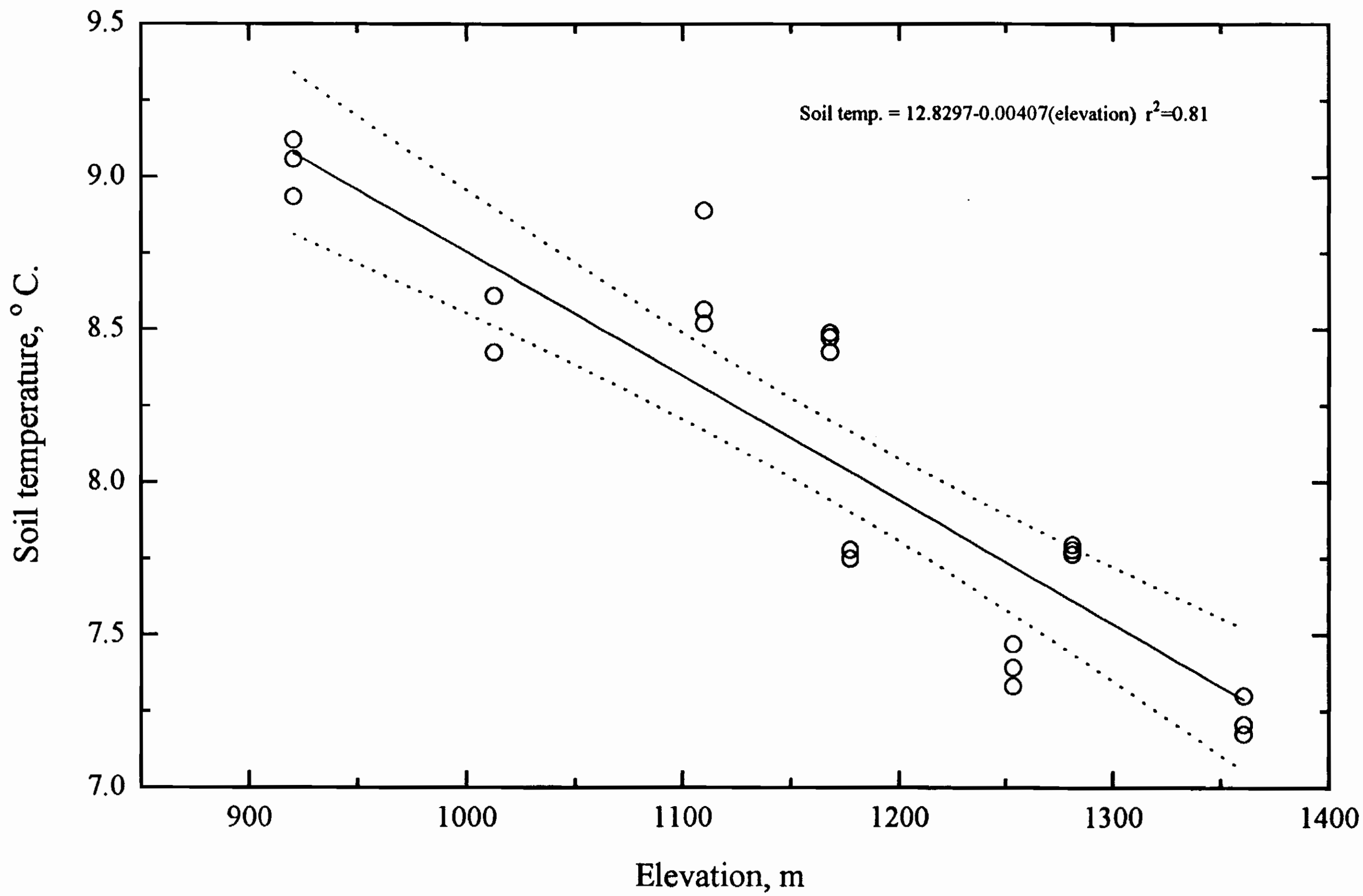

Fig. 2. Relation of soil temperature with elevation on the north aspect (270-360 and 0-90°) with 90% confidence bands in the George Washington National Forest, Virginia.

More measurements within the 1000 to 1100 m (3300 to 3600 ft.) range would decrease variation and increase the confidence of prediction. Also, differences in slope steepness and slope position of the sites where soil temperature was measured, affects the amount of solar radiation striking the surface of the soil, affecting soil temperature dynamics.

An approximate 1200 m delineation for the mesic-frigid soil temperature boundary may meet the needs of the survey. This boundary is not absolute, and allows for adjustments as appropriate.

Precipitation Quantification

Precipitation in mountainous areas may vary considerably due to topographic effects on air mass movement and weather patterns. To gain insight into the possibility of orographic effects or uneven precipitation distribution within the study area, available precipitation information was gathered for the period beginning in 1951 through 1980 (Weather Disk Associates, 1994).

Figure 3 shows considerable variation in average precipitation for areas in and around the George Washington National Forest, Virginia. The region's lowest mean annual precipitation is about 82.45 cm (32.46 in.), and the highest is 111.28 cm (43.81 in.). These weather stations are not representative of the variation in elevation found within the study area. The site sampled with the highest elevation in the study had an elevation of 1360 m (4460 feet), while the highest elevation for which precipitation is recorded is 930 m (3050 feet). This data yields little information into prediction of precipitation at the highest elevations in the study area. Precipitation induced by moist air ascending over mountains does not have a linear trend with elevation; therefore, weather trends at lower elevations yield little information into climatological occurrences at high elevations (Grafton and Dickerson, 1969). Figure 3 does indicate, however, an increasing trend in precipitation with elevation.

Some researchers (Meiners, 1982; Trimble and Weitzman, 1956; Wathen, 1977) found, or claim, available soil moisture is the growth limiting factor during the later part of the growing season. To investigate this presumption for the study area, potential evapotranspiration (ET) was compared to precipitation for the growing season.

Potential evapotranspiration was calculated by the Thornthwaithe method using available precipitation and temperature data (Gray, 1973). The formula developed by Thornthwaithe:

$$E = cTm^{a}$$

where:

E = evaporation or potential evapotranspiration (water unlimited), cm
c = coefficient
Tm = mean monthly temperature, °C
a = exponent.

Both a and c depend on the location for which ET is being calculated. This

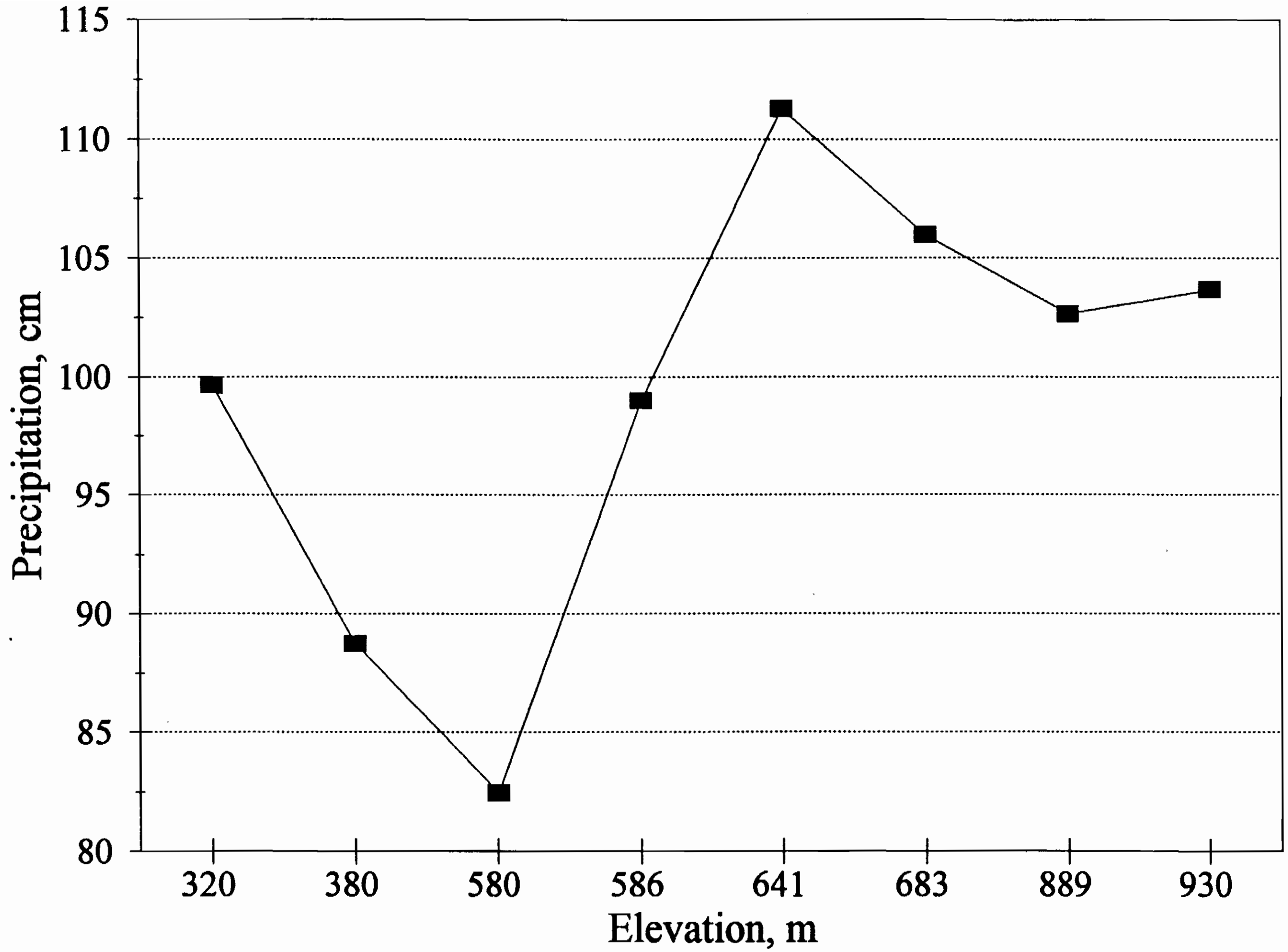

Fig. 3. Precipitation distribution plotted against elevation for areas in and around the George Washington National Forest, Virginia.

equation is simplified if it is assumed that each month has 12 hours of sunshine each day and there are 30 days a month. Using a nomograph as described by Gray (1973) simplifies the equation to:

$$I=\sum_{m=1}^{12}\left[\frac{T_m}{5}\right]^{1.51}$$

where:

I = heat index
Tm = mean monthly temperature, °C

From the use of this equation and the nomograph, monthly evapotranspiration can be obtained from the mean monthly air temperature.

Six locations had mean monthly precipitation and air temperatures available for use in ET estimates. Only Hot Springs and Monterey weather stations lie geographically within the study area. The other four, Franklin, White Sulphur Springs, Buckeye, and Spruce Knob, are near to the study area in West Virginia. Figures 4 through 9 show the monthly precipitation and growing season evapotranspiration plotted together at each location.

At Franklin, West Virginia (Fig. 4), the topographically lowest of the four sites (580 m) it appears May has an excess of available moisture. June, July, and August have deficits. Plant available soil moisture is the source for needed moisture beyond that provided by precipitation during the growing season. The soil will need to supply the plant with at least four centimeters of available moisture. Furthermore, the Thornthwaithe equation is based on 12 hours of sunlight per day. This is a conservative estimate. Water deficits may become greater during the later part of the growing season than is indicated by Figure 4.

White Sulphur Springs (586 m), West Virginia (Fig. 5), at nearly the same elevation as Franklin (580 m) West Virginia has a different precipitation pattern. Evapotranspiration rates are higher at the White Sulphur Springs location. The high July precipitation supplies needed moisture at a critical point in the growing season, yet, this amount is insufficient to keep the vegetation from experiencing moisture stress.

Ascending to the next location, Buckeye (641 m), West Virginia (Fig. 6), there is a slight increase in precipitation as compared to the Franklin location, however, the distribution of the precipitation may be more advantageous for growing vegetation. Also, an increase in elevation, and therefore, decrease in air temperature, may decreasing ET sufficiently to limit moisture stress to the end of the growing season.

Hot Springs (683 m), Virginia (Fig. 7) has less annual precipitation, and greater growing season ET than does the Buckeye location. This creates the potential for plant moisture stress beginning as early as late June. There is a slight decrease in ET after July, which follows the precipitation pattern, and may create a window where moisture is not limiting late in the growing season if

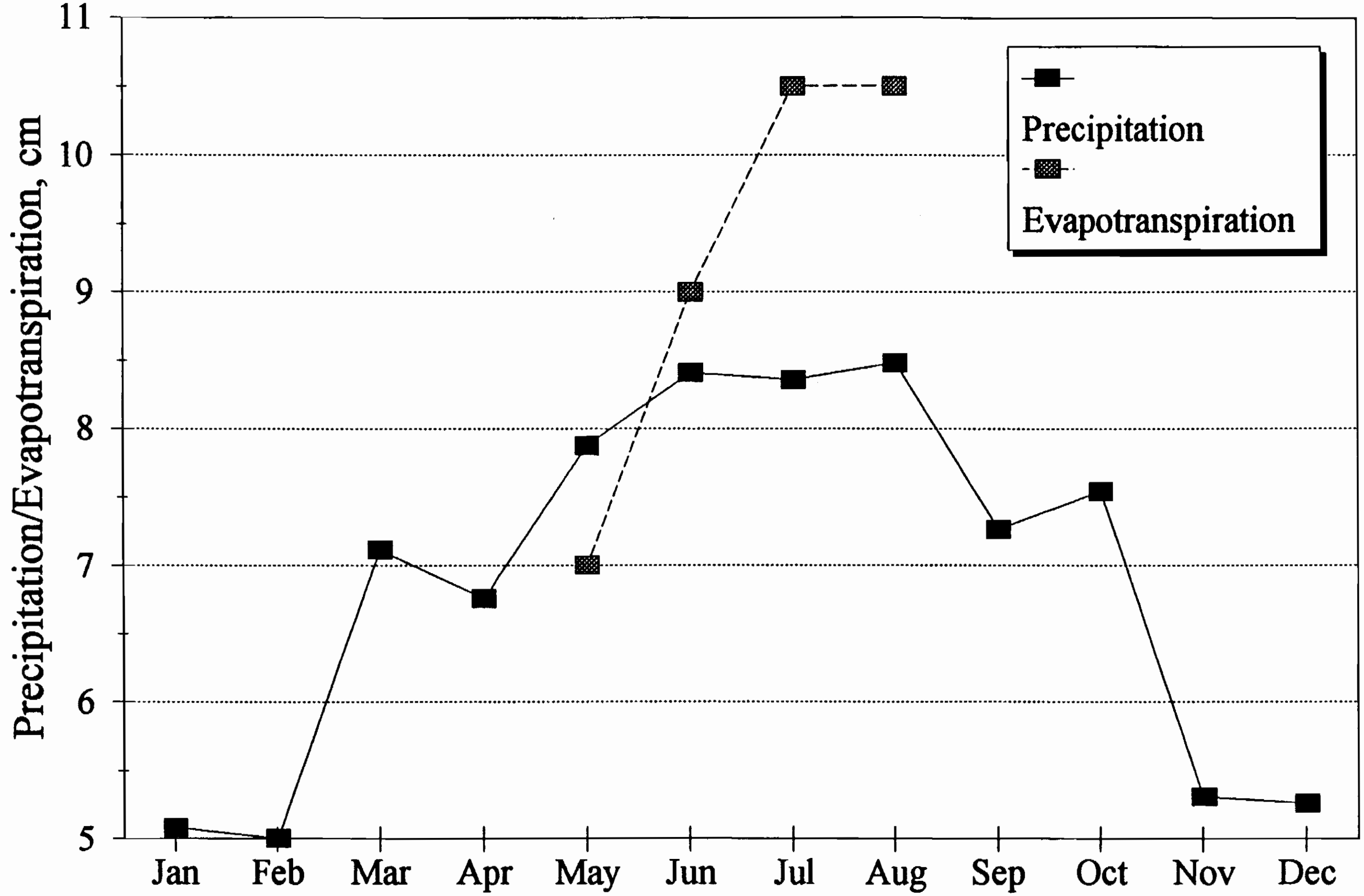

Fig. 4. Precipitation and growing season (May, June, July, and August) evapotranspiration for Franklin, West Virginia (elevation: 580 m).

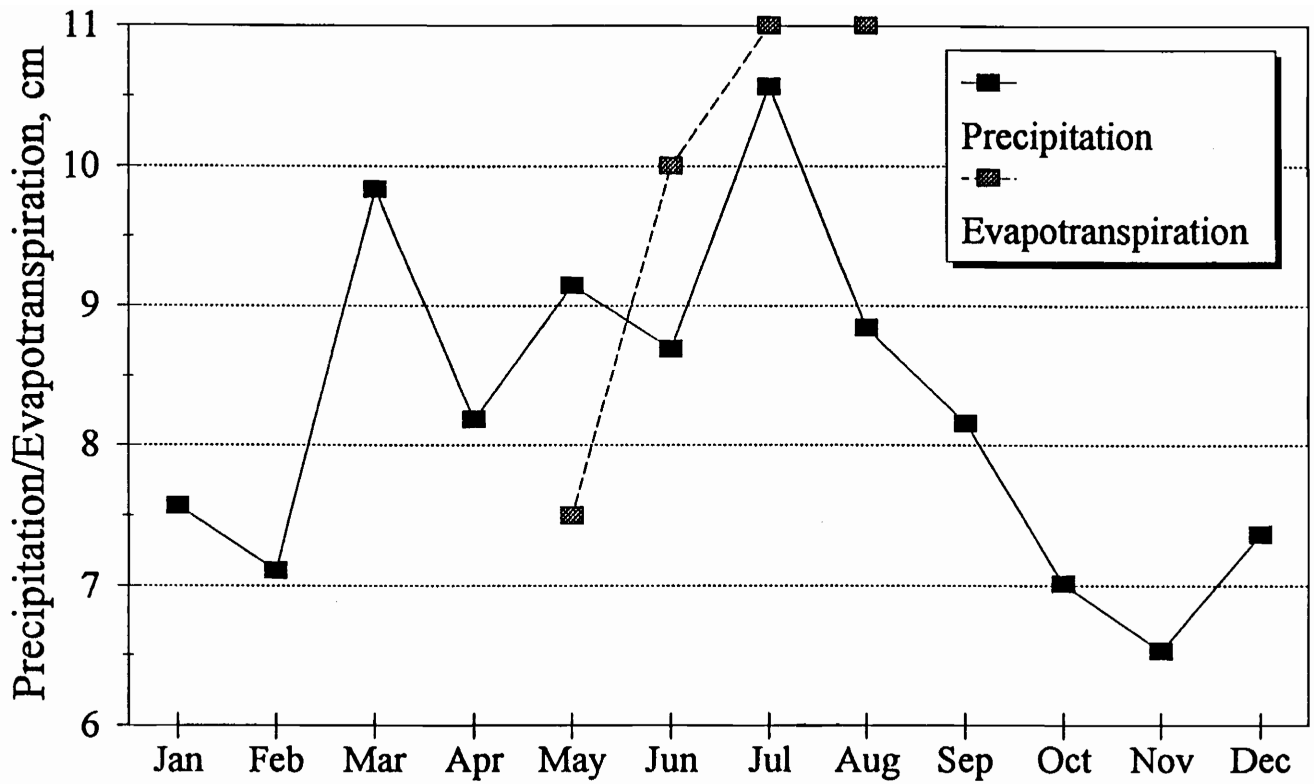

Fig. 5. Precipitation and growing season (May, June, July, and August) evapotranspiration for White Sulphur Springs, West Virginia (elevation: 586 m).

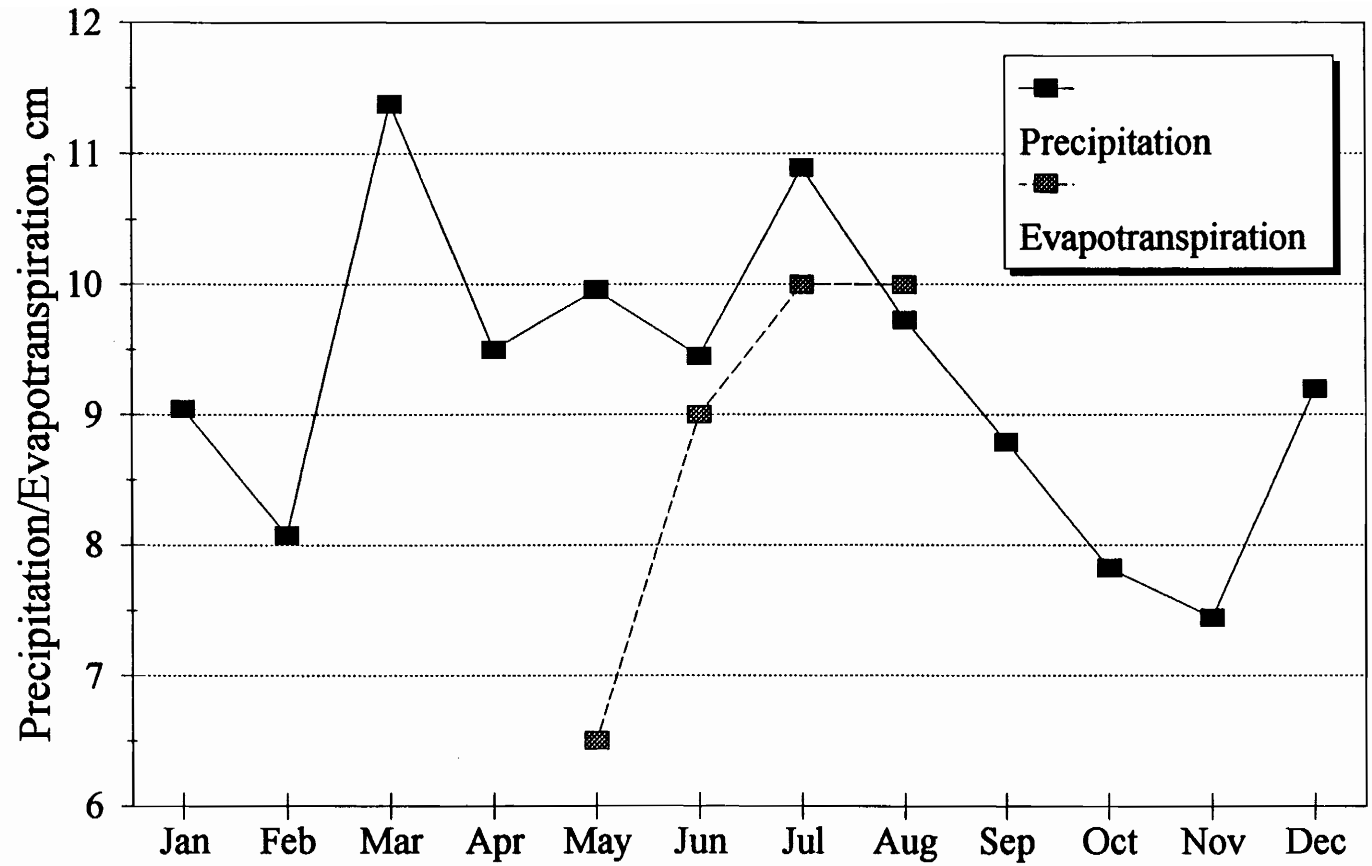

Fig. 6. Precipitation and growing season (May, June, July, and August) evapotranspiration for Buckeye, West Virginia (elevation: 641 m).

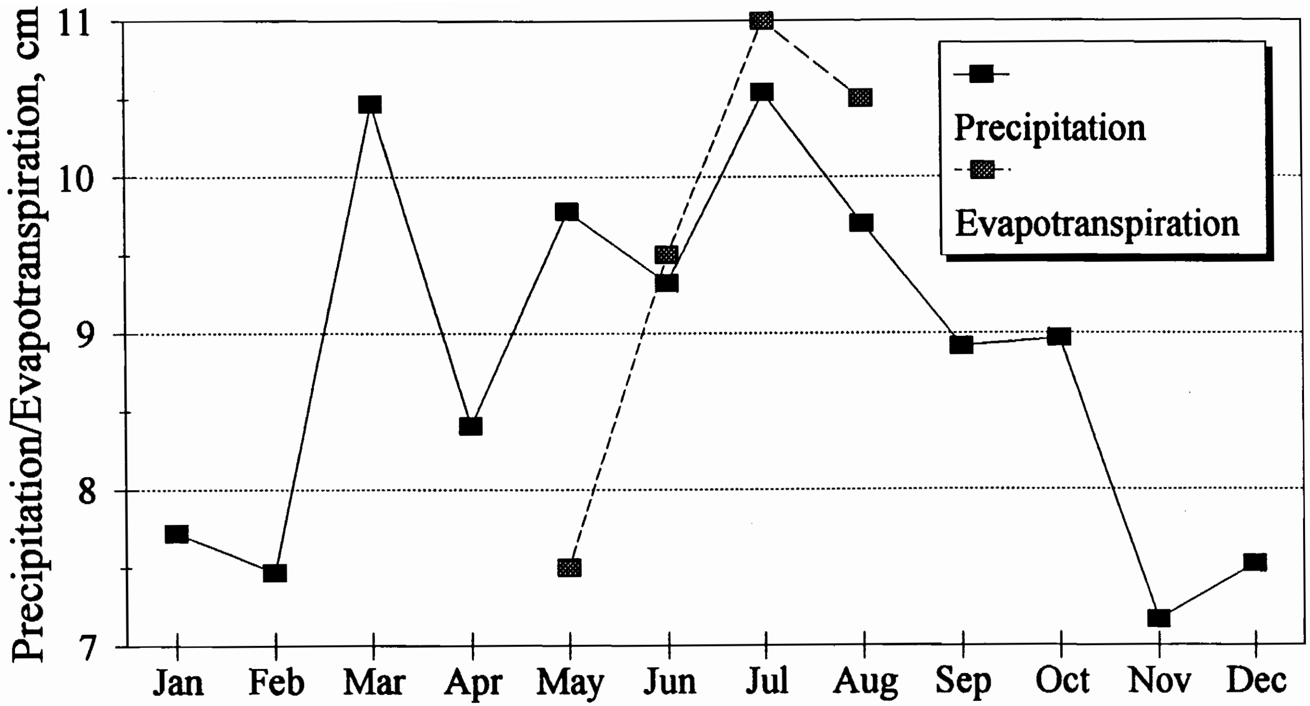

Fig. 7. Precipitation and growing season (May, June, July, and August) evapotranspiration for Hot Springs, Virginia (elevation: 683 m).

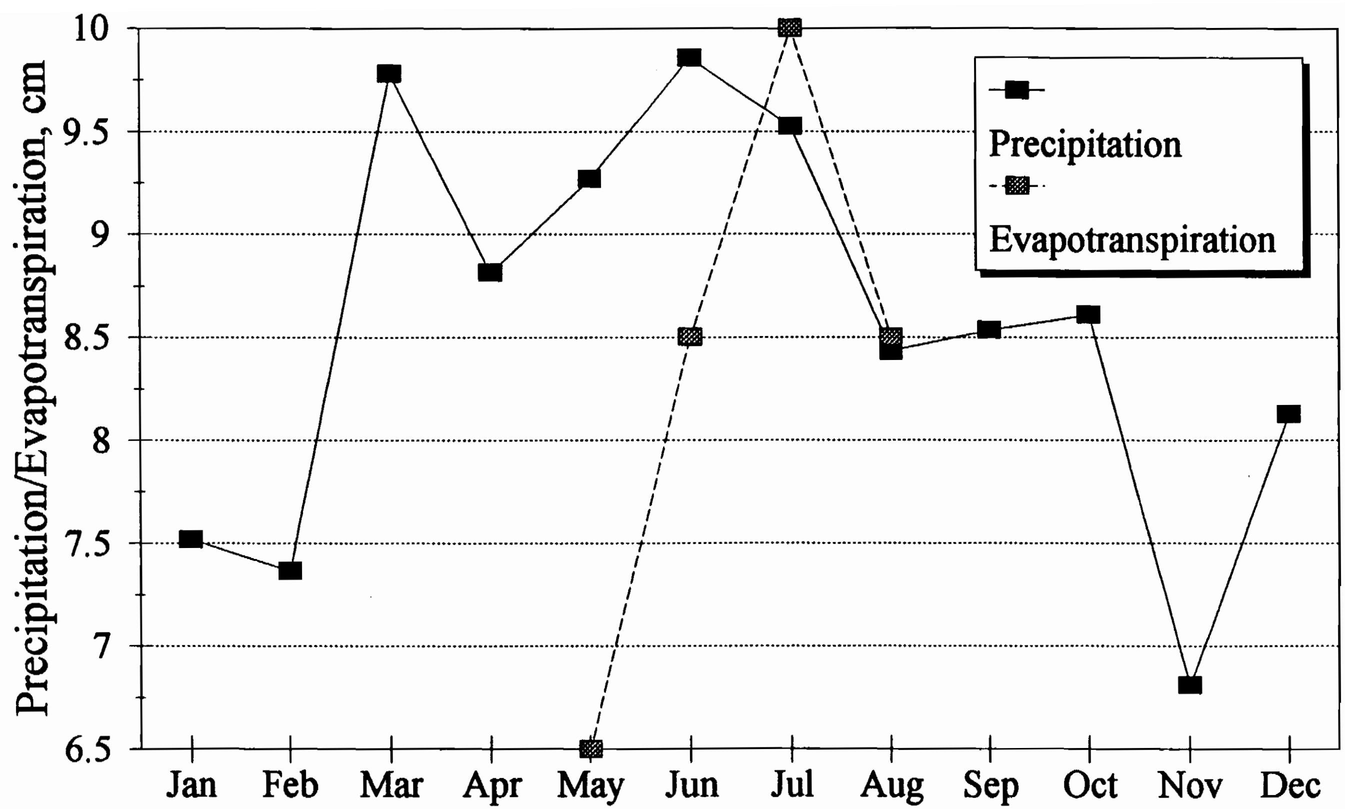

Fig. 8. Precipitation and growing season (May, June, July, and August) evapotranspiration for Monterey, Virginia (elevation: 889 m).

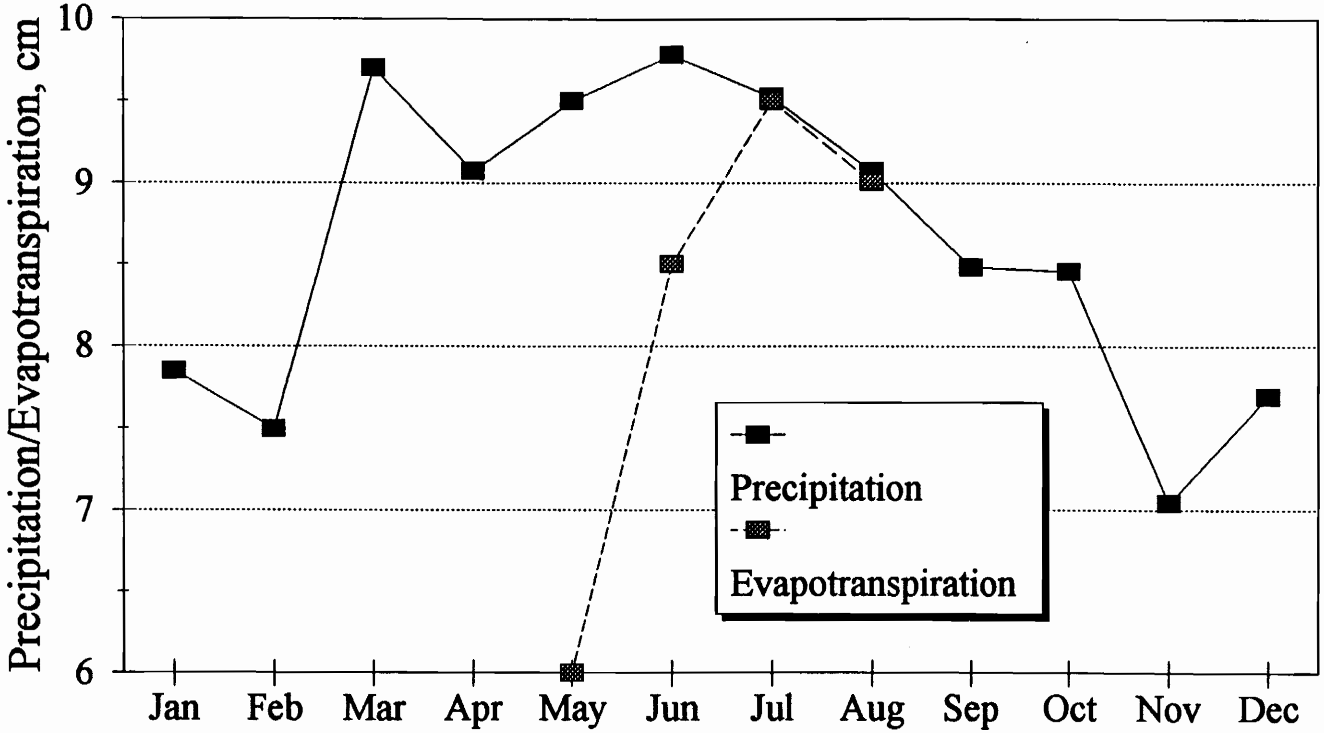

Fig. 9. Precipitation and growing season (May, June, July, and August) evapotranspiration for Spruce Knob, West Virginia (elevation: 930 m).

summer precipitation is above normal, or temperatures are below normal. Many soils in the George Washington National Forest may have the available water capacity to supply the vegetation with sufficient moisture at Hot Springs and areas with similar temperature and precipitation distribution.

At Monterey (889 m), Virginia (Fig. 8), there is an early summer high in precipitation that meets the demands of the vegetation for moisture into July. The July deficit is approximately one-half cm, within the moisture supplying capacity of the soils in the area. A sharp decline in August precipitation corresponds with a sharp decline in ET, lessening the need for precipitation. The sites within the study area located near Monterey Virginia may not experience moisture stress for any duration during the growing season with the exception of unusually dry and hot summers.

A similar trend is seen at Spruce Knob (930 m), West Virginia (Fig. 9). Summertime precipitation is sufficient to supply moisture demanded by the vegetation. July and August have a near balance between available moisture in the form of precipitation to meet the ET demands of the vegetation, with an added soil moisture reserve for unusually hot or dry summers.

As expected, the ET curves from the different elevations reveal a lower and shorter period of ET during the summer growing season at areas of higher elevation. These potentially shorter periods of growth increase the importance of available moisture when the demand occurs. This may lend insight into the growth differences between the vegetation at the lower and higher elevations in the study.

Figure 10 shows moisture deficits for the six sites collectively. The total moisture deficit was calculated by the sum of the differences between precipitation and ET for each month during the growing season. Only two locations had a total deficit (Franklin (580 m) and White Sulphur Springs (586 m)). The remaining four sites had an excess amount of available moisture.

This excess precipitation, including that reaching the soil during the winter and spring, may recharge the soil's available moisture capacity. Generally, there are three subgroups of soils found in the study area: the Typic and Lithic Dystrochrepts, and Humic Hapludults. The ability of these soils to retain winter and spring moisture from precipitation may be the determining factor if plants undergo moisture stress during the growing season. For the Lithic Dystrochrepts, roughly 38 cm deep, and having 35% coarse fragment content, the potential storage capacity is approximately 5 cm of available moisture holding capacity. This assumes a water holding capacity of 20%, for an average texture of silt loam (National Soil Survey Laboratory, 1981). The Typic Dystrochrepts, on average, have loam textures, 40% coarse fragments, and are approximately 60 cm deep. Assuming an available moisture holding capacity of 19% (National Soil Survey Laboratory, 1981), this translates to approximately 6 cm of moisture that can potentially be held in the soil profile. For the Typic Dystrochrepts, if the soil

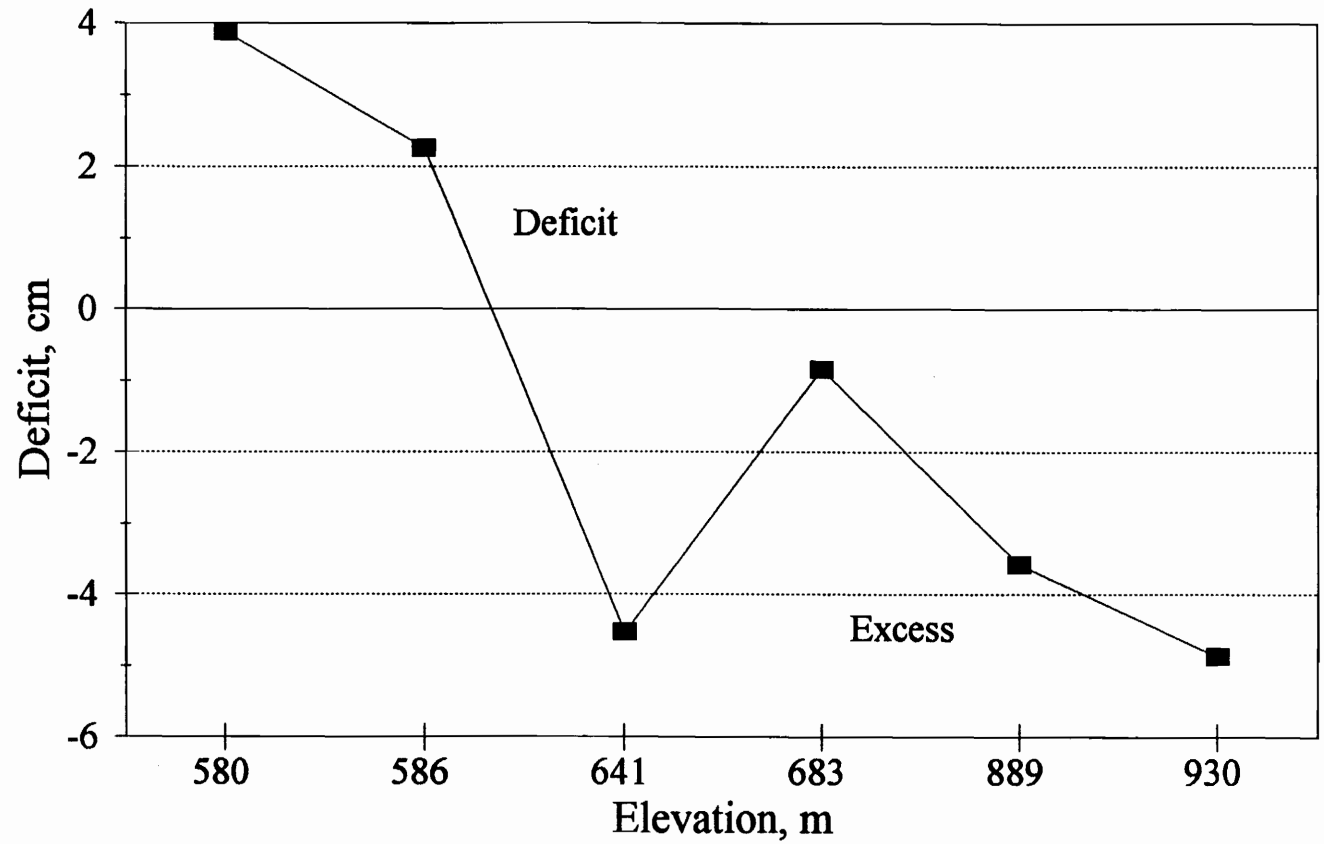

Fig. 10. Growing season (May, June, July, and August) water deficit calculated for data from weather stations in and around the George Washington National Forest, Virginia.

becomes fully recharged by the beginning of the growing season, there may be a reserve supply of 6 cm of soil moisture to offset deficits in precipitation during the growing season. The deeper, finer textured soils in the study area, although less common, can store significantly more moisture. On average, these soils contain approximately 15% coarse fragments, are nearly 90 cm deep, and have an average texture of silty clay loam. The Humic Hapludults, specifically, can store approximately 14 cm of available soil moisture. The potential storage capacity of some soils may exceed the amount of moisture deficit during the growing season.

Subtracting ET from precipitation, where precipitation is greater than evapotranspiration assumes this excess moisture is stored and will become available when needed. Some moisture may be held by the soil, yet much will become unavailable for plant uptake. Much of the excess precipitation may become runoff, groundwater, or become intercepted by standing vegetation. Therefore, the potential deficit may be underestimated.

These estimates of potentially plant available moisture must be used with caution. From the previous discussion, it seems some soils are capable of storing and making available needed moisture. Figure 10 indicates the maximum amount of moisture deficit is 4 cm. The Lithic Dystrochrepts have potentially 5 cm of available moisture storage capacity for use by plants when needed. This implies the vegetation may never experience moisture stress. This is contrary to research done by Meiners (1982), Trimble and Weitzman (1956), and Wathen (1977).

These researchers found that there is some period of time, in areas near the George Washington National Forest, where plants experience moisture stress during the later portion of the growing season.

Soil Properties and Woodland Site Quality

Woodland site quality as discussed here is expressed by the site index of upland oak. The group upland oak consists of several species, including scarlet oak (*Quercus coccinea*), black oak (*Quercus velutina*), chestnut oak (*Quercus prinus*), and northern red oak (*Quercus rubra*). These oaks are grouped together because their growth rates are relatively similar, providing for easy comparison between sites. Doolittle (1957, 1958) found that on site index comparisons for western North Carolina and northern Georgia, scarlet, black, northern red, and chestnut oak had no significant differences in their height growth. Evans et al. (1974) cite other researchers, like Olson (1937), who developed site index curves for upland oaks in the Southeast, particularly the Virginia-Carolina Piedmont and southern Appalachian Mountains. Olson found no statistical significant differences in the rates of height growth of the various oak species. Within the study area, at least one of these species is present on most sites. Site index data for those sites that did not have an upland oak species were transformed to upland oak site index. These transformations were made using curves from Carmean and Vasilevsky (1971), Carmean (1979), or Doolittle (1958).

Average upland oak site index varied from 8.9 to 30 meters, with a mean site index of 18.2 meters (Table 1). This value agrees well with the data reported by Doolittle (1958), who listed ranges for the various oaks: northern red oak, 14.6-26.8 m; black oak, 14.9-27.4 m; scarlet oak, 13.1-27.1 m; and chestnut oak, 10.6-24.4 m. These values also agree with those reported by Olson (Evans et al., 1974). Table 1 gives selected data for the sites sampled. Sand and clay are the weighted averages for the top 25 cm (10 inches) of the soil profile. Most of the sites had shallow, sloping, coarse, strongly acid, loamy soils. Soil solution was primarily composed of acid cations, hydrogen and aluminum, reflecting the acid, low nutrient status of the parent material from which these soils were derived. Table 2 contains soil chemical properties for the upper 25 cm (10 inches) of the soil profile. Organic matter (OM) varied considerably, from a minimum of 0.86 g kg^{-1} to a maximum of 10.12 g kg^{-1}, with the mean at 3.87 g kg^{-1}. The low nutrient status of these acid shale and sandstone derived soils increases the importance of nutrient cycling within the organic fraction of the soil profile.

Classification of the soils (Soil Survey Staff, 1992) at each site further illustrates the homogeneous nature of the soil (Table 3). The predominance of the soils were classified into the Typic or Lithic Dystrochrepts subgroup.

Classification of the soils illustrates that most soils contain an appreciable amount of course fragments and high amounts of siliceous minerals. It appears the primary distinction between most soils involve depth, coarse fragment content,

Table 1. Selected soil and site properties of the sites sampled within the George Washington National Forest, Virginia.

	N	Median	Mean	Std. dev.	Minimum	Maximum
Elevation, m	58	972	1018	158	671	1360
Slope, %	56	25	26	14	2	65
Rock fragments in profile, %	58	33	38	14	4	63
Siliceous minerals, %	39	91	91	7	71	100
Depth to rock, cm	58	67	73	28	20	152
Sand, $g\ kg^{-1}$	58	300	355	225	60	830
Clay, $g\ kg^{-1}$	58	189	210	137	21	844
Upland oak site index, m	56	18.0	18.2	4.9	8.9	30.0
Basal area, $m^2\ ha^{-1}$	56	23.0	23.9	6.1	4.6	39.0

Table 2. Selected soil chemical properties of the sites sampled within the George Washington National Forest, Virginia.

	N	Median	Mean	Std. dev.	Minimum	Maximum
pH	58	4.55	4.44	0.38	3.12	5.00
Cation exchange capacity, $cmol_c\ kg^{-1}$†	58	11.40	11.04	4.61	2.10	21.10
Base saturation, %‡	58	5.39	7.52	7.91	1.16	45.15
Organic matter, $g\ kg^{-1}$	58	3.41	3.87	2.48	0.86	10.12
Calcium, $cmol_c\ kg^{-1}$	58	0.24	0.54	0.96	0.03	4.82
Magnesium, $cmol_c\ kg^{-1}$	58	0.08	0.14	0.18	0.02	0.91
Potassium, $cmol_c\ kg^{-1}$	58	0.16	0.17	0.09	0.04	0.45
Hydrogen, $cmol_c\ kg^{-1}$	58	13.45	14.68	7.41	1.40	32.50
Aluminum, $cmol_c\ kg^{-1}$	58	4.75	4.66	2.06	0.95	9.25

†Cation exchange capacity by Kjeldahl distillation.
‡Base saturation = (Ca+Mg+K/CEC)100.

mineralogy, and soil temperature. Three sites had umbric epipedons and resulted in classification as Humic Hapludults or Umbric Dystrochrepts. Several other sites may have marginal umbric epipedons as well.

Some generalizations can be made from the correlation matrix presented in Table 4. Several soil and site features are correlated with site index of upland oak. Site index appears to increase as elevation increases, possibly due to climatic factors. A study by Ike and Huppuch (1968) revealed that site index for yellow poplar increased with an increase in elevation; this increased growth at higher elevations is thought to be the influence of higher amounts of precipitation. Studying precipitation distribution in West Virginia, Grafton and Dickerson (1969), claim higher elevation sites receive more precipitation. Similar results were found by Donley and Mitchell (1939) for the Southern Appalachians. When an orographic effect is present, the windward and top of the barrier generally receive the heaviest precipitation. The lee side, where air is descending and warming, is marked by lower precipitation. Orographic influences can be significant in determining the amount of water that will precipitate at a given location. Another possible explanation for increased site index with increased elevation may be that decreased rates of evaporation and evapotranspiration, associated with cooler temperatures at higher elevations, conserving soil moisture.

Higher site index is associated with deeper soil profiles and gentler slopes. This association reflects the significance of soil volume for nutrient and moisture

Table 3. Classification of soils in the George Washington National Forest, Virginia.

Number of sites	Classification
18	Loamy-skeletal, siliceous, mesic Typic Dystrochrepts
8	Coarse-loamy, siliceous, mesic Typic Dystrochrepts
4	Fine-loamy, siliceous, mesic Typic Hapludults
3	Loamy-skeletal, mixed, mesic Typic Dystrochrepts
3	Fine-loamy, siliceous, mesic Typic Dystrochrepts
3	Loamy-skeletal, mixed, mesic Lithic Dystrochrepts
3	Loamy-skeletal, siliceous, mesic Lithic Dystrochrepts
2	Loamy-skeletal, mixed, frigid Typic Dystrochrepts
2	Coarse-loamy, mixed, frigid Typic Dystrochrepts
2	Fine-loamy, mixed, frigid Typic Dystrochrepts
1	Fine-loamy, siliceous, frigid Humic Hapludults
1	Loamy-skeletal, siliceous, mesic Lithic Udorthents
1	Fine-loamy, mixed, mesic Humic Hapludults
1	Loamy-skeletal, siliceous, frigid Umbric Dystrochrepts
1	Loamy-skeletal, siliceous, frigid Typic Dystrochrepts
1	Clayey-skeletal, mixed, mesic Typic Dystrochrepts
1	Loamy, siliceous, mesic Lithic Dystrochrepts
1	Coarse-loamy, mixed, mesic Lithic Udorthents
1	Coarse-loamy, siliceous, mesic Typic Hapludults
1	Clayey, mixed, mesic Typic Hapludults

Table 4. Correlation matrix for selected data in the George Washington National Forest, Virginia.†

	Site Index	Aspect	Elevation	Depth to R	Slope	Sand	Clay	pH	NCEC	NBS	OM	Ca	Mg	K	H	Al
Site Index	1	-0.08034	0.41346	0.39085	-0.36358	-0.25351	0.10052	-0.14811	0.32338	-0.09937	0.18503	-0.00304	0.02486	-0.09419	0.42318	0.19696
	0	0.5561	0.0015	0.0029	0.0059	0.0594	0.461	0.276	0.0151	0.4662	0.1722	0.9823	0.8557	0.4899	0.0012	0.1457
Aspect	-0.08034	1	-0.13127	-0.11143	-0.0375	-0.08878	0.05399	0.18765	-0.16722	-0.20126	-0.18548	-0.23344	-0.03897	0.03032	-0.22083	-0.10319
	0.5561	0	0.326	0.405	0.7838	0.5075	0.6873	0.1584	0.2096	0.1298	0.1633	0.0778	0.7715	0.8213	0.0958	0.4408
Elevation	0.41346	-0.13127	1	0.32348	-0.36256	0.07226	-0.09579	-0.32459	0.45864	-0.0824	0.45742	0.04551	0.02717	0.06053	0.57301	0.26504
	0.0015	0.326	0	0.0133	0.006	0.5898	0.4745	0.0129	0.0003	0.5386	0.0003	0.7344	0.8396	0.6517	0.0001	0.0444
Depth to R	0.39085	-0.11143	0.32348	1	-0.42648	0.19556	-0.01475	-0.19248	-0.05553	-0.28308	0.022	-0.21396	-0.27808	-0.36679	0.16135	-0.05037
	0.0029	0.405	0.0133	0	0.001	0.1413	0.9125	0.1477	0.6789	0.0313	0.8698	0.1068	0.0345	0.0046	0.2263	0.7073
Slope	-0.36358	-0.0375	-0.36256	-0.42648	1	-0.01353	0.23301	0.00963	0.01707	0.15078	-0.11403	0.12231	0.19148	0.16	-0.11354	0.09992
	0.0059	0.7838	0.006	0.001	0	0.9212	0.084	0.9438	0.9006	0.2673	0.4027	0.3692	0.1574	0.2388	0.4047	0.4637
Sand	-0.25351	-0.08878	0.07226	0.19556	-0.01353	1	-0.08839	-0.11881	-0.50183	-0.02137	0.00587	-0.13902	-0.20046	-0.39118	-0.32239	-0.64711
	0.0594	0.5075	0.5898	0.1413	0.9212	0	0.5094	0.3744	0.0001	0.8735	0.9651	0.298	0.1314	0.0024	0.0136	0.0001
Clay	0.10052	0.05399	-0.09579	-0.01475	0.23301	-0.08839	1	0.08165	0.08182	0.0259	-0.08641	-0.00077	0.07407	0.06859	0.07911	0.10251
	0.461	0.6873	0.4745	0.9125	0.084	0.5094	0	0.5423	0.5415	0.847	0.519	0.9954	0.5806	0.6089	0.555	0.4438
pH	-0.14811	0.18765	-0.32459	-0.19248	0.00963	-0.11881	0.08165	1	-0.30799	0.12135	-0.31722	0.07977	0.12186	0.09679	-0.44019	-0.40237
	0.276	0.1584	0.0129	0.1477	0.9438	0.3744	0.5423	0	0.0187	0.3642	0.0153	0.5517	0.3621	0.4698	0.0005	0.0017
NCEC	0.32338	-0.16722	0.45864	-0.05553	0.01707	-0.50183	0.08182	-0.30799	1	0.0652	0.6951	0.30862	0.39445	0.52292	0.9025	0.7625
	0.0151	0.2096	0.0003	0.6789	0.9006	0.0001	0.5415	0.0187	0	0.6268	0.0001	0.0184	0.0022	0.0001	0.0001	0.0001
NBS	-0.09937	-0.20126	-0.0824	-0.28308	0.15078	-0.02137	0.0259	0.12135	0.0652	1	0.03601	0.93446	0.74637	0.55402	-0.10543	-0.267
	0.4662	0.1298	0.5386	0.0313	0.2673	0.8735	0.847	0.3642	0.6268	0	0.7884	0.0001	0.0001	0.0001	0.4309	0.0428
OM	0.18503	-0.18548	0.45742	0.022	-0.11403	0.00587	-0.08641	-0.31722	0.6951	0.03601	1	0.18439	0.23836	0.33683	0.72413	0.32946
	0.1722	0.1633	0.0003	0.8698	0.4027	0.9651	0.519	0.0153	0.0001	0.7884	0	0.1659	0.0716	0.0097	0.0001	0.0116
Ca	-0.00304	-0.23344	0.04551	-0.21396	0.12231	-0.13902	-0.00077	0.07977	0.30862	0.93446	0.18439	1	0.73077	0.57554	0.12562	-0.06536
	0.9823	0.0778	0.7344	0.1068	0.3692	0.298	0.9954	0.5517	0.0184	0.0001	0.1659	0	0.0001	0.0001	0.3474	0.626
Mg	0.02486	-0.03897	0.02717	-0.27808	0.19148	-0.20046	0.07407	0.12186	0.39445	0.74637	0.23836	0.73077	1	0.81081	0.1758	-0.02194
	0.8557	0.7715	0.8396	0.0345	0.1574	0.1314	0.5806	0.3621	0.0022	0.0001	0.0716	0.0001	0	0.0001	0.1868	0.8701
K	-0.09419	0.03032	0.06053	-0.36679	0.16	-0.39118	0.06859	0.09679	0.52292	0.55402	0.33683	0.57554	0.81081	1	0.26324	0.24249
	0.4899	0.8213	0.6517	0.0046	0.2388	0.0024	0.6089	0.4698	0.0001	0.0001	0.0097	0.0001	0.0001	0	0.0459	0.0666
H	0.42318	-0.22083	0.57301	0.16135	-0.11354	-0.32239	0.07911	-0.44019	0.9025	-0.10543	0.72413	0.12562	0.1758	0.26324	1	0.70162
	0.0012	0.0958	0.0001	0.2263	0.4047	0.0136	0.555	0.0005	0.0001	0.4309	0.0001	0.3474	0.1868	0.0459	0	0.0001
Al	0.19696	-0.10319	0.26504	-0.05037	0.09992	-0.64711	0.10251	-0.40237	0.7625	-0.267	0.32946	-0.06536	-0.02194	0.24249	0.70162	1
	0.1457	0.4408	0.0444	0.7073	0.4637	0.0001	0.4438	0.0017	0.0001	0.0428	0.0116	0.626	0.8701	0.0666	0.0001	0

†Pearson correlation coefficients / probability > R under H_0: Rho=0.

availability. Generally, as elevation and profile depth increase, woodland site quality increases. As slope increases, woodland site quality decreases. These relationships emphasize the importance of soil moisture to woodland site quality in the study area. Similar relationships were found by Ike and Huppuch (1968), who state that, of the variables measured, topographic features were more closely related to site quality than were physical or chemical soil properties. Most reliable for use as predictors were those site features that influence climate and moisture supply, such as elevation, position on slope, aspect, and steepness of slope.

The correlation matrix shows that there is a positive trend between site index and hydrogen content (H). This is not as strongly indicated by the relationship between site index and pH or organic matter. Yet, there is a strong association between the direction of change in hydrogen content and organic matter. A weak, but positive, correlation between organic matter and elevation indicates sites at higher elevations have higher organic matter content. This is true also for the cation exchange capacity and hydrogen, as they are likely linked to organic matter content.

To further evaluate soil and site characteristics and how they relate to woodland site quality, multiple linear regression was attempted on the data set. All variables listed in Tables 1 and 2, except siliceous minerals and basal area were used. Indicator variables were created for landscape positions and slope positions.

After evaluation of the suitability for the variables to use in the model, the variables cation exchange capacity, base saturation, and hydrogen were removed due to high collinearity and variable inflation. A total of fifty observations were used in a backward elimination procedure, generating the following linear regression equation:

(1)

$$\text{Site index} = 39.124 + 2.278(\text{upper third of slope}) + 0.016(\text{elevation}) - 0.022(\text{sand}) + 0.008(\text{clay}) - 4.905(\text{pH}) + 0.624(\text{organic matter}) - 35.083(\text{K}) - 1.705(\text{Al}) \quad R^2 = 0.53$$

where:

Site index = Site index, m
upper third of slope = if the site is on the upper third of the slope a 1 is entered here, otherwise a 0 is entered
elevation = elevation, m
sand = sand, g kg^{-1}
clay = clay, g kg^{-1}
pH = pH
organic matter = organic matter, g kg^{-1}
K = potassium, $cmol_c$ kg^{-1}
Al = aluminum, $cmol_c$ kg^{-1}

The variables used in the model are significant at the 0.10 level. The variable selection technique determined that if the site was located on the upper one-third of the slope, this had a significant influence on prediction of site index. Similarly, elevation of the sites had a significant influence on predicting site index. Sand and clay, possibly important for their water relations of the soils is also contained in the regression equation. Organic matter, pH, and potassium, possibly for their importance in estimating nutrient status, or availability, are also included in the model. The model accounts for approximately 53% of the total variation in the data set.

Due to the distribution of the data, a multiple linear regression equation was generated based on ranks. This approach reduces the number of assumptions regarding the distribution of the data. After evaluation of the suitability for the variables to use in the model, the variables cation exchange capacity, base saturation, and hydrogen were removed due to high collinearity and variable inflation. A total of fifty observations were used in a backward elimination procedure, generating the following linear regression equation:

(2)

Site index = 41.500 - 11.279(summit position) + 0.289(elevation) - 0.301(slope) - 0.293(sand) + 0.629(Mg) - 0.766(K) R^2 = 0.51

where:

Site index = Site index, m
summit position = if the site is on the summit position a 1 is entered here, otherwise a 0 is entered
elevation = elevation, m
slope = slope, %
sand = sand, g kg^{-1}
Mg = magnesium, $cmol_c$ kg^{-1}
K = potassium, $cmol_c$ kg^{-1}

The variables used in the model are significant at the 0.10 level. The variable selection technique determined that if the site was located on the summit landscape position, this had a significant influence on prediction of site index. Compared to equation 1, this model has several different variables. First, Equation 2 has only six significant variables included in the regression equation. Equation 2 includes an indicator variable, summit position, indicating this had some significance in the prediction of site index. Summit position, as indicated by the variable selection technique, causes a downward shift in the regression line when a site is located on the summit position. That is, if a site is on the summit position, the site index is consistently lower than the site index for sites not located on the summit position.

Both equations have elevation, sand, and K included. The significance of elevation is related to the change in environmental conditions, more favorable at increased elevations. The inclusion of sand, and its sign, indicates sand content is less for the sites with better site index. The inclusion of K and Mg in Equation 2 is not clear. Potassium may be included because it has some indirect relationship to sand content, or other factor. It appears that K decreases with increased site index. Magnesium is included in Equation 2, and not in Equation 1. The inclusion of Mg in Equation 2 indicates a possible link between site index and base status. The influence of variables indicating nutrient status do not appear to have as much influence as those variables indicating site conditions related to moisture supply. Equation 2 also indicates site index decreases with increasing slope. Equation 2 accounts for approximately 51% of the total variation in the data set.

Although there are differences between Equations 1 and 2, due to the form of the distribution of the data, one point remains: variables related to site conditions and soil moisture availability have a large controlling influence on site index. Some of these relationships will be investigated in subsequent sections.

Comparison of Soil and Site Properties Between Soils with Mesic and Frigid Soil Temperature Regimes.

Nine sites were classified within a frigid soil temperature regime. The remaining sites were classified within a mesic soil temperature regime. To investigate differences between properties of soils and sites where the soils were classified as having mesic or frigid temperature regimes, the Wilcoxon Rank Sum test was performed. Table 5 illustrates the significance of differences between several soil properties.

At the 0.10 level of significance, site index between sites classified as mesic and those classified as frigid are not significantly different. The frigid sites had a significantly lower mean slope angle, which confounds the comparison for site index, since site index generally increases with decreasing slope percent. The P value for sand and siliceous minerals suggests that, at the P=0.10 level, there exists some difference between the medians of the two soil temperature classes. Both differences may be the result of a change in the underlying geology.

Table 5. Comparison between soil and site properties of soils with mesic and frigid soil temperature regimes in the George Washington National Forest, Virginia.

	Means		Medians		
Property	Mesic	Frigid	Mesic	Frigid	P†
Site index, m	18.1	18.9	18.0	18.3	0.4678
Depth to rock, cm	72	77	64	71	0.3718
Slope, %	27	19	25	20	0.0874
Sand, g kg^{-1}	326	513	230	488	0.0166
Clay, g kg^{-1}	219	162	196	186	0.1795
Siliceous minerals, %	93	85	93	86	0.0085
pH	4.46	4.31	4.57	4.35	0.2208
Cation exchange capacity, $cmol_c$ kg^{-1}‡	10.53	13.83	11.1	13.6	0.0764
Base saturation, %§	7.48	7.72	5.43	4.97	0.9315
Organic matter, g kg^{-1}	3.37	6.43	3.08	7.00	0.0062
Calcium, $cmol_c$ kg^{-1}	0.51	0.73	0.22	0.42	0.2167
Magnesium, $cmol_c$ kg^{-1}	0.14	0.16	0.07	0.17	0.1316
Potassium, $cmol_c$ kg^{-1}	0.16	0.19	0.14	0.19	0.2160
Hydrogen, $cmol_c$ kg^{-1}	13.98	19.39	12.80	18.7	0.0210
Aluminum, $cmol_c$ kg^{-1}	4.71	4.82	4.90	4.6	0.8467

†P-value from the Wilcoxon Rank Sum test.
‡Cation exchange capacity by Kjeldahl distillation.
§Base saturation = (Ca+Mg+K/CEC)100.

Increasing elevation within the study area results in ascending through a series of different geologic materials. Unexpectedly, however, the direction of the two values do not agree. The frigid sites have the higher mean sand content, while the mesic sites have a higher mean siliceous mineral content.

Three properties showing significant differences are soil organic matter, cation exchange capacity, and soil hydrogen. These measurements are influenced indirectly by changes in elevation, which affects the soil and air temperatures, influencing accumulation and decomposition of the organic fraction. Increase in the organic matter from the mesic to the frigid sites is nearly twofold. Soil hydrogen content is increased as well, possibly influenced by soil organic matter. There is a decline in the pH from the mesic to the frigid soils, yet, this difference is not statistically significant.

From comparisons of sites with mesic and frigid soil temperature regimes, it appears that six properties differ at the 0.10 level of significance. The first two, sand and siliceous minerals, may be confounded by a change in geology. Another confounding factor, soil slope, differing between the two groups, may have unequal effects on each group. Other properties, soil hydrogen, cation exchange capacity, and organic matter, generally increase with elevation. From this data, it appears those variables that show significant differences between mesic and frigid soils do not have a significant influence on site index, which does not differ significantly at the P=0.10 level.

Comparison of Soil and Site Properties of Soils Derived from the Chemung and Hampshire Formations.

Comparison of mesic and frigid sites revealed sand and siliceous mineral content varied significantly between the two groups of comparison. Some properties may be influenced by parent material, or rock type, from which the soils were derived. The two most common rock types from which the soils in the study area were derived are the Chemung and the Hampshire formations. There were 28 sites observed on the Chemung formation and 14 sites on the Hampshire formation.

The topographically lower of these formations, the Chemung, is composed of shale and sandstone with no sharply marked lithologic change from the one to the other (Butts, 1940). The sandstone is generally coarse, occurring in thicker layers, and occupies the greatest proportion of the whole formation. Most of the shale in the Chemung is green, soft, and poorly fissile and is clayey instead of sandy.

The Hampshire formation overlies the Chemung. The Hampshire consists of sandstone and interbedded mudstone, grayish-red or greenish or brownish-gray, fine-grained, locally conglomeratic sandstone with frequent massive sandstone beds (Virginia Division of Mineral Resources, 1993). It is relatively nonresistant as compared with the underlying Chemung and overlying Pocono formations (Butts, 1940). This is perhaps because the sandstone beds are flaggy, thin and being arkosic, weather more readily.

Comparing properties between these formations (Table 6) it appears sand, clay, and aluminum are different at the 0.10 level. The Chemung formation yields soils that have higher silt, clay, and aluminum content. The soils of the Hampshire formation, having the higher mean elevation, also have a higher organic matter content, however, this difference is not significant at the 0.10 level.

Soils derived from the Hampshire formation are sandier, and therefore more prone to drought than are the soils derived from the Chemung formation. This is suggested by the higher sand and lower clay content of the Hampshire derived soils. There are several differences in the soil properties between the Chemung and Hampshire formations, yet these differences appear to have limited influence on the mean site index values between the two groups.

Comparison of Soil and Site Properties Between Selected Elevations.

A correlation matrix (Table 4) shown earlier revealed some variables change with variation in elevation. Similarly, the comparison between mesic and frigid soils revealed some differences between the two groups. To further investigate the influence of climate change along an elevation gradient, site index is plotted against elevation in Figure 11. This figure shows a general increase in site index with elevation. A group of observations between 1100 and 1200 m in elevation is of particular interest. This group has exceptionally high site index

Table 6. Comparison between soil and site properties of soils derived from the Chemung and Hampshire formations in the George Washington National Forest, Virginia.

	Means		Medians		
Property	Chemung	Hampshire	Chemung	Hampshire	P†
Site index, m	19.7	18.4	20.4	18.0	0.3163
Depth to rock, cm	75	69	69	64	0.6782
Slope, %	26	24	25	20	0.3357
Sand, g kg^{-1}	189	510	178	490	0.0001
Clay, g kg^{-1}	216	190	220	127	0.0016
Siliceous minerals, %	90	89	90	91	0.7180
pH	4.49	4.38	4.62	4.45	0.2246
Cation exchange capacity, $cmol_c$ kg^{-1}‡	12.71	11.18	13.05	10.20	0.1652
Base saturation, %§	6.50	7.45	4.51	5.85	0.1613
Organic matter, g kg^{-1}	3.66	5.14	3.39	4.57	0.2050
Calcium, $cmol_c$ kg^{-1}	0.53	0.57	0.26	0.34	0.2857
Magnesium, $cmol_c$ kg^{-1}	0.15	0.13	0.09	0.10	0.7277
Potassium, $cmol_c$ kg^{-1}	0.17	0.17	0.16	0.16	0.9787
Hydrogen, $cmol_c$ kg^{-1}	16.84	15.16	15.00	14.25	0.4469
Aluminum, $cmol_c$ kg^{-1}	5.71	4.26	5.50	4.10	0.0104

†P-value from the Wilcoxon Rank Sum test.
‡Cation exchange capacity by Kjeldahl distillation.
§Base saturation = (Ca+Mg+K/CEC)100.

values. To investigate soil and site influences, those sites above 1100 m are compared to all sites below to reveal any significant differences in site quality. Soil and site properties and their probabilities for the comparisons between sites above and below 1100 m are listed in Table 7.

Many variables above and below 1100 m. are significantly different from one another at the P = 0.10 level. One potential reason, as seen in the comparison between mesic and frigid sites, is the higher elevation sites have deeper profiles. Also, soil slope is significantly different, and may be caused by insufficient sampling or sampling bias. Gentler slopes are generally associated with deeper profiles, adding bias to the site index comparison. A significant difference exists at the 0.10 level for the comparison between siliceous mineral content of the two groups. This reflects a potentially more favorable plant growing condition at the higher elevation if the difference is considered practically significant, although statistically, it is marginally significant at the 0.10 level.

Cation exchange capacity, base saturation, pH, and hydrogen are all significantly different between the two groups of comparison. There may be some relationship between some variables and the significantly higher organic matter content found on those sites above 1100 m. This increased organic matter content may be the result of slower decomposition rates caused by cooler temperatures and increased growth rates of the vegetation above 1100 m, producing greater

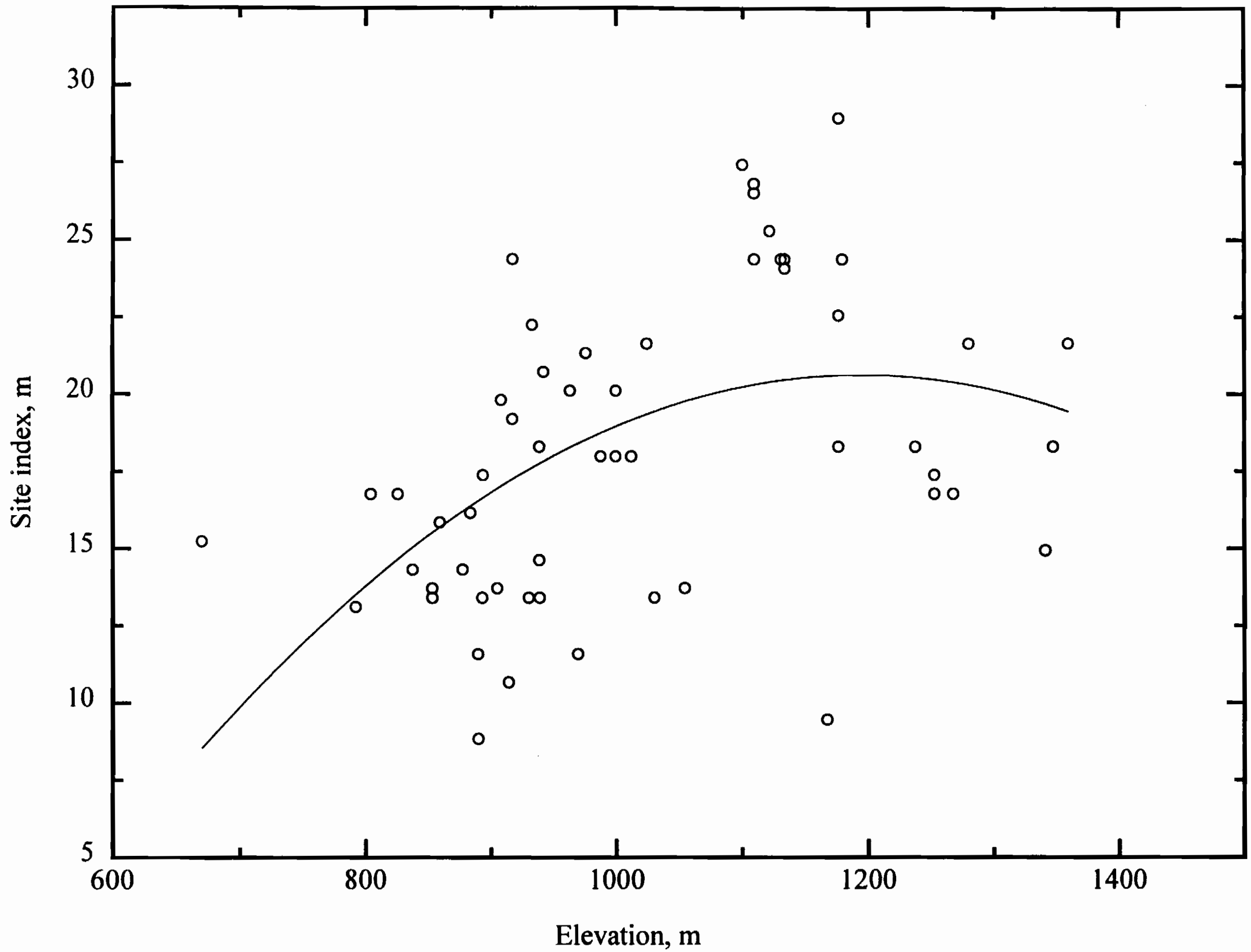

Fig. 11. Site index plotted against elevation for sites sampled in the George Washington National Forest, Virginia.

Table 7. Comparison of soil and site properties between sites above and below selected elevations in the George Washington National Forest, Virginia.

	Means		Medians		
Property	<1100 m	>1100 m	<1100 m	>1100 m	P†
Site index, m	16.2	21.6	15.9	22.6	0.0001
Depth to rock, cm	64	89	64	79	0.0007
Slope, %	30	19	28	20	0.0124
Sand, g kg^{-1}	348	352	283	319	0.9291
Clay, g kg^{-1}	210	210	161	219	0.1223
Siliceous minerals, %	93	89	93	91	0.0906
pH	4.55	4.25	4.66	4.21	0.0018
Cation exchange capacity, $cmol_c$ kg^{-1}‡	9.12	14.43	9.5	14.3	0.0001
Base saturation, %§	8.48	5.83	5.97	3.86	0.0484
Organic matter, g kg^{-1}	3.03	5.34	2.93	4.49	0.0024
Calcium, $cmol_c$ kg^{-1}	0.54	0.55	0.22	0.31	0.4091
Magnesium, $cmol_c$ kg^{-1}	0.14	0.14	0.06	0.11	0.3262
Potassium, $cmol_c$ kg^{-1}	0.16	0.16	0.16	0.16	0.9483
Hydrogen, $cmol_c$ kg^{-1}	10.70	21.76	10.60	20.70	0.0001
Aluminum, $cmol_c$ kg^{-1}	4.13	5.73	3.90	5.60	0.0040

†P-value from the Wilcoxon Rank Sum test.
‡Cation exchange capacity by Kjeldahl distillation.
§Base saturation = (Ca+Mg+K/CEC)100.

amounts of leaf litter during the growing season.

Significantly higher aluminum content may be related to a change in geology. The rock at the higher elevation is possibly one of higher aluminum content and lower silica content, as supported by the content of siliceous minerals in the soils. Similar properties between the two areas are sand, clay, calcium, magnesium, and potassium.

There are several variables associated, or contributing to, the "unexpected" woodland site quality. These variables include elevation, soil depth, slope, pH, organic matter, cation exchange capacity, and soil hydrogen. These variables may be, at least in part, responsible for the increased site index noticed at the higher elevations in the study area. Yet, soil temperature data suggests that there is some further effect of elevation, or other factor, on site quality. Generally, if all variables except elevation and temperature are held constant, the expected result would be one of lower vegetative performance due to a shorter growing season (limited by temperature) as elevation increases.

Comparison of Soil and Site Properties Between Opposing Aspects.

The determination of whether aspect is a key factor warranting separate map unit phases in mapping is a major objective of this study. Map unit phases are generally designated for ranges in properties that are too wide for an interpretation. Map unit phases are also used to indicate features outside the soil that are important for soil and land use or management, for example, flooding or increased precipitation (Soil Survey Division Staff, 1993). The objective, therefore, is to investigate differences in soil and site properties between aspects that significantly affect management.

Properties between north (270-360 and 0-90°) and south (90-270°) aspects were compared to detect differences between soil and site properties. Means, medians, and P-values, as generated by the Wilcoxon Rank Sum test, compare properties in Table 8. The only property that is significantly different at the 0.10 level is soil pH. From a practical perspective, this difference may not have a significant effect on management, therefore, not warranting separate map unit phases based on this criterion.

Properties between east (0-90°) and west (180-360°) were compared to detect differences between soil and site properties. Means, medians, and P-values, as generated by the Wilcoxon Rank Sum test, compare properties in Table 9. Two properties are significantly different at the 0.10 level. Organic matter and soil hydrogen are greater on the east aspect. There appears to be a weak trend indicating the possibility of higher site index values occurring on the east aspect.

Figure 12 reveals differences in site index by aspect for the two groups separated by elevation, As was shown earlier, site index generally increases with elevation. Some differences in site index on opposing aspect directions within the "high" (>1100 m) elevation groups is apparent.

The <1100 m group has an average site index of approximately 15 m on all aspects. On the north aspect, some values reach 20 m. One site located on a south-east aspect has a site index of nearly 25 m. Discerning if there is a difference on the east aspect between 60 and 120° and other aspects is not possible since there are no observations for the range made for the <1100 m group.

In contrast, the sites above 1100 m show some differences in site index by aspect. Most noticeable are those sites on the directly east aspect, which have site index values near 25 m. This is significantly different from the directly west aspect. A difference of between 5 to 10 m occurs between these opposing aspect directions. These differences are not illustrated by comparison of the two entire groups, east versus west, and therefore were not illustrated by the comparison made in Table 8 and 9.

Differences in site quality controlled by elevation, or associated factors, are significant for management purposes. The areas of best productivity need to be separated from those areas of normal productivity. In areas where accessibility is nearly impossible or cost prohibitive, the importance of delineating exceptionally productive sites decreases. In areas where the sites are accessible, and are under management for timber production, delineation of high quality timber sites is essential since the primary land use is for timber production.

Increased site index values on the east aspect, over the west aspect, are

Table 8. Comparison between soil and site properties on north (270-360 and 0-90°) and south (90-270°) aspects in the George Washington National Forest, Virginia.

	Means,		Medians,		
Property	North aspect	South aspect	North aspect	South aspect	P†
Site index, m	18.7	17.7	18.7	16.8	0.3169
Depth to rock, cm	71	74	69	64	0.5379
Slope, %	24	28	21	27	0.2004
Sand, g kg^{-1}	337	372	318	265	0.8215
Clay, g kg^{-1}	178	240	162	217	0.2400
Siliceous minerals, %	90	93	91	93	0.2314
pH	4.53	4.36	4.63	4.44	0.0710
Cation exchange capacity, $cmol_c$ kg^{-1}‡	11.45	10.66	11.10	11.50	0.7146
Base saturation, %§	7.32	7.70	5.48	4.94	0.8215
Organic matter, g kg^{-1}	3.92	3.82	3.54	3.04	0.9876
Calcium, $cmol_c$ kg^{-1}	0.61	0.48	0.24	0.25	0.7853
Magnesium, $cmol_c$ kg^{-1}	0.13	0.16	0.07	0.08	0.6011
Potassium, $cmol_c$ kg^{-1}	0.16	0.17	0.16	0.16	0.8761
Hydrogen, $cmol_c$ kg^{-1}	15.03	14.35	13.40	13.60	0.9318
Aluminum, $cmol_c$ kg^{-1}	4.63	4.78	4.55	5.05	0.7204

†P-value from the Wilcoxon Rank Sum test.
‡Cation exchange capacity by Kjeldahl distillation.
§Base saturation = (Ca+Mg+K/CEC)100.

Table 9. Comparison between soil and site properties on east (0-180°) and west (180-360°) aspects in the George Washington National Forest, Virginia.

Property	Means, East aspect	Means, West aspect	Medians, East aspect	Medians, West aspect	P†
Site index, m	19.5	17.4	20.0	17.7	0.1930
Depth to rock, cm	76	70	71	64	0.3392
Slope, %	25	26	21	25	0.6201
Sand, g kg^{-1}	376	341	283	316	0.9114
Clay, g kg^{-1}	213	208	212	186	0.6278
Siliceous minerals, %	92	91	96	90	0.2015
pH	4.34	4.51	4.40	4.59	0.1594
Cation exchange capacity, $cmol_c$ kg^{-1}‡	12.07	10.37	14.00	11.10	0.1192
Base saturation, %§	8.35	6.97	4.90	5.43	0.9260
Organic matter, g kg^{-1}	4.57	3.40	3.91	2.93	0.0737
Calcium, $cmol_c$ kg^{-1}	0.66	0.47	0.24	0.23	0.5404
Magnesium, $cmol_c$ kg^{-1}	0.13	0.15	0.09	0.06	0.4071
Potassium, $cmol_c$ kg^{-1}	0.16	0.17	0.15	0.16	0.6442
Hydrogen, $cmol_c$ kg^{-1}	17.19	13.03	15.50	12.20	0.0435
Aluminum, $cmol_c$ kg^{-1}	4.98	4.45	5.20	4.60	0.4084

†P-value from the Wilcoxon Rank Sum test.
‡Cation exchange capacity by Kjeldahl distillation.
§Base saturation = (Ca+Mg+K/CEC)100.

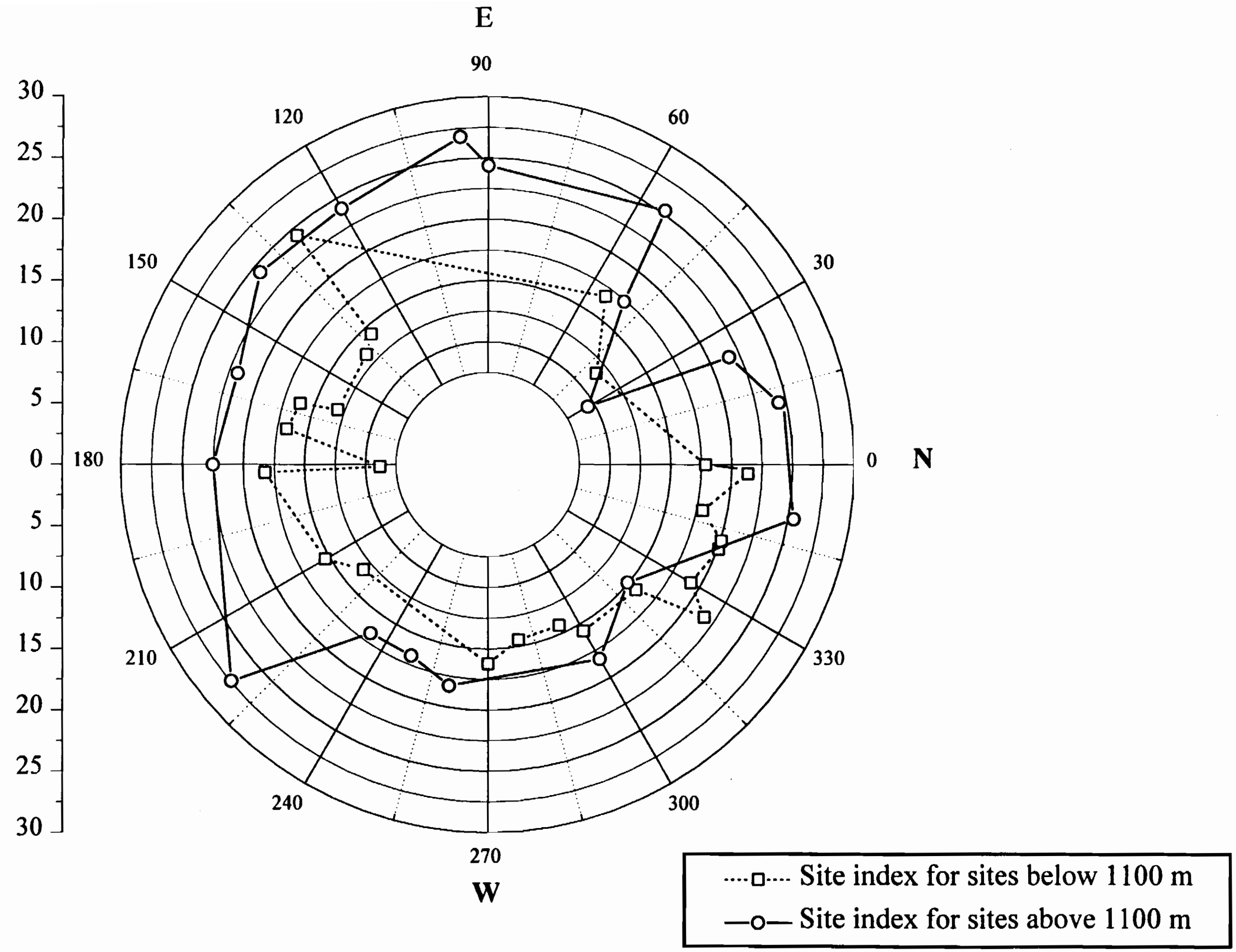

Fig. 12. Site index plotted by aspect for sites above and below 1100 m in the George Washington National Forest, Virginia.

apparent for the high elevation sites. This trend is not apparent for the lower elevation sites (<1100 m), there is a lack of observations near the due east aspect direction. Awareness of differences in productivity of this magnitude is important for management of the forest resource. A differences of 5 to 10 m in site index between two sites may have profound differences in the volume of timber, and, therefore, value of the site.

Across any mountainous landscape growth of vegetation will vary as controlled by soil and environmental factors. Ideally, prediction of this spatial pattern allows for better management of the resource. If the trends shown here are consistent over the landscape to the extent that ignoring the differences in site quality may lead to mismanagement of a significant proportion, these differences need to be included in a resource inventory.

Separation of soils strictly by their temperature regime may be impractical. Between the mesic and frigid soils, few differences were found. The separation of the mesic from the frigid soils would result in a division of soils at approximately 1200 m. A more practical separation would be separation of soils on sites where productivity is noticeably increased. From the data shown, a separation of high elevation soils at approximately 1100 m would be practical. If it is found that separations of soils based on soil temperature and productivity coincide geographically, use of soil temperature classes may suffice for the delineation of high productivity sites. This separation would require different ranges in site index expected for the frigid soils. If delineations are made that do not reflect differences in productivity or use, the separation is purely taxonomic, and adds little to the use of the soil inventory for productivity management.

Comparison of Soil and Site Properties Between Summit, Shoulder, and Side Slope Landscape Positions.

One objective of this study is development of woodland site quality data on major landscape positions in the study area. There are three primary landscape positions in the study area: summit, shoulder, and side slope positions. Means and medians for selected properties are listed in Table 10.

Site index is least on the summit, followed by the side slope, and highest on the shoulder position. The Kruskal-Wallis test indicates that based on median values, woodland site quality is not significantly different between these landscape positions at the 0.10 level. Table 10 shows that there may be a significant difference in the depth of the soil between landscape positions. The Kruskal-Wallis test suggests there is some significant difference between at least two landscape positions (P=0.0308) at the 0.10 level. Dunn's test revealed the summit is significantly different at the 0.10 level from both the side slope and shoulder positions. The summit position, having the least slope, is less likely to be affected by erosional forces, resulting in deeper profiles.

Similarly, sand was significantly different between at least two landscape

Table 10. Comparison between summit, shoulder, and side slope landscape positions in the George Washington National Forest, Virginia.

Property	Means			Medians		
	Summit	Shoulder	Side slope	Summit	Shoulder	Side slope
Site index, m	15.6	18.9	17.8	13.4	18.0	16.8
Depth to rock, cm	88	65	66	81	61	64
Slope, %	17	27	29	12	25	25
Sand, g kg^{-1}	643	242	347	701	178	319
Clay, g kg^{-1}	185	211	213	134	222	186
Siliceous minerals, %	94	90	91	99	91	91
pH	4.46	4.59	4.42	4.68	4.62	4.53
Cation exchange capacity, $cmol_c$ kg^{-1}†	7.60	11.69	10.97	6.30	12.75	11.50
Base saturation, %‡	7.42	6.47	8.08	6.03	5.09	5.43
Organic matter, g kg^{-1}	3.21	2.70	4.11	2.93	2.63	3.48
Calcium, $cmol_c$ kg^{-1}	0.42	0.40	0.59	0.18	0.19	0.24
Magnesium, $cmol_c$ kg^{-1}	0.10	0.19	0.14	0.06	0.09	0.09
Potassium, $cmol_c$ kg^{-1}	0.13	0.16	0.18	0.10	0.14	0.16
Hydrogen, $cmol_c$ kg^{-1}	11.50	14.75	14.14	13.20	13.10	13.30
Aluminum, $cmol_c$ kg^{-1}	2.89	5.24	4.81	2.50	5.30	4.90

†Cation exchange capacity by Kjeldahl distillation.
‡Base saturation = (Ca+Mg+K/CEC)100.

positions according to the Kruskal-Wallis test (P=0.0068) at the 0.10 level. Dunn's test confirmed that the summit is significantly different from the shoulder and side slope positions.

Aluminum also showed some significant difference between at least two landscape positions at the 0.10 level (Kruskal-Wallis test, P=0.0511). Dunn's test confirmed that the summit position had significantly different aluminum content as compared to the shoulder and side slope.

The side slope position was divided into thirds: upper, middle, and lower third, to investigate possible differences. Some researchers have found this method useful (Ike and Huppuch, 1968). This division of the side slope showed no significant differences between those properties, at the 0.10 level of comparison, listed in table 10.

Between these landscape positions few properties differed significantly. Depth to rock, sand, and aluminum differed between at least two positions. These properties, however, appear to have little influence on site index, which did not differ significantly between landscape positions.

SUMMARY AND CONCLUSIONS

Assessment of soil temperature data indicates the mesic-frigid boundary occurs at approximately 1230 m (4032 feet) on the south (90-270°) aspect, and at approximately 1180 m (3869 feet) on the north (270-360 and 0-90°) aspect. An approximate 1200 m delineation for the mesic-frigid soil temperature boundary may meet the needs of the survey. This boundary is not absolute, and allows for adjustments as appropriate.

Available climatic data shows precipitation generally increases with increased elevation. This coupled with lower mean monthly air temperatures and decreasing evapotranspiration, allows for greater amounts of plant available moisture during the growing season at higher elevations in the study area. In some locations at lower elevations, there may be a potential for growth limiting conditions controlled by plant available moisture during the later part of the growing season. Estimation of plant available soil moisture indicates many soils may have the potential for supplying sufficient moisture during the growing season. Additional site specific soil moisture measurements need to be taken to substantiate true soil moisture conditions. Since higher elevations generally have greater precipitation and lower air temperatures, the period of inadequate available soil moisture may be much shorter in duration or non-existent in comparison to lower elevation sites. Therefore, conceptually, the growing season controlled by plant available moisture may be shorter at the lower elevations in comparison to the higher elevations.

Approximately one-third of the soils are classified as Loamy-skeletal, siliceous, mesic Typic Dystrochrepts. This soil typifies the soils found on summit, shoulder, and side slope landscape positions in the George Washington National Forest. The highest elevations have Typic frigid Dystrochrepts representing the predominance of soils. Frigid soils have higher organic matter content, greater sand content, higher cation exchange properties, and less siliceous minerals in comparison to the mesic soils.

Comparison of the soils above to those occurring below selected elevations revealed an average 5 m difference in site index between all sites above 1100 m in comparison to all sites below. There are several soil properties that differ between these two groups of comparison. Total soil depth is greater and slope percent is less for soils above 1100 m (3600 feet). Soil organic matter and cation exchange capacity are higher on the sites with higher elevation. Also, base saturation and pH are lower for the higher elevation sites. These properties are not accounted for by a change in geology. Sand, clay, and aluminum content are significantly different between the two dominant rock types in the study area, the Chemung and Hampshire formations. Separation of these higher productivity sites is necessary for their proper management.

Three major landscape positions were sampled in this study: summit, shoulder, and side slope positions. From analysis of the data there is a deeper soil found on the summit position. Also, it was found that the summit position has the highest sand content of the three landscape positions.

From analysis conducted on the data, aspect may warrant separate map unit phases in mapping. Between north and south aspects, only one soil feature, pH, was significantly different. This variable, pH, will not have an influence on use and management of timber stands or soils. Two properties between the east and west aspect are significantly different; organic matter and soil hydrogen are greater on the east aspect. Also, there appears to be a weak trend indicating the possibility of higher site index values occurring on the east aspect. Increased site index values on the east aspect, over the west aspect, are apparent for the high elevation sites. A difference of between 5 to 10 m occurs between these opposing aspect directions. This trend is not apparent for the lower elevation sites (<1100 m), there is a lack of observations near the due east aspect direction. Awareness of differences in productivity of this magnitude is important for management of the forest resource. A differences of 5 to 10 m in site index between two sites may have profound differences in the volume of timber, and, therefore, value of the site.

Differences in site quality controlled by elevation, or associated factors, are significant for management purposes. The areas of best productivity need to be separated from those areas of normal productivity. In areas where the sites are accessible, and are under management for timber production, delineation of high woodland site is essential since the primary land use is timber production.

Across any mountainous landscape growth of vegetation will vary as controlled by soil and environmental factors. Ideally, prediction of this spatial pattern allows for better management of the resource. If the trends shown here are consistent over the landscape to the extent that ignoring the differences in site quality may lead to mismanagement of a significant proportion, these differences need to be included in a resource inventory.

Separation of soils strictly by their temperature regime may be impractical. Between the mesic and frigid soils, few differences were found. The separation of the mesic from the frigid soils would result in a division of soils at approximately 1200 m. A more practical separation would be separation of soils on sites where productivity is noticeably increased. From the data shown, a separation of high elevation soils at approximately 1100 m would be practical. If it is found that separations of soils based on soil temperature and productivity coincide geographically, use of soil temperature classes may suffice for the delineation of high productivity sites.

In summary, the following conclusions are made:

1) Although the mesic-frigid boundary occurs at approximately 1200 m across all aspects, a more practical separation of 1100 m is recommended. This separation more closely coincides with differences noticed in woodland site

quality.

2) Precipitation is generally greater and evapotranspiration is less at higher elevations.

3) Frigid soils have more organic matter and higher cation exchange properties than do mesic soils.

4) Aspect warrants separate map unit phases for high elevation sites where site index is noticeably higher on the east aspect in comparison to other aspect directions.

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APPENDIX A. COMMON AND SCIENTIFIC PLANT NAMES

COMMON AND SCIENTIFIC PLANT NAMES

Azalea	*Rhodendron sp.*	Maple, sugar	*Acer saccharum*
Basswood, american	*Tilia americana*	Mountain laurel	*Kalmia latifolia*
Beech, american	*Fagus grandifolia*	Oak, black	*Quercus velutina*
Chestnut, american	*Castanea dentata*	Oak, chestnut	*Quercus prinus*
Birch, black	*Betula lenta*	Oak, chinquapin	*Quercus muehlenbergii*
Birch, yellow	*Betula alleghaniensis*	Oak, n. red	*Quercus rubra*
Black cherry	*Prunus serotina*	Oak, scarlet	*Quercus coccinea*
Black gum	*Nyssa sylvanica*	Oak, white	*Quercus alba*
Black locust	*Robinia pseudoacacia*	Pine, e. white	*Pinus strobus*
Blueberry	*Vaccinium sp.*	Pine, pitch	*Pinus rigida*
Buckeye, painted	*Aesculus sylvatica*	Pine, shortleaf	*Pinus echinata*
Cucumber	*Magnolia acuminata*	Pine, table mtn.	*Pinus pungens*
Dogbane	*Apocynum sp.*	Pine, virginia	*Pinus virginiana*
Dogwood, flowering	*Cornus florida*	Sassafras	*Sassafras albidum*
Fern	*Polystichum sp.*	Sedge	*Carex sp.*
Greenbrier	*Smilax sp.*	Serviceberry	*Amelanchier sp.*
Hackberry	*Celtis occidentalis*	Silverbell	*Halesia carolina*
Hawthorn	*Crataegus sp.*	Smartweed	*Polygonum lapathifolium*
Hemlock	*Tsuga canadensis*	Snakeroot	*Eupatorium rugosum*
Hickory, red	*Carya ovalis*	Spruce, red	*Picea rubens*
Huckleberry	*Gaylussacia sp.*	Teaberry	*Pyrola sp.*
Ironwood	*Carpinus caroliniana*	Violet	*Viola sp.*
Magnolia, southern	*Magnolia grandiflora*	White ash	*Fraxinus americana*
Maple, red	*Acer rubrum*	Witch hazel	*Hamamelis virginiana*
Maple, striped	*Acer pennsylvanicum*	Yellow poplar	*Liriodendron tulipifera*

APPENDIX B. SOIL TEMPERATURE DATA

Table 1. Mean annual soil temperature for sites within the George Washington National Forest, Virginia.

Site	Repe-tition	Aspect	Elevation, m	Soil Temp., °C	Minimum	Maximum
Duncan Knob 4A	1	30	1168	8.49	1.11	15.56
Duncan Knob 4A	2	30	1168	8.43	1.11	15.00
Duncan Knob 4A	3	30	1168	8.47	1.67	15.56
Duncan Knob 4B	1	130	921	9.58	2.22	16.11
Duncan Knob 4B	2	130	921	9.43	2.22	16.11
Duncan Knob 4B	3	130	921	9.57	2.22	16.67
Duncan Knob 4C	1	330	921	9.06	1.67	15.56
Duncan Knob 4C	2	330	921	9.12	2.22	16.11
Duncan Knob 4C	3	330	921	8.94	1.67	16.11
Elleber Knob 2A	1	235	1254	8.07	1.67	13.89
Elleber Knob 2A	2	235	1254	8.03	1.67	14.44
Elleber Knob 2A	3	235	1254	8.12	1.67	14.44
Elleber Knob 2B	1	50	1254	7.33	1.11	13.89
Elleber Knob 2B	2	50	1254	7.47	1.11	13.89
Elleber Knob 2B	3	50	1254	7.39	1.11	13.89

Table 1 (continued). Mean annual soil temperature for sites within the George Washington National Forest, Virginia.

Site	Repe-tition	Aspect	Elevation, m	Soil Temp., °C	Minimum	Maximum
Locust Springs 1A	1	180	1177	8.33	1.67	15.00
Locust Springs 1A	2	180	1177	8.24	1.67	14.44
Locust Springs 1A	3	180	1177	8.23	1.11	14.44
Locust Springs 1B	1	160	1177	7.42	1.11	13.89
Locust Springs 1B	2	160	1177	7.59	1.67	13.33
Locust Springs 1B	3	160	1177	7.27	1.11	13.33
Locust Springs 1C	1	55	1177	7.78	1.11	13.89
Locust Springs 1C	2	55	1177	7.78	1.11	13.89
Locust Springs 1C	3	55	1177	7.75	1.11	13.89
Paddy Knob 3A	1	55	1360	7.18	0.56	13.89
Paddy Knob 3A	2	55	1360	7.21	0.00	13.89
Paddy Knob 3A	3	55	1360	7.30	0.55	14.44
Paddy Knob 3B	1	248	1269	8.30	2.22	14.44
Paddy Knob 3B	2	248	1269	8.26	2.22	14.44
Paddy Knob 3B	3	248	1269	8.32	2.22	14.44

Table 1 (continued). Mean annual soil temperature for sites within the George Washington National Forest, Virginia.

Site	Repe- tition	Aspect	Elevation, m	Soil Temp., °C	Minimum	Maximum
Paddy Knob 3C	1	24	1281	7.79	1.11	14.44
Paddy Knob 3C	2	24	1281	7.76	0.56	14.44
Paddy Knob 3C	3	24	1281	7.78	0.56	13.89
Paddy Knob 3D	1	60	1110	8.52	1.11	15.56
Paddy Knob 3D	2	60	1110	8.56	1.11	15.00
Paddy Knob 3D	3	60	1110	8.89	1.67	15.56
Paddy Knob 3E	1	330	1013	8.61	2.22	14.44
Paddy Knob 3E	2	330	1013	8.43	1.67	14.44
Paddy Knob 3E	3	330	1013	8.43	1.67	14.44

APPENDIX C. SOIL AND SITE DESCRIPTIONS

Stop: AL1 -- Gilpin silty clay loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Jordan Mines, VA

Location: Alleghany County, VA

Latitude: 37°42'18" north **Longitude:** 80°6'33" west

Parent material: Millboro shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry 60%, mountain laurel 10%, American chestnut, sassafras *Overstory:* red maple, chestnut oak, black oak, scarlet oak *Regeneration:* black oak, sassafras

Slope gradient: 14 percent **Complexity:** Convex, convex

Slope length: 300 feet, upper

Aspect: 280°

Relief:

Elevation: 2200 feet

Erosion class: Class 2

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 32 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Clayey, mixed, mesic Typic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

BE--0 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine granular structure; friable, non-sticky, non-plastic; 5 percent shale channers; extremely acid; abrupt smooth boundary.

Bt1--16 to 25 inches; yellowish brown (10YR 5/6) silty clay; moderate fine subangular blocky structure; friable, non-sticky, non-plastic; common faint clay films on faces of peds; 2 percent shale channers; very strongly acid; gradual smooth boundary.

Bt2--25 to 32 inches; yellowish brown (10YR 5/8) silty clay; common medium distinct light brownish gray (2.5Y 6/2) Fe-Mn oxide depletions and strong brown (7.5YR 5/8)masses of weathered rock fragments; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; common faint clay films on faces of peds; 5 percent shale channers; very strongly acid; abrupt wavy boundary.

Cr--32 to 35 inches; dark yellowish brown (10YR 4/4) soft shale.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	$g\ kg^{-1}$ of soil							
0-16	14	16	12	10	8	60	579	361
16-25	8	7	5	4	3	27	404	569
25-32	33	34	16	13	6	102	428	470

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-16	0.10	0.05	0.18	12.20	12.53	2.63
16-25	0.14	0.30	0.27	13.80	14.51	4.89
25-32	0.21	0.31	0.23	10.40	11.15	6.73

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-16	12.8	11.10	2.97
16-25	3.8	13.90	5.11
25-32	4.8	11.90	6.30

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-16	4.35	7.45	7.78	4.24
16-25	4.60	9.05	9.76	7.27
25-32	4.80	7.35	8.10	9.26

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
1	56	0	43

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
26.0	7.4	4.0	20.8	0.42

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	80
Species	Site index, ft
Virginia Pine	52
Scarlet Oak	48

Stop: AL2 -- Dekalb very channery loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Alleghany VA-WV

Location: Alleghany County, VA; 10,000 feet 325° northwest of the intersection of Highways VA-18 and VA-608; 10,270 feet 90° east of the intersection of VA-600 and VA-604

Latitude: 37°40'17" north **Longitude:** 80°10'13" west

Parent material: Rose Hill and Clinch colluvium over Oriskany sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry 80%, mountain laurel 3%, witchazel 3%, American chestnut *Overstory:* pitch pine, chestnut oak, red maple *Regeneration:* black oak, chestnut oak, red maple

Slope gradient: 42 percent **Complexity:** Linear, concave

Slope length: 500 feet, lower

Aspect: 138°

Relief:

Elevation: 2800 feet

Erosion class: Class 1

Drainage class: Excessively well to well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 21 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 10 percent

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystorchrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 12 inches; brown (7.5YR 5/2) very channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 40 percent quartz and sandstone channers; extremely acid; clear smooth boundary.

2Bw--12 to 21 inches; brown (7.5YR 5/4) very channery loam; weak fine subangular blocky structure; friable, non-sticky, non-plastic; 45 percent sandstone channers; extremely acid; clear wavy boundary.

2R--21 inches; hard Oriskany sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-12	68	65	123	167	74	497	385	118
12-21	75	59	92	184	77	487	394	119

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-12	0.21	0.09	0.13	21.40	21.83	1.97
12-21	0.15	0.04	0.09	7.80	8.08	3.47

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-12	73.8	15.9	2.70
12-21	22.8	7.3	3.84

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-12	3.75	6.85	7.28	5.91
12-21	4.24	3.45	3.73	7.51

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	80
Species	Site index, ft
Chestnut Oak	44
Pitch Pine	40

Stop: AL3 -- Alticrest loamy sand

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Alleghany VA-WV

Location: Alleghany County, VA; 4,800 feet 174° southeast of the intersection of Highways VA-600 and VA-613; 19,750 feet 70° east of the intersection of Highways VA-604 and VA-600

Latitude: 37°41'21" north **Longitude:** 80°8'30" west

Parent material: Keefer sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry 20%, American chestnut, blackgum *Overstory:* black oak, chestnut oak, red maple, scarlet oak, pitch pine *Regeneration:* sassafras, red maple

Slope gradient: 17 percent **Complexity:** Convex, convex

Slope length: 200 feet, lower

Aspect: 132°

Relief:

Elevation: 2750 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 25 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

E1--0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand; weak fine granular structure; very friable, non-sticky, non-plastic; 5 percent sandstone channers; extremely acid; clear smooth boundary.

E2--5 to 10 inches; light brownish gray (10YR 6/2) loamy fine sand; weak fine granular structure; very friable, non-sticky, non-plastic; 5 percent sandstone channers; extremely acid; abrupt smooth boundary.

Bw--10 to 14 inches; yellowish brown (10YR 5/6) fine sandy loam; weak fine granular structure; very friable, non-sticky, non-plastic; 5 percent sandstone channers; very strongly acid; abrupt smooth boundary.

C--14 to 25 inches; yellowish brown (10YR 5/4) channery fine sandy loam; single grain; loose; 15 percent sandstone channers; very strongly acid; clear wavy boundary.

R--25 inches; hard Keefer sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-10	18	8	70	608	126	830	149	21
10-14	6	6	64	509	141	726	205	69
14-25	2	1	54	528	158	743	198	59

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-10	0.21	0.04	0.04	1.40	1.69	17.16
10-14	0.13	0.03	0.06	4.60	4.82	4.56
14-25	0.18	0.02	0.04	1.60	1.84	13.04

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-10	13.1	2.1	13.81
10-14	13.1	3.1	7.10
14-25	4.5	1.7	14.12

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-10	4.00	0.95	1.24	23.39
10-14	4.62	1.55	1.77	12.43
14-25	4.92	0.75	0.99	24.24

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
99	0	0	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
14.0	6.1	1.1	2.8	0.54

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	100
Species	Site index, ft
Scarlet Oak	47
Pitch Pine	43

Stop: AL4 -- Dekalb channery fine sandy loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Alleghany VA-WV

Location: Alleghany County, VA; 4,050 feet 94° southeast of the intersection of Highways VA-600 and VA-613; 20,350 feet 18° northeast of the intersection of Highways VA-18 and VA-608

Latitude: 37°42'6" north **Longitude:** 80°7'46" west

Parent material: Rose Hill sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, witch hazel, dogwood, blueberry *Overstory:* red hickory, chestnut oak, red maple, red oak, blackgum, Virginia pine *Regeneration:* sassafras, chestnut oak, red maple, red hickory

Slope gradient: 56 percent **Complexity:** Linear, convex

Slope length: 300 feet, lower

Aspect: 162°

Relief:

Elevation: 2900 feet

Erosion class: Class 2

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 21 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 3 inches; dark grayish brown (10YR 4/2) channery fine sandy loam; weak very fine granular structure; very friable, non-sticky, non-plastic; 25 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw--3 to 13 inches; dark brown (10YR 4/3) very channery fine sandy loam; weak very fine granular structure; very friable, non-sticky, non-plastic; 45 percent sandstone channers; very strongly acid; clear smooth boundary.

2C--13 to 21 inches; yellowish brown (10YR 5/4) very channery fine sandy loam; weak very fine granular structure; very friable, non-sticky, non-plastic; 40 percent sandstone channers; very strongly acid; abrupt smooth boundary.

2R--21 inches; hard Rose Hill sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-3	44	71	122	340	76	653	258	89
3-13	33	66	140	364	87	690	245	65
13-21	22	59	138	374	88	681	261	58

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-3	1.04	0.27	0.21	12.40	13.92	10.92
3-13	0.57	0.18	0.11	6.60	7.46	11.53
13-21	0.43	0.14	0.08	2.60	3.25	20.00

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-3	56.6	10.3	14.76
3-13	19.7	5.1	16.86
13-21	3.5	3.5	18.57

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-3	4.70	2.25	3.77	40.32
3-13	4.85	1.55	2.41	35.68
13-21	4.84	1.45	2.10	30.95

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
33	0	0	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
92	7.3	1.5	3.2	0.47

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	90
Species	Site index, ft
Northern Red Oak	53

Stop: AL5 -- Calvin channery silt loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Alleghany VA-WV

Location: Alleghany County, VA; 2,330 feet 319° northwest of the intersection of Highways VA-600 and VA-613; 15,850 feet 106° southeast of the intersection of Highways VA-311 and VA-159

Latitude: 37°42'23" north **Longitude:** 80°8'56" west

Parent material: Juanita sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry 5%, serviceberry, grasses 50% *Overstory:* chestnut oak, black oak, black locust *Regeneration:* red oak, black oak, black locust

Slope gradient: 56 percent **Complexity:** linear, convex

Slope length: 150 feet, middle

Aspect: 220°

Relief:

Elevation: 3180 feet

Erosion class: Class 2

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 22 inches

Rock fragments on the soil surface: 5 percent

Bedrock outcrops: 1 percent

Additional notes: Loamy-skeletal, mixed, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; dark reddish gray (5YR 4/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; extremely acid; clear smooth boundary.

Bw--2 to 22 inches; reddish brown (5YR 4/4) very channery loam; weak fine subangular blocky structure; friable, non-sticky, non-plastic; 45 percent sandstone channers; extremely acid; clear smooth boundary.

R--22 inches; hard Juanita sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-2	55	28	20	94	158	355	587	58
2-22	39	30	24	99	179	371	420	209

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-2	0.78	0.45	0.34	33.20	34.77	4.52
2-22	0.30	0.06	0.18	15.20	15.74	3.43

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-2	133.2	21.9	7.17
2-22	15.9	11.1	4.86

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-2	3.90	10.05	11.62	13.51
2-22	4.42	6.55	7.09	7.62

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
68	19	9	4

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
20.0	9.9	2.6	10.7	0.48

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	90
Species	Site index, ft
Chestnut Oak	38

Stop: AL6 -- Weikert channery loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Alleghany VA-WV

Location: Alleghany County, VA; 15,750 feet 109° southeast of the intersection of High-ways VA-311 and VA-159; 2,300 feet 300° northwest of the intersection of Highways VA-613 and VA-600

Latitude: 37°42'19" north **Longitude:** 80°9'1" west

Parent material: Martinsburg shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* dogbane, snakeroot, striped maple, sassafras, hawthorn *Overstory:* black oak, chestnut oak, red hickory *Regeneration:* black locust, red oak, red hickory, red maple

Slope gradient: 33 percent **Complexity:** Convex, convex

Slope length: 100 feet, middle

Aspect: 220°

Relief:

Elevation: 3080 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 8 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Coarse-loamy, mixed, mesic Lithic Udorthents

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 4 inches; very dark grayish brown (10YR 3/2) channery loam; moderate medium granular structure; friable, non-sticky, non-plastic; few coarse, medium, and fine roots; common tubular pores; 25 percent sandstone channers; moderately acid; clear smooth boundary.

Bw--4 to 8 inches; strong brown (7.5YR 4/6) channery silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few fine roots; common tubular pores; 15 percent sandstone channers; very strongly acid; clear irregular boundary.

Cr--8 to 17 inches; fractured shale with lenses of silt loam material.

R--17 inches; hard Martinsburg shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-4	219	124	33	15	8	399	481	120
4-8	79	74	36	14	12	215	554	231

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-4	10.40	1.67	0.60	14.60	27.27	46.46
4-8	1.38	0.61	0.47	d15.20	17.66	13.93

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-4	86.9	20.7	61.21
4-8	26.2	12.7	19.37

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-4	5.70	0.15	12.82	98.83
4-8	5.00	3.45	5.91	41.62

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
46	36	13	5

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
18.0	8.6	2.8	14.4	0.55

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	110
Species	Site index, ft
Chestnut Oak	48

Stop: AL7 -- Berks channery silt loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Alleghany VA-WV

Location: Alleghany County, VA; 6,250 feet 202° southwest of the intersection of High-ways VA-602 and VA-311; 14,050 feet 288° northwest of the intersection of Highways VA-311 and VA-159

Latitude: 37°43'51" north **Longitude:** 80°14'54" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* serviceberry, blueberry 10%, azalea *Overstory:* chestnut oak, red hickory, red oak *Regeneration:* black oak, red hickory, chestnut oak

Slope gradient: 40 percent **Complexity:** Convex, convex

Slope length: 150 feet, top

Aspect: 0°

Relief:

Elevation: 3080 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 25 inches

Rock fragments on the soil surface: 0.5 percent

Bedrock outcrops: 2 percent

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 7 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw--7 to 25 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; clear smooth boundary.

R--25 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-7	40	21	8	13	70	152	651	197
7-25	44	25	11	19	88	187	564	249

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-7	1.01	0.28	0.22	18.60	20.11	7.51
7-25	0.19	0.15	0.18	12.60	13.12	3.96

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-7	51.8	15.3	9.87
7-25	9.3	11.1	4.68

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-7	4.50	6.35	7.86	19.21
7-25	4.60	7.15	7.67	6.78

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
62	28	1	9

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
22.0	9.3	3.2	10.0	0.42

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	130
Species	Site index, ft
Chestnut Oak	44

Stop: AL8 -- Calvin channery loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Glace VA-WV

Location: Alleghany County, VA; 5,150 feet 242° southwest of the intersection of High-ways VA-602 and VA-603; 4,650 feet 87° northeast of the intersection of the Alleghany County, VA and Greenbrier and Monroe County lines, WV

Latitude: 37°41'27" north **Longitude:** 80°17'29" west

Parent material: Hampshire interbedded shale and sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, blueberry, sassafras *Overstory:* red maple, black gum, black locust, chestnut oak, red oak *Regeneration:* sassafras, black oak, red hickory, chesnut oak

Slope gradient: 47 percent **Complexity:** Linear, linear

Slope length: 100 feet, middle

Aspect: 270°

Relief:

Elevation: 2980 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 21 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; dark brown (7.5YR 4/2) channery fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent shale and sandstone channers; extremely acid; clear smooth boundary.

Bw--2 to 21 inches; reddish brown (5YR 4/3) very channery loam; weak fine subangular blocky structure; friable, non-sticky, non-plastic; 45 percent shale and sandstone channers; very strongly acid; clear wavy boundary.

R--21 inches; hard Hampshire interbedded shale and sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-2	26	25	60	310	158	579	307	114
2-21	13	19	57	263	162	514	409	77

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-2	1.07	0.24	0.18	13.00	14.49	10.28
2-21	0.16	0.04	0.11	7.00	7.31	4.24

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-2	41.4	9.5	15.68
2-21	12.1	4.9	6.33

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-2	4.20	4.55	6.04	24.67
2-21	4.58	2.85	3.16	9.81

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
85	8	1	6

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
19.0	9.3	0.2	5.5	0.50

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	120
Species	Site index, ft
Chestnut Oak	65

Stop: AL9 -- Alticrest loam

Date: 5 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Glace VA-WV

Location: Alleghany County, VA; 500 feet 135° southwest of the intersection of Highways VA-602 and VA-603; 9,800 feet 73° northeast of the intersection of the Alleghany County, VA and Greenbrier and Monroe County lines, WV

Latitude: 37°41'47" north **Longitude:** 80°16'29" west

Parent material: Hampshire interbedded shale and sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* red maple, mountain laurel, black gum, blueberry, striped maple *Overstory:* white pine, chestnut oak, white oak, black oak, red maple *Regeneration:* sassafras, red maple, white pine, chestnut oak

Slope gradient: 60 percent **Complexity:** Linear, linear

Slope length: 300 feet, middle

Aspect: 220°

Relief:

Elevation: 2800 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 16 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 5 percent

Additional notes: Loamy, siliceous, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; dark grayish brown (10YR 4/2) loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent shale and sandstone fragments; extremely acid; clear smooth boundary.

Bw--2 to 16 inches; yellowish brown (10YR 5/4) channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 25 percent sandstone and shale channers; very strongly acid; clear wavy boundary.

R--16 inches; hard Hampshire interbedded shale and sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-2	28	24	17	208	199	476	413	111
2-16	26	32	17	202	208	485	406	109

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-2	0.40	0.08	0.15	23.60	24.23	2.60
2-16	0.17	0.04	0.16	4.80	5.17	7.16

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-2	45.5	10.7	5.89
2-16	9.3	5.1	7.25

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-2	4.13	5.55	6.18	10.19
2-16	4.56	3.15	3.52	10.51

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
94	4	1	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
20.0	7.4	3.6	4.7	0.41

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	51
Basal area, ft^2/ac	100
Species	Site index, ft
Eastern White Pine	54

Stop: AL50 -- Berks channery loam (4B)

Date: 21 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA

Latitude: 37°42'5.8" north **Longitude:** 80°7'46" west

Parent material: Rose Hill shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, witch hazel, dogwood, blueberry *Overstory:* black oak, red maple, red oak, white pine *Regeneration:* sassafras, red maple

Slope gradient: 62 percent **Complexity:** smooth

Slope length: 300 feet, upper

Aspect: 140°

Relief:

Elevation: 3000 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 22 inches

Rock fragments on the soil surface: 15 percent

Bedrock outcrops: 5 percent

Additional notes: Clayey-skeletal, mixed, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 3 inches; very dark grayish brown (10YR 3/2) channery loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and medium roots; 15 percent shale channers; extremely acid; clear smooth boundary.

Bw1--3 to 13 inches; yellowish brown (10YR 5/4) very channery silty clay loam; weak fine subangular blocky structure; very friable, slightly sticky, non-plastic; common fine and medium roots; 40 percent shale channers; very strongly acid; gradual wavy boundary.

Bw2--13 to 19 inches; yellowish brown (10YR 5/4) very channery silty clay; moderate fine subangular blocky structure; common fine and medium roots; 40 percent shale channers; very strongly acid; clear wavy boundary.

Cr--19 to 23 inches; light gray (10YR 6/1) very channery clay; common medium prominent strong brown (7.5YR 5/6) and brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, slightly sticky, non-plastic; few fine and medium roots; 55 percent shale channers; very strongly acid.

R--23 inches; hard Rose Hill shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-3	19	44	68	156	72	359	397	244
3-13	42	29	18	31	55	175	434	391
13-19	16	14	10	17	53	110	441	449
19-23	51	31	15	30	77	204	377	419

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-3	2.47	0.76	0.65	26.80	30.68	12.65
3-13	0.50	0.47	0.37	10.60	11.94	11.22
13-19	0.42	0.34	0.34	16.00	17.10	6.43
19-23	0.48	0.51	0.38	14.00	15.37	8.91

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-3	115.9	23.7	16.37
3-13	8.3	10.5	12.76
13-19	9.7	12.3	8.94
19-23	13.1	9.9	13.84

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-3	4.22	5.85	9.73	39.88
3-13	4.86	6.45	7.79	17.20
13-19	4.76	8.35	9.45	11.64
19-23	4.70	9.65	11.02	12.43

Stop: AL51 -- Series not designated

Date: 20 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA

Latitude: 37°50'6" north **Longitude:** 79°54'35" west

Parent material: Keefer sandstone

Physiography: Ridge and Valley

Landscape position: Summit

Vegetation: *Understory:* chestnut oak, scarlet oak, mountain laurel, blueberry, rhododendron *Overstory:* scarlet oak, chestnut oak *Regeneration:* chestnut oak, scarlet oak

Slope gradient: 12 percent **Complexity:** Convex, convex

Slope length:

Aspect: 270°

Relief:

Elevation: 3052 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 48 inches

Rock fragments on the soil surface: Less than 1 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and very fine and common medium roots; 1 percent sandstone channers; extremely acid; abrupt smooth boundary.

E--3 to 6 inches; light gray (10YR 6/1) fine sand; single grain; loose; common fine and medium roots; 1 percent sandstone channers; extremely acid; abrupt smooth boundary.

Bw--6 to 18 inches; yellowish brown (10YR 5/6) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; common fine and medium roots; 5 percent sandstone channers; very strongly acid; diffuse wavy boundary.

C1--18 to 40 inches; yellowish brown (10YR 5/8) fine sand; single grain; loose; few fine roots; 10 percent sandstone channers; very strongly acid; gradual wavy boundary.

C2--40 to 48 inches; yellowish brown (10YR 5/8) gravelly fine sand; single grain; loose; few fine roots; 30 percent sandstone gravel; very strongly acid; gradual smooth boundary.

R--48 inches; hard Keefer sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-3	3	43	223	480	65	814	156	30
3-6	13	20	133	611	99	876	111	13
6-18	6	5	150	496	101	758	149	93
18-40	33	27	116	599	120	895	41	64
40-48	5	7	168	603	107	890	49	61

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-3	0.06	0.09	0.14	12.60	12.89	2.25
3-6	0.03	0.04	0.06	3.20	3.33	3.90
6-18	0.03	0.04	0.05	5.20	5.32	2.26
18-40	0.02	0.02	0.03	3.80	3.87	1.81
40-48	0.02	0.02	0.02	1.80	1.86	3.23

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-3	38.6	9.9	2.93
3-6	9.7	2.3	5.65
6-18	4.5	3.1	3.87
18-40	0	2.5	2.80
40-48	0	1.5	4.00

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-3	3.87	2.95	3.24	8.95
3-6	4.31	0.95	1.08	12.04
6-18	4.91	1.25	1.37	8.76
18-40	4.83	1.55	1.62	4.32
40-48	4.77	1.10	1.16	5.17

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
99	0	0	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
17.0	9.2	1.1	4.2	0.59

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	80
Species	Site index, ft
Chestnut Oak	44

Stop: AL52 -- Jefferson fine sandy loam (11A)

Date: 20 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°50'0.4" north **Longitude:** 79°54'31" west

Parent material: Colluvium

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* mountain laurel, blueberry *Overstory:* scarlet oak, chestnut oak, pitch pine *Regeneration:* chestnut oak, scarlet oak, pitch pine

Slope gradient: 30 percent **Complexity:** Linear, linear

Slope length:

Aspect: 210°

Relief:

Elevation: 2930 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 44 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and medium roots; 5 percent sandstone channers; extremely acid; clear smooth boundary.

Bw1--3 to 7 inches; dark yellowish brown (10YR 4/6) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; common fine and medium roots; 5 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw2--7 to 19 inches; yellowish brown (10YR 5/8) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; common fine and medium roots; 5 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw3--19 to 28 inches; yellowish brown (10YR 5/6) channery fine sandy loam; moderate fine subangular blocky structure; few fine and medium roots; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

2Bt--28 to 44 inches; yellowish brown (10YR 5/8) channnery clay loam; 25 percent sandstone channers; moderate medium subangular blocky structure; friable, moderately sticky, slightly plastic; few fine roots; very strongly acid; abrupt wavy boundary.

2R--44 inches; hard bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-3	7	31	156	437	118	749	190	61
3-7	9	20	124	430	129	712	196	92
7-19	16	20	110	427	108	681	187	132
19-28	15	22	112	383	106	639	177	184
28-44	12	17	55	215	143	442	230	328

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-3	0.07	0.06	0.07	11.40	11.60	1.72
3-7	0.02	0.02	0.05	7.40	7.49	1.20
7-19	0.03	0.02	0.06	4.40	4.51	2.44
19-28	0.05	0.02	0.06	6.20	6.33	2.05
28-44	0.06	0.07	0.08	10.80	11.01	1.91

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-3	43.5	7.3	2.74
3-7	17.3	4.3	2.09
7-19	1.7	2.9	3.79
19-28	1	4.1	3.17
28-44	0	6.5	3.23

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-3	4.00	4.00	4.20	4.76
3-7	4.82	1.95	2.04	4.41
7-19	4.84	1.75	1.86	5.91
19-28	4.65	2.92	3.08	4.22
28-44	4.68	5.15	5.36	3.92

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	70
Species	Site index, ft
Pitch Pine	48
Chestnut Oak	41

Stop: AL53 -- Dekalb cobbly fine sandy loam (11B)

Date: 21 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°50'0.4" north **Longitude:** 79°54'30.5" west

Parent material: Residuum from Keefer sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* azalea, greenbrier *Overstory:* scarlet oak, chestnut oak

Slope gradient: 55 percent **Complexity:** Convex, convex

Slope length:

Aspect: 210°

Relief:

Elevation: 2930 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 30 inches

Rock fragments on the soil surface: 15 percent

Bedrock outcrops: 5 percent

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) cobbly fine sandy loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and medium roots; 15 percent sandstone cobbles; extremely acid; clear smooth boundary.

E--1 to 18 inches; yellowish brown (10YR 5/6) cobbly loamy sand; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; many fine and medium roots; 30 percent sandstone cobbles; very strongly acid; gradual wavy boundary.

Bw--18 to 30 inches; yellowish brown (10YR 5/6) very cobbly fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; common fine and medium roots; 45 percent sandstone cobbles; very strongly acid; clear wavy boundary.

R--30 inches; hard Keefer sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-1	15	76	271	327	58	747	166	87
1-18	45	45	178	432	88	788	127	85
18-30	34	45	170	447	87	783	113	104

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-1	0.21	0.08	0.12	18.20	18.61	2.20
1-18	0.04	0.02	0.03	2.80	2.89	3.11
18-30	0.03	0.02	0.03	4.00	4.08	1.96

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c\ kg^{-1}$ of soil	%
0-1	127.0	12.7	3.23
1-18	23.0	2.3	3.91
18-30	31.0	3.1	2.58

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-1	4.00	4.65	5.06	8.10
1-18	4.71	1.35	1.44	6.25
18-30	4.68	1.75	1.83	4.37

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
98	2	0	0

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
20.0	10.7	1.6	4.2	0.53

Stop: AL54 -- Alticrest loamy sand (12A)

Date: 20 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°49'46" north **Longitude:** 79°53'42" west

Parent material: Residuum from Oriskany sandstone

Physiography: Ridge and Valley

Landscape position: Summit

Vegetation: *Understory:* chestnut oak, scarlet oak, yellow pine, mountain laurel, sassafras *Overstory:* chestnut oak, scarlet oak *Regeneration:* chestnut oak, scarlet oak

Slope gradient: 30 percent **Complexity:** Convex, convex

Slope length:

Aspect: 160°

Relief:

Elevation: 2600 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 42 inches

Rock fragments on the soil surface: 15 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; black (10YR 2/1) fine sandy loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and very fine and few medium roots; 10 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw1--1 to 14 inches; red (2.5YR 4/6) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; many fine, very fine, and medium roots; 10 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw2--14 to 34 inches; yellowish red (5YR 4/6) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; common fine and medium roots; 12 percent sandstone channers; very strongly acid; gradual wavy boundary.

BC--34 to 42 inches; yellowish red (5YR 4/6) gravelly loamy fine sand; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; few fine and medium roots; 25 percent sandstone channers; strongly acid; clear wavy boundary.

R--42 inches; hard Oriskany sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-14	37	34	128	486	60	745	131	124
14-34	12	22	86	536	88	744	101	155
34-42	1	4	64	647	94	810	99	91

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-1	1.37	0.43	0.60	18.90	21.30	11.27
1-14	0.05	0.02	0.04	9.20	9.31	1.18
14-34	0.04	0.04	0.04	4.80	4.92	2.44
34-42	0.05	0.21	0.02	3.40	3.68	7.61

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-1	431.3	11.9	20.08
1-14	15.5	3.9	2.82
14-34	2.40	3.3	3.64
34-42	0.30	1.7	16.47

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		cmol$_c$ kg^{-1} of soil		%
0-1	4.70	2.65	5.05	47.71
1-14	4.76	1.05	1.16	9.48
14-34	4.82	1.05	1.17	10.26
34-42	5.18	0.45	0.73	38.36

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
98	1	0	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
21.0	21.4	0.8	5.7	0.56

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	80
Species	Site index, ft
Chestnut Oak	43

Stop: AL55 -- Alticrest fine sandy loam (13A)

Date: 20 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°49'53" north **Longitude:** 79°53'36" west

Parent material: Residuum from Oriskany sandstone

Physiography: Ridge and Valley

Landscape position: Summit

Vegetation: *Understory:* mountain laurel, greenbriar, blueberry *Overstory:* scarlet oak, chestnut oak *Regeneration:* scarlet oak, chestnut oak

Slope gradient: 42 percent **Complexity:** Convex, convex

Slope length:

Aspect: 55°

Relief:

Elevation: 2710 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 30 inches

Rock fragments on the soil surface: 10 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and medium roots; 2 percent sandstone channers; very strongly acid; abrupt smooth boundary.

Bw1--1 to 7 inches; strong brown (7.5YR 4/6) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; many fine and medium roots; 5 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw2--7 to 30 inches; strong brown (7.5YR 5/8) fine sandy loam; weak fine subangular blocky structure; very friable, non-sticky, non-plastic; common fine and medium roots; 10 percent sandstone channers; very strongly acid; abrupt wavy boundary.

R--30 inches; hard Oriskany sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-7	15	20	15	535	113	698	172	130
7-30	9	21	111	495	72	708	149	143

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-7	0.03	0.02	0.04	7.20	7.29	1.23
7-30	0.04	0.02	0.04	5.20	5.30	1.89

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-7	20.7	5.1	1.76
7-30	1.0	3.5	2.86

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-7	4.84	1.75	1.84	4.89
7-30	4.78	2.35	2.45	4.08

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
96	3	0	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
21.0	15.7	0.8	7.3	0.49

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	120
Species	Site index, ft
Scarlet Oak	55

Stop: AL56 -- Weikert very channery silt loam (14A)

Date: 20 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°47'13" north **Longitude:** 80°10'44" west

Parent material: Residuum from Chemung shale

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* dogwood, black gum, red oak *Overstory:* black oak, white oak *Regeneration:* black oak, white oak

Slope gradient: 35 percent **Complexity:** Convex, convex

Slope length:

Aspect: 210°

Relief:

Elevation: 2933 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 19 inches

Rock fragments on the soil surface: 30 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and medium roots; 25 percent sandstone channers; extremely acid; clear smooth boundary.

Bw1--2 to 10 inches; pale brown (10YR 6/3) channery silty clay loam; moderate fine subangular blocky structure; very friable, slightly sticky, non-plastic; common fine and medium roots; 30 percent sandstone channers; extremely acid; clear smooth boundary.

Bw2--10 to 19 inches; pale brown (10YR 6/3) very channery silty clay loam; moderate fine subangular blocky structure; very friable, slightly sticky, non-plastic; few fine and medium roots; 40 percent sandstone channers; extremely acid; clear smooth boundary.

R--19 inches; hard Chemung shale bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-2	38	55	34	31	22	180	556	264
2-10	52	38	13	14	15	132	596	272
10-19	73	27	12	5	6	123	577	300

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-2	3.29	0.89	0.50	29.20	33.88	13.81
2-10	1.29	0.78	0.25	9.40	11.72	19.80
10-19	1.82	0.80	0.22	9.40	12.24	23.20

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-2	110.4	27.9	16.77
2-10	10.0	9.5	24.42
10-19	6.6	9.5	29.89

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-2	4.54	7.15	11.83	39.56
2-10	5.04	3.85	6.17	37.60
10-19	5.00	3.45	6.29	45.15

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
63	24	0	13

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
11.0	4.6	2.9	9.9	0.35

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	53
Basal area, ft^2/ac	100
Species	Site index, ft
Northern Red Oak	57

Stop: AL57 -- Calvin very gravelly loam (15A)

Date: 20 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°47'43" north **Longitude:** 80°10'11" west

Parent material: Hampshire interbedded sandstone and shale

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* blueberry, mountain laurel *Overstory:* chestnut oak, scarlet oak *Regeneration:* scarlet oak, chestnut oak

Slope gradient: 25 percent **Complexity:** Convex, convex

Slope length:

Aspect: 320°

Relief:

Elevation: 2820 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 23 inches

Rock fragments on the soil surface: 30 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; light gray (10YR 6/1) very gravelly loam; weak fine granular structure; very friable, non-sticky, non-plastic; many fine and medium roots; 40 percent shale and sandstone gravels; extremely acid; clear wavy boundary.

Bw1--2 to 9 inches; brown (7.5YR 5/4) gravelly loam; weak fine subangular blocky structure; very friable, slightly sticky, non-plastic; common fine and medium roots; 30 percent shale and sandstone gravels; very strongly acid; gradual wavy boundary.

Bw2--9 to 18 inches; reddish brown (5YR 5/4) gravelly loam; moderate fine subangular blocky structure; friable, slightly sticky, slightly plastic; few fine and medium roots; 30 percent shale and sandstone gravels; very strongly acid; clear wavy boundary.

Bw3--18 to 23 inches; reddish brown (5YR 5/4) very gravelly loam; strong medium subangular blocky structure; friable, slightly sticky, slightly plastic; few fine and medium roots; 40 percent shale and sandstone gravels; very strongly acid; abrupt wavy boundary.

R--23 inches; hard Hampshire interbedded shale and sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-2	13	24	36	263	139	475	404	121
2-9	39	22	33	204	162	460	439	101
9-18	36	30	40	158	149	413	448	139
18-23	55	35	32	103	107	332	465	203

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-2	0.23	0.12	0.20	13.20	13.75	4.00
2-9	0.04	0.03	0.13	8.80	9.00	2.22
9-18	0.03	0.03	0.13	5.80	5.99	3.17
18-23	0.04	0.07	0.14	6.40	6.65	3.76

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-2	60.7	28.1	1.96
2-9	14.5	5.7	3.51
9-18	3.1	5.1	3.73
18-23	2.1	6.9	3.62

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-2	4.16	5.95	6.50	8.46
2-9	4.62	3.45	3.65	5.48
9-18	4.79	3.45	3.64	5.22
18-23	4.77	4.77	4.80	5.21

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	100
Species	Site index, ft
Chestnut Oak	52

Stop: AL58 -- Weikert channery silt loam (16A)

Date: 21 October 1992

Described by: DS, TA

Topographic quadrangle:

Location: Alleghany County, VA;

Latitude: 37°55'13" north **Longitude:** 80°0'52" west

Parent material: Chemung shale

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* reindeer moss, mountain laurel, blueberry *Overstory:* Virginia pine, pitch pine, chestnut oak *Regeneration:* chestnut oak, pitch pine, Virginia pine

Slope gradient: 41 percent **Complexity:** Convex, convex

Slope length:

Aspect: 300°

Relief:

Elevation: 3000 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 19 inches

Rock fragments on the soil surface: 55 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; very friable, slightly sticky, non-plastic; many fine and medium roots; 30 percent shale channers; extremely acid; clear smooth boundary.

Bw--1 to 19 inches; brownish yellow (10YR 6/6) very channery silt loam; weak fine granular structure; very friable, slightly sticky, non-plastic; common fine and medium roots; 50 percent shale channers; very strongly acid; clear smooth boundary.

R--19 inches; hard Chemung shale bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-1	122	87	33	19	6	267	520	213
1-19	99	52	17	6	4	178	628	194

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-1	4.88	0.77	0.50	11.20	17.35	35.45
1-19	0.24	0.19	0.24	13.00	13.67	4.90

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-1	180.8	29.7	20.71
1-19	22.1	12.1	5.54

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-1	4.40	4.85	11.00	55.91
1-19	4.71	5.95	6.62	10.12

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	45
Basal area, ft^2/ac	90
Species	Site index, ft
Virginia Pine	37
Chestnut Oak	30

Stop: BA10 -- Weikert channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Pocahontas County, WV; 16,850 feet 289° northwest of the intersection of Highways VA-39 and VA-600; 7,500 feet 258° southwest of the intersection of Highways VA-39 and VA-601

Latitude: 38°7'0.2" north **Longitude:** 79°56'31.7" west

Parent material: Braillier shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry, azalea *Overstory:* chestnut oak, red oak, pitch pine, scarlet oak *Regeneration:* red hickory, black oak, white pine, red maple

Slope gradient: 16 percent **Complexity:** Linear, convex

Slope length: 300 feet, lower

Aspect: 170°

Relief: 80 feet

Elevation: 2640 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 11 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 5 inches; dark grayish brown (10YR 4/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 25 percent shale channers; extremely acid; clear smooth boundary.

Bw--5 to 14 inches; dark yellowish brown (10YR 4/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent shale channers; very strongly acid; clear wavy boundary.

R--14 inches; hard Braillier shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-5	54	25	11	10	24	124	698	178
5-14	54	32	17	13	22	138	718	144

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-5	0.25	0.10	0.24	17.20	17.79	3.32
5-14	0.18	0.04	0.17	6.80	7.19	5.42

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-5	78.0	13.5	4.37
5-14	19.7	6.9	5.65

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-5	4.38	4.65	5.24	11.26
5-14	4.70	3.15	3.54	11.02

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
79	7	3	11

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
23.0	8.7	2.3	9.2	0.43

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	110
Species	Site index, ft
Scarlet Oak	55
Pitch Pine	53

Stop: BA11 -- Weikert channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Pocahontas County, WV; 13,750 feet 322° northwest of the intersection of Highways VA-39 and VA-600; 6,100 feet 218° southwest of the intersection of Highways VA-39 and VA-601

Latitude: 38°6'31.5" north **Longitude:** 79°55'46.5" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* American chestnut, striped maple, red maple, hickory, blueberry 5% *Overstory:* red oak, black oak, chestnut oak, red maple, white oak *Regeneration:* chestnut oak, black oak, white oak, red maple, white pine

Slope gradient: 43 percent **Complexity:** Linear, convex

Slope length: 150 feet, upper

Aspect: 182°

Relief: 250 feet

Elevation: 3080 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 19 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 4 inches; dark brown (7.5YR 4/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; extremely acid; clear smooth boundary.

Bw1--4 to 15 inches; brown (7.5YR 5/2) very channery silt; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw2--15 to 19 inches; brown (7.5YR 5/2) very channery silt; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 50 percent sandstone channers; very strongly acid; clear wavy boundary.

R--19 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-4	56	28	16	13	33	146	681	173
4-19	64	41	10	9	27	151	815	34

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-4	0.67	0.26	0.34	23.20	24.47	5.19
4-19	0.27	0.40	0.17	8.80	9.64	8.71

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-4	93.8	18.5	6.86
4-19	9.0	6.9	12.17

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-4	4.45	6.65	7.92	16.04
4-19	4.90	3.75	4.59	18.30

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
72	17	2	9

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
19.0	11.3	3.1	7.1	0.47

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	110
Species	Site index, ft
Northern Red Oak	60

Stop: BA12 -- Weikert channery loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Bath County, VA; 9,000 feet 260° west of the intersection of Highways VA-39 and VA-600

Latitude: 38°5'43.8" north **Longitude:** 79°55'16.6" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* serviceberry, striped maple, fern, red hickory, red maple
Overstory: scarlet oak, red oak, red maple, black birch, black cherry
Regeneration: red oak, white oak, red maple, black birch

Slope gradient: 25 percent **Complexity:** Linear, convex

Slope length: 300 feet, upper

Aspect: 358°

Relief: 450 feet

Elevation: 3200 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 15 inches

Rock fragments on the soil surface: 0.5 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; very dark grayish brown (10YR 3/2) channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 30 percent sandstone channers; extremely acid; clear smooth boundary.

Bw--2 to 15 inches; dark yellowish brown (10YR 4/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 40 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--15 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-2	45	25	16	85	144	315	493	192
2-15	51	27	12	72	154	316	529	155

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-2	0.78	0.27	0.27	23.20	24.52	5.38
2-15	0.22	0.06	0.14	8.00	8.42	4.99

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-2	95.9	17.9	7.37
2-15	17.3	7.9	5.32

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-2	4.25	6.05	7.37	17.91
2-15	4.68	2.85	3.27	12.84

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
77	12	6	5

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
17.0	7.6	1.6	7.1	0.52

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	120
Species	Site index, ft
Northern Red Oak	70

Stop: BA13 -- Berks channery loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Pocahontas County, WV; 14,300 feet 215° southwest of the intersection of Highways VA-39 and VA-601; 14,100 feet 285° southwest of the southern intersection of Highways VA-39 and VA-600

Latitude: 38°5'23" north **Longitude:** 79°56'23" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* fern, striped maple, American chestnut, magnolia, black birch *Overstory:* red oak, scarlet oak, chestnut oak, red maple, white oak, black cherry *Regeneration:* black oak, white oak, chestnut oak

Slope gradient: 20 percent **Complexity:** Convex, convex

Slope length: 300 feet, upper

Aspect: 340°

Relief: 450 feet

Elevation: 3160 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 27 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 3 inches; very dark grayish brown (10YR 3/2) channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 25 percent sandstone channers; extremely acid; clear smooth boundary.

Bw--3 to 27 inches; yellowish brown (10YR 5/4) very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers and 10 percent sandstone cobbles; very strongly acid; gradual wavy boundary.

R--27 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-3	27	28	33	126	157	371	431	198
3-27	21	21	3	103	171	319	499	182

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-3	0.98	0.33	0.36	33.00	34.67	4.82
3-27	0.16	0.07	0.14	6.60	6.97	5.31

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-3	191.8	26.5	6.30
3-27	14.8	7.1	5.21

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-3	4.08	7.45	9.12	18.31
3-27	4.78	3.85	4.22	8.77

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
75	9	7	9

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
26.0	8.1	3.3	10.1	0.42

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	120
Species	Site index, ft
Northern Red Oak	66

Stop: BA14 -- Dekalb channery fine sandy loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Pocahontas County, WV; 16,500 feet 218° southwest of the intersection of Highways VA-39 and VA-601; 15,200 feet 277° northwest of the southern intersection of Highways VA-39 and VA-600

Latitude: 38°5'5.2" north **Longitude:** 79°56'58" west

Parent material: Hampshire interbedded sandstone and shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, blueberry 1% *Overstory:* black birch, black oak, red oak, chestnut oak *Regeneration:* black oak

Slope gradient: 31 percent **Complexity:** Convex, convex

Slope length: 200 feet, upper

Aspect: 342°

Relief: 450 feet

Elevation: 3280 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 25 inches

Rock fragments on the soil surface: 2 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 4 inches; dark brown (7.5YR 4/2) channery fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 25 percent sandstone and shale channers; extremely acid; clear smooth boundary.

Bw--4 to 16 inches; brown (7.5YR 4/4) very flaggy fine sandy loam; weak fine granular and subangular blocky structure; friable, slightly sticky, non-plastic; 40 percent sandstone and shale flags; very strongly acid; gradual wavy boundary.

C--16 to 25 inches; reddish brown (5YR 4/4) extremely flaggy fine sandy loam; massive; friable, slightly sticky, non-plastic; 65 percent sandstone and shale flags; very strongly acid; gradual wavy boundary.

R--25 inches; hard Hampshire interbedded sandstone and shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-4	11	11	38	339	126	525	338	137
4-16	12	23	28	338	159	560	327	113
16-25	17	19	47	337	163	583	316	101

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-4	0.59	0.16	0.21	25.00	25.96	3.70
4-16	0.18	0.02	0.05	6.60	6.85	3.65
16-25	0.14	0.02	0.06	4.40	4.62	4.76

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-4	123.5	17.3	5.55
4-16	16.6	4.9	5.10
16-25	4.8	4.5	4.89

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-4	3.98	7.95	8.91	10.77
4-16	4.66	2.15	2.40	10.42
16-25	4.68	2.35	2.57	8.56

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
93	4	1	2

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
11.0	8.3	1.5	4.6	0.53

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	150
Species	Site index, ft
Northern Red Oak	66

Stop: BA15 -- Gilpin loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Pocahontas County, WV; 19,050 feet 218° southwest of the intersection of Highways WV-39 and WV-601; 16,800 feet 270° west of the southern intersection of Highways VA-39 and VA-600

Latitude: 38°4'46.3" north **Longitude:** 79°57'19.4" west

Parent material: Hampshire interbedded shale and sandstone

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* blueberry 1%, striped maple, dogwood, azalea *Overstory:* white oak, black oak, red hickory *Regeneration:* red oak

Slope gradient: 12 percent **Complexity:** Convex, convex

Slope length: 400 feet, upper

Aspect: 270°

Relief: 500 feet

Elevation: 3240 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 25 inches

Rock fragments on the soil surface: 2 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark grayish brown (10YR 4/2) loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent shale and sandstone channers; very strongly acid; clear smooth boundary.

BA--1 to 10 inches; brown (7.5YR 4/4) channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; very strongly acid; clear smooth boundary.

Bt--10 to 20 inches; brown (7.5YR 4/4) channery loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds; 15 percent sandstone channers; very strongly acid; gradual wavy boundary.

C--20 to 25 inches; strong brown (7.5YR 4/6) channery loam; massive; friable, slightly sticky, slightly plastic; 30 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--25 inches; hard Hampshire interbedded shale and sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
7-10	11	9	42	267	162	491	384	125
10-20	13	17	42	201	179	452	382	166
20-25	34	29	29	157	175	424	365	211

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	cmol$_c$ kg^{-1} of soil					%
7-10	0.21	0.03	0.08	5.20	5.52	5.80
10-20	0.24	0.06	0.10	8.00	8.40	4.76
20-25	0.25	0.10	0.13	8.00	8.48	5.66

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	cmol$_c$ kg^{-1} of soil	%
7-10	8.6	5.1	6.27
10-20	4.1	7.3	5.48
20-25	4.1	7.9	6.08

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
7-10	4.73	2.85	3.17	10.09
10-20	4.58	5.45	5.85	6.84
20-25	4.78	5.25	5.73	8.38

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
83	7	0	10

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
18.0	6.3	2.7	7.1	0.51

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	90
Species	Site index, ft
Black Oak	59

Stop: BA16 -- Gilpin channery loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mountain Grove VA-WV

Location: Pocahontas County, WV; 19,450 feet 220° southwest of the intersection of Highways WV-39 and WV-601; 22,750 feet 325° northwest of McClintic Bridge along VA-603 over northern end of Lake Moomaw

Latitude: 38°4'43.3" north **Longitude:** 79°57'20.6" west

Parent material: Hampshire interbedded shale and sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* American chestnut, blueberry 5%, striped maple, red hickory *Overstory:* scarlet oak, red maple, chestnut oak *Regeneration:* black oak, red maple

Slope gradient: 17 percent **Complexity:** Convex, convex

Slope length: 200 feet, middle

Aspect: 348°

Relief: 500 feet

Elevation: 3280 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 27 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; very dark gray (5YR 3/1) channery loam; weak fine granular structure; friable, slightly sticky, non-plastic; 20 percent sandstone channers; extremely acid; clear smooth boundary.

BA--2 to 16 inches; reddish brown (5YR 4/4) channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 30 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw--16 to 27 inches; reddish brown (5YR 4/3) channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; few distinct clay films on faces of peds; 20 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--27 inches; hard Hampshire interbedded shale and sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-2	19	17	35	202	141	414	422	164
2-16	25	13	26	213	164	441	439	120
16-27	21	20	40	210	160	451	410	139

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-2	0.28	0.18	0.24	20.00	20.70	3.38
2-16	0.15	0.03	0.11	5.20	5.49	5.28
16-27	0.17	0.03	0.10	8.60	8.90	3.37

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-2	118.7	16.9	4.14
2-16	13.8	4.5	6.44
16-27	7.2	5.9	5.08

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-2	4.20	5.55	6.25	11.20
2-16	4.85	2.25	2.54	11.42
16-27	4.75	3.85	4.15	7.23

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
83	9	0	8

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
16.0	6.7	2.4	7.1	0.48

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	90
Species	Site index, ft
Northern Red Oak	59

Stop: BA17 -- Berks channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Minnehaha Springs VA-WV

Location: Pocahontas County, WV; 18,900 feet 90° east of the intersection of Highways WV-28 and WV-39; 15,350 feet 159° southeast of the intersection of Highway WV-28 and Blind Path Road at Westminster Church

Latitude: 38°9'52.9" north **Longitude:** 79°55'1.5" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry 80%, mountain laurel 15% *Overstory:* chestnut oak, black oak, pitch pine *Regeneration:* white pine, chestnut oak

Slope gradient: 22 percent **Complexity:** Convex, convex

Slope length: 400 feet, upper

Aspect: 294°

Relief: 250 feet

Elevation: 2880 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 25 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark gray (10YR 3/1) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; very strongly acid; abrupt smooth boundary.

Bw--1 to 14 inches; light yellowish brown (10YR 6/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 40 percent sandstone channers; very strongly acid; clear smooth boundary.

C--14 to 25 inches; light yellowish brown (10YR 6/4) extremely channery silt loam; massive; friable, non-sticky, non-plastic; 40 percent sandstone channers and 20 percent sandstone flags; very strongly acid; gradual wavy boundary.

R--25 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-14	24	13	4	5	138	184	663	153
14-25	33	22	11	15	142	223	636	141

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-14	0.12	0.03	0.11	9.20	9.46	2.75
14-25	0.18	0.03	0.10	6.80	7.11	4.36

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-14	19.0	6.3	4.13
14-25	10.0	6.7	4.63

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-14	4.66	3.25	3.51	7.41
14-25	4.62	3.75	4.06	7.64

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
81	8	2	9

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
22.0	6.9	1.4	7.5	0.50

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	100
Species	Site index, ft
Chestnut Oak	47
Pitch Pine	35

Stop: BA18 -- Berks channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Minnehaha Springs VA-WV

Location: Pocahontas County, WV; 14,850 feet 155° southeast of the intersection of Highway WV-28 and Blind Path Road at Westminster Church; 19,300 feet 89° northeast of the intersection of Highways WV-39 and WV-28

Latitude: 38°9'58.8" north **Longitude:** 79°54'56.5" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* blueberry 80%, azalea 10%, mountain laurel 9%, white pine *Overstory:* white oak, chestnut oak, black oak, scarlet oak *Regeneration:* black oak, chestnut oak, white pine

Slope gradient: 28 percent **Complexity:** Convex, convex

Slope length: 300 feet, middle

Aspect: 270°

Relief: 200 feet

Elevation: 2970 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 21 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark grayish brown (10YR 4/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw--1 to 11 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; gradual smooth boundary.

C--11 to 21 inches; yellowish brown (10YR 5/4) very channery silt loam; massive; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--21 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-11	47	32	10	8	35	132	651	217
11-21	47	31	15	14	47	154	637	209

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-11	0.17	0.06	0.23	10.60	11.06	4.16
11-21	0.18	0.12	0.20	10.00	10.50	4.76

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-11	15.5	9.5	4.84
11-21	10.0	9.1	5.49

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-11	4.79	5.45	5.91	7.78
11-21	4.81	5.55	6.05	8.26

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
68	15	2	15

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
21.0	9.2	2.8	9.2	0.42

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	90
Species	Site index, ft
Chestnut Oak	45

Stop: BA19 -- Sequoia channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Minnehaha Springs VA-WV

Location: Pocahontas County, WV; 18,500 feet 83° northeast of the intersection of Highways WV-39 and WV-28; 12,900 feet 156° southeast of the intersection of Highway WV-28 and Blind Path Road at Westminster Church

Latitude: 38°10'16.7" north **Longitude:** 79°55'8" west

Parent material: Chemung colluvium over bedrock

Physiography: Ridge and Valley

Landscape position: Bench

Vegetation: *Understory:* white pine (open understory) *Overstory:* red maple, black oak, white oak, red oak, red hickory *Regeneration:* white pine

Slope gradient: 10 percent **Complexity:** Concave, convex

Slope length: 150 feet, bottom

Aspect: 0°

Relief: 250 feet

Elevation: 3060 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 42 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, mesic Typic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark grayish brown (10YR 4/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

E--1 to 15 inches; yellowish brown (10YR 5/4) silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone channers; very strongly acid; clear smooth boundary.

BE--15 to 28 inches; strong brown (7.5YR 5/6) silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone channers; very strongly acid; clear smooth boundary.

Bt(1)--28 to 38 inches; yellowish red (5YR 5/6) silty clay loam; common medium distinct yellow (10YR 7/8) and yellowish brown (10YR 5/4) mottles; weak fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds; 10 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bt(2)--38 to 42 inches; yellowish red (5YR 5/6) silty clay loam; common medium distinct yellow (10YR 7/8) mottles; weak fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds; 10 percent sandstone channers; very strongly acid; gradual wavy boundary.

2R--42 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-15	20	15	3	3	83	124	769	107
15-28	20	15	6	13	111	165	617	218
28-38	6	9	5	10	85	115	598	287
38-42	8	11	6	12	85	122	584	294

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-15	0.29	0.04	0.10	4.40	4.83	8.90
15-28	0.36	0.11	0.12	7.00	7.59	7.77
28-38	0.48	0.24	0.17	8.60	9.49	9.38
38-42	0.34	0.41	0.17	8.80	9.72	9.47

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-15	21.7	5.5	7.82
15-28	2.1	8.9	6.63
28-38	2.4	9.1	9.78
38-42	2.4	9.3	9.89

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
1-15	4.75	2.45	2.88	14.93
15-28	4.92	5.65	6.24	9.46
28-38	4.78	6.85	7.74	11.50
38-42	4.78	6.55	7.47	12.32

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	90
Species	Site index, ft
Northern Red Oak	73

Stop: BA20 -- Berks channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Minnehaha Springs VA-WV

Location: Bath County, VA; 12,000 feet 149° southeast of the intersection of Highway WV-28 and Blind Path Road at Westminster Church; 19,400 feet 80° northeast of the intersection of Highways WV-39 and WV-28

Latitude: 38°10'30.6" north **Longitude:** 79°55'0.5" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* white pine, red maple, blueberry 1% *Overstory:* red oak, black oak, red maple, white oak *Regeneration:* white pine, black oak

Slope gradient: 5 percent **Complexity:** Convex, convex

Slope length: 150 feet, upper

Aspect: 300°

Relief: 600 feet

Elevation: 3090 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 22 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw1--1 to 14 inches; yellowish brown (10YR 5/4) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw2--14 to 22 inches; yellowish brown (10YR 5/8) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; gradual smooth boundary.

R--22 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-14	7	7	2	6	180	202	636	162
14-22	22	24	8	9	92	155	582	263

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-14	0.21	0.05	0.11	6.80	7.17	5.16
14-22	0.29	0.12	0.13	11.20	11.74	4.60

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-14	12.4	6.7	5.52
14-22	6.6	9.9	5.45

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-14	4.77	3.65	4.02	9.20
14-22	4.74	6.95	7.49	7.21

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	100
Species	Site index, ft
Black Oak	68

Stop: BA21 -- Berks channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Minnehaha Springs VA-WV

Location: Pocahontas County, WV; 21,350 feet 67° northeast of the intersection of Highways WV-39 and WV-28; 8,600 feet 130° southeast of the intersection of Highway WV-28 and Blind Path Road at Westminster Church

Latitude: 38°11'16.2" north **Longitude:** 79°54'53" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* striped maple, white pine, blueberry 1% *Overstory:* red oak, black oak, red maple *Regeneration:* white pine, red maple

Slope gradient: 24 percent **Complexity:** Convex, convex

Slope length: 150 feet, upper

Aspect: 348°

Relief: 450 feet

Elevation: 3320 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 21 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw1--1 to 14 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 35 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw2--14 to 21 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--21 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-14	40	30	10	8	30	118	729	153
14-21	34	34	14	8	32	122	686	192

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-14	0.37	0.10	0.16	9.40	10.03	6.28
14-21	0.28	0.19	0.15	7.20	7.82	7.93

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-14	16.2	8.7	7.24
14-21	4.5	7.5	8.27

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
1-14	4.81	5.05	5.68	11.09
14-21	4.76	4.85	5.47	11.33

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	100
Species	Site index, ft
Chestnut Oak	59

Stop: BA22 -- Berks channery silt loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Minnehaha Springs VA-WV

Location: Pocahontas County WV; 28,100 feet 250° southwest of the intersection of Highways VA-600 and VA-603; 26,100 feet 66° northeast of the intersection of Highways WV-39 and WV-28

Latitude: 38°11'35.6" north **Longitude:** 79°53'55.3" west

Parent material: Chemung sandstone colluvium

Physiography: Ridge and Valley

Landscape position: Side slope (cove)

Vegetation: *Understory:* blueberry 1%, striped maple, American chestnut, white pine, red maple, black birch, azalea *Overstory:* chestnut oak, white oak, red oak, red maple *Regeneration:* red maple, white pine

Slope gradient: 35 percent **Complexity:** Linear, concave

Slope length: 300 feet, middle

Aspect: 280°

Relief: 600 feet

Elevation: 3460 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: Greater than 32 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochretps

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw1--1 to 15 inches; yellowish brown (10YR 5/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 40 percent sandstone channers and 15 percent rounded sandstone pebbles; very strongly acid; gradual smooth boundary.

Bw2--15 to 32 inches; yellowish brown (10YR 5/4) extremely channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 55 percent sandstone channers and 10 percent rounded sandstone pebbles; very strongly acid.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-15	92	50	5	17	45	209	635	156
15-32	108	40	11	5	43	207	617	176

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-15	0.24	0.06	0.16	7.00	7.46	6.17
15-32	0.29	0.10	0.16	8.20	8.75	6.29

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-15	10.4	7.1	6.48
15-32	2.4	7.5	7.33

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-15	4.88	3.65	4.11	11.19
15-32	4.76	4.95	5.50	10.00

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	120
Species	Site index, ft
Chestnut Oak	45

Stop: BA23 -- Mandy channery loam

Date: 6 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Sunrise VA-WV

Location: Pocahontas County, WV; 28,600 feet 64° northeast of the intersection of Highway WV-28 and Blind Path Road at Westminster Church; 28,100 feet 249° southwest of the intersection of Highways VA-600 and VA-603

Latitude: 38°14'16.3" north **Longitude:** 79°50'32.1" west

Parent material: Hampshire interbedded sandstone and shale over Chemung bedrock (not colluvium)

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* snake root, striped maple, ferns, sugar maple *Overstory:* white ash, black birch, red oak, red maple *Regeneration:* chestnut oak

Slope gradient: 17 percent **Complexity:** Convex, convex

Slope length: 150 feet, upper

Aspect: 12°

Relief: 300 feet

Elevation: 3870 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 25 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, mixed, frigid Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

Ap--0 to 6 inches; very dark brown (10YR 2/2), moist, and dark grayish brown (10YR 4/2), dry, channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw--6 to 25 inches; brown (7.5YR 5/4) very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone and shale channers; strongly acid; gradual wavy boundary.

R--25 inches; hard Hampshire interbedded sandstone and shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-6	60	42	27	73	118	320	480	200
6-25	66	37	16	68	130	317	489	194

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-6	3.53	0.44	0.32	37.20	41.49	10.34
6-25	1.37	0.16	0.13	10.80	12.46	13.32

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-6	124.2	26.5	16.19
6-25	17.3	10.3	16.12

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-6	4.58	4.95	9.24	46.43
6-25	5.22	3.45	5.11	32.49

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
65	15	11	9

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
17.0	6.7	3.0	11.2	0.49

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	90
Species	Site index, ft
White Ash	84

Stop: BA24 -- Calvin channery loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Paddy Knob VA-WV

Location: Bath County, VA; 1,600 feet 142° southeast of the intersection of Forest Service Roads 55 and 141; 5,400 feet 229° southwest of the intersection of Forest Ser-vice Roads 55 and 636

Latitude: 38°15'25.8" north **Longitude:** 79°48'28" west

Parent material: Hampshire interbedded shale and sandstone with Chemung interbedding

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* American chestnut, blueberry 30%, striped maple, azalea, black birch *Overstory:* chestnut oak, red oak, scarlet oak, red maple *Regeneration:* chestnut oak, red oak, black birch

Slope gradient: 20 percent **Complexity:** Convex, convex

Slope length: 200 feet, upper

Aspect: 248°

Relief: 250 feet

Elevation: 4160 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 29 inches

Rock fragments on the soil surface: 5 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, mixed, frigid Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 3 inches; dark brown (7.5YR 3/2) channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; extremely acid; clear smooth boundary.

Bw1--3 to 16 inches; reddish brown (5YR 4/4) channery loam; weak medium subangular blocky structure; friable, slightly sticky, non-plastic; 25 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw2--16 to 29 inches; dark reddish brown (5YR 3/4) fine sandy loam; weak medium subangular blocky structure; friable, slightly sticky, non-plastic; 25 percent sandstone channers and 15 percent sandstone flagstones; very strongly acid; gradual wavy boundary.

R--29 inches; hard interbedded Hampshire and Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-3	29	25	46	182	123	405	401	194
3-16	31	25	35	176	163	430	388	182
16-29	37	28	13	278	172	528	303	169

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-3	0.76	0.28	0.25	35.80	37.09	3.48
3-16	0.20	0.04	0.13	11.40	11.77	3.14
16-29	0.20	0.03	0.14	9.20	9.57	3.87

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-3	231.8	25.7	5.02
3-16	36.2	8.7	4.25
16-29	4.8	7.7	4.81

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-3	3.62	9.55	10.84	11.90
3-16	4.77	3.55	3.92	9.44
16-29	4.69	5.25	5.62	6.58

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
79	8	1	12

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
17.0	8.4	2.4	10.4	0.59

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	90
Species	Site index, ft
Northern Red Oak	55

Stop: BA25 -- Dekalb extremely flaggy fine sandy loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Paddy Knob VA-WV

Location: Bath County, VA; 14,100 feet 195° southwest of the intersection of highway VA- 84 and Forest Service Road 55; 17,400 feet 259° southwest of the intersection of Highways VA-600 and VA-603

Latitude: 38°15'17.9" north **Longitude:** 79°48'55.7" west

Parent material: Colluvium over Hampshire interbedded sandstone and shale

Physiography: Ridge and Valley

Landscape position: Ridgetop

Vegetation: *Understory:* ferns, violets, striped maple, snakeroot, smartweed
Overstory: red hickory, red maple, black cherry, black locust, white ash
Regeneration: black locust

Slope gradient: 6 percent **Complexity:** Concave, linear

Slope length: 150 feet, upper

Aspect: 24°

Relief: 250 feet

Elevation: 4200 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 26 inches

Rock fragments on the soil surface: 20 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, frigid Typic Dystrochrepts
Site is in old field with open canopy
Temperature site 3C (1,2,3)

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 10 inches; dark reddish brown (5YR 3/2) extremely flaggy fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 45 percent sandstone flagstones and 15 percent sandstone channers; extremely acid; clear wavy boundary.

2Bw--10 to 26 inches; dark brown (7.5YR 3/4) extremely flaggy loam; weak medium subangular blocky structure; friable, slightly sticky, non-plastic; 50 percent sandstone flagstones and 15 percent sandstone channers; very strongly acid; gradual wavy boundary.

Auger refusal at 26 inches due to flagstones.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-10	2	41	83	460	99	685	225	90
10-26	30	31	16	284	102	463	293	244

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-10	1.20	0.20	0.19	15.40	16.99	9.36
10-26	0.43	0.08	0.18	49.10	49.79	1.39

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-10	44.9	11.1	14.32
10-26	66.2	23.3	2.96

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-10	3.86	5.75	5.44	29.23
10-26	4.73	3.85	6.44	10.71

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
69	2	2	27

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
16.0	9.3	1.2	19.2	1.30

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	70
Species	Site index, ft
Black Cherry	72
White Ash	62

Stop: BA26 -- Dekalb very channery loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Paddy Knob VA-WV

Location: Pocahontas County, WV; 1,500 feet 270° west of the intersection of Forest Service Roads 55 and 636; 4,300 feet 60° northeast of the intersections of Forest Service Roads 55 and 141

Latitude: 38°15'59.5" north **Longitude:** 79°47'53.9" west

Parent material: Hampshire interbedded sandstone and shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* greenbrier, red oak, witch hazel, black birch *Overstory:* red oak *Regeneration:* red oak

Slope gradient: 15 percent **Complexity:** Linear, linear

Slope length: 200 feet, upper

Aspect: 320°

Relief: 1000 feet

Elevation: 4400 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 25 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, frigid Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 5 inches; very dark grayish brown (10YR 3/2) very channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 35 percent sandstone channers; extremely acid; clear smooth boundary.

Bw--5 to 25 inches; dark yellowish brown (10YR 4/6) very channery sandy loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--25 inches; hard Hampshire interbedded sandstone and shale bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	$g\ kg^{-1}$ of soil							
0-5	29	25	290	85	33	462	320	218
5-25	51	56	246	116	56	525	312	163

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-5	0.63	0.31	0.47	29.40	30.81	4.58
5-25	0.23	0.04	0.18	9.60	10.05	4.48

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-5	128.3	20.1	7.01
5-25	11.7	7.1	6.34

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-5	4.21	7.05	8.46	16.67
5-25	4.88	3.85	4.30	10.47

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
84	6	3	7

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
18.0	7.9	2.3	9.4	0.57

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	90
Species	Site index, ft
Northern Red Oak	49

Stop: BA37 -- Murril-like loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Burnsville VA-WV

Location: Bath County, VA; 6200 feet 224° southwest of the intersection of Forest Service Roads 124 and 1912; 2150 feet 126° southeast of the intersection of Highway US- 220 and Forest Service Road 124

Latitude: 38°8'21.6" north **Longitude:** 79°44'7.2" west

Parent material: Keefer sandstone colluvium over shale

Physiography: Ridge and Valley

Landscape position: Backslope

Vegetation: *Understory:* striped maple, ferns, dogwood, chinqapin, huckleberry, sassafras *Overstory:* hickory, red oak, scarlet oak, black oak, locust, red maple *Regeneration:* red maple, hickory, red oak

Slope gradient: 20 percent **Complexity:** Linear, linear

Slope length: 150 feet, upper

Aspect: 130°

Relief: 400 feet

Elevation: 3010 feet

Erosion class: Class 1

Drainage class: Well

Flooding: None

Soil moisture: Dry

Root restricting depth: 38 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, mesic Typic Hapludults
Temperature site 4B

Oi--1 to 0 inches; undecomposed leaves and twigs.

E--0 to 5 inches; yellowish brown (10YR 5/4) loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone channers; very strongly acid; clear smooth boundary.

Bt--5 to 17 inches; strong brown (7.5YR 5/8) clay loam; weak medium subangular blocky structure; friable, slightly sticky, non-plastic; common faint clay films on faces of peds; 10 percent sandstone channers; very strongly acid; gradual smooth boundary.

2C--17 to 38 inches; yellowish red (5YR 5/6) and red (2.5YR 4/6) silty clay; massive; friable, slightly sticky, slightly plastic; 10 percent shale channers; extremely acid; gradual smooth boundary.

2R--38 inches; clayey shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-5	18	22	22	78	159	299	496	205
5-17	24	21	11	70	141	267	430	303
17-38	1	1	1	27	69	99	442	459

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-5	0.46	0.10	0.20	12.80	13.56	5.60
5-17	0.44	0.13	0.17	10.00	10.74	6.89
17-38	0.26	0.22	0.21	12.00	12.69	5.44

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-5	19.7	9.1	8.35
5-17	5.2	7.7	9.61
17-38	0.3	11.5	6.00

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-5	4.87	3.85	4.61	16.49
5-17	4.57	4.95	5.69	13.01
17-38	4.33	8.65	9.34	7.39

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
94	3	0	3

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
24.0	7.6	5.4	14.2	0.46

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	100
Species	Site index, ft
Northern Red Oak	80

Stop: BA38 -- Gilpin-Lilly silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Burnsville VA-WV

Location: Bath County, VA; 1600 feet 124° southeast of the intersection of Highway US-220 and Forest Service Road 124; 9000 feet 186° southwest of the intersection of Highway US-220 and Forest Service Road 1747

Latitude: 38°8'25.6" north **Longitude:** 79°44'12.2" west

Parent material: Colluvium over Oriskany sandstone

Physiography: Ridge and Valley

Landscape position: Backslope

Vegetation: *Understory:* mountain laurel, azalea, witchhazel, teaberry, red maple *Overstory:* red oak, chestnut oak, white oak *Regeneration:* chestnut oak, red oak

Slope gradient: 20 percent **Complexity:** Linear, linear

Slope length: 200 feet, upper

Aspect: 330°

Relief: 400 feet

Elevation: 3010 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 30 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Fine loamy, siliceous, mesic Typic Dystrochrepts
Temperature site 4C

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark brown (10YR 3/3) silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone gravels; very strongly acid; clear smooth boundary.

E--1 to 10 inches; yellowish brown (10YR 5/4) silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone gravels; very strongly acid; clear smooth boundary.

Bw--10 to 23 inches; strong brown (7.5YR 5/8) loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; 10 percent sandstone gravels; very strongly acid; clear smooth boundary.

2C--23 to 30 inches; yellowish red (5YR 5/6) gravelly sandy clay loam; massive; friable, slightly sticky, non-plastic; 20 percent sandstone gravels; very strongly acid; gradual smooth boundary.

2R--30 inches; hard Keefer sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-10	20	19	20	136	165	360	536	104
10-23	20	17	25	133	169	364	456	180
23-30	14	13	32	312	203	574	198	228

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-10	0.23	0.03	0.11	5.80	6.17	6.00
10-23	0.17	0.05	0.11	7.40	7.73	4.27
23-30	0.18	0.22	0.11	5.60	6.11	8.35

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-10	11.7	3.9	9.49
10-23	3.5	4.9	6.73
23-30	0	4.1	12.44

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-10	4.72	3.25	2.42	15.29
10-23	4.76	2.45	3.58	9.22
23-30	4.97	2.55	2.96	17.23

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
93	7	0	0

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
19.0	18.6	2.6	10.5	0.51

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	110
Species	Site index, ft
Chestnut Oak	63

Stop: BA39 -- Schloss gravelly fine sandy loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Burnsville VA-WV

Location: Bath County, VA; 16,950 feet 255° southwest of the intersection of Highways VA-609 and VA-614; 8300 feet 92° southeast of the intersection of Highway US- 220 and Forest Service Road 1747

Latitude: 38°9'52.9" north **Longitude:** 79°42'17.8" west

Parent material: Rose Hill sandstone

Physiography: Ridge and Valley

Landscape position: Ridgetop

Vegetation: *Understory:* mountain laurel *Overstory:* white oak *Regeneration:* white oak

Slope gradient: 7 percent **Complexity:** Convex, convex

Slope length: 200 feet, middle

Aspect: 30°

Relief: 650 feet

Elevation: 3830 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 36 inches

Rock fragments on the soil surface: 20 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic, Dystrochrepts
Temperature site 4A

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark reddish brown (2.5YR 2.5/4) gravelly fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone gravels; very strongly acid; clear smooth boundary.

Bw1--1 to 15 inches; dark red (2.5YR 3/6) gravelly fine sandy loam; weak fine subangular blocky structure; friable, non-sticky, non-plastic; 20 percent sandstone gravels; very strongly acid; clear smooth boundary.

Bw2--15 to 25 inches; dark reddish brown (2.5YR 3/4) very gravelly fine sandy loam; weak fine subangular blocky structure; friable, non-sticky, non-plastic; 35 percent sandstone gravels; very strongly acid; gradual wavy boundary.

C--25 to 36 inches; dusky red (2.5YR 3/2) very gravelly sand; massive; loose; 35 percent sandstone gravels; very strongly acid; gradual wavy boundary.

R--36 inches; hard Oriskany sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-15	23	71	276	307	55	732	134	134
15-25	21	42	275	378	44	760	139	101
25-36	6	101	522	224	27	880	77	43

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-15	0.24	0.04	0.10	13.20	13.58	2.80
15-25	0.30	0.03	0.08	5.80	6.21	6.60
25-36	0.25	0.01	0.04	2.00	2.30	13.04

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-15	15.5	6.3	6.03
15-25	5.9	4.1	10.00
25-36	0	0.9	33.33

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-15	4.73	2.55	2.93	12.97
15-25	4.76	2.15	2.56	16.02
25-36	4.88	0.45	0.75	40.00

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
95	0	0	5

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
15.0	13.3	0.7	2.8	0.72

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	90
Species	Site index, ft
White Oak	31

Stop: HI27 -- Dekalb channery loam (spodic intergrade)

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Paddy Knob VA-WV

Location: Highland County, VA; 700 feet 237° southwest of the intersections of Forest Service Roads 55 and 636; 4,950 feet 67° northeast of the intersections of Forest Service Roads 55 and 141

Latitude: 38°15'55.6" north **Longitude:** 79°47'41.3" west

Parent material: Colluvium over Hampshire interbedded shale and sandstone

Physiography: Ridge and Valley

Landscape position: Ridgetop

Vegetation: *Understory:* witch hazel, striped maple, hazelnut, black cherry, hawthorn, blackberry 10%, ferns, red maple *Overstory:* black cherry, red oak, white ash *Regeneration:* none

Slope gradient: 15 percent **Complexity:** Concave, concave

Slope length: 200 feet, upper

Aspect: 55°

Relief: 800 feet

Elevation: 4460 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 32 inches

Rock fragments on the soil surface: 5 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, frigid Umbric Dystrochrepts
Temperature site 3A (1,2,3)

Oi--1 to 0 inches; undecomposed leaves and twigs.

Ap--0 to 8 inches; dark brown (7.5YR 3/2), moist and dark gray (10YR 4/1), dry channery fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 30 percent sandstone channers; extremely acid; clear wavy boundary.

Bh--8 to 15 inches; dark reddish brown (5YR 3/3) very channery fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 35 percent sandstone channers; extremely acid; clear wavy boundary.

2Bw--15 to 32 inches; dark yellowish brown (10YR 4/6) very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid; clear wavy boundary.

2R--32 inches; hard Hampshire interbedded sandstone and shale bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-8	57	47	46	407	121	678	226	96
8-15	26	40	33	409	127	635	264	101
15-32	67	59	36	250	99	511	303	186

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-8	1.35	0.29	0.23	13.80	15.67	11.93
8-15	0.73	0.13	0.15	17.20	18.21	5.55
15-32	0.36	0.06	0.14	34.00	34.56	1.62

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-8	49.7	9.9	18.89
8-15	33.8	11.7	8.63
15-32	59.0	16.1	3.48

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-8	3.88	2.55	4.42	42.31
8-15	4.07	5.55	6.56	15.40
15-32	4.88	3.75	4.31	12.99

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
84	12	3	1

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
9.4	6.0	1.5	8.6	0.85

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	28
Basal area, ft^2/ac	20
Species	Site index, ft
White Ash	72
Black Cherry	58
Northern Red Oak	45

Stop: HI28 -- Shelocta silt loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Paddy Knob VA-WV

Location: Pocahontas County, WV; 5000 feet 3° northeast of the intersection of Forest Service Roads 55 and 636; 11,300 feet 299° northwest of the intersection of Highways VA-600 and VA-603

Latitude: 38°16'49.1" north **Longitude:** 79°47'28.8" west

Parent material: Chemung colluvium

Physiography: Ridge and Valley

Landscape position: Cove

Vegetation: *Understory:* striped maple, snakeroot, red maple, white oak *Overstory:* striped maple, basswood, black birch, black locust, red oak *Regeneration:* white ash, sugar maple

Slope gradient: 35 percent **Complexity:** Linear, concave

Slope length: 250 feet, middle

Aspect: 350°

Relief: 100 feet

Elevation: 3720 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: Greater than 38 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, mixed, mesic Humic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 7 inches; very dark grayish brown (10YR 3/2) moist, and dark grayish brown (10YR 4/2) dry, silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone channers; very strongly acid; clear smooth boundary.

BA--7 to 17 inches; yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds; 5 percent sandstone channers; very strongly acid; gradual wavy boundary.

Bt1--17 to 28 inches; yellowish brown (10YR 5/6) clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds; 5 percent sandstone channers; strongly acid; gradual wavy boundary.

Bt2--28 to 38 inches; yellowish brown (10YR 5/6) very channery clay loam; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few distinct clay films on faces of peds; 35 percent sandstone channers; very strongly acid.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-7	74	30	18	36	50	208	558	234
7-17	87	44	19	34	33	217	547	236
17-28	59	43	23	39	37	201	510	289
28-38	76	58	25	31	34	224	482	294

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-7	3.03	0.81	0.41	32.80	37.05	11.47
7-17	1.03	0.24	0.21	16.80	18.28	8.10
17-28	0.95	0.33	0.22	11.40	12.90	11.63
28-38	0.96	0.37	0.22	11.40	12.95	11.97

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-7	68.7	24.9	17.07
7-17	27.3	12.1	12.23
17-28	4.5	10.5	14.29
28-38	3.5	10.5	14.76

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-7	4.62	4.85	9.10	46.70
7-17	4.98	5.35	6.83	21.67
17-28	5.06	6.25	7.75	19.35
28-38	5.00	6.45	8.00	19.38

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
58	26	5	11

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
20.0	8.6	3.2	12.8	0.48

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	120
Species	Site index, ft
Northern Red Oak	80
American Basswood	72

Stop: HI29 -- Weikert very channery silt loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mustoe VA-WV

Location: Highland County, VA; 1400 feet 31° northeast of the intersection of Forest Service Roads 258 and 258A; 6000 feet 332° northwest of the intersection of Highways VA-84 and VA-604

Latitude: 38°19'5.6" north **Longitude:** 79°44'4.7" west

Parent material: Chemung sandstone and shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* witch hazel, teaberry, huckleberry, red oak, blueberry 35%, white pine *Overstory:* table mountain pine, Virginia pine, hickory, chestnut oak *Regeneration:* black oak, chestnut oak, Virginia pine

Slope gradient: 38 percent **Complexity:** Linear, convex

Slope length: 300 feet, upper

Aspect: 181°

Relief: 500 feet

Elevation: 2920 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 10 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Lithic Udorthents

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark brown (10YR 3/3) moist, and dark grayish brown (10YR 4/2) dry, silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 40 percent sandstone and shale channers; very strongly acid; clear wavy boundary.

C--1 to 10 inches; yellowish brown (10YR 5/6) extremely channery silt loam; weak fine granular structure; friable, slightly sticky, non-plastic; 65 percent sandstone and shale channers; very strongly acid; gradual wavy boundary.

R--10 inches; hard Chemung sandstone and shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-10	72	39	14	6	7	138	622	240

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^{+}	H^{+}		
inches	$cmol_c$ kg^{-1} of soil					%
1-10	0.56	0.15	0.22	15.40	16.33	5.70

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-10	23.5	13.9	6.69

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
1-10	4.64	7.45	8.38	11.10

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	45
Basal area, ft^2/ac	70
Species	Site index, ft
Pitch Pine	32
Chestnut Oak	30

Stop: HI30 -- Weikert very channery silt loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mustoe VA-WV

Location: Highland County, VA; 1,500 feet 27° northeast of the intersection of Forest Service Roads 258 and 258A; 6,100 feet 331° northwest of the intersection of Highways VA-84 and VA-604

Latitude: 38°19'7.6' north **Longitude:** 79°44'4.7" west

Parent material: Chemung sandstone and shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* witch hazel, blueberry 35%, mountain laurel 35%, white pine, serviceberry, teaberry *Overstory:* table mountain pine, chestnut oak, Virginia pine *Regeneration:* white pine, Virginia pine, red oak

Slope gradient: 65 percent **Complexity:** Linear, linear

Slope length: 200 feet, upper

Aspect: 40°

Relief: 1000 feet

Elevation: 2920 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Dry

Root restricting depth: 17 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Lithic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

Bw--0 to 9 inches; yellowish brown (10YR 5/6) very channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 40 percent sandstone and shale channers; extremely acid; clear wavy boundary.

C--9 to 17 inches; yellowish brown (10YR 5/6) extremely channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 65 percent sandstone and shale channers; very strongly acid; gradual wavy boundary.

R--17 inches; hard Chemung sandstone and shale bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-9	43	25	5	5	19	97	656	247
9-17	52	25	5	4	17	103	663	234

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-9	0.06	0.06	0.20	13.60	13.92	2.30
9-17	0.04	0.05	0.16	13.80	14.05	1.78

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-9	38.0	15.9	2.01
9-17	18.3	12.1	1.98

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-9	4.43	7.05	8.87	3.61
9-17	4.54	6.45	7.29	3.29

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	45
Basal area, ft^2/ac	70
Species	Site index, ft
Chestnut Oak	38
Pitch Pine	38

Stop: HI31 -- Berks channery silt loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mustoe VA-WV

Location: Highland County, VA; 16,050 feet 5° northeast of the intersection of Highways VA-84 and VA-600; 11,400 feet 328° northwest of the intersection of Highways VA-84 and VA- 604

Latitude: 38°19'51.3" north **Longitude:** 79°44'44.9" west

Parent material: Chemung sandstone and shale

Physiography: Ridge and Valley

Landscape position: Ridgetop

Vegetation: *Understory:* black locust, blueberry 20%, witch hazel, striped maple, mountain laurel (present), black locust, tea berry *Overstory:* chestnut oak, red oak, red maple *Regeneration:* chestnut oak, black oak, hickory

Slope gradient: 10 percent **Complexity:** Convex, convex

Slope length: 200 feet, middle

Aspect: 220°

Relief: 300 feet

Elevation: 3380 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 27 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, slightly sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw--1 to 27 inches; yellowish brown (10YR 5/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 40 percent sandstone channers and 2 percent sandstone flagstones; very strongly acid; gradual wavy boundary.

R--27 inches; hard Chemung sandstone and shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-27	22	10	2	14	113	161	622	217

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-27	0.04	0.05	0.16	13.80	14.05	1.78

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-27	29.3	11.3	2.21

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
1-27	4.68	6.45	6.70	3.73

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	44
Basal area, ft^2/ac	100
Species	Site index, ft
Chestnut Oak	44

Stop: HI32 -- Berks channery silt loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Mustoe VA-WV

Location: Highland County, VA; 17,700 feet 2° northeast of the intersection of Highways VA-84 and VA-600; 5,800 feet 299° northwest of the intersection of Highway VA-600 and Forest Service Road 258

Latitude: 38°20'8.1" north **Longitude:** 79°44'47.4" west

Parent material: Chemung sandstone; surface is colluvial

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, sugar maple, red maple *Overstory:* red oak, sugar maple, chestnut oak

Slope gradient: 25 percent **Complexity:** Convex, linear

Slope length: 100 feet, upper

Aspect: 325°

Relief: 800 feet

Elevation: 3360 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 27 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 2 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 30 percent sandstone channers; extremely acid; clear wavy boundary.

Bw--2 to 27 inches; yellowish brown (10YR 5/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--27 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	$g\ kg^{-1}$ of soil							
0-2	41	24	12	15	63	155	609	236
2-27	68	45	9	7	47	176	602	222

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-2	0.29	0.20	0.22	29.80	30.51	2.33
2-27	0.05	0.13	0.12	9.20	9.50	3.16

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-2	120.8	22.9	3.10
2-27	24.5	8.7	3.45

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-2	4.09	7.95	8.66	8.20
2-27	4.80	3.75	4.05	7.41

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	160
Species	Site index, ft
Northern Red Oak	71

Stop: HI33 -- Mandy channery loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Hightown VA-WV

Location: Pocahontas County, WV; 18,650 feet 318° north-northwest of the intersection of Highways VA-84 and VA-640 at Meadowdale, 22,600 feet 250° south-southwest of the intersection of Highways US-250 and VA-640

Latitude: 38°24'52.9" north **Longitude:** 79°42'28.7" west

Parent material: Hampshire interbedded sandstone and shale

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, red maple, fern 70%, grasses 20%, witch hazel *Overstory:* red oak, beech, red maple, magnolia, black birch, yellow birch *Regeneration:* beech

Slope gradient: 20 percent **Complexity:** Convex, convex

Slope length: 300 feet, lower

Aspect: 50°

Relief: 50 feet

Elevation: 4110 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 28 inches

Rock fragments on the soil surface: 2 percent

Bedrock outcrops: 0

Additional notes: Coarse-loamy, mixed, frigid Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 5 inches; black (10YR 2/1), moist, and dark grayish brown (10YR 4/2), dry, channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 25 percent sandstone channers; extremely acid; clear wavy boundary.

Bh--5 to 8 inches; dark reddish brown (5YR 3/4) channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; very strongly acid; clear wavy boundary.

Bw1--8 to 15 inches; yellowish brown (10YR 5/4) channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 15 percent sandstone channers; very strongly acid; clear wavy boundary.

Bw2--15 to 28 inches; dark yellowish brown (10YR 4/4) channery fine sandy loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 15 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--28 inches; hard Hampshire interbedded sandstone and shale bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-5	14	27	60	269	145	515	346	139
5-8	38	25	39	183	145	430	393	177
8-15	53	32	39	210	171	505	368	127
15-28	46	32	48	254	190	570	324	106

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-5	0.25	0.16	0.21	28.60	29.22	2.12
5-8	0.03	0.07	0.13	48.00	48.23	0.48
8-15	0.03	0.02	0.06	18.80	18.91	0.58
15-28	0.02	0.02	0.06	10.00	10.10	0.99

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-5	147.7	19.9	3.12
5-8	68.7	22.7	1.01
8-15	33.8	9.3	1.18
15-28	14.5	6.5	1.54

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-5	3.63	7.15	7.77	7.98
5-8	4.70	6.45	6.68	3.44
8-15	4.90	2.65	2.76	3.99
15-28	4.90	2.15	2.25	4.44

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
70	9	3	18

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
18.0	8.7	2.6	6.9	0.70

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	80
Species	Site index, ft
Northern Red Oak	57

Stop: HI34 -- Mandy channery loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Hightown VA-WV

Location: Pocahontas County, WV; 18,750 feet 322° northwest of the intersection of Highways VA-84 and VA-640 at Meadowdale; 22,400 feet 220° south-southwest of the intersection of Highways US-250 and VA-640 at Hightown

Latitude: 38°24'54.8" north **Longitude:** 79°42'26.2" west

Parent material: Hampshire sandstone

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* striped maple, ironwood, ferns 5% *Overstory:* black birch, sugar maple, red maple, red oak *Regeneration:* sedge 80%, red oak

Slope gradient: 20 percent **Complexity:** Convex, convex

Slope length: 200 feet, middle

Aspect: 235°

Relief: 40 feet

Elevation: 4110 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 23 inches

Rock fragments on the soil surface: 5 percent

Bedrock outcrops: 0

Additional notes: Fine-loamy, mixed, frigid Typic Dystrochrepts
Temperature site 2A

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 4 inches; dark brown (7.5YR 3/2), moist, very dark grayish brown (10YR 3/2), dry, channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; extremely acid; clear wavy boundary.

Bw--4 to 23 inches; strong brown (7.5YR 4/6), moist, very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; very strongly acid; gradual wavy boundary.

R--23 inches; hard Hampshire interbedded sandstone and shale bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-4	43	31	36	202	120	432	341	227
4-23	36	25	34	198	162	455	334	211

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-4	0.89	0.36	0.35	36.80	38.40	4.17
4-23	0.11	0.05	0.15	17.20	17.51	1.77

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-4	182.2	25.9	6.18
4-23	31.1	10.3	3.01

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-4	3.83	8.15	9.75	16.41
4-23	4.70	4.35	4.66	6.65

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
74	12	7	7

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
18.0	9.6	2.0	9.8	0.58

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	120
Species	Site index, ft
Northern Red Oak	55

Stop: HI35 -- Series not designated fine sandy loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Hightown VA-WV

Location: Highland County, VA; 23,200 feet 230° southwest of the intersection of Highways US-250 and VA-600; 17,350 feet 109° northwest of the intersection of Highways VA-640 and VA-638

Latitude: 38°24'31" north **Longitude:** 79°42'59" west

Parent material: Hampshire colluvium over residuum

Physiography: Ridge and Valley

Landscape position: Side slope

Vegetation: *Understory:* ferns 90%, striped maple, sugar maple, beech *Overstory:* sugar maple, red oak, black cherry, red maple

Slope gradient: 28 percent **Complexity:** Convex, convex

Slope length: 300 feet, middle

Aspect: 260°

Relief: 600 feet

Elevation: 4420 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: Greater than 53 inches

Rock fragments on the soil surface: 5 percent

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, frigid Humic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 10 inches; dark reddish brown (5YR 3/2), moist, dark grayish brown (10YR 4/2), dry, fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone channers; extremely acid; clear smooth boundary.

AB--10 to 27 inches; dark reddish brown (5YR 3/3), moist, dark grayish brown (10YR 4/2), dry, channery fine sandy loam; weak fine granular structure; friable, non-sticky, non-plastic; 25 percent sandstone channers; extremely acid; clear smooth boundary.

Bw--27 to 38 inches; reddish brown (5YR 4/3) very gravelly fine sandy loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bt--38 to 43 inches; dark reddish brown (5YR 3/3) silty clay loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; few thin clay films on faces of peds; 10 percent sandstone channers; very strongly acid; clear smooth boundary.

Ab--43 to 49 inches; dark reddish brown (5YR 3/2) channery loam; weak fine granular structure; friable, slightly sticky, non-plastic; 25 percent sandstone channers; strongly acid; gradual smooth boundary.

Cb--49 to 53 inches; dark reddish brown (5YR 3/3) very channery loam; massive; friable, slightly sticky, non-plastic; 45 percent sandstone channers; strongly acid.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-10	18	33	136	332	159	678	234	88
10-27	16	54	126	295	131	622	227	151
27-38	64	94	164	288	153	763	164	73
38-43	70	89	109	181	103	552	209	239
43-49	124	86	48	86	63	407	295	298
49-53	103	88	47	118	88	444	313	243

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
0-10	0.08	0.05	0.08	10.80	11.01	1.91
10-27	0.08	0.05	0.09	24.20	24.42	0.90
27-38	0.03	0.01	0.05	7.80	7.89	1.14
38-43	0.05	0.02	0.11	12.80	12.98	1.39
43-49	0.19	0.18	0.17	15.80	16.34	3.30
49-53	0.43	0.41	0.17	14.00	15.01	6.73

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-10	29.0	8.5	2.47
10-27	43.5	14.3	1.54
27-38	3.1	5.7	1.58
38-43	2.8	9.3	1.94
43-49	2.8	13.1	4.12
49-53	5.2	11.7	8.63

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-10	3.67	4.65	4.86	4.32
10-27	4.22	7.55	7.77	2.83
27-38	4.75	3.15	3.24	2.78
38-43	4.80	5.65	5.83	3.09
43-49	5.07	5.35	5.89	9.17
49-53	5.10	4.05	5.06	19.96

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	130
Species	Site index, ft
Northern Red Oak	60

Stop: HI36 -- Mandy channery loam

Date: 7 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Hightown VA-WV

Location: Pocahontas County, WV; 16,800 feet 107° northwest of the intersection of Highways VA-640 and VA-638; 24,350 feet 228° southwest of the intersection of Highways US-250 and VA-600

Latitude: 38°24'14.2" north **Longitude:** 79°43'0.2" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Bench

Vegetation: *Understory:* ferns 90%, striped maple, sedges *Overstory:* sugar maple, red oak, red maple *Regeneration:* red oak

Slope gradient: 27 percent **Complexity:** Linear, convex

Slope length: 100 feet, lower

Aspect: 300°

Relief: 50 feet

Elevation: 4060 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 31 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, mixed, frigid Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark brown (7.5YR 3/4) channery loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw1--1 to 15 inches; strong brown (7.5YR 4/6) channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw2--15 to 31 inches; dark yellowish brown (10YR 4/4) very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; extremely acid; gradual wavy boundary.

R--31 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-15	55	43	49	138	133	418	343	239
15-31	41	42	52	137	154	426	405	169

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^{+}	H^{+}		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-15	0.05	0.02	0.07	15.80	15.94	0.88
15-31	0.07	0.05	0.09	10.40	10.61	1.98

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-15	19.0	12.1	1.16
15-31	3.1	7.5	2.80

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-15	4.76	4.05	4.79	2.92
15-31	4.15	4.65	5.46	3.85

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
73	11	7	9

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
18.0	10.2	2.1	7.7	0.58

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	120
Species	Site index, ft
Northern Red Oak	60

Stop: HI40 -- Mandy channery silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 300 feet 160° southeast of the intersection of Highland County, VA and Pocahontas and Pendleton County lines, WV; 2300 feet 192° south-southwest of the junction of Highway WV-28 and Forest Service Road 60

Latitude: 38°35'25" north **Longitude:** 79°38'55.9" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* striped maple, ferns 20%, sedge 50%, beech, hawthorn, red maple *Overstory:* red oak, red maple *Regeneration:* beech

Slope gradient: 22 percent **Complexity:** Convex, convex

Slope length: 150 feet, lower

Aspect: 180°

Relief: 200 feet

Elevation: 3860 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 39 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts
Temperature site 1A

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; extremely acid; clear smooth boundary.

Bw1--1 to 18 inches; yellowish brown (10YR5/6) very channery silty clay loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; extremely acid; gradual wavy boundary.

Bw2--18 to 39 inches; light olive brown (2.5Y 5/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 55 percent sandstone channers; extremely acid; gradual wavy boundary.

R--39 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-18	45	29	11	14	69	168	509	323
18-39	35	26	10	7	86	164	682	154

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-18	0.45	0.14	0.14	16.40	17.13	4.26
18-39	0.30	0.22	0.11	8.40	9.03	6.98

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-18	21.0	12.3	5.93
18-39	1.0	7.7	8.18

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-18	4.45	5.65	6.38	11.44
18-39	4.36	4.75	5.38	11.71

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	130
Species	Site index, ft
Northern Red Oak	74

Stop: HI41 -- Mandy very channery silty clay loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 500 feet 200° south-southwest of the intersection of Highland County, VA and Pocahontas and Pendleton Counties, WV lines; 2600 feet 198° south-southwest of the intersection of Highway WV-28 and Forest Service Road 60

Latitude: 38°35'24" north **Longitude:** 79°38'59.8" west

Parent material: Chemung colluvium over residuum

Physiography: Ridge and Valley

Landscape position: Cove, head of drain

Vegetation: *Understory:* ferns 5%, striped maple, hawthorne, beech *Overstory:* red spruce, beech, red maple, red oak *Regeneration:* beech, red maple

Slope gradient: 5 percent **Complexity:** Linear, concave

Slope length: 100 feet, upper

Aspect: 160°

Relief: 200 feet

Elevation: 3860 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: Greater than 46 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts
Temperature site 1B

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 4 inches; black (10YR2/1), moist, and dark grayish brown (10YR 4/2), dry, very channery silty clay loam; weak fine granular structure; friable, non-sticky, non-plastic; 40 percent sandstone channers; ultra acid; clear smooth boundary.

Bw1--4 to 18 inches; strong brown (7.5YR 4/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; extremely acid; gradual smooth boundary.

2Bw2--18 to 46 inches; light olive brown (2.5Y 5/4) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 45 percent sandstone channers; very strongly acid.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
0-4	21	16	14	25	89	165	512	232
4-18	29	17	12	26	115	199	533	268
18-46	67	56	10	39	91	263	619	118

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-4	0.60	0.21	0.23	46.20	47.24	2.20
4-18	0.06	0.04	0.13	23.40	23.63	0.97
18-46	0.27	0.10	0.07	9.20	9.64	4.56

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-4	189.1	30.3	3.43
4-18	41.7	11.9	1.93
18-46	1.4	6.7	6.57

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-4	3.44	11.25	12.29	8.46
4-18	3.92	5.25	5.48	4.20
18-46	4.50	3.95	4.39	10.02

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
71	21	1	7

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
19.0	11.4	1.3	12.8	0.78

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	60
Basal area, ft^2/ac	100
Species	Site index, ft
Red Spruce	73

Stop: HI42 -- Mandy very channery clay loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Pocahontas County, WV; 100 feet 264° west of the intersection of Forest Service Roads 106 and 52

Latitude: 38°35'21" north **Longitude:** 79°38'59.8" west

Parent material: Colluvium over Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Backslope

Vegetation: *Understory:* ferns 80%, striped maple, red maple, red oak, beech, black cherry *Overstory:* red oak, red maple, black locust, black cherry *Regeneration:* red maple, beech

Slope gradient: 20 percent **Complexity:** Convex, linear

Slope length: 200 feet, upper

Aspect: 55°

Relief: 240 feet

Elevation: 3860 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 38 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts
Temperature site 1C

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 4 inches; very dark brown (10YR 2/2), moist, and dark grayish brown (10YR 4/2), dry, very channery clay loam; weak fine granular structure; friable, non-sticky, non-plastic; 45 percent sandstone channers; ultra acid; clear smooth boundary.

Bw--4 to 19 inches; dark yellowish brown (10YR 4/6) very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 30 percent sandstone channers; extremely acid; gradual wavy boundary.

C--19 to 38 inches; yellowish brown (10YR 5/4) very channery loam with silt flows on rock faces; massive; friable, slightly sticky, non-plastic; 20 percent sandstone channers, 25 percent sandstone gravel; very strongly acid; gradual wavy boundary.

2R--38 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-4	25	27	21	37	169	279	433	288
4-19	53	28	9	25	255	370	456	174
19-38	197	83	31	22	156	489	363	148

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
0-4	0.82	0.34	0.32	55.40	56.88	2.60
4-19	0.06	0.02	0.06	14.40	14.54	0.96
19-38	0.07	0.02	0.06	7.40	7.55	1.99

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
0-4	213.9	35.5	4.17
4-19	16.2	7.9	1.77
19-38	3.8	6.3	2.38

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
0-4	3.15	11.25	12.73	11.63
4-19	4.36	3.75	3.89	3.60
19-38	4.62	2.65	2.80	5.36

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
86	9	0	5

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
19.0	12.0	1.4	11.3	0.66

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	59
Basal area, ft^2/ac	150
Species	Site index, ft
Black Cherry	97
Northern Red Oak	76

Stop: HI43 -- Mandy channery silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Pocahontas County, WV; 5900 feet 246° south-southwest of the intersection of Forest Service Roads 598 and 598B; 7700 feet 170° south-southeast of the inter-section of Forest Service Roads 271, 271A, and 806

Latitude: 38°34'33.4" north **Longitude:** 79°39'26.3" west

Parent material: Chemung sandstone colluvium

Physiography: Ridge and Valley

Landscape position: Swale

Vegetation: *Understory:* striped maple, ferns, red spruce, beech, cherry, mountain magnolia, red oak *Overstory:* red spruce *Regeneration:* red spruce, beech

Slope gradient: 11 percent **Complexity:** Convex, convex

Slope length: 150 feet, upper

Aspect: 350°

Relief: 80 feet

Elevation: 3640 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: Greater than 37 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark grayish brown (10YR 4/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; extremely acid; clear wavy boundary.

Bw1--1 to 9 inches; dark yellowish brown (10YR 4/6) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 25 percent sandstone channers; extremely acid; clear wavy boundary.

Bw2--9 to 25 inches; yellowish brown (10YR 5/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers; extremely acid; gradual wavy boundary.

C--25 to 37 inches; yellowish brown (10YR 5/6) very channery silt loam; massive; 45 percent sandstone channers; extremely acid.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-9	47	32	14	21	70	184	548	268
9-25	64	39	17	19	82	221	590	189
25-37	33	29	20	29	119	230	648	122

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-9	0.13	0.04	0.07	29.20	29.44	0.82
9-25	0.11	0.03	0.07	18.00	18.21	1.15
25-37	0.08	0.02	0.07	9.40	9.57	1.78

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-9	36.2	15.9	1.51
9-25	21.4	14.3	1.47
25-37	7.2	7.3	2.33

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
1-9	4.08	7.05	7.29	3.29
9-25	4.12	5.65	5.86	3.58
25-37	4.12	4.85	5.02	3.39

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	60
Basal area, ft^2/ac	160
Species	Site index, ft
Red Spruce	100

Stop: HI44 -- Mandy channery silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County VA; 5000 feet 112° north-northwest of the junction of Forest Service Roads 633, 633A, and 598B; 5800 feet 247° south-southwest of Forest Service Roads 598 and 598B

Latitude: 38°34'30.4" north **Longitude:** 79°39'23.8" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* striped maple, ferns, beech *Overstory:* black cherry, white ash, red oak, red maple *Regeneration:* red maple, beech, black cherry

Slope gradient: 25 percent **Complexity:** Convex, convex

Slope length: 100 feet, lower

Aspect: 90°

Relief: 120 feet

Elevation: 3640 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 28 inches

Rock fragments on the soil surface: 1 percent

Bedrock outcrops: 0

Additional notes: **Loamy-skeletal, siliceous, mesic Typic Dystrochrepts**

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; dark brown (10YR 4/3) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 25 percent sandstone channers; extremely acid; clear wavy boundary.

Bw1--1 to 14 inches; dark yellowish brown (10YR 4/6) very channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; 35 percent sandstone channers; extremely acid; gradual wavy boundary.

Bw2--14 to 28 inches; yellowish brown (10YR 5/4) very channery loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 35 percent sandstone channers, 10 percent sandstone flagstones; extremely acid; gradual wavy boundary.

R--28 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

	Sand							
Depth	VC	C	M	F	VF	Total	Silt	Clay
inches	g kg^{-1} of soil							
1-14	32	28	18	18	146	242	511	247
14-28	35	34	21	23	171	284	489	227

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c\ kg^{-1}$ of soil					%
1-14	0.15	0.05	0.08	25.80	26.08	1.07
14-28	0.15	0.04	0.07	15.20	15.46	1.68

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	$g\ kg^{-1}$ of soil	$cmol_c\ kg^{-1}$ of soil	%
1-14	38.6	14.3	1.96
14-28	12.1	10.1	2.57

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-14	4.40	5.75	6.03	4.64
14-28	4.20	5.75	6.01	4.33

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
77	13	0	10

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
20.0	10.0	2.0	12.0	0.61

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	28
Basal area, ft^2/ac	100
Species	Site index, ft
White Ash	91
Black Cherry	88
Northern Red Oak	76

Stop: HI45 -- Gilpin channery silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 5750 feet 272° north-northwest of the intersection of Forest Service Roads 633, 633A, and 598B; 6350 feet 19° north-northeast of Forest Service Roads 57, 58, and 106

Latitude: 38°34'13.6" north **Longitude:** 79°39'36.4" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Backslope

Vegetation: *Understory:* striped maple, beech, red maple, sugar maple, fern, witch hazel, black birch *Overstory:* red oak, red maple, locust *Regeneration:* red maple, beech

Slope gradient: 25 percent **Complexity:** Linear, convex

Slope length: 300 feet, middle

Aspect: 160°

Relief: 80 feet

Elevation: 3680 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 24 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, mesic Typic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; extremely acid; clear smooth boundary.

E--1 to 9 inches; yellowish brown (10YR 5/4) channery silty clay loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; extremely acid; clear smooth boundary.

BE--9 to 16 inches; yellowish brown (10YR 5/4) channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 25 percent sandstone channers; extremely acid; gradual wavy boundary.

Bt--16 to 24 inches; yellowish brown (10YR 5/4) channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 25 percent sandstone channers; extremely acid; gradual wavy boundary.

R--24 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-9	20	19	7	12	37	95	634	271
9-16	19	20	7	10	33	89	633	278
16-24	14	12	8	5	16	55	615	330

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-9	0.07	0.06	0.15	23.00	23.28	1.20
9-16	0.06	0.04	0.11	18.40	18.61	1.13
16-24	0.43	0.18	0.12	15.20	15.93	4.58

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-9	38.6	15.3	1.83
9-16	21.4	12.1	1.74
16-24	4.1	11.1	6.58

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		cmol$_c$ kg^{-1} of soil		%
1-9	3.80	7.95	8.23	3.40
9-16	4.16	6.85	7.06	2.97
16-24	4.16	6.95	7.68	9.51

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	55
Basal area, ft^2/ac	130
Species	Site index, ft
Northern Red Oak	83

Stop: HI46 -- Gilpin silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 9100 feet 213° south-southwest of the intersection of Forest Service Roads 598 and 142; 9550 feet 175° south-southeast of the intersection of Forest Service Roads 271, 271A, and 806

Latitude: 38°33'50.8" north **Longitude:** 79°39'36.4" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Backslope

Vegetation: *Understory:* beech, sugar maple, striped maple *Overstory:* black cherry, beech, red maple, sugar maple, black birch *Regeneration:* beech

Slope gradient: 26 percent **Complexity:** Convex, convex

Slope length: 100 feet, upper

Aspect: 140°

Relief: 150 feet

Elevation: 3710 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 24 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, mesic Typic Hapludults

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark gray (10YR 3/1) silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 10 percent sandstone channers; extremely acid; clear smooth boundary.

BE--1 to 2 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 10 percent sandstone channers; extremely acid; clear smooth boundary.

Bt(1)--2 to 13 inches; yellowish brown (10YR 5/6) channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 25 percent sandstone channers; extremely acid; gradual wavy boundary.

Bt(2)--13 to 24 inches; yellowish brown (10YR 5/6) channery silty clay loam; moderate medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 25 percent sandstone channers; extremely acid; gradual wavy boundary.

R--24 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
2-13	16	18	13	8	18	73	614	313
13-24	24	24	12	6	15	81	610	309

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	cmol$_c$ kg^{-1} of soil					%
2-13	0.10	0.07	0.12	19.80	20.09	1.44
13-24	0.10	0.05	0.12	16.40	16.67	1.62

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	cmol$_c$ kg^{-1} of soil	%
2-13	26.6	14.3	2.03
13-24	11.7	11.3	2.39

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
2-13	4.06	9.25	9.54	3.04
13-24	4.10	7.75	8.02	3.37

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
71	21	0	8

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
24.0	8.4	3.6	15.4	0.52

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	28
Basal area, ft^2/ac	170
Species	Site index, ft
Black Cherry	81

Stop: HI47 -- Muskingum channery silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 8500 feet 236° south-southwest of the intersection of Forest Service Roads 633, 633A, and 598B; 14,100 feet 181° south-southwest of the intersection of Forest Service Roads 271, 271A, and 806

Latitude: 38°33'30.3" north **Longitude:** 79°39'56.6" west

Parent material: Chemung sandstone

Physiography: Ridge and Valley

Landscape position: Shoulder

Vegetation: *Understory:* beech, striped maple, fern, greenbrier, black cherry, red oak, sugar maple, cucumber magnolia *Overstory:* red oak, black cherry, sugar maple, red maple *Regeneration:* beech, red maple

Slope gradient: 33 percent **Complexity:** Convex, convex

Slope length: 200 feet, upper

Aspect: 120°

Relief: 60 feet

Elevation: 3720 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: 29 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Loamy-skeletal, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 15 percent sandstone channers; extremely acid; clear smooth boundary.

Bw1(1)--1 to 9 inches; yellowish brown (10YR 5/4) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; 25 percent sandstone channers; extremely acid; gradual wavy boundary.

Bw1(2)--9 to 16 inches; yellowish brown (10YR 5/4) channery silty clay loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; 25 percent sandstone channers; extremely acid; gradual wavy boundary.

Bw2--16 to 29 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 40 percent sandstone channers; extremely acid; gradual wavy boundary.

R--29 inches; hard Chemung sandstone bedrock.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-9	49	31	13	10	23	126	612	262
9-16	76	48	17	11	22	174	547	279
16-29	86	51	18	14	24	193	566	241

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-9	0.13	0.07	0.12	25.60	25.92	1.23
9-16	0.44	0.14	0.09	20.00	20.67	3.24
16-29	0.28	0.11	0.09	15.20	15.68	3.06

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-9	43.1	16.3	1.96
9-16	21.7	12.3	5.45
16-29	13.5	10.7	4.49

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c\ kg^{-1}$ of soil		%
1-9	4.10	8.55	8.87	3.61
9-16	4.40	6.15	6.82	9.82
16-29	4.20	6.25	6.73	7.13

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	52
Basal area, ft^2/ac	140
Species	Site index, ft
Black Cherry	80
Northern Red Oak	76

Stop: HI48 -- Shelocta channery silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 23,000 feet 88° north-northeast of the intersection Highways VA-28 and VA-250; 9600 feet 233° south-southwest of the intersection of Forest Service Roads 633, 633A, and 598B

Latitude: 38°33'12.5" north **Longitude:** 79°40'0.4" west

Parent material: Chemung sandstone colluvium over Hampshire residuum

Physiography: Ridge and Valley

Landscape position: Backslope

Vegetation: *Understory:* beech, ferns 10%, sedges 20%, striped maple *Overstory:* black cherry, sugar maple, black birch, red maple *Regeneration:* beech, sugar maple

Slope gradient: 22 percent **Complexity:** Linear, convex

Slope length: 300 feet, middle

Aspect: 95°

Relief: 80 feet

Elevation: 3640 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: Greater than 60 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Fine-loamy, siliceous, mesic Typic Dystrochrepts

Oi--1 to 0 inches; undecomposed leaves and twigs.

A--0 to 1 inches; very dark grayish brown (10YR 3/2) channery silt loam; weak fine granular structure; friable, non-sticky, non-plastic; 20 percent sandstone channers; extremely acid; clear wavy boundary.

Bw1(1)--1 to 10 inches; dark yellowish brown (10YR 4/4) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 30 percent sandstone channers; extremely acid; gradual smooth boundary.

Bw1(2)--10 to 22 inches; dark yellowish brown (10YR 4/4) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 30 percent sandstone channers; extremely acid; gradual smooth boundary.

Bw2(1)--22 to 37 inches; dark yellowish brown (10YR 4/4) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 20 percent sandstone channers; very strongly acid; clear smooth boundary.

Bw2(2)--37 to 52 inches; dark yellowish brown (10YR 4/4) channery silt loam; weak fine subangular blocky structure; friable, slightly sticky, non-plastic; 20 percent sandstone channers; extremely acid; clear smooth boundary.

2Bw3--52 to 57 inches; strong brown (7.5YR 5/8) loam; common medium distinct yellowish red (5YR 5/6) mottles; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; 5 percent sandstone channers; very strongly acid; gradual wavy boundary.

2C--57 to 60 inches; yellowish red (5YR 5/6) loam; massive; friable, slightly sticky, non-plastic; 5 percent sandstone channers; very strongly acid.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
1-10	23	20	5	32	161	241	547	212
10-22	44	19	8	15	156	242	534	224
22-37	29	19	6	10	154	218	528	254
37-52	14	15	8	19	250	306	527	167
52-57	16	19	8	8	292	343	459	198
57-60	6	10	4	9	407	436	380	184

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	$cmol_c$ kg^{-1} of soil					%
1-10	0.31	0.11	0.13	19.00	19.55	2.81
10-22	0.10	0.05	0.07	15.60	15.82	1.39
22-37	0.46	0.09	0.10	12.40	13.05	4.98
37-52	0.17	0.10	0.08	9.20	9.55	3.66
52-57	0.15	0.12	0.10	9.00	9.37	3.95
57-60	0.12	0.12	0.09	5.80	6.13	5.38

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
1-10	29.7	11.5	4.78
10-22	17.6	9.9	2.22
22-37	3.5	12.7	5.12
37-52	0	8.3	4.22
52-57	0	7.9	4.68
57-60	1	5.1	6.47

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
1-10	4.38	5.25	5.80	9.48
10-22	4.03	4.25	4.47	4.92
22-37	4.68	4.95	5.60	11.61
37-52	4.40	4.25	4.60	7.61
52-57	4.50	4.55	4.92	7.52
57-60	4.60	3.95	4.28	7.71

Table 5. Sand and silt mineralogy: chalcedony, feldspar, and other, for taxonomic control sections†.

Quartz	Chal	Feld	Other
%			
82	15	0	3

†Chal = chalcedony, Feld = potassium feldspar, Other = muscovite, iron oxide, opaques, biotite, plagioclase feldspar, resistant aggregates, zircon, iron coated quartz, hornblende, tourmaline, and other weatherable minerals.

Table 6. Elemental clay mineralogy, 15-bar water, and 15-bar water:clay ratio, for taxonomic control sections.

Al_2O_3	Fe_2O_3	K_2O	15-bar water	15-bar water:clay
%				
24.0	11.4	2.1	12.3	0.56

Table 7. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	28
Basal area, ft^2/ac	110
Species	Site index, ft
Black Cherry	90

Stop: HI49 -- Shelocta silt loam

Date: 8 October 1992

Described by: TA, MC, MC, EE, JF, DS, JT, PT, BW

Topographic quadrangle: Thornwood VA-WV

Location: Highland County, VA; 11,800 feet 217° south-southwest of the intersection of Forest Service Roads 633, 633A, and 598B; 14,400 feet 150° south-southeast of the intersection of Highway VA-28 and Forest Service Road 52

Latitude: 38°32'44.7" north **Longitude:** 79°40'4.2" west

Parent material: Alluvium/colluvium from Chemung

Physiography: Ridge and Valley

Landscape position: Drainageway

Vegetation: *Understory:* red maple, ferns 10%, sedges 20%, beech, striped maple, red spruce *Overstory:* black cherry, black birch, white oak, red spruce, red maple *Regeneration:* white ash, red maple

Slope gradient: 2 percent **Complexity:** Linear, convex

Slope length: 500 feet, middle

Aspect: 220°

Relief: 20 feet

Elevation: 3610 feet

Erosion class: Class 1

Drainage class: Well drained

Flooding: None

Soil moisture: Moist

Root restricting depth: Greater than 60 inches

Rock fragments on the soil surface: 0

Bedrock outcrops: 0

Additional notes: Coarse-loamy, siliceous, mesic Typic Dystrochrepts

Oi--2 to 0 inches; undecomposed leaves and twigs.

A--0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine granular structure; friable, non-sticky, non-plastic; 5 percent sandstone channers; extremely acid; abrupt smooth boundary.

Bw1--5 to 15 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable, slightly sticky, slightly plastic; few thin clay films on faces of peds; 5 percent sandstone channers; extremely acid; gradual smooth boundary.

Bw2--15 to 33 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct light brownish gray (10YR 6/2) redox depletions; moderate fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 5 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw3--33 to 49 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 5 percent sandstone channers; very strongly acid; gradual smooth boundary.

Bw4--49 to 60 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; friable, slightly sticky, slightly plastic; common thin clay films on faces of peds; 5 percent sandstone channers; very strongly acid.

Table 1. Particle size distribution.

Depth	Sand						Silt	Clay
	VC	C	M	F	VF	Total		
inches	g kg^{-1} of soil							
0-5	24	11	12	19	85	151	615	234
5-15	34	16	10	56	103	219	578	203
15-33	51	32	17	15	138	253	591	156
33-49	45	42	18	18	140	263	566	171
49-60	92	48	19	16	145	320	526	154

Table 2. Chemical properties: CEC by sum of cations (SCEC), NH_4OAc, pH 7.

Depth	Exchangeable cations				SCEC	SBS
	Ca^{2+}	Mg^{2+}	K^+	H^+		
inches	cmol$_c$ kg^{-1} of soil					%
0-5	0.42	0.20	0.25	30.20	31.07	2.80
5-15	0.20	0.07	0.10	11.20	11.57	3.20
15-33	0.21	0.09	0.10	6.60	7.00	5.71
33-49	0.09	0.12	0.09	6.40	6.70	4.48
49-60	0.11	0.20	0.09	3.80	4.20	9.52

Table 3. Chemical properties: organic matter; CEC by saturation (NCEC), NH_4OAc, pH 7.

Depth	Organic Matter	NCEC	NBS
inches	g kg^{-1} of soil	$cmol_c$ kg^{-1} of soil	%
0-5	84.2	20.1	4.33
5-15	10.4	7.9	4.68
15-33	2.8	6.5	6.15
33-49	0	5.7	5.26
49-60	0	5.3	7.55

Table 4. Chemical properties: pH; exchangeable Al^{3+}; CEC by saturation (ECEC), NH_4OAc, pH 7.

Depth	pH	Al^{3+}	ECEC	EBS
inches		$cmol_c$ kg^{-1} of soil		%
0-5	4.10	7.05	7.92	10.98
5-15	4.30	5.25	5.62	6.58
15-33	4.58	3.85	4.25	9.41
33-49	4.68	3.35	3.65	8.22
49-60	4.60	3.15	3.55	11.27

Table 5. Additional woodland data: Society of American Foresters Cover type, dominant species, site index, and basal area.

SAF Cover type	28
Basal area, ft^2/ac	90
Species	Site index, ft
Black Cherry	92
White Ash	85
Red Spruce	58

VITA

Marc Mathew Corrigan was born on May 27, 1969 in Furth, West Germany to George and Christa Corrigan. Primary and secondary education was obtained in various locations, including the Netherlands, and several locations in the United States, including Arizona, New Jersey, and Virginia. Marc graduated from the Prince George High School, Prince George, Virginia in 1988. Following high school, Marc enrolled in Virginia Polytechnic Institute and State University, and obtained a degree in Crop and Soil Environmental Sciences in May of 1992.

Marc is a member of the Soil Science Society of America and the Virginia Tech Chapter of the Alpha Zeta Agricultural Honorary Fraternity.

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