Ecological site F130AY005PA
Mixed Metamorphic - Metabasalt Footslopes And Terraces

Accessed: 04/25/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 130A–Northern Blue Ridge

Major Land Resource Area 130A is in the Northern Section of the Blue Ridge Province of the Appalachian Highlands. The region is characterized by rugged mountains with steep slopes, sharp crests, and narrow valleys. The mountain range forms a narrow band that runs north to south between the Piedmont Upland Section to the east, the Ridge and Valley section to the west, and the Southern Section of the Blue Ridge to the south. Stream dissection is deep and intricate. Major streams and their tributaries flow through gorges and gaps. Elevation ranges from about 820 feet (250 meters) in the lower valleys and on footslopes along the Potomac River just east of Harpers Ferry, where West Virginia joins Maryland and Virginia, to more than 4,200 feet (1,280 meters) along the Appalachian Trail in Bedford County, Virginia. Apple Orchard Mountain, the highest peak, is at an elevation of 4,225 feet (1,288 meters) (USDA 2006).

The backbone of the northern Blue Ridge is an anticline composed of rocks that can be can be divided into geological groupings based on age. In general, the oldest rocks are the furthest east, and become younger towards the west (Fichter and Baedke, 2000; Barnes and Sevon, 2002). The first group are plutonic rocks that formed when liquid molten rock, called magma, solidified deep within the earth's crust over a billion years ago. Collectively referred to as the Grenville rocks, they make up much of the eastern half of the mountains and are composed of granites, gneisses, and granulites. The second group, characterized by the Catoctin greenstone formation, is slightly younger, and is made up of metabasalts and metarhyolites, types of igneous rocks that have been metamorphosed by heat and pressure. The third group was formed during the Cambrian period about 500 million years ago and are represented by the Harpers, Antiedam, Weverton, and Loudoun formations which comprise the Chilhowee group. These rocks are primariliy quartzites, phyllites, and meta-sandstones, and form the western flank of the Blue Ridge.

Preliminary ecological site differentiation is based on these three main age groups and geologies. The variable characteristics of the underlying rocks give rise to different soil physical and chemical properties and exert control on the landscape, slope shape, aspect, and elevation, all of which affect vegetation.

Classification relationships

This ecological site is found in Major Land Resource Area 130A – the Northern Blue Ridge. MLRA 130A is located within Land Resource Region N – East and Central Farming and Forest Region (USDA 2006), and in United States Forest Service ecoregion M221D – Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province, Blue Ridge Mountain Province (Bailey, 1995).In addition, MLRA 130A falls within area #66 of EPA Ecoregion Level III – the Blue Ridge (US EPA 2013). The Mixed Metamorphic - Metabasalt Footslopes and Terraces ecological site occurs primarily within 66a - Northern Igneous Ridges (Woods et. al., 1996).
Northeastern Interior Dry-Mesic Oak Forest System - CES202.592
Liriodendron tulipifera - *Pinus strobus* - *Tsuga canadensis* - *Quercus rubra* / *Polystichum acrostichoides* Forest association - CEGL006304
Southern and Central Appalachian Cove Forest Systems - CES202.373
Tsuga canadensis - Quercus prinus - *Liriodendron tulipifera* / *Kalmia latifolia* - (*Rhododendron catawbiense*) Forest

association - CEGL008512
(NatureServe 2017)

Ecological site concept

Mixed Metamorphic - Metabasalt Footslopes and Terraces are found throughout the Northern Blue Ridge of the Appalachian Highlands on mountain footslopes, toeslopes, coves, benches, drainageways, mountain valleys, stream terraces, and fans. The underlying geology includes gneiss, granite, granodiorite, granulite, metabasalt, phyllite, schist, and some sandstone, and shale. Soils are deep, mostly well drained and generally acidic with low to moderate fertility. These low to mid slope areas will be deeper and hold more moisture than ecological sites further upslope. The Quartzitic Footslopes and Terraces ecological site is on similar landscapes, but the underlying bedrock is composed primarily of quartzites and metasandstones. These areas are drier, more acidic, and less fertile, and will include more pine and oak forest types. At least 15% of the Mixed Metamorphic-Metabasalt Footslope and Terraces ecological site has been converted to agricultural use verses approximately only 2 percent of the Quartzitic ecological site.

The reference forest state is a combination of several vegetation communities within the Northeastern Interior Dry-Mesic Oak Forest and the Southern and Central Appalachian Cove Forest Systems as defined by NatureServe (NatureServe 2009). These areas will have oak and hickory species characteristic of dry to mesic conditions as well as mesophytic (moisture loving) hardwood or hemlock-hardwood forests. Generally, the drier, convex, slopes will contain more oaks while the sheltered and concave lowest slope positions will be dominated by tuliptree, maple, hemlock, basswood, elm, birch, and beech. Vegetation varies according to soil chemistry. Disturbance agents in these forests include fire, wind throw, ice damage, human activity, and pests like gypsy moths and the woolly adelgid which heavily impact oak and hemlock species respectively.

Associated sites

F130AY001PA	**Mixed Metamorphic And Granitic Upland** The Mixed Metamorphic and Granitic Uplands ecological site occurs on adjacent upper slopes.
F130AY002PA	**Metabasalt Upland** The Metabasalt Uplands ecological site occurs on adjacent upper slopes.
F130AY003PA	**Phyllite-Metasandstone Upland** The Phyllite-Metasandstone Upland ecological site occurs on adjacent upper slopes.
F130AY007PA	**Fine To Loamy Mixed Metamorphic Floodplain** The Fine to Loamy Mixed Metamorphic Floodplain ecological site occurs along adjacent drainageways and streams.
F130AY008PA	**Poorly To Somewhat Poorly Drained Floodplains And Toeslopes** The Poorly to Somewhat Poorly Drained Floodplains and Toeslopes ecological site is on depressions, and slope break seep areas in and around the footslope and terrace landscapes.

Similar sites

F147XY007PA	**Loamy To Coarse Terrace** This provisional ecological site is similar to the Loamy to Coarse Terrace ecological site of Major Land Resource Area 147 – Northern Appalachian Ridges and Valley. Future analysis and field work may result in combining these ecological sites.

Table 1. Dominant plant species

Tree	(1) *Liriodendron tulipifera* (2) *Pinus strobus*
Shrub	Not specified
Herbaceous	(1) *Polystichum acrostichoides*

Physiographic features

The Mixed Metamorphic - Metabasalt Footslopes and Terraces provisional ecological site occurs on geologies of gneiss, granite, granodiorite, granulite, metabasalt, phyllite, schist, and some quartzite, sandstone, and shale. Typical landscapes are lower mountain slopes, footslopes, toeslopes, coves, benches, drainageways, mountain valleys, stream terraces, and fans. Elevation is generally around 1380 feet (420m) but can range from 235 to 3,000 feet (72 to 915m). Slopes range from 2 to 35 percent. Depth to bedrock is usually greater than 60 inches (152 cm). This ecological site is subject to occasional flooding but no ponding.

Table 2. Representative physiographic features

Landforms	(1) Cove (2) Terrace (3) Fan
Flooding frequency	None
Ponding frequency	None
Elevation	235–3,000 ft
Slope	2–35%
Water table depth	24–60 in
Aspect	Aspect is not a significant factor

Climatic features

The Northern Blue Ridge, Major Land Resource Area (MLRA) 130A, appears to have three somewhat distinct sections based on PRISM data for average annual precipitation and minimum average annual temperature (PRISM 2013). The northernmost section that runs from Adams County, Pennsylvania south through Washington County, Maryland has an average annual average precipitation of 38 inches (97cm) in the lower elevations up to 50 inches (127 cm) in the higher elevations - about 2000 feet (610m). The average annual minimum temperature is 40 to 44°F (4.4 to 6.7°C). From Washington County, Maryland south to the northern tip of Rappahannock County, Virginia, the average annual precipitation is less variable, ranging from approximately 38 to 42 inches (97 to 107cm). The average annual minimum temperature remains about the same as to the north, 40 to 44°F (4.4 to 6.7°C). The lower third of MLRA 130A starting from northern Rappahannock County down through Bedford County, Virginia receives more moisture and is colder, with average annual precipitation that ranges from 40 (107cm) to greater than 50 inches (127cm) at elevations higher than 2000 feet (610m) which is a significant part of this section of the MLRA. Average minimum temperatures range from 34°F (1.1°C) at elevation greater than 3000 feet (914m) to 38°F (3.3°C) at the lowest elevations, less than 1000 feet (305m).

These three climate regions seem to correspond to differences in elevation and relief. Most of the Blue Ridge ranging from Adams County, Pennsylvania through Maryland to Rappahannock County, Virginia rises no higher than 2000 feet (610m). Much of the Blue Ridge south of and including Rappahannock County rises above 2000 feet up to 4000 feet (610 to 1219m).

The higher elevations interact with moist air that flows inland from the Atlantic Ocean. Along the east coast of the United States, winter storms moving across the continent encounter the warm Gulf Stream waters and begin to track northeastward paralleling the coast. As the moisture-laden air from the storms crosses Virginia, the eastern slopes and foothills of the Blue Ridge receive much of this precipitation (Hayden and Michaels 2017). In addition, the high relief of the mountains intercepts much of any moisture moving inland from the east coast. The Shenandoah Valley which lies just to the west of the Blue Ridge is one of the driest parts of the state of Virginia. Where the Blue Ridge elevation is greater than 2000 feet (610m), the east-facing slopes appear to receive over 50 inches (127cm) of annual rainfall on average while the Valley to the west of the mountains receives less than 38 inches (97 cm), and the mountains' western footslopes receive 2 to 4 inches (5 to 10cm) less of precipitation than the eastern ones (PRISM). This rain shadow effect is not as pronounced where the ridges are below 1640 ft (500m) of elevation.

Currently, the Mixed Metamorphic - Metabasalt Footslopes and Terraces provisional ecological site is mapped throughout the MLRA. Field work is needed to determine if the precipitation and annual average temperature differences are significant enough to cause major shifts in ecological sites from north to south or from east to west

necessitating the further subdivision of broadly mapped PES into more refined climatic groupings.
Data for mean annual precipitation, frost-free and freeze-free periods and monthly precipitation for this ecological site are shown below. The original data used in developing the tables was obtained from the USDA-NRCS National Water & Climate Center (2015) climate information database for 4 weather stations throughout MLRA 130A in proximity to this ecological site. All climate station monthly averages for maximum and minimum temperature and precipitation were then added together and averaged to make this table.

Table 3. Representative climatic features

Frost-free period (average)	169 days
Freeze-free period (average)	187 days
Precipitation total (average)	48 in

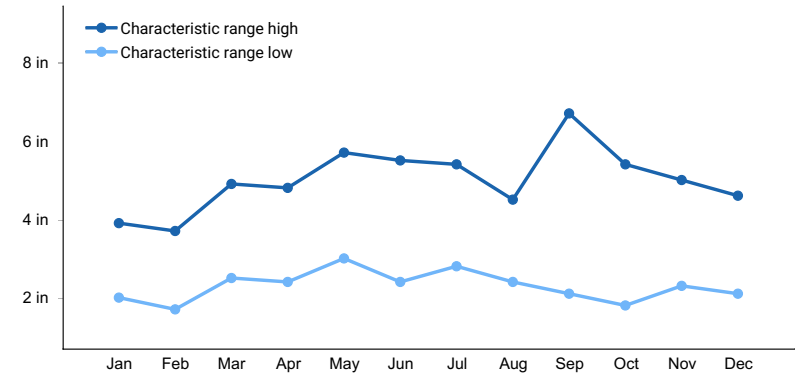

Figure 1. Monthly precipitation range

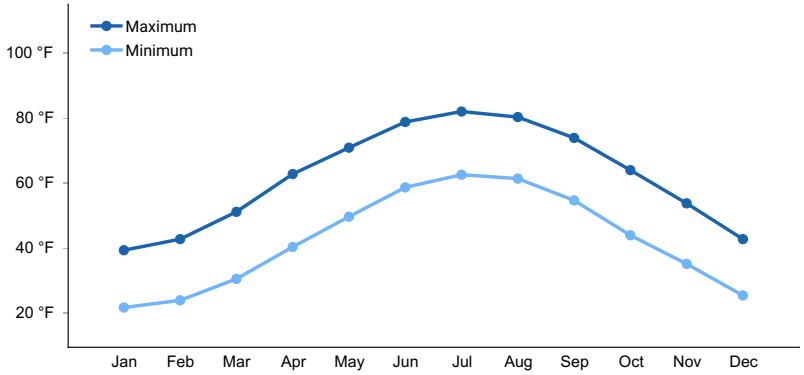

Figure 2. Monthly average minimum and maximum temperature

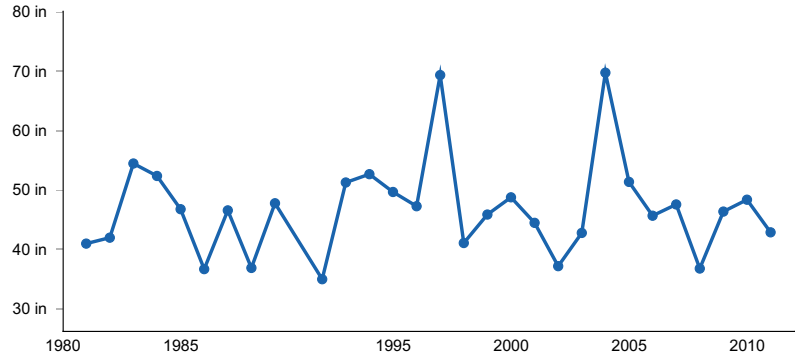

Figure 3. Annual precipitation pattern

Climate stations used

- (1) LURAY 5 E [USC00445096], Luray, VA
- (2) CATOCTIN MTN PARK [USC00181530], Sabillasville, MD

- (3) MT WEATHER [USC00445851], Paris, VA
- (4) BIG MEADOWS [USC00440720], Syria, VA

Influencing water features

This ecological site is not influenced by wetland features. Some areas experience occasional flooding.

Soil features

The soil series associated with this site are: Wintergreen, Vanella, Unison, Tusquitee, Trego, Thurmont, Thunder, Tate, Saunook, Hawksbill, Flairmont, Dyke, Brumbaugh, and Braddock. These soils have weathered from mixed geologies of gneiss, granite, granodiorite, granulite, metabasalt, phyllite, schist, and some quartzite, sandstone, and shale. The soils are mostly derived from material that has moved from upper slopes to lower slope positions, called colluvium. Some of these soils have formed from alluvial sediments that were originally deposited along former floodplains which are now considered upland as the current floodplain has incised downward over geologic time.

Depth to bedrock is over 60 inches (152 cm), but may have a subsurface root restrictive layer called a fragipan within 17 inches (43 cm) of the soil surface. The soils are moderately to well-drained with average water table depth ranging from 24 to 60 inches (61 to 152 cm). Soil permeability is slow to rapid, and soil is very strongly to slightly acid with pH ranging from 4.6 to 6.1. Surface textures are clay loam, sandy loam, loam, silt loam, and silty clay loam. Subsurface texture tends to be clayey. Soils data was obtained from the Natural Resources and Conservation Service (NRCS) National Soils Information System database (USDA 2015).

Table 4. Representative soil features

Parent material	(1) Colluvium–gneiss (2) Alluvium–greenstone
Surface texture	(1) Cobbly silt loam (2) Very cobbly clay loam (3) Extremely stony loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Slow to rapid
Soil depth	17–60 in
Surface fragment cover <=3"	0–65%
Surface fragment cover >3"	0–65%
Available water capacity (0-40in)	3.3–7 in
Soil reaction (1:1 water) (0-40in)	4.6–6.1
Subsurface fragment volume <=3" (Depth not specified)	0–55%
Subsurface fragment volume >3" (Depth not specified)	0–50%

Ecological dynamics

The vegetation groupings described in this section are based on the terrestrial ecological system classification and vegetation associations developed by NatureServe (Comer 2003) and the Natural Heritage Programs of Pennsylvania (Zimmerman et al. 2012), Virginia (Fleming et al. 2013), West Virginia (WVDNR 2014), and Maryland (Harrison 2004). Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. They are intended to provide a classification unit that is readily mappable, often from remote imagery, and readily identifiable by conservation and resource managers in the field. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will

persist for 50 or more years. A vegetation association is a plant community that is much more specific to a given soil, geology, landform, climate, hydrology, and disturbance history. It is the basic unit for vegetation classification. Each association will be named by the dominant species that occupy the different strata (tree, sapling, shrub, and herb). Within the NatureServe database, individual vegetation associations are assigned an identification number called a Community Element Global Code (CEGL). Most of the Information contained in this section was adapted from several sources, including the Nature Conservancy's Northeast Terrestrial and Aquatic Habitat map (Anderson et al., 2013), NatureServe's Ecological Systems of the United States (Comer 2003; NatureServe 2009), and Landfire's Biophysical Settings and Existing Vegetation Type layers (Landfire 2010; Landfire 2013). The USDA Plants database was used to verify species' scientific and common names (USDA, NRCS. 2017).

The characteristic forest system of this ecological site, and in most of the Northern Blue Ridge is the Northeastern Interior Dry-Mesic Oak Forest (NatureServe 2009; Anderson et. al 2013). This is an oak-dominated, mostly closed canopy forest that occurs as a matrix (dominant) type through much of the Appalachians. It occurs at low to mid elevations on gently rolling to steep topography on planar, slightly concave, and slightly convex slopes. Oak species characteristic of dry to mesic conditions and hickories are dominant in mature stands. These may include *Quercus rubra*, *Quercus alba*, *Quercus velutina*, and *Quercus coccinea* (red, white, black, and scarlet oaks) and Carya spp. (hickories). Quercus prinus (Chestnut oak) may be present but is generally less important than other oak species. *Acer rubrum* (Red maple), *Betula lenta* (Sweet birch), and *Betula alleghaniensis* (Yellow birch) may be common associates.

This ecological site also hosts associations within the Southern and Central Appalachian Cove Forest System (NatureServe 2009). Sheltered and concave areas will provide more moisture and shade relative to areas further upslope. Vegetation consists of forests dominated by various combinations of mesophytic (moisture-loving but non wetland) species of primarily deciduous trees. *Liriodendron tulipifera* (Tulip tree), Tilia Americana (American basswood), *Fraxinus americana* (White ash), *Betula lenta* (Sweet birch), *Magnolia acuminata* (Cucumber tree) and *Tsuga canadensis* (Eastern hemlock) are the most frequent dominant canopy species.

Disturbance agents in these forests include fire, wind throw, and ice damage. Gypsy moths can wreak havoc in the oak over story periodically. Oak forests historically have been maintained by periodic fire. Fire suppression since the early 20th century in the eastern United States is believed to be leading to the overall replacement of oaks with fire-sensitive, non-oak species like maples, beeches, birches, tulip poplars, and black cherry (Brose et. al., 2008). Fire dynamics in these lower slope and sheltered areas are not well-known, and probably only occurred in years that were extremely dry, as these areas naturally hold more moisture than upper slopes and ridge tops. Since most of the component species in the cove areas are among the less fire-tolerant, perhaps it can be assumed that fire historically has had only a limited effect on these particular landscapes. Hemlock has been greatly reduced by recent outbreaks of the hemlock woolly adelgid and may be restricted to the understory.

Much of this ecological site has been subjected to human activity including logging, settlement, or other disturbance, therefore many of the forests are mid successional. These ruderal (growing where the natural vegetation has been disturbed by humans) forests and woodlands comprise about 18% of the area and are generally characterized by unnatural combinations of species, primarily native species, though they often contain slight or substantial numbers and amounts of species alien to the region as well. As much as 15 percent of this ecological site has been converted to agricultural use, mainly pasture and hayland (Landfire 2013).

The information presented is representative of very complex vegetation communities. Key indicator plants and ecological processes are described to help inform land management decisions. Plant communities will differ across the major land resource region because of the naturally occurring variability in weather, soils, and aspect. The reference plant community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

State and transition model

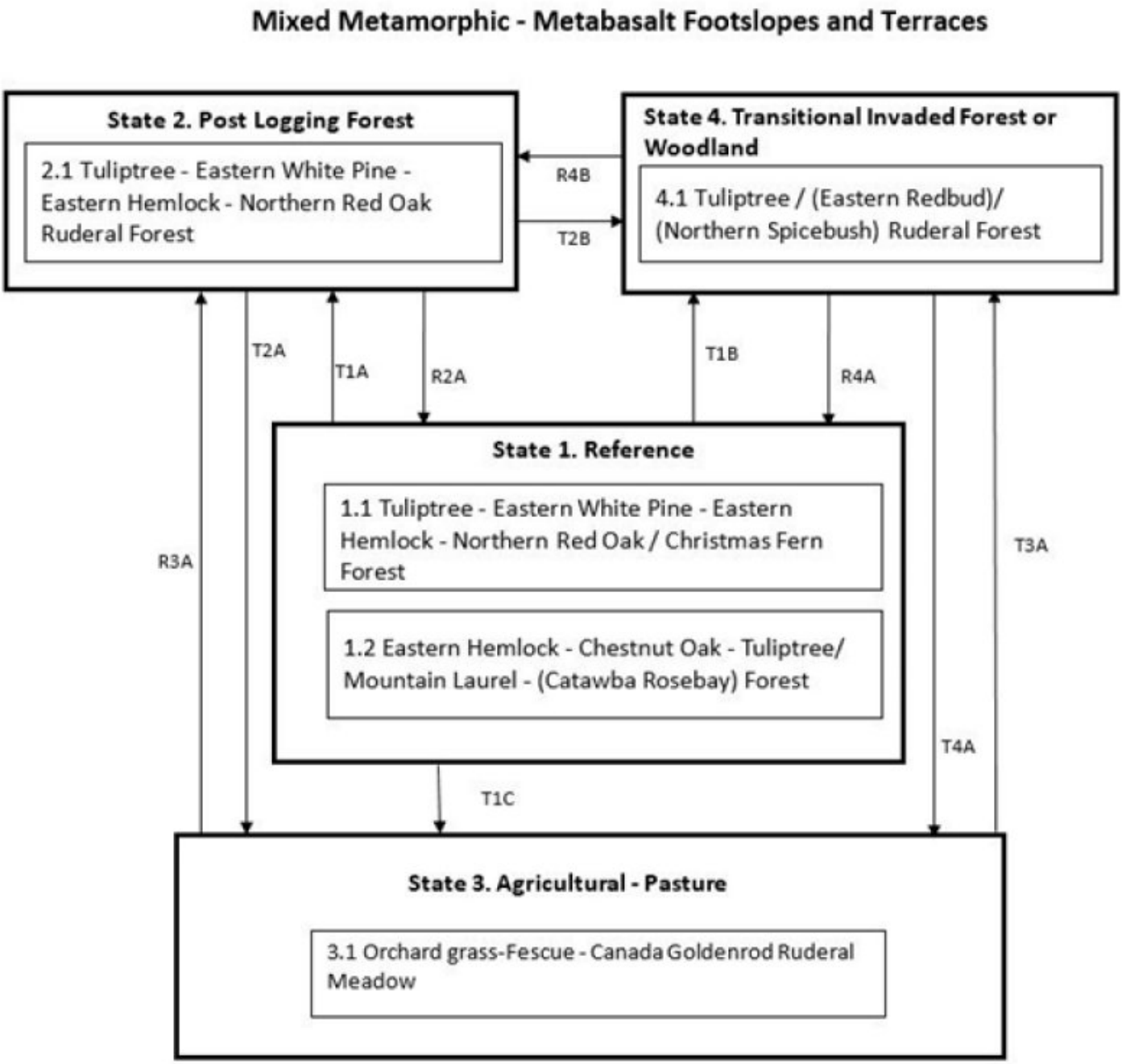

Figure 5. State and Transition Model

Code	Event/Activity
T1A	Logging followed by forest regrowth
T1B	Clearcutting, conversion to pasture, then successional forest regrowth.
T1C	Clearcutting, conversion to pasture, pasture seeding, and grassland management with regular mowing and grazing.

T2A, T4A	Clearcutting, conversion to pasture, pasture seeding, and grassland management with regular mowing and grazing.
T2B	Clearcutting, conversion to pasture, then successional forest regrowth.
R2A	Understory removal to promote growth of oak seedlings; possible use of prescribed fire plan if the desired forest is to be oak dominated.
T3A	Cease mowing and pasture management, exclude grazing, allow natural forest succession.
R3A	Cease mowing and pasture management, exclude grazing, plant native seeds and seedlings, eliminate and manage nonnative species, implement a prescribed fire plan if desired forest is to be oak dominated.
R4A	Remove understory, plant native seeds and seedlings, eliminate and manage nonnative species, implement a prescribed fire plan if desired forest is to be oak dominated.
R4B	Remove understory, plant native seeds and seedlings, eliminate and manage nonnative species, implement a prescribed fire plan if desired forest is to be oak dominated.

Figure 6. Legend

State 1
Reference

The reference forest state is a combination of several vegetation communities within the Northeastern Interior Dry-Mesic Oak Forest and the Southern and Central Appalachian Cove Forest Systems as defined by NatureServe (NatureServe 2009). Due to the long history of human activity, the associations listed below may in reality reflect the current naturalized, minimally managed state rather than the historic, pre-European settlement condition. These

areas will have oak and hickory species characteristic of dry to mesic conditions as well as mesophytic (moisture loving) hardwood or hemlock-hardwood forests. Generally, the drier, convex, slopes will contain more oaks while the sheltered and concave lower slope positions will be dominated by tuliptree, maple, hemlock, basswood, elm, birch, and beech. Vegetation varies according to soil chemistry. The reference communities listed below have been documented on this ecological site and are associated with the Northern Blue Ridge. Due to the heterogeneity and the broadness of this provisional ecological unit, they are not intended to cover every situation nor the full range of conditions and species. There are no transition pathways designated between the two communities in the reference state because the differences in vegetation are more controlled by landscape position than by management or disturbance.

Community 1.1
Liriodendron tulipifera - Pinus strobus -Quercus rubra / Polystichum acrostichoides Forest

The Tuliptree - Eastern White Pine - Eastern Hemlock - Northern Red Oak / Christmas Fern Forest also known as the Central Appalachian Acidic Cove Forest (White Pine - Hemlock - Mixed Hardwoods Type) (CEGL006304; NatureServe 2017) occurs on the lower slopes and bottoms of ravines and coves at lower elevations, generally below 3000 feet (915 m). The overstory is codominated by variable mixtures of *Liriodendron tulipifera* (Tuliptree), *Pinus strobus* (White pine), *Tsuga canadensis* (Eastern hemlock), *Quercus rubra* (Northern red oak), and *Quercus alba* (White oak). This forest generally has a moderate to strong evergreen component, but *Pinus strobus* varies from widely scattered to codominant, and *Tsuga canadensis* has been greatly reduced by recent outbreaks of the hemlock woolly adelgid and may be restricted to the understory. Less frequent overstory associates include *Acer rubrum* (Red maple), *Betula lenta* (Sweet birch), Carya spp. (Hickory), *Fagus grandifolia* (American Beech), Fraxinus Americana (White ash), *Nyssa sylvatica* (Sourgum), and Quercus prinus (Chestnut oak). Characteristic understory species include *Acer pensylvanicum* (Striped maple), *Amelanchier arborea* (Common serviceberry), Cercis Canadensis (Eastern redbud), *Cornus florida* (Flowering dogwood), *Ostrya virginiana* (Hophornbeam), Oxydendrum arboretum (Sourwood), *Viburnum acerifolium* (Mapleleaf viburnum), Rubus spp. (Blackberry), Corylus Americana (American hazelnut), *Hamamelis virginiana* (American witchhazel), *Hydrangea arborescens* (Wild hydrangea), and *Lindera benzoin* (Spicebush). The herb layer is usually patchy to moderately dense. Frequent patch-dominants include *Amphicarpaea bracteata* (Hogpeanut), *Dennstaedtia punctilobula* (Eastern hayscented fern), Eurybia divaricate (White wood aster), and *Polystichum acrostichoides* (Christmas fern). Other constant but low-cover herbs include *Botrychium virginianum* (Rattlesnake fern), *Desmodium nudiflorum* (Nakedflower ticktrefoil), *Dioscorea quaternata* (Fourleaf yam), *Galium triflorum* (Fragrant bedstraw), *Maianthemum racemosum* ssp. Racemosum (Feathery false lily of the valley), *Mitchella repens* (Partridgeberry), and *Stellaria pubera* (Star chickweed). Many additional herbs occur at low constancy.

Community 1.2
Tsuga canadensis - Quercus prinus / Kalmia latifolia - (Rhododendron catawbiense) Forest

The Eastern Hemlock - Chestnut Oak - Tuliptree / Mountain Laurel - (Catawba Rosebay) Forest, also known as the Central Appalachian Acidic Cove Forest (CEGL008512; NatureServe 2017), occurs somewhat locally throughout the Northern Blue Ridge and Ridge and Valley regions of west-central and northwestern Virginia and may extend into West Virginia. Sites are located between 900 and 2500 feet (275 to 760 m) elevation. Stands often occupy elongated, linear patches in mesic ravines with incising first-, second-, and third-order streams. Vegetation is a hemlock-hardwood or mixed hardwood forest that usually, but not always, has a dense evergreen shrub layer. Tsuga Canadensis (Eastern hemlock), Quercus prinus (Chestnut oak), *Liriodendron tulipifera* (Tuliptree), *Acer rubrum* (Red maple), *Betula lenta* (Sweet birch), *Quercus rubra* (Northern red oak), and *Nyssa sylvatica* (Sourgum) are the most characteristic and abundant trees. *Fagus grandifolia* (American beech), *Magnolia acuminata* (Cucumber tree), *Pinus strobus* (Eastern white pine), and *Quercus alba* (White oak) are minor and localized overstory associates. Understory tree layers are mostly composed of younger trees of the canopy species. *Kalmia latifolia* (Mountain laurel), *Hamamelis virginiana* (American witchhazel), and *Acer pensylvanicum* (Striped maple) are the most constant and abundant species of the shrub layer; less frequently *Menziesia pilosa* (Minniebush), *Rhododendron catawbiense* (Catawba rosebay), and rarely *Rhododendron maximum* (Great laurel) may form large colonies. The herb layer is typically sparse, but some stands have substantial cover by the clonal ferns *Dennstaedtia punctilobula* (Eastern hayscented fern) and/or *Thelypteris noveboracensis* (New York fern).

State 2
Post Logging Forest

Community 2.1
Liriodendron tulipifera - Pinus strobus - Tsuga canadensis - Quercus rubra Ruderal Forest

The existence of the Tuliptree - Eastern White Pine - Eastern Hemlock - Northern Red Oak Ruderal Forest (no CEGL currently exists, but assumed it is similar to CEGL006304; NatureServe 2017) alternative state is assumed based on the long settlement history of the Appalachians. The post logging forests are similar to the reference state with the exception that overall species diversity is less and trees are even-aged due to logging. Oak trees, where present are frequently multi-stemmed, resulting from coppicing. Sites are invaded by Rosa Multiflora (multiflora rose), Lonicera spp. (honeysuckle), and other herbaceous invasive species.

State 3
Agricultural - Pasture

Community 3.1
Dactylis glomerata - Festuca spp. - Solidago canadensis Ruderal Mesic Meadow Alliance

The Orchardgrass - Fescue species - Canada Goldenrod Ruderal Mesic Meadow Alliance (A1190, NatureServe 2017) is a broadly defined community which includes mesic abandoned pastures and agricultural fields and is largely composed of non-native cool-season grasses and herbs (generally of European origin) in the early stages of succession. Species composition varies from site to site, depending on land-use history and perhaps soil type, but in general this vegetation is quite wide-ranging in northeastern and midwestern states. Dominant grasses vary from site to site but generally include the exotic grasses *Agrostis stolonifera* (Creeping bentgrass), *Agrostis hyemalis* (Winter bentgrass), *Anthoxanthum odoratum*, (Sweet vernalgrass), *Bromus inermis* (Smooth Brome), *Bromus tectorum* (Cheatgrass), *Dactylis glomerata* (Orchardgrass), Schedonorus arundinaceum (Tall fescue), *Lolium perenne* (Perennial ryegrass), Phleum pretense (Timothy) as well as weedy natives such as *Elymus repens* (Quackgrass), *Poa pratensis* (Kentucky bluegrass), and, less commonly, *Schizachyrium scoparium* (Little bluestem). Herbaceous species may be minor or dominant and include various Solidago spp. (goldenrods), Symphyotrichum spp. (Asters), and other native and non-native species. At least 15% of the Mixed Metamorphic-Metabasalt Footslopes and Terraces provisional ecological site is in agricultural use, mostly pasture and hayland (Landfire 2013).

State 4
Transitional Invaded Forest or Woodland

Community 4.1
Liriodendron tulipifera Ruderal Forest

The Tuliptree Ruderal Forest (combination of several CEGL associations) is an early successional community dominated by Liriodentron tulipifera (Tuliptree) that occurs on sites that are becoming reforested after having been logged, cleared for agriculture, or otherwise heavily disturbed in the past. A slightly rich variant of this forest type has been documented on the Mixed Metamorphic-Metabasalt Footslope and Terraces ecological site. Recorded canopy species include *Liriodendron tulipifera* (Tuliptree), *Acer saccharum* (Sugar maple), *Carya cordiformis* (Bitternut hickory), and *Robinia pseudoacacia* (Black locust). Subcanopy species include *Acer pensylvanicum* (Striped maple), *Carpinus caroliniana* (American hornbeam), *Quercus rubra* (Northern red oak), *Acer rubrum* (Red maple), Fraxinus Americana (White ash), *Fagus grandifolia* (American beech), *Acer saccharum*, *Cercis canadensis*, *Nyssa sylvatica* (Sourgum), Tsuga Canadensis (Eastern hemlock), *Tilia americana* (American basswood), and *Ulmus rubra* (Slippery elm). Shrub and sapling species include *Sassafras albidum* (Sassafras), Ulmus Americana (American elm), *Celtis occidentalis* (Common hackberry), *Lindera benzoin* (Spicebush), *Cornus alternifolia* (Alternateleaf dogwood), *Cornus florida* (flowering dogwood), *Magnolia tripetala* (Umbrella tree), and *Viburnum acerifolium* (Mapleleaf viburnum). Herbaceous species and vines include *Rubus phoenicolasius* (Wine raspberry), *Rubus occidentalis* (Black raspberry), *Toxicodendron radicans* (Poison ivy), *Parthenocissus quinquefolia* (Virginia creeper), *Vitis vulpina* (Frost grape *Smilax rotundifolia* (roundleaf greenbriar), *Polystichum acrostichoides*, *Viola pubescens*/pensylvanica (downy yellow violet), *Galearis spectabilis* (Showy orchid), Galium lanceolaturm (Lanceleaf wild licorice), *Galium triflorum* (Fragrant bedstraw) and more. Nonnative species like *Alliaria petiolata* (Garlic mustard), *Microstegium vimineum* (Nepalese browntop), and Polygonum caespitosum (Oriental lady's thumb), can be abundant in this disturbed forest type. These forests are often young and resulted from the colonization of old agricultural fields by woody species. Recent disturbance or abundant invasive species can give

these forest stands a weedy character.

Transition T1A
State 1 to 2

Logging, but no agricultural conversion. Trees are allowed to stump sprout, soil is minimally disturbed, seed bank remains. Fire suppression allows fire sensitive species like tuliptree, red maple, and birches to out compete oak seedlings in the understory.

Transition T1C
State 1 to 3

Logging, clearing, and then planting of non-native pasture grass mixes, and grazing. Maintenance with periodic mowing to prevent trees and shrubs from reestablishing.

Transition T1B
State 1 to 4

Logging followed by agricultural conversion. Soil surface is disturbed by tillage or clearing of tree stumps and vegetation. Colonization by successional species is allowed. Field is then abandoned. If surrounding forests are still intact, they can provide native seed sources. If surrounding forests are not intact, or area is surrounded by agriculture, or other human development, nonnative species may become dominant.

Restoration pathway R2A
State 2 to 1

Control of understory to allow oak seedling recruitment. Prescribed fire will further advance the growth of oaks over fire sensitive species.

Conservation practices

Brush Management
Prescribed Burning
Tree/Shrub Establishment
Early Successional Habitat Development/Management
Forest Stand Improvement
Invasive Plant Species Control
Forest Management Plan - Written
Herbaceous Weed Control

Transition T2A
State 2 to 3

Logging, clearing, and then planting of non-native pasture grass mixes, and grazing. Maintenance with periodic mowing to prevent trees and shrubs from reestablishing.

Transition T2B
State 2 to 4

Logging followed by agricultural conversion. Soil surface is disturbed by tillage or clearing of tree stumps and vegetation, and allows colonization by successional species. Field is then abandoned. If surrounding forests are still intact, they can provide native seed sources. If surrounding forests are not intact, or area is surrounded by agriculture, or other human development, nonnative species may become dominant.

Restoration pathway R3A
State 3 to 2

Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. If using acorns, direct seeding must be done fairly heavily. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance. These communities are distinctly different from the reference forest state (Dyer, 2010).

Transition T3A
State 3 to 4

Abandonment of pasture or old field. Discontinue mowing and do not allow grazing. Allow natural regeneration.

Restoration pathway R4A
State 4 to 1

Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. If using acorns, direct seeding must be done fairly heavily. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance. These communities are distinctly different from the reference forest state (Dyer, 2010).

Restoration pathway R4B
State 4 to 2

Return to the reference or post logged minimally managed state may require a very long term series of costly management options and stages. Many species may need to be planted or seeded to restore the system. If using acorns, direct seeding must be done fairly heavily. Herbivory can be a problem as well as competition from faster growing species. Depending on the existing seed bank and the proximity of a mature forest from which to recruit seeds, ruderal forests may regain a mixed forest stand. Nevertheless, sites that have been cleared and tilled have significant soil disturbance which may include compaction, erosion, loss of native soil structure, loss of soil organic matter, disruption of soil microorganisms, all which affect the soil's nutrient availability and water holding capacity (Duiker and Myers, 2005). These characteristics favor recolonization by plant species that have wind dispersed seeds (verses those that propagate through underground roots called rhizomes, or which have heavy seeds that stay near the parent tree), are shade intolerant, have rapid to moderate growth rates, and drought tolerance. These communities are distinctly different from the reference forest state (Dyer, 2010).

Transition T4A
State 4 to 3

Logging, clearing, and then planting of non-native pasture grass mixes, and grazing. Maintenance with periodic mowing to prevent trees and shrubs from establishing.

Additional community tables

Other references

Anderson, M.G. M. Clark, C.E. Ferree, A. Jospe, A. Olivero Sheldon and K.J. Weaver. 2013. Northeast Habitat Guides: A companion to the terrestrial and aquatic habitat maps. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. http://nature.ly/HabitatGuide.

Bailey, Robert G. 1995. Description of the ecoregions of the United States 2d ed. Rev. and expanded (1st ed. 1980). Misc. Publ. No. 1391 (rev.), Washington, DC: USDA Forest Service. 108p. with separate map at 1:7,500,000.

Barnes, John H. and W.D. Sevon, The Geological Story of Pennsylvania, Pennsylvania Geological Survey Fourth Series, Harrisburg, 2002.

Brose, P. H., K.W. Gottschalk, S. B. Horsley, P.D. Knopp, J. N. Kochenderfer, B. J. McGuinness, G.W. Miller, T.E. Ristau, S. H. Stoleson, and S.L. Stout. 2008. Prescribing regeneration treatments for mixed-oak forests in the Mid-Atlantic region. Gen. Tech. Rep. NRS-33. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 100 p.)

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K., Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia.

Duiker, S. W. and J.C. Myers, 2005. Better Soils with the NoTill System, A Publication to Hellp Farmers Understand the Effect of No-Till Systems of the Soil. USDA Natural Resources Conservation Service.

Dyer, James, M. 2010. Land-use legacies in a central Appalachian forest differential response of trees and herbs to to historic agricultural practices. Applied Vegetation Science 13:195-206.

ESRI, arcgisonline.com/maps/World_Topo_Map, accessed April 3, 2017.

Fichter, Lynn S. and Steve J. Baedke, Structural Cross Section Through the Blue Ridge Province in Central Virginia, last modified September 13, 2000, http://csmres.jmu.edu/geollab/vageol/vahist/blurdgdiv.html.

Fleming, G.P., K.D. Patterson, K. Taverna, and P.P. Coulling. 2013. The natural communities of Virginia: classification of ecological community groups. Second approximation. Version 2.6. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Harrison, J.W. 2004. Classification of vegetation communities of Maryland: First iteration. NatureServe and Maryland Natural Heritage Program, Wildlife and Heritage Service, Maryland Department of Natural Resources. Annapolis, MD.

Hayden, Bruce P. and Patrick J. Michaels, “Virginia’s Climate.” Accessed April 5, 2017, http://climate.virginia.edu/description.htm.

LANDFIRE: LANDFIRE Biophysical Settings. (2010, January 01 - last update). U.S. Department of Interior, Geological Survey. [Online]. Available: http://landfire.cr.usgs.gov/viewer/ [2015, June 5].

LANDFIRE: LANDFIRE Existing Vegetation Type Layer. (2013, June – last update). U.S. Department of Interior, Geological Survey. [Online]. Available: https://landfire.cr.usgs.gov/viewer/[2015, June 5].

Latham, R. E., J. Beyea, M. Benner, C. A. Dunn, M. A. Fajvan, R. R. Freed, M. Grund, S. B. Horsley, A. F. Rhoads and B. P. Shissler. 2005. Managing White-tailed Deer in Forest Habitat From an Ecosystem Perspective: Pennsylvania Case Study. Report by the Deer Management Forum for Audubon Pennsylvania and Pennsylvania Habitat Alliance, Harrisburg. xix + 340 pp.

NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 06 February 2009.

NatureServe 2017. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: June 2017).

PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created February 26, 2013.

United States Department of Agriculture, Natural Resources Conservation Service, 2015. National Soils Information System.

United States Department of Agriculture, Natural Resources Conservation Service, National Water and Climate Center, http://www.wcc.nrcs.usda.gov, Accessed February 2015.

United States Department of Agriculture, Natural Resources Conservation Service, 2006. Land Resource Regions and Major land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296, 669p.

USDA, NRCS. 2017. The PLANTS Database (http://plants.usda.gov, 20 July 2017). National Plant Data Team, Greensboro, NC 27401-4901 USA.

United States Environmental Protection Agency, 2013, Level III ecoregions of the continental United States: Corvallis, Oregon, U.S. EPA National health and Environmental Effects Research Laboratory, map scale 1:7,500,000, http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm.

Woods, A.J., J.O. Omernik, D.D. Brown, C.W. Kiilsgaard. 1996. Level IV Ecoregions of EPA Region 3. US Environmental Protection Agency National Health and Environmental Effects Research Laboratory, Corvallis, Oregon. Map scale 1:250,000.

WVDNR [West Virginia Division of Natural Resources]. 2014. Plots2-WV database of community ecology plots. West Virginia Natural Heritage Program, WVDNR, Elkins, WV.

Zimmerman, E., T. Davis, G. Podniesinski, M. Furedi, J. McPherson, S. Seymour, B. Eichelberger, N. Dewar, J. Wagner, and J. Fike (editors). 2012. Terrestrial and Palustrine Plant Communities of Pennsylvania, 2nd Edition. Pennsylvania Natural Heritage Program, Pennsylvania Department of Conservation and Natural Resources, Harrisburg, Pennsylvania.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

   _____

2. **Presence of water flow patterns:**

   _____

3. **Number and height of erosional pedestals or terracettes:**

   _____

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

   _____

5. **Number of gullies and erosion associated with gullies:**

   _____

6. **Extent of wind scoured, blowouts and/or depositional areas:**

   _____

7. **Amount of litter movement (describe size and distance expected to travel):**

   _____

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

   _____

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

   _____

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

    _____

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

    _____

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

    _____

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

---

17. **Perennial plant reproductive capability:**
