USDA Natural Resources Conservation Service

Ecological site F127XY003WV
Acidic Shale Upland Oak/Heath

Accessed: 05/02/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 127X–Eastern Allegheny Plateau and Mountains

The Acidic Shale Upland Oak/Heath site occupies the Allegheny Mountain Section of the Appalachian Highlands of the Appalachian Plateau Province. The deeply dissected plateau in this area terminates in a high escarpment, the Allegheny Front, in the eastern part of the area. Steep slopes are dominant, but level to gently rolling plateau remnants are conspicuous in the northern part of the area. The area is dominantly forest, containing large blocks of state forest, game lands, and national forest. Less than one-tenth of the MLRA consists of urban areas.

Classification relationships

Natureserve system: Alleghany-Cumberland Dry Oak Forest and Woodland (CES202.359)

This site correlates to Natureserve/USNVC association CEGL005023
Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia) Forest

Ecological site concept

This chestnut oak - mixed oak forest community is found in the Allegheny Plateau region of West Virginia. Stands occur on upper slopes and narrow ridgetops. Soils are shallow to moderately deep and occur over non-calcareous bedrock of sandstone, or shale. Tree species commonly include Quercus prinus and *Quercus coccinea*, along with *Quercus alba*, *Quercus rubra*, and *Quercus velutina*. *Castanea dentata* was a major component in the past and may be evident as root sprouts and/or decaying stumps and logs. Other associates can include Acer rubrum var. rubrum, Carya alba, Nyssa sylvatica, Oxydendrum arboreum, and occasional Pinus spp. (Pinus echinata, Pinus rigida, Pinus virginiana). Tall shrubs and small trees can include Cornus florida, Sassafras albidum, and Viburnum acerifolium. Characteristic dwarf-shrubs and vines include Gaylussacia baccata, Gaultheria procumbens, Smilax glauca, Smilax rotundifolia, Vaccinium pallidum, Vaccinium stamineum, and, more locally, Kalmia latifolia. The herbaceous layer includes Antennaria plantaginifolia, Symphyotrichum cordifolium (= Aster cordifolius), Carex pensylvanica, Cypripedium acaule, Danthonia spicata, Epigaea repens, Helianthus divaricatus, Helianthus hirsutus, Dichanthelium dichotomum (= Panicum dichotomum), Polystichum acrostichoides, and others. Lichens (Cladina spp. and Cladonia spp.) and mosses can form a prominent layer.

Table 1. Dominant plant species

Tree	(1) *Quercus montana* (2) *Quercus rubra*
Shrub	(1) *Vaccinium* (2) *Kalmia latifolia*
Herbaceous	(1) *Gaultheria procumbens* (2) *Danthonia spicata*

Physiographic features

This area is generally composed of mountain ranges oriented in a northeast-southwest direction, with deep valleys intervening. The area of the site terminates in the eastern part in a high escarpment known as the Allegheny Front. Steep slopes are dominant but level to gently rolling plateau remnants are present. Water table at this site is deeper than 60 inches and the site both receives and generates runoff.

Table 2. Representative physiographic features

Landforms	(1) Interfluve (2) Mountain slope (3) Mountain
Flooding frequency	None
Ponding frequency	None
Elevation	549–1,036 m
Slope	15–65%
Water table depth	152–251 cm
Aspect	Aspect is not a significant factor

Climatic features

On many days in a normal winter there is no snow cover, but some years the ground is snow covered all winter. Cloudiness is more common than clear skies. About 81 days per year have clear skies, 196 days are cloudy, and the rest partly cloudy. In valleys, fog is prevalent in summer and fall. Rainfall is heaviest in summer and lowest in the fall. Westerly winds prevail in all months of the year except August when southwesterly winds prevail. Damaging windstorms are rare.

Table 3. Representative climatic features

Frost-free period (average)	140 days
Freeze-free period (average)	161 days
Precipitation total (average)	1,219 mm

Climate stations used

- (1) ELKINS RANDOLPH CO AP [USW00013729], Elkins, WV

Influencing water features

This site is not directly influenced by water from wetland or stream

Soil features

The soils of this site are dark grayish brown, shallow to moderately deep silt loams and loams and are represented by the Inceptisol soil order. Sandstone and shale fragments and rocks occur in the profile in quantities high enough to classify as skeletal. Rock fragments and bedrock outcrop occur on the soil surface, but not to the extent that they impair the production of native vegetation. Plant-soil moisture relationships are adequate for adapted plants. In healthy condition, rills, gullies, wind scoured areas, pedestals, and soil compaction layers are not present on the site.

Figure 6. Berks scale centimeters

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone and shale
Surface texture	(1) Channery silt loam (2) Very channery loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Soil depth	25–102 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–3%
Available water capacity (0-101.6cm)	2.29–9.4 cm
Soil reaction (1:1 water) (0-101.6cm)	3.3–5.2
Subsurface fragment volume <=3" (Depth not specified)	15–60%
Subsurface fragment volume >3" (Depth not specified)	5–40%

Ecological dynamics

The information contained in the State and Transition Model (STM) and the Ecological Site Description was developed using historical data, professional experience, and scientific studies. The information presented is representative of a very complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals and ecological processes are described to inform land management decisions.

The Acidic Shale Upland Oak/Heath is a chestnut oak - mixed oak forest community is found in the Allegheny Plateau and mountains region of West Virginia. Stands currently occur on dry upper slopes with southerly aspects and narrow ridgetops. Soils are shallow to moderately deep and occur over non-calcareous bedrock of sandstone or shale. Tree species commonly include Quercus montana, and *Quercus coccinea*, along with *Quercus alba*, *Quercus rubra*, and *Quercus velutina*. *Castanea dentata* was a major component in the past and may be evident as root sprouts and/or decaying stumps and logs.

This oak-dominated forests is currently prominent on xeric, infertile upland sites. In some cases, these communities have replaced former mixed oak - American chestnut (*Castanea dentata*) forests following the decimation of chestnut overstory trees by an introduced fungal blight (Cryphonectria parasitica) early in the twentieth century. All have soils with a distinctly oligotrophic nutrient regime, i.e. strongly acidic, with low base cation levels and relatively high levels of iron. Accumulations of duff (Oi horizons) and high biomass of inflammable shrubs in these forests make them susceptible to periodic fires, which in turn favors recruitment of oaks.

Fire was widespread and frequent throughout much of the eastern United States before European settlement (Pyne 1982, Abrams 1992). Widespread burning created a mismatch between the physiological limits set by climate and the actual expression of vegetation, a common phenomenon throughout the world (Bond et al. 2005). In the eastern United States, specifically the area of this ESD, presettlement vegetation types were principally pyrogenic; that is, they formed systems assembling under and maintained by recurrent fire (Frost 1998, Wade et al. 2000). Thomas-Van Gundy and Nowacki (2013) mapped fire-adapted traits across a landscape by categorizing trees into two classes, pyrophiles and pyrophobes, and applying this classification to a geospatial layer of witness-tree points centered on the Monongahela National Forest, West Virginia. The location of this ESD is mapped as pyrophitic.

Presettlement fire regimes produced low- to mixed-severity surface burns, which maintained the vast expanses of oak and pine forests that dominated much of the eastern United States, often in open “park-like” conditions (Wright and Bailey 1982, Frost 1998). Native Americans were the primary ignition source in many locations, given the moist and humid conditions of the East (Whitney 1994). Historical documents indicate that Native American ignitions far outnumbered natural causes (principally lightning) in most locations (Gleason 1913, DeVivo 1991). Native Americans actively managing the environment with fire over millennia (Sauer 1975, Guyette et al. 2006).

Fire regimes began to reduce with the onset of fire-suppression policies in the 1920s. As a result of these policies, fire declined through effective wildfire detection and universal containment. This wholesale shift in fire regimes had unforeseen ecological consequences across the United States. A cascade of compositional and structural changes took place whereby open lands (grasslands, savannas, and woodlands) succeeded to closed-canopy forests, followed by the eventual replacement of fire-dependent plants by shade-tolerant, fire-sensitive vegetation. This trend continues today with ongoing fire suppression (Nowacki and Abrams 2008).

In eastern Kentucky, Delcourt et al. (1998) linked Native American use of fire to the dominance of oak–hickory forests starting 3000 yr ago (also see Ison 2000). White's (2007) recent analysis of pollen and charcoal deposits in a West Virginia cave suggests an increase in fire in that location beginning 4000 yr BP and lasting until the arrival of Europeans. Here too, Native Americans were implicated (see also Springer 2010 and 2012). In the only additional soil charcoal study in the southern portion of the Eastern Deciduous Biome, Hart et al. (2008) describe a comparable range of fire occurrence (five fire events spanning 6785 to 174 yr BP) in a hardwood deciduous forest on the Cumberland Plateau of middle Tennessee.

Abrams(2005) documented what he believes are stands representative of oak forests throughout much of the eastern oak forests. Fire history and dendroecology (tree ring) were investigated for two stands in an old-growth, mixed-oak stands in western Maryland (see Shumway et al. 2001). "Basal cross-sections were obtained from a partial timber cut in 1986, which provided evidence of 42 fires from 1615 to 1958. Fires occurred on average every 8 years during the presettlement (1600 –1780) and early postsettlement (1780 –1900) periods. These included seven major fires year in which 25% of the sample trees were scarred in a given year. No major fire years occurred after 1900, and no fires were recorded after 1960. The South Savage stand had a larger component of older trees, including a 409-year-old white oak, and exhibited continuous recruitment of oaks from the late 1500s until 1900. White oak and chestnut oak dominated recruitment from 1650 to 1800, whereas red oak and black oak dominated recruitment from 1800 to 1900. The lack of red oak and black oak recruitment prior to 1800 may be due to their relatively short longevity at the site. However, the large reduction in white oak and chestnut oak recruitment after 1800 is difficult to explain, although they might have been out-competed by the other oaks. After 1900, the only oak species to recruit in significant numbers was red oak, and this was associated with the loss of overstory chestnut from the blight" (from Abrams 2005).

State and transition model

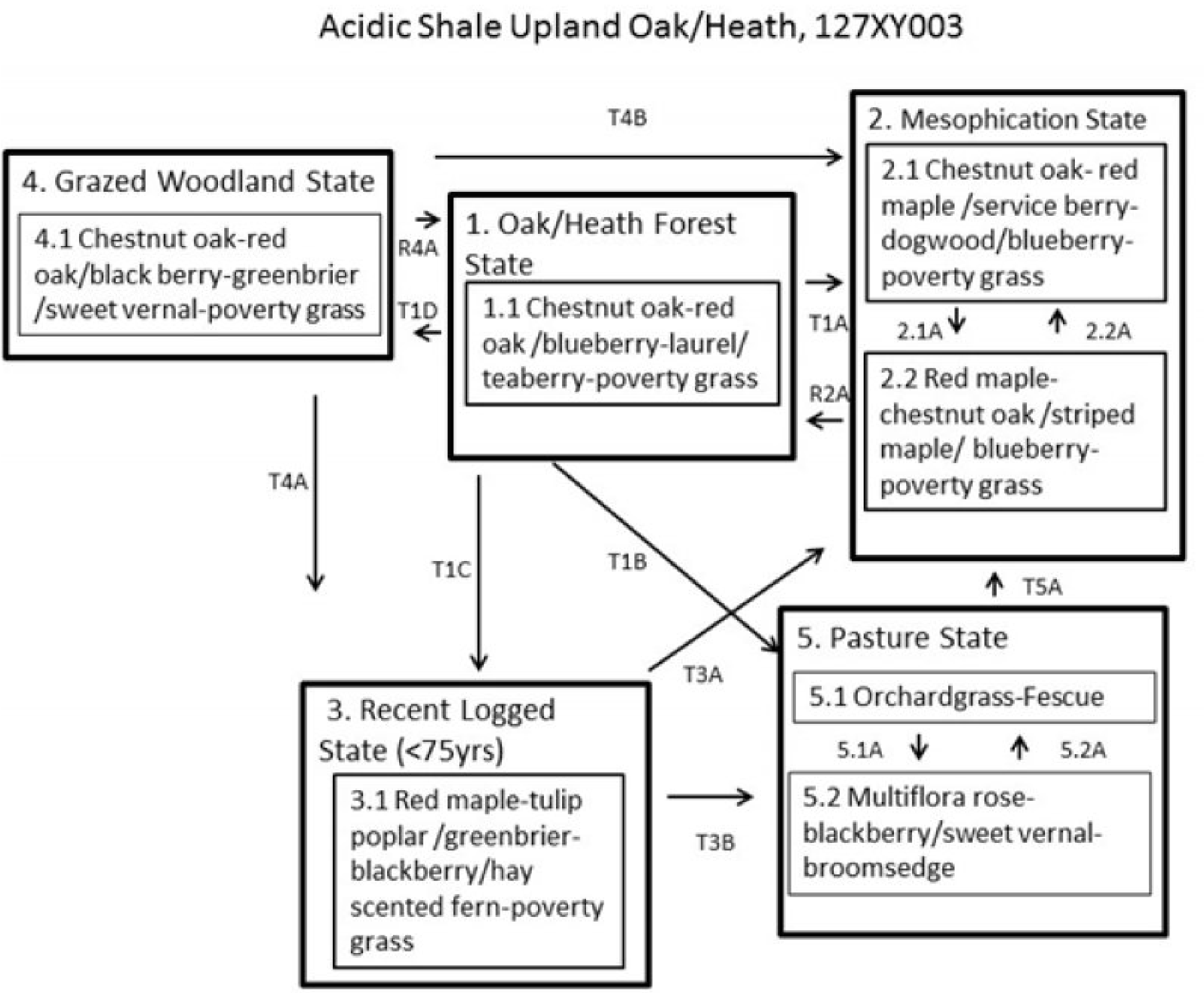

Figure 7. Acidic Shale Upland Oak/Heath

T1A absence of fire and/or disturbance for 100+ years; T1B tree clearing and pasture species planting/recruitment;T1C logging without fire <75 years; T1D Partial canopy tree removal pasture species planting/recruitment; T3A mesophitic tree (i.e. maple) regeneration; T3B pasture species planting/recruitment T4A logging and removal of trees; T4B maple invasion into the site; T5A maple invasion of pasture; R2A harvest/removal of maple reintroduction of fire; R4A removal of grazers (browsers), reintroduce fire; 2.1A Increase of red maple overstory over time, mesophication of shrub layer; 2.2A harvest red maple overstory shrub layer recruitment of xeric-mesic species; 5.1A reduction in stocking rate 5.2A mowing/herbicide Treatment soil fertility improvement, managed grazing.

Figure 8. Acidic Shale Upland Oak/Heath Legend

State 1
Reference State Oak-Heath

The reference state for this ecological site is characterized by a closed-canopy hardwood forest dominated by oaks. Maintenance of this state requires that oak species occur in multiple age classes. In many situations red maple, sugar maple and American beech are colonizing the midstory and understory. A species composition shift toward these more mesophytic species is widely recognized throughout the eastern United States (McEwan et al. 2011). The reference state described represents a condition dependent on complex, multiple disturbances. In order to get oak to succeed and recruit into the next stand, advanced oak regeneration must be present before a major canopy disturbance. Oaks must be able to reach a size that is competitive via canopy disturbance (through smaller-scale clear cuts or fire or herbicide of midstory, and/or tree planting with vigorous seedlings/saplings). There may need to be multiple disturbances to eliminate competition.

Community 1.1
Chestnut oak-red oak /blueberry-laurel/ teaberry-poverty grass

Figure 9. Oak/Heath Forest

Without management, stands may succeed to a more mesophytic forest type dominated by shade tolerant species (i.e. maples and American beech) (Nowacki and Abrams, 2008). Dendroecology studies in old-growth forest stands indicate that oak species have dominated stands for the past 300 years. Researchers speculate that the recent proliferation of maples in the understory will inhibit regeneration of oak under the current disturbance regime (Hart et al. 2012). Oak can regenerate in canopy gaps formed by uprooted trees, but only on very dry sites, indicating that gap-phase dynamics will favor maple overall (Hart and Kupfer 2011). The American chestnut was an important part of this ecological site prior to decimation by the chestnut blight but it is unclear how abundant it would have been. Colloquial estimates based on local names like "Chestnut Ridge" indicate that it may have been prolific.

Forest overstory. Tree species commonly include Quercus prinus and Quercus coccinea, along with Quercus alba, Quercus rubra, and Quercus velutina. Other associates can include Acer rubrum , Carya alba, Nyssa sylvatica. Tall shrubs and small trees can include Cornus florida, Sassafras albidum, and Viburnum acerifolium.

Forest understory. Characteristic dwarf-shrubs and vines include Gaylussacia baccata, Gaultheria procumbens, Smilax glauca, Smilax rotundifolia, Vaccinium pallidum, Vaccinium stamineum, and, more locally, Kalmia latifolia. The herbaceous layer includes Antennaria plantaginifolia, Symphyotrichum cordifolium (= Aster cordifolius), Carex pensylvanica, Cypripedium acaule, Danthonia spicata, Epigaea repens, Helianthus divaricatus, Helianthus hirsutus, Dichanthelium dichotomum (= Panicum dichotomum), Polystichum acrostichoides, and others. Lichens (Cladina spp. and Cladonia spp.) and mosses can form a prominent layer.

Table 5. Soil surface cover

Tree basal cover	2-4%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	0-1%

Biological crusts	0%
Litter	40-90%
Surface fragments >0.25" and <=3"	2-15%
Surface fragments >3"	2-10%
Bedrock	0.0-0.1%
Water	0%
Bare ground	0-1%

Table 6. Woody ground cover

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	1-2%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	1-3%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	1-3%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	1-4%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	1-6%
Tree snags** (hard***)	–
Tree snags** (soft***)	–
Tree snag count** (hard***)	2-99 per hectare
Tree snag count** (hard***)	0-49 per hectare

*** Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.**

**** >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.**

***** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.**

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	0-1%	0-1%	0-2%	0-1%
>0.15 <= 0.3	0-1%	1-20%	0-1%	0-2%
>0.3 <= 0.6	0-1%	1-20%	0-1%	0-1%
>0.6 <= 1.4	0-1%	1-10%	0-1%	0-1%
>1.4 <= 4	5-10%	0-2%	–	–
>4 <= 12	5-20%	–	–	–
>12 <= 24	25-75%	–	–	–
>24 <= 37	0-20%	–	–	–
>37	–	–	–	–

State 2
Mesophication State

This site is resultant of micro environmental conditions (cool, damp, and shaded conditions; less flammable fuel beds) continually improving for shade-tolerant mesophytic species (i.e. maples) and deteriorate for shade-intolerant, fire-adapted species (i.e. oaks). As a result of abandonment of extensive woodland grazing, and the industrialization of timber harvest in the 1880's, the use of fire to maintain woodland pasture was largely abandoned. Fire-suppression policies in the 1920s resulted in additional compositional and structural changes and these sites are on a trajectory towards the eventual replacement of fire-dependent plants by shade-tolerant, fire-sensitive vegetation. This trend continues today with ongoing fire suppression. Historic oak forests in MLRA 127 have had “multiple interacting ecosystem drivers” (McEwan and others 2011) including decades of fire suppression and increasing deer herbivory that have facilitated the proliferation of shade-tolerant, fire-intolerant species into historically oak-dominated stands (Abrams 1992). In many stands red maple dominates the seedling and sapling pool beneath the oak overstory (Abrams 1998). Oak seedlings, which have relatively high light requirements and a conservative growth strategy, require periodic disturbances to open the canopy and promote height growth (Abrams 1992). In an undisturbed understory, shade-tolerant, fast-growing species like red maple outcompete oaks (Lorimer 1984). Although overstory oaks still dominate stands in eastern forests, many researchers predict a compositional shift following mortality of the current canopy dominants in the absence of successful restoration attempts (Goins et al. 2013). Numerous attempts have been made to restore fire to these forests and halt compositional changes, but results are highly site-specific and largely inconclusive (Arthur et al. 2012). Brose et al. (2014) provides and synthesis of the fire oak literature and guidelines for using fire in oak ecosystems.

Community 2.1
Chestnut oak- red maple /service berry-dogwood/blueberry-poverty grass

This phase is characterized by canopy dominance of chestnut oak, but has a major canopy component of red maple. The shrub layer shows a mix of xerotropic and mesotrophic species. This phase is maintained in the absence of fire by being located on shallower soil on steep convex south aspects. Extended periods of drought may favor this phase. Red maple can influence its surrounding environment via a suite of mechanisms: Decreased fuel loads and higher fuel moisture associated with increased red maple cover could decrease forest flammability, whereas decreased N availability could hinder growth of plants with higher N requirements than red maples. All these changes could feed back to exacerbate red maple proliferation and the mesophication of this phase. (Alexander and Arthur 2014)

Community 2.2
Red maple-chestnut oak /stripped maple/ blueberry-poverty grass

This phase is characterized by canopy domminance of red maple, but has a major canopy component of chestnut oak. The shrub layer shows mesotrophic species. This phase is maintained in the absence of fire by being located on moderately deep soil on steep linear south aspects and north aspect slopes. Red maple can influence its surrounding environment via a suite of mechanisms: Decreased fuel loads and higher fuel moisture associated with increased red maple cover could decrease forest flammability, whereas decreased N availability could hinder growth of plants with higher N requirements than red maples. All these changes could feed back to exacerbate red maple proliferation and the mesophication of this phase. (Alexander and Arthur 2014) As red maple grows to maturity and dominates the canopy, this phase may reach a tipping point, where restoration via prescribed fire or other stand management techniques is impossible (Abrams 2005; Nowacki and Abrams 2008).

Pathway 2.1A
Community 2.1 to 2.2

When average precipitation is greater than normal during several growing seasons red maple can gain canopy dominance. Under reduced light conditions, fire-adapted species perform poorly in the understory and increasingly give way to shade-tolerant species.

Pathway 2.2A
Community 2.2 to 2.1

Harvest of red maple and a fire could set this community on a differennt trajectory.

State 3
Recent Logged State (<75yrs)

Forests in this state have often been logged using diameter-limit cut methods multiple times in most cases. This results in a stand with mesophytic species (i.e. maple and tulip poplar)composition, low vigor and poor health. The genetic quality of the forest has been depleted due to the best trees being taken out over time. While oak species may be present in this state, microenvironmental conditions (cool, damp, and shaded conditions; less flammable fuel beds) continually improve for shade-tolerant mesophytic species and deteriorate for shade-intolerant, fire-adapted species. As a result of fire-suppression policies in the 1920s compositional and structural changes took place and sites succeeded to closed-canopy forests, followed by the eventual replacement of fire-dependent plants by shade-tolerant, fire-sensitive vegetation. This trend continues today with ongoing fire suppression.

Community 3.1
Red maple-tulip poplar /greenbrier-blackberry/hay scented fern-poverty grass

Canopies in the logged state are generally thick enough to prevent adequate oak regeneration; more shade tolerant species such as red maple and tulip poplar will predominate. Oak species that remain are typically of low genetic quality in terms of timber. Stands that have had multiple entries have a conspicuous lack of oak.

State 4
Grazed Woodland State

Scattered, open-grown oaks with large, spreading branches are characteristic. Woodlands have a closed overstory of trees but maintain an open understory. This allows enough sunlight to reach the ground to favor a group of sedges, grasses, low shrubs and wildflowers that do best in a woodland environment. Fire was widespread and frequent throughout much of the eastern United States before European settlement (Pyne 1982, Abrams 1992). Widespread burning created a mismatch between the physiological limits set by climate and the actual expression of vegetation—a common phenomenon throughout the world (Bond et al. 2005). In the eastern United States, presettlement vegetation types were principally pyrogenic; that is, they formed systems assembling under and maintained by recurrent fire (Frost 1998, Wade et al. 2000). Fire frequency remained the same or even increased where settlers adopted Native burning practices. Here, frequent understory burning helped maintain the dominance of oak and of fire-adapted associates, especially grasses for pasturage.

Community 4.1
Chestnut oak-red oak/black berry-greenbrier /sweet vernal-poverty grass

This phase may be a relict of the open “park-like” conditions (Wright and Bailey 1982, Frost 1998)established by Native burning practices. This is a xerotrophic plant community in an area of abundant precipitation. The shrub layer may be resultant of absent fire return intervals and/or absence of livestock browsers.

State 5
Pasture State

This state represents a once-forested area now cleared for pasture. Most pastures are very old and have been established for a long time. Management practices focus primarily on maintaining healthy pasture conditions; examples include balancing stocking rates to forage availability, grazing rotation, weed control and nutrient inputs. In general, pasture management recommendations focus on maximizing desirable forage species to outcompete undesirable/weedy species. Production practices that result in overgrazing and low fertility levels favor emergence, propagation, and growth of weeds (Green et al. 2006).

Community 5.1
Orchardgrass-Fescue

The dominance of orchardgrass (*Dactylis glomerata*), and tall fescue (*Schedonorus arundinaceus*) in this community phase indicate that nutrient levels are adequate and grazing management is adequate to allow pasture plants to recover. Overstocking and infrequent pasture rotation will allow weedier species to invade such as multiflora rose and brambles.

Community 5.2
Multiflora rose-blackberry/sweet vernal-broomsedge

This community phase is a more degraded phase for livestock. While some utilization ofpasture plants will occur undesirable species are prolithic. Soil nutrient improvement through fertilization and liming is necessary. Control of multiflora rose (i.e. herbicide) is necessary.

Pathway 5.1A
Community 5.1 to 5.2

Lack of soil fertility management (N,P,K) and lack of lime application. Lack of herbicide treatment of invasive species and brambles.

Pathway 5.2A
Community 5.2 to 5.1

Addition of fertilizer and lime. Herbicide treatment of invasive palnts.

Transition T1A
State 1 to 2

The absence of fire and/or disturbance (i.e. clearcutting) for over 100 years. Without the rejuvenating effects of recurrent fire, environmental conditions shifted incrementally to favor fire-sensitive, shade-tolerant competitors. Under reduced light conditions, fire-adapted species performed poorly in the understory and increasingly gave way to shade-tolerant species.

Transition T1C
State 1 to 3

Selective harvesting and high grading multiple times results in degradation of forest stand quality in terms of altered species composition, forest structure, and genetic fitness. Diameter limit cuts, incorrectly implemented, remove the biggest and best trees and leave those of lowest quality in terms of both timber and ecology.

Transition T1D
State 1 to 4

Long term (100+ years) access by livestock and subsequent browsing of woody understory and establishment/maintenance of grassy understory. Over the past 50 years sheep and goats have been removed from the grazing scenario and brambles have established.

Transition T1B
State 1 to 5

Tree clearing and the establishment of pasture plants. A majority of pasture conversions occured many years ago.

Restoration pathway R2A
State 2 to 1

Harvest or elimination (i.e. herbicide)of red maple. Reintroduce fire according to recomendation made by a forester or fire ecologist.

Transition T3A
State 3 to 2

mesophitic tree (i.e. maple) regeneration Harvest of tulip poplar

Transition T3B
State 3 to 5

Eliminate woody species combined with pasture species planting/recruitment. This transition rarely occurs currently.

Restoration pathway R4A
State 4 to 1

Removal of grazing (browsing) livestock, herbicide treatment of undesirable shrubs and/or prescribed fire. Reintroduce fire according to recommendations made by a forester or fire ecologist.

Transition T4A
State 4 to 3

logging and removal of trees in the abscence of advanced regeneration oak.

Transition T5A
State 5 to 2

maple invasion of pasture livestock have been removed or stocked at a low rate.

Additional community tables

Table 8. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
chestnut oak	QUMO4	*Quercus montana*	Native	4.3–27.4	20–50	25.4–55.9	–
red maple	ACRU	*Acer rubrum*	Native	4.3–9.8	0–25	7.6–20.3	–
northern red oak	QURU	*Quercus rubra*	Native	4.3–27.4	5–20	7.6–43.2	–
scarlet oak	QUCO2	*Quercus coccinea*	Native	4.3–27.4	0–20	10.2–43.2	–
white oak	QUAL	*Quercus alba*	Native	10.7–24.4	5–10	17.8–71.1	–
black oak	QUVE	*Quercus velutina*	Native	10.7–27.4	0–10	25.4–43.2	–
mockernut hickory	CATO6	*Carya tomentosa*	Native	4–11.9	2–10	10.2–17.8	–
pignut hickory	CAGL8	*Carya glabra*	Native	4–7.3	0–5	7.6–15.2	–

Table 9. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
poverty oatgrass	DASP2	*Danthonia spicata*	Native	0–0.9	0.1–0.5
cypress panicgrass	DIDI6	*Dichanthelium dichotomum*	Native	0–0.9	0–0.1
Willdenow's sedge	CAWI2	*Carex willdenowii*	Native	0–0.2	0–0.1
bentgrass	AGROS2	*Agrostis*	Native	0–0.5	0–0.1
slender woodland sedge	CADI5	*Carex digitalis*	Native	0–0.2	0–0.1
early bluegrass	POCU4	*Poa cuspidata*	Native	0–0.2	0–0.1
ribbed sedge	CAVI4	*Carex virescens*	Native	0–0.2	0–0.1
variable panicgrass	DICO2	*Dichanthelium commutatum*	Native	0–0.9	0–0.1
broad looseflower sedge	CALA19	*Carex laxiflora*	Native	0–0.2	0–0.1
Forb/Herb					
eastern teaberry	GAPR2	*Gaultheria procumbens*	Native	–	0.1–0.5
American lily-of-the-valley	COMA19	*Convallaria majuscula*	Native	0–0.2	0–0.5
rattlesnakeroot	PRENA	*Prenanthes*	Native	0–0.2	0–0.1
smooth Solomon's seal	POBI2	*Polygonatum biflorum*	Native	0.2–0.8	0–0.1

downy rattlesnake plantain	GOPU	*Goodyera pubescens*	Native	0–0.6	0–0.1
gaywings	POPA5	*Polygala paucifolia*	Native	0–0.2	0–0.1
rattlesnakeweed	HIVE	*Hieracium venosum*	Native	0–0.2	0.1
narrowleaf cowwheat	MELI2	*Melampyrum lineare*	Native	0–0.3	0–0.1
dwarf cinquefoil	POCA17	*Potentilla canadensis*	Native	0–0.1	0–0.1
American cancer-root	COAM	*Conopholis americana*	Native	0–0.2	0–0.1
fourleaf yam	DIQU	*Dioscorea quaternata*	Native	0–0.2	0–0.1
wreath goldenrod	SOCA4	*Solidago caesia*	Native	0–0.6	0–0.1
Fern/fern ally					
marginal woodfern	DRMA4	*Dryopteris marginalis*	Native	0–0.3	0–0.1
Christmas fern	POAC4	*Polystichum acrostichoides*	Native	0–0.4	0–0.1
New York fern	THNO	*Thelypteris noveboracensis*	Native	0–0.4	0–0.1
Shrub/Subshrub					
Blue Ridge blueberry	VAPA4	*Vaccinium pallidum*	Native	0–0.6	5–10
mountain laurel	KALA	*Kalmia latifolia*	Native	0.2–1.5	2–10
common serviceberry	AMAR3	*Amelanchier arborea*	Native	0.6–3.7	0.1–5
flowering dogwood	COFL2	*Cornus florida*	Native	0.9–2.7	0.1–3
smooth azalea	RHAR3	*Rhododendron arborescens*	Native	0.2–0.6	0–1
sassafras	SAAL5	*Sassafras albidum*	Native	0.6–0.9	0–1
deerberry	VAST	*Vaccinium stamineum*	Native	0.1–1.2	0–0.1
mapleleaf viburnum	VIAC	*Viburnum acerifolium*	Native	0.3–1.2	0–0.1
Tree					
chestnut oak	QUMO4	*Quercus montana*	Native	0.2–1.2	0.1–3
chestnut oak	QUMO4	*Quercus montana*	Native	1.2–4	0.1–2
pignut hickory	CAGL8	*Carya glabra*	Native	1.2–4	0.1–1
red maple	ACRU	*Acer rubrum*	Native	0.5–1.2	0.1–1
red maple	ACRU	*Acer rubrum*	Native	1.2–4	0.1–1
northern red oak	QURU	*Quercus rubra*	Native	0.2–1.2	0.1–0.5
northern red oak	QURU	*Quercus rubra*	Native	1.2–4	0–0.5
American beech	FAGR	*Fagus grandifolia*	Native	0.5–1.2	0–0.1
red maple	ACRU	*Acer rubrum*	Native	0–0.1	0–0.1
red maple	ACRU	*Acer rubrum*	Native	0.1–0.5	0–0.1
scarlet oak	QUCO2	*Quercus coccinea*	Native	1.2–4	0–0.1
scarlet oak	QUCO2	*Quercus coccinea*	Native	0.2–1.2	0–0.1
pignut hickory	CAGL8	*Carya glabra*	Native	0–0.5	0–0.1
blackgum	NYSY	*Nyssa sylvatica*	Native	0.2–0.3	0–0.1
sweet birch	BELE	*Betula lenta*	Native	0.2–0.5	0–0.1
American beech	FAGR	*Fagus grandifolia*	Native	0.2–0.5	0–0.1
Vine/Liana					
roundleaf greenbrier	SMRO	*Smilax rotundifolia*	Native	0–1.2	0–1
leather flower	CLEMA	*Clematis*	Native	0–0.3	0–0.1
Nonvascular					
dicranum moss	DISC71	*Dicranum scoparium*	Native	0–0.1	0.1–5
leucobryum moss	LEGL19	*Leucobryum glaucum*	Native	0–0.1	0–2

leucobryum moss	LEGL10	*Leucobryum glaucum*	Native	0–0.1	0–2
reindeer lichen	CLADI3	*Cladina*	Native	–	0–0.1

Inventory data references

5 high intensity plots
10 low intensity traverses

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Contributors

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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:**

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

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

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

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

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

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

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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:

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

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

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

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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:**