USDA Natural Resources
Conservation Service

Ecological site RX143X00Y903
Subalpine Slope

Last updated: 2/03/2025
Accessed: 05/14/2025

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): 143X–Northeastern Mountains

MLRA 143, known as the Northeastern Mountains, covers approximately 23 million acres of mountains, hills, and valleys in northern Maine, New Hampshire, Vermont, New York, and Massachusetts. The area is sparsely populated, with less than five percent of the land area developed for agriculture, residential, and urban development. About 90 percent of the area is forested, most of which is actively managed for timber. Elevations are mostly between 1,000 to 4,000 feet, with a few isolated peaks more than 5,000 feet above sea level. The present day mountains are but remnants of a much larger ancient range that has been eroding for approximately 500 million years. Bedrock consists of mostly very old metamorphic rock (gneiss, schist, slate, marble, quartzite, etc.) with younger intrusions of igneous rock (e.g. granite and granodiorite) from the Triassic and Cretaceous periods. MLRA 143 differs somewhat geologically from its neighboring MLRAs (142, 144A, 144B, 145, and 146), which have greater amounts of nutrient-rich sedimentary rock. Compared to MLRA 143, they are all lower in elevation, with longer growing seasons large areas that were once submerged by the ocean following glaciation.

The characteristic landforms and soils of northern New England were derived from the massive continental ice sheet that engulfed the region during North America’s most recent glaciation. Mighty glaciers, embedded with sediment and rock fragments, scoured bedrock and compacted mineral beds in a steady march south and east toward the Atlantic Ocean. The softer sedimentary rocks were pulverized into fine silts and clays under the immense weight of ice a mile thick, while the more resistant igneous and metamorphic rocks were sculpted into steep mountains and hills or plucked and dragged along the base of the glacier. With a warming climate, the ice retreated northward, depositing a thin layer of unsorted glacial till sediment atop the newly-exposed bedrock and compacted mineral beds. Deeper mounds of unsorted till formed small hills, kames, moraines and drumlins. Enormous chunks of ice detached as the glacier retreated, melting slowly in place and forming many kettle lakes and basins where water and fine sediments collect. Raging torrents of glacial meltwater dissected much of the barren landscape, entraining coarse and fine sediments, carving river valleys, and leaving well-sorted deposits of mostly sand and gravel along the watercourse. By 10,000 years ago the ice sheet had fully receded from MLRA 143. Silty floodplains developed along perennial rivers, many of which occupy the same channels that once gushed with sediment-rich glacial meltwater. Over time, wet basins accumulated fine sediment, some dried out, and still others became acidified by organic matter inputs from colonizing vegetation.

In terms of climate, MLRA 143 is distinguished from neighboring MLRAs by a shorter growing season and the occurrence of cryic soil temperature regimes at high elevations. The majority of MLRA 143 averages 32 to 44 inches of precipitation annually with a five to six month growing season and frigid winter temperatures. However, the higher elevations may receive up to double the annual precipitation of the lower elevations, and have a three to four month growing season with extremely cold winters. As the northernmost MLRA in the region with the coldest temperatures and shortest growing season, the Northeastern Mountains have less overall tree diversity, fewer pine and oak trees, and more abundant spruce and fir trees than neighboring MLRAs.

Classification relationships

This site occurs in Ecological Site Group 9 (Alpine/Subalpine) of MLRA 143 (The Northeastern Mountains), in the Northeastern Forage and Forest Region (Land Resource Region R).

The Northeastern Forage and Forest LRR includes all of Maine, New Hampshire, Vermont, Rhode Island, and Connecticut, as well as large portions of Massachusetts, New York, New Jersey, Pennsylvania, and Ohio. Its southern boundary marks the extent of the Wisconsin ice sheet, which engulfed the entire LRR as recently as 10,000 to 15,000 years ago. Erosional and depositional processes associated with glaciation created many of the topographic patterns that distinguish MLRAs within the Northeastern region. Harder granitic and metamorphic bedrock to the north were more resistant to glacial erosion, resulting in the relatively nutrient poor mountains of MLRA 143; whereas nutrient-rich sedimentary bedrock of MLRAs 139, 140, and 146 resulted in relatively flat, fertile landscapes ideal for cultivation. Other areas were depressed below sea-level by the sheer mass of the glacier, resulting in pockets of marine sediments which distinguish MLRAs 142, 144A, 144B, and 145.

Precipitation is sufficient to support productive forestland throughout the Northeastern region. Still, a latitudinal temperature gradient from mesic to frigid soil temperatures results in a general transition from central hardwoods and pine in the southern MLRAs to northern hardwoods and spruce-fir forests farther north (no true boreal forests exist in the region). Elevations are generally low throughout the Northeastern region, with the exception of MLRA 143 which has many high mountain ecosystems with cryic temperature regimes and alpine vegetation above the tree line.

Ecological site concept

This site occurs on high mountain slopes at elevations between 2500 and 4000 feet (762 and 1219 meters) below tree line and is the first community evident of the cryic soil temperature regime. A broad range of soils are included in this provisional site concept since the primary factors driving vegetation dynamics have to do with the localized climate along the high elevations of the site. Soils may be organic or mineral, shallow to deep, with or without rock fragments in the profile. All soils are well- to excessively-drained, and pH is typically between 3.4 and 6.0.

This site is dominated by balsam fir, with black spruce, red spruce, and heartleaf paper birch common. It is resistant to disturbance, but may be susceptible to occasional tree removal by fire, logging, insects, disease, or blowdowns. Downslope movement of soils may also act as an ecological driver when soils are super saturated in steep areas. Other ecological processes which may shift the dominant species includes snow and ice loading, as well as rare fires. Following tree removal, a brief herbaceous phase may be followed by an early successional softwood or heartleaf paper birch phase before eventually returning to softwood dominance.

Associated sites

RX143X00Y902	**Alpine Ridge Krummholz** These sites tend to occur immediately upslope of this site and is a indicator of the tree line, often seen as stunted black spruce or balsam fir trees (less than 6.5 feet [2 meters] in height).The gradient between the two is correlated to elevation rather than soil properties.

Similar sites

RX143X00Y902	**Alpine Ridge Krummholz** These sites are dominated by stunted balsam fir and black spruce (less than 6.5 feet [2 meters]), whereas this site is dominated by taller balsam fir, red or black spruce, and heartleaf paper birch (up to 80 feet [24 meters]), in the community.
F143XY503ME	**Loamy Flat** These sites are dominated by red spruce and balsam fir found on wetter, poorly to somewhat poorly drained loamy soils at lower elevations. They occur on deep till flats rather than the steep mountain slopes of this site. A densely compacted layer can be found 10 to 30 inches below the surface that perches water in the upper soil layers.
F143XY703ME	**Shallow And Moderately Deep Humic Till** These sites are dominated by red spruce and balsam fir found on well drained, bedrock controlled, loamy to sandy loam soils at lower elevations. They will have an accumulation of organic matter at the surface and can be found on upper backslopes and shoulders of hills or mountains below 2,500 feet in elevation.

Table 1. Dominant plant species

Tree	(1) *Abies balsamea* (2) *Betula papyrifera var. cordifolia*
Shrub	(1) *Sorbus* (2) *Alnus*
Herbaceous	(1) *Cornus canadensis* (2) *Clintonia borealis*

Legacy ID

F143XY903ME

Physiographic features

This site occurs on high mountain slopes at elevations between 2500 and 4000 feet (762 and 1219 meters). Despite high rainfall, these landscape positions shed water rapidly, are exposed to high winds and heavy snows, and represent harsh growing conditions for vegetation.

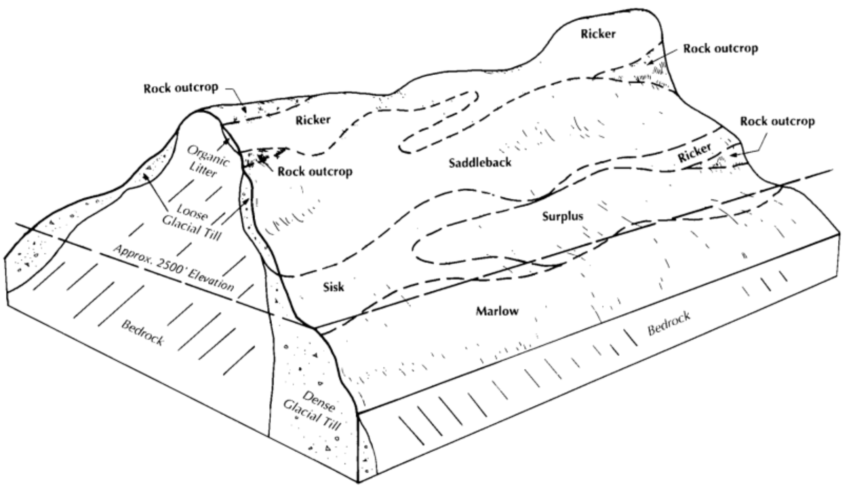


Figure 1. Typical patterns of soils and underlying material in the Saddleback-Ricker high elevation map unit in Grafton County, New Hampshire.

Table 2. Representative physiographic features

Geomorphic position, mountains	(1) Mountaintop
Landforms	(1) Mountains > Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	762–1,219 m
Slope	15–100%
Aspect	Aspect is not a significant factor

Climatic features

The climate of this site is much cooler that the typical climate of MLRA 143, with very cold snowy winters, high winds, cool rainy summers, and a very short growing season. Precipitation is fairly constant from month to month and averages about 83 inches annually. Growing degree days ranges from 88-124 days from June to September. Soil temperature regime is cryic on this site.

Table 3. Representative climatic features

Frost-free period (characteristic range)	33-83 days
Freeze-free period (characteristic range)	78-127 days
Precipitation total (characteristic range)	1,778-2,311 mm
Frost-free period (actual range)	20-95 days
Freeze-free period (actual range)	63-138 days
Precipitation total (actual range)	1,626-2,413 mm
Frost-free period (average)	58 days
Freeze-free period (average)	102 days
Precipitation total (average)	2,032 mm

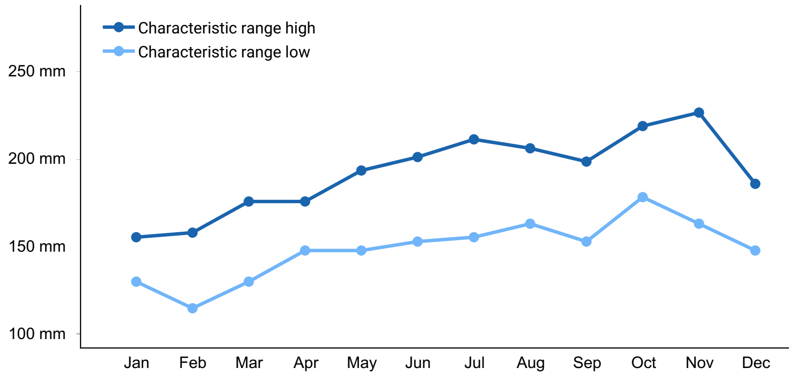


Figure 2. Monthly precipitation range

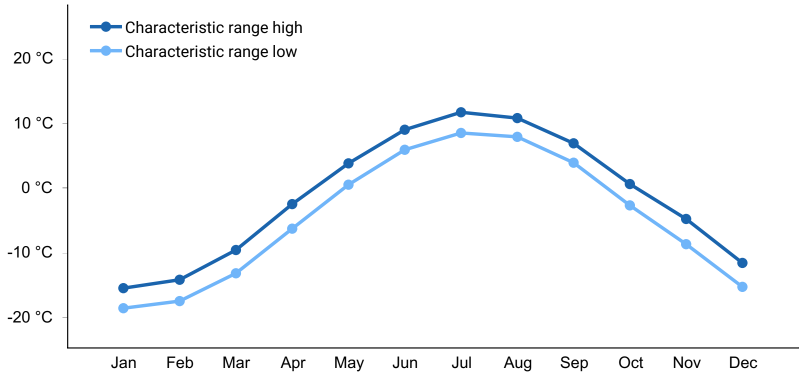


Figure 3. Monthly minimum temperature range

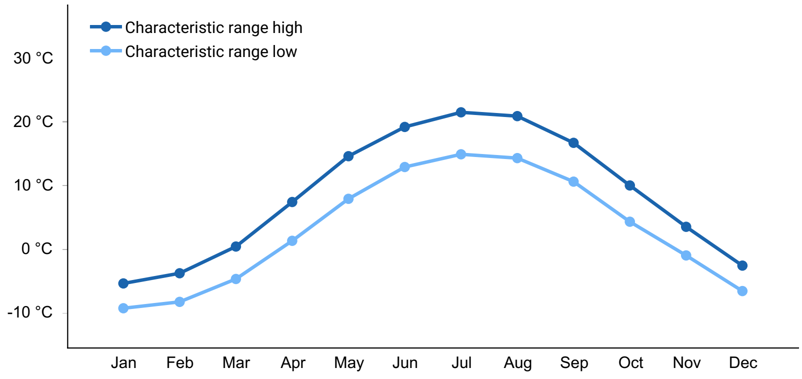


Figure 4. Monthly maximum temperature range

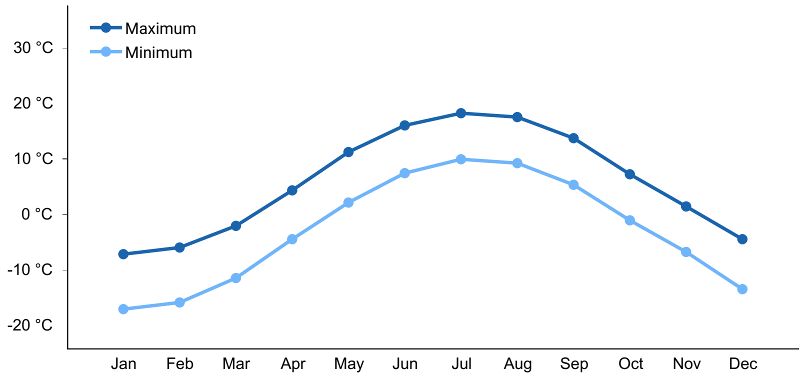


Figure 5. Monthly average minimum and maximum temperature

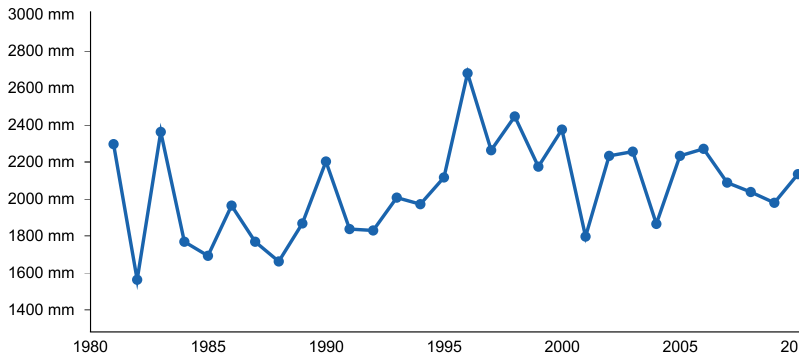


Figure 6. Annual precipitation pattern

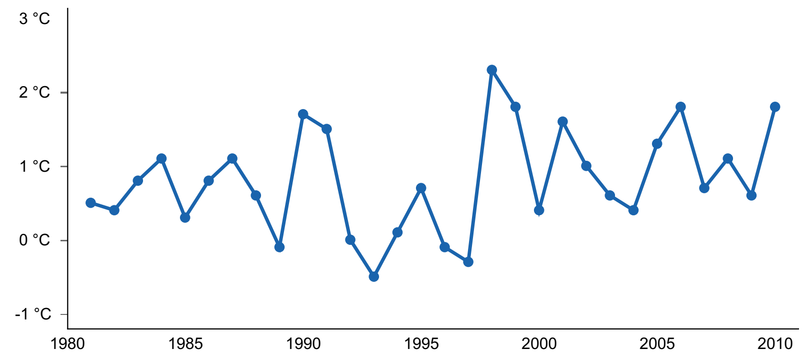


Figure 7. Annual average temperature pattern

Climate stations used

- (1) PINKHAM NOTCH [USC00276818], Sargents Purchase, NH
- (2) MT MANSFIELD [USC00435416], Underhill, VT
- (3) MT WASHINGTON [USW00014755], Sargents Purchase, NH

Influencing water features

Due to its landscape position, this site is not typically influenced by streams or wetlands.

Soil features

There is a diverse set of soil taxa associated with site and is most influenced by abiotic climatic factors (high elevation and exposed landscape position) rather than soils. Soils are dominantly cryic (a mean annual temperature ranging from 32 to 46 degree Fahrenheit [0 to 8 degree Celsius]) in the cryod, orthents, and folist suborders. These include cryofolists (Mahoosuc, Ricker), humicryods (Couchsachraga, Enchanted, Ester, Glebe, Saddleback, Santanoni, Sisk, Skylight, Stratton, Wallface), cryorthents (Londonderry), and haplocryods (Surplus). All soils are well- to excessively-drained with variable amounts of gravel and stones throughout the profile. The pH of the soil ranges from extremely acidic to slightly acidic.

Further study is needed to identify how the broad variability in soil properties correlates with particular herbaceous/shrubby plant communities in these landscape settings.

Table 4. Representative soil features

Parent material	(1) Lodgment till–mica schist (2) Organic material–granite (3) Colluvium–phyllite
Surface texture	(1) Fine sandy loam (2) Silt loam (3) Loamy sand
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Soil depth	25–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–35%
Available water capacity (0-101.6cm)	2.54–38.1 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	3.4–6
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–22%

Ecological dynamics

The Subalpine Slope ecological site consists of forests dominated by balsam fir, with common associates of red spruce, black spruce, and heartleaf paper birch in lower amounts. These communities are often found just below treeline on upper mountain slopes and ridgetops between 2500 and 4000 feet (762 and 1219 meters). Along higher elevations, the canopy height will range approximately from 7 to 33 feet (2 to 10 meters), grading into krummholz communities (less than 7 feet [2 meters] tall), and ultimately growing up to 82 feet (25 meters) tall in lower elevations. As elevation increases, environmental stresses (colder temperatures, higher winds, thin, nutrient poor soils, etc.) that will often limit the growth of some species, such as black spruce, will also increase. This will often give the appearance of a gradient of fir dominated forests to a mixed spruce-fir forest before transitioning to lower elevation northern hardwood forest complexes.

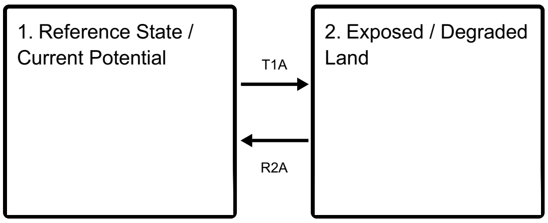
Clouds are frequent within these communities, with fog drip acting as a significant and important source of moisture for plants. Intense cloud cover and fog drip results in a light limited system, often giving the forest a cool temperature, limiting species diversity. Herbaceous and bryophyte plant cover is closely correlated with light availability; canopy gaps tend to have greater understory plant cover, whereas dense, closed canopies tend to reduce it. Ground surface cover of mosses and liverworts appears to be closely correlated with high moisture availability and moderate light levels (e.g., a more open canopy may produce drier conditions that impede bryophyte growth) (Sperduto and Nichols 2012). The groundcover will often exceed 40% cover, with a large proportion of feathermosses.

Due to the high saturation, soils may be more easily influenced by downslope movement and wind throw, often resulting in localized patches of varying states of succession. Snow and ice loading may cause individual tree mortality, with small gaps often returning to the reference forest due to high regeneration rates. At higher elevations, large scale blowdowns (locally known as “fir-waves”) may induce a temporary herbaceous and shrub dominated phase before returning to a softwood dominated forest. In areas where soil is laid bare, hardwood species may become dominant and persist for long periods of time where the disturbance recurs with frequency, returning to the spruce and fir dominant forests when soils begin to stabilize. Timber harvesting of these sites may have occurred in the early 20th century, resulting in steady high elevation (mixed) hardwood states that can still persist today.

It is currently unclear whether the recently documented warming climate has contributed to greater observations of non-native plants or facilitated invasion (Sperduto et al, 2023). However, climate warming has contributed to the upper elevational shifts of all species, affecting biodiversity at all levels (Nelson et al, 2022). Any such changes could potentially impact floral and faunal species in subalpine habitats and may lead to the displacement or loss of specific niche habitats and species over time. More detailed studies are needed to assess population dynamics of high elevation plants throughout the Northeast and the impact a changing climate may have. Studies and management may include preparing areas for managed relocation in areas undergoing rapid changes (Smetzer and Morelli 2019), identifying places that are buffered from shifts in extensive climate changes (increased drought, seasonal flooding, extreme temperatures) to be conserved to help enable persistence of target species and key resources (Morelli et al. 2020).

State and transition model

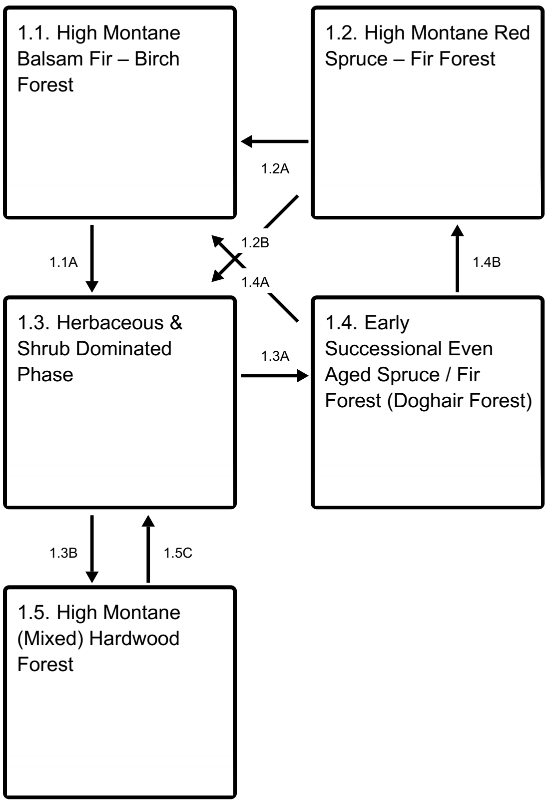
Ecosystem states



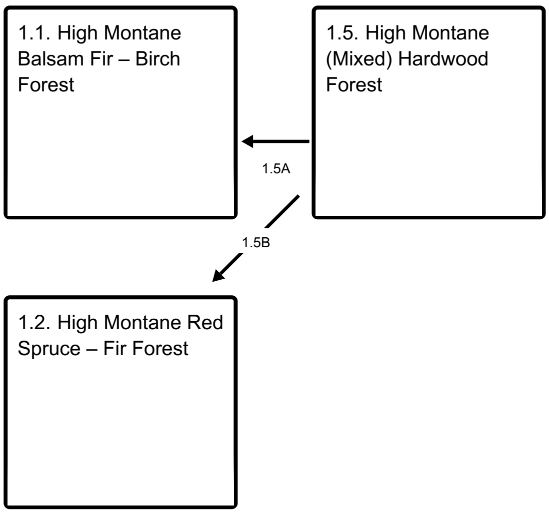
T1A - Soil Degradation / Erosion

R2A - Habitat protection, Seedbank Establishment

State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



1.1A - Canopy Disturbance

1.2A - Spruce Removal

1.2B - Canopy Disturbance

1.3A - Conifer Regeneration

1.3B - Canopy Disturbance / Intense Soil Disturbance/ Hardwood Establishment

1.4A - Time / Self or Selective Thinning / Fir Dominance

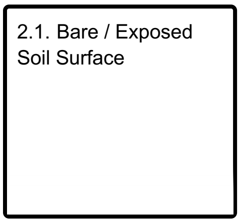
1.4B - Time / Self or Selective Thinning / Spruce & Fir Dominance

1.5A - Time / Soil Stabilization / Absence of Disturbance / Conifer Regeneration

1.5B - Time / Soil Stabilization / Absence of Disturbance / Conifer Regeneration

1.5C - Canopy Disturbance

State 2 submodel, plant communities



State 1
Reference State / Current Potential

Figure 8. Dense forest of Abies balsamea with a groundcover of bryoids and coarse woody debris on slopes of Mount Washington, New Hampshire. Photo taken May 17th, 2024.

These are forests dominated by balsam fir, with common associates of red spruce, black spruce, and heartleaf paper birch in lower amounts. These communities are often seen as the first community types when transitioning into the alpine zone between 2500 and 4000 feet (762 and 1219 meters) in elevation, with a noticeable shift from the Northern Hardwood Forest complexes lower in elevation. These community types all correlate to the International Vegetation Classification (IVC) Hierarchy Alliance A443 “High Montane Red Spruce – Fir – Yellow Birch Forest” and LandFire’s CES201.566 “Acadian-Appalachian Montane Spruce-Fir Forest” classifications.

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- red spruce (*Picea rubens*), tree
- black spruce (*Picea mariana*), tree

- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- mountain maple (*Acer spicatum*), shrub
- mountain ash (*Sorbus*), shrub
- viburnum (*Viburnum*), shrub
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- bluebead (*Clintonia borealis*), other herbaceous
- woodfern (*Dryopteris*), other herbaceous
- mountain woodsorrel (*Oxalis montana*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- knights plume moss (*Ptilium crista-castrensis*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- dicranum moss (*Dicranum*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- (*Bazzania trilobata*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Compaction
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure
- Wildfire hazard from biomass accumulation
- Terrestrial habitat for wildlife and invertebrates

Community 1.1
High Montane Balsam Fir – Birch Forest

Figure 9. Forest of Abies balsamea and Betula papyrifera var. cordifolia on steep slopes of Mount Canon, New Hampshire. Photo taken May 12th, 2024.

Figure 10. Forest of Abies balsamea on moderate slopes of Mount Washington, New Hampshire. Photo taken May 17th, 2024.

Abies balsamea is often the dominant overstory species, with canopy cover averaging 70 to 85%, but may have minor associations with *Betula papyrifera* var. cordifolia and *Picea rubens*. Where the canopy is closed, the shrub and herbaceous layers are often sparse, and will often have a high coverage of bryoids (as much as 80 to 100%), often forming a thick, deep carpet over rock or soil. When present, the shrub layer will predominantly be Abies seedlings with occasional *Sorbus americana*, *Alnus viridis*, *Viburnum nudum* var. cassinoides, and *Ledum groenlandicum*. Characteristic herbs include *Dryopteris campyloptera*, *Oxalis montana*, *Maianthemum canadense*, *Clintonia borealis*, *Cornus canadensis*, *Coptis trifolia*, *Solidago macrophylla*, and the clubmoss *Lycopodium annotinum*. Bryophytes include *Dicranum scoparium*, *Dicranum fuscescens*, *Polytrichum ohioense*, *Plagiothecium laetum*, *Bazzania trilobata*, and *Pleurozium schreberi*. Arboreal lichens may be present on the limbs and trunks of trees. Within the Northeast US, this community type correlates to Maine's "Fir – heart-leaved birch subalpine forest" concept (Gawler and Cutko 2010), New Hampshire's "High-elevation balsam fir forest" concept (Sperduto and Nichols 2012), New York's "Mountain fir forest" concept (Edinger et al. 2014), Massachusetts "High elevation spruce-fir forest" concept (Swain 2020) and Vermont's "Montane Fir Forest" concept (Thompson, Sorenson, and Zaino 2019). This correlates with NatureServes '*Abies balsamea* - (*Betula papyrifera* var. cordifolia) Forest' Association (CEGL006112).

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- red spruce (*Picea rubens*), tree
- American mountain ash (*Sorbus americana*), shrub
- mountain alder (*Alnus viridis ssp. crispa*), shrub
- withe-rod (*Viburnum nudum var. cassinoides*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- mountain woodfern (*Dryopteris campyloptera*), other herbaceous
- mountain woodsorrel (*Oxalis montana*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- bluebead (*Clintonia borealis*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- threeleaf goldthread (*Coptis trifolia*), other herbaceous
- goldenrod (*Solidago*), other herbaceous
- stiff clubmoss (*Lycopodium annotinum*), other herbaceous
- dicranum moss (*Dicranum scoparium*), other herbaceous
- dicranum moss (*Dicranum fuscescens*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- knights plume moss (*Ptilium crista-castrensis*), other herbaceous
- (*Bazzania trilobata*), other herbaceous

Community 1.2
High Montane Red Spruce – Fir Forest

The canopy is dominated by *Picea rubens* and *Abies balsamea* with associates including *Betula papyrifera* var. cordifolia, *Betula alleghaniensis*, and *Picea mariana*. Spruce will often make up 50 to 95% cover, with fir covering up to 35% of the canopy in younger stands and in canopy gaps. The shrub and herb layers are variable in cover, generally sparse under closed canopies and better developed in gaps (15 to 30% cover). Scattered shrubs include *Sorbus americana*, *Sorbus decora*, *Amelanchier bartramiana*, *Ilex mucronata*, and *Vaccinium myrtilloides*. Particularly characteristic herbs are boreal/montane species such as *Oxalis montana*, *Clintonia borealis*, *Linnaea borealis*, *Coptis trifolia*, *Huperzia lucidula*, *Dryopteris campyloptera*, and *Gaultheria hispidula*. More widespread associated herbs include *Trientalis borealis*, *Maianthemum canadense*, *Cornus canadensis*, and the ferns *Dryopteris intermedia* and *Phegopteris connectilis*. A few sedges are present in low amount, including northern stalked sedge (*Carex debilis* v. rudgei) and New England sedge (*C. nova*e- angliae). The bryoid layer is well-developed and often exceeds 40% cover, forming a lush carpet of mosses and liverworts. Bryophytes include *Pleurozium schreberi*, *Hylocomium splendens*, *Bazzania trilobata*, *Dicranum scoparium*, *Hypnum curvifolium*, and *Ptilium crista-castrensis*. Within the Northeast US, this community type correlates to Maine's "Spruce - fir - wood-sorrel - feather-moss forest" concept (Gawler and Cutko 2010), New Hampshire's "High-elevation balsam fir forest" concept (Sperduto and Nichols 2012), New York's "Mountain spruce-fir forest" concept (Edinger et al. 2014), Massachusetts "High elevation spruce-fir forest" concept (Swain 2020) and Vermont's "Montane Spruce-Fir Forest" concept (Thompson, Sorenson, and Zaino 2019). This correlates with NatureServes '*Picea rubens - Abies balsamea / Sorbus americana* Forest' Association (CEGL006128).

Dominant plant species

- red spruce (*Picea rubens*), tree
- balsam fir (*Abies balsamea*), tree
- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- yellow birch (*Betula alleghaniensis*), tree
- black spruce (*Picea mariana*), tree
- American mountain ash (*Sorbus americana*), shrub
- northern mountain ash (*Sorbus decora*), shrub
- oblongfruit serviceberry (*Amelanchier bartramiana*), shrub
- catberry (*Ilex mucronata*), shrub
- velvetleaf huckleberry (*Vaccinium myrtilloides*), shrub
- white edge sedge (*Carex debilis var. rudgei*), grass
- New England sedge (*Carex novae-angliae*), grass
- mountain woodsorrel (*Oxalis montana*), other herbaceous
- bluebead (*Clintonia borealis*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- threeleaf goldthread (*Coptis trifolia*), other herbaceous
- shining clubmoss (*Huperzia lucidula*), other herbaceous
- mountain woodfern (*Dryopteris campyloptera*), other herbaceous
- creeping snowberry (*Gaultheria hispidula*), other herbaceous
- starflower (*Trientalis borealis*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- intermediate woodfern (*Dryopteris intermedia*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- (*Bazzania trilobata*), other herbaceous
- dicranum moss (*Dicranum scoparium*), other herbaceous
- curveleaf hypnum moss (*Hypnum curvifolium*), other herbaceous
- knights plume moss (*Ptilium crista-castrensis*), other herbaceous

Community 1.3
Herbaceous & Shrub Dominated Phase

Figure 11. Herbaceous and shrub dominated understory with standing dead Abies balsamea species, a result of large-scale disturbance from extreme winds (fir-wave) on the side slopes of Mount Washington, New Hampshire. Photo taken May 17th, 2024.

Disturbance created patches within the forested phases may allow for dense shrub cover before tree regeneration occurs. Species will often be like that of the reference phases, and may include Abies seedlings with occasional *Sorbus americana*, *Alnus viridis* var. crispa, *Viburnum nudum* var. cassinoides, and *Ledum groenlandicum*. Red raspberry (*Rubus idaeus*) and skunk currant (*Ribes glandulosum*) may become dominant in recently disturbed areas. As stands regenerate, bryophytes and herbaceous plant cover may be limited due to high canopy density and high litter accumulation from hardwood leaf production.

Dominant plant species

- American mountain ash (*Sorbus americana*), shrub
- northern mountain ash (*Sorbus decora*), shrub
- mountain alder (*Alnus viridis ssp. crispa*), shrub
- withe-rod (*Viburnum nudum var. cassinoides*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- American red raspberry (*Rubus idaeus*), shrub
- skunk currant (*Ribes glandulosum*), shrub

Community 1.4
Early Successional Even Aged Spruce / Fir Forest (Doghair Forest)

Figure 12. Young short dense stand of Abies balsamea regeneration within a fir wave along steep slopes of Mount Washington, New Hampshire. Photo taken May 17th, 2024.

Figure 13. Young tall dense stand of Abies balsamea along gentle slopes of Mount Adams, New Hampshire. Photo taken August 10th, 2024.

This phase consists of spruce and / or balsam fir saplings that are the dominant species growing extremely close together. This forested phase will often be extremely dense and greater than 6 inches (15 centimeters) but less than 15 feet (4.5 meters) in height. As these trees grow, competition will weed out individual trees until a balanced density is achieved. Mixed in with the highly dense spruce-fir forest will often be other early successional forest species such as paper birch, aspen, and pine. As the ground surface become more shaded and more deposits of downed woody materials occur, bryophyte cover may begin to reestablish.

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- red spruce (*Picea rubens*), tree

Community 1.5
High Montane (Mixed) Hardwood Forest

Deciduous hardwoods are the dominant trees in this community, primarily *Betula papyrifera* var. cordifolia, *B. alleghaniensis*, *B. papyrifera*, *Populus tremuloides*, and / or *Prunus pensylvanica*. Softwoods representative of the reference conditions, such as *Abies balsamea*, *Picea rubens*, and *P. mariana* may be present but less than 50% total canopy cover. Shrub and herb layers are variable in cover but may include species more characteristic of lower elevation forests. Characteristic species may include Viburnum alnifolium, *Acer pensylvanicum*, *A. spicatum*, and associated forbs include *Dryopteris campyloptera*, *Oxalis montana*, *Clintonia borealis*, Maianthemum canadensis, *Dryopteris intermedia*, *Aralia nudicaulis*, and *Linnaea borealis*. In some places, the forb layer can be extremely abundant and seem to almost exclude other species. Sites which maintain soil instability may contribute to the prominence of birch as a dominant overstory species. The groundcover may have a sparse to moderately well-developed bryoid layer interspersed with hardwood leaf litter. More study may be needed to fully characterize this potential phase.

Dominant plant species

- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- yellow birch (*Betula alleghaniensis*), tree
- paper birch (*Betula papyrifera*), tree
- quaking aspen (*Populus tremuloides*), tree
- pin cherry (*Prunus pensylvanica*), tree
- balsam fir (*Abies balsamea*), tree
- red spruce (*Picea rubens*), tree
- black spruce (*Picea mariana*), tree
- viburnum (*Viburnum*), shrub
- striped maple (*Acer pensylvanicum*), shrub
- mountain maple (*Acer spicatum*), shrub
- American mountain ash (*Sorbus americana*), shrub
- mountain woodfern (*Dryopteris campyloptera*), other herbaceous
- intermediate woodfern (*Dryopteris intermedia*), other herbaceous

- mountain woodsorrel (*Oxalis montana*), other herbaceous
- bluebead (*Clintonia borealis*), other herbaceous
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- wild sarsaparilla (*Aralia nudicaulis*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.3

High Montane Balsam Fir – Birch Forest

Herbaceous & Shrub Dominated Phase

This transition can occur following a disturbance that creates canopy gaps, removing the dominant overstory species. Wind-induced mortality will often create linear patches of blowdown or standing dead trees oriented perpendicular to the prevailing wind, locally known as “fir-waves”. Other small-scale disturbances such as single tree mortality (snow/ice loading, insect damage [spruce budworm/ balsam wooly adelgid], single tree tip ups, etc.) may also revert to the reference forest following a brief shrub / herb dominated phase. Selective logging may reflect this transition in smaller patches and if the mineral soil is not heavily disturbed.

Pathway 1.2A
Community 1.2 to 1.1

This transition may occur following the removal of spruce, in which the dominant trees become balsam fir and birch species. This may occur via selective repetitive removal of spruce from the overstory, from biological (spruce budworm/ spruce bark beetle) or chemical (Al toxicity, acid rain, etc.) removal and if there is no longer a viable seedbank to reseed an area (McNulty et al. 1996, Friedland 1989, Janowiak et al. 2018). Spruce seeds are often not viable for more than one year on the forest floor, and if conditions are not met for germination and survival of the seedlings, it may be replaced as the dominant trees. This may include excessive too much light exposure, damage from late frost, or mineral disturbance of the topsoil during harvest or from a natural disturbance event, creating suitable habitat for birch regeneration.

Pathway 1.2B
Community 1.2 to 1.3

This transition can occur following a disturbance that creates canopy gaps, removing the dominant overstory species. Wind-induced mortality will often create linear patches of blowdown or standing dead trees oriented perpendicular to the prevailing wind, locally known as “fir-waves”. Other small-scale disturbances such as single tree mortality (snow/ice loading, insect damage [spruce budworm/ balsam wooly adelgid], single tree tip ups, etc.) may also revert to the reference forest following a brief shrub / herb dominated phase. Selective logging may reflect this transition in smaller patches and if the mineral soil is not heavily disturbed.

Pathway 1.3A
Community 1.3 to 1.4

Herbaceous & Shrub Dominated Phase

Early Successional Even Aged Spruce / Fir Forest (Doghair Forest)

This transition can occur if the basic requirements for successful spruce and / or fir regeneration are met, primarily an adequate seed supply, proper seedbed, and light, temperature, and moisture conditions are conductive for seed germination and survival. Regenerating saplings will often be extremely dense and greater than 6 inches but less than 15 feet in height. As these trees grow, competition will weed out individual trees until a balanced density is achieved.

Pathway 1.3B
Community 1.3 to 1.5

If the mineral soil is heavily disturbed, from logging practices such as clearcutting, wildfires, or mass movement (landslides/ avalanches), the softwoods may be replaced by hardwood species such as yellow birch, heartleaf paper birch, paper birch, mountain maple, striped maple, mountain ash, and / or pin cherry.

Pathway 1.4A
Community 1.4 to 1.1

Early Successional Even Aged Spruce / Fir Forest (Doghair Forest)

High Montane Balsam Fir – Birch Forest

This transition will occur with time as the early successional forest is thinned either naturally or via human interference. Tree height will surpass 15 feet and will have more spaced trees with intermediate understory regeneration and development. If frequent wind-induced disturbances are present, balsam fir tends to be favored over red spruce when occurring together.

Pathway 1.4B
Community 1.4 to 1.2

This transition will occur with time as the early successional forest is thinned either naturally or via human interference. Tree height will surpass 15 feet and will have more spaced trees with intermediate understory regeneration and development. If frequent wind-induced disturbances are present, balsam fir tends to be favored over red spruce when occurring together.

Pathway 1.5A
Community 1.5 to 1.1

This transition can occur over varying amounts of time following a disturbance. If small scale disturbances continually affect the site, the hardwood dominated forest may persist for extended periods of time. For this community to return to the reference community, there needs to be an absence of large-scale disturbances that allows the soil to stabilize, building a suitable medium conductive for seed germination and survival. A viable seedbank is needed for continuous regeneration of softwood species to become dominant in the overstory again. This transition can be assisted by selective harvesting of hardwood species with the intent of maintain or increasing softwood species.

Pathway 1.5B
Community 1.5 to 1.2

This transition can occur over varying amounts of time following a disturbance. If small scale disturbances continually affect the site, the hardwood dominated forest may persist for extended periods of time. For this community to return to the reference community, there needs to be an absence of large-scale disturbances that allows the soil to stabilize, building a suitable medium conductive for seed germination and survival. A viable seedbank is needed for continuous regeneration of softwood species to become dominant in the overstory again. This transition can be assisted by selective harvesting of hardwood species with the intent of maintain or increasing softwood species.

Pathway 1.5C
Community 1.5 to 1.3

This transition can occur following a disturbance that creates canopy gaps, removing the dominant overstory species. Wind-induced mortality will often create linear patches of blowdown or standing dead trees oriented perpendicular to the prevailing wind, locally known as “fir-waves”. Other small-scale disturbances such as single tree mortality (snow/ice loading, insect damage [spruce budworm/ balsam wooly adelgid], single tree tip ups, etc.) may also revert to the reference forest following a brief shrub / herb dominated phase. Selective logging may reflect this transition in smaller patches and if the mineral soil is not heavily disturbed.

State 2
Exposed / Degraded Land

This state consists of exposed areas within alpine communities in which the native vegetation is absent, displaced, or destroyed by soil degradation and erosion and will lack dominant vegetation cover.

Dominant resource concerns

- Sheet and rill erosion
- Classic gully erosion
- Organic matter depletion

Community 2.1
Bare / Exposed Soil Surface

This community phase consists of little to no existing vegetation, often a result of the absence of a soil medium or the result of disturbance. Bare soil or previously unexposed bedrock may be present.

Dominant resource concerns

- Sheet and rill erosion
- Wind erosion
- Compaction
- Organic matter depletion

Transition T1A
State 1 to 2

Soil degradation and erosion may lead to loss of habitat, resulting exposed soil or bedrock. This often occurs in localized zones of trampled vegetation, soil erosion, and unofficial trail development. Extreme loss of soils materials may create localized channels which can funnel snowmelt and increase habitat loss. Extreme loss may be more common on steeper, more slide-prone areas. Other factors such as historical high elevation logging, development (ski areas, wind generators, etc.), or historical fires may have similar or compounding effects.

Restoration pathway R2A
State 2 to 1

Habitat protection is needed to restore subalpine communities, allowing the soil and seedbank to recover without disturbance from human traffic. This is often a slow and sensitive process and requires more detailed study.

Additional community tables

Animal community

DRAFT
The following information is provided from University of New Hampshire’s “Dirt to Trees to Wildlife”. Asterisks denotes Species of Greatest Conservation Need and hyperlinks will take you to recommendations specific to those species.

Common animals found in Spruce-Fir Forest Types at ANY elevation may include:

Snowshoe hare (Lepus americanus), Red squirrel (Sciurus vulgaris), Southern red-backed vole (Myodes gapperi), Long-tailed shrew (Sorex dispar)*, American marten (Martes americana)*, Boreal chickadee (Poecile hudsonicus), Dark-eyed junco (Junco hyemalis), Pine siskin (Spinus pinus), Spruce grouse (Canachites canadensis)*, and Red-breasted nuthatch (Sitta canadensis).

Common animals found in Spruce-Fir Forest Types at high-elevation (generally above 2,500 feet) only may include:

Bicknell's Thrush (Catharus bicknelli)*, Black-backed woodpecker (Picoides arcticus), Rock vole (Microtus chrotorrhinus)*, Northern bog lemming (Synaptomys borealis)*, Eastern small-footed bat (Myotis leibii)*, and Canada lynx (Lynx canadensis)*.

Silvicultural recommendations for managing wildlife habitat

Composition and Structure Goals:

• Within the managed area at least 60 percent should remain in stands with an average DBH of 4 inches or greater and a stocking of at least 90 square feet of basal area per acre.
• Leave 10 percent of the area unharvested. The remaining 30 percent of the area can be less than 4 inches in DBH and less than 90 square feet of basal area.
• Distribute these cut areas across the managed area rather than concentrating them.
• Direct management toward maintaining or increasing softwood types at high elevations.

Harvesting Provisions:

• Use group selection with small groups—1 4 to ½ acre is preferred.
• Install larger groups (up to 3 acres) or small clearcuts (3 to 5 acres) only where adequate regeneration is in place.
• Minimize residual stand damage.
• Minimize soil compaction.
• Winter harvest is preferred.
• Avoid whole-tree harvest. Use a cut-to-length harvest method, leaving tops and limbs in place.
• Retain three to five large live cull or cavity trees per acre.

Inventory data references

Information presented was derived from NRCS clipping data, current and historical literature, field observations, and personals contacts with local, state and federal partners. This is a provisional level ESD and is subject to change as more information becomes available, for any questions please contact your local NRCS office.

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Jamin Johanson, original author, 2016
Jack Ferrara, revisions, 2025

Approval

Nels Barrett, 2/03/2025

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	01/24/2025
Approved by	Nels Barrett
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:**