USDA Natural Resources Conservation Service

Ecological site RX143X00Y902
Alpine Ridge Krummholz

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Accessed: 02/28/2025

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 is found on high mountain slopes and ridges, just below the tree line where trees exhibit a stunted growth form in response to wind and damage caused by snow loading and ice. Elevations range from 3500 to 4000 feet (1066 to 1220 meters). A broad range of soils are included in this provisional site concept since the primary factors driving vegetation dynamics have to do with the exposed landscape position and high elevation 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 stunted trees, typically dominated by black spruce and balsam fir. On the harshest sites, the branches of fir trees may only grow on the leeward side of the tree trunk in relation to the direction of prevailing winds. These trees range up to a few feet in height and will often grow so densely they form an impenetrable thicket.

These communities are fairly resistant to disturbance, though foot traffic or other disturbances which may cause the soil to be laid bare may result in a shift of dominant species and result in erosion-related degradation. This could potentially impact wildlife species in alpine krummholz habitats.

Associated sites

RX143X00Y903	**Subalpine Slope** These sites tend to occur immediately downslope from this site and will often smoothly transition into one another. These sites are generally found at lower montane elevations and will reflect a more well developed forest structure.
RX143X00Y901	**Alpine Ridge Meadow** These sites tend to occur immediately upslope from this site and may often form a mosaic along the tree line. These are generally more open habitats dominated by alpine grasses, sub-shrubs, and forbs. Trees are generally absent.

Similar sites

RX143X00Y901	**Alpine Ridge Meadow** These sites are dominated by herbs and shrubs rather than stunted trees. However, at its lower extent it may include small patches of stunted trees within a matrix of its characteristic shrub and herb species.

RX143X00Y903	**Subalpine Slope** These sites are dominated by a more well developed forest structure of balsam fir and red spruce rather than a stunted forest of balsam fir and black spruce. Canopy heights will often range greater than 7 feet (2 meters) and be more spaced allowing for the development of a herbaceous understory.

Table 1. Dominant plant species

Tree	(1) *Abies balsamea* (2) *Picea mariana*
Shrub	(1) *Vaccinium* (2) *Ledum groenlandicum*
Herbaceous	(1) *Cornus canadensis* (2) *Maianthemum canadense*

Legacy ID

F143XY902ME

Physiographic features

This site is found on high mountain slopes and ridges, just below the tree line where trees exhibit a stunted growth form due to wind, snow loading, and ice. Elevations range from 3500 to 4500 feet (1066 to 1220 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.

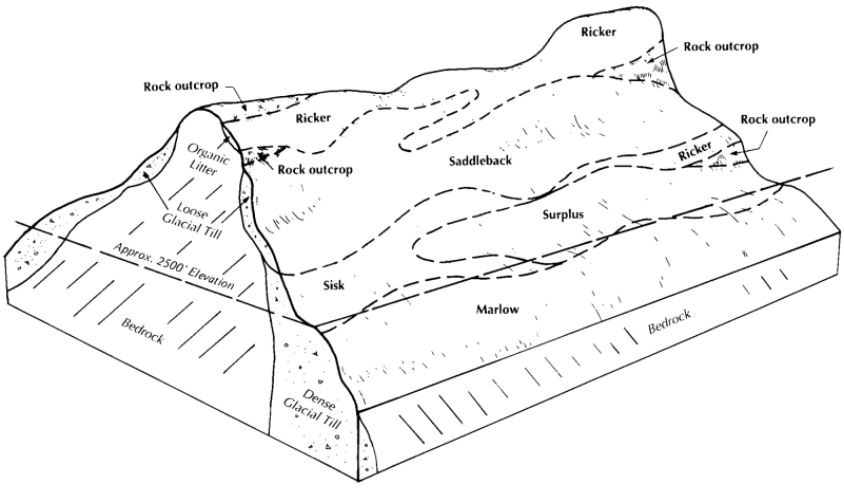


Figure 1. Typical patterns of soils and underlying material in the Saddleback-Ricker high elevation map unit in Grafton County, New Hampshire.

Table 2. Representative physiographic features

Geomorphic position, mountains	(1) Mountaintop
Landforms	(1) Mountains > Mountain slope (2) Mountains > Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	3,500–4,500 ft
Slope	5–100%
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 (average)	88 days
Freeze-free period (average)	124 days
Precipitation total (average)	83 in

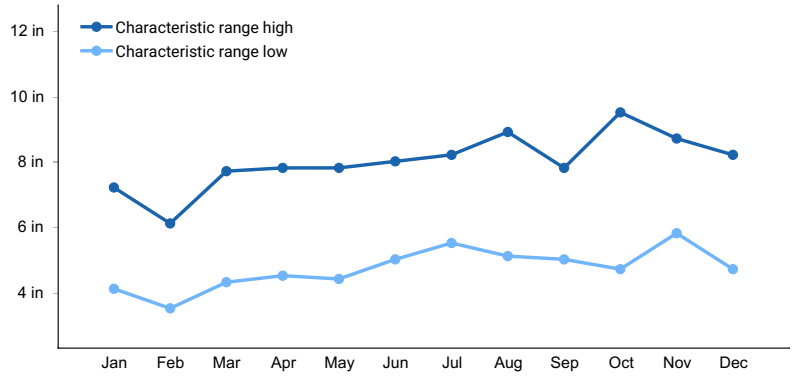


Figure 2. Monthly precipitation range

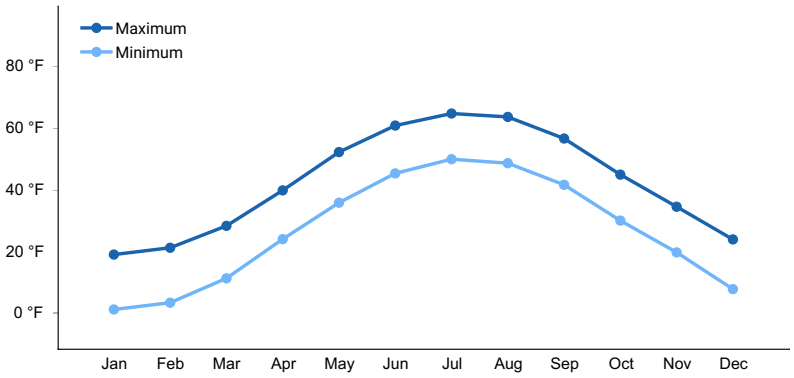


Figure 3. Monthly average minimum and maximum temperature

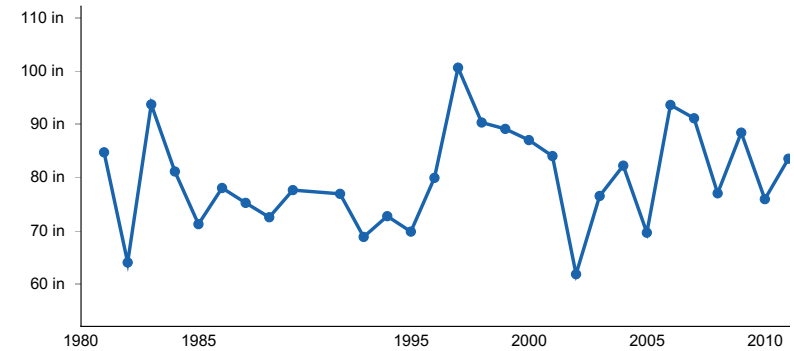


Figure 4. Annual precipitation pattern

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 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	10–60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–35%
Available water capacity (0-40in)	1–15 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	3.4–6
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–22%

Ecological dynamics

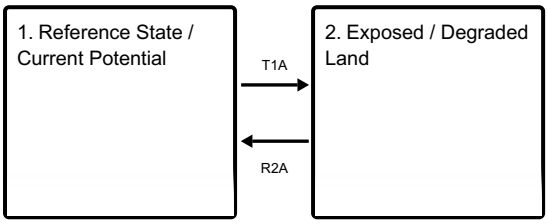
The Alpine Ridge Krummholz ecological site consists of severely wind-pruned, stunted *Picea mariana*, *Abies balsamea*, and boreal shrub thickets just above treeline in mountains, or on exposed, northern acidic rock outcrops, and at lower elevations where a cold microclimate is sustained by cold-air drainage. The vegetation ranges from dense coniferous thickets to patches interspersed with deciduous dwarf-shrubs, forbs, graminoids, mosses, and lichens. Temperature and winds are the main limiting factors that structure the vegetation, and in harsher sites the branches of the trees may only grow on the leeward side of the tree trunk in relation to the direction of prevailing winds. Growth rates are often very slow under these conditions, with stunted trees approximately 5 to 7 feet (1.5 to

2 meters) or less in height.

These communities are resilient to disturbances. However, extensive human use, often recreational foot traffic, may decrease or destroy cover of the native vegetation, increase bare ground, and result in erosion-related degradation. 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 alpine krummholz 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

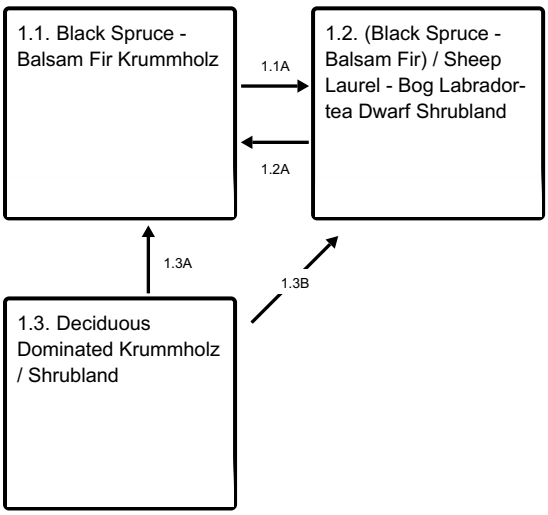
Ecosystem states



T1A - Soil Degradation / Erosion

R2A - Habitat protection, Seedbank Establishment

State 1 submodel, plant communities



1.1A - Gap Disturbance

1.2A - Softwood Regeneration / Dominance

1.3A - Time, Softwood Regeneration

1.3B - Gap Disturbance

State 2 submodel, plant communities

2.1. Bare / Exposed Soil Surface

State 1
Reference State / Current Potential

Figure 6. Alpine krummholz on South Twin Mountain, New Hampshire. Photo taken September 7th, 2024.

This state consists of severely wind-pruned, stunted *Picea mariana*, *Abies balsamea*, and less frequent deciduous species such as *Alnus viridis*, *Betula papyrifera* v. cordifolia, *Acer spicatum*, and *Betula glandulosa* just above treeline in mountains. They are the transitional forest between the Alpine Meadows above the Montane Spruce – Fir Forests below. Following the death or removal of individual tree species in these systems, seedlings of spruce of fir will often replace it, following a short period of dwarf-shrub or forb dominance in the gap. These community types all correlate to the International Vegetation Classification (IVC) Hierarchy Alliance A3360 “Black Spruce Krummholz” and LandFire’s CES201.568 “Acadian-Appalachian Subalpine Woodland and Heath-Krummholz” classifications.

Dominant plant species

- balsam fir (*Abies balsamea*), tree
- black spruce (*Picea mariana*), tree
- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- blueberry (*Vaccinium*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- mountain maple (*Acer spicatum*), shrub
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- bluebead (*Clintonia borealis*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- starflower (*Trientalis borealis*), other herbaceous
- creeping snowberry (*Gaultheria hispidula*), other herbaceous
- goldenrod (*Solidago*), other herbaceous

Dominant resource concerns

- Classic gully erosion
- Compaction
- Organic matter depletion
- Aggregate instability
- Plant productivity and health
- Plant structure and composition
- Plant pest pressure

- Terrestrial habitat for wildlife and invertebrates

Community 1.1
Black Spruce - Balsam Fir Krummholz

Figure 7. A high-elevation Black Spruce-Balsam Fir Krummholz on Mount Washington, New Hampshire. The stunted, wind pruned thickets area a result of the extreme climate, allowing for growth on the leeward side of prevailing winds. Photo taken May 17th, 2024.

This community is found at wind exposed alpine peaks and exposed high elevation summits, typically from 3500 to 4900 feet (1067 to 1494 meters). Soils are often thin organic Histosols or peat over bedrock. These trees are often stunted in form, matted, and wind pruned thickets, often no higher than 7 feet (2 meters) and usually of 60 to 100% cover. A variable mixture of *Picea mariana*, *Abies balsamea*, and *Betula papyrifera* var. cordifolia are the dominant trees, with dwarf-shrubs and herbs including *Ledum groenlandicum*, *Vaccinium uliginosum*, *Empetrum nigrum*, *Vaccinium vitis-idaea*, *Clintonia borealis*, *Cornus canadensis*, *Sibbaldiopsis tridentata*, *Trientalis borealis*, *Gaultheria hispidula*, and *Solidago macrophylla*. Within the Northeast US, this community type correlates to Maine's "Spruce – fir – birch krummholz" concept (Gawler and Cutko 2010), New Hampshire's "Black spruce – balsam fir" concept (Sperduto and Nichols 2012), New York's "Alpine krummholz" concept (Edinger et al. 2014), and Vermont's "Subalpine Krummholz" concept (Thompson, Sorenson, and Zaino 2019). This correlates with NatureServes '*Picea mariana* - *Abies balsamea* / *Sibbaldiopsis tridentata* Shrubland' Association (CEGL006038).

Dominant plant species

- black spruce (*Picea mariana*), tree
- balsam fir (*Abies balsamea*), tree
- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- shrubby fivefingers (*Sibbaldiopsis tridentata*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- sedge (*Carex*), grass
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- bluebead (*Clintonia borealis*), other herbaceous
- starflower (*Trientalis borealis*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- creeping snowberry (*Gaultheria hispidula*), other herbaceous
- goldenrod (*Solidago*), other herbaceous
- mountain woodsorrel (*Oxalis montana*), other herbaceous
- threeleaf goldthread (*Coptis trifolia*), other herbaceous
- polytrichum moss (*Polytrichum*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- dicranum moss (*Dicranum*), other herbaceous

Community 1.2
(Black Spruce - Balsam Fir) / Sheep Laurel - Bog Labrador-tea Dwarf Shrubland

This community is found between the lower open alpine ridges and the lower elevation forests. Exposed bedrock is typical; soil development is minimal and restricted to crevices or sheltered areas, where shallow organic accumulation occurs over thin mineral layers, often consisting of stony, coarse gravels and sands over gravel, scree, or bedrock. Physiognomy of this community is variable, ranging from sparse woodland to shrubland to sparsely vegetated rock; with the tree canopy often averaging less than 20% as stunted individuals (up to 7 feet [2 meters] tall). Tall shrubs may be scattered, or form patches in somewhat protected areas. The dwarf-shrub layer is very well-developed, and the dominant feature of the vegetation (20 to 100% cover; 3 to 12 inches [7 to 30 cm] tall). Herbs are sparse. The bryoid layer is variable but is often extensive, with both bryophytes and lichens. The most typical trees are *Picea mariana*; associates include *Abies balsamea*, and *Betula papyrifera* var. cordifolia. Characteristic tall shrubs are *Ilex mucronata*, *Sorbus americana*, *Sorbus decora*, and *Viburnum nudum* var. cassinoides. *Kalmia angustifolia* and *Ledum groenlandicum* are prominent dwarf heaths, in association with others such as *Vaccinium angustifolium*, *Vaccinium myrtilloides*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, *Gaylussacia baccata*, *Rhododendron canadense*, *Empetrum nigrum*, and *Empetrum eamesii* ssp. atropurpureum. At the higher elevations (greater than 4,000 feet [1220 m]), *Kalmia angustifolia* drops out. Herbs include *Sibbaldiopsis tridentata*, *Maianthemum canadense*, *Deschampsia flexuosa*, and *Geocaulon lividum*. The bryoid layer includes *Pleurozium schreberi*, *Polytrichum commune*, *Leucobryum glaucum*, and Cetraria and Cladonia lichens. This community is distinguished from other northeastern subalpine/alpine types by the prevalence of dwarf-shrubs (rather than tree species or bare rock) and the lack of true alpine plants (*Diapensia lapponica*, *Carex bigelowii*, etc). While this community description in NatureServe may extend below the range of this site concept, the higher elevation (greater than 3500 ft (1067 meters)) sites may fall under this phase. Within the Northeast US, this community type correlates to Maine's "Rocky Summit Heath" concept (Gawler and Cutko 2010), New Hampshire's "Labrador tea heath - krummholz" and "Sheep laurel - Labrador tea heath - krummholz" concepts (Sperduto and Nichols 2012), New York's "Alpine krummholz" concept (Edinger et al. 2014), and Vermont's "Subalpine Krummholz" concept (Thompson, Sorenson, and Zaino 2019). This correlates with NatureServes '(*Picea mariana*, *Abies balsamea*) / *Kalmia angustifolia* - *Ledum groenlandicum* Dwarf-shrubland' Association (CEGL006031).

Dominant plant species

- black spruce (*Picea mariana*), tree
- balsam fir (*Abies balsamea*), tree
- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- catberry (*Ilex mucronata*), shrub
- American mountain ash (*Sorbus americana*), shrub
- northern mountain ash (*Sorbus decora*), shrub
- withe-rod (*Viburnum nudum var. cassinoides*), shrub
- sheep laurel (*Kalmia angustifolia*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- velvetleaf huckleberry (*Vaccinium myrtilloides*), shrub
- lowbush blueberry (*Vaccinium angustifolium*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- black huckleberry (*Gaylussacia baccata*), shrub
- rhodora (*Rhododendron canadense*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- wavy hairgrass (*Deschampsia flexuosa*), grass
- Canada mayflower (*Maianthemum canadense*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- polytrichum moss (*Polytrichum commune*), other herbaceous
- leucobryum moss (*Leucobryum glaucum*), other herbaceous
- cetraria lichen (*Cetraria*), other herbaceous
- cup lichen (*Cladonia*), other herbaceous

Community 1.3

Deciduous Dominated Krummholz / Shrubland

This community may be found as a dominantly deciduous stunted shrubland / dwarf forest, often a result of disturbances where large areas are laid bare and organic material is scraped off the surface. These hardwood communities may persist for extended periods of time (persisting for up to multiple decades), building up an organic duff layer needed for softwood regeneration. Dominant species often include *Betula papyrifera* var. cordifolia, *Alnus viridis* var. crispa, *Acer spicatum*, and *Sorbus americana*. Stunted softwood species may be present in smaller amounts, and may include *Abies balsamea* and *Picea mariana*, with *P. rubens* possibly replacing *P. mariana* at lower elevation krummholz. As this community persists and organic material is built up, boreal herbs, mosses, and lichens may become temporarily present in small openings among and beneath the shrubs before reverting to a spruce-fir dominated krummholz.

Dominant plant species

- mountain paper birch (*Betula papyrifera var. cordifolia*), tree
- balsam fir (*Abies balsamea*), tree
- black spruce (*Picea mariana*), tree
- mountain alder (*Alnus viridis ssp. crispa*), shrub
- mountain maple (*Acer spicatum*), shrub
- American mountain ash (*Sorbus americana*), shrub
- northern mountain ash (*Sorbus decora*), shrub

Pathway 1.1A
Community 1.1 to 1.2

This transition can occur following individual mortality which results in a gap dynamic in which shrubs, herbs, and bryoids are most dominant. Individual trees may be present but will average less than 20%.

Pathway 1.2A
Community 1.2 to 1.1

This transition can occur as coniferous seedlings become established as the dominant life form. This transition may be very slow or may never occur, often as a result of shallow soil or crevices/ sheltered areas where tree roots may not become established.

Pathway 1.3A
Community 1.3 to 1.1

This transition can occur if the basic requirements for successful spruce-fir regeneration are met, primarily an adequate seed supply, proper seedbed, and light, temperature, and moisture conditions are conductive for seed germination and survival. More study is needed to fully characterize the transition from a hardwood dominant krummholz / shrubland back to a spruce – fir krummholz.

Pathway 1.3B
Community 1.3 to 1.2

This transition can occur following individual mortality which results in a gap dynamic in which shrubs, herbs, and bryoids are most dominant. Individual trees may be present but will average less than 20%.

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
- Wind erosion

- Classic gully erosion

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

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 alpine communities, allowing the soil and seedbank to recover without disturbance from human traffic. This is often a very slow and sensitive process and requires more detailed study.

Additional community tables

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.

Other references

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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:**