USDA Natural Resources Conservation Service

Ecological site R231XY113AK
Alpine Dwarf Scrub Gravelly Moist Slopes

Last updated: 2/13/2024
Accessed: 07/18/2024

General information

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

MLRA notes

Major Land Resource Area (MLRA): 231X–Interior Alaska Highlands

The Interior Alaska Uplands (MLRA 231X) is in the Interior Region of Alaska and includes the extensive hills, mountains, and valleys between the Tanana River to the south and the Brooks Range to the north. These hills and mountains surround the Yukon Flats Lowlands (MLRA 232X). MLRA 231X makes up about 69,175 square miles. The hills and mountains of the area tend to be moderately steep to steep resulting in high-relief slopes. The mountains are generally rounded at lower elevations and sharp-ridged at higher elevations. Elevation ranges from about 400 feet in the west, along the boundary with the Interior Alaska Lowlands (MLRA 229X), to 6,583 feet at the summit of Mt. Harper, in the southeast. Major tributaries include large sections of the Yukon, Koyukuk, Kanuti, Charley, Coleen, and Chatanika Rivers. This area is traversed by several major roads, including the Taylor Highway in the east and the Steese, Elliott, and Dalton Highways north of Fairbanks. The area is mostly undeveloped wild land that is sparsely populated. The largest community along the road system is Fairbanks with smaller communities like Alatna, Allakaket, Chicken, Eagle, Eagle Village, Hughes, and Rampart occurring along the previously mentioned rivers and highways.

The vast majority of this MLRA was unglaciated during the Pleistocene epoch with the exceptions being the highest mountains and where glaciers extended into the area from the Brooks Range. For the most part, glacial moraines and drift are limited to the upper elevations of the highest mountains. Most of the landscape is mantled with bedrock colluvium originating from the underlying bedrock. Valley bottoms are filled with Holocene fluvial deposits and colluvium from the adjacent mountain slopes. Silty loess, which originated from unvegetated flood plains in and adjacent to this area, covers much of the surface. On hill and mountain slopes proximal to major river valleys (e.g., Tanana and Yukon Rivers), the loess is many feet thick. As elevation and distance from major river valleys increases, loess thickness decreases significantly. Bedrock is commonly exposed on the highest ridges.

This area is in the zone of discontinuous permafrost. Permafrost commonly is close to the surface in areas of the finer textured sediments throughout the MLRA. Isolated masses of ground ice occur in thick deposits of loess on terraces and the lower side slopes of hills. Solifluction lobes, frost boils, and circles and stripes are periglacial features common on mountain slopes in this area. Pingos, thermokarst pits and mounds, ice-wedge polygons, and earth hummocks are periglacial features common on terraces, lower slopes of hills and mountains, and in upland valleys in the area.

The dominant soil orders in this area are Gelisols, Inceptisols, Spodosols, and Entisols. The soils in the area have a subgelic or cryic soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. Gelisols are common on north facing slopes, south facing footslopes, valley bottoms, and stream terraces. Gelisols are typically shallow or moderately deep to permafrost (10 to 40 inches) and are poorly or very poorly drained. Wildfires can disturb the insulating organic material at the surface, lowering the permafrost layer, eliminating perched water tables from Gelisols, and thus changing the soil classification. Inceptisols and Spodosols commonly form on south facing hill and mountain slopes. Entisols are common on flood plains and high elevation mountain slopes. Miscellaneous (non-soil) areas make up about 2 percent of this MLRA. The most common miscellaneous areas are rock outcrop and rubble land. In many valleys placer mine tailings are common.

Short, warm summers and long, cold winters characterize the subarctic continental climate of the area. The mean annual temperature of the area ranges from 22 to 27 degrees F. The mean annual temperature of the southern half of the area is approximately 3 degrees warmer compared to the northern half (PRISM 2018). The warmest months span June through August with mean monthly temperatures ranging from 50 to 56 degrees F. The coldest months span November through February with mean monthly temperatures ranging from -5 to 3 degrees F. When compared to the high-elevation alpine and subalpine life zones, the lower elevation boreal life zone tends to be 2-3 degrees F colder during the coldest months and 1-2 degrees F warmer during the warmest months (PRISM 2018). The freeze-free period at the lower elevations averages about 60 to 100 days, and the temperature usually remains above freezing from June through mid-September.

Precipitation is limited across this area, with the average annual precipitation ranging from 12 to 19 inches. The southern half of the areas receives approximately 2.5 inches more annual precipitation then the northern half (PRISM 2018). The lower elevation boreal life zone receives approximately 2.5 inches less annual precipitation than the high-elevation alpine and subalpine life zones (PRISM 2018). Approximately 3/5th of the annual precipitation occurs during the months of June through September with thunderstorms being common. The average annual snowfall ranges from about 45 to 100 inches. The ground is consistently covered with snow from November through March.

Most of this area is forested below an elevation of about 2500 feet. Dominant tree species on slopes are white spruce and black spruce. Black spruce stands are most common on north-facing slopes, stream terraces, and other sites with poor drainage and permafrost. White spruce stands are most common on warm slopes with dry soils. At lower elevations, lightning-caused wildfires are common, often burning many thousands of acres during a single fire. Following wildfires, forbs, grasses, willow, ericaceous shrubs, paper birch, and quacking aspen communities are common until they are eventually replaced by stands of spruce. Tall willow and alder scrub is extensive on low flood plains. White spruce and balsam poplar are common on high flood plains.

With increasing elevation, the forests and woodlands give way to subalpine communities dominated by krummholz spruce, shrub birch, willow, and ericaceous shrubs. At even higher elevations, alpine communities prevail which are characterized by diverse forbs, dwarf ericaceous shrubs, and eightpetal mountain-avens. Many of these high elevation communities have a considerable amount of lichen cover and bare ground.

LRU notes

This area supports three life zones defined by the physiological limits of plant communities along an elevational gradient: boreal, subalpine, and alpine. The boreal life zone is the elevational band where forest communities dominate. Not all areas in the boreal life zone are forest communities, however, particularly in places with too wet or dry soil to support tree growth (e.g., bogs or river bluffs). Above the boreal band of elevation, subalpine and alpine vegetation dominate. The subalpine zone is typically a narrow transitional band between the boreal and the alpine life zones, and is characterized by sparse, stunted trees. In the subalpine, certain types of birch and willow shrub species grow at ≥ 1 m in height (commonly *Betula glandulosa* and Salix pulchra). In the alpine, trees no longer occur, and all shrubs are dwarf or lay prostrate on the ground. In this area, the boreal life zone occurs below 2500 feet elevation on average. The transition between boreal and alpine vegetation can occur within a range of elevations, and is highly dependent on slope, aspect, and shading from adjacent mountains.

Within each life zone, there are plant assemblages that are typically associated with cold slopes and warms slopes. Cold slopes and warm slopes are created by the combination of the steepness of the slope, the aspect, and shading from surrounding ridges and mountains. Warm slope positions typically occur on southeast to west facing slopes that are moderate to very steep (>10% slope) and are not shaded by the surrounding landscape. Cold slopes typically occur on northwest to east facing slopes, occur in shaded slope positions, or occur in low-lying areas that are cold air sinks. Examples of shaded positions include head slopes, low relief backslopes of hills, and the base of hills and mountains shaded by adjacent mountain peaks. Warm boreal slope soils have a cryic soil temperature regime and lack permafrost. In this area, white spruce forests are an indicator of warm boreal slopes. Cold boreal slope soils typically have a gelic soil temperature regime and commonly have permafrost. In this area, black spruce forests and woodlands are an indicator of cold boreal slopes. The boreal life zone can occur at higher elevations on warm slopes, and lower elevations on cold slopes.

Classification relationships

Landfire BPS – 7616101 – Western North American Boreal Mesic Scrub Birch-Willow Shrubland - Boreal

Ecological site concept

This site occurs on alpine slopes with moist, gravelly soils that do not have permafrost. This site is associated with backslopes of mountains at high elevation. Solifluction lobes are common periglacial features that develop from the slow, viscous downslope flow of water-saturated soil (Schoeneberger and Wysocki 2017). For this site, formation of solifluction lobes results in unique vegetation and an altered state. Reference and solifluction state soils do not flood but do occasionally pond. These somewhat poorly to poorly drained soils have a high-water table during the early portion of the growing season and remain moist throughout the year. The soils formed in silty parent material and gravelly parent material. Soils with residuum commonly contact bedrock at moderate depths.

The alpine life zone has a harsh climate that limits growth of vegetation and prevents the establishment of many species common at lower elevations. In this area, alpine vegetation is characterized as dwarf and prostrate shrubs intermixed with low-lying herbaceous plants. These unique plant communities are the result of high winds, a short growing season, deep and persistent snow beds, and cold soils. These climatic factors prevent the establishment and growth of many dominant boreal species like white spruce and black spruce.

The reference plant community is characterized as willow dwarf scrub (Viereck et al. 1992). Krummholz white spruce occasionally occur but have limited cover. Common species include tealeaf willow, Chamisso's willow, scrub birch, lingonberry, eight petal mountain-avens, dwarf birch, white arctic mountain heather, crowberry, marsh Labrador tea, Bigelow's sedge, curled snow lichen, splendid feathermoss, Schreber's big red stem moss, knights plume moss, and Sphagnum. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), and mosses.

The solifluction state has three distinct communities all associated with different positions on or adjacent to the solifluction lobe. The first plant community occurs upslope from the solifluction lobe (community 2.1) and generally resembles the reference plant community. The second plant community occurs on the solifluction, has more productive shrubs, and is classified as closed low scrub (Viereck et al. 1992). The third community occurs downslope from the solifluction lobe (community 2.3.) and is a protected position that collects wind drifted snow that is classified as dryas dwarf scrub (Viereck et al. 1992).

Associated sites

R231XY101AK	**Alpine dwarf scrub gravelly slopes** Occurs in the alpine but on dry, gravelly soils without permafrost.
R231XY115AK	**Alpine sedge silty frozen slopes** Occurs on the same alpine slopes but with siltier soils that are frozen.
R231XY134AK	**Alpine Dwarf Scrub Gravelly Frozen Slopes** Occurs on the same alpine slopes but with wet, gravelly, and frozen soils.
R231XY152AK	**High-elevation scrub gravelly drainageways** Occurs downslope in high elevation drainageways.

Similar sites

R231XY106AK	**Alpine Dwarf Scrub Gravelly Frozen Alkaline Slopes** Both sites occur on alpine slopes with moist, gravelly, and frozen soils. Site 106 has alkaline soils resulting in different kinds and amounts of vegetation.
R231XY115AK	**Alpine sedge silty frozen slopes** Site 115 has siltier, frozen soils. Plant communities associated with 115 tend to have less shrub cover and more sedge cover.
R231XY134AK	**Alpine Dwarf Scrub Gravelly Frozen Slopes** Site 134 has gravelly, frozen soils. The frozen layer perches water so soils are saturated for longer durations of time. Site 134 has different kinds and amounts of vegetation.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Salix pulchra* (2) *Betula glandulosa*
Herbaceous	(1) *Carex bigelowii* (2) *Hylocomium splendens*

Physiographic features

This site occurs at high elevation on slopes that commonly have solifluction lobes in the alpine life zone. This site is associated with backslopes of mountains. Solifluction lobes are common which are isolated tongue-shaped mounds that are often 25 feet or more wide, 300 feet or more long, and have a steep front. At the base of the steep fronted solifluction lobes are nivation hallows that can accumulate deep snowdrifts. Elevation typically ranges between 2500 and 3950 feet but can go as low as 2300 feet on colder backslopes and up to 4500 feet or more on warmer backslopes. Slopes commonly range from strongly sloping to moderately steep, and this site occurs on all aspects. This site does not flood and often does not pond, though some gently sloping areas can pond occasionally for brief durations of time. A water table occurs at very shallow to shallow depths during the early portions of the growing season. This site generates limited runoff to adjacent, downslope sites.

Figure 1. Solifluction lobes on a mountain slope in the area.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope
Landforms	(1) Mountains > Mountain slope (2) Mountains > Mountain slope > Solifluction lobe (3) Mountains > Mountain slope > Nivation hollow
Runoff class	Low to medium
Flooding frequency	None
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to occasional
Elevation	762–1,006 m
Slope	8–20%
Ponding depth	15 cm
Water table depth	0–25 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding duration	Not specified
Ponding frequency	Not specified
Elevation	701–1,501 m
Slope	1–55%
Ponding depth	30 cm
Water table depth	0–51 cm

Climatic features

When compared to the boreal life zone, this high-elevation site has a harsh climate. In this MLRA, snow first blankets and persists the longest in the alpine and subalpine life zones. From spring through fall (April through September) , it is consistently 1 to 2 degrees F colder in the alpine and subalpine. These small differences in temperature are exacerbated due to constant and strong winds. Winds are much more intense in these high elevation areas because of limited trees providing windbreaks. When compared to the boreal life zone, this site has a much shorter growing season and the growing season is significantly colder for associated vegetation.

Short, warm summers and long, cold winters characterize the subarctic continental climate associated with this high-elevation site. The mean annual temperature of the site ranges from 23 to 27 degrees F. The warmest months span June through August with mean normal maximum monthly temperatures ranging from 57 to 63 degrees F. The coldest months span November through February with mean normal minimum temperatures ranging from -9 to -1 degrees F. The freeze-free period for the site ranges from 80 to 120 days, and the temperature usually remains above freezing from late May through mid-September.

The area receives minimal annual precipitation with the summer months being the wettest. Average annual precipitation in the alpine across the area typically ranges between 14 to 21 inches. Approximately 3/5th of the annual precipitation occurs during the months of June through September with thunderstorms common. The average annual snowfall ranges from about 45 to 100 inches. The ground is consistently covered with snow from mid-October through March.

Table 4. Representative climatic features

Frost-free period (characteristic range)	16-78 days
Freeze-free period (characteristic range)	76-114 days
Precipitation total (characteristic range)	356-533 mm
Frost-free period (actual range)	4-87 days
Freeze-free period (actual range)	48-120 days
Precipitation total (actual range)	254-635 mm
Frost-free period (average)	53 days
Freeze-free period (average)	90 days
Precipitation total (average)	432 mm

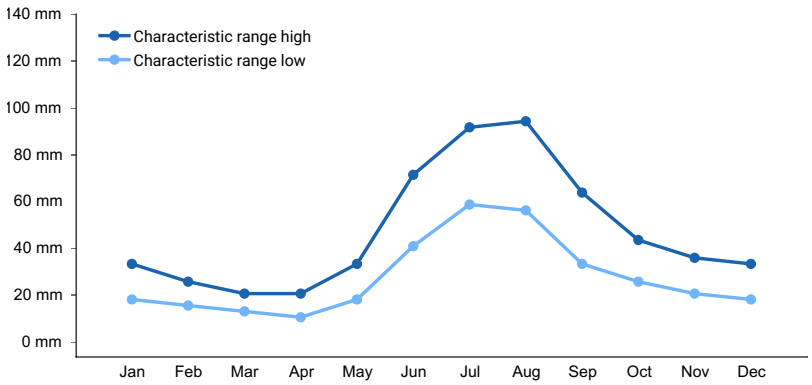


Figure 2. Monthly precipitation range

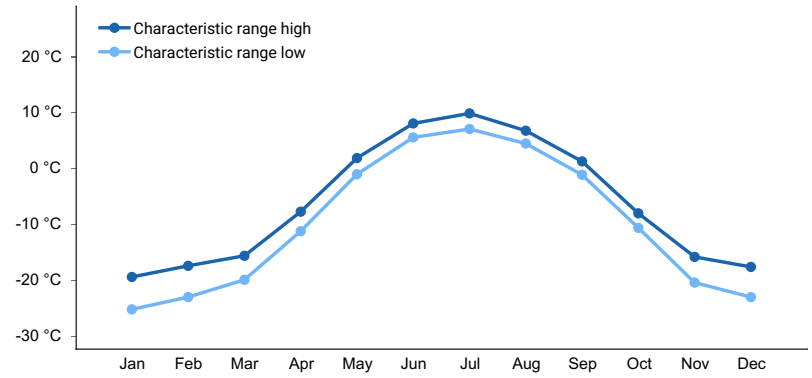


Figure 3. Monthly minimum temperature range

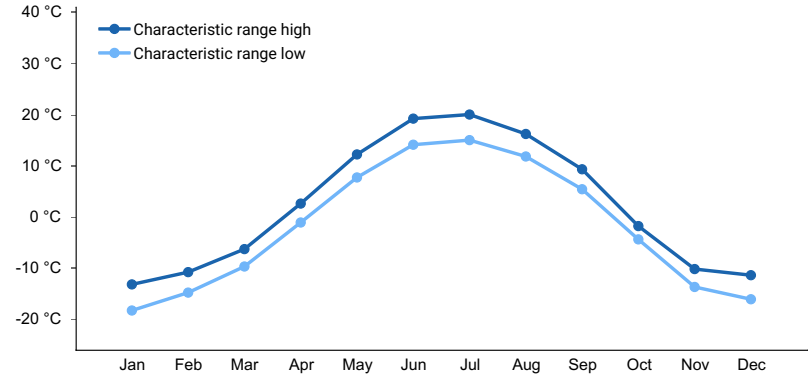


Figure 4. Monthly maximum temperature range

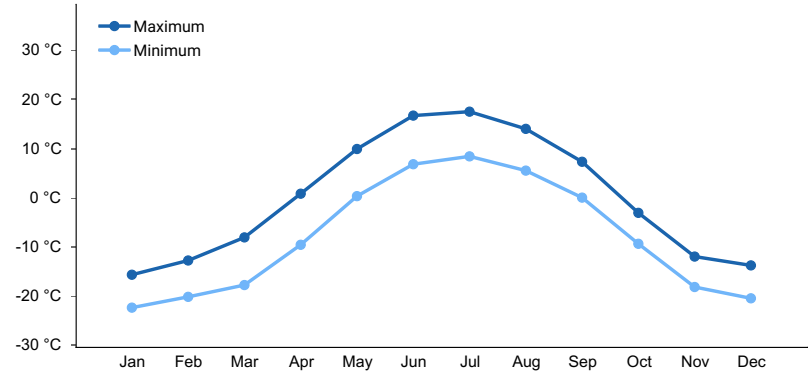


Figure 5. Monthly average minimum and maximum temperature

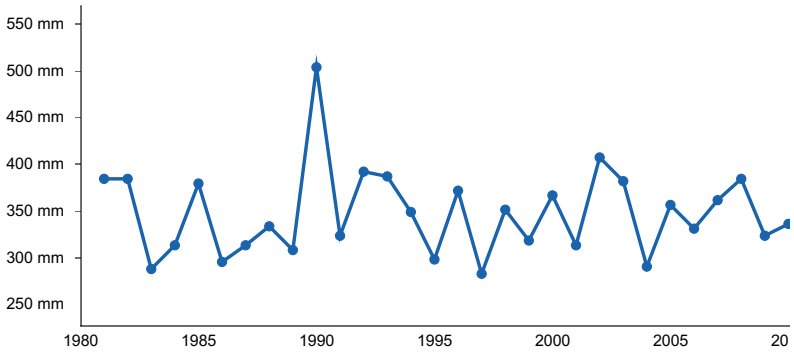


Figure 6. Annual precipitation pattern

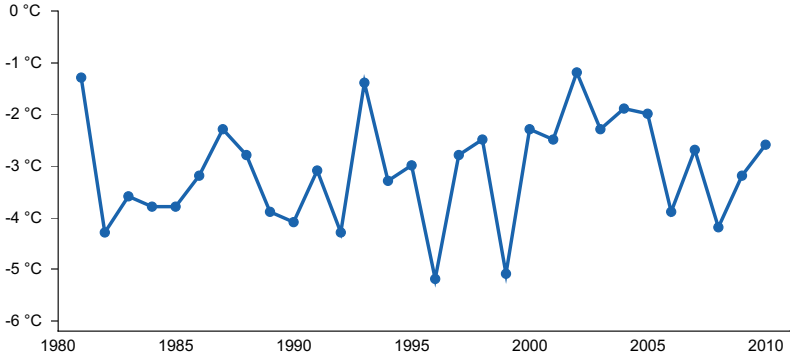


Figure 7. Annual average temperature pattern

Climate stations used

- (1) EAGLE AP [USW00026422], Tok, AK
- (2) CHICKEN [USC00501684], Tok, AK
- (3) MILE 42 STEESE [USC00505880], Fairbanks, AK
- (4) BETTLES AP [USW00026533], Bettles Field, AK
- (5) CIRCLE HOT SPRINGS [USC00501987], Central, AK
- (6) FT KNOX MINE [USC00503160], Fairbanks, AK
- (7) GILMORE CREEK [USC00503275], Fairbanks, AK
- (8) FOX 2SE [USC00503181], Fairbanks, AK
- (9) ESTER DOME [USC00502868], Fairbanks, AK
- (10) ESTER 5NE [USC00502871], Fairbanks, AK
- (11) COLLEGE 5 NW [USC00502112], Fairbanks, AK
- (12) COLLEGE OBSY [USC00502107], Fairbanks, AK
- (13) KEYSTONE RIDGE [USC00504621], Fairbanks, AK

Influencing water features

At times, the reference state can be classified as a Slope wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008). Precipitation and ground water are the main sources of water (Smith et al. 1995).

Depth to the water table may decrease following summer storm events or spring snowmelt and increase during extended dry periods.

Soil features

Soils formed in windblown silt and gravelly parent material and do not have permafrost. Surface rock fragments are common and at the highest range of associated elevation can range up to 40 percent cover. These are mineral soils capped with 2 to 4 inches of organic material. The mineral soil below the organic material is a silt loam derived from wind-blown loess commonly cryoturbated with gravelly colluvium or residuum. Rock fragments tend to increase significantly with increased depth and typically range between 30 to 80 percent of the soil profile by

volume. Soils with residuum commonly contact bedrock at moderately deep to deep depths (24 to 52 inches). Soils with colluvium are very deep without restrictions. The pH of the soil profile generally ranges from strongly acidic to slightly acidic. A perched water table sits on seasonal frost early in the growing season and soils range from poorly to somewhat poorly drained.

Figure 8. A typical soil profile associated with this site.

Table 5. Representative soil features

Parent material	(1) Loess (2) Eolian deposits (3) Colluvium (4) Residuum
Surface texture	(1) Stony silt loam (2) Very cobbly silt loam
Family particle size	(1) Loamy-skeletal (2) Sandy or sandy-skeletal
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	61 cm
Soil depth	61 cm
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	1.52–11.94 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	4–8%
Electrical conductivity (25.4-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (25.4-101.6cm)	0
Soil reaction (1:1 water) (25.4-101.6cm)	5.1–6
Subsurface fragment volume <=3" (0-152.4cm)	15–35%
Subsurface fragment volume >3" (0-152.4cm)	15–45%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–30%
Available water capacity (0-101.6cm)	1.52–18.03 cm
Calcium carbonate equivalent (25.4-101.6cm)	Not specified
Clay content (0-50.8cm)	Not specified
Electrical conductivity (25.4-101.6cm)	Not specified
Sodium adsorption ratio (25.4-101.6cm)	Not specified
Soil reaction (1:1 water) (25.4-101.6cm)	5–6.5
Subsurface fragment volume <=3" (0-152.4cm)	10–40%
Subsurface fragment volume >3" (0-152.4cm)	10–45%

Ecological dynamics

Climate

Located in the alpine life zone, this site is exposed to a variety of harsh environmental conditions. In this area, snowfall first appears and persists the longest in the alpine. As a result, snowpack tends to be deeper and persist for longer durations of time compared to lower-elevation sites and alpine vegetation has a comparatively shorter growing season. When this site is snow-free, cold soil temperatures and high winds also inhibit plant growth and vigor. This harsh climate maintains the dwarfed vegetation within this site and prevents the establishment and/or growth of dominant boreal species like white spruce and black spruce.

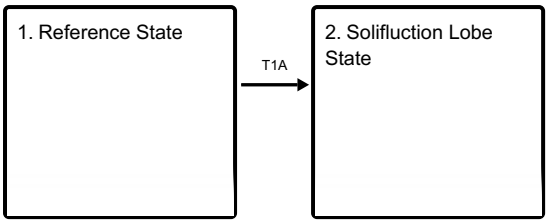
Solifluction Lobe State

Solifluction lobes are a type of patterned ground that develop from the slow, viscous downslope flow of water-saturated soil (Schoeneberger and Wysocki 2017). A solifluction lobe is an isolated tongue-shaped feature that for this site is commonly 25 feet or more wide and 300 feet or more long. This feature commonly has a steep front and a relatively smooth upper surface (Schoeneberger and Wysocki 2017) that for this site results in a unique mosaic of vegetation.

This vegetation mosaic has three distinct communities all associated with different positions on or adjacent to the solifluction lobe. The first plant community occurs upslope from the solifluction lobe (community 2.1) and generally resembles the reference state vegetation being willow dwarf scrub (Viereck et al. 1992). The second plant community occurs on the solifluction lobe (community 2.2), which has a substantially taller shrub community compared to the surrounding alpine vegetation and is classified as closed low scrub (Viereck et al. 1992). As it occurs on the steep face of these solifluction lobes, community 2.2 may have more productive shrubs due to comparatively warmer and drier soil conditions. The third community occurs downslope from the solifluction lobe (community 2.3.) and is a protected position that collects wind drifted snow that is classified as dryas dwarf scrub (Viereck et al. 1992).

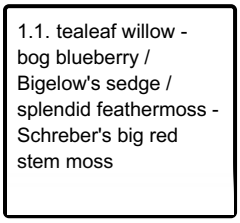
State and transition model

Ecosystem states

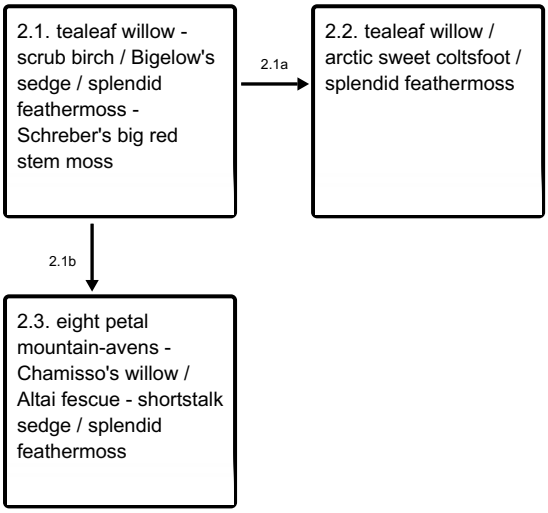


T1A - Solifluction formation

State 1 submodel, plant communities



State 2 submodel, plant communities



2.1a - formation of solifluction lobes

2.1b - formation of solifluction lobe

State 1
Reference State

Figure 9. A dwarf scrub community associated with the reference state.

The reference plant community is willow dwarf scrub (Viereck et al. 1992). There is one documented plant community in the reference state.

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous

Community 1.1
tealeaf willow - bog blueberry / Bigelow's sedge / splendid feathermoss - Schreber's big red stem moss

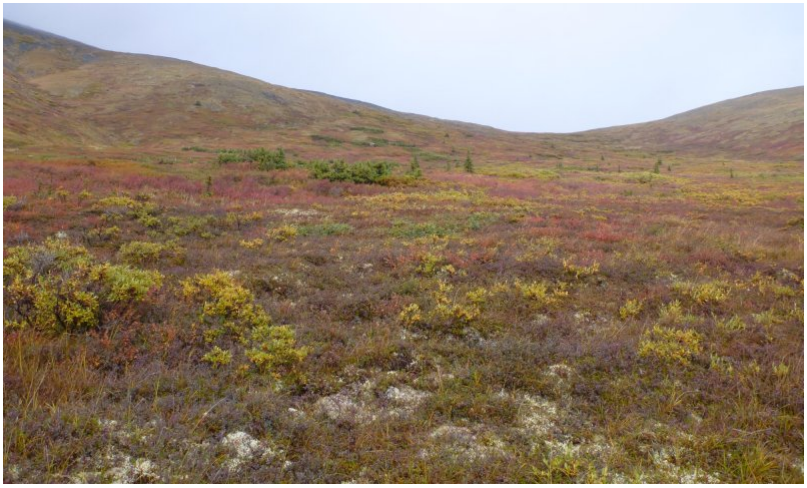


Figure 10. A typical plant community associated with community 1.1.

The reference plant community is characterized as willow dwarf scrub (Viereck et al. 1992). Stunted white spruce occasionally occur but have limited cover. Common species include tealeaf willow, Chamisso's willow, scrub birch (*Betula glandulosa*), lingonberry, eight petal mountain-avens, dwarf birch, white arctic mountain heather, crowberry, marsh Labrador tea, Bigelow's sedge, curled snow lichen (*Flavocetraria cucullata*), splendid feathermoss, Schreber's big red stem moss, knights plume moss, and Sphagnum. The vegetative strata that characterize this community are dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), and mosses. The soil surface is primarily covered with herbaceous litter and moss.

Forest understory. In some instances, tealeaf willow and scrub birch grew tall enough to be considered a low shrub (between 8 and 36 inches). This generally occurred at the lower bands of elevation associated with this site. In these instances, community 1.1 was classified as open low scrub.

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- resin birch (*Betula glandulosa*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- eightpetal mountain-avens (*Dryas octopetala ssp. octopetala*), shrub
- dwarf birch (*Betula nana*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- Chamisso's willow (*Salix chamissonis*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- knights plume moss (*Ptilium crista-castrensis*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

State 2
Solifluction Lobe State

Figure 11. Solifluction lobes on an alpine slopes in the White Mountains National Recreation Area.

Figure 12. A mosaic of vegetation on and adjacent to solifluction lobes.

Solifluction is the slow, viscous downslope flow of water-saturated soil (Shoeneberger and Wysocki 2017). This process is most active for this site during spring thaw where the upper band of soil material slips on a seasonally frozen layer. Solifluction is a common process associated with many ecological sites in this area. However, this site can experience solifluction to a degree that results in the formation of solifluction lobes. A solifluction lobe is an isolated tongue-shaped feature up to 25 meters wide and 150 meters or more long, formed by the rapid solifluction

of certain sections of a slope showing variations in gradient. This feature commonly has a steep front and a relatively smooth upper surface (Shoeneberger and Wysocki 2017). Larger solifluction lobes tend to have a distinct mosaic of vegetation, while smaller solifluction lobes do not. The presence of this vegetation mosaic led to the development of an alternate state. This vegetation mosaic has three distinct communities all associated with different positions on or adjacent to the solifluction lobe. The first plant community occurs upslope from the solifluction lobe (community 2.1) and generally resembles the reference state vegetation. The second plant community occurs on the solifluction lobe (community 2.2) , which has a productive stand of shrubs that grow substantially taller compared to the surrounding alpine vegetation. The steep front associated with large solifluction lobes results in comparatively warmer and drier soils. The third community occurs downslope from the solifluction lobe (community 2.3.) and is a protected position that collects wind drifted snow. Community 2.3 has deep snowpack that persists for longer durations of time compared to surrounding vegetation, which results in comparatively moister soils.

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- arctic sweet coltsfoot (*Petasites frigidus*), other herbaceous

Community 2.1
tealeaf willow - scrub birch / Bigelow's sedge / splendid feathermoss - Schreber's big red stem moss

Figure 13. A typical plant community associated with community 2.1.

This plant community is characterized as either willow dwarf scrub or open low scrub (Viereck et al. 1992) with tealeaf willow and scrub birch the dominant vegetation. Krummholz white spruce occasionally occur but have limited cover. Other common species include bog blueberry, dwarf birch, eight petal mountain-avens, lingonberry, Chamisso's willow, white arctic mountain heather, Bigelow's sedge, curled snow lichen, splendid feathermoss, Schreber's big red stem moss, and knights plume moss. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), and mosses. The soil surface is primarily covered with herbaceous litter and moss.

Forest understory. When comparing communities 1.1 and 2.1, both tealeaf willow and scrub birch tend to grow taller directly adjacent to solifluction lobes.

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- resin birch (*Betula glandulosa*), shrub
- dwarf birch (*Betula nana*), shrub
- eightpetal mountain-avens (*Dryas octopetala ssp. octopetala*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub

- Chamisso's willow (*Salix chamissonis*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- Bigelow's sedge (*Carex bigelowii*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- knights plume moss (*Ptilium crista-castrensis*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous

Community 2.2
tealeaf willow / arctic sweet coltsfoot / splendid feathermoss

Figure 14. A typical plant community associated with community 2.2. Shrubs on the solifluction lobe are significantly larger than the surrounding alpine vegetation.

This plant community is characterized as closed low scrub (Viereck et al. 1992) with tealeaf willow the dominant overstory vegetation. Other common species include scrub birch, bog blueberry, bluejoint, arctic sweet coltsfoot, tall Jacob's-ladder, larkspurleaf monkshood, narcissus anemone, boreal sagebrush, splendid feathermoss, Schreber's big red stem moss, and Sphagnum. The vegetative strata that characterize this community are medium shrubs (between 3 and 10 feet), medium forbs (between 4 and 24 inches), and mosses. The soil surface is primarily covered with herbaceous litter and moss.

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- resin birch (*Betula glandulosa*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- arctic sweet coltsfoot (*Petasites frigidus*), other herbaceous
- tall Jacob's-ladder (*Polemonium acutiflorum*), other herbaceous
- larkspurleaf monkshood (*Aconitum delphiniifolium*), other herbaceous
- narcissus anemone (*Anemone narcissiflora*), other herbaceous
- boreal sagebrush (*Artemisia arctica*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

Community 2.3
eight petal mountain-avens - Chamisso's willow / Altai fescue - shortstalk sedge / splendid feathermoss

Figure 15. A typical plant community associated with community 2.3.

This plant community is characterized as dryas dwarf scrub (Viereck et al. 1992). Common species include eight petal mountain-avens, Chamisso's willow, crowberry, white arctic mountain heather, netleaf willow, lingonberry, Altai fescue, shortstalk sedge, smallawned sedge, Bigelow's sedge, narcissus anemone, Rocky Mountain goldenrod, splendid feathermoss, Dicranum moss, and Schreber's big red stem moss. The vegetative strata that characterize this community are dwarf shrubs (less than 8 inches), medium graminoids (between 4 and 24 inches), medium forbs (between 4 and 24 inches), and mosses. The soil surface is primarily covered with herbaceous litter and moss.

Forest understory. The mountain-avens most commonly associated with this site is Dryas ajanensis (DROCO). The Flora of North America no longer recognizes eightpetal mountain-avens (Dryas octopetala) as occurring in Alaska and has split this species concept into several new species (Springer and Parfitt 2015).

Dominant plant species

- eightpetal mountain-avens (*Dryas octopetala ssp. octopetala*), shrub
- Chamisso's willow (*Salix chamissonis*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- netleaf willow (*Salix reticulata*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- Altai fescue (*Festuca altaica*), grass
- shortstalk sedge (*Carex podocarpa*), grass
- smallawned sedge (*Carex microchaeta*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- narcissus anemone (*Anemone narcissiflora*), other herbaceous
- dicranum moss (*Dicranum*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- Rocky Mountain goldenrod (*Solidago multiradiata*), other herbaceous

Pathway 2.1a
Community 2.1 to 2.2

tealeaf willow - scrub birch / Bigelow's sedge / splendid feathermoss - Schreber's big red stem moss

tealeaf willow / arctic sweet coltsfoot / splendid feathermoss

Rapid solifluction results in the development of large solifluction lobes. The steep front associated with these large solifluction lobes results in drier and warmer soils.

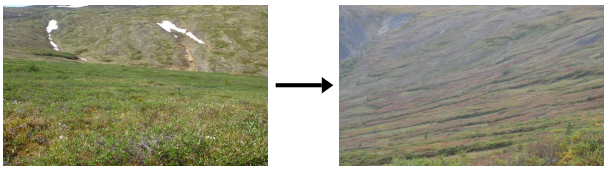
Pathway 2.1b
Community 2.1 to 2.3

tealeaf willow - scrub birch / Bigelow's sedge / splendid feathermoss - Schreber's big red stem moss

eight petal mountain-avens - Chamisso's willow / Altai fescue - shortstalk sedge / splendid feathermoss

Large solifluction lobes catch wind drifted snow. This snowpack persists for longer duration of time compared to the surrounding vegetation and result in slightly moister soils during the growing season.

Transition T1A
State 1 to 2



Reference State

Solifluction Lobe State

Solifluction results in the formation of a solifluction lobe. This solifluction lobe is large enough to result in a mosaic of vegetation.

Additional community tables

Table 7. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white spruce	PIGL	*Picea glauca*	Native	–	0–1	–	–
black spruce	PIMA	*Picea mariana*	Native	–	0–0.1	–	–

Table 8. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.1–0.3	7–30
Altai fescue	FEAL	*Festuca altaica*	Native	0.1–0.3	0–10
Forb/Herb					
boreal sagebrush	ARAR9	*Artemisia arctica*	Native	0.1–0.3	0–2
arctic sweet coltsfoot	PEFR5	*Petasites frigidus*	Native	0.1–0.3	0–2
lousewort	PEDIC	*Pedicularis*	Native	0.1–0.3	0–1
captiate valerian	VACA3	*Valeriana capitata*	Native	0.1–0.3	0–1
saxifrage	SAXIF	*Saxifraga*	Native	0.1–0.3	0–1
meadow bistort	POBI5	*Polygonum bistorta*	Native	0–0.1	0–0.1
Shrub/Subshrub					
tealeaf willow	SAPU15	*Salix pulchra*	Native	0.1–0.5	3–40
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0–0.2	0–35
resin birch	BEGL	*Betula glandulosa*	Native	0.1–0.5	0–30
dwarf birch	BENA	*Betula nana*	Native	0–0.2	0–25
white arctic mountain heather	CATE11	*Cassiope tetragona*	Native	0–0.2	0–20
eightpetal mountain-avens	DROCO	*Dryas octopetala ssp. octopetala*	Native	0–0.1	0–20
netleaf willow	SARE2	*Salix reticulata*	Native	0–0.1	0–20
black crowberry	EMNI	*Empetrum nigrum*	Native	0–0.1	0–15
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0–0.2	0–15
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0–0.1	0–15
Chamisso's willow	SACH	*Salix chamissonis*	Native	0–0.2	0–10
Nonvascular					
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0–0.1	0–60
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0–0.1	0–50
turgid aulacomnium moss	AUTU70	*Aulacomnium turgidum*	Native	0–0.1	0–45
sphagnum	SPHAG2	*Sphagnum*	Native	0–0.1	0–25
knights plume moss	PTCR70	*Ptilium crista-castrensis*	Native	0–0.1	0–25
	FLCU	*Flavocetraria cucullata*	Native	0–0.1	0–20
greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	Native	0–0.1	0–10
Richardson's masonhalea lichen	MARI60	*Masonhalea richardsonii*	Native	0–0.1	0–10
reindeer lichen	CLST5	*Cladina stygia*	Native	0–0.1	0–5
cetraria lichen	CELA60	*Cetraria laevigata*	Native	0–0.1	0–2
arctic dactylina lichen	DAAR60	*Dactylina arctica*	Native	0–0.1	0–1

Table 9. Community 2.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white spruce	PIGL	*Picea glauca*	Native	–	0–1	–	–

Table 10. Community 2.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.1–0.3	7–20
Forb/Herb					
boreal sagebrush	ARAR9	*Artemisia arctica*	Native	0.1–0.3	0–2
lousewort	PEDIC	*Pedicularis*	Native	0.1–0.3	0–1.1
arctic sweet coltsfoot	PEFR5	*Petasites frigidus*	Native	0.1–0.3	0–1
captiate valerian	VACA3	*Valeriana capitata*	Native	0.1–0.3	0–1
Shrub/Subshrub					
tealeaf willow	SAPU15	*Salix pulchra*	Native	0.2–0.9	10–40
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0–0.2	2–35
resin birch	BEGL	*Betula glandulosa*	Native	0.2–0.9	0–30
dwarf birch	BENA	*Betula nana*	Native	0.2–0.9	0–25
eightpetal mountain-avens	DROC	*Dryas octopetala*	Native	0–0.1	0–20
white arctic mountain heather	CATE11	*Cassiope tetragona*	Native	0–0.2	0–20
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0–0.1	0.1–15
Chamisso's willow	SACH	*Salix chamissonis*	Native	0–0.2	0–10
black crowberry	EMNI	*Empetrum nigrum*	Native	0–0.1	0–5
Nonvascular					
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0–0.1	0–60
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0–0.1	0–50
turgid aulacomnium moss	AUTU70	*Aulacomnium turgidum*	Native	0–0.1	0–45
knights plume moss	PTCR70	*Ptilium crista-castrensis*	Native	0–0.1	0–25
	FLCU	*Flavocetraria cucullata*	Native	0–0.1	0–20
aulacomnium moss	AUPA70	*Aulacomnium palustre*	Native	0–0.1	0–20
greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	Native	0–0.1	0–10
sphagnum	SPHAG2	*Sphagnum*	Native	0–0.1	0–10
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0–0.1	0–7
arctic dactylina lichen	DAAR60	*Dactylina arctica*	Native	0–0.1	0.1–1
	FLNI	*Flavocetraria nivalis*	Native	0–0.1	0–1

Table 11. Community 2.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
bluejoint	CACA4	*Calamagrostis canadensis*	Native	0.6–1.2	0–65
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.1–0.3	0–10
Forb/Herb					
arctic sweet coltsfoot	PEFR5	*Petasites frigidus*	Native	0.1–0.3	0–50
larkspurleaf monkshood	ACDE2	*Aconitum delphiniifolium*	Native	0.1–0.6	0–10
yellow thimbleweed	ANRI	*Anemone richardsonii*	Native	0–0.1	0–10
tall Jacob's-ladder	POAC	*Polemonium acutiflorum*	Native	0.1–0.3	0–7
narcissus anemone	ANNA	*Anemone narcissiflora*	Native	0.1–0.6	0–6
boreal sagebrush	ARAR9	*Artemisia arctica*	Native	0.1–0.6	0–4
captiate valerian	VACA3	*Valeriana capitata*	Native	0.1–0.3	0–2
ledge stonecrop	RHIN11	*Rhodiola integrifolia*	Native	0.1–0.3	0–1
Shrub/Subshrub					
tealeaf willow	SAPU15	*Salix pulchra*	Native	0.9–1.8	65–98
resin birch	BEGL	*Betula glandulosa*	Native	0.9–1.8	0–30
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0.2–0.6	0–15
Nonvascular					
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0–0.1	0–85
sphagnum	SPHAG2	*Sphagnum*	Native	0–0.1	0–15
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0–0.1	0–10

Table 12. Community 2.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Altai fescue	FEAL	*Festuca altaica*	Native	0.1–0.6	0–20
shortstalk sedge	CAPO	*Carex podocarpa*	Native	0.1–0.6	0–15
smallawned sedge	CAMI4	*Carex microchaeta*	Native	0.1–0.3	0–15
red fescue	FERU2	*Festuca rubra*	Native	0.1–0.3	0–10
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.1–0.3	0–7
Forb/Herb					
narcissus anemone	ANNA	*Anemone narcissiflora*	Native	0.1–0.3	0–35
Rocky Mountain goldenrod	SOMU	*Solidago multiradiata*	Native	0.1–0.3	0–20
larkspurleaf monkshood	ACDE2	*Aconitum delphiniifolium*	Native	0.1–0.3	0–5
western arctic shootingstar	DOFR	*Dodecatheon frigidum*	Native	0.1–0.3	0–5
boreal sagebrush	ARAR9	*Artemisia arctica*	Native	0.1–0.3	0–2
Shrub/Subshrub					
eightpetal mountain-avens	DROCO	*Dryas octopetala ssp. octopetala*	Native	0–0.1	10–30
Chamisso's willow	SACH	*Salix chamissonis*	Native	0–0.2	3–25
white arctic mountain heather	CATE11	*Cassiope tetragona*	Native	0–0.2	0–15
netleaf willow	SARE2	*Salix reticulata*	Native	0–0.1	0–15
black crowberry	EMNI	*Empetrum nigrum*	Native	0–0.1	0–10
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0–0.2	0–10
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0–0.1	0–5
Nonvascular					
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0–0.1	0–50
dicranum moss	DICRA8	*Dicranum*	Native	0–0.1	0–30
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0–0.1	0–30
turgid aulacomnium moss	AUTU70	*Aulacomnium turgidum*	Native	0–0.1	0–30
polytrichum moss	POLYT5	*Polytrichum*	Native	0–0.1	0–10
snow lichen	STERE2	*Stereocaulon*	Native	0–0.1	0–8

Animal community

n/a

Hydrological functions

n/a

Recreational uses

n/a

Wood products

n/a

Other products

n/a

Other information

n/a

Inventory data references

Tier 2 sampling plots used to develop the reference state. Plot numbers as recorded in NASIS with associated community phase.

Community 1.1

11BB03904, 12NR03503, 12NR03602, 12NR03604, 12SN1702, 2015AK290568, 2016AK290570, 2017AK290521, 2017AK290526

Community 2.1

12NR03503, 2015AK290568, 2016AK290570, 2017AK290521, 2017AK290526

Community 2.2

11BB04305, 11BB04309, 11MC01204, 13EG00803, 2015AK290569, 2016AK290569, 2017AK290520, 2017AK290525

Community 2.3

11MC01205, 12NR03502, 13EG00804, 2016AK290568, 2017AK290519

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Approval

Kirt Walstad, 2/13/2024

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	07/18/2024
Approved by	Kirt Walstad
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:**