USDA Natural Resources Conservation Service

Ecological site R228XY701AK
High elevation scrub-sedge depressions

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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): 228X–Interior Alaska Mountains

Physiography
The Interior Alaska Mountains Major Land Resource Area (MLRA) (228X) includes portions of the high mountain slopes, hills, and plains of the Alaska Range, Talkeetna Mountains, Chugach Mountains, Wrangell Mountains and the northern Aleutian Range. This MLRA comprises 54,205 square miles and consists of rugged, high mountains and low, rounded hills and extended footslopes along the base of the mountains. Most of the area is undeveloped wildland and includes true alpine and subalpine life zones. Geology consists of sedimentary, metamorphic, and igneous bedrock. Climate is considered continental subarctic.

MLRA boundaries
MLRA 228X is expansive and therefore shares a boundary with many MLRAs. Boundaries with other mountainous MLRAs such as 222X (Southern Alaska Coastal mountains), 223X (Cook Inlet Mountains), and 225X (Southern Alaska Peninsula Mountains) result from orogenic differences (225X,223X) or variation in climate (222X). Other MLRAs such as 236X (Bristol-Bay-Northern Alaska Peninsula Lowlands), 227X (Copper River Basin), 229X (Interior Alaska Lowlands), and 230X (Yukon-Kuskokwim Highlands) have distinct physiographic boundaries where steep mountains meet lowlands, basins, and floodplains.

Waterways
Encompassed within the Pacific Mountain system, the mountains of MLRA 228X are dissected by high-gradient valleys with braided floodplains in the valley bottoms. Glaciers, snowfields, and ice fields make up 15 percent of the area and elevations range from about 1,500 feet in the Copper River Basin to 20,320 feet at the summit of Denali. The major

rivers of this MLRA include the Tanana, Kuskokwim, and Copper, and drain into the Bering Sea (Tanana, Kuskokwim), and the Gulf of Alaska (Copper). The headwaters of the Susitna River are part of this MLRA and drain into Cook Inlet through the Cook Inlet Mountains, and Cook inlet Lowlands (MLRA 223X and 224X, respectively). This MLRA is in the zone of discontinuous permafrost, where permafrost mostly occurs in fine-textured soils on gently sloping landforms and/or on northerly aspects.

Geology
Except for the highest peaks and upper ridges, all of this area was glaciated during the late Pleistocene. Glacial deposits have mostly eroded or have been buried by colluvium and alluvium throughout the Holocene, yet some highly modified glacial deposits remain at lower elevations on low mountain slopes and valleys. Loess also occurs at lower elevations, and most valley bottoms have been buried by recent alluvial deposits. Bedrock geology is comprised of sedimentary, metamorphic, igneous, and volcanic rock, and gold mining does take place in this MLRA.

Soils
The dominant soil orders in MLRA 228X are Gelisols, Inceptisols, Spodosols, and Entisols. The Gelisols are shallow or moderately deep to permafrost, occur on finer textured sediments, and are poorly drained or very poorly drained. Common Gelisol suborders are Histels, Orthels, and Turbels. The Histels have thick accumulations of surface organic material and occur in depressions and peat plateau. The Orthels and Turbels have comparably thinner surface organic material and occur on drainageways, stream terraces, and outwash plains. The Inceptisols, Spodosols, and Entisols lack permafrost in the soil profile. Spodosols are formed from weathering processes that strip organic matter combined with aluminum from upper horizons and deposit them into lower horizons. Entisols and Inceptisols are characteristically undeveloped, with Inceptisols exhibiting only moderate weathering and development while Entisols exhibit little to no evidence of development at all. Soils have a subgelic or cryic temperature regime with aquic or udic moisture regime and mixed minerology. Miscellaneous areas make up 58 percent of this MLRA and are classified as rock outcrop, rubble land, and glaciers.

Climate
The climate of this area is characterized by brief, cool summer, and long, cold winters, but extreme variation in elevation results in a wide range of climatic conditions. Average annual precipitation ranges from 15 to 20 inches at lower elevations to 100 inches at high elevations. Rainfall is generally highest in July, August, and early September. The average annual snowfall ranges from 70 to 400 inches, and the average annual temperature at Denali Park headquarters is 27 degrees F. Freeze-free period ranges from 50 to 80 days, but at higher elevations, freezing temperatures can occur at any point throughout the year.

Vegetation
The Interior Mountains MLRA is defined by subalpine and alpine life zones; therefore, true forested communities do not occur and are restricted to surrounding lowland MLRAs. Black and white spruce trees do occur in the subalpine zone, but are often sporadic, and

exhibit Krummholz (stunted and/or crooked) growth forms and do not produce viable seed. Subalpine vegetation is characterized by birch-willow scrublands or spruce-scrub woodlands on loamy, stable mountain slopes. Unstable, colluvial slopes are typically dominated by alder scrub communities which can, on occasion, include scattered black and white spruce. Willow typically dominates drainages, while wet, poorly to very poorly drained swales are comprised of tussock sedge-scrub species. Low birch-ericaceous scrub communities climb up mountain slopes until they are replaced by dryas-ericaceous dwarf scrub communities in the true alpine zone. Lichen also plays an important role in skeletal and bedrock-controlled high elevation mountain slopes, ridges, and summits. There is generally little to no plant growth at elevations above 7,500 feet (USDA, 2022).

LRU notes

This area supports two life zones defined by the physiological limits of plant communities along an elevational gradient: subalpine, and alpine. In this area, the boreal life zone occurs below 2500 feet elevation on average, and is relegated to surrounding, lowland MLRAs. 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 over one meter in height (commonly resin birch (Betula glandulosa) and tealeaf willow (*Salix pulchra*)). In the alpine, trees no longer occur, and all shrubs are dwarf or lay prostrate on the ground. 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 (over 10 percent 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. These warm and cold slopes can shift the elevation at which life zones occur. Warm slopes can allow communities to persist at higher elevations, while cold slopes can restrict these same communities to lower elevations.

Classification relationships

Alaska Vegetation Classification
Depression state:
Mixed shrub-sedge tussock tundra (II.C.2.a – level IV)
Peat mound state:
Shrub birch-ericaceous shrub bog (II.C.2.d – level IV)
(Viereck et al. 1992)

Circumboreal Vegetation Map – Alaska-Yukon Region
Southern Alaska Sphagnum Bogs and Herbaceous Fens
(Jorgensen and Meidinger, 2015)

LANDFIRE Biophysical Settings
7416280 - Western North American Boreal Low Shrub-Tussock Tundra
(LANDFIRE biophysical settings, 2009)

Ecological site concept

• Ecological site R228XY701AK is a high elevation mixed shrub-sedge community on depressions on mountain slopes, hillslopes, and valleys
• Very poorly to poorly drained soils formed in organic material over silty loess and glacial till that do not pond
• Elevations range from 1790 to 3470 feet
• Vegetation community is influenced by harsh climate, short growing season, persistent snowpack, and poor drainage resulting from permafrost and micro topographic position
• In some cases, peat mound formation occurs adjacent to depressions as a result of ice lens and organic matter accumulation
• The representative plant community for the depression reference state (community 1.1) is characterized by a mixed shrub-sedge tussock tundra community while the representative plant community for the peat mounds alternative state (community 2.1) is characterized by a shrub birch-ericaceous shrub bog community (Viereck et al., 1992)

Associated sites

R228XY706AK	**White spruce/willow-birch scrub dry slopes** Occurs on mountain slopes adjacent to R228XY701AK on well drained slopes, and supports a white spruce willow-birch woodland community.

Similar sites

R228XY711AK	**High elevation scrub drainageways** Occurs on dry, somewhat poorly to well drained drainageways and depressions and supports a willow scrub community.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Betula nana* (2) *Salix pulchra*
Herbaceous	(1) *Carex aquatilis* (2) *Eriophorum angustifolium*

Physiographic features

Ecological site R228XY701AK occurs at high elevations on depressions in the alpine and subalpine zones. This site is associated with mountain slopes, foothills, and valleys. Elevation ranges from 1790 to 3470 feet above sea level on slopes ranging from 0 to 20 percent. This ecological site occurs on all aspects. A shallow water table persists within 0 to 10 inches of the soil surface throughout the growing season and has a strong influence on the plant community that occupies this site.

Peat mounds state
A peat mound state occurs on raised areas adjacent to the depression reference state. Peat mounds are dome-like mounds that result from layers of ice lenses and organic or mineral soil accumulation. When substantial build up occurs, distance between the soil surface and water table increases. This improves drainage and decreasing odds of ponding.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Depression (2) Mountains > Drainageway
Runoff class	Very low to low
Flooding duration	Not specified
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	546–1,058 m
Slope	0–20%
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 duration	Long (7 to 30 days)
Flooding frequency	Frequent
Ponding duration	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–30%

Water table depth	Not specified

Climatic features

The climate of this high-elevation area is characterized by short growing season, cool summers, and long winters. Mean annual precipitation is around 15 inches at lower elevations but can reach much higher totals at higher elevations. June, July, and August are the wettest months of the year, while February, March, and April are the driest. On average, there are 17 frost free days per year, but at high elevations, freezing temperatures can occur any month of the year. The mean maximum temperature is 67 degrees Fahrenheit in July, while the mean low temperature is -9 degrees Fahrenheit in January. At higher elevations, this temperature range will be greatly skewed towards colder temperatures.

Table 4. Representative climatic features

Frost-free period (characteristic range)	5-30 days
Freeze-free period (characteristic range)	63-77 days
Precipitation total (characteristic range)	305-432 mm
Frost-free period (actual range)	1-41 days
Freeze-free period (actual range)	50-84 days
Precipitation total (actual range)	305-457 mm
Frost-free period (average)	17 days
Freeze-free period (average)	69 days
Precipitation total (average)	381 mm

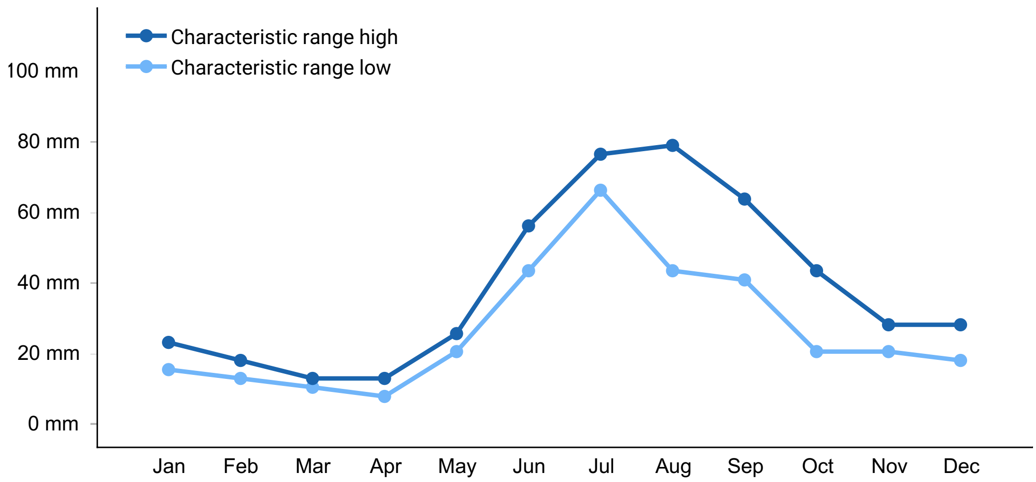


Figure 1. Monthly precipitation range

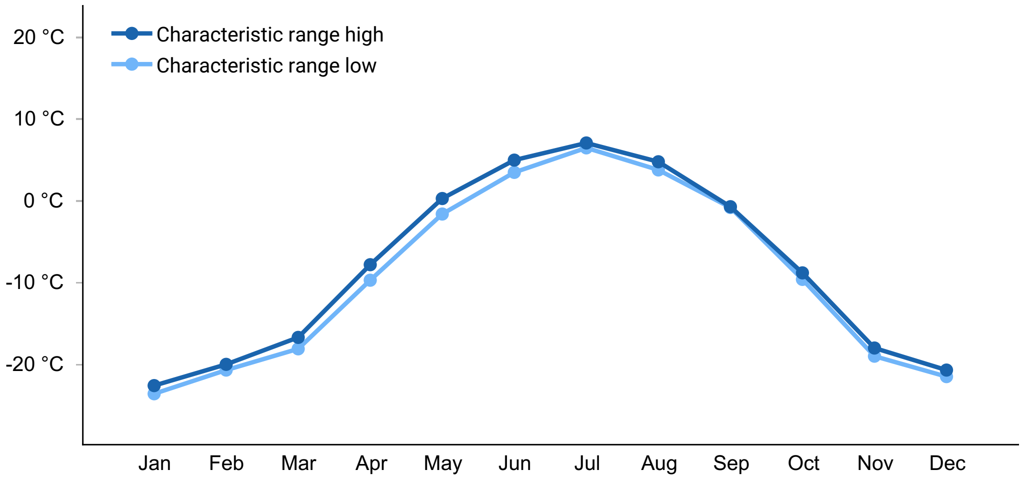


Figure 2. Monthly minimum temperature range

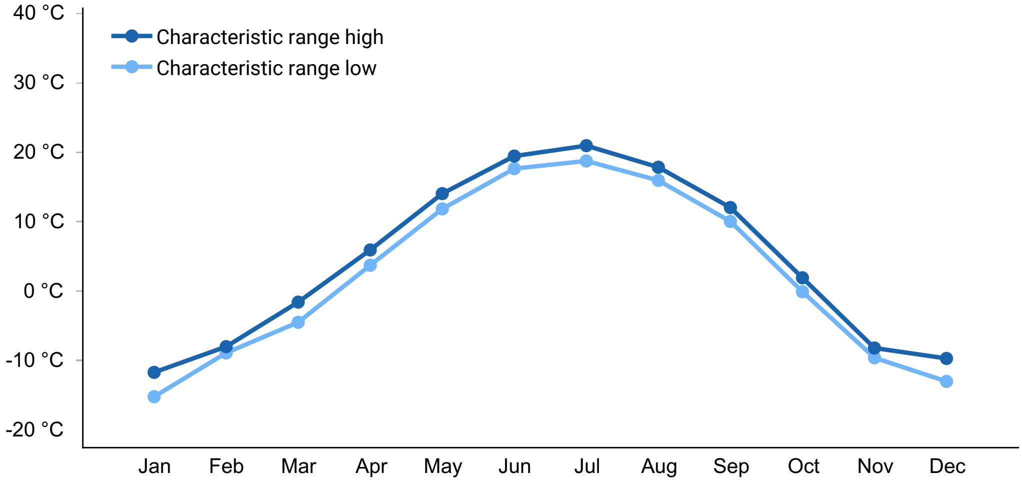


Figure 3. Monthly maximum temperature range

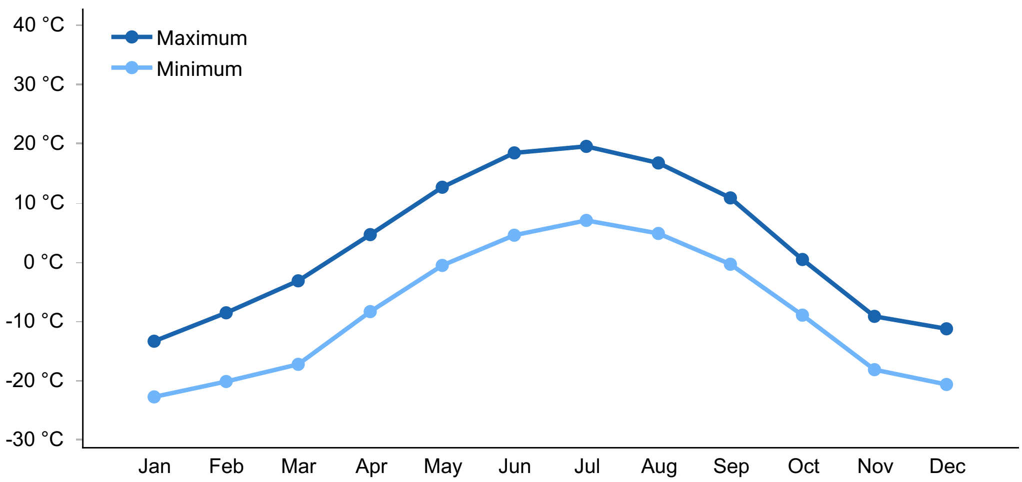


Figure 4. Monthly average minimum and maximum temperature

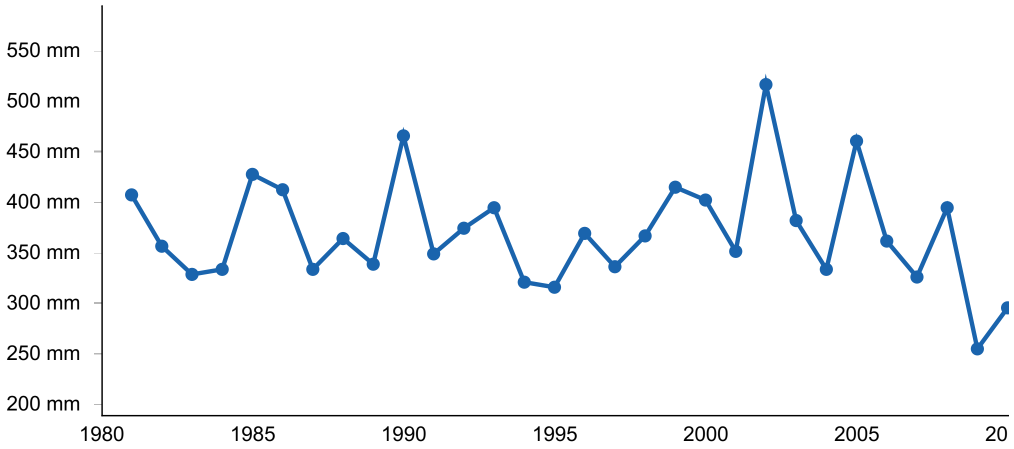


Figure 5. Annual precipitation pattern

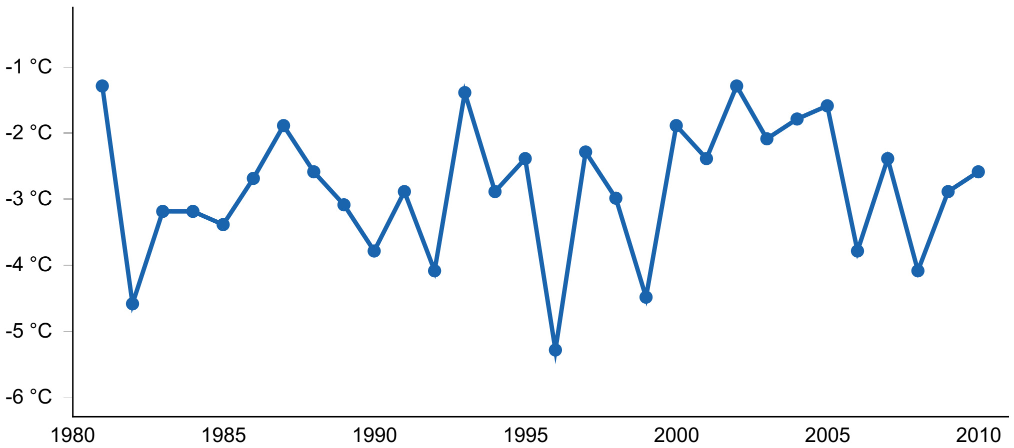


Figure 6. Annual average temperature pattern

Climate stations used

- (1) PAXSON [USC00507097], Copper Center, AK
- (2) MCKINLEY PARK [USC00505778], Healy, AK
- (3) CANTWELL 2 E [USC00501243], Cantwell, AK
- (4) NABESNA [USC00506147], Gakona, AK
- (5) FAREWELL LAKE [USC00503009], Mc Grath, AK
- (6) TONSINA [USC00509385], Copper Center, AK

Influencing water features

A water table persists throughout the growing season within 0 to 10 inches of the soil surface and affects the plant community.

Wetland description

According to the NRCS Hydrogeomorphic Wetland Classification System, this ecological site is classified as a depressional wetland. Dominant water sources are precipitation, ground water discharge, and throughflow/overland flow from adjacent uplands.

Soil features

Soils formed in organic material over loess and glacial till. Surface fragments are not common, and surface textures are peat. The mineral soil is considered loamy and forms in windblow loess and glacial till deposits. Restrictive layers are common between 15 and 30 inches of the soil surface in the form of permafrost or strongly contrasting textural stratification. Despite these restrictions, soils are considered very deep. These skeletal soils range from shallow to moderately deep and pH ranges from very acidic to slightly basic, depending upon parent material orogeny. Drainage class is rated as very poorly to poorly drained, but in the peat mound state, drainage can improve to somewhat poorly drained.

Table 5. Representative soil features

Parent material	(1) Organic material (2) Loess (3) Till
Surface texture	(1) Peat
Drainage class	Very poorly drained to poorly drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	38–76 cm
Soil depth	152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-25.4cm)	3.81–11.18 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Clay content (0-101.6cm)	5–30%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	3.5–7.4
Subsurface fragment volume <=3" (0-152.4cm)	0–15%

Subsurface fragment volume >3" (0-152.4cm)	0–20%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	33–89 cm
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-25.4cm)	3.05–14.99 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Clay content (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	Not specified
Subsurface fragment volume >3" (0-152.4cm)	Not specified

Ecological dynamics

Growing conditions

Located in the subalpine and alpine life zones, ecological site R228XY701AK is exposed to a variety of harsh conditions including high winds, persistent snowpack, and extremely cold temperatures. Persistent snowpack and cold temperatures reduce the growing season in the alpine, when compared to lower elevations. These harsh climate conditions result in stunted vegetative growth forms, inhibiting growth of tree species and causing shrubby vegetation to be dwarf-like in stature.

Disturbance

Although fire plays an important role in shaping plant communities across Alaska, fire frequency in high elevation communities is largely unstudied, when compared to interior forest stands. Most wildfires in Alaska are caused by lightning strikes which tend to occur near tree line, decreasing in frequency into the subalpine and alpine zones (Dewilde et al, 2006). Despite the propensity of fires to move from boreal stands upslope into higher life zones, it is likely a general lack of fuel in scrub communities that accounts for diminished fire frequency (Kasischke et al. 2002, Dewild et al. 2006). Given the influence of a seasonal water table on this wetland ecological site, fire is even less likely to occur when compared to surrounding alpine and subalpine scrub communities. The disturbance regime in this community is likely driven by avalanche, rockslides, and other mass movement events associated with eroding, unstable mountain slopes coupled with substantial snowfall.

Peat mounds state

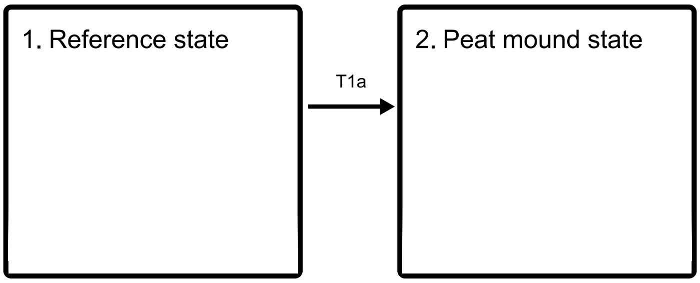
Peat mound formation and morphology is complex and can be referenced in greater detail in literature by Seppälä (1986, 2011). Peat mound formation occurs when ice lenses and organic matter accumulation occurs at such a rate that the build-up creates dome-like formations. The depressional features in the reference state create a water-accumulating environment necessary for peat formation. This is further exacerbated when permafrost occurs close to the soil surface, limiting drainage on the surrounding landforms. When peat mounds form, the soil surface increases in distance from the underlying persistent water table, and there is a considerable probability that soil drainage improves for the upper horizon(s). If these mounds rise high enough above the water table, soil temperature can increase, melting ice lenses and leading to collapse of the dome-like mounds, creating a depression once again.

Reference community 1.1

Field data suggest that the depressional reference state and the peat mound alternative state each include a single dominant plant community. The reference plant community 1.1 is characterized by a mixed shrub-sedge tussock tundra (Viereck et al., 1992). Notable plant species include dwarf birch (*Betula nana*), and tealeaf willow (*Salix pulchra*), water sedge (*Carex aquatilis*), and tall cottongrass (*Eriophorum angustifolium*). As peat mounds accumulate, species composition starts to favor shrub species over sedge species. Community 2.1 is a shrub birch-ericaceous shrub bog community (Viereck et al., 1992). Notable species include dwarf birch (*Betula nana*), sphagnum species, and variable ericaceous dwarf shrubs such as bog blueberry (*Vaccinium uliginosum*), and marsh Labrador tea (*Ledum palustre* decumbens).

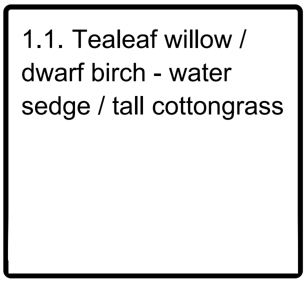
State and transition model

Ecosystem states

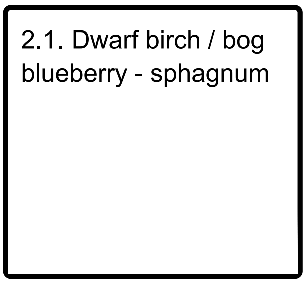


T1a - Peat mound formation

State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference state

The reference state supports one reference plant community which is characterized as a mixed shrub-sedge tussock tundra (Viereck et al., 1992).

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- dwarf birch (*Betula nana*), shrub
- water sedge (*Carex aquatilis*), grass
- tall cottongrass (*Eriophorum angustifolium*), grass

Community 1.1
Tealeaf willow / dwarf birch - water sedge / tall cottongrass

The reference plant community is a mixed shrub-sedge tussock tundra (Viereck et al., 1992). The major plant groups are low to dwarf shrubs (less than 8 inches tall), medium graminoids (4 to 24 inches), and moss. Common shrub species include various willow species, scrub birch, various tussock-forming sedges and cottongrass. Sphagnum moss of various species is also common on this ecological site.

Dominant plant species

- tealeaf willow (*Salix pulchra*), shrub
- dwarf birch (*Betula nana*), shrub
- water sedge (*Carex aquatilis*), grass
- tall cottongrass (*Eriophorum angustifolium*), grass
- sphagnum (*Sphagnum*), other herbaceous

State 2
Peat mound state

The alternative peat mound state supports one dominant plant community, which is characterized as a shrub birch - ericaceous shrub bog (Viereck et al., 1992). This alternative state occurs as a result of ice-lensing and organic matter accumulation. This creates dome-like formations that create dry, micro-habitats where shrubby vegetation can establish. If enough organic material builds up, drainage can improve because the distance between the soil surface and the shallow water table increases.

Dominant plant species

- dwarf birch (*Betula nana*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- sphagnum (*Sphagnum*), other herbaceous

Community 2.1
Dwarf birch / bog blueberry - sphagnum

The alternative peat mounds plant community is a Shrub birch-ericaceous shrub bog (Viereck et al., 1992). The major plant groups are low to dwarf shrubs (less than 8 inches tall), and moss. Common shrub species include scrub birch, various Vaccinium and other ericaceous dwarf shrub species, and sphagnum moss.

Dominant plant species

- dwarf birch (*Betula nana*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- sphagnum (*Sphagnum*), other herbaceous

Transition T1a
State 1 to 2

This transition occurs as ice lenses and organic matter accumulates, creating dome-like peat mounds. In order for this to occur, sufficient moisture must be present. These conditions occur in and adjacent to depressions where groundwater and throughflow supplies necessary moisture. Once mounds form, there is potential for drainage to improve, if mounds grow large enough to increase the distance between the water table and soil surface. In some cases, this can lead to melting of the ice lenses, and subsequent collapse of the peat mounds, creating a depression once more.

Additional community tables

Inventory data references

The vegetation modeled for this site has limited data and is considered provisional. The associated model was largely developed from NRCS staff with working knowledge of the area and literature review.

Plant community composition is largely based on ecological sites from AK638: Soil Survey of Cantwell Area, Alaska.

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Contributors

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	01/22/2026
Approved by	Blaine Spellman
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:**