USDA Natural Resources Conservation Service

Ecological site R223XY702AK
Alpine dwarf scrub earth hummocks

Last updated: 6/12/2025
Accessed: 02/15/2026

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): 223X–Cook Inlet Mountains

Physiography
The Cook Inlet Mountains (Major Land Resource Area (MLRA) 223) are part of the Pacific Mountain physiographic system and occur in Southcentral Alaska. Comprising 19,550 square miles, this alpine MLRA includes mountains of the Chugach, Kenai, Talkeetna, Aleutian, and Alaska Ranges that drain into the Cook Inlet via the Cook Inlet Lowlands (MLRA 224). These rugged mountains are primarily undeveloped and sparsely populated. This MLRA concept is defined by the true alpine zone, while the Cook Inlet Lowlands (MLRA 224) are characterized by lower elevation hills and plains of the subalpine and boreal life zones. Large glaciers and icefields make up 15 percent of the Cook Inlet Mountains, and some glaciers extend down into the Cook Inlet Lowlands to elevations of 1,000 feet. The alpine zone in this MLRA ranges in elevation from roughly 2,500 feet near the boundary MLRA 224 to 20,320 feet at the summit of Denali, the tallest mountain in North America. All rivers in this MLRA drain into Cook Inlet including the Matanuska, Susitna and Little Susitna, Knik, Kenai, and Chakachatna Rivers.

Geology
The entire Cook Inlet Mountains area, except for the highest peaks and upper ridges, was glaciated during the Pleistocene. Throughout the Holocene, most of the Pleistocene glacial deposits have eroded or were buried in colluvium and slope alluvium, of which now comprise 65 percent of the current landscape. Mid-to-lower mountain slopes and valleys consist of modified moraine and outwash deposits overlain by varying thickness of eolian loess and volcanic ash. Lower valley bottoms are covered in contemporary fluvial deposits. Underlying bedrock consists of Late Paleozoic and Early Mesozoic sedimentary and Tertiary intrusive rock.

Soils
The dominant soil orders in MLRA 223 are Entisols, Inceptisols, and Spodosols. Soils have a cryic temperature regime or a subgelic soil temperature class, udic or aquic moisture regime, and amorphic or mixed minerology. Miscellaneous areas such as rock outcrop, rubble land, and glaciers, and others make up 70 percent of this MLRA.

Climate
The climate of this area is characterized by short summers, cloudy conditions, and moderate to cold temperatures. The average annual precipitation ranges from 15 to 30 inches at lower elevations to more than 100 inches in the high mountains, with most rain occurring in the late summer and fall. This area sees high levels of snowfall, ranging from 80 to 400 inches or more. Average annual temperatures in this alpine MLRA are near freezing, with freeze-free periods averaging 60 to 80 days, while at higher elevations, freezing temperatures can occur throughout any time of year.

Vegetation
The Cook Inlet Mountains are defined by an alpine life zone and therefore plant communities in this area are void of tree and tall shrub species that are common in subalpine and boreal zones. Alpine vegetation primarily consists of dwarf scrub, lichen and herbaceous communities. Low willow-graminoid communities are common in drainages, depression, and stream terraces. On shallow soils on mountain slopes and rocky ridges lichen and ericaceous scrub mosaics are accompanied by scattered forbs are alpine grasses. At elevations above 7,500 feet, little to no plant growth takes place.

Classification relationships

Alaska Vegetation Classification
Community 1.1
Dwarf ericaceous scrub crowberry tundra (II.D.2.c – level IV)
(Viereck et al., 1992)

LANDFIRE Biophysical Settings:
7516430 – Alaskan Pacific Maritime Alpine Dwarf Shrubland
(LANDFIRE biophysical settings, 2009)

Ecological site concept

• Ecological site R223XY702AK is an alpine dwarf scrub community on earth hummocks on mountain slopes
• Well-drained soils formed in volcanic ash and silty loess over gravelly colluvium and glacial till
• Elevations generally range between 2,170 and 3,360 feet above sea level
• Vegetation community influenced by harsh conditions, short growing season, and persistent snowpack.

• Reference community 1.1 is characterized by a dwarf ericaceous scrub crowberry tundra community (Viereck et al., 1992)

Associated sites

R223XY710AK	**Alpine dwarf scrub gravelly slopes** Ecological site R223XY710AK occurs on gravelly mountain slopes, adjacent to ecological site R223XY102AK.

Similar sites

R223XY710AK	**Alpine dwarf scrub gravelly slopes** Ecological site R223XY710AK occurs on mountain slopes and supports a dwarf alpine scrub community with different species composition.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Luetkea pectinata* (2) *Empetrum nigrum*
Herbaceous	(1) *Gymnocarpium dryopteris* (2) *Cornus canadensis*

Physiographic features

This ecological site occurs on earth hummocks on mountain slopes in the alpine zone. Elevations range from 2,170 to 3,360 feet or higher with slopes generally ranging from 12 to 35 percent. This ecological site is on all aspects. Flooding and ponding do not occur nor is it influenced by a seasonal water table.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope > Hummock
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	661–1,024 m
Slope	12–35%
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 frequency	Not specified
Elevation	396–1,615 m
Slope	0–70%

Climatic features

The climate associated with this high-elevation, alpine ecological site is characterized by a short growing season, cloudy conditions, and cold temperatures. Mean annual precipitation ranges from 15 to 32 inches at lower elevations to 100 inches or more at higher elevations. Snowfall ranges from 80 to 400 inches or more, increasing with elevation. Frost free period averages between 23 and 85 days at lower elevations, but at higher elevations, temperatures below freezing can occur any month of the year. Precipitation is greatest between August and October and least in March and April.

Table 4. Representative climatic features

Frost-free period (characteristic range)	23-85 days
Freeze-free period (characteristic range)	69-119 days
Precipitation total (characteristic range)	381-813 mm
Frost-free period (actual range)	15-108 days
Freeze-free period (actual range)	65-138 days
Precipitation total (actual range)	356-1,245 mm
Frost-free period (average)	56 days
Freeze-free period (average)	96 days
Precipitation total (average)	635 mm

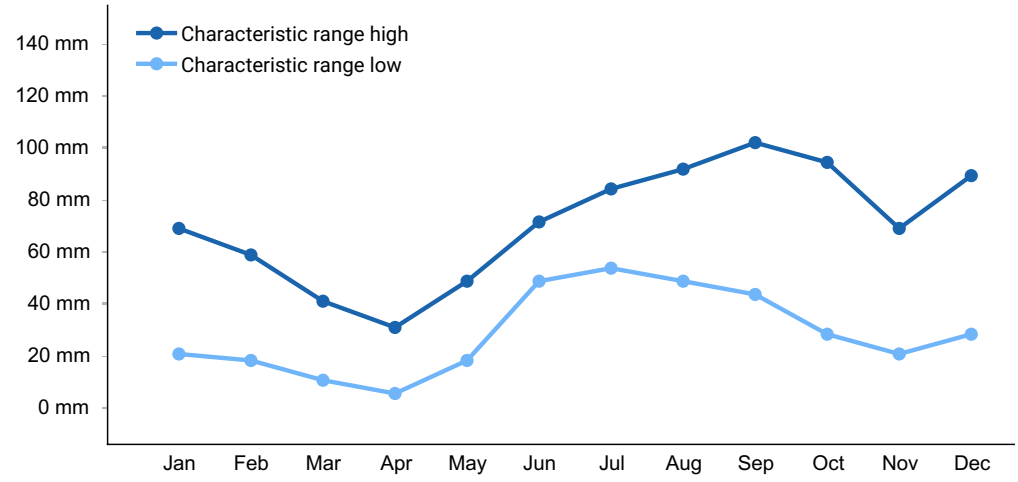

Figure 1. Monthly precipitation range

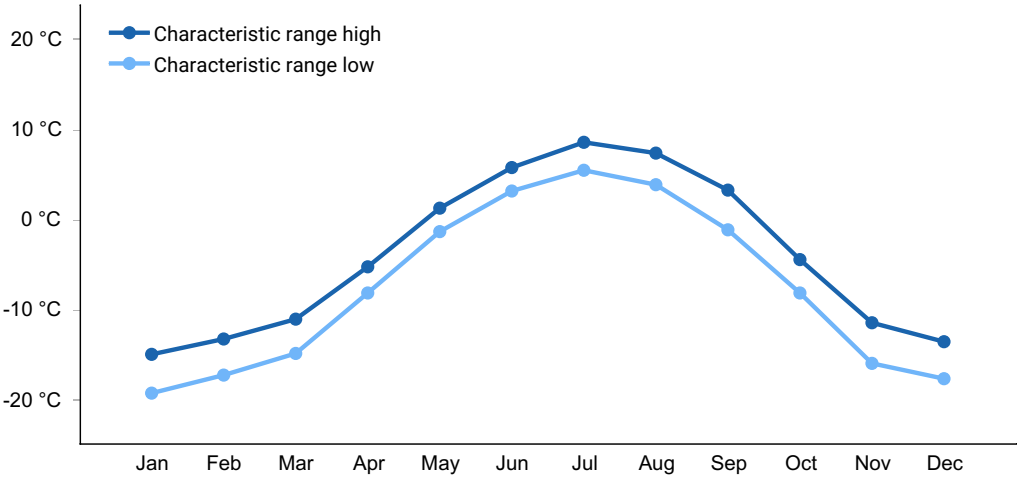

Figure 2. Monthly minimum temperature range

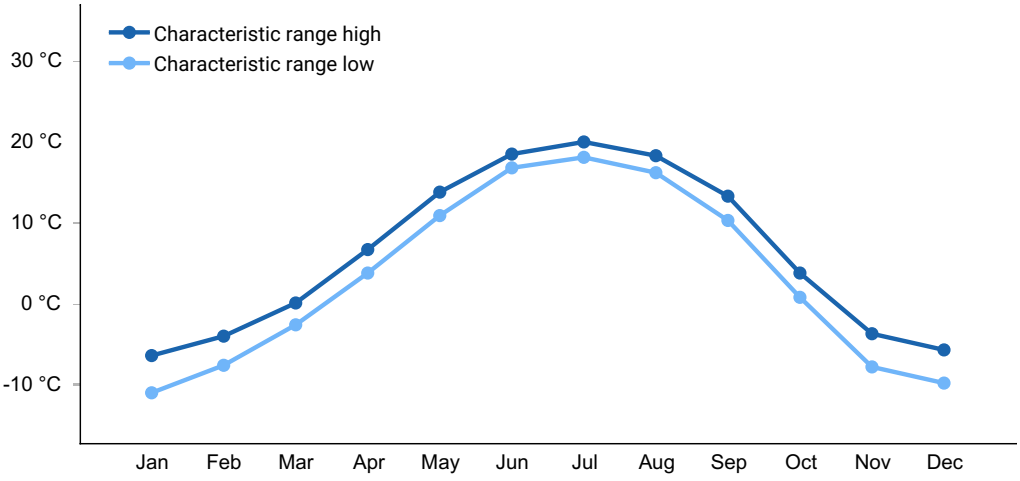

Figure 3. Monthly maximum temperature range

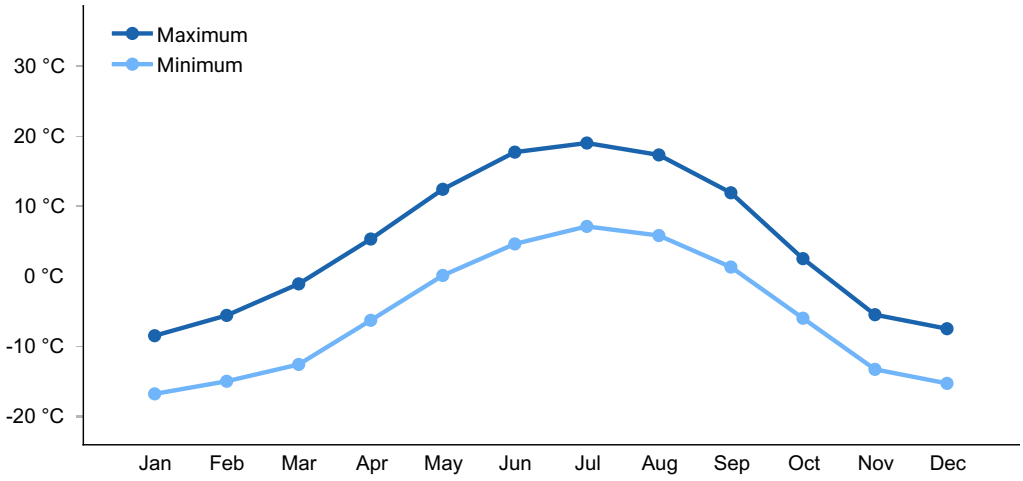

Figure 4. Monthly average minimum and maximum temperature

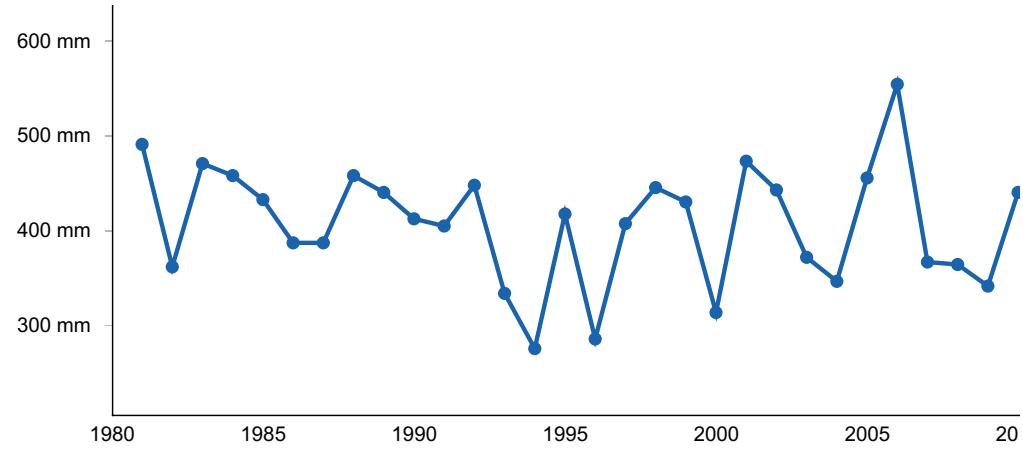

Figure 5. Annual precipitation pattern

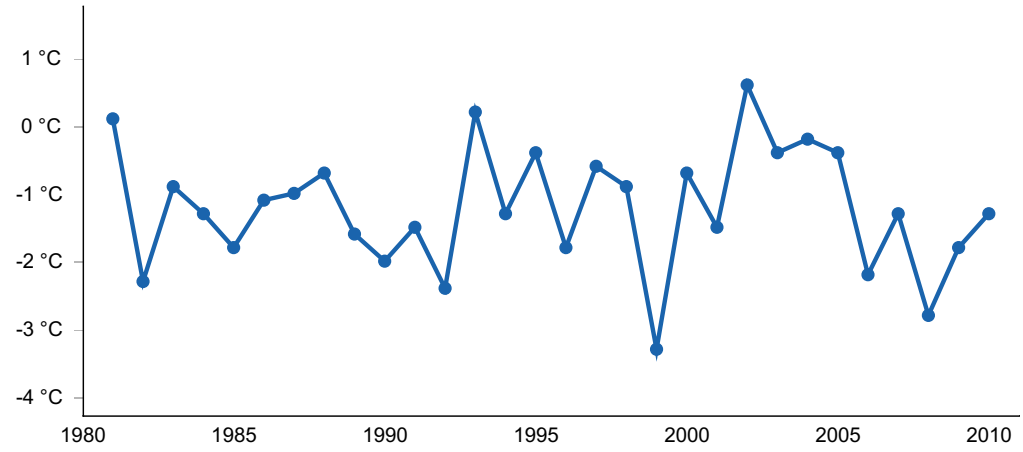

Figure 6. Annual average temperature pattern

Climate stations used

- (1) PUNTILLA [USC00507783], Matanuska-Sustina Bor, AK
- (2) SHEEP MTN LODGE [USC00508409], Palmer, AK
- (3) TAHNETA PASS [USC00508945], Palmer, AK
- (4) BIG RIVER LAKES [USC00500788], W Kenai Peninsula Boroug, AK

Influencing water features

Due to topographic position, no streams, wetlands, or other water features are associated with this well-drained ecological site.

Soil features

The soils of this ecological site formed in silty volcanic ash or windblown silts over gravelly till and colluvial material. Surface fragments are not common, and surface textures are silt loams. Mineral soils typically lack an organic cap and are considered medial over loamy-skeletal. Soils are very deep, with a textural stratification, lithic bedrock, or ortstein (cemented layer) acting as a restriction. Soil pH ranges from strongly acidic to moderately acidic and drainage class is rated as well-drained.

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Loess (3) Colluvium (4) Till
Surface texture	(1) Silt loam
Family particle size	(1) Medial (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	23–58 cm
Soil depth	150–152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-25.4cm)	2.79–8.38 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Clay content (0-50.8cm)	5–10%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0

Soil reaction (1:1 water) (0-25.4cm)	3.2–6.6
Subsurface fragment volume <=3" (0-152.4cm)	0–12%
Subsurface fragment volume >3" (0-152.4cm)	0–3%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	15–66 cm
Soil depth	53–152 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	0%
Available water capacity (0-25.4cm)	2.29–9.14 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Clay content (0-50.8cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-25.4cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	0–27%
Subsurface fragment volume >3" (0-152.4cm)	0–15%

Ecological dynamics

Alpine vegetation
Located in the alpine life zone, this ecological site is exposed to a variety of harsh environmental conditions. In the Cook Inlet Mountains, 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 ecological 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 ecological site and prevents the establishment and/or growth of dominant boreal species like white spruce and black spruce.

Disturbance
Although fire plays an important role in shaping vegetation communities throughout Alaska, fire frequency in alpine communities is largely unstudied, when compared to interior forest stands. This is likely due to the diminished influence of fire above tree line. 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 alpine scrub communities that accounts for diminished fire frequency (Kasischke et al. 2002, Dewilde et al. 2006). Due to low fire frequency, the disturbance regime in this alpine community is likely driven by avalanche, rockslides, and other mass movement events associated with eroding and unstable mountain slopes.

Earth Hummocks
Earth hummocks form as a result of frost action. Freeze-thaw cycles cause cryoturbation in the mineral soil, leading to dome-like landforms, or earth hummocks, on mountain slopes in the alpine zone. These hummocks are repeatable across the landform, and result in micro-relief between the top of the hummock and the low space between hummocks. Although no quantifiable difference occurs in the soils between these positions, the high position is slightly more water-shedding, while the low position is slightly more water-collecting. This can be exaggerated in cases where hummocks are comparatively large, allowing for snowpack to persist longer in lower positions. Although species composition remains similar along micro-topographic gradients, variation in species cover values can occur between high and low positions.

Community 1.1
The reference plant community is a dwarf ericaceous scrub crowberry tundra community (Viereck et al., 1992). Notable species include partridgefoot (*Luetkea pectinata*), Alaska bellheather (Cassiope stelleriana), and black crowberry (*Empetrum nigrum*). Various lichen and moss species are common in this community and account for a substantial portion of ground cover on this ecological site. On micro-low positions cover elevated cover values exist for some species. This includes bog blueberry (*Vaccinium uliginosum*), *Empetrum nigrum*, bunchberry dogwood (*Cornus canadensis*), as well as various lichen species.

State and transition model

Ecosystem states

1. Reference state

State 1 submodel, plant communities

1.1. Partridge foot - crowberry / Pacific oakfern - bunchberry dogwood

State 1
Reference state

The reference community supports a single dominant plant community which is characterized as a dwarf ericaceous scrub crowberry tundra community (Viereck et al., 1992). Notable shrub species include crowberry (*Empetrum nigrum*), partridgefoot (*Luetkea pectinata*), Alaska bellheather (*Harrimanella stelleriana*), and bog blueberry (*Vaccinium uliginosum*). Slight variation in micro-topography may alter species composition between high positions on top of hummocks and low positions between hummocks and is discussed further in the community 1.1 description.

Dominant plant species

- partridgefoot (*Luetkea pectinata*), shrub
- Alaska bellheather (*Harrimanella stelleriana*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- western oakfern (*Gymnocarpium dryopteris*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Community 1.1
Partridge foot - crowberry / Pacific oakfern - bunchberry dogwood

The reference plant community is characterized as a dwarf ericaceous scrub crowberry tundra community (Viereck et al., 1992). Slight variation in species composition exists between micro high positions on top of the hummocks and micro low positions between

hummocks. High positions have increased cover in partridgefoot (Leutkea pectinata), Alaska bellheather (*Harrimanella stelleriana*), and crowberry (*Empetrum nigrum*) while low positions have increased cover in bog blueberry (*Vaccinium uliginosum*), lingonbery (*Vaccinium vitis-idaea*), white arctic mountain heather (*Cassiope tetragona*), and bunchberry dogwood (*Cornus canadensis*). Despite differences in cover values, all species can be found in high or low positions and therefore this community is treated as a single reference plant community. Various lichen and moss species are included in this plant community.

Dominant plant species

- partridgefoot (*Luetkea pectinata*), shrub
- Alaska bellheather (*Harrimanella stelleriana*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- bunchberry dogwood (*Cornus canadensis*), other herbaceous
- alpine clubmoss (*Lycopodium alpinum*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous
- western oakfern (*Gymnocarpium dryopteris*), other herbaceous
- Richardson's masonhalea lichen (*Masonhalea richardsonii*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- dicranum moss (*Dicranum*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous
- cup lichen (*Cladonia*), other herbaceous

Additional community tables

Inventory data references

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

Plant community composition is largely based on ecological sites from AK651: Soil Survey of Denali National Park Area, Alaska.

References

Viereck, L.A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska vegetation classification. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station General Technical Report PNW-GTR-286..

Other references

Chapin, F.S., L.R. Walker, C.L. Fastie, and L.C. Sharman. 1994. Mechanisms of primary succession following deglaciation at Glacier Bay, Alaska. Ecological Monographs 64: 149-175.

DeWilde, La'ona; Chapin, F. Stuart, III. 2006. Human impacts on the fire regime of interior Alaska: interactions among fuels, ignition sources, and fire suppression. Ecosystems. 9(8): 1342-1353.

Jorgensen, T. and Meidlinger, D., 2015. The Alaska Yukon Region of the Circumboreal Vegetation map (CBVM). Conservation of Arctic Flora and Fauna (CAFF).

Kasischke, E.S., Williams, D. and Barry, D., 2002. Analysis of the patterns of large fires in the boreal forest region of Alaska. International Journal of Wildland Fire, 11(2), pp.131-144.

LANDFIRE. 2009. Western North American Boreal Alpine Dwarf-Shrub Summit. In: LANDFIRE National Vegetation Dynamics Models. USDA Forest Service and US Department of Interior. Washington, DC.

United States Department of Agriculture. 2022. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.

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	02/15/2026
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:**