USDA Natural Resources Conservation Service

Ecological site R231XY149AK
High-elevation Sedge Peat Depressions

Last updated: 2/13/2024
Accessed: 05/03/2024

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.

Ecological site concept

This site is associated with depressions in the subalpine and alpine that have very thick layers of peat and do not have permafrost. Soils pond frequently for very long durations of time and are considered very poorly drained. The typical soil profile is a very thick layer of saturated organic material over loamy alluvium.

The alpine and subalpine life zones have a harsh climate that limits growth of vegetation and prevents the establishment of many species common at lower elevations. The high-elevation vegetation associated with this site is 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.

The reference plant community is characterized as wet graminoid herbaceous (Viereck et al. 1992) with the dominant graminoids being water sedge and tall cottongrass. Other commonly observed species include bog rosemary, tealeaf willow, bog blueberry, dwarf birch, and shrubby cinquefoil. The vegetative strata that characterize this community are tall graminoids (greater than 24 inches) and medium graminoids (between 4 and 24 inches in height).

Associated sites

R231XY148AK	**Subalpine Scrub Gravelly Slopes Moist** Occurs upslope of site 148 on warm backslopes in the subalpine.
R231XY152AK	**High-elevation scrub gravelly drainageways** Occurs downslope in high elevation drainageways.
R231XY185AK	**Subalpine Scrub Loamy Frozen Footslopes** Occurs upslope of site 149 on footslopes and toeslopes in the subalpine.

Similar sites

R231XY137AK	**Boreal Sedge Peat Depressions** This boreal site occurs on depressions of stream terraces. Occurring at lower elevations results in unique kinds and amounts of vegetation.
R231XY138AK	**Boreal Sedge Loamy Flood Plain Depressions** This boreal site occurs on depressions of flood plains. Occurring at lower elevations results in unique kinds and amounts of vegetation.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Carex aquatilis* (2) *Eriophorum angustifolium*

Physiographic features

This site occurs on swales on the toeslopes of hills and mountains at high elevation. Elevation typically ranges between 2500 and 4000 feet. These depressional features are nearly level and occur on all slope aspects. Flooding does not occur. Ponding occurs frequently for very long durations of time. During ponding events, water can commonly be 10 to 12 inches above the soil surface. A water table remains at very shallow depth throughout the growing season.

Associated depressions were commonly identified as swales on the toeslope of hills. Swales are open systems that lack a defined channel and can funnel overland or subsurface water flow. Other types of high-elevation depressions with thick saturated organic soils that lack permafrost likely support this site.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Landforms	(1) Mountains > Mountain slope (2) Mountains > Hill (3) Mountains > Swale
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Very long (more than 30 days)
Ponding frequency	Frequent
Elevation	2,500–4,000 ft
Slope	0–2%
Ponding depth	6–12 in
Water table depth	0 in
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	Not specified
Slope	0–5%
Ponding depth	Not specified
Water table depth	Not specified

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)	14-21 in
Frost-free period (actual range)	4-87 days
Freeze-free period (actual range)	48-120 days
Precipitation total (actual range)	10-25 in
Frost-free period (average)	53 days
Freeze-free period (average)	90 days
Precipitation total (average)	17 in

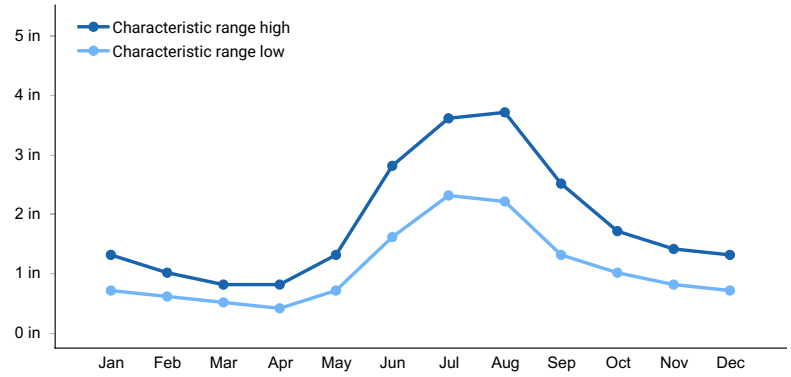

Figure 1. Monthly precipitation range

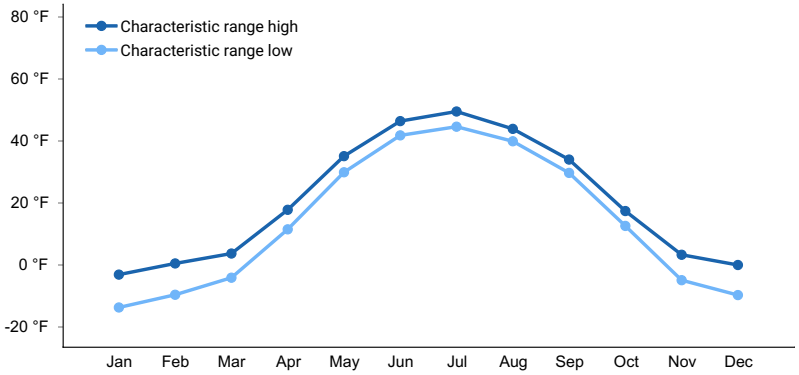

Figure 2. Monthly minimum temperature range

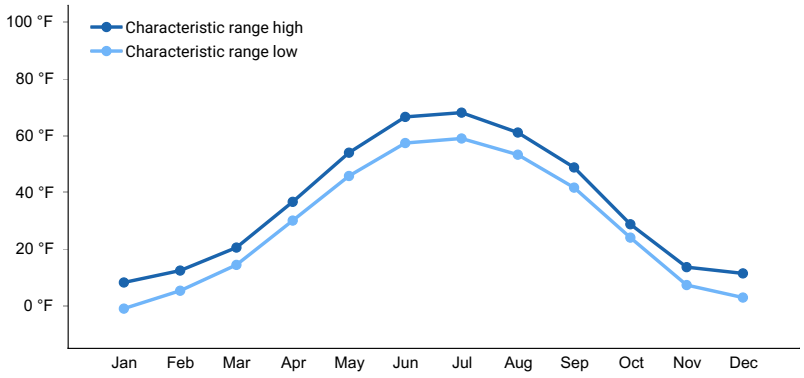

Figure 3. Monthly maximum temperature range

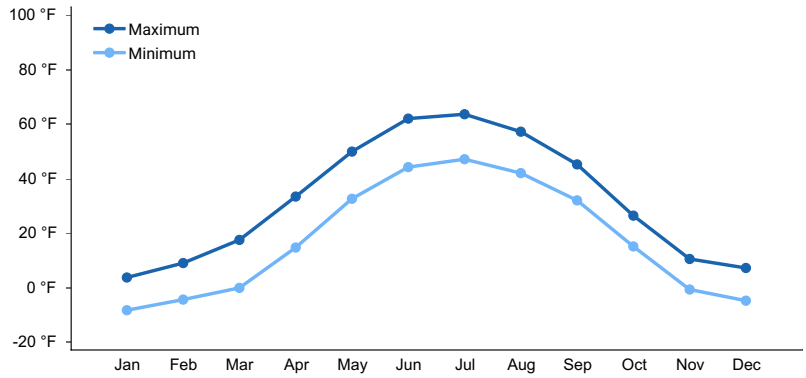

Figure 4. Monthly average minimum and maximum temperature

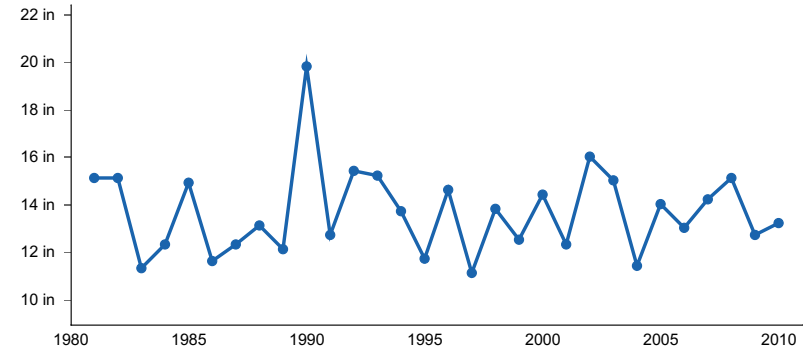

Figure 5. Annual precipitation pattern

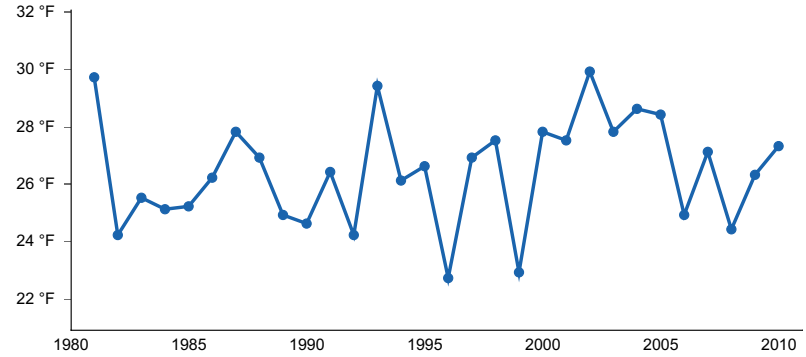

Figure 6. Annual average temperature pattern

Climate stations used

- (1) 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

This site is classified as a depressional wetland under the Hydrogeomorphic (HGM) classification system (Smith et

al. 1995; USDA-NRCS 2008). In the associated depressions, precipitation, overland flow, or interflow 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 peat and loamy alluvium and lack permafrost. Rock fragments do not occur on the soil surface. These are thick organic soils commonly capped with 25 inches or more peat. The mineral soil below the organic material is a silt loam formed from alluvium. Rock fragments range up to 20 percent of the soil profile by volume. The pH of the soil profile ranges from strongly acidic to neutral. The soils are wet for long portions of the growing season and are considered very poorly drained.

Figure 7. A typical soil profile associated with this site.

Table 5. Representative soil features

Parent material	(1) Organic material (2) Alluvium
Surface texture	(1) Peat
Family particle size	(1) Loamy
Drainage class	Very poorly drained
Permeability class	Very slow
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3.9–14.8 in
Calcium carbonate equivalent (10-40in)	0%
Clay content (0-20in)	0%
Electrical conductivity (10-40in)	0–3 mmhos/cm
Sodium adsorption ratio (10-40in)	0
Soil reaction (1:1 water) (10-40in)	5.1–6.7

Subsurface fragment volume <=3" (0-60in)	0–10%
Subsurface fragment volume >3" (0-60in)	0–10%

Ecological dynamics

Climate

Located in the subalpine and alpine life zones, this site is exposed to a variety of harsh environmental conditions. Snowpack tends to be deeper and persist for longer durations of time compared to the boreal life zone, so vegetation has a comparatively shorter season to grow and reproduce. When the site is snow-free, cold temperatures and high winds also inhibit plant growth and performance. This harsh climate maintains vegetation within this site and prevents the establishment, growth, and production of dominant boreal species.

Water table influences

Frequent ponding (greater than 50 times in 100 years) occurs for very long durations of time (30 days or more). When ponding occurs, the water is commonly 10 to 12 inches above the soil surface. These hydric soils are interpreted as very poorly drained. Due to the depth and persistence of the water table, wetland indicator plants are commonly observed in the reference state.

State and transition model

Ecosystem states

1. Reference State

State 1 submodel, plant communities

1.1. water sedge - tall cottongrass

State 1
Reference State

Figure 8. A high-elevation depression in the area.

The reference plant community is wet graminoid herbaceous (Viereck et al. 1992) with the dominant graminoids being water sedge and tall cottongrass. This site has no known associated disturbance regimes and has one plant community within the reference state.

Dominant plant species

- water sedge (*Carex aquatilis*), grass
- tall cottongrass (*Eriophorum angustifolium*), grass

Community 1.1
water sedge - tall cottongrass

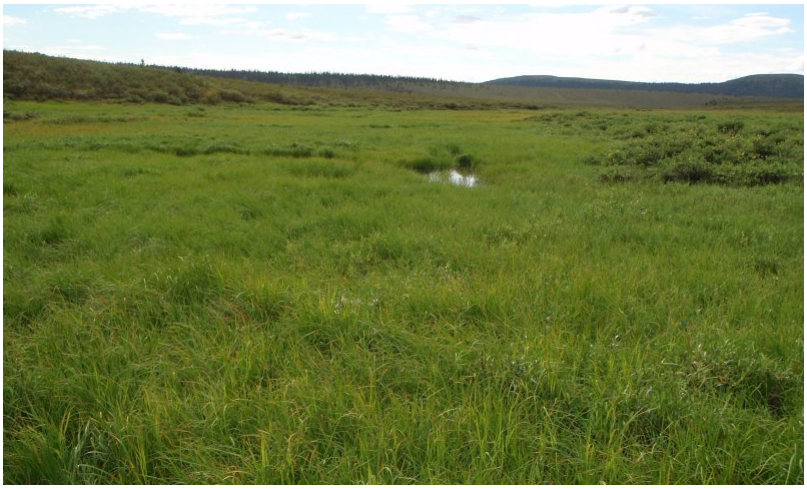

Figure 9. A typical plant community associated with community 1.1.

The reference plant community is characterized as wet graminoid herbaceous (Viereck et al. 1992) with the dominant graminoids being water sedge and tall cottongrass. Other commonly observed species include bog rosemary, tealeaf willow, bog blueberry, dwarf birch, and shrubby cinquefoil. The vegetative strata that characterize this community are tall graminoids (greater than 24 inches) and medium graminoids (between 4 and 24 inches in height). The soil surface is primarily covered with herbaceous litter. Ponded water over herbaceous litter was often extensive (as much as 65 percent of plot).

Dominant plant species

- bog rosemary (*Andromeda polifolia*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- dwarf birch (*Betula nana*), shrub
- shrubby cinquefoil (*Dasiphora fruticosa*), shrub
- water sedge (*Carex aquatilis*), grass
- tall cottongrass (*Eriophorum angustifolium*), grass

Additional community tables

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
water sedge	CAAQ	*Carex aquatilis*	Native	2–4	30–70
tall cottongrass	ERAN6	*Eriophorum angustifolium*	Native	2–4	10–45
sparseflower sedge	CATE5	*Carex tenuiflora*	Native	0.3–2	0–30
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.3–2	0–20
tussock cottongrass	ERVA4	*Eriophorum vaginatum*	Native	0.3–2	0–15
bluejoint	CACA4	*Calamagrostis canadensis*	Native	2–4	0–10
northern green rush	JUAL4	*Juncus alpinoarticulatus*	Native	0.1–0.3	0–5
Forb/Herb					
purple marshlocks	COPA28	*Comarum palustre*	Native	0.3–2	0–15
Shrub/Subshrub					
tealeaf willow	SAPU15	*Salix pulchra*	Native	0.8–3	0–7
bog rosemary	ANPO	*Andromeda polifolia*	Native	0.1–0.3	0–5
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0.8–3	0–5
dwarf birch	BENA	*Betula nana*	Native	0.8–3	0–3
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0.8–3	0–3
shrubby cinquefoil	DAFR6	*Dasiphora fruticosa*	Native	0.8–3	0–1
red fruit bearberry	ARRU	*Arctostaphylos rubra*	Native	0.1–0.3	0–1
small cranberry	VAOX	*Vaccinium oxycoccos*	Native	0.1–0.3	0–0.1
Nonvascular					
sphagnum	SPHAG2	*Sphagnum*	Native	0.1–0.3	0–10

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
09NP01202, 10NP02501, 10TC01802

References

Schoeneberger, P.J. and D.A. Wysocki. 2012. Geomorphic Description System. Natural Resources Conservation Service, 4.2 edition. National Soil Survey Center, Lincoln, NE.

Smith, R.D., A.P. Ammann, C.C. Bartoldus, and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices.

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

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

Alaska Interagency Coordination Center (AICC). 2022. http://fire.ak.blm.gov/

PRISM Climate Group. 2018. Alaska – average monthly and annual precipitation and minimum, maximum, and mean temperature for the period 1981-2010. Oregon State University, Corvallis, Oregon. https://prism.oregonstate.edu/projects/alaska.php. (Accessed 4 September 2019).

United States Department of Agriculture-Natural Resources Conservation Service. 2016. U.S. General Soil Map (STATSGO2). Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov. Accessed (Accessed 3 March 2021).

Contributors

Blaine Spellman
Jamin Johanson
Stephanie Shoemaker
Phillip Barber

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	05/03/2024
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:**
