USDA Natural Resources Conservation Service

Ecological site F231XY118AK
Boreal Woodland Organic Frozen Slopes

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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): 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 – 7416211 – Western North American Boreal Black Spruce Dwarf-tree Peatland – Boreal Complex (Landfire 2009)

Ecological site concept

This boreal site occurs on cold slopes with wet, peaty, frozen soils that are prone to thermokarst. This site is associated with toeslopes and footslopes of hills, valley sides, and low-elevation mountains. Thermokarst is common and results from the thawing of ice rich permafrost and subsequent settling of ground. Because of the unique associated soil and site properties, thermokarst depressions result in an alternate state. Reference state soils pond, have a high-water table throughout the growing season, and are considered very poorly to poorly drained. These soils have permafrost at shallow to moderately deep depths. Mineral soil horizons have minimal to no rock fragments and are commonly cryoturbated. A typical soil profile is a thick layer of organic material over a thick layer of silty parent material.

The thermokarst state has unique soil and site properties resulting in different kinds and amounts of vegetation. The thermokarst state has soils that lack permafrost and have a water table at or above the soil surface for the entire growing season. Thermokarst vegetation is commonly characterized as open low scrub (Viereck et al. 1992) with common species including bog rosemary, marsh Labrador tea, sedges, cottongrass, and Sphagnum.

Fire has highly variable impacts to the soils associated with this site. This site has a thick organic mat that insulates its cold soils, which is a key factor in maintaining the depth and presence of permafrost. Fire can significantly reduce the thickness of that organic mat, which can in turn increase soil temperature. These increases in soil temperature can thaw frozen soils and result in thermokarst. Field data in areas without thermokarst show that fire has negligible impacts to the depth and presence of permafrost. Field data in areas with thermokarst show a complete loss of permafrost within the soil profile (0-60 inches).

Multiple plant communities occur within the reference state and the vegetation in each community differs in large part due to fire. When the reference state vegetation burns, the post-fire plant community is dominantly ericaceous shrubs, graminoids, and mosses. With time and lack of another fire event, the post-fire vegetation goes through multiple stages of succession. For this site, the reference plant community is the most stable with the longest time since the vegetation was burned. This community is typically characterized as dwarf tree scrub woodland (Viereck et al. 1992) with black spruce the dominant tree. For this ecological site to progress from the earliest stages of post-fire succession to the oldest stages of succession, data suggest that 70-100 years or more must elapse without another fire event (Johnstone et al. 2010a).

The reference plant community understory commonly has marsh Labrador tea, bog blueberry, small cranberry, lingonberry, tussock cottongrass, cloudberry, various reindeer lichen, curled snow lichen, and various Sphagnum. Tree cover primarily occurs in the stunted tree stratum (greater than 50 years of age and less than 15 feet). The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), mosses, and lichens.

Associated sites

F231XY111AK	**Boreal Forest Loamy Frozen Slopes** Occurs upslope of site 118, on steeper slopes that support stands of black spruce.
R231XY128AK	**Boreal Tussock Peat Frozen Slopes** Commonly occurs on the summits of the same hills as site 118 supporting a sedge tussock community.
F231XY160AK	**Boreal Forest Loamy Frozen Slopes** Occurs upslope of site 118, on steeper slopes that support stands of black spruce.
F231XY169AK	**Boreal Woodland Peat Frozen Flats** Occurs downslope of site 118, on stream terraces.
F231XY171AK	**Boreal Woodland Loamy Frozen Terraces** Occurs downslope of site 118, on stream terraces.

F231XY182AK	**Boreal Forest Gravelly Slopes** Occurs upslope of site 118, on warmer slopes that support stands of white spruce.
R231XY191AK	**Boreal Scrubland Gravelly Drainageways Wet** Occurs in adjacent drainageways with shrubby communities.

Similar sites

R231XY128AK	**Boreal Tussock Peat Frozen Slopes** Both sites occur on the same boreal hills and occasionally on the same footslopes. Mixed shrub-sedge tussock bog is the vegetation associated with site 128.
F231XY169AK	**Boreal Woodland Peat Frozen Flats** Both sites have similar soils, vegetation, and are prone to thermokarst. Site 169 occurs on flat landforms like stream terraces, while site 118 occurs on toeslopes and footslopes of hills, plains, and mountains.
F231XY171AK	**Boreal Woodland Loamy Frozen Terraces** Both sites have similar soils and vegetation. Site 171 is less prone to thermokarst. Site 171 occurs on stream terraces, while site 118 occurs on toeslopes and footslopes hills, plains, and mountains.

Table 1. Dominant plant species

Tree	(1) *Picea mariana*
Shrub	(1) *Ledum palustre ssp. decumbens* (2) *Vaccinium oxycoccos*
Herbaceous	(1) *Sphagnum*

Physiographic features

This boreal site occurs on cold footslope and toeslopes of hills, valley sides, and mountains. On occasion, this site is associated with thermokarst depressions. The boreal life zone typically occurs below 2500. Slopes commonly range from 1 percent on toeslopes to 12 percent or more on footslopes and occurs on all aspects. This site does not flood. On gentle slopes, this site ponds frequently for very long durations of time. As slope increases, ponding occurs occasionally for brief durations of time. Reference state soils have a water table at very shallow depths for much of the growing season. The thermokarst state soils have a water table at or above the soil surface for the entire growing season. This site generates limited runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope (2) Toeslope
Landforms	(1) Mountain (2) Hill (3) Valley side (4) Thermokarst depression
Runoff class	Very low to low
Flooding frequency	None
Ponding duration	Brief (2 to 7 days) to very long (more than 30 days)
Ponding frequency	Occasional to frequent
Elevation	825–2,500 ft
Slope	1–8%
Ponding depth	0–12 in
Water table depth	0–10 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	Very long (more than 30 days)
Ponding frequency	None to frequent
Elevation	320–2,625 ft
Slope	0–40%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

Short, warm summers and long, cold winters characterize the subarctic continental climate associated with this boreal site. The mean annual temperature of the site ranges from 22 to 27 degrees F. The warmest months span June through August with mean normal maximum monthly temperatures ranging from 60 to 66 degrees F. The coldest months span November through February with mean normal minimum temperatures ranging from -3 to -12 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 across the area typically ranges between 12 to 18 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 November 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)	12-18 in
Frost-free period (actual range)	4-87 days
Freeze-free period (actual range)	48-120 days
Precipitation total (actual range)	9-20 in
Frost-free period (average)	53 days
Freeze-free period (average)	90 days
Precipitation total (average)	15 in

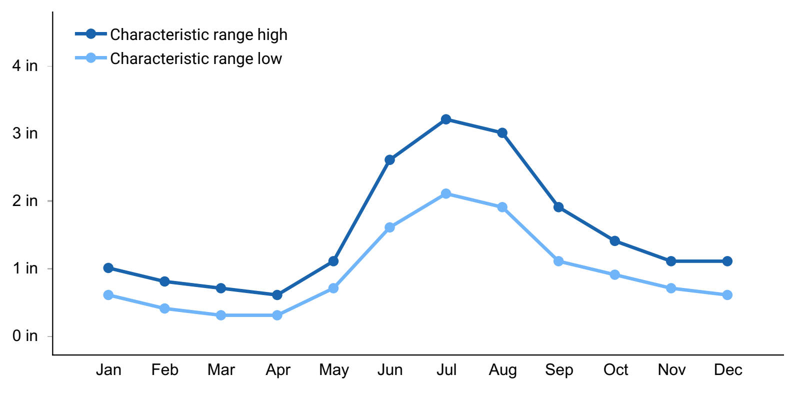


Figure 1. Monthly precipitation range

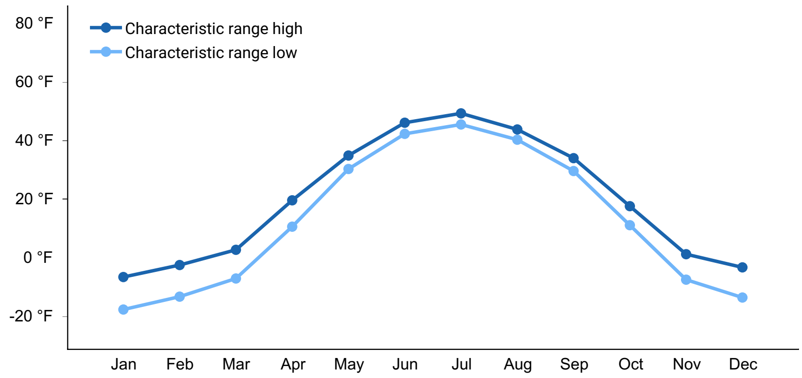


Figure 2. Monthly minimum temperature range

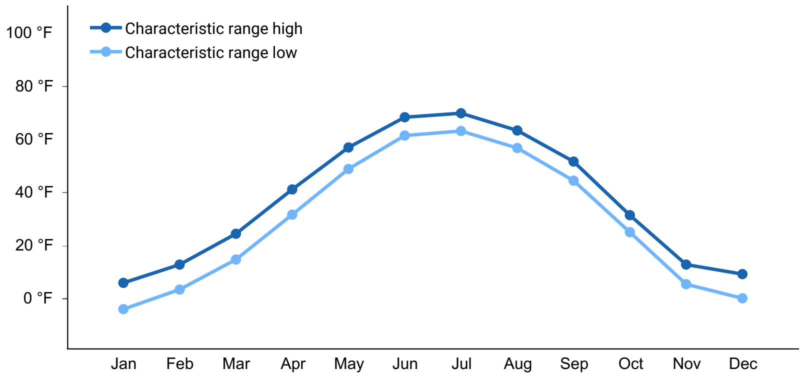


Figure 3. Monthly maximum temperature range

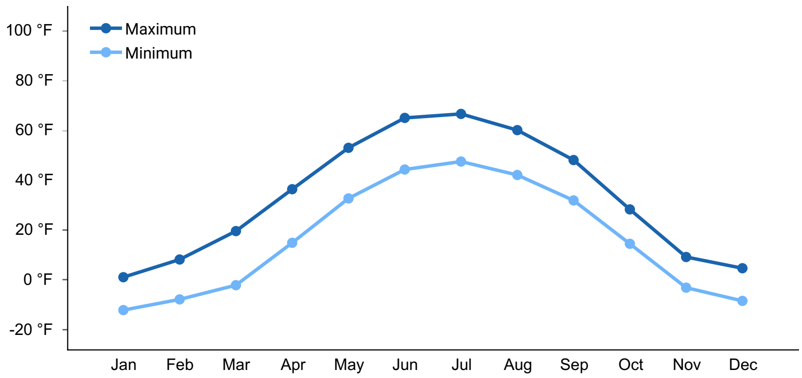


Figure 4. Monthly average minimum and maximum temperature

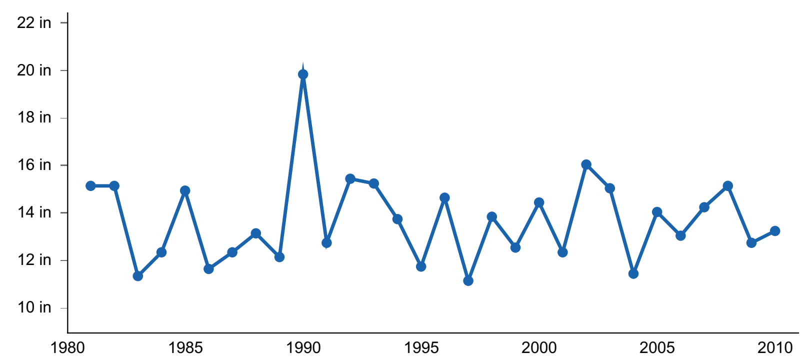


Figure 5. Annual precipitation pattern

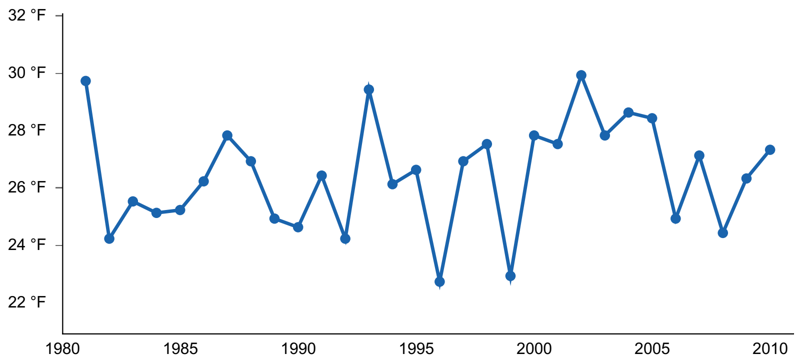


Figure 6. Annual average temperature pattern

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 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.

Wetland description

n/a

Soil features

Soils formed in organic material, windblown silts, and silty colluvium and commonly have permafrost. Rock fragments do not occur on the soil surface. These are mineral soils capped with 11 to 17 inches of saturated organic material. The mineral soil below the organic material is most commonly silt loam derived from alluvium that is often capped with wind-blown loess, which generally lacks rock fragments and has high water holding capacity. All soils are very deep but reference state soils are commonly cryoturbated and have permafrost at shallow to moderate depths (14 to 35 inches). Thermokarst state soils have no permafrost. The pH of the soil profile typically ranges from strongly acidic to moderately acidic. The reference state soils are wet for long portions of the growing season and are considered very poorly to poorly drained.

Figure 7. A typical soil profile associated with the reference state of this site.

Table 5. Representative soil features

Parent material	(1) Organic material (2) Loess (3) Eolian deposits (4) Colluvium
Surface texture	(1) Peat (2) Mucky peat (3) Mucky silt loam
Family particle size	(1) Loamy (2) Coarse-silty
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow to moderately rapid
Depth to restrictive layer	14–35 in
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3.9–13.5 in
Calcium carbonate equivalent (10-40in)	0%
Clay content (0-20in)	2–8%
Electrical conductivity (10-40in)	0–3 mmhos/cm
Sodium adsorption ratio (10-40in)	0
Soil reaction (1:1 water) (10-40in)	5.1–6
Subsurface fragment volume <=3" (0-60in)	0%
Subsurface fragment volume >3" (0-60in)	0%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	12 in
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	1.9–16.1 in
Calcium carbonate equivalent (10-40in)	Not specified
Clay content (0-20in)	Not specified
Electrical conductivity (10-40in)	Not specified
Sodium adsorption ratio (10-40in)	Not specified
Soil reaction (1:1 water) (10-40in)	3.5–7.3
Subsurface fragment volume <=3" (0-60in)	0–40%
Subsurface fragment volume >3" (0-60in)	0–30%

Ecological dynamics

Fire

In the Interior Alaska Uplands area, fire is a common and natural event that has a significant control on the vegetation dynamics across the landscape. A typical fire event in the lands associated with this ecological site will reset plant succession and alter dynamic soil properties (e.g., soil organic matter and depth of permafrost). For this ecological site to progress from the earliest stages of post-fire succession to the oldest stages of succession, data suggest that 70-100 years or more must elapse without another fire event (Johnstone et al. 2010a).

Within this area, fire is considered a natural and common event that typically is unmanaged. Fire suppression is limited, and generally occurs adjacent to Fairbanks and the various villages spread throughout the area or on allotments with known structures, all of which have a relatively limited acre footprint. Most fires are caused by lightning strikes. From 2000 to 2020, 596 known fire events occurred in the Interior Alaska Uplands area and the burn perimeter of the fires totaled about 13.8 million acres (AICC 2022). Fire-related disturbances are highly patchy and can leave undisturbed areas within the burn perimeter. During this time frame, 80% of the fire events were smaller than 20,000 acres but 18 fire events were greater than 200,000 acres in size (AICC 2022). These burn perimeters cover approximately 30% of the Interior Alaska Uplands area.

The fire regime within Interior Alaska follows two general scenarios—low-severity burns and high-severity burns. It should be noted, however, that the fire regime in Interior Alaska is generally thought to be much more complex (Johnstone et al. 2008). Burn severity refers to the proportion of the vegetative canopy and organic material consumed in a fire event (Chapin et al. 2006). Fires in cool and moist habitat tend to result in low-severity burns, while fires in warm and dry habitat tend to result in high-severity burns. Because the soils have a thick organic cap and are very poorly to poorly drained, the typical fire scenario for this ecological site is considered to result in a low-severity burn.

Reference State Soil and Vegetation Dynamics

The low-severity fire regime associated with this site has modest impacts to soil organic matter thickness, depth of permafrost, and soil drainage. While a low-severity fire can consume the bulk of above ground vegetation, minimal proportions of the organic mat are typically removed. Organic matter continues to insulate these cold soils. Field data support that each plant community has permafrost and that the associated low-severity fire event had a negligible impact on the depth of permafrost. If permafrost remains at similar depths after a fire event, then soil drainage is unlikely to improve post-fire.

In areas prone to low-severity fire events, the pre-fire vegetative community generally reestablishes quickly and there is minimal long-term alteration to community composition (Johnstone et al. 2010; Bernhardt et al. 2011). When minimal proportions of the organic mat are consumed, many species regenerate asexually using below ground root systems and rhizomes. Species known to regenerate after low-severity fire events include various graminoids (e.g., Carex spp. and Eriophorum spp.), forbs (e.g., Equisetum sp.), and shrubs (e.g., *Ledum groenlandicum*, *Vaccinium uliginosum*, Salix sp.) (Johnstone et al. 2010). Black spruce is the Interior Alaska tree species best adapted to a low-severity fire regime. Black spruce have semi-serotenous cones and a low-severity fire often results in a flush of black spruce seedlings at the burned location.

The later stages of succession have an overstory that is a mix of broadleaf and immature needleleaf trees (community 1.2) or mature needleleaf trees (community 1.1). The recruitment of trees species during the early stages of post-fire succession largely controls the composition of the stand of trees in the later stages of post-fire succession (Johnstone et al. 2010a). During these later stages of succession, the slower growing black spruce seedlings mature and eventually replace the shade-intolerant broadleaf tree species. The typical fire return interval for black spruce stands in the boreal forest is 70-130 years (Johnstone et al. 2010a).

Lands associated with this site may be burning more frequently than in the past, which may result in alternative pathways of succession. The historic fire return interval for black spruce stands in Interior Alaska occurs approximately once per century. Due to global climate change, stands of spruce in certain portions of the Alaskan boreal forest are burning more frequently than these historic averages (Kelly et al. 2013). Increases to burn frequency favors forested stands dominated by quick growing deciduous trees. A major reason being that increased fire frequency decreases the presence and abundance of mature, cone-bearing trees. Less mature trees result in less spruce seedlings post-fire and an overall decreased abundance of spruce in the developing forest canopy. Increased burn frequency in the boreal forest may result in alternative pathways of post-fire succession with stands of deciduous trees persisting for longer than normal durations of time (Johnstone et al. 2010b).

Field Observations of Reference State Soils

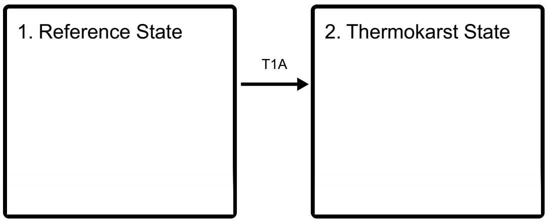
Field data indicate the low severity fires associated with this site have minimal impacts to soil organic matter, depth to permafrost, and drainage. From 2009 to 2015, six field observations were collected in areas that burned 10 to 11 years before sampling occurred (AICC 2022) and resemble the earliest stage of fire-related succession for this ecological site (community 1.3). When comparing soils between the more recently burned plots and plots not recently burned, there were modest differences in soil mean organic matter thickness (14 inches [burned] vs. 20 inches [not burned]) and negligible difference in mean depth of permafrost (22 inches vs. 20 inches). Since this site is associated with a perched water table and permafrost remained at similar depths, soil drainage is not likely improved in recently burned plots. From these data and for this site, it appears that low-severity fire events typically have minimal impacts to the soil organic matter thickness, depth of permafrost, and soil drainage. For this site, additional plots and environmental co-variate data will help clarify the variability in fire severity (e.g., timing of fire, soil organic matter moisture content, and pre-fire vegetation) and its effects to soil organic thickness, depth to permafrost, and drainage.

Thermokarst State

Thermokarst occurs due to the thaw of ice-rich permafrost in soil after disturbances such as fire events or land clearing. For this site, thermokarst pits and gulleys that cut up slopes are common landforms associated with toeslopes and footslopes in the area. From 2008 to 2009, four field observation were collected in areas that had undergone various degrees of thermokarst. When compared to reference state soils, all four observations had comparatively wetter soils that pond for longer durations of time. Two of these observations no longer had permafrost in the soil profile (0-60 inches).

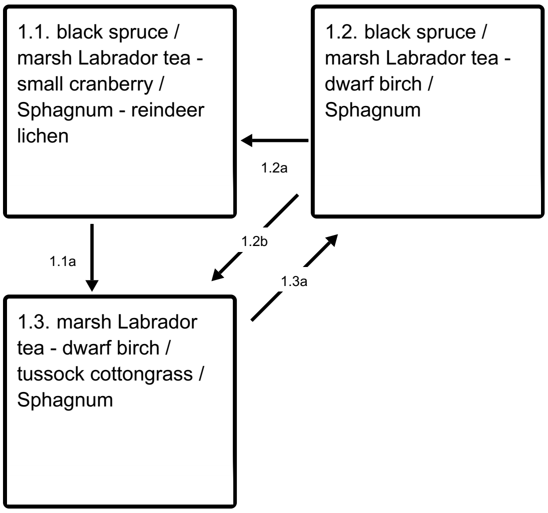
State and transition model

Ecosystem states



T1A - Disturbance leads to the thermal erosion of ground ice and the subsidence of soil resulting in formation of thermokarst depressions.

State 1 submodel, plant communities



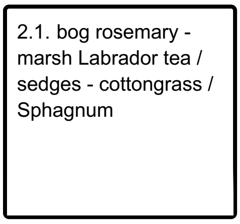
1.1a - A low-severity fire sweeps through and incinerates much of the above ground vegetation.

1.2a - Time without fire.

1.2b - A low-severity fire sweeps through and incinerates much of the above ground vegetation.

1.3a - Time without fire.

State 2 submodel, plant communities



State 1
Reference State

Figure 8. Black spruce community on the footslope of a hill in the area.

The reference plant community is dwarf tree scrub woodland (Viereck et al. 1992) with the dominant tree being black spruce. There are three plant communities within the reference state related to fire.

Dominant plant species

- black spruce (*Picea mariana*), tree
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- small cranberry (*Vaccinium oxycoccos*), shrub
- sphagnum (*Sphagnum*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous

Community 1.1
black spruce / marsh Labrador tea - small cranberry / Sphagnum - reindeer lichen

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

The reference plant community is characterized as dwarf tree scrub woodland (Viereck et al. 1992) with black spruce as the dominant tree. Black spruce tree cover primarily occurs in the stunted tree stratum (greater than 50 years of age and less than 15 feet). Live deciduous trees, primarily resin birch, occasionally occur in the tree canopy. The soil surface is primarily covered with moss and lichen. Common understory species include marsh Labrador tea, bog blueberry, small cranberry, lingonberry, tussock cottongrass, cloudberry, various reindeer lichen, curled snow lichen (*Flavocetraria cucullata*), various Sphagnum. The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), mosses, and lichens.

Forest overstory. Cover from seedlings and saplings (tree regeneration) were not included in the overstory canopy cover values but are included in the cover percent values for individual tree species.

Forest understory. Sphagnum and Polytrichum moss were typically identified to genus. Sphagnum angustifolium, S. fuscum, S. magellanicum, Polytrichum juniperinum, and P. strictum were species occasionally identified in plots.

Dominant plant species

- black spruce (*Picea mariana*), tree
- resin birch (*Betula neoalaskana*), tree
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- small cranberry (*Vaccinium oxycoccos*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- cloudberry (*Rubus chamaemorus*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- reindeer lichen (*Cladina mitis*), other herbaceous

Community 1.2
black spruce / marsh Labrador tea - dwarf birch / Sphagnum

Figure 10. A typical plant community associated with community 1.2.

Community 1.2. is in the late stage of fire-induced secondary succession for this ecological site. It is characterized as dwarf tree scrub woodland (Viereck et al. 1992). Black spruce seedlings are abundant and tree cover primarily occurs in regenerative tree stratum. The soil surface is primarily covered with herbaceous litter and mosses. Common understory species include marsh Labrador tea, lingonberry, dwarf birch, bog blueberry, tussock cottongrass, Bigelow's sedge, cloudberry, curled snow lichen, various Sphagnum moss, splendid feathermoss, and Schreber's big redstem moss. The understory vegetative strata that characterize this community are tree regeneration, low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), and mosses.

Forest overstory. Cover from seedlings and saplings (tree regeneration) were not included in the overstory canopy cover values but are included in the cover percent values for individual tree species.

Forest understory. Sphagnum and Polytrichum moss were typically identified to genus. Sphagnum angustifolium, S. fuscum, S. magellanicum, Polytrichum juniperinum, and P. strictum were species occasionally identified in plots.

Dominant plant species

- black spruce (*Picea mariana*), tree
- resin birch (*Betula neoalaskana*), tree
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- dwarf birch (*Betula nana*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- small cranberry (*Vaccinium oxycoccos*), shrub
- willow (*Salix*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- Bigelow's sedge (*Carex bigelowii*), grass

- sphagnum (*Sphagnum*), other herbaceous
- cloudberry (*Rubus chamaemorus*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- reindeer lichen (*Cladina mitis*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- woodland horsetail (*Equisetum sylvaticum*), other herbaceous
- peppermint drop lichen (*Icmadophila ericetorum*), other herbaceous
- polytrichum moss (*Polytrichum*), other herbaceous

Community 1.3
marsh Labrador tea - dwarf birch / tussock cottongrass / Sphagnum

Figure 11. A typical plant community associated with community 1.1.

Community 1.3 is in the early stage of fire-induced secondary succession for this ecological site. This community is characterized as open low scrub (Viereck et al. 1992). Seedlings of black spruce are common but have limited cover. Common species include marsh Labrador tea, dwarf birch, lingonberry, bog blueberry, small cranberry, tussock cottongrass, Bigelow's sedge, cloudberry, various Sphagnum, and juniper polytrichum moss. The strata that characterize this community are low shrubs (between 8 and 36 inches), medium graminoids (between 4 and 24 inches), and mosses.

Forest overstory. Cover from seedlings and saplings (tree regeneration) were not included in the overstory canopy cover values but are included in the cover percent values for individual tree species.

Forest understory. Sphagnum and Polytrichum moss were typically identified to genus. Sphagnum angustifolium, S. fuscum, S. magellanicum, Polytrichum juniperinum, and P. strictum were species occasionally identified in plots.

Dominant plant species

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- dwarf birch (*Betula nana*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub

- bog blueberry (*Vaccinium uliginosum*), shrub
- small cranberry (*Vaccinium oxycoccos*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- tealeaf willow (*Salix pulchra*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- bluejoint (*Calamagrostis canadensis*), grass
- slimstem reedgrass (*Calamagrostis stricta*), grass
- sphagnum (*Sphagnum*), other herbaceous
- cloudberry (*Rubus chamaemorus*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.3

black spruce / marsh Labrador tea - small cranberry / Sphagnum - reindeer lichen

marsh Labrador tea - dwarf birch / tussock cottongrass / Sphagnum

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated cold and wet soils, this site commonly experiences low-severity fires. Minimal proportions of the organic mat are typically removed. The pre-fire vegetation generally reestablishes quickly from below ground root systems and rhizomes.

Pathway 1.2a
Community 1.2 to 1.1

black spruce / marsh Labrador tea - dwarf birch / Sphagnum

black spruce / marsh Labrador tea - small cranberry / Sphagnum - reindeer lichen

Time without fire. Black spruce seedlings and saplings mature into a stunted woodland.

Pathway 1.2b
Community 1.2 to 1.3

black spruce / marsh Labrador tea - dwarf birch / Sphagnum

marsh Labrador tea - dwarf birch / tussock cottongrass / Sphagnum

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated cold and wet soils, this site commonly experiences low-severity fires. Minimal proportions of the organic mat are typically removed. The pre-fire vegetation generally reestablishes quickly from below ground root systems and rhizomes.

Pathway 1.3a
Community 1.3 to 1.2

marsh Labrador tea - dwarf birch / tussock cottongrass / Sphagnum

black spruce / marsh Labrador tea - dwarf birch / Sphagnum

Time without fire. Black spruce seedlings and sapling start to become a characteristic component of the plant community.

State 2
Thermokarst State

Figure 12. A thermokarst pit on a toeslope in the area.

Figure 13. Pits and head cut gulleys on the toeslope and footslope of a hill caused by thermokarst in the area.

Thermokarst occurs due to the thermal erosion of ice-rich permafrost in soil after disturbances such as fire events or land clearing. For this site, pits and gulleys that cut up a footslope are common landforms associated with thermokarst. While thermokarst can be readily observed, details related to thermokarst succession are poorly understood. After an unknown timeframe, thermokarst depressions could theoretically revert back to plant communities associated with the reference state (Myers-Smith et al. 2008). However, the timeframe for recovery is likely outside the scope of typical land management priorities. At this time, restoration back to reference conditions is not considered within the state-and-transition model. Thermokarst vegetation is commonly characterized as open low scrub (Viereck et al. 1992). Associated soils pond and have a persistent high water table. The thermokarst state has one documented plant community. Future data collection efforts and research would likely enhance information about existing plant communities within this state and allow for better understanding of the potential transitions from one community or state to another.

Dominant plant species

- bog rosemary (*Andromeda polifolia*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- sedge (*Carex*), grass
- cottongrass (*Eriophorum*), grass
- sphagnum (*Sphagnum*), other herbaceous

Community 2.1
bog rosemary - marsh Labrador tea / sedges - cottongrass / Sphagnum

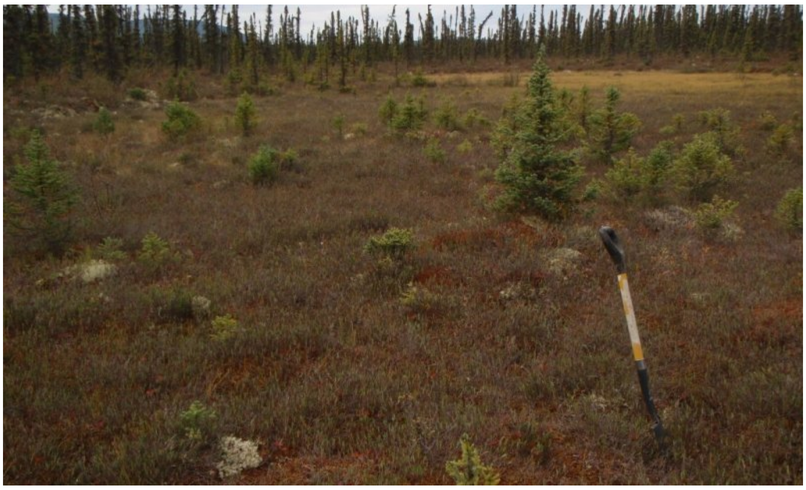


Figure 14. A typical plant community associated with community 2.1.

Community 2.1 develops after thermokarst for this ecological site. This community is characterized as open low scrub (Viereck et al. 1992). Seedlings of black spruce occasionally occur but with limited cover. Common species include bog rosemary, marsh Labrador tea, dwarf birch, leatherleaf, small cranberry, lingonberry, tussock cottongrass, red cottongrass, mud sedge, and Sphagnum. The vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), medium graminoids (between 4 and 24 inches), and mosses.

Forest understory. Sphagnum was typically identified to genus. Sphagnum fuscum and S. magellanicum were species occasionally identified in plots.

Dominant plant species

- bog rosemary (*Andromeda polifolia*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- dwarf birch (*Betula nana*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- small cranberry (*Vaccinium oxycoccos*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- tussock cottongrass (*Eriophorum vaginatum*), grass
- mud sedge (*Carex limosa*), grass
- red cottongrass (*Eriophorum russeolum*), grass
- sphagnum (*Sphagnum*), other herbaceous
- peppermint drop lichen (*Icmadophila ericetorum*), other herbaceous
- cloudberry (*Rubus chamaemorus*), other herbaceous

Transition T1A
State 1 to 2

Reference State

Thermokarst State

Land clearing or fire can thaw permafrost and the thermal erosion of ground ice results in the settling of soil, which is thermokarst. Subsidence can be significant with collapsed pits going down and spanning across several feet.

Additional community tables

Table 7. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
black spruce	PIMA	*Picea mariana*	Native	–	5–40	–	–
resin birch	BENE4	*Betula neoalaskana*	Native	–	0–1	–	–

Table 8. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
tussock cottongrass	ERVA4	*Eriophorum vaginatum*	Native	0.3–2	0–60
Forb/Herb					
cloudberry	RUCH	*Rubus chamaemorus*	Native	0.1–0.3	0.1–55
roundleaf sundew	DRRO	*Drosera rotundifolia*	Native	0.1–0.3	0–3
Labrador lousewort	PELA	*Pedicularis labradorica*	Native	0.3–1	0–1
Shrub/Subshrub					
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0.6–3	3–35
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0.6–3	0–25
black crowberry	EMNI	*Empetrum nigrum*	Native	0.1–0.3	0–20
bog Labrador tea	LEGR	*Ledum groenlandicum*	Native	0.6–3	0–15
small cranberry	VAOX	*Vaccinium oxycoccos*	Native	0.1–0.3	0.1–8
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0.1–0.3	0–7
dwarf birch	BENA	*Betula nana*	Native	0.6–3	0–4
bog rosemary	ANPO	*Andromeda polifolia*	Native	0.1–0.3	0–3
leatherleaf	CHCA2	*Chamaedaphne calyculata*	Native	0.6–3	0–3
Nonvascular					
sphagnum	SPHAG2	*Sphagnum*	Native	0.1–0.3	15–100
	FLCU	*Flavocetraria cucullata*	Native	0.1–0.3	0–45
greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	Native	0.1–0.3	0–25
reindeer lichen	CLMI60	*Cladina mitis*	Native	0.1–0.3	0–15
cup lichen	CLADO3	*Cladonia*	Native	0.1–0.3	0–8
island cetraria lichen	CEIS60	*Cetraria islandica*	Native	0.1–0.3	0–8
star reindeer lichen	CLST60	*Cladina stellaris*	Native	0.1–0.3	0–8
peppermint drop lichen	ICER	*Icmadophila ericetorum*	Native	0.1–0.3	0–3
polytrichum moss	POLYT5	*Polytrichum*	Native	0.1–0.3	0–3

Table 9. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
black spruce	PIMA	*Picea mariana*	Native	0.1–15	12–45	–	–

Table 10. Community 1.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
tussock cottongrass	ERVA4	*Eriophorum vaginatum*	Native	0.3–2	2–40
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.3–2	0–5
Forb/Herb					
cloudberry	RUCH	*Rubus chamaemorus*	Native	0.1–0.3	2–10
woodland horsetail	EQSY	*Equisetum sylvaticum*	Native	0.3–2	0–7
Shrub/Subshrub					
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0.6–3	15–30
dwarf birch	BENA	*Betula nana*	Native	0.6–3	0–25
resin birch	BEGL	*Betula glandulosa*	Native	0.6–3	0–20
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0.6–3	1–15
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0.1–0.3	7–15
leatherleaf	CHCA2	*Chamaedaphne calyculata*	Native	0.6–3	0–10
Nonvascular					
sphagnum	SPHAG2	*Sphagnum*	Native	0.1–0.3	30–70
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0.1–0.3	1–30
	FLCU	*Flavocetraria cucullata*	Native	0.1–0.3	0–10
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0.1–0.3	0–10
greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	Native	0.1–0.3	0–10
cup lichen	CLSC60	*Cladonia scabriuscula*	Native	0.1–0.3	0–5
felt lichen	PEAP60	*Peltigera aphthosa*	Native	0.1–0.3	0–5
reindeer lichen	CLMI60	*Cladina mitis*	Native	0.1–0.3	0–4

Table 11. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
black spruce	PIMA	*Picea mariana*	Native	0.1–15	0–12	–	–

Table 12. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
tussock cottongrass	ERVA4	*Eriophorum vaginatum*	Native	0.3–2	0–45
Bigelow's sedge	CABI5	*Carex bigelowii*	Native	0.3–2	0–40
Forb/Herb					
cloudberry	RUCH	*Rubus chamaemorus*	Native	0.1–0.3	0.1–30
Shrub/Subshrub					
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0.6–3	0–40
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0.6–3	5–37
black crowberry	EMNI	*Empetrum nigrum*	Native	0.1–0.3	0–20
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0.1–0.3	0.1–20
dwarf birch	BENA	*Betula nana*	Native	0.6–3	2–15
tealeaf willow	SAPU15	*Salix pulchra*	Native	3–10	0–8
small cranberry	VAOX	*Vaccinium oxycoccos*	Native	0.1–0.3	0.1–5
Nonvascular					
sphagnum	SPHAG2	*Sphagnum*	Native	0.1–0.3	20–85
	FLCU	*Flavocetraria cucullata*	Native	0.1–0.3	0–7

Table 13. Community 2.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
black spruce	PIMA	*Picea mariana*	Native	–	0–5	–	–

Table 14. Community 2.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
tussock cottongrass	ERVA4	*Eriophorum vaginatum*	Native	0.3–2	0–85
mud sedge	CALI7	*Carex limosa*	Native	0.3–2	0–35
red cottongrass	ERRU2	*Eriophorum russeolum*	Native	0.3–2	0–15
ryegrass sedge	CALO4	*Carex loliacea*	Native	0.1–0.3	0–5
Forb/Herb					
cloudberry	RUCH	*Rubus chamaemorus*	Native	0.1–0.3	0–8
roundleaf sundew	DRRO	*Drosera rotundifolia*	Native	0.1–0.3	0–1
Shrub/Subshrub					
bog rosemary	ANPO	*Andromeda polifolia*	Native	0.1–0.3	0–40
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0.1–0.3	0–35
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0.6–3	0–15
willow	SALIX	*Salix*	Native	0.6–3	0–15
dwarf birch	BENA	*Betula nana*	Native	0.6–3	0–12
resin birch	BEGL	*Betula glandulosa*	Native	0.6–3	0–10
beauverd spirea	SPST3	*Spiraea stevenii*	Native	0.6–3	0–5
leatherleaf	CHCA2	*Chamaedaphne calyculata*	Native	0.6–3	0–5
small cranberry	VAOX	*Vaccinium oxycoccos*	Native	0.1–0.3	0.1–5
Nonvascular					
sphagnum	SPHAG2	*Sphagnum*	Native	0.1–0.3	30–100
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0.1–0.3	0–25
peppermint drop lichen	ICER	*Icmadophila ericetorum*	Native	0.1–0.3	0–5

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

09NP02404, 09TC02701, 09TC02703, 10TC04205, 10TC04404, 11BB02601, 11BE00202, 12SN02103, 2015AK290530, 2015AK290902, 2015AK290951, 2015AK290954, 2015AK290956, 2015AK290959, 2016AK290719, 2016AK290721

Community 1.2

09TC02704, 09TC02705, 10NP04206, 10TC01406, 10TC04401, 2016AK290618

Community 1.3

09TC00503, 10TC00905, 10TC03702, 14NR05104, 2015AK290840, 2015AK290972

Community 1.4

08TC02703, 09NP02402, 09NP02403, 09TC02702

References

Bernhardt, E.L., T.N. Hollingsworth, and . 2011. Fire severity mediates climate-driven shifts in understorey community composition of black spruce stands of interior Alaska. Journal of Vegetation Science 22:32–44.

Chapin, F.S., L.A. Viereck, P.C. Adams, K.V. Cleve, C.L. Fastie, R.A. Ott, D. Mann, and J.F. Johnstone. 2006. Successional processes in the Alaskan boreal forest. Page 100 in Alaska's changing boreal forest. Oxford University Press.

Hinzman, L.D., L.A. Viereck, P.C. Adams, V.E. Romanovsky, and K. Yoshikawa. 2006. Climate and permafrost dynamics of the Alaskan boreal forest. Alaska's changing boreal forest 39–61.

I. H. Myers-Smith, J. W. Harden, M. Wilmking, C. C. Fuller, A. D. McGuire, and F. S. Chapin III. 2008. Wetland succession in a permafrost collapse: interactions between fire and thermokarst. Biogeosciences 5:1273–1286.

Johnstone, J.F., T.N. Hollingsworth, F.S. CHAPIN III, and M.C. Mack. 2010. Changes in fire regime break the legacy lock on successional trajectories in Alaskan boreal forest. Global change biology 16:1281–1295.

Johnstone, J.F., F.S. Chapin, T.N. Hollingsworth, M.C. Mack, V. Romanovsky, and M. Turetsky. 2010. Fire, climate change, and forest resilience in interior Alaska. Canadian Journal of Forest Research 40:1302–1312.

Johnstone, J.F. 2008. A key for predicting postfire successional trajectories in black spruce stands of interior Alaska. US Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Kelly, R., M.L. Chipman, P.E. Higuera, I. Stefanova, L.B. Brubaker, and F.S. Hu. 2013. Recent burning of boreal forests exceeds fire regime limits of the past 10,000 years. Proceedings of the National Academy of Sciences 110:13055–13060.

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/

LANDFIRE. 2009. Western North American Boreal Black Spruce Dwarf-tree Peatland – Boreal Complex. In: LANDFIRE National Vegetation Dynamics Models. USDA Forest Service and US Department of Interior. Washington, DC.

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).

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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	05/11/2025
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:**