Ecological site F231XY162AK
Boreal Woodland Gravelly Slopes Cold

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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 – 7416041 – Western North American Boreal Mesic Black Spruce Forest - Boreal (Landfire 2009)

Ecological site concept

This boreal site occurs on cold slopes with moist to dry gravelly soils that do not have permafrost. The most common hillslope positions are summits and backslopes of hills and low-elevation mountains that are north to east facing. Soils do not pond or flood. This site is associated with dry and well drained soils and moist and somewhat poorly drained soils. The moist soils commonly have a high-water table at shallow depths. Soils formed in a thin layer of windblown silts over gravelly residuum and/or colluvium. While these soils support stands of black spruce, soils with greater amounts of windblown silt are much more productive. Soils are typically very deep without restrictions.

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 grasses, forbs, and weedy mosses. Field data indicate most of the soil organic matter is consumed during these fire events which could increase site erosion. 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 needleleaf woodland (Viereck et al. 1992) with black spruce as 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 bog blueberry, lingonberry, bog Labrador tea, crowberry, false toadflax, various reindeer lichen, curled snow lichen, crinkled snow lichen, tomentose snow lichen, various cup lichen, splendid feathermoss, and Schreber's big red stem moss. Black spruce tree cover is split between the stunted tree (greater than 50 years of age and less than 15 feet) and medium tree strata (between 15 and 40 feet). Live deciduous trees, primarily resin birch and quaking aspen, occasionally occur in the tree canopy but with limited cover. The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), mosses, and foliose and fruticose lichens.

Associated sites

F231XY118AK	**Boreal Woodland Organic Frozen Slopes** Occurs downslope on wet, frozen toeslopes and footslopes supporting stands of stunted black spruce.
F231XY160AK	**Boreal Forest Loamy Frozen Slopes** Occurs on the same cold slopes but on wet, gravelly, frozen soils supporting stands of black spruce.
F231XY166AK	**Boreal Woodland Gravelly Frozen Slopes** Occurs on the same hill slopes but on steeper slopes with permafrost. Soils support stands of stunted black spruce.
F231XY180AK	**Boreal Woodland Gravelly Slopes Dry** Occurs on the same hills and low-elevation mountains but on warm slopes with stands of white spruce.
F231XY182AK	**Boreal Forest Gravelly Slopes** Occurs on the same hills and low-elevation mountains but on warm slopes with stands of white spruce.

Similar sites

F231XY180AK	**Boreal Woodland Gravelly Slopes Dry** Both sites are associated with dry and gravelly soils and occur on the same boreal hills. White spruce is the dominant overstory species associated with site 180.
F231XY182AK	**Boreal Forest Gravelly Slopes** Both sites are associated with dry and gravelly soils and occur on the same boreal hills. White spruce is the dominant overstory species associated with site 180.

F231XY190AK	**Boreal Forest Silty Slopes Cold** Both sites occur on the same cold boreal slopes. Due to having a thicker layer of silty loess, site 190 has more productive black spruce stands.

Table 1. Dominant plant species

Tree	(1) *Picea mariana*
Shrub	(1) *Vaccinium uliginosum* (2) *Vaccinium vitis-idaea*
Herbaceous	(1) *Cladina* (2) *Flavocetraria cucullata*

Physiographic features

This boreal site occurs on cold slopes of hills and low-elevation mountains. The most common hillslope position is summits and backslopes. This site occurs in the boreal life zone which is typically below 2500 feet. At times, this site occurs on mountain slopes at 3000 feet or more elevation. Slopes commonly range from 8 percent on summits to 35 percent or more on backslopes, which are northwest to east facing. This site does not flood or pond. It is common for soils to have no water table in the soil profile. It is also common for soils to have a high-water table at shallow depths perched on seasonal frost. As the seasonal frost melts, the water table drains from the soil profile. This site generates limited to medium amounts of runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Backslope
Landforms	(1) Hill (2) Mountain
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	274–762 m
Slope	8–35%
Water table depth	25 cm
Aspect	NW, N, NE, E

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	61–945 m
Slope	3–70%
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)	305-457 mm
Frost-free period (actual range)	4-87 days
Freeze-free period (actual range)	48-120 days
Precipitation total (actual range)	229-508 mm
Frost-free period (average)	53 days
Freeze-free period (average)	90 days
Precipitation total (average)	381 mm

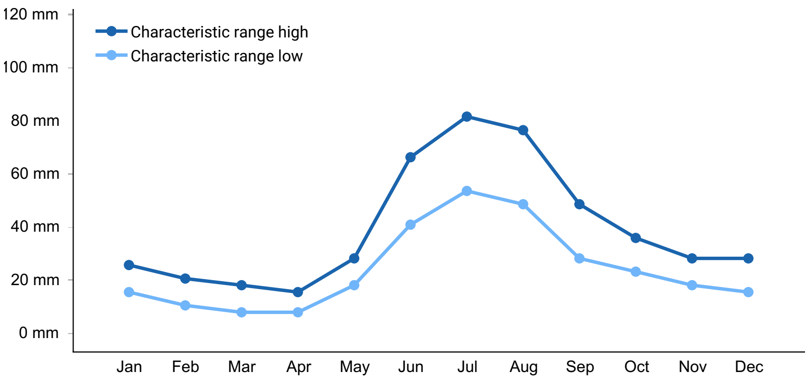


Figure 1. Monthly precipitation range

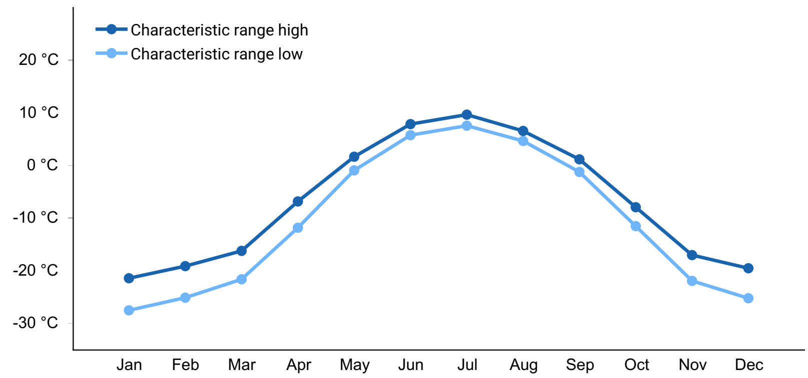


Figure 2. Monthly minimum temperature range

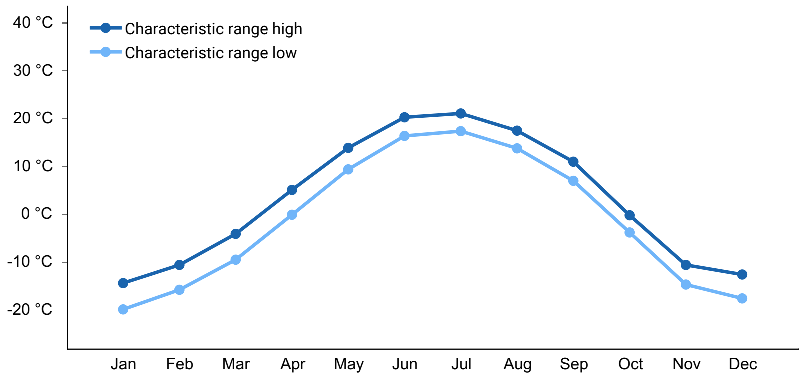


Figure 3. Monthly maximum temperature range

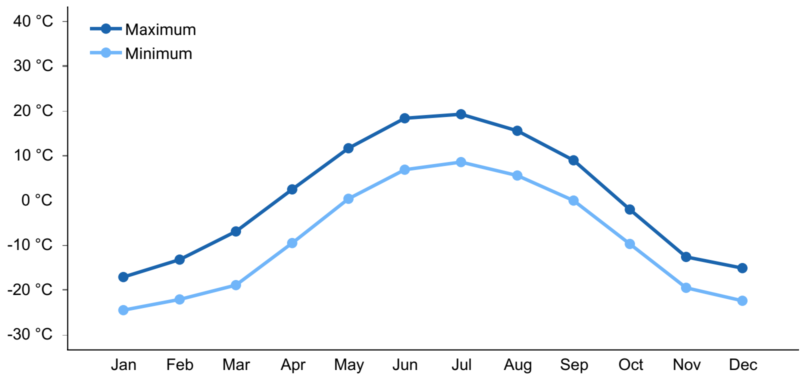


Figure 4. Monthly average minimum and maximum temperature

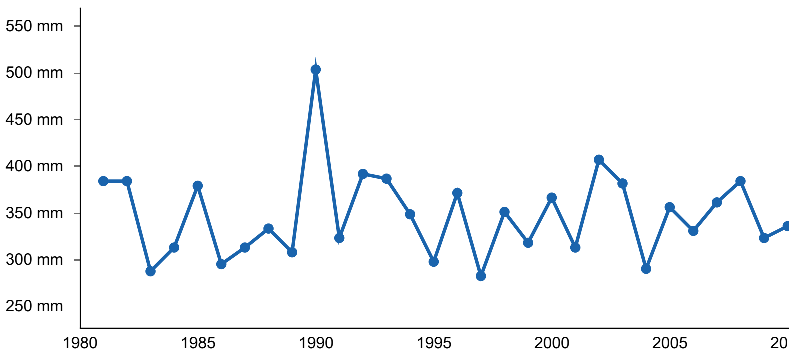


Figure 5. Annual precipitation pattern

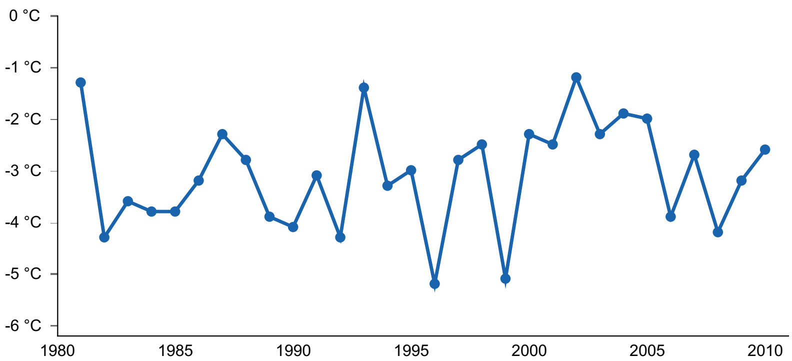


Figure 6. Annual average temperature pattern

Climate stations used

- (1) 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

Due to its landscape position, this site is neither associated with or influenced by streams or wetlands. Precipitation and throughflow are the main source of water for this ecological site. Surface runoff and throughflow contribute some water to downslope ecological sites.

Wetland description

n/a

Soil features

Soils formed in windblown silts over gravelly parent material and do not have permafrost. Rock fragments commonly range up to 5 percent cover of the soil surface. These are mineral soils capped with up to 6 inches of organic material. The mineral soil below the organic material is a silt loam formed from wind-blown loess, which lacks rock fragments and has high water holding capacity. This silty layer is thin and variable ranging in thickness from 0 to 9 inches. Below the silty parent material is gravelly colluvium or residuum with rock fragments ranging between 25 and 60 percent of the mineral soil profile by volume. Soils are typically very deep. At times, soil have an abrupt change between the silty loess and gravelly colluvium resulting in restrictions at very shallow to shallow depths (6 to 12 inches). On occasion, soils with residuum contact bedrock at shallow to moderate depths (12 to 24 inches). The pH of the soil profile typically ranges from moderately acidic to slightly acidic. Soils range from somewhat poorly to well drained.

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

Table 5. Representative soil features

Parent material	(1) Loess (2) Residuum (3) Colluvium
Surface texture	(1) Silt loam (2) Gravelly silt loam

Family particle size	(1) Loamy-skeletal
Drainage class	Somewhat poorly drained to well drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	30 cm
Soil depth	152 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	3.3–13.72 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	5–15%
Electrical conductivity (25.4-101.6cm)	0–3 mmhos/cm
Sodium adsorption ratio (25.4-101.6cm)	0
Soil reaction (1:1 water) (25.4-101.6cm)	5.6–6.5
Subsurface fragment volume <=3" (0-152.4cm)	20–50%
Subsurface fragment volume >3" (0-152.4cm)	5–10%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Moderately rapid to very rapid
Depth to restrictive layer	15 cm
Soil depth	30 cm
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0–12%
Available water capacity (0-101.6cm)	2.54–21.08 cm
Calcium carbonate equivalent (25.4-101.6cm)	Not specified
Clay content (0-50.8cm)	Not specified
Electrical conductivity (25.4-101.6cm)	Not specified
Sodium adsorption ratio (25.4-101.6cm)	Not specified
Soil reaction (1:1 water) (25.4-101.6cm)	3.6–7.3
Subsurface fragment volume <=3" (0-152.4cm)	11–63%
Subsurface fragment volume >3" (0-152.4cm)	3–26%

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., thickness of the organic material). 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 over a period of 20 years.

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 thin organic cap and are commonly well drained, the typical fire scenario for this ecological site is considered to result in a high-severity burn.

Large portions of the organic mat are consumed during a high-severity fire event, commonly exposing pockets of mineral soil. The loss of this organic mat, which insulates the mineral soil, and the decrease in site albedo tends to cause overall soil temperatures to increase (Hinzman et al. 2006). These alterations to soil temperature may result in increased depths of seasonal frost in the soil profile and improve soil drainage. High-severity fire events also destroy a majority of the vascular and nonvascular biomass above ground.

Field data suggest that each of the forested communities burn and that fire events will cause a transition to the pioneering stage of fire succession. This stage (community 1.4) is a mix of species that either regenerate in place (e.g., subterranean root crowns for willow and rhizomes for graminoids) and/or from wind-dispersed seed or spores that colonize exposed mineral soil (e.g., quaking aspen [*Populus tremuloides*] and Ceratodon moss [*Ceratodon purpureus*]). The pioneering stage of fire succession is primarily composed of tree seedlings, forbs, grasses, and weedy bryophytes. This stage of succession is thought to persist for up to 10 years post-fire. Willow (Salix spp.) and quick growing deciduous tree seedlings continue to colonize and grow in stature on recently burned sites until they become dominant in the overstory, which marks the transition to the early stage of fire succession (community 1.3). This early stage of fire succession is thought to persist 10 to 30 years post-fire. In the absence of fire, tree species continue to become more dominant in the stand and eventually develop into forests.

The later stages of succession have an overstory that is a mix of broadleaf and/or immature needleleaf trees (community 1.2) or mature needleleaf trees (community 1.1). The recruitment of trees species during the pioneering and 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.

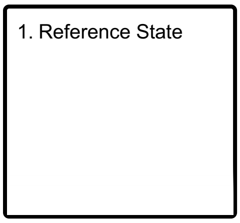
Increased burn frequency in the boreal forest may result in alternative pathways of post-fire succession with stands of deciduous trees persisting for longer than normal durations of time (Johnstone et al. 2010b).

Field Observations

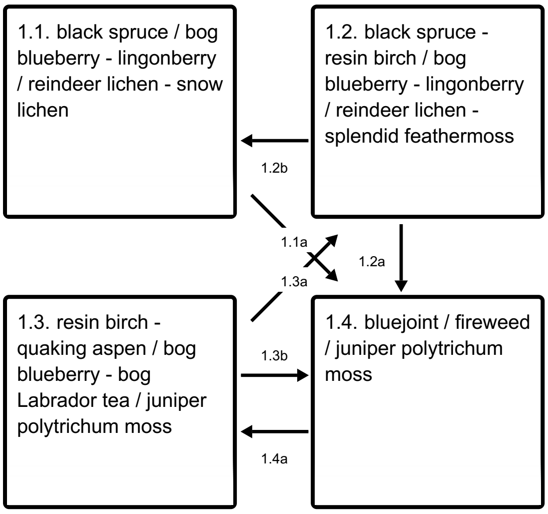
Field data indicate the high severity fires associated with this site impacts soil organic matter thickness. From 2008 to 2016, six field observations were collected in areas that burned 4 to 12 years before sampling occurred (AICC 2022) and resemble the earliest stages of fire-related succession for this ecological site (communities 1.3 and 1.4). When comparing soils between the more recently burned plots and plots not recently burned, there were noticeable differences in soil mean organic matter thickness (1 inch [burned] vs. 3 inches [not burned]). All the organic mat was consumed in one of the six sample plots. From these data and for this site, it appears that high-severity fire events cause impactful alterations to the soil organic matter thickness. 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 mat thickness and other important dynamic soil properties.

State and transition model

Ecosystem states



State 1 submodel, plant communities



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

1.2b - Time without fire.

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

1.3a - Time without fire.

1.3b - A high-severity fire sweeps through and incinerates much of the above ground vegetation.

1.4a - Time without fire.

State 1
Reference State

Figure 8. A black spruce woodland on a cold slope with dry and gravelly soils in the area.

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

Dominant plant species

- black spruce (*Picea mariana*), tree
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- reindeer lichen (*Cladina*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous

Community 1.1
black spruce / bog blueberry - lingonberry / reindeer lichen - snow lichen

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

The reference plant community is characterized as needleleaf woodland (Viereck et al. 1992) with black spruce as the dominant tree. Black spruce tree cover is split between the stunted tree (greater than 50 years of age and less than 15 feet) and medium tree strata (between 15 and 40 feet). Live deciduous trees, primarily resin birch and quaking aspen, occasionally occur in the tree canopy but with limited cover. The soil surface is primarily covered with moss and lichen. Common understory species include bog blueberry, lingonberry, bog Labrador tea, crowberry, false toadflax, various reindeer lichen, curled snow lichen (*Flavocetraria cucullata*), crinkled snow lichen (*F. nivalis*), tomentose snow lichen, various cup lichen, splendid feathermoss, and Schreber's big red stem moss. The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches), dwarf shrubs (less than 8 inches), mosses, and foliose and fruticose 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.

Dominant plant species

- black spruce (*Picea mariana*), tree
- resin birch (*Betula neoalaskana*), tree
- quaking aspen (*Populus tremuloides*), tree
- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous
- (*Flavocetraria nivalis*), other herbaceous
- tomentose snow lichen (*Stereocaulon tomentosum*), other herbaceous

Community 1.2
black spruce - resin birch / bog blueberry - lingonberry / reindeer lichen - splendid feathermoss

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

Figure 11. 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 typically characterized as mixed woodland (Viereck et al. 1992) with mature resin birch or quaking aspen and a mixture of immature and mature black spruce as the dominant trees. Tree cover is split between the regenerative (less than 15 feet) and medium strata (between 15 and 40 feet). The soil surface is primarily covered with herbaceous litter, mosses, and lichen. Common understory species include lingonberry, crowberry, bog blueberry, bog Labrador tea, false toadflax, curled snow lichen, various reindeer lichen, various cup lichen, and splendid feathermoss. The understory vegetative strata that characterize this community are tree regeneration, low shrubs (between 8 and 36 inches), foliose and fruticose lichens, 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.

Dominant plant species

- black spruce (*Picea mariana*), tree
- resin birch (*Betula neoalaskana*), tree
- quaking aspen (*Populus tremuloides*), tree
- lingonberry (*Vaccinium vitis-idaea*), shrub
- black crowberry (*Empetrum nigrum*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- prickly rose (*Rosa acicularis*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- Bebb willow (*Salix bebbiana*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- splendid feather moss (*Hylocomium splendens*), other herbaceous
- false toadflax (*Geocaulon lividum*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- island cetraria lichen (*Cetraria islandica*), other herbaceous
- reindeer lichen (*Cladina mitis*), other herbaceous
- felt lichen (*Peltigera aphthosa*), other herbaceous
- Schreber's big red stem moss (*Pleurozium schreberi*), other herbaceous
- cup lichen (*Cladonia*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- stiff clubmoss (*Lycopodium annotinum*), other herbaceous
- running clubmoss (*Lycopodium clavatum*), other herbaceous
- groundcedar (*Lycopodium complanatum*), other herbaceous

Community 1.3
resin birch - quaking aspen / bog blueberry - bog Labrador tea / juniper polytrichum moss

Figure 12. A typical plant community associated with community 1.3.

Community 1.3 is in the early stage of fire-induced secondary succession for this ecological site. While black spruce, quacking aspen, and resin birch are all common, deciduous tree seedlings form the majority of tree cover. Common understory species include Bebb willow, bog blueberry, prickly rose, lingonberry, bog Labrador tea, bluejoint, purple reedgrass, fireweed, Alaska wild rhubarb, juniper polytrichum moss, and Pohlia moss. The strata that characterize this community are tree regeneration, low shrubs (between 8 and 36 inches), and mosses.

Dominant plant species

- resin birch (*Betula neoalaskana*), tree

- quaking aspen (*Populus tremuloides*), tree
- black spruce (*Picea mariana*), tree
- bog blueberry (*Vaccinium uliginosum*), shrub
- Bebb willow (*Salix bebbiana*), shrub
- prickly rose (*Rosa acicularis*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- purple reedgrass (*Calamagrostis purpurascens*), grass
- fireweed (*Chamerion angustifolium*), other herbaceous
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- Alaska wild rhubarb (*Polygonum alpinum*), other herbaceous
- pohlia moss (*Pohlia nutans*), other herbaceous
- narrowleaf arnica (*Arnica angustifolia ssp. angustifolia*), other herbaceous

Community 1.4
bluejoint / fireweed / juniper polytrichum moss

Figure 13. A typical plant community associated with community 1.4.

Community 1.4 is in the pioneering stage of fire-induced secondary succession for this ecological site. The community is often sparsely vegetated and is typically characterized as open low scrub or mesic forb herbaceous (Viereck et al. 1992). Seedlings of black spruce, resin birch, and quaking aspen are commonly observed but have limited cover. Common species include Bebb willow, bog blueberry, bog Labrador tea, lingonberry, bluejoint, fireweed, juniper polytrichum moss, Ceratodon moss, and Pohlia moss. The strata that characterize this community are medium graminoids (between 4 and 24 inches), medium forbs (between 4 and 24 inches), and mosses.

Dominant plant species

- bog blueberry (*Vaccinium uliginosum*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog Labrador tea (*Ledum groenlandicum*), shrub
- Bebb willow (*Salix bebbiana*), shrub
- bluejoint (*Calamagrostis canadensis*), grass
- juniper polytrichum moss (*Polytrichum juniperinum*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous
- ceratodon moss (*Ceratodon purpureus*), other herbaceous
- dwarf scouringrush (*Equisetum scirpoides*), other herbaceous
- pohlia moss (*Pohlia nutans*), other herbaceous

Pathway 1.1a
Community 1.1 to 1.4

black spruce / bog blueberry - lingonberry / reindeer lichen - snow lichen

bluejoint / fireweed / juniper polytrichum moss

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.2b
Community 1.2 to 1.1

black spruce - resin birch / bog blueberry - lingonberry / reindeer lichen - splendid feathermoss

black spruce / bog blueberry - lingonberry / reindeer lichen - snow lichen

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

Pathway 1.2a
Community 1.2 to 1.4

black spruce - resin birch / bog blueberry - lingonberry / reindeer lichen - splendid feathermoss

bluejoint / fireweed / juniper polytrichum moss

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.3a
Community 1.3 to 1.2

resin birch - quaking aspen / bog blueberry - bog Labrador tea / juniper polytrichum moss

black spruce - resin birch / bog blueberry - lingonberry / reindeer lichen - splendid feathermoss

Time without fire. Black spruce tree cover increases and community turns into a mixed woodland.

Pathway 1.3b
Community 1.3 to 1.4

resin birch - quaking aspen / bog blueberry - bog Labrador tea / juniper polytrichum moss

bluejoint / fireweed / juniper polytrichum moss

A fire sweeps through and incinerates much of the above ground vegetation. Because of the associated dry soils, this site commonly experiences high-severity fires. A significant proportion of organic matter is consumed, leaving exposed mineral soil. Vegetation usually resprouts from surviving individuals or is recruited from nearby areas via seed or seedbank.

Pathway 1.4a
Community 1.4 to 1.3

bluejoint / fireweed / juniper polytrichum moss

resin birch - quaking aspen / bog blueberry - bog Labrador tea / juniper polytrichum moss

Time without fire. Deciduous tree and shrub cover increases.

Additional community tables

Table 7. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
black spruce	PIMA	*Picea mariana*	Native	5.5–12.5	11–50	7.1–29.7	–
resin birch	BENE4	*Betula neoalaskana*	Native	–	0–7	–	–
quaking aspen	POTR5	*Populus tremuloides*	Native	–	0–5	–	–

Table 8. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Forb/Herb					
false toadflax	GELI2	*Geocaulon lividum*	Native	0.1–0.6	0–10
groundcedar	LYCO3	*Lycopodium complanatum*	Native	0–0.1	0–5
Shrub/Subshrub					
bog Labrador tea	LEGR	*Ledum groenlandicum*	Native	0.2–0.9	0–25
lingonberry	VAVI	*Vaccinium vitis-idaea*	Native	0–0.1	5–20
bog blueberry	VAUL	*Vaccinium uliginosum*	Native	0.2–0.9	0.1–15
black crowberry	EMNI	*Empetrum nigrum*	Native	0–0.1	0–15
marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	Native	0.2–0.9	0–15
kinnikinnick	ARUV	*Arctostaphylos uva-ursi*	Native	0–0.1	0–10
Nonvascular					
splendid feather moss	HYSP70	*Hylocomium splendens*	Native	0–0.1	0–60
greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	Native	0–0.1	0–50
star reindeer lichen	CLST60	*Cladina stellaris*	Native	0–0.1	0–45
tomentose snow lichen	STTO60	*Stereocaulon tomentosum*	Native	0–0.1	0–20
Schreber's big red stem moss	PLSC70	*Pleurozium schreberi*	Native	0–0.1	0–20
cup lichen	CLADO3	*Cladonia*	Native	0–0.1	0–15
	FLNI	*Flavocetraria nivalis*	Native	0–0.1	0–15
reindeer lichen	CLMI60	*Cladina mitis*	Native	0–0.1	0–15
island cetraria lichen	CEIS60	*Cetraria islandica*	Native	0–0.1	0–10
	FLCU	*Flavocetraria cucullata*	Native	0–0.1	0–10
Richardson's masonhalea lichen	MARI60	*Masonhalea richardsonii*	Native	0–0.1	0–5

Table 9. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
quaking aspen	POTR5	*Populus tremuloides*	Native	–	0–40	–	–
black spruce	PIMA	*Picea mariana*	Native	–	12–38	–	–
resin birch	BENE4	*Betula neoalaskana*	Native	–	0–30	–	–

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

08TC01403, 08TC01505, 09NP02606, 09TC02101, 10NP03002, 10TC01504, 11RS00101, 11RS00102, 2016AK090004

Community 1.2

09NP02601, 09NP02701, 09TC00705, 10NP01003, 10NP04102, 10NP04201, 10NP04202, 10TC03605, 12CP00703

Community 1.3

10NP01905, 2015AK290986

Community 1.4

08CS01002, 10TC02403, 11BB03103, 11BB03105, 2016AK290374, 2016AK290605

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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	11/23/2024

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:**