USDA Natural Resources Conservation Service

Ecological site XA232X01Y201
Boreal Woodland Peat Frozen Terraces

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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): 232X–Yukon Flats Lowlands

The Yukon Flats Lowlands MLRA is an expansive basin characterized by numerous levels of flood plains and terraces that are separated by minimal breaks in elevation. This MLRA is in Interior Alaska and is adjacent to the middle reaches of the Yukon River. Numerous tributaries of the Yukon River are within the Yukon Flats Lowlands MLRA. The largest are Beaver Creek, Birch Creek, Black River, Chandalar River, Christian River, Dall River, Hadweenzic River, Hodzana River, Porcupine River, and Sheenjek River. The MLRA has two distinct regions—lowlands and marginal uplands. The lowlands have minimal local relief and are approximately 9,000 square miles in size (Williams 1962). Landforms associated with the lowlands are flood plains and stream terraces. The marginal uplands consist of rolling and dissected plains that are a transitional area between the lowlands and adjacent mountain systems. The marginal uplands are approximately 4,700 square miles in size (Williams 1962).

This MLRA is bounded by the Yukon-Tanana Plateau to the south, Hodzana Highlands to the west, Porcupine Plateau to the east, and southern foothills of the Brooks Range to the north (Williams 1962). These surrounding hills and mountains partially isolate the Yukon Flats Lowlands MLRA from weather systems affecting other MLRAs of Interior Alaska. As a result, temperatures are generally warmer in summer and colder in winter than is characteristic in other areas at comparable latitude. There is a moisture and temperature gradient in which the lowlands region tends to be drier and colder and the surrounding marginal uplands region tends to be moister and warmer (PRISM Climate Group 2006).

The Yukon Flats Lowlands MLRA is mostly undeveloped lands that are sparsely populated and not accessible by a road system. A number of villages, including Beaver, Birch Creek, Chalkyitsik, Circle, Fort Yukon, Stevens Village, and Venetie, are adjacent to the Yukon River or one of its major tributaries. The largest village is Fort Yukon, which according to the 2010 U.S. Census has 583 residents that are dominantly Gwich'in Alaska Natives.

LRU notes

Alaska has no officially recognized LRU. However, there appear to be two distinct LRU in the Yukon Flats Lowlands MLRA. These LRU are thought to have differing climatic regimes, landforms, and soil types (STATSGO and Jorgensen and Meidinger 2015). The two LRU were previously discussed in the MLRA notes section above and are termed the lowlands LRU and the marginal uplands LRU.

This ecological site is associated with both the lowlands and marginal uplands LRU.

Classification relationships

Yukon Flats Lowlands MLRA.

Ecological site concept

This ecological site is associated with organic-rich bogs in the Yukon Flats Lowlands MLRA. The cumulative thickness of organic material often exceeds 50 inches in the soil profile. Reference state soils are poorly drained and organic material is considered ultra to extremely acidic. The soils associated with the reference plant community 1.1 generally have permafrost at moderate depth (20 to 40 inches). The reference state supports multiple plant communities related to a fire regime. This ecological site has an alternative state related to thermokarst.

Reference plant community 1.1 is characterized as a needleleaf woodland (10 to 25 percent cover; Viereck et al. 1992) composed of mature black spruce (Picea mariana). Tree cover primarily occurs in the stunted tree stratum (less than 15 feet in height). Commonly observed understory species include lingonberry (Vaccinium vitis-idaea), marsh Labrador tea (Ledum palustre ssp. decumbens), cottongrass (Eriophorum spp.), cloudberry (Rubus chamaemorus), greygreen reindeer lichen (Cladina rangiferina), star reindeer lichen (Cladina stellaris), and Sphagnum moss (Sphagnum spp.).

Associated sites

XA232X02Y217	**Boreal Woodland Loamy Frozen Plain Wet** This ecological site occurs in the marginal uplands region of the Yukon Flats Lowlands MLRA. The marginal uplands are characterized by broad and extensive plains. This ecological site occurs where water accumulates on the slopes of these plains (e.g. lower third of slopes or in swales). Associated soils have very deep loess deposition and range from poorly to very poorly drained. The reference plant community is characterized as needleleaf woodland (10 to 25 percent cover; Viereck et al. 1992) primarily composed of black spruce (Picea mariana).
XA232X02Y227	**Boreal Forest Loamy Frozen Plains Cold** This ecological site occurs in the marginal uplands region of the Yukon Flats Lowlands MLRA. The marginal uplands are characterized by broad and extensive plains. This ecological site occurs on colder slopes of these plains. Associated soils have very deep loess deposition and range from poorly to somewhat poorly drained. The reference plant community is characterized as an open needleleaf forest (25 to 60 percent cover; Viereck et al. 1992) primarily composed of black spruce.
XA232X01Y209	**Boreal Tussock Loamy Frozen Terraces** This ecological site occurs on stream terraces in the lowlands region of the Yukon Flats Lowlands MLRA. Soils commonly have permafrost at moderate depth (20 to 40 inches) and pond frequently for very long durations. The reference plant community is characterized as open low mixed shrub-sedge tussock bog (Viereck et al. 1992).
XA232X01Y280	**Boreal Scrub Loamy Flood Plain Wet** This ecological site occurs on the flood plain and adjacent terraces of minor, low-gradient tributaries in the lowlands region of the Yukon Flats Lowlands MLRA. The reference plant community is associated with soils that both pond and flood. The reference plant community phase is characterized as closed tall scrub (greater than 75 percent shrub cover; Viereck et al. 1992) primarily composed of a mixture of willow (Salix spp.).
XA232X02Y210	**Boreal Forest Loamy Frozen Plains Warm** This ecological site occurs in the marginal uplands region of the Yukon Flats Lowlands MLRA. The marginal uplands are characterized by broad and extensive plains. This ecological site occurs on warm slopes of these plains. Associated soils have very deep loess deposition and are well drained. The reference plant community phase is characterized as an open needleleaf forest (25 to 60 percent cover; Viereck et al. 1992) primarily composed of mature white spruce (Picea glauca).
XA232X02Y203	**Boreal Scrub Loamy Frozen Drainages** This ecological site occurs in the marginal uplands region of the Yukon Flats Lowlands MLRA. The marginal uplands are characterized by broad and extensive plains. This ecological site occurs in drainageways on these plains. Associated soils flood occasionally (5 to 50 times in 100 years) for long durations of time (between 7 and 30 days). Soils range from poorly to very poorly drained. The reference plant community phase is characterized as closed tall scrub (Viereck et al. 1992). Black spruce commonly occurs but cover is generally low.

Similar sites

XA232X01Y207	**Boreal Herbaceous Peat Flood Plain Depressions** The thermokarst alternative state for ecological site XA232X01Y201 and the reference state for XA232X01Y207 both are associated with soils that have thick organic mats that are considered very poorly drained. Soils associated with XA232X01Y201 are acidic, while soils associated with XA232X01Y207 are neutral to basic. The difference in pH results in different plant communities.
XA232X02Y217	**Boreal Woodland Loamy Frozen Plain Wet** Both ecological sites XA232X02Y217 and XA232X01Y201 have wet soils, have ice-rich permafrost in the soil profile, and are associated with low-severity fire regimes. When compared to ecological site XA232X02Y217, soils associated with XA232X01Y201 have comparatively more organic matter and have more acidic soil profiles. While the reference plant communities share similar overstories, XA232X01Y201 has comparably greater Sphagnum moss and reindeer lichen cover and soils are much more prone to thermokarst events.
XA232X01Y218	**Boreal Woodland Loamy Frozen Terraces** Both ecological sites XA232X01Y201 and XA232X01Y218 have wet soils, have ice-rich permafrost in the soil profile, and are associated with low-severity fire regimes. When compared to ecological site XA232X01Y201, soils associated with XA232X01Y218 have comparatively less organic matter and have less acidic soil profiles. While the reference plant communities share similar overstories, XA232X01Y201 has comparably greater Sphagnum moss and reindeer lichen cover and soils are much more prone to thermokarst events.
XA232X01Y209	**Boreal Tussock Loamy Frozen Terraces** Both ecological sites XA232X01Y201 and XA232X01Y209 have wet soils, have ice-rich permafrost in the soil profile, and are associated with low-severity fire regimes. When compared to ecological site XA232X01Y201, soils associated with XA232X01Y209 have comparatively less organic matter and have less acidic soil profiles. When compared to XA232X01Y201, this ecological site has less forest cover, Sphagnum moss and reindeer lichen cover, and soils are much less prone to thermokarst events.
XA232X01Y262	**Boreal Woodland Gravelly Terraces** Both ecological sites XA232X01Y201 and XA232X01Y262 have wet soils and are associated with low-severity fire regimes. When compared to ecological site XA232X01Y201, soils associated with XA232X01Y262 have comparatively less organic matter, have less acidic soil profiles, and lack permafrost. While the reference plant communities share similar overstories,XA232X01Y201 has comparably greater Sphagnum moss and reindeer lichen cover and soils are much more prone to thermokarst events.

Table 1. Dominant plant species

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

Legacy ID

F232XY201AK

Physiographic features

This ecological site and its associated plant communities are associated with organic-rich bogs in the Yukon Flats Lowlands MLRA. These bogs occur in both the lowlands and marginal upland regions of this MLRA. Within the lowland region, bogs have a limited extent primarily occurring North of Stevens Village and in areas adjacent to Circle. Within these bogs, thermokarst depressions are prevalent.

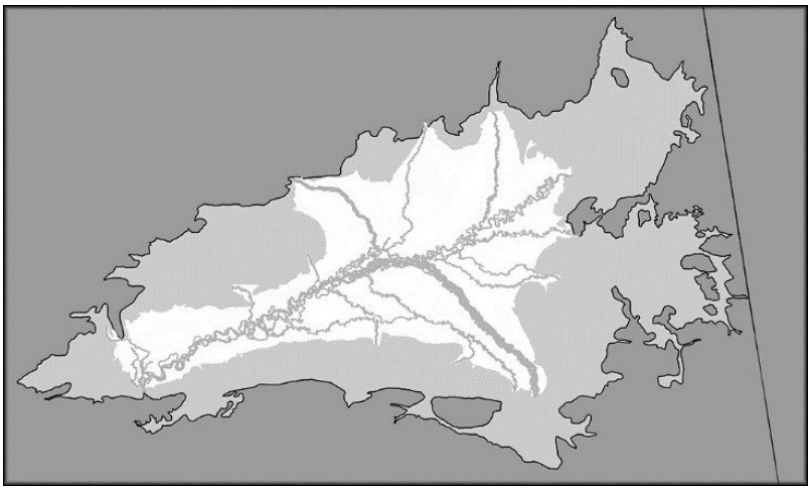


Figure 1. Lowlands (white) and marginal uplands (light gray) LRU of the Yukon Flats Lowlands MLRA.

Table 2. Representative physiographic features

Geomorphic position, flats	(1) Talf
Geomorphic position, terraces	(1) Tread
Landforms	(1) Plains > Bog (2) Alluvial plain > Bog
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Occasional
Elevation	91–305 m
Slope	0–1%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

Short, warm summers and long, very cold winters characterize the subarctic continental climate of the area. The surrounding hills and mountains of this MLRA partially isolate it from weather systems affecting other interior lowlands. As a result, temperatures are generally warmer in summer and colder in winter than is characteristic in other areas of comparable latitude. The average annual temperature ranges from about 20 to 25 degrees F (-7 to -4 degrees C). The freeze-free period averages 70 to 120 days. The temperature usually remains above freezing from early June through late August. The average annual precipitation ranges from about 6 inches (150 millimeters) in the central basin to 15 inches (380 millimeters) along the boundary with the surrounding highlands. The maximum precipitation occurs in late summer, mainly as a result of thunderstorms. The average annual snowfall is about 45 to 55 inches (115 to 140 centimeters) (USDA, NRCS 2006).

The tabular data in this report is specific to the marginal uplands LRU in the Yukon Flats Lowlands MLRA. All tabular data was calculated from the PRISM dataset (1971-2000).

Table 3. Representative climatic features

Frost-free period (characteristic range)	45-97 days
Freeze-free period (characteristic range)	70-120 days
Precipitation total (characteristic range)	229-559 mm
Frost-free period (average)	75 days
Freeze-free period (average)	
Precipitation total (average)	279 mm

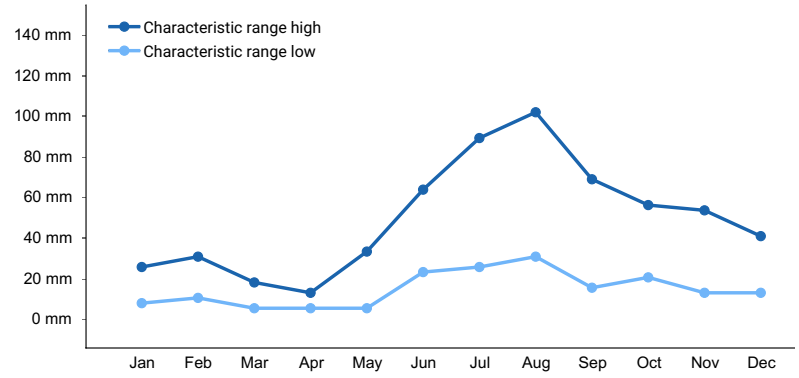


Figure 2. Monthly precipitation range

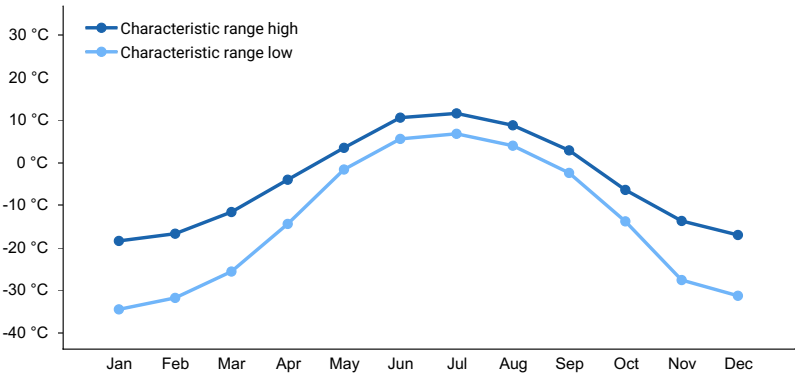


Figure 3. Monthly minimum temperature range

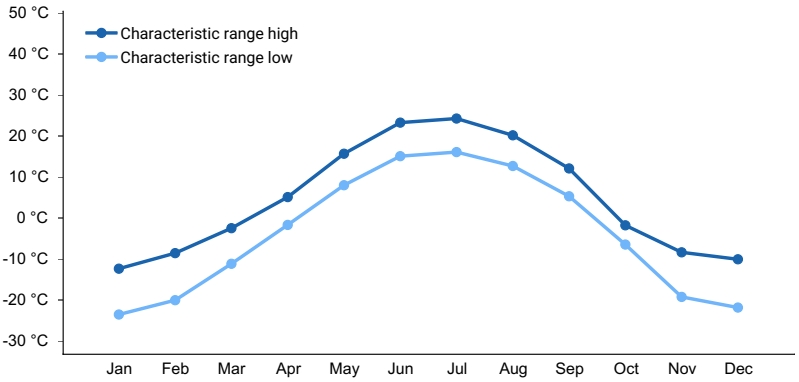


Figure 4. Monthly maximum temperature range

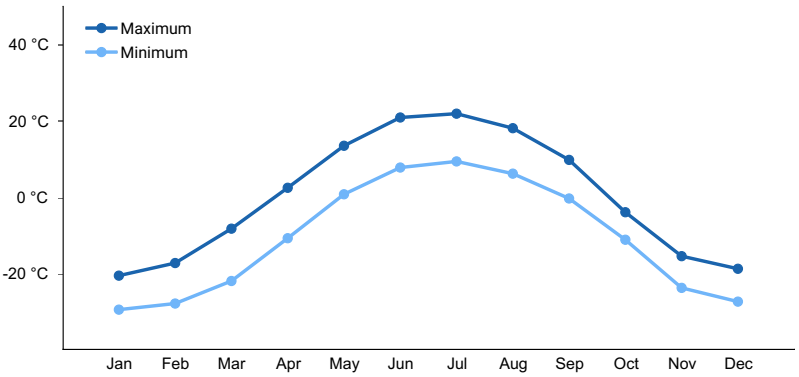


Figure 5. Monthly average minimum and maximum temperature

Influencing water features

Reference state soils are associated with permafrost and are considered poorly drained (Sussaymin soils). During the spring and early growing season (May and June), these soils have a perched water table over the seasonal frost

in the soil profile resulting in wet soils at very shallow depth (less than 10 inches). During this time frame, ponding of water over the soil surface occurs occasionally (between 5 and 50 times in 100 years) for long durations of time (between 7 and 30 days). As the seasonal frost melts, the water drains from these soils. During long portions of the growing season, a water table is commonly at shallow depths (10 to 20 inches) in the soil profile.

Thermokarst state soils lack permafrost and are considered very poorly drained (Hydric Cryofibrists). Ponding of water over the soil surface occurs continuously during the growing season. Ponding duration and the typical depth to the water table was determined through field observations.

Due to the depth and persistence of this water table, wetland indicator plants are commonly observed in both the reference and thermokarst states.

Soil features

Correlated soil components from Soil Survey of Yukon-Charley Rivers National Preserve (AK684): D32-Boreal taiga organic plains, frozen.

Correlated soil components from Yukon Flats Areas, Alaska soil survey (AK685): Hydric Cryofibrists, dysic; Sussaymin.

Sussaymin and D32-Boreal taiga organic plains, frozen soils are associated with the reference state. Hydric Cryofibrists, dysic soils are associated with the alternative state related to thermokarst.

Figure 6. Typical soil profile associated with Sussaymin soil component.

Figure 7. The Sussaymin soil component is prone to thawing and thermokarst.

Table 4. Representative soil features

Parent material	(1) Mossy organic material

Surface texture	(1) Mucky peat (2) Muck
Drainage class	Very poorly drained to poorly drained

Ecological dynamics

Fire

In the Yukon Flats Lowlands MLRA, fire is a common and natural event that has a significant control on the vegetation dynamics across the landscape. A typical fire event in areas associated with this ecological site will reset plant succession and alter dynamic soil properties (e.g., presence or thickness of permafrost). For this ecological site to progress from the early fire stage to the reference plant community, data suggest that 70 years or more must elapse without another fire event.

When comparing all MLRAs of Interior Alaska, land in the Yukon Flats Lowlands MLRA burns most frequently (Begét et al. 2006). Within the Yukon Flats Lowlands MLRA, fire is considered to be a natural and common event that typically goes unmanaged. Fire suppression generally occurs adjacent to villages or on allotments with known structures, both of which have a relatively limited acre footprint. From 2000 to 2015, 132 known fire events occurred on land in the Yukon Flats Lowlands MLRA and the burn perimeters of the fires totaled about 4.1 million acres (AICC 2016). Fire-related disturbances are highly patchy and can leave large undisturbed areas within the burn perimeters. Ten fires were attributed to human activities (affecting a total of 2,864 acres), but the majority of the fires were caused by lightning strikes (AICC 2016).

The fire regime within Interior Alaska follows two basic scenarios—low-severity burns and high-severity burns. It should be noted, however, that the fire regime in this area 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. From field observations and because the associated soils are cooler and poorly drained, the typical fire scenario for this ecological site is considered to result in a low-severity burn.

While a low-severity fire can consume the bulk of above ground vegetation, minimal proportions of the organic mat are removed. Organic matter continues to insulate these cold soils and permafrost remains in the soil profile. While field observations support that each reference state plant community is associated with permafrost, fire was thought to increase active layer depth causing the permafrost to occur deeper in the soil profile. For this ecological site, fire also results in thermokarst.

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 tissues. 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.

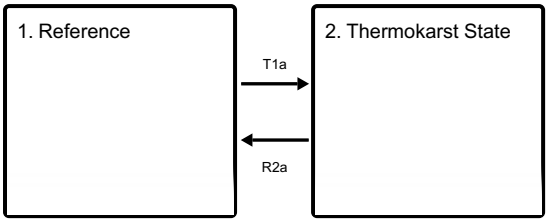
Field data suggest that each of the woodland community phase burn and that fire events will cause a transition to the early stage of fire succession. This stage (plant community 1.3) is a mix of species that either regenerate in place (e.g., subterranean root crowns for willow and rhizomes for graminoids) and/or from wind-dispersed seeds or spores (e.g., resin birch [*Betula neoalaskana*] and Polytrichum moss [Polytrichum spp.]). The early stage of fire succession is primarily composed of tree seedlings, ericaceous shrubs, willow, and graminoids. In the absence of fire, tree seedlings continue to colonize and grow in recently burned areas until they become dominant in the overstory. The later stages of succession have an overstory that is a mix of immature broadleaf and needleleaf trees (community 1.2) or is primarily a mixed age needleleaf stand (reference community 1.1).

Other Observations

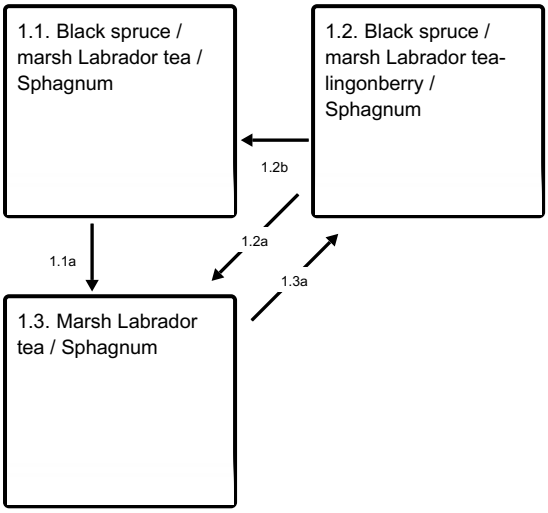
Animal use (browsing and grazing) was not typically observed in community phases related to this ecological site.

State and transition model

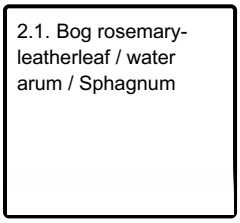
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference

Figure 8. Aerial image of reference state plant communities related to this ecological site.

The reference state has three associated plant communities. The plant communities are grouped by the structure and dominance of the vegetation (e.g., coniferous trees, deciduous trees, shrubs, and forbs) and their ecological

function and stability. Plant communities in the reference state appear to be largely controlled by the influences of fire. This report provides baseline vegetation inventory data for the ecological site. More data collection is needed to provide further information about existing plant communities and the disturbance regimes that would result in transitions from one community to another. The common and scientific plant names are from the USDA PLANTS database. All communities in this report are characterized using the Alaska Vegetation Classification (Viereck et al. 1992).

Community 1.1
Black spruce / marsh Labrador tea / Sphagnum

Figure 9. Typical plant community associated with community 1.1.

Community Phase 1.1 Canopy Cover Table

Vegetation data is aggregated from all sample plots for this community phase. The data is provided as frequency (percent) and mean canopy cover (percent) of the most dominant and ecologically relevant species. Canopy cover is represented as a mean with the range in parentheses.

Plant group	Common name	Scientific name	USDA plant code	Frequency (percent)	Mean canopy cover (percent)
T	black spruce	*Picea mariana*	PIMA	100	25 (15-35)
S	marsh Labrador tea	*Ledum palustre ssp. decumbens*	LEPAD	100	45 (25-60)
S	lingonberry	*Vaccinium vitis-idaea*	VAVI	100	5 (1-15)
S	bog rosemary	*Andromeda polifolia*	ANPO	50	0.1 (0-1)
S	small cranberry	*Vaccinium oxycoccos*	VAOX	33	2 (0-10)
G	cottongrass	*Eriophorum spp.*	ERIOP	83	0.1 (0-1)
F	cloudberry	*Rubus chamaemorus*	RUCH	100	5 (1-20)
B	*Sphagnum* moss	*Sphagnum spp.*	SPHAG2	100	45 (15-90)
L	greygreen reindeer lichen	*Cladina rangiferina*	CLRA60	83	25 (0-45)
L	star reindeer lichen	*Cladina stellaris*	CLST60	83	7 (0-30)
L	flavo lichen	*Flavocetraria cucullata*	FLCU	67	3 (0-15)
L	cup lichen	*Cladonia gracilis*	CLGR13	67	1 (0-5)
L	reindeer lichen	*Cladina stygia*	CLST5	50	8 (0-25)

This dataset includes data from six sample plots. The plots are distributed across the survey area and are independent of one another.

Values for tall, medium, regenerative, and stunted tree strata are used to calculate mean canopy cover and range values. Regenerative trees are not considered part of the overstory canopy.

Plant functional group classifications—T = trees, S = shrubs, G = graminoids, F = forbs, B = bryophytes, L = lichens

Canopy cover data is rounded, except trace (0.1 percent) cover. Data ranging from 1 to 9 percent cover is rounded to the nearest integer. Data ranging from 10 to 100 percent cover is rounded to the nearest factor of 5.

Figure 10. Canopy cover table for community 1.1.

Reference plant community 1.1 is characterized as a needleleaf woodland (10 to 25 percent cover) composed of black spruce. Tree age was highly variable, which is likely due to patchy low-intensity fire events. Tree cover primarily occurs in the stunted tree stratum (less than 15 feet in height). The soil surface is covered primarily with bryophytes and lichen. Commonly observed understory species include lingonberry, marsh Labrador tea,

cottongrass, cloudberry, greygreen reindeer lichen, star reindeer lichen, and Sphagnum moss. The understory vegetative strata that characterize this community are low shrubs (between 8 and 36 inches in height), bryophytes, and foliose and fruticose lichens. Black spruce were sampled for diameter at breast height (dbh), height, and age at dbh (18 trees). The basal area of the stand was determined for each sample plot. The mean dbh of black spruce is 2.0 inches (ranging from 0.8 to 3.2), the mean height is 11 feet (ranging from 3 to 19 feet), and the mean age is 76 years (ranging from 38 to 132 years). The mean basal area is 6 (ranging from 3 to 9).

Dominant plant species

- black spruce (*Picea mariana*), tree
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog rosemary (*Andromeda polifolia*), shrub
- small cranberry (*Vaccinium oxycoccos*), shrub
- cottongrass (*Eriophorum*), grass
- cloudberry (*Rubus chamaemorus*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- cup lichen (*Cladonia gracilis*), other herbaceous
- reindeer lichen (*Cladina stygia*), other herbaceous

Community 1.2
Black spruce / marsh Labrador tea-lingonberry / Sphagnum

Figure 11. Typical plant community associated with community 1.2.

Community Phase 1.2 Canopy Cover Table

Vegetation data is aggregated from all sample plots for this community phase. The data is provided as frequency (percent) and mean canopy cover (percent) of the most dominant and ecologically relevant species. Canopy cover is represented as a mean with the range in parentheses.

Plant group	Common name	Scientific name	USDA plant code	Frequency (percent)	Mean canopy cover (percent)
T	black spruce	*Picea mariana*	PIMA	100	15 (5-25)
T	resin birch	*Betula neoalaskana*	BENE4	50	1 (0-1)
S	marsh Labrador tea	*Ledum palustre* ssp. *decumbens*	LEPAD	100	70 (55-80)
S	lingonberry	*Vaccinium vitis-idaea*	VAVI	100	6 (2-10)
S	bog rosemary	*Andromeda polifolia*	ANPO	100	1 (0.1-2)
F	cloudberry	*Rubus chamaemorus*	RUCH	100	2 (1-2)
B	Sphagnum moss	*Sphagnum spp.*	SPHAG2	100	15 (3-30)
L	greygreen reindeer lichen	*Cladina rangiferina*	CLRA60	100	15 (7-25)
L	reindeer lichen	*Cladina stygia*	CLST5	100	10 (3-20)
L	cup lichen	*Cladonia spp.*	CLADO3	100	10 (4-15)
L	island Cetraria lichen	*Cetraria islandica*	CEIS60	100	5 (2-7)
L	star reindeer lichen	*Cladina stellaris*	CLST60	100	4 (2-5)
L	flavo lichen	*Flavocetraria cucullata*	FLCU	100	2 (1-3)

This dataset includes data from two sample plots. The plots are distributed across the survey area and are independent of one another.

Values for tall, medium, regenerative, and stunted tree strata are used to calculate mean canopy cover and range values. Regenerative trees are not considered part of the overstory canopy.

Plant functional group classifications—T = trees, S = shrubs, G = graminoids, F = forbs, B = bryophytes, L = lichens

Canopy cover data is rounded, except trace (0.1 percent) cover. Data ranging from 1 to 9 percent cover is rounded to the nearest integer. Data ranging from 10 to 100 percent cover is rounded to the nearest factor of 5.

Figure 12. Canopy cover table for community 1.2.

Plant community 1.2 is in the late stage of fire-induced secondary succession for this ecological site. It is characterized as needleleaf woodland (Viereck et al. 1992) that is composed of immature spruce. Resin birch (*Betula neoalaskana*) has minimal canopy cover, and individuals are commonly observed as standing and fallen dead. Tree cover primarily occurs in the tree regeneration stratum (less than 15 feet in height). The soil surface is covered with a mixture of herbaceous litter, lichens, and bryophytes. Commonly observed understory species include lingonberry, marsh Labrador tea, reindeer lichen (primarily C. rangiferina, C. stygia, and C. stellaris), and Sphagnum moss. The understory vegetative that characterize this plant community are low shrubs (between 8 and 36 inches in height), bryophytes, and foliose and fruticose lichens. Black spruce were sampled for diameter at breast height (dbh), height, and age at dbh (6 trees). The basal area of the stand was determined for each sample plot. The mean dbh of black spruce is 2.5 inches (ranging from 1.3 to 4.5), the mean height is 15 feet (ranging from 6 to 25), and the mean age is 39 years (ranging from 25 to 62). The mean basal area of the stands is 7 (ranging from 3 to 11).

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
- bog rosemary (*Andromeda polifolia*), shrub
- cloudberry (*Rubus chamaemorus*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- reindeer lichen (*Cladina stygia*), other herbaceous
- cup lichen (*Cladonia*), other herbaceous
- island cetraria lichen (*Cetraria islandica*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous

Community 1.3
Marsh Labrador tea / Sphagnum

Figure 13. Typical plant community associated with community 1.3.

Community Phase 1.3 Canopy Cover Table

Vegetation data is aggregated from all sample plots for this community phase. The data is provided as frequency (percent) and mean canopy cover (percent) of the most dominant and ecologically relevant species. Canopy cover is represented as a mean with the range in parentheses.

Plant group	Common name	Scientific name	USDA plant code	Frequency (percent)	Mean canopy cover (percent)
T	black spruce	*Picea mariana*	PIMA	100	25 (25)
S	marsh Labrador tea	*Ledum palustre ssp. decumbens*	LEPAD	100	30 (30)
S	bog birch	*Betula nana*	BENA	100	15 (15)
S	leatherleaf	*Chamaedaphne calyculata*	CHCA2	100	15 (15)
S	bog blueberry	*Vaccinium uliginosum*	VAUL	100	15 (15)
S	grayleaf willow	*Salix glauca*	SAGL	100	7 (7)
S	lingonberry	*Vaccinium vitis-idaea*	VAVI	100	5 (5)
S	bog rosemary	*Andromeda polifolia*	ANPO	100	3 (3)
G	sedge	*Carex spp.*	CAREX	100	8 (8)
F	cloudberry	*Rubus chamaemorus*	RUCH	100	7 (7)
B	*Sphagnum* moss	*Sphagnum spp.*	SPHAG2	100	55 (55)
B	*Ditrichum* moss	*Ditrichum spp.*	DITRI2	100	5 (5)
L	star reindeer lichen	*Cladina stellaris*	CLST60	100	3 (3)
L	cup lichen	*Cladonia gracilis*	CLGR13	100	2 (2)
L	felt lichen	*Peltigera aphthosa*	PEAP60	100	1 (1)

This dataset includes data from one sample plot. The plots are distributed across the survey area and are independent of one another.

Plant functional group classifications—T = trees, S = shrubs, G = graminoids, F = forbs, B = bryophytes, L = lichens

Values for tall, medium, regenerative, and stunted tree strata are used to calculate mean canopy cover and range values. Regenerative trees are not considered part of the overstory canopy.

Canopy cover data is rounded, except trace (0.1 percent) cover. Data ranging from 1 to 9 percent cover is rounded to the nearest integer. Data ranging from 10 to 100 percent cover is rounded to the nearest factor of 5.

Figure 14. Canopy cover table for community 1.3.

Plant community 1.3 is in the early stage of fire-induced secondary succession for this ecological site. It is characterized as open low scrub (Viereck et al. 1992). Tree cover occurs primarily in the regenerative tree stratum (less than 15 feet in height) and common species include black spruce. The soil surface is covered with a mixture of herbaceous litter, woody debris, and bryophytes. Commonly observed understory species include marsh Labrador tea, bog birch (*Betula nana*), leatherleaf (*Chamaedaphne calyculata*), bog blueberry (*Vaccinium uliginosum*), sedge (Carex spp.), cloudberry, and Sphagnum moss. The vegetative strata that characterize this plant are low shrubs (between 8 and 36 inches in height), dwarf shrubs (less than 8 inches in height), and bryophytes.

Dominant plant species

- black spruce (*Picea mariana*), tree

- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- dwarf birch (*Betula nana*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- grayleaf willow (*Salix glauca*), shrub
- lingonberry (*Vaccinium vitis-idaea*), shrub
- bog rosemary (*Andromeda polifolia*), shrub
- sedge (*Carex*), grass
- sphagnum (*Sphagnum*), other herbaceous
- cloudberry (*Rubus chamaemorus*), other herbaceous
- ditrichum moss (*Ditrichum*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous
- cup lichen (*Cladonia gracilis*), other herbaceous
- felt lichen (*Peltigera aphthosa*), other herbaceous

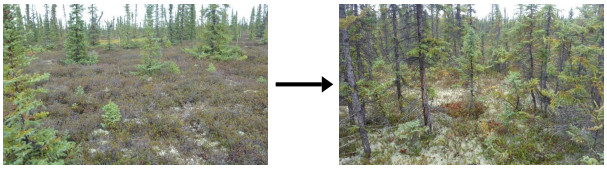
Pathway 1.1a
Community 1.1 to 1.3

Black spruce / marsh Labrador tea / Sphagnum

Marsh Labrador tea / Sphagnum

Fire.

Pathway 1.2b
Community 1.2 to 1.1

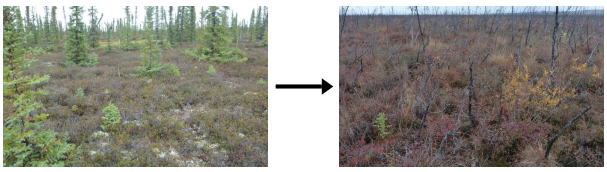


Black spruce / marsh Labrador tea-lingonberry / Sphagnum

Black spruce / marsh Labrador tea / Sphagnum

Time without fire. For more information, refer to the "ecological dynamics of the site" section.

Pathway 1.2a
Community 1.2 to 1.3



Black spruce / marsh Labrador tea-lingonberry / Sphagnum

Marsh Labrador tea / Sphagnum

Fire.

Pathway 1.3a
Community 1.3 to 1.2

Marsh Labrador tea / Sphagnum

Black spruce / marsh Labrador tea-lingonberry / Sphagnum

Time without fire. For more information, refer to the "ecological dynamics of the site" section.

State 2
Thermokarst State

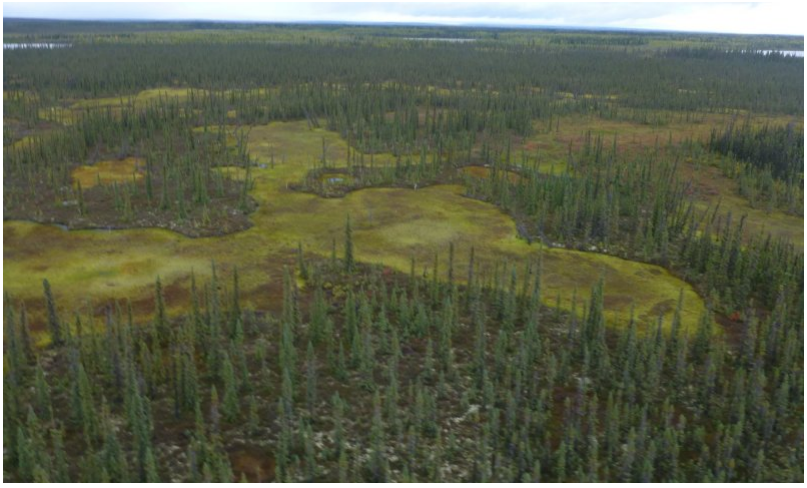


Figure 15. Aerial image of a thermokarst pit in the Yukon Flats Lowlands MLRA.

Thermokarst occurs due to thawing of permafrost after fire events. The collapse of adjacent vegetation into thermokarst depressions was commonly observed and many depressions are actively growing in size. While thermokarst can be readily observed, details related to thermokarst succession are poorly understood. The thermokarst state currently has one associated plant community. After an unknown timeframe, thermokarst depressions could theoretically revert back to plant communities associated with the reference state. Due to this uncertainty, a restoration pathway back to the reference state was included in the state-and-transitional model (R2a). For more information on thermokarst in boreal forests, refer to the publication by Smith et al. 2008. 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.

Community 2.1
Bog rosemary-leatherleaf / water arum / Sphagnum

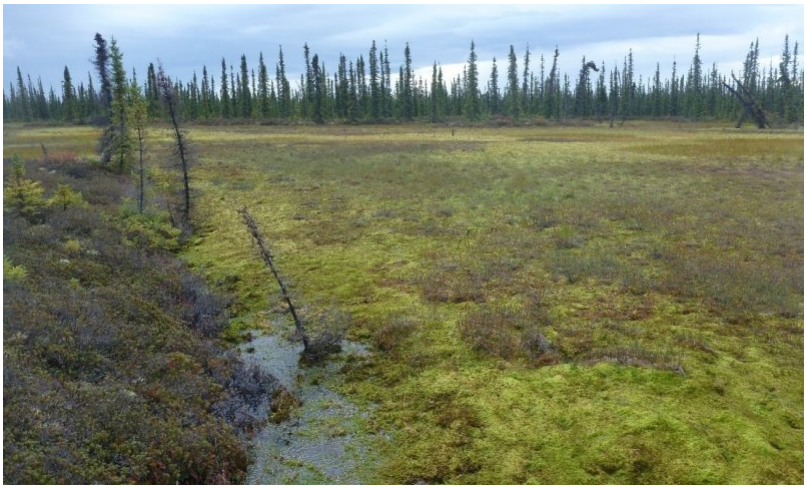


Figure 16. Typical plant community associated with community 2.1.

Community Phase 2.1 Canopy Cover Table

Vegetation data is aggregated from all sample plots for this community phase. The data is provided as frequency (percent) and mean canopy cover (percent) of the most dominant and ecologically relevant species. Canopy cover is represented as a mean with the range in parentheses.

Plant group	Common name	Scientific name	USDA plant code	Frequency (percent)	Mean canopy cover (percent)
S	bog rosemary	*Andromeda polifolia*	ANPO	100	20 (0.1-75)
S	leatherleaf	*Chamaedaphne calyculata*	CHCA2	100	7 (0.1-15)
G	cottongrass	*Eriophorum spp.*	ERIOP	60	8 (0-20)
F	water arum	*Calla palustris*	CAPA	60	1 (0-3)
B	Sphagnum moss	*Sphagnum spp.*	SPHAG2	100	95 (90-100)

This dataset includes data from five sample plot. The plots are distributed across the survey area and are independent of one another.

Plant functional group classifications—T = trees, S = shrubs, G = graminoids, F = forbs, B = bryophytes, L = lichens

Values for tall, medium, regenerative, and stunted tree strata are used to calculate mean canopy cover and range values. Regenerative trees are not considered part of the overstory canopy.

Canopy cover data is rounded, except trace (0.1 percent) cover. Data ranging from 1 to 9 percent cover is rounded to the nearest integer. Data ranging from 10 to 100 percent cover is rounded to the nearest factor of 5.

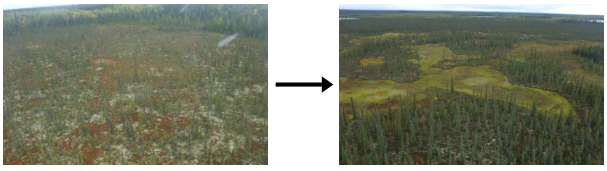
Figure 17. Canopy cover table for community 2.1.

Plant community 2.1 is linked to the thermokarst of reference state communities and is characterized as wet forb herbaceous (Viereck et al. 1992). Adjacent vegetation was observed actively falling into thermokarst depressions. Soils are considered very poorly drained and vegetation occurs as a floating mat. Commonly observed species include bog rosemary (*Andromeda polifolia*), leatherleaf, cottongrass, water arum (*Calla palustris*), and Sphagnum moss. The vegetative strata that characterize this plant community are low shrubs (between 8 and 36 inches) and bryophytes. The soil surface is covered with a mixture of standing water and bryophytes.

Dominant plant species

- bog rosemary (*Andromeda polifolia*), shrub
- leatherleaf (*Chamaedaphne calyculata*), shrub
- cottongrass (*Eriophorum*), grass
- water arum (*Calla palustris*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous

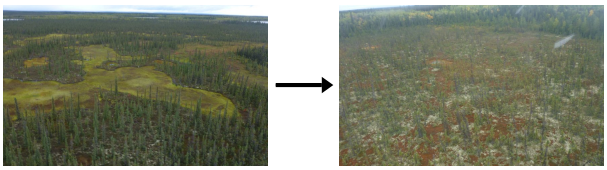
Transition T1a
State 1 to 2



Reference **Thermokarst State**

Thermokarst. Ice-rich permafrost thaws and vegetation collapses into a depression. In boreal forests, fire is commonly linked to thermokarst (Smith et al. 2008).

Restoration pathway R2a
State 2 to 1



Thermokarst State | Reference

Thermokarst recovery. This pathway is speculative and requires additional research to verify.

Additional community tables

Table 5. 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	0.9–5.8	15–35	2–8.1	–

Table 6. Community 1.2 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	1.8–7.6	5–25	3.3–11.4	–
resin birch	BENE4	*Betula neoalaskana*	Native	–	0–1	–	–

Inventory data references

NASIS User Site ID / Modal Datasets
12NR02803 Plant Community 1.1
2015AK290643 Plant Community 1.1
2015AK290658 Plant Community 1.1
2015AK290612 Plant Community 1.1
2015AK290614 Plant Community 1.1
S2015AK290004 Plant Community 1.1
2015AK290608 Plant Community 1.2
2015AK290616 Plant Community 1.2
2015AK290640 Plant Community 1.3
2015AK290609 Plant Community 2.1
2015AK290610 Plant Community 2.1
2015AK290615 Plant Community 2.1
2015AK290617 Plant Community 2.1
2015AK290642 Plant Community 2.1

Other references

Alaska Interagency Coordination Center (AICC). 2016. http://fire.ak.blm.gov/

Begét, J.E., D. Stone, and D.L. Verbyla. 2006. Regional overview of Interior Alaska. In Alaska's Changing Boreal Forest. F.S. Chapin III, M.W. Oswood, K. Van Cleve, L.A. Viereck, and D.L. Verbyla, editors. New York, Oxford University Press. Pages 12-20.

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

Chapin, F.S., III, L.A. Viereck, P.C. Adams, K. Van Cleve, C.L. Fastie, R.A. Ott, D. Mann, and J.F. Johnstone. 2006. Successional processes in the Alaskan boreal forest. In Alaska's Changing Boreal Forest. F.S. Chapin III, M.W. Oswood, K. Van Cleve, L.A. Viereck, and D.L. Verbyla, editors. New York, Oxford University Press. Pages 100-120.

Farr, W.A. 1967. Growth and yield of well-stocked white spruce stands in Alaska. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station General Technical Report PNW-GTR-53.

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. In Alaska's Changing Boreal Forest. F.S. Chapin III, M.W. Oswood, K. Van Cleve, L.A. Viereck, and D.L. Verbyla, editors. New York, Oxford University Press. Pages 39-61.

Johnstone, J.F., T.N. Hollingsworth, and F.S. Chapin III. 2008. A key for predicting postfire successional trajectories in black spruce stands of Interior Alaska. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station General Technical Report PNW-GTR-767.

Johnstone J.F., T.N. Hollingsworth, F.S. Chapin III, M.C. Macks. 2010. Changes in fire regime break the legacy lock on successional trajectories in Alaskan boreal forest. Global Change Biology, 16: 1281-1295.

PRISM Climate Group. 2006. Climate data of United States, 1971-2000. Oregon State University, Corvallis.
Schoeneberger, P.J., and D.A. Wysocki. 2012. Geomorphic description system. Version 4.2. U.S. Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center, Lincoln, Nebraska.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and W.D. Broderson, editors. 2012. Field book for describing and sampling soils. Version 3.0. U.S. Department of Agriculture, Natural Resources Conservation Service.

Myers-Smith, I.H., 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.

Soil Survey Division Staff. 2017. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.
United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wezlick. 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.
Williams, J.R. 1962. Geologic reconnaissance of the Yukon Flats District, Alaska. U.S. Department of the Interior, Geologic Survey Bulletin 1111-H.

Contributors

Blaine Spellman

Approval

Michael Margo, 5/11/2020

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	05/07/2020

Approved by	Michael Margo
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:**
