USDA Natural Resources Conservation Service

Ecological site R239XY063AK
Arctic Dwarf Scrub Loamy Frozen Slopes

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 239X–Northern Bering Sea Islands

The Northern Bering Sea Islands (MLRA 239X) occurs in Western Alaska and includes Saint Lawrence (1,792 square miles), Nunivak (1,632 square miles), and Saint Matthew (137 square miles) Islands and several smaller adjacent islands all of which are surrounded by the Bering Sea. This MLRA makes up 3,705 square miles. The terrain primarily consists of nearly level to rolling plains and highlands with mostly gentle slopes. Coastal lowlands dotted with numerous small- and medium-size lakes make up a significant part of St. Lawrence Island. Steep, low-relief volcanic cones, vents, and lava flows are common throughout Nunivak Island and less common on St. Lawrence and St. Matthew Islands. Narrow, discontinuous sea cliffs, sand dunes, and sand sheets are along many stretches of the coast. Elevation ranges from sea level along the coast to 2,207 feet at the summit of Atuk Mountain, on St. Lawrence Island. The area is mostly undeveloped wild land that is sparsely populated. Residents use this remote area primarily for subsistence hunting, fishing, and gathering. Reindeer and/or muskox herding provides meat and other products to residents on Nunivak Island and St. Lawrence Islands. The largest communities on the islands are Diomede, Gambell, Mekoryuk, and Savoonga.

Geology and Soils

Across the islands, most of the landscape is mantled with late Tertiary and Quaternary alluvial, marine, and eolian surficial deposits. While a small portion of the northwest coast of St. Lawrence Island was glaciated (Patton et al. 2011), the vast majority of the MLRA was unglaciated during the Pleistocene Epoch. St. Lawrence Island is the most geologically complex of the islands in this area. The St. Lawrence Island coastal plain is dotted with numerous small- and medium-size lakes with a mosaic primarily composed of surficial deposits and volcanic and sedimentary rock, including coal beds and limestone. The highlands on this island are primarily composed of Cretaceous granitic bedrock except for Atuk Mountain which is composed of young volcanic bedrock from the Quaternary to late Tertiary. Nunivak and St. Matthew Islands are made up almost exclusively of early and late Tertiary and Quaternary volcanic rocks.

These islands are in the zone of discontinuous permafrost. Frozen soils are common across the vast extents of rolling plains and gentle sloping highlands. In these areas, the layer of permafrost is generally thin or moderately thick and occurs primarily in fine textured deposits. Permafrost generally does not occur on flood plains, in coarse textured sediments on the slopes of volcanic cones and other highlands, along the coast, or near lakes and other bodies of water. Common periglacial features include solifluction lobes, frost boils, and palsen (Swanson et al. 1986, USDA 2022).

The majority of soils are acidic, and the dominant soil order is Gelisols. Except for some non-acidic uplands on St. Lawrence Island, the vast majority of soil substrate across the MLRA is acidic (pH less than 5.5) (CAVM Team 2023). The Gelisols are shallow or moderately deep to permafrost (10 to 40 inches) and are typically very poorly to poorly drained. Common Gelisol suborders are Histels, Orthels, and Turbels. The Histels have thick accumulations of surface organic material and primarily occur in very wet coastal plain depressions and low-gradient drainageways. The Orthels and Turbels have comparably thinner surface organic material and primarily occur on the coastal lowlands and other areas with gentle slopes. The MLRA also has small areas of Andisols, Entisols, Inceptisols, and Mollisols. Andisols and Inceptisols primarily occur on volcanic cones and other slopes with coarse textured, acidic soils. Mollisols occur on areas with limestone on St. Lawrence Island (USDA 2022). Entisols primarily occur on flood plains and estuaries. Miscellaneous (non-soil) areas make up about 10 percent of the area and are primarily water, lava flows, rubble composed of volcanic rock, and beach sediments.

Climate

The presence of sea ice in the Bering Sea strongly influences the climate across the islands in this area. Sea ice in the Bering Sea historically forms in early December, increases in thickness until late April, and breaks apart in June (Zuesler 1941). When sea ice is absent, the Bering Sea and North Pacific Ocean moderate diurnal and monthly temperatures resulting in a maritime climate. As sea ice forms around the islands, temperatures decrease significantly with the area shifting to a continental climate.

Vegetation

Tidal flats and estuaries support sedge dominant communities, while drier beach dune communities support American dunegrass and seacoast angelica communities (Swanson et al. 1986). The coastal lowlands and nearly level to rolling plains have a mosaic of sedge and moss dominant wetlands and various tundra. The tundra often has dwarf shrubs like crowberry; tussock forming and non-tussock forming sedges; and a variety of forbs, lichen, and mosses. Very wet drainages and the shores of lakes support wet sedge meadows. Drier soils on flood plains commonly support low to tall willow scrub with dense grasses and forbs in the understory. Shallow soils with coarse textured rocks common on volcanic cones, mountain slopes, and ridges commonly support alpine dwarf scrub dominated by ericaceous shrubs, Dryas, and dwarf willows. These communities commonly have a considerable amount of lichen and bare ground. Bedrock exposures and barrens with lichens and scattered shrubs and herbs in pockets of fine earth dominate the highest elevations, ridges, and other windblown sites.

Introduced ungulates

Introduced herds of reindeer and muskox provide a rich history of land use across the Northern Bering Sea Islands MLRA. Of the many islands in this MLRA, Nunivak was the only island historically grazed by ungulates. Inhabited by caribou until the late 1800’s, the caribou on Nunivak Island were extirpated with the introduction of rifles (Griffin 2001).
Reindeer were introduced to St. Lawrence Island as early as 1901 (Jackson 1902), Nunivak Island in 1920, and St. Matthew Island in 1944 (Swanson and Barker 1991). Muskox were introduced to Nunivak Island in 1930 (ADFG 2024). Nunivak Island currently has managed herds of reindeer and muskox, St. Lawrence Island currently has managed herds of reindeer, and St. Matthew Island currently has no herds of reindeer. Some small islands in this MLRA are believed to have no history of natural or introduced ungulate herds (e.g. Pinnace Islands, Hall Island, and Punuk Islands).

LRU notes

There are two distinct bioclimates in this MLRA resulting in slight differences in vegetation. St. Lawrence Island is more than 200 miles North of Nunivak and St. Matthew Islands. As a result, St. Lawrence Island is significantly colder. Mean annual air temperatures on Nunivak and St. Matthew Islands typically range from 30 to 34 degrees Fahrenheit and are between 24 to 28 degrees Fahrenheit on St. Lawrence Islands (PRISM 2018). More southerly islands in this area fall into the Circumpolar Arctic Vegetation Mapping (CAVM) subzone E and more northerly islands fall into CAVM subzone D (CAVM 2022). Moist and dry tundra common to the near level to rolling plains across the islands are thought to support plant communities with similar species but have different plant community structures. Subzone E supports low shrub communities and subzone D erect dwarf shrub communities (CAVM 2022). At this time, these differences in community structure are recognized but unique ecological sites for each CAVM bioclimate subzone were not developed.

This area supports two life zones defined by the physiological limits of plant communities along an elevational gradient: arctic and alpine. In this MLRA, the arctic life zone occurs below 500 feet elevation on average (Swanson et al. 1986) and is the elevational band where lowland vegetation dominates. For this MLRA, certain vascular plant species are common in the lowlands and much less common in the alpine (i.e. Salix pulchra, Salix fuscescens, Betula nana, Ledum palustre ssp. decumbens, and Calamagrostis canadensis). Above the arctic band of elevation, alpine vegetation dominates. For this MLRA, certain vascular plant and lichen species are common in the alpine and much less common in the lowlands (i.e. Dryas octopetala ssp. octopetala, Diapensia lapponica var. obovata, Anthoxanthum monticola ssp. alpinum, Oxytropis nigrescens, Alectoria ochroleuca, and Flavocetraria nivalis). The lowlands also have much higher potential for lichen biomass yields compared to the alpine (Swanson et al. 1986). The transition between arctic and alpine vegetation can occur within a range of elevations, and is highly dependent on latitude, slope, aspect, and shading from adjacent mountains.

Classification relationships

Landfire BPS – 6816902 - Alaska Arctic Dwarf – Shrubland – Infrequent Fire (Landfire 2009)
Crowberry Tundra (Viereck et al. 1992)
Lichen-Sedge (Tundra) (Swanson et al. 1986)

Ecological site concept

This arctic ecological site occurs on broad and gentle slopes with wet and silty soils that have permafrost. Slopes occur on broad loess covered hills and plains and the backslopes of low mountains. Associated soils do not pond or flood, have a high-water table at very shallow depth throughout much of the growing season, and are considered poorly drained. A typical soil profile has 6 to 14 inches of peat over a thick layer of silty loess.

The presence of introduced ungulate herds on Nunivak, St Lawrence, and St. Matthews Islands, in some places for over a century, plays an integral role in shaping vegetation across this MLRA. Islands in this MLRA without a history of introduced reindeer and muskox herds are associated with reference state vegetation, while islands with introduced herds are associated with grazing state vegetation.

Two plant communities have been documented within the grazing state for this ecological site and are based on the degree of ungulate use. Community 2.1 is considered the potential natural vegetation for the grazing state. This community is characterized as crowberry tundra (Viereck et al. 1992). Common and dominant species include crowberry, water sedge, small awned sedge, Bigelow’s sedge, and various preferred lichen range species (i.e. reindeer lichen and Cetraria lichen). The vegetative strata that characterize this community are dwarf shrubs (less than 8 inches height), medium graminoids (between 4 and 24 inches height), and foliose and fruticose lichen.

Associated sites

R239XY032AK	**Arctic Scrub Silty Frozen Slopes Wet** Occurs on gentle slopes of hills and plains and in broad depressions. Ecological site 32 often occurs downslope of ecological site 63 in comparatively wetter landform positions.
R239XY052AK	**Arctic Sedge Loamy Frozen Slopes** Occurs on nearly level slopes at lower elevations. Soils pond frequently and have comparatively wetter soils.
R239XY058AK	**Arctic Grass Loamy Slopes** Occurs on gentle slopes of hills and plains. Ecological site 58 occurs on adjacent slopes with comparatively drier soils.

Similar sites

R239XY043AK	**Alpine Dwarf Scrub Silty Slopes** Both ecological sites 43 and 63 support crowberry tundra. Ecological site 43 occurs in the alpine typically at elevations above 1000 feet (Swanson et al. 1986), while ecological site 63 occurs at lower elevations. These differences in life zone result in different kinds and amounts of vegetation.
R239XY032AK	**Arctic Scrub Silty Frozen Slopes Wet** When compared to ecological site 63, ecological site 32 has much less crowberry and lichen cover and biomass and much more willow and dwarf birch.

Table 1. Dominant plant species

Tree	Not specified

Shrub	(1) *Empetrum nigrum*
Herbaceous	(1) *Carex bigelowii* (2) *Cladina*

Physiographic features

This ecological site occurs on gentle sloping hills, plains, and mountain back slopes. On Nunivak Island, additional associated landforms were identified as earth hummocks on plains and nearly level areas in the uplands (herein referred to as plateau) at the base of low mountains (Swanson et al. 1986). Earth hummocks are patterned ground features, which are cored with silty mineral soil and are typically 10 to 50 cm in height and 20 to 300 cm in diameter (Schoeneberger and Wysocki 2017). Slopes occur on all aspects and are most commonly gently sloping (1 to 8 percent slope) with some mountain back slopes and plateau being strongly slopes (8 to 16 percent slope). Elevation typically ranges between 20 and 500 feet but can go slightly higher on certain warm, south facing plateau and mountain back slopes. Flooding and ponding do not occur. These are wet soils with a water table commonly occurring at very shallow depths. This site generates limited runoff to adjacent, downslope ecological sites.

Figure 1. Earth hummocks are common on many slopes of Nunivak Island.

Table 2. Representative physiographic features

Geomorphic position, flats	(1) Talf
Hillslope profile	(1) Backslope
Landforms	(1) Coastal plain > Plain (2) Coastal plain > Plain > Earth hummock (3) Coastal plain > Hill (4) Mountain system > Plateau (5) Mountain system > Mountain
Runoff class	Very low to low
Flooding frequency	None
Ponding frequency	None
Elevation	20–500 ft
Slope	1–8%
Water table depth	2–6 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified

Ponding frequency	Not specified
Elevation	20–2,150 ft
Slope	0–16%
Water table depth	Not specified

Climatic features

Sea ice strongly influences the climate of the islands in MLRA 239X. For the Northern Bering Sea Islands, sea ice starts forming in December and often persists through early June. In the absence of sea ice, the Bering Sea and North Pacific Ocean moderate diurnal and monthly temperatures resulting in a maritime climate. Summer temperatures (June through August) are relatively stable with mean maximum monthly temperatures ranging between 50 to 55 degrees Fahrenheit. As sea ice forms around the islands, temperatures decrease significantly with the area shifting to a continental climate. The coldest months (January through March) have mean monthly minimum temperatures ranging from 4 to 6 degrees Fahrenheit. The extent, thickness, and duration of the Bering Sea ice appears to be in flux resulting in southerly storms that can bring significantly warmer winter monthly temperatures (Stabeno et al. 2018, Gramling 2019).

The Northern Bering Sea Islands have summers that are short and cool and winters that are long and cold. Strong winds are common throughout the year. Mean annual air temperatures typically range from 26 to 32 degrees Fahrenheit with Saint Lawrence Island (mean annual air temperatures between 24 to 28 degrees Fahrenheit) being significantly colder compared to Nunivak and Saint Michael Islands (mean annual air temperatures between 30 to 34 degrees Fahrenheit) (PRISM 2018). The warmest months are June, July, and August. During these summer months, the typical freeze free period for the area ranges from 94 to 111 days. The coldest months are January, February, and March.

This area is semi-arid with mean annual precipitation typically ranging between 14 and 17 inches. The warmest months have overcast skies with frequent fog and precipitation while the coldest months have clear skies. The two wettest months are August and September where the islands typically receive a quarter of the annual precipitation. The rest of the months receive similar amounts of precipitation. Saint Michael Island receives greater mean annual precipitation (between 17 and 21 inches) compared to Nunivak and Saint Lawrence Islands (between 13 to 17 inches) (PRISM 2018). The average annual snowfall ranges from about 50 to 80 inches (USDA 2022) with the highest snowfall occurring during the months spanning November through March (USDA 1986).

Table 4. Representative climatic features

Frost-free period (characteristic range)	51-75 days
Freeze-free period (characteristic range)	94-111 days
Precipitation total (characteristic range)	14-17 in
Frost-free period (actual range)	50-85 days
Freeze-free period (actual range)	93-117 days
Precipitation total (actual range)	13-18 in
Frost-free period (average)	64 days
Freeze-free period (average)	103 days
Precipitation total (average)	15 in

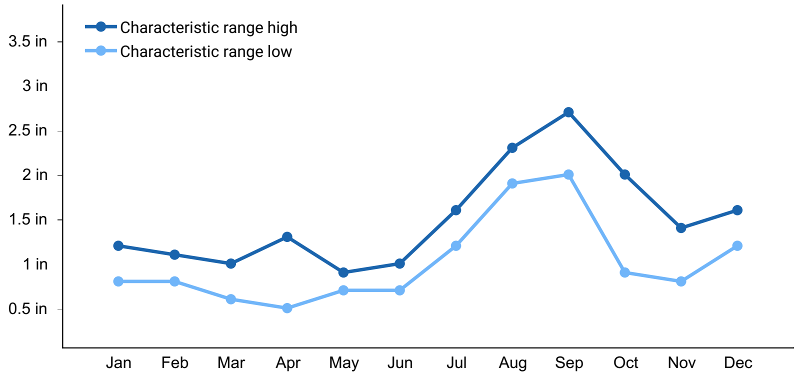


Figure 2. Monthly precipitation range

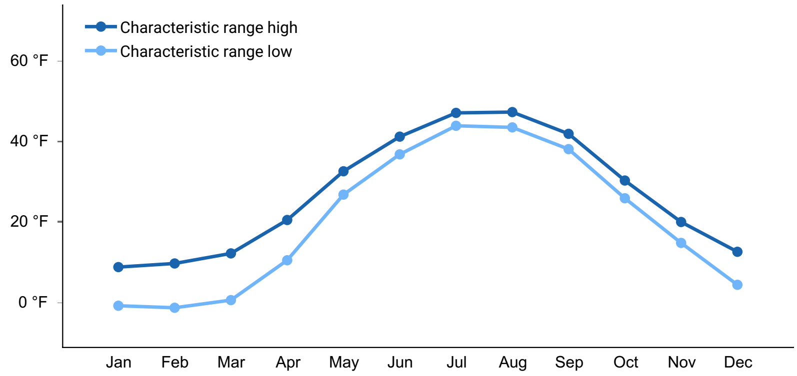


Figure 3. Monthly minimum temperature range

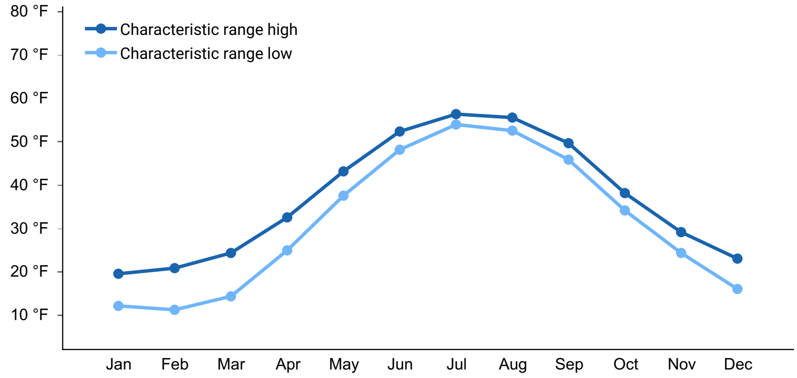


Figure 4. Monthly maximum temperature range

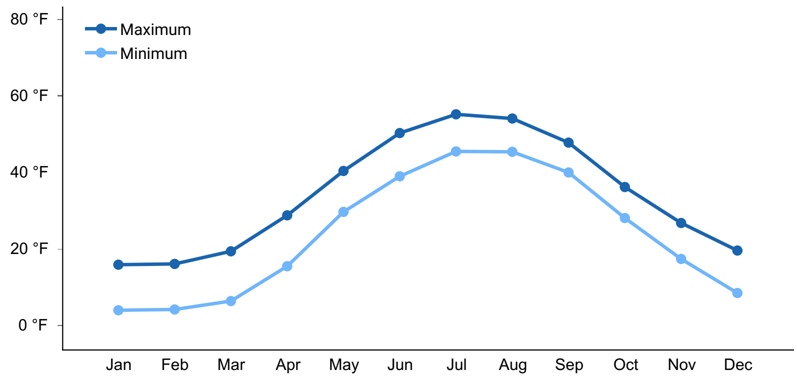


Figure 5. Monthly average minimum and maximum temperature

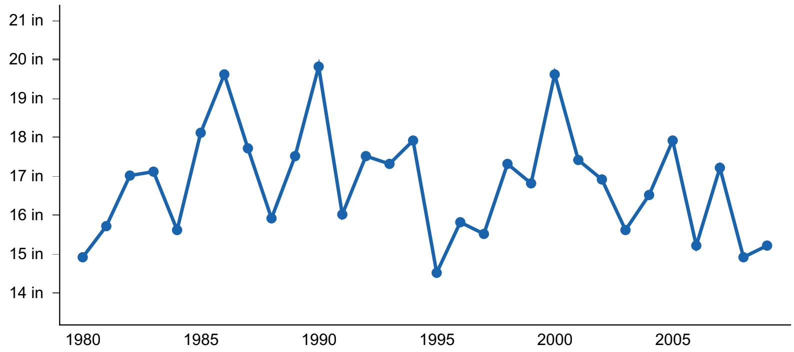


Figure 6. Annual precipitation pattern

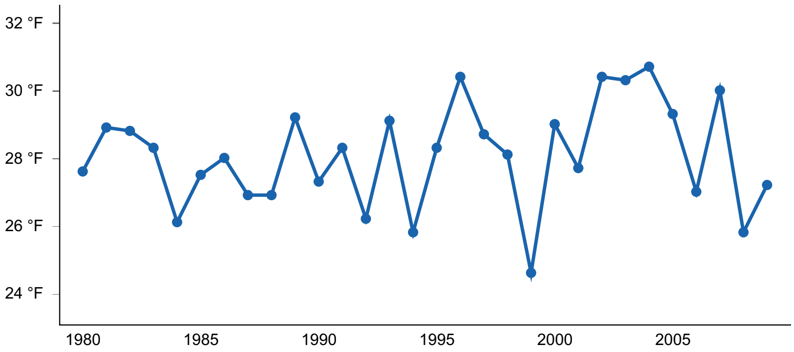


Figure 7. Annual average temperature pattern

Climate stations used

- (1) NOME MUNI AP [USW00026617], Nome, AK
- (2) WALES [USW00026618], Wales, AK
- (3) BETHEL AP [USW00026615], Bethel, AK

Influencing water features

This site is classified as a Slope wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008). Precipitation and groundwater are the main sources of water (Smith et al. 1995).

Depth to the water table may decrease following summer storm events or spring snowmelt and increase during extended dry periods.

Wetland description

n/a

Soil features

Soils formed in windblown loess and have permafrost. Rock fragments do not occur on the soil surface. These are mineral soils often capped with 6 to 14 inches of saturated organic material. The mineral soil below the organic material is composed of silt loam formed from wind-blown loess, which lacks rock fragments and has high water holding capacity. For plains and hills, this loess layer is thick going to 60 inches or more depth. For mountains, this loess layer is comparatively thin (1 to 13 inches thick on average) occurring over gravelly till and/or colluvium. For all associated soils, rock fragments can range between 0 and 35 percent of the soil profile by volume. While soils are considered very deep, permafrost commonly occurs at shallow to moderate depths (10 to 26 inches). The pH of the soil profile ranges from very strongly acidic to slightly acidic. The soils are wet for long portions of the growing season and are considered poorly drained.

Table 5. Representative soil features

Parent material	(1) Loess (2) Colluvium (3) Till
Surface texture	(1) Silt loam (2) Mucky silt loam
Family particle size	(1) Coarse-silty (2) Loamy-skeletal
Drainage class	Poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	10–26 in
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	8.5–11.3 in
Calcium carbonate equivalent (10-40in)	0%
Clay content (0-20in)	5–10%
Electrical conductivity (10-40in)	0 mmhos/cm
Sodium adsorption ratio (10-40in)	0
Soil reaction (1:1 water) (10-40in)	5–6.2
Subsurface fragment volume <=3" (0-60in)	0–35%
Subsurface fragment volume >3" (0-60in)	0%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	5–11.3 in
Calcium carbonate equivalent (10-40in)	Not specified
Clay content (0-20in)	Not specified
Electrical conductivity (10-40in)	Not specified
Sodium adsorption ratio (10-40in)	0–3

Soil reaction (1:1 water) (10-40in)	5–6.6
Subsurface fragment volume <=3" (0-60in)	Not specified
Subsurface fragment volume >3" (0-60in)	Not specified

Ecological dynamics

The Northern Bering Sea Islands MLRA (MLRA 239X) occurs in the arctic where the harsh climate limits the composition and structure of plant communities. This area has cool and short summers and long and cold winters. Limited warmth during the short summer months, inhibits trees from occurring, and the expansive tundra is composed of a mosaic of low growing shrubs, sedges, moss, and lichen. The cold temperatures limit the vertical and horizontal structure of shrubs and other functional groups of the tundra (CAVM 2022). For instance, shrubs do not typically exceed 80 cm in height across these islands (Swanson et al. 1986; CAVM 2022). The exception is micro-climates where snow can accumulate, which protects vegetation from harsh winds and insulates soils. These micro-climates allow for shrubs to grow much taller and occur on landforms such as flood plains.

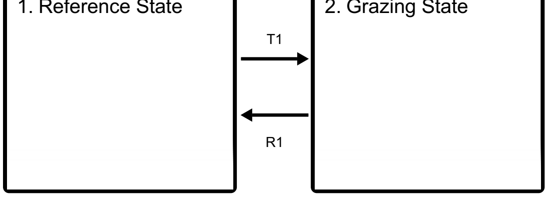
Ungulate History and Use

In this MLRA, the lack of predators paired with quality forage can lead to dramatic population growth of reindeer which in turn can lead to significant die-offs. Eighty-one reindeer were introduced to Nunivak Island in 1920. Due to a lack of predators and an abundance of high-quality forage, the reindeer population climbed to peaks of greater than 30 thousand in 1944 and 23 thousand in 1965 (Swanson and Barker 1991). After each peak in population, the reindeer herds experienced dramatic population die offs that resulted in less than 5 thousand animals (Swanson and Barker 1991). These die offs are largely attributed to lichen range depletion. Lichen forage makes up 47 percent of the March diet for reindeer herds on Nunivak Island (Swanson et al. 1986) so the depletion of lichen range can directly lead to stress and mortality of reindeer populations.

The presence of introduced ungulate herds on Nunivak, St Lawrence, and St. Matthews Islands, in some places for over a century, plays an integral role in shaping vegetation across this MLRA. Some small islands in this MLRA are believed to have no history of natural or introduced ungulate herds (e.g. Pinnace Islands, Hall Island, and Punuk Islands). On islands with introduced herds, grazing by reindeer and/or muskox has impacted the potential natural vegetation. For instance, continuous grazing of slow growing fruticose lichen can lead to changes in lichen species composition (Swanson and Barker 1991) and can lead to increases in shrub and bryophyte cover (Kautz et al. 1992). Because of the mixed history in grazing in this MLRA, the STM for this ecological site has two states. Islands in this MLRA without a history of ungulate herds are associated with reference state vegetation, while islands with introduced ungulate herds are associated with grazing state vegetation.

State and transition model

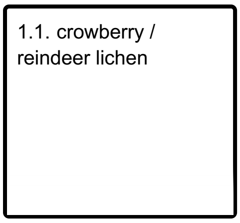
Ecosystem states



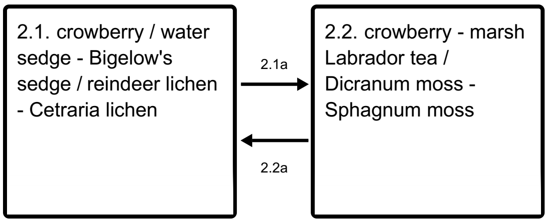
T1 - Human introduction of reindeer and/or muskox to islands.

R1 - Long periods of time after extirpation of human introduced ungulates.

State 1 submodel, plant communities



State 2 submodel, plant communities



2.1a - Continuous grazing by reindeer and/or muskox

2.2a - Time without continuous grazing by reindeer and/or muskox

State 1
Reference State

The historic and current use of introduced ungulates in this MLRA may have altered the potential natural vegetation on these islands. Islands in this MLRA without a history of introduced grazing have reference state vegetation, while islands with introduced herds of reindeer and/or muskox (Nunivak, St. Lawrence, and St. Matthews Islands) have grazing state vegetation. Currently no data has been collected in areas of this MLRA in reference condition. Future targeted data collection efforts can address whether range in excellent condition within the grazing state is similar to reference state vegetation and these results could dramatically alter this provisional state and transition model.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- (*Flavocetraria cucullata*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous
- cetraria lichen (*Cetraria*), other herbaceous

Community 1.1
crowberry / reindeer lichen

Community 1.1 is the potential natural vegetation for this state. It is characterized as crowberry tundra (Viereck et al. 1992) with crowberry the dominant dwarf shrub. Other common and abundant species include an assortment of sedges and lichen.

Dominant plant species

- crowberry (*Empetrum*), shrub
- sedge (*Carex*), grass
- (*Flavocetraria cucullata*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous
- cetraria lichen (*Cetraria*), other herbaceous

State 2
Grazing State

Figure 8. A gentle sloping plain on Nunivak Island.

Two plant communities occur within the grazing state and the vegetation differs in large part due to the degree of ungulate use. The data for this state is based on a mixture of recent field work conducted on Nunivak Island (2022-2023) and historical range surveys conducted on Nunivak Island (Swanson et al. 1986, Kautz et al. 1992). Future work will be required to determine if the vegetation on Nunivak Island represent the vegetation across the grazed islands of this MLRA.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- water sedge (*Carex aquatilis*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- (*Flavocetraria cucullata*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous
- cetraria lichen (*Cetraria*), other herbaceous

Community 2.1
crowberry / water sedge - Bigelow's sedge / reindeer lichen - Cetraria lichen

Figure 9. Typical vegetation associated with community 2.1.

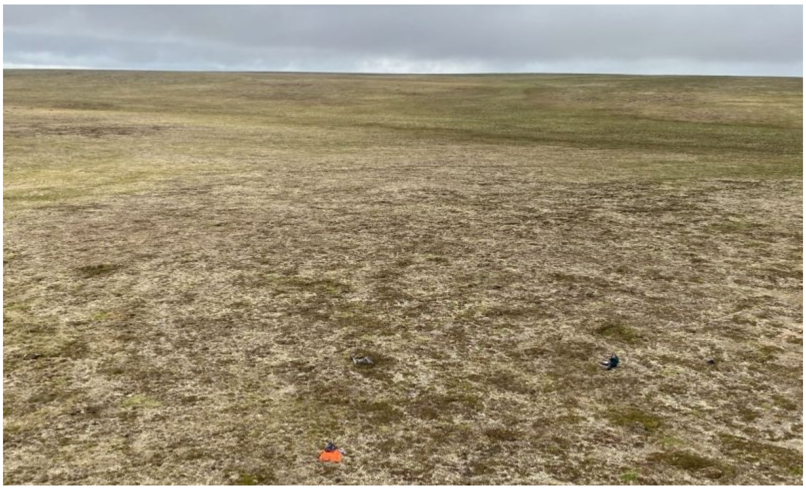


Figure 10. An aerial image of the above vegetation on the coastal plains of Nunivak Island.

Community 2.1 is considered the potential natural vegetation for the grazing state. This community is characterized as crowberry tundra (Viereck et al. 1992). Common and dominant species include crowberry, dwarf birch, Alaska bog willow, netleaf willow, marsh Labrador tea, water sedge, Bigelow's sedge, small awned sedge, Sphagnum moss, and various preferred lichen range species (i.e. reindeer lichen, Cetraria lichen, Flavocetraria lichen, and cup lichen). The vegetative strata that characterize this community are dwarf shrubs (less than 8 inches height), medium graminoids (between 4 and 24 inches height), and foliose and fruticose lichen.

Forest understory. Live lichen and moss annual production cannot be measured accurately due to a lack of information on growth rates and/or slow annual growth rates. Lichen and moss biomass data below refers to total biomass, while vascular plants biomass refers to annual production.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- dwarf birch (*Betula nana*), shrub
- Alaska bog willow (*Salix fuscescens*), shrub
- netleaf willow (*Salix reticulata*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- water sedge (*Carex aquatilis*), grass
- smallawned sedge (*Carex microchaeta*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- reindeer lichen (*Cladina arbuscula*), other herbaceous
- island cetraria lichen (*Cetraria islandica*), other herbaceous
- sphagnum (*Sphagnum*), other herbaceous
- cup lichen (*Cladonia gracilis*), other herbaceous
- (*Flavocetraria cucullata*), other herbaceous
- reindeer lichen (*Cladina mitis*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous
- dicranum moss (*Dicranum*), other herbaceous

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Lichen	3500	5000	11000
Moss	200	350	500
Shrub/Vine	150	275	400
Grass/Grasslike	105	195	280
Forb	45	85	120
Total	**4000**	**5905**	**12300**

Table 8. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	10-50%
Grass/grasslike foliar cover	5-15%
Forb foliar cover	0-5%
Non-vascular plants	50-80%
Biological crusts	0%
Litter	10-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0-5%

Table 9. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	15-50%	–	0-5%
>0.5 <= 1	–	–	5-10%	0-5%
>1 <= 2	–	–	5-10%	–
>2 <= 4.5	–	–	–	–
>4.5 <= 13	–	–	–	–
>13 <= 40	–	–	–	–
>40 <= 80	–	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 2.2
crowberry - marsh Labrador tea / Dicranum moss - Sphagnum moss

Community 2.2 has been continuously grazed. Cover and biomass of crowberry, marsh Labrador tea, and less preferred lichen species increase, while cover and biomass of Alaska bog willow, least willow, sedges, and preferred lichen decrease. Lichen biomass goes from 5000 pounds or more per acre for community 2.1 to 1000 pounds or less per acre for community 2.2. Preferred lichens for this community are reindeer lichen and Cetraria lichen. The less preferred lichens are cup lichen, white worm lichen, and lung lichen.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- marsh Labrador tea (*Ledum palustre ssp. decumbens*), shrub
- dwarf birch (*Betula nana*), shrub
- sphagnum (*Sphagnum*), other herbaceous
- dicranum moss (*Dicranum*), other herbaceous
- polytrichum moss (*Polytrichum*), other herbaceous
- cup lichen (*Cladonia*), other herbaceous
- whiteworm lichen (*Thamnolia vermicularis*), other herbaceous
- lung lichen (*Lobaria linita*), other herbaceous
- reindeer lichen (*Cladina*), other herbaceous
- island cetraria lichen (*Cetraria islandica*), other herbaceous

Pathway 2.1a
Community 2.1 to 2.2

Continuous grazing by reindeer and/or muskox. Continuous grazing reduces the cover and abundance of desirable forage lichen and increases the cover and abundance of dwarf shrubs, forbs, and less desirable forage lichen.

Pathway 2.2a
Community 2.2 to 2.1

Time without continuous grazing by reindeer and/or muskox. The cover and abundance of desirable forage lichen increases, competing and reducing the cover of dwarf shrubs, forbs, and less desirable forage lichen.

Transition T1
State 1 to 2

Human introduction of reindeer and/or muskox to islands.

Restoration pathway R1
State 2 to 1

Long periods of time after extirpation of human introduced ungulates.

Additional community tables

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
2	**Shrubs Annual Production**			150–400	
	dwarf birch	BENA	*Betula nana*	45–160	–
	black crowberry	EMNI	*Empetrum nigrum*	45–160	–
	marsh Labrador tea	LEPAD	*Ledum palustre ssp. decumbens*	15–80	–
	Alaska bog willow	SAFU	*Salix fuscescens*	15–80	–
	netleaf willow	SARE2	*Salix reticulata*	15–80	–
	alpine bearberry	ARAL2	*Arctostaphylos alpina*	10–65	–
	bog blueberry	VAUL	*Vaccinium uliginosum*	5–55	–
	lingonberry	VAVI	*Vaccinium vitis-idaea*	5–55	–
	eightpetal mountain-avens	DROCO	*Dryas octopetala ssp. octopetala*	0–30	–
	least willow	SARO2	*Salix rotundifolia*	0–25	–
	blue mountainheath	PHCA10	*Phyllodoce caerulea*	0–10	–
Grass/Grasslike					
3	**Graminoid Annual Production**			105–280	
	water sedge	CAAQ	*Carex aquatilis*	25–95	–
	smallawned sedge	CAMI4	*Carex microchaeta*	25–95	–
	Bigelow's sedge	CABI5	*Carex bigelowii*	5–40	–
	smallflowered woodrush	LUPA4	*Luzula parviflora*	0–10	–
Forb					
4	**Fob Annual Production**			45–120	
	cloudberry	RUCH	*Rubus chamaemorus*	5–25	–
	ledge stonecrop	RHIN11	*Rhodiola integrifolia*	0–15	–

	woolly lousewort	PELA14	*Pedicularis lanata*	0–10	–
Moss					
5	**Total Bryophyte Biomass**			200–500	
	sphagnum	SPHAG2	*Sphagnum*	160–450	–
	dicranum moss	DICRA8	*Dicranum*	30–100	–
Lichen					
6	**Total Lichen Biomass**			3500–11000	
	greygreen reindeer lichen	CLRA60	*Cladina rangiferina*	1225–4950	–
	reindeer lichen	CLAR60	*Cladina arbuscula*	875–3850	–
	island cetraria lichen	CEIS60	*Cetraria islandica*	525–2200	–
	cup lichen	CLGR13	*Cladonia gracilis*	70–550	–
	reindeer lichen	CLMI60	*Cladina mitis*	70–440	–
	star reindeer lichen	CLST60	*Cladina stellaris*	70–440	–
		FLCU	*Flavocetraria cucullata*	70–440	–
		FLNI	*Flavocetraria nivalis*	0–220	–
	cup lichen	CLADO3	*Cladonia*	0–110	–
	peppermint drop lichen	ICMAD	*Icmadophila*	0–110	–
	lung lichen	LOLI60	*Lobaria linita*	0–110	–
	arctic kidney lichen	NEAR60	*Nephroma arcticum*	0–110	–
	felt lichen	PELTI2	*Peltigera*	0–110	–
	whiteworm lichen	THVE60	*Thamnolia vermicularis*	0–110	–

Table 11. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Shrub/Vine					
1	**Shrubs Annual Production**			0	
Grass/Grasslike					
2	**Grass/Grasslike Annual Production**			1080–1890	
	bluejoint	CACA4	*Calamagrostis canadensis*	900–1785	–
	common woodrush	LUMU2	*Luzula multiflora*	25–125	–
	sedge	CAREX	*Carex*	0–40	–
	Altai fescue	FEAL	*Festuca altaica*	0–40	–
	American dunegrass	LEMOV	*Leymus mollis ssp. villosissimus*	0–20	–
Forb					
3	**Fob Annual Production**			120–210	
	field horsetail	EQAR	*Equisetum arvense*	2–125	–
	Canadian burnet	SACA14	*Sanguisorba canadensis*	25–85	–
	purple marshlocks	COPA28	*Comarum palustre*	10–65	–
	tall Jacob's-ladder	POAC	*Polemonium acutiflorum*	0–40	–
	ledge stonecrop	RHIN11	*Rhodiola integrifolia*	10–40	–
	silverweed cinquefoil	ARAN7	*Argentina anserina*	0–20	–
	cloudberry	RUCH	*Rubus chamaemorus*	0–20	–
	woolly geranium	GEER2	*Geranium erianthum*	0–20	–
	tall bluebells	MEPA	*Mertensia paniculata*	0–20	–
	Fremont's beardtongue	PEFR	*Penstemon fremontii*	0–20	–
	arctic sweet coltsfoot	PEFRF	*Petasites frigidus var. frigidus*	0–20	–
	Tilesius' wormwood	ARTI	*Artemisia tilesii*	0–20	–
	Sierra larkspur	DEGL3	*Delphinium glaucum*	0–20	–
Moss					
4	**Total Bryophyte Biomass**			0	
Lichen					
5	**Total Lichen Biomass**			0	

Animal community

The principal use of this site by wildlife is as feeding for a variety of shorebirds and waterfowl. Brant, emperor geese, turnstones, and sandhill cranes commonly use this site for nesting and feeding; while a large variety of other bird species may forage and rest in these areas. Muskoxen also use this site.

Hydrological functions

N/A

Recreational uses

The varied seascapes and landscapes present scenic views of high aesthetic value. Opportunities for photography are excellent. This is especially true in the vicinity of the sea cliffs on the northwestern coast and the impressive sand dunes and estuaries along the western and southern shores. There is high potential for wildlife-oriented recreation. Fishing for arctic char, Dolly Varden, and salmon is excellent, while waterfowl and ptarmigan offer fall hunting opportunities to sportsmen. Muskoxen hunting is also a very big sport during the winter months.

Wood products

No wood products available from this site.

Other products

Reindeer Grazing

This site is best suited for early spring and early fall and winter range. Due to the fragile nature of lichen, this site should not be used during other seasons; lichen can become very brittle when dry and therefore, easily trampled. The abundance of reindeer lichens and sedges on good condition range can supply adequate forage for reindeer during the winter and early spring and fall months.

Other information

These interpretive narratives were all developed in a report for range sites on Nunivak Island (Swanson et al. 1986).

Inventory data references

Tier 2 sampling plots used to develop the grazing state. Plot numbers as recorded in NASIS with associated community phase.

Community 2.1

896304, 896307

Plant species and production information are based on a historic range survey on Nunivak Island (Swanson et al. 1986).

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Approval

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product.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/11/2025
Approved by	Marji Patz
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:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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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):**

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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:**

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17. **Perennial plant reproductive capability:**
