

Ecological site R239XY054AK

Arctic Sedge Peat Frozen Drainageways

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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 Diomedé, 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 dune grass 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. Pinnacle 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 – 6916980 – Alaska Arctic Wet Sedge Meadow (Landfire 2009) Wet Sedge Meadow Tundra (Viereck et. al 1992) Sedge (Drainageway) (Swanson et al. 1986)

Ecological site concept

This arctic ecological site occurs on nearly level drainageways with wet and peaty soils that have permafrost. These drainageways are relatively small, roughly linear depressions that move concentrated water throughout the growing season and have a small defined channel. In this area, the soils directly adjacent to the small defined channel of a drainageway typically have minimal to no bare alluvium, which significantly differs from flood plain systems. Given their limited footprint, drainageways have a narrow band of associated vegetation. Associated soils do not flood, pond frequently, have a high-water table throughout the growing season, and are considered very poorly drained. A typical soil profile has 21 to 25 inches of peat over silty, frozen alluvium. 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. One plant community has been documented within the grazing state for this ecological site. This community is characterized as wet sedge meadow tundra (Viereck et al. 1992) with the dominant plant being water sedge. Other commonly observed species include tealeaf willow, bluejoint, purple marshlocks, and Sphagnum moss. The vegetative strata that characterize this community are medium graminoids (between 4 and 24 inches in height) and moss.

Associated sites

R239XY052AK	Arctic Sedge Loamy Frozen Slopes Occurs on nearly level and very wet coastal plains across these islands. Ecological sites 52 and 54 are commonly adjacent to each other.
R239XY057AK	Arctic Sedge Peat Depressions Occurs in breached lakes, on the margins of lakes, and in other large organic depressions. Ecological site 54 commonly drains these depressional landforms.

Similar sites

R239XY052AK	Arctic Sedge Loamy Frozen Slopes While ecological sites 52 and 54 are characterized as wet sedge meadow tundra (Viereck et al. 1992) there are differences in the kinds and amounts of dominant vegetation. Site 52 has different shrubby and graminoid dominant plants.
R239XY057AK	Arctic Sedge Peat Depressions While ecological sites 54 and 57 are characterized as wet sedge meadow tundra (Viereck et al. 1992), there are differences in the kinds and amounts of dominant vegetation. Site 57 has different shrubby, graminoid, and forb dominant plants.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Carex aquatilis</i> (2) <i>Comarum palustre</i>

Physiographic features

This ecological site occurs in gently sloping drainageways on coastal plains. These drainageways occur on all aspects. Elevation typically occurs between 10 and 500 feet. Flooding does not occur. Ponding occurs frequently for very long durations of time with ponding depth ranging between 2 and 6 inches. During the growing season, a water table commonly occurs at the soil surface. This site generates negligible runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Landforms	(1) Coastal plain > Drainageway
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Very long (more than 30 days)
Ponding frequency	Frequent
Elevation	0 – 150 m
Slope	0 %

Ponding depth	10 – 20 cm
Water table depth	0 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding duration	Not specified
Ponding frequency	Not specified
Elevation	0 – 510 m
Slope	Not specified
Ponding depth	Not specified
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)	50-80 days
Freeze-free period (characteristic range)	90-110 days
Precipitation total (characteristic range)	360-430 mm
Frost-free period (actual range)	50-90 days
Freeze-free period (actual range)	90-120 days
Precipitation total (actual range)	330-460 mm
Frost-free period (average)	60 days
Freeze-free period (average)	100 days
Precipitation total (average)	380 mm

- (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 Depressional wetland under the Hydrogeomorphic (HGM) classification system (Smith et al. 1995; USDA-NRCS 2008). In the associated depressions, precipitation, overland flow, or interflow are the main sources of water (Smith et al. 1995).

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

Wetland description

n/a

Soil features

Soils formed in a thick layer of silty alluvium. Rock fragments do not occur on the soil surface. These are mineral soils capped with 21 to 25 inches of saturated organic material. The mineral soil below the organic material is a silt loam, which lacks rock fragments and has high water holding capacity. While soils are considered very deep, permafrost commonly occurs in the silty alluvium at moderate depths. The pH of the soil profile is often very strongly acidic to moderately acidic. The soils are wet for long portions of the growing season and are considered very poorly drained.

Table 5. Representative soil features

Parent material	(1) Organic material (2) Alluvium
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Surface texture	(1) Peat
Family particle size	(1) Loamy
Drainage class	Very poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	50 – 60 cm
Soil depth	150 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	26.92 – 44.7 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)	4.9 – 10
Subsurface fragment volume <=3" (0-152.4cm)	Not specified

Subsurface fragment volume >3" (0-152.4cm)	Not specified
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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 (0-101.6cm)	Not specified
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)	0
Soil reaction (1:1 water) (25.4-101.6cm)	4.9 – 6.6

Subsurface fragment volume <=3" (0-152.4cm)	Not specified
Subsurface fragment volume >3" (0-152.4cm)	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. Pinnacle 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

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Shrub/Vine					
2	Shrub Annual Production			179-364	
	tealeaf willow	SAPU15	<i>Salix pulchra</i>	34-269	–
	Alaska bog willow	SAFU	<i>Salix fuscescens</i>	11-106	–
Grass/Grasslike					
3	Graminoid Annual Production			420-846	
	water sedge	CAAQ	<i>Carex aquatilis</i>	404-1009	–
	cottongrass	ERIOP	<i>Eriophorum</i>	0-67	–
	bluejoint	CACA4	<i>Calamagrostis canadensis</i>	22-67	–
Forb					

4	Forb Annual Production			67-135	
	purple marshlocks	COPA28	Comarum palustre	34-135	–
	cottongrass	ERIOP	Eriophorum	0-67	–
	arctic dock	RUAR6	Rumex arcticus	7-39	–
	ledge stonecrop	RHIN11	Rhodiola integrifolia	7-28	–
	field horsetail	EQAR	Equisetum arvense	0-11	–
	arctic sweet coltsfoot	PEFR5	Petasites frigidus	0-11	–
	curly dock	RUCR	Rumex crispus	0-11	–
Moss					
5	Total Bryophyte Biomass			2242-6725	
	sphagnum	SPHAG2	Sphagnum	2018-6591	–
	Moss	2moss	Moss	0-336	–
	mnium calcareous moss	MNIUM2	Mnium	0-67	–
Lichen					
6	Total Lichen Biomass			0	

Animal community

The principal use of this site by wildlife is 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 in addition to reindeer, especially during the summer to escape from oestrid flies; the coastal breezes can provide escape from these insects.

Hydrological functions

N/A

Recreational uses

N/A

Wood products

No wood products available from this site.

Other products

Reindeer Grazing This site is suited for all seasons; however, it is best suited for spring and summer range. Growing grasses and sedges produce high levels of digestible protein. Browse also provides forage during the fall and early winter. Green portions of sedges may be grazed during the winter and this site can provide one of the few sources of high-quality green feed during the winter. Insect harassment is high on warm summer days.

Other information

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

Inventory data references

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

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Contributors

Blaine Spellman

Approval

Marji Patz, 2/18/2025

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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	09/20/2026
Approved by	
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:
