Aniakchak National Monument and Preserve

Landcover Classification

National Park Service
U.S. Department of the Interior



PROJECT DESCRIPTION

The vegetation classification system for Aniakchak National Monument and Preserve is a two tiered system composed of a landcover map (earth cover classes), and plant associations. The map was produced by Ducks Unlimited as part of the Alaska Peninsula and Becharof National Wildlife Refuges earth cover classification project (USFWS 2007), and plant associations were produced by the Alaska Natural Heritage Program (AKNHP). Twenty-four vegetated earth cover classes were mapped using 30-meter Landsat TM imagery covering Aniakchak National Monument and Preserve. These earth cover classes represent coarse-scale vegetation map units based on the Alaska Vegetation Classification levels II through IV. Detailed descriptions of each vegetated earth cover class including characteristic landforms, elevation and slope ranges, dominant plant species, and common plant associations are provided below and can also be found in the Natural Resource Technical Report produced by this project entitled Plant Associations, Vegetation Succession, and Earth Cover Classes: Aniakchak National Monument and Preserve. All totalled, sixty-eight plant associations were described for Aniakchak National Monument and Preserve based on 204 plots sampled in 2009 and 2010. These plant associations represent the finest level of community classification of both the Alaska Vegetation Classification and the National Vegetation Classification Standard. They are based on diagnostic species, distinct floristic composition, uniform habitat conditions and physiognomy. Each plant association represents a relatively narrow segment of the variation in vegetation defined by topo-edaphic climate, substrate, hydrology, and disturbance regimes. The two levels of classification used in this project provide baseline information about the extent and distribution of habitats and plant species, and can be used to assess status and trends in the condition of ecosystems within the park.

Closed Poplar Forest



Classification: At least 60% of the cover is trees, ≥75% of the trees are deciduous, and ≥75% of the deciduous trees are *Populus balsamifera*.

Environment: Small stands of *Populus balsamifera* ssp. *balsamifera* occur on low relief hills associated with lowland plains along the northern border of the study area. This class occurs on gently sloping terrain at low elevations. These forests appear to represent the southernmost limit of this forested class on the Alas ka Peninsula. This class was mapped on 0.003% of study the area.

Vegetation: *Populus balsamifera* ssp. *balsamifera* dominates the tree canopy. Understory shrubs may include *Alnus viridis* spp. *sinuata*, *Salix barclayi, S. pulchra*, and *S. glauca*. Common species in the herbaceous layer include *Chamerion angustifolium*, *Heracleum maximum*, *Angelica lucida*, *Calamagrostis canadensis*, *Athyrium filix-femina*, *Achillea millefolium* var. *borealis*, *Geranium erianthum*, and *Equisetum arvense*.

Plant association:

Populus balsamifera ssp. *balsamifera*/Herbaceous

Tall Shrub–Willow



Classification: Shrub cover is 25 to 100% and average shrub height is >1.3 meters. *Salix* species comprise at least 75% of the total shrub cover.

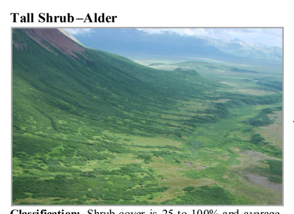
Environment: This class is widespread on river terraces, river bars, pumice plains and dunes, and low relief hills. Slopes are flat to moderate, and sites are mesic to mesic–wet. This class was mapped on 7.2% of study the area.

Vegetation: *Salix glauca*, *Salix pulchra*, and *Salix barclayi* are the most common overstory species on throughout this class. *Salix commutata* is locally common. *Salix alaxensis* is common on floodplain terraces and along narrow riparian corridors. Common understory species include *Equisetum arvense*, *Chamerion angustifolium*, *Heracleum maximum*, *Empetrum nigrum*, *Achillea millefolium* var. *borealis*, *Carex macrochaeta*, and *Calamagrostis canadensis*.

Plant associations:

Salix alaxensis/*Equisetum arvense*
Salix barclayi–Salix commutata
Salix glauca–Salix barclayi
Salix glauca–Salix pulchra
Salix glauca–Salix pulchra/*Empetrum nigrum* G4;S4

Tall Shrub–Alder



Classification: Shrub cover is 25 to 100% and average shrub height is ≥1.3 meters. *Alnus viridis* spp. *sinuata* comprises at least 75% of the total shrub cover.

Environment: The Tall Alder class is widespread on steep, well-drained side slopes. It also occurs as small to medium sized patches on dunes, pumice plains, and in river corridors. Sites are typically mesic and slopes range from flat to steep. Elevation ranges from se a level to alpine. This class was mapped on 12.8% of the study area.

Vegetation: *Alnus viridis* spp. *sinuata* dominates the overstory. *Salix* spp. may occur as minor canopy component. Common understory species include *Calamagrostis canadensis*, *Equisetum arvense*, *Chamerion angustifolium*, *Dryopteris expansa*, *Athyrium filix-femina*, *Heracleum maximum*, *Angelica lucida*, and *Achillea millefolium* var. *borealis*. On side slopes and toe slopes the Tall Alder class often occurs in a mosaic with Mesic Forb and Mesic Grami noid classes.

Plant associations:

Alnus viridis spp. *sinuata*
Alnus viridis spp. *sinuata*/*Calamagrostis canadensis*
Alnus viridis spp. *sinuata*/Fern
Alnus viridis spp. *sinuata*/Forb

Tall Shrub–Alder-Willow



Classification: Shrubs make up 25 to100% of the cover, and average shrub height is ≥1.3 meters. A combination of alder and willow species comprise at least 75% of the total shrub cover.

Environment: This class occurs on low elevation flood plains, dunes, and pumice plains. It was also mapped on mountain side slopes and toe slopes where alder and willow classes co -occur in a fine mosaic. The slope ranges from flat to gently sloping, and sites are mesic to mesic-wet. This class was mapped on 3.3% of the study area.

Vegetation: *Alnus viridis* spp. *sinuata* and *Salix alaxensis* are co-dominant in s the overstory. Common understory species include *Calamagrostis canadensis*, *Equisetum arvense*, *Angelica genuflex a*, and *Achillea millefolium* var. *borealis*.

Plant associations:

Salix alaxensis –Alnus viridis spp. *sinuata*/ *Calamagrostis canadensis*

(Also see Tall Alder and Tall Willow classes for additional plant associations that may occur as a mosaic within this Earth Cover class.)

Low Shrub–Willow



Classification: Shrub cover is 25 to 100%, average shrub height is > 0.25 meters and <1.3 meters, and >75% of the shrub cover is willow.

Environment: This class is widespread on river terraces, river bars, shallow drainageways, lacustrine deposits, side slopes, toe slopes, and dunes. Elevation ranges from sea level to alpine, slopes are typically flat to gently sloping, and sites are mesic to wet. This class was mapped on 7.2% of the study area.

Vegetation: The most common overstory species are *Salix glauca* and *S. pulchra*. *Salix barclayi* may be co-dominant locally. Common understory species on mesic sites including terraces, side slopes and toe slopes include *Empetrum nigrum*, *Chamerion angustifolium*, *Calamagrostis canadensis*, *Carex macrochaeta*, *Achillea millefolium* var. *borealis*, and *Equisetum arvense*. Common species in poorly drained wetland sites, such as the *S. pulchra*/ *Carex aquatilis* and *S. pulchra*/ *C. lyngbyei* associations, include *S. fuscescens*, *Andromeda polifolia*, *C. aquatilis*, and *C. lyngbyei*. On mountain sides lopes and toe slopes this class is often co-occurs with the Tall Shrub Alder class.

Plant associations:

Salix glauca–Salix barclayi
Salix glauca–Salix pulchra
Salix pulchra/*Carex aquatilis* G4; S4
Salix pulchra/*Carex lyngbyei*
Salix pulchra/*Empetrum nigrum*

Dwarf Shrub–Upland



Classification: Shrub cover is 25 to 100%, average shrub height is ≤0.25 meters. This class is more open than the other Dwarf Shrub classes, and it is generally occurs at higher elevations.

Environment: This class is the most commonly mapped vegetation within the study area. It is common on side slopes, summits, pumice plains, river terraces, mid to high elevation valleys, and terraces. This class occurs from mid elevation through alpine and is often matrix-forming. Slopes are flat to steep, and sites are typically mesic. This class was mapped on 21.8% of the study area.

Vegetation: *Empetrum nigrum* and *Vaccinium uliginosum* typically dominate this class. Other species that have high constancy include *Loiseleuria procumbens*, *Diapensia lapponica*, *Vaccinium vitis-idaea*, *Rhododendron camtschaticum*, *Carex microchaeta*, *Geum rossii*, *Cetraria* spp., and *Cladina* spp.

Plant associations:

Empetrum nigrum
Empetrum nigrum/Lichen
Empetrum nigrum–Mixed dwarf shrub
Empetrum nigrum–Vaccinium uliginosum
Empetrum nigrum–Vaccinium uliginosum/Rock
Mixed dwarf shrub/Rock

Dwarf Shrub –Wet



Classification: Shrub cover is 25 to 100%, the average shrub height is <0.25 meters. Standing water or wetland plant species are present.

Environment: This is an uncommon lowland wetland class that occurs on lacustrine deposits and poorly drained terraces. Sites are generally flat and underlain with organic soil and peat -forming mosses and sedges; standing water is often present. Sites are low elevation and typically small patch. This class was mapped on 0.7% of the study area.

Vegetation: Common species in this class include *Empetrum nigrum, Betula nana, Vaccinium uliginosum, Ledum palustre, Andromeda polifolia, Carex rariflora, C. aquatilis, Trichopho rum cespitosum,* and *Sphagnum* spp.

Plant associations:

Empetrum nigrum -Vaccinium uliginosum /*Carex* wet

Dwarf Shrub–Lush



Classification: Shrub cover is 25 to 100%, the average shrub height is ≤0.25 meters. Shrub cover on these sites typically exceeds 50%.

Environment: This class occurs on river terraces, valley bottoms, side slopes, toe slopes, stabilized dunes, and dune slacks from sea level to alpine. High elevation sites occur in protected areas such as swales and late snow beds. Sites are typically mesic, and slopes range from flat to moderately steep. This class was mapped on 2.3% of the study area.

Vegetation: This class is characterized by a continuous carpet of dwarf shrub cover. Exposed rock, bare ground, and lichen are less common in this class than in the Dwarf Shrub–Upland class. *Empetrum nigrum* is often the dominant dwarf shrub, though *Vaccinium uliginosum* can be co-dominant. *Betula nana*, and *Ledum palustre* ssp. *decumbens* may be common on lowland sites. On stabilized dunes and plains common associated species include *Leymus mollis* and *Lathyrus japonicas*. On late snow bed sites, dominant species are *Harrimanella stelleriana*, *Luetkea pectinata*, and *Phyllodoce aleutica*.

Plant associations:

Harrimanella stellariana–Luetkea pectinata
Empetrum nigrum
Empetrum nigrum/*Lathyrus japonicas* var. *maritimus*
Empetrum nigrum/*Leymus mollis* G4; S4
Empetrum nigrum–Vaccinium uliginosum

Dwarf Shrub–Lichen



Classification: Shrub cover is 25 to 100%, average shrub height is ≤0.25 meters, and ≥20% of the cover is made up of lichens. Shrub cover generally does not exceed 35%.

Environment: This class typically occurs on summits, mountain side slopes and benches, pumice plains, and terraces. It often occurs in conjunction with the Dwarf Shrub–Upland class. Slopes are flat to gently sloping, and elevation ranges from sea level to alpine. Sites are typically mesic to dry. This class was mapped on 3.4% of the study area.

Vegetation: *Empetrum nigrum* is typically the dominant dwarf shrub, though *Vaccinium uliginosum* can be co-dominant. Other shrubs with high constancy but low cover include *Loiseleuria procumbens*, *Arctostaphylos alpina*, and *Salix arctica*; common herbaceous species include *Carex microchaeta* and *Geum rossii*. The lichen component is dominated by fruticose species such as *Cladina rangiferina*, *Cladina* spp. *Cetraria* spp., and *Sphaerophorus globosus*.

Plant associations:

Empetrum nigrum/Lichen
Empetrum nigrum–Mixed dwarf shrub

Dwarf Shrub–Other



Classification: Shrub cover is 25 to 100%, and average shrub height is <0.25 meters. This class is described as "a collection of those dwarf shrub types that were not clearly spectrally distinguishable by any of the criteria described for the other varieties described in the dwarf shrub section."

Environment: This class occurs on a wide variety of landforms including mountain side slopes, hills, pumice plains, dunes, river terraces, and depressions. Elevations range from sea level to alpine and slopes are flat to steep. Sites are dry-mesic to mesic-wet. This class was mapped on 6.2% of the study area.

Vegetation: This class includes sites that have abundant dwarf shrub cover and also those that have low cover of dwarf shrubs and high herbaceous cover. Bare ground may be common in these sites as well. Dominant shrub species may include *Empetrum nigrum*, *Salix stolonifera*, *S. ovalifolia*, *S. arctica*, *S. reticulata*, *Luetkea pectinata*, and *Arctostaphylos uva-ursi*. Common herbaceous and non-vascular species may include *Carex macrochaeta*, *Leptarrhena pyrolifolia*, and *Racomitrium lanuginosum*.

Plant associations:

Empetrum nigrum/*Racomitrium* spp. G3G4; S3S4
E. nigrum–Arctostaphylos uva-ursi G3G4; S3S4
Salix ovalifolia–Luetkea pectinata
Salix ovalifolia/*Racomitrium* spp. G3G4; S3S4
Salix arctica–Salix reticulata
Luetkea pectinata/*Leptarrhena pyrolifolia*

Mesic/Dry Grass



Classification: Shrub cover is <25%; cover of herbaceous species is >40%; cover of water is <5%; cover of grass species is >50%.

Environment: This class occurs on mountain side slopes and toe slopes (*Calamagrostis canadensis* sites), and coastal and inland dunes, beaches, and beach berms (*Leymus mollis* sites). Sites are mesic to dry and occur on gentle to steep slopes from sea level to mid elevations. This class was mapped on 1.1% of the study area.

Vegetation: This class is characterized by stands dominated by *Calamagrostis canadensis* or *Leymus mollis*. Species that occur with Calamagrostis canadensis on side slopes and toe slopes include *Chamerion angustifolium*, *Carex macrochaeta*, *Heracleum maximum*, and *Angelica lucida*. Species that occur with *Leymus mollis* on dunes, beaches, and beach berms include *Poa eminens*, *Deschampsia beringensis*, *Festuca rubra*, *Chamerion angustifolium*, and *Rubus arcticus*.

Plant associations:

Leymus mollis
Leymus mollis/Pumice G3G4; S3S4
Poa eminens–Deschampsia beringensis–Festuca rubra
Leymus mollis–Calamagrostis canadensis–Poa spp.
Calamagrostis canadensis–Carex macrochaeta
Calamagrostis canadensis

Mesic/Dry Sedge Meadow



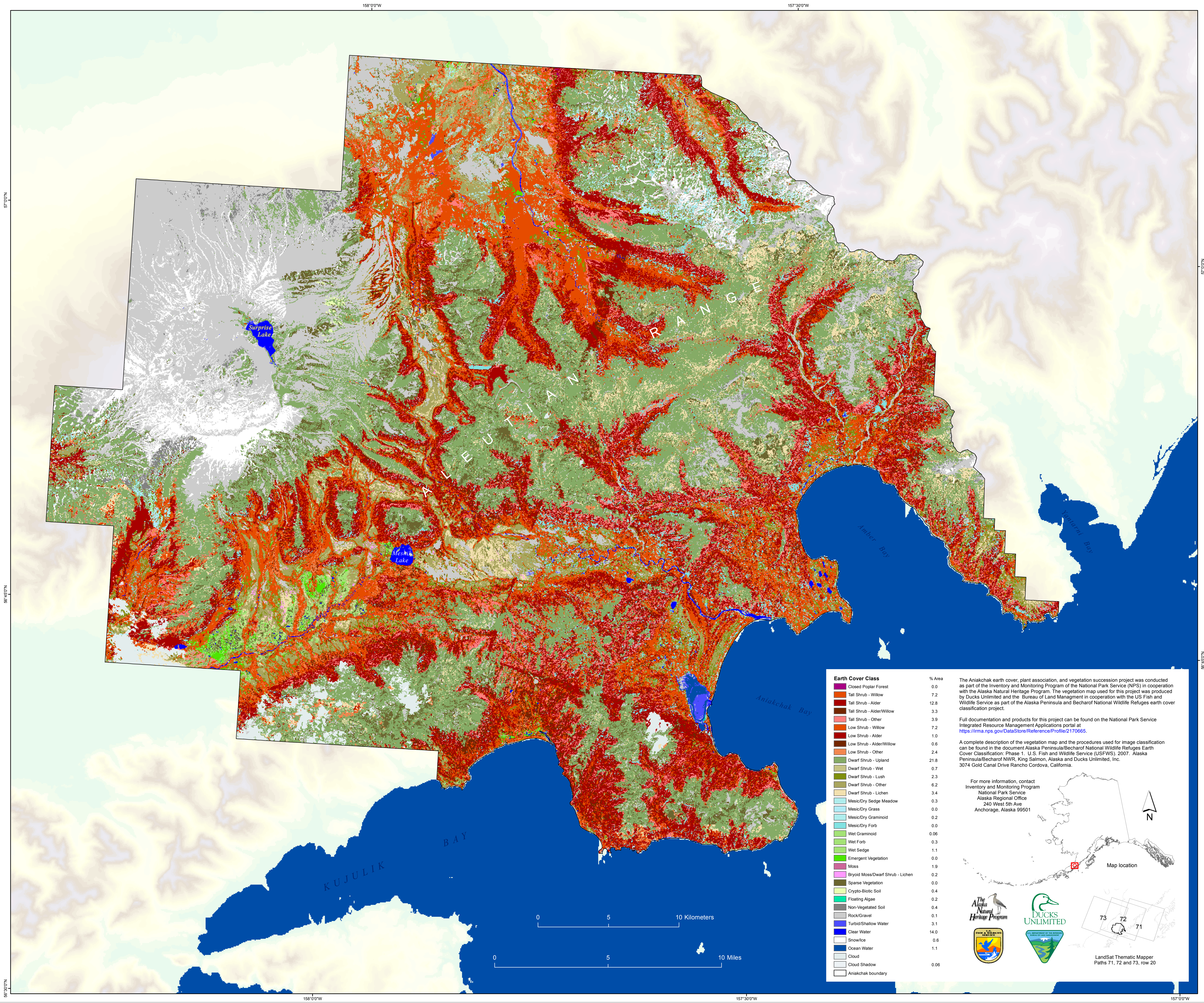
Classification: Shrub cover is <25%; cover of herbaceous species is ≥40%; cover of water is <5%; cover of sedge species is ≥50%.

Environment: This class may occur on mountain toe slopes, benches, drainageways and depressions, although it was not encountered during field sampling in patches large enough to map as an Earth Cover class. Very small patches (10 m X 10 m) were encountered that fit the classification, however, more typically, sites with >50% sedge species were classified as wet. This class was mapped on 0.4% of the study area.

Vegetation: Common species in this class may include *Carex macrochaeta*, *Arctagrostis latifolia* ssp. *arundinacea*, and *Calamagrostis canadensis*.

Plant associations:

Carex machrochaeta–Arctagrostis latifolia ssp. *arundinacea*



Earth Cover Class	% Area
Closed Poplar Forest	0.0
Tall Shrub - Willow	7.2
Tall Shrub - Alder	12.8
Tall Shrub - Alder/Willow	3.3
Tall Shrub - Other	3.9
Low Shrub - Willow	7.2
Low Shrub - Alder	1.0
Low Shrub - Alder/Willow	0.6
Low Shrub - Other	2.4
Dwarf Shrub - Upland	21.8
Dwarf Shrub - Wet	0.7
Dwarf Shrub - Lush	2.3
Dwarf Shrub - Other	6.2
Dwarf Shrub - Lichen	3.4
Mesic/Dry Sedge Meadow	0.3
Mesic/Dry Grass	0.0
Mesic/Dry Graminoid	0.2
Mesic/Dry Forb	0.0
Wet Graminoid	0.06
Wet Forb	0.3
Wet Sedge	1.1
Emergent Vegetation	0.0
Moss	1.9
Bryoid Moss/Dwarf Shrub - Lichen	0.2
Sparse Vegetation	0.0
Crypto-Biotic Soil	0.4
Floating Algae	0.2
Non-Vegetated Soil	0.4
Rock/Gravel	0.1
Turbid/Shallow Water	3.1
Clear Water	14.0
Snow/Ice	0.6
Ocean Water	1.1
Cloud	
Cloud Shadow	0.06
Aniakchak boundary	

The Aniakchak earth cover, plant association, and vegetation succession project was conducted as part of the Inventory and Monitoring Program of the National Park Service (NPS) in cooperation with the Alaska Natural Heritage Program. The vegetation map used for this project was produced by Ducks Unlimited and the Bureau of Land Managment in cooperation with the US Fish and Wildlife Service as part of the Alaska Peninsula and Becharof National Wildlife Refuges earth cover classification project.

Full documentation and products for this project can be found on the National Park Service Integrated Resource Management Applications portal at https://irma.nps.gov/DataStore/Reference/Profile/2170665.

A complete description of the vegetation map and the procedures used for image classification can be found in the document Alaska Peninsula/Becharof National Wildlife Refuges Earth Cover Classification: Phase 1. U.S. Fish and Wildlife Service (USFWS). 2007. Alaska Peninsula/Becharof NWR, King Salmon, Alaska and Ducks Unlimited, Inc. 3074 Gold Canal Drive Rancho Cordova, California.

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Unique and Rare Plant Associations of Volcanic Substrates of the Alaska Peninsula

PLANT ASSOCIATION STATUS RANKS

Conservation status ranks were assigned to each of the 68 plant associations following international guidelines established by NatureServe (http://www.natureserve.org/explorer/ranking.htm). Because of the low level of anthropogenic disturbance within Aniakchak National Monument and Preserve, most plant associations were ranked "secure" or "apparently secure" (G5S5 or G4S4). Two were ranked as "vulnerable" (G3S3), and six were ranked "vulnerable" to "apparently secure" (G3G4; S3S4). Examples of plant associations that are unique to the volcanic substrates of the Alaska Peninsula are shown here.

Anthelia juratzkana–Gymnomitrion corallioides

(Liverwort Biological Soil Crust)



Plots sampled: 9
Rank: G3G4; S3S4
Other studies: Not previously described.

Distribution: This association is widespread within Aniakchak caldera on eolian and volcanic deposits on flat to gently sloping terrain. It also occurs on volcanic deposits in alpine environments on shoulder slopes and gently sloping upper mountain side slopes.
Elevation: 361 to 773 meters
Slope: 0 to 18°
Landform: Aniakchak caldera; mountain side slopes, summits and benches.

Vegetation: This association is characterized by a well-developed cryptogamic crust composed primarily of the liverwort species *Anthelia juratzkana* and *Gymnomitrion corallioides*. This layer is the dominant vegetation cover occupying at least 30% of the site. Moss, lichen and vascular plant species are common, but generally have low canopy cover. Common vascular species include *Loiseleuria procumbens*, *Empetrum nigrum*, *Salix ovalifolia*, *S. rotundifolia*, *S. stolonifera*, *Vaccinium uliginosum*, and *Deschampsia cespitosa*. Common nonvascular species include *Dicranum* spp. and *Racomitrium* spp.

Stereocaulon vesuvianum–Racomitrium lanuginosum (provisional)

(Snow Lichen–Racomitrium Moss)



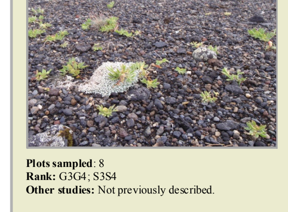
Plots sampled: 1
Rank: provisional G3; S3
Other studies: Hasselbach 1995

Distribution: Widespread association on blocky lava flows within Aniakchak caldera; uncommon elsewhere.
Patch size: Small to large
Elevation: 481 meters
Slope: 7°
Landform: Lava flows
Hydrology: Mesic to Dry
Soil: Parent material consists of volcanic pumice and rhyolitic lava with soil development occurring in interstitial spaces in blocky lava.
Earth cover class: Not mapped
Seral stage: Early-seral

Vegetation: *Racomitrium lanuginosum* and *Stereocaulon vesuvianum* share dominance in this nonvascular association. Other mosses and lichens include *Dicranum acutifolium*, *Cladonia gracilis*, *C. deformis*, and *Codriophorus varius*. Vascular plant species have low cover and may include species such as *Luetkea pectinata*, *Carex pyrenaica* ssp. *micropoda*, *Luzula arcuata* ssp. *unalaschcensis*, *L. piperi*, and *Poa arctica*. More information is needed about this association.

Artemisia campestris ssp. borealis–Rumex beringensis–Festuca spp./Pumice

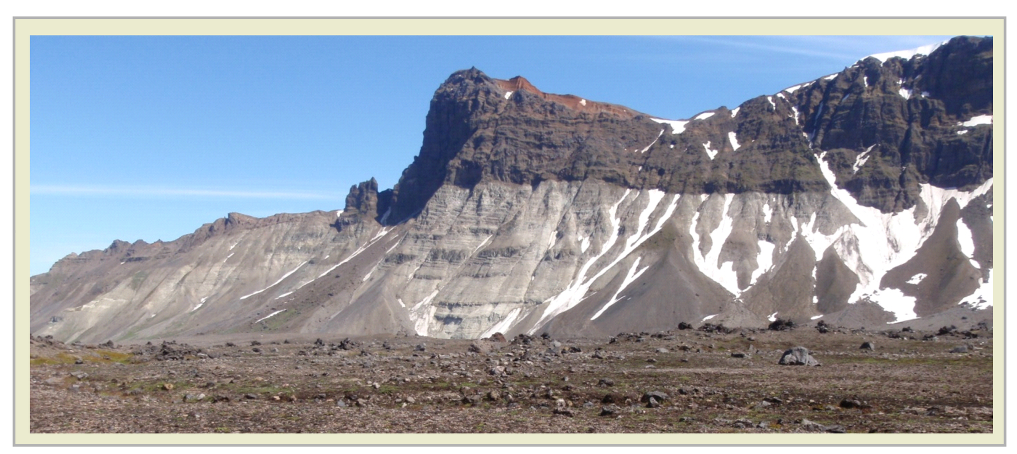
(Field Sagewort–Bering Sea Dock–Fescue)



Plots sampled: 8
Rank: G3G4; S3S4
Other studies: Not previously described.

Distribution: Common association on pumice plains throughout the study area.
Patch size: Small to large
Elevation: 27 to 264m
Slope: 0 to 5°
Landform: Pumice plains
Hydrology: Mesic to dry
Soil: Very little soil development; parent material is volcanic pumice reworked by wind (pH 5.8 to 7.5).
Earth cover class: Rock/Gravel; Sparse Vegetation
Seral stage: Early-seral

Vegetation: Barren pumice is the dominant ground cover in this sparsely vegetated early-seral plant association. Vascular species with high constancy include *Artemisia campestris* ssp. *borealis*, *Rumex beringensis*, *Festuca* spp. (*F. rubra* ssp. *richardsonii*, *F. brevissima*, or *F. brachyphylla*), *Deschampsia cespitosa*, *Equisetum arvense*, and *Papaver radicatum* ssp. *alaskanum*. Nonvascular species such as *Racomitrium ericoides* and *R. lanuginosum* may be present with low cover.





Mesic/Dry Forb



Classification: Shrub cover is <25%; cover of herbaceous species is ≥40%; cover of water is ≤5%; cover of graminoids is <50%.

Environment: This class occurs on headlands, upper beaches, beach berms, mountain side slopes, toe slopes, valley bottoms, and swales. Slopes are gentle to steep, and elevation ranges from sea level to alpine. Sites are typically mesic and small patch. On side slopes and toe slopes this class often occurs in a mosaic with the Tall Shrub–Alder class. This class was mapped on 1.9% of the study area.

Vegetation: Common species in this class include *Chamerion angustifolium, Calamagrostis canadensis, Achillea millefolium var. borealis, Angelica lucida, Equisetum arvense*, *Geranium erianthum, Heracleum maximum, Rubus arcticus, Solidago* spp., *Sanguisorba canadensis*, *Athyrium filix-femina*, *Carex macrochaeta*, and *Poa* spp. On beaches and beach berms *Leymus mollis, Lathyrus japonicus*, and *Honckenya peploides* may also be common.

Plant associations:

Athyrium filix-femina
Heracleum maximum–Angelica lucida
Honckenya peploides–Leymus mollis
Leymus mollis–Chamerion angustifolium
Geranium erianthum

Wet Sedge



Classification: Shrub cover is <25%; cover of herbaceous species is ≥40%; cover of water is ≥5% and ≤25%, ≥60% of the herbaceous cover is graminoid, and ≥20% of the graminoid cover is made up of *Carex* spp.

Environment: This class occurs on lacustrine deposits, poorly drained river terraces, valley bottom depressions, estuaries, sloughs, and on the margins of ponds, lakes, and slow-moving rivers. Sites have little or no slope and elevations range from sea-level to mid elevation. Patch size is small to large. Sites are wet and may be either fresh or brackish. Freshwater sites may be seasonally flooded, and brackish sites are subject to periodic tidal inundation. This class was mapped on 0.2 % of the study area.

Vegetation: *Carex aquatilis* commonly dominates the sedge cover on inland sites. *Carex lyngbyei* is common in coastal wetlands but also occurs on inland site. Other common species include *Carex saxatilis*, *Eriophorum angustifolium*, and *Comarum palustre*.

Plant associations:

Carex lyngbyei G4; S4
Carex aquatilis
Carex lyngbyei–Carex saxatilis G4; S4
Carex lyngbyei–Comarum palustre G4; S4
Carex ramenskii G4; S4
Carex saxatilis–Eriophorum angustifolium G4; S4

Wet Graminoid



Classification: Shrub cover is <25%; cover of herbaceous species is >40%; cover of water is >5% and ≤25%, and ≥60% of the herbaceous cover is graminoid. If water was not present or not visible through the vegetation cover, then the presence of ≥20% *Carex aquatilis* also allows a site to fall into the wet graminoid class.

Environment: This class occurs on lacustrine deposits, estuaries, sloughs, valley bottom depressions, and margins of lakes, ponds, and slow-moving rivers. Freshwater sites may be seasonally flooded, and brackish sites are subject to periodic tidal inundation. Sites have little or no slope, and patch size is typically small. Elevations range from sea-level to mid elevation. This class was mapped on 0.3% of the study area.

Vegetation: Common species in this class include *Carex lyngbyei*, *Carex aquatilis*, *Carex saxatilis*, *Eriophorum angustifolium* ssp. *subarcticum*, *Trichophorum cespitosum*, *Argentina egedii*, *Poa eminens*, and *Equisetum fluviatile*.

Plant associations:

Carex aquatilis–Trichophorum cespitosum
Carex lyngbyei–Argentina egedii–Poa eminens G4; S4

Wet Forb



Classification: Shrub cover is <25%; cover of herbaceous species is >40%; cover of water is <25%, and where ≥60% of the herbaceous cover is forb, and <50% graminoid cover.

Environment: This class occurs on lacustrine deposits, estuaries, sloughs, valley bottom depressions, and margins of lakes, ponds, and slow-moving rivers. Freshwater sites may be seasonally flooded, and brackish sites are subject to periodic tidal inundation. Sites have little or no slope, and patch size is typically small. Elevations range from sea-level to low elevation. This class was mapped on 0.003 % of the study area.

Vegetation: This class is highly associated with the Emergent class. *Menyanthes trifoliata* and *Comarum palustre* are common on freshwater sites. Other associated freshwater species include *Carex aquatilis* and *Equisetum fluviatile*. *Argentina egedii* and *Triglochin maritima* are common on coastal wetlands.

Plant associations:

Argentina egedii–Triglochin maritima G4; S4
Carex aquatilis–Comarum palustre
Menyanthes trifoliata

Emergent Vegetation



Classification: Shrub cover is <25%; aquatic vegetation (excluding *Nuphar* spp.) makes up ≥20% of the cover; cover or water is generally >25%.

Environment: This class occurs on lacustrine deposits, sloughs, valley bottom depressions, and margins of lakes and ponds. Sites are flat and have standing water during the growing season. Patch size is typically small. Elevations range from sea -level to low elevation. This class was mapped on 0.3 % of the study area.

Vegetation: This class is typically dominated by either *Menyanthes trifoliata* or *Equisetum fluviatile* or a combination of the two species. Other common species include *Comarum palustre*, *Hippuris vulgaris*, *Sparganium* spp., and *Stuckenia pectinata*. Sedges such as Carex limosa, C. aquatilis, C. chordorrhiza, C. lyngbyei and *Eleocharis kamtschatica* may be present but usually have low canopy cover.

Plant associations:

Equisetum fluviatile
Menyanthes trifolia ta
Stuckenia pectinata –Equisetum fluviatile

Moss



Classification: Shrub cover is <25%; cover of herbaceous species is ≥40%; cover of water is ≤25% water, and moss cover is ≥60%.

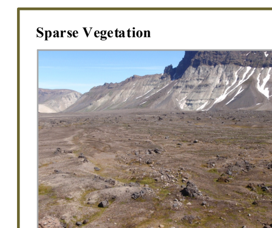
Environment: This class is common within the Aniakchak caldera on side slopes, eruption pits, and lava flows. It also occurs pumice plains both within and on the outer flanks of the caldera. Sites are mesic to dry and slopes are gentle to steep. This class typically occurs on mid to high elevation sites. This class was mapped on 0.002 % of the study area.

Vegetation: *Racomitrium lanuginosum* and *R. ericoides* are the most common mosses in this class. The genus *Racomitrium* is known as an early colonizer of disturbed sites (Tallis 1959). Within the Aniakchak caldera, both blocky lava and wind-deposited pumice are often blanketed with *Racomitrium* spp. *Stereocaulon vesuvianum* may be co-dominant on blocky lava sites. Other species with high constancy but low cover include *Salix ovalifolia*, *Anthelia juratzkana*, *Luzula piperi*, *L. arcuata* ssp. *unalaschcensis*, and *Trisetum spicatum*.

Plant associations:

Stereocaulon vesuvianum spp.–*Racomitrium lanuginosum* spp. G3; S3 (provisional)
Racomitrium spp.

Sparse Vegetation



Classification: >50% barren, but vegetation makes up ≥20% of the cover.

Environment: This class generally occurs on disturbance-prone substrates or near the upper elevation limit of vegetation. It is common in alpine areas, and it also occurs on gravel bars, steep colluvial slopes, pumice plains, lava flows and other disturbed areas throughout the monument and preserve. This class was mapped on 3.1 % of the study area.

Vegetation: This class includes a wide variety of herbaceous and dwarf shrub plant associations that occur in areas that are prone to disturbance or near the elevational limit of plant growth. Common species include *Empetrum nigrum*, *Arctostaphylos uva-ursi*, *Leymus mollis*, *Luzula piperi*, *Silene acaulis*, *Geum rossii*, *Carex microchaeta*, *Artemisia campestris* ssp. *borealis*, *Rumex beringensis*, *Festuca* spp., and *Saxifraga* spp.

Plant associations:

Arctostaphylos uva-ursi/Pumice
Empetrum nigrum/Pumice
Leymus mollis/Pumice
Luzula piperi/Pumice
Mixed Dwarf Shrub/Rock
Silene acaulis–Geum rossii
Artemisia campestris ssp. *borealis–Rumex beringensis–Festuca* spp./Pumice G3G4; S3S4
Saxifraga spp./Rock

Cryptobiotic Soil



Classification: This class does not have defining characteristics in the Alaska Peninsula/Becharof National Wildlife Refuges Earth Cover Classification (2007). It is described as covering all sites that do not fall into any other category. The only areas that were characterized as "Other" were extensive areas of biological crust.

Environment: This class is common within Aniakchak caldera on eolian and volcanic deposits on flat to gently sloping terrain. It also occurs in alpine environments on shoulder slopes and gently sloping upper mountain side slopes. Sites are mesic and range from mid to high elevation. This class was mapped on 0.06% of the study area.

Vegetation: This class is characterized by a well-developed cryptogamic crust composed primarily of the liverwort species *Anthelia juratzkana* and *Gymnomitrion corallioides*. This layer is the dominant vegetation cover occupying at least 30% of the site. Moss, lichen and vascular plant species are common, but generally have low canopy cover. Common vascular species include *Loiseleuria procumbens*, *Empetrum nigrum*, *Salix ovalifolia*, *S. rotundifolia*, *S. stolonifera*, *Vaccinium uliginosum*, *Deschampsia cespitosa*. Common nonvascular species include *Dicranum* spp. and *Racomitrium* spp.

Plant association:

Anthelia juratzkana–Gymnomitrion corallioides G3G4; S3S4