

# Plant community-level mapping of arctic Alaska based on the Circumpolar Arctic Vegetation Map

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with 5 figures, 1 table and 1 appendix

**Abstract.** A plant community-level map of arctic Alaska was derived in a hierarchical fashion from the Circumpolar Arctic Vegetation Map (CAVM). The new map has 33 units described for Alaska, an increase from the original 13 units shown on the CAVM. The polygons of the new map refer through the legend to the appropriate dominant plant community described in a table. The table includes eighty-five plant community descriptions used in creating the Alaska portion of the CAVM, including dominant and characteristic plant species that define the community, literature citations for the descriptions and published plant community names. Researchers can use the literature citations to find more complete species lists, habitat descriptions and plot locations. The map is an important tool for research and management at the regional level. A 1:4,000,000 version of the map is available from the authors.

**Keywords:** tundra, plant physiognomy, arctic bioclimate subzones, floristic provinces, topographic gradient, soil pH.

## Introduction

Fifteen map units appear on the Circumpolar Arctic Vegetation Map (CAVM), 13 of which occur in arctic Alaska (CAVM Team 2003). These units are circumpolar in distribution, and are described on the basis of the dominant growth forms of the plants that characterize each type. The data used to create the CAVM are much more detailed than could be displayed on the final 1 : 7,500,000-scale map, and include plant-community-level descriptions with literature citations. This paper demonstrates an approach for displaying this important detailed information in a hierarchical way within the CAVM legend, using Alaska as an example.

## Methods

In creating the CAVM, a central problem in the mapping method was how to depict the large variation in vegetation that would occur in all map polygons at a 1 : 7.5 million scale. The solution was to map the zonal vegetation of a polygon. Zonal sites are areas where the vegetation develops under the prevailing climate, uninfluenced by extremes of soil moisture, snow, soil chemistry, or disturbance. Zonal sites are flat or gently sloping, moderately drained,

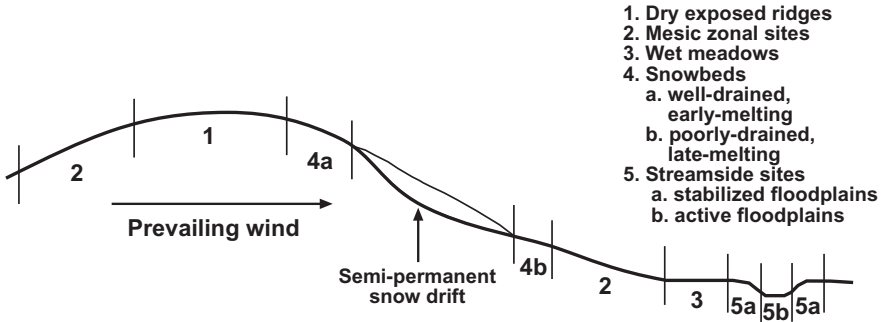


Fig. 1. Conceptual toposequence of dry ridge-tops, mesic slopes, wet meadows, snowbeds and riparian areas (modified from CAVM TEAM 2003).

with fine-grained soils. The vegetation of extensive non-zonal areas such as mountain ranges, large wetlands, and river systems was also mapped.

Most of the variation *within* a polygon was captured using a conceptual toposequence of dry ridge-tops, mesic zonal sites, wet meadows, snowbeds, and streamside sites (Fig. 1). Lists of plant community descriptions were assembled, including plant community names (Braun-Blanquet association where described), common and characteristic species, and the literature citations. The dominant plant communities in each of the five toposequence positions were arranged into tables for each of five bioclimate subzones and eleven floristic regions (WALKER 1999, 2000, WALKER et al. 2002). Bioclimate subzones are north-south subdivisions of the Tundra Zone, based mainly on summer temperatures (ELVEBAKK et al. 1999). There are three bioclimate subzones in Alaska (Subzones C, D and E), with southern boundaries corresponding approximately to mean July temperatures of 7, 9 and 12°C, respectively (Fig. 2). The two colder subzones (A and B) do not occur in Alaska. Floristic regions are east-west circumpolar subdivisions, based on the floristic provinces of YURTSEV (1994). There are three floristic provinces in Alaska: Northern Alaska, Beringian Alaska, and North Beringian Islands (Fig. 3).

There were four tables for Alaska, one for each of the Alaska floristic provinces and an additional table for Southwestern Alaska. These tables could not be used directly as a legend, because there was redundancy between the tables and many of the communities occurred in patches smaller than the minimum mapping unit (10 km<sup>2</sup>). Less common communities, such as those occurring on snowbeds and streamsidings, were useful in describing the range of plant communities occurring in a polygon, but were not the dominant community mapped for a polygon.

The combined table lists the communities found in each bioclimate subzone, on each of the topographic positions, and on acidic and non-acidic substrates (Appendix A). When combining the tables, the original community descriptions from the literature were compared. If the community de-

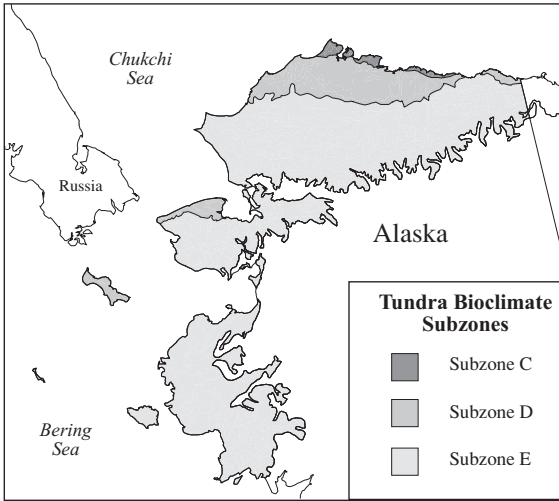


Fig. 2. Alaska bioclimate subzones (modified from CAVM TEAM 2003).

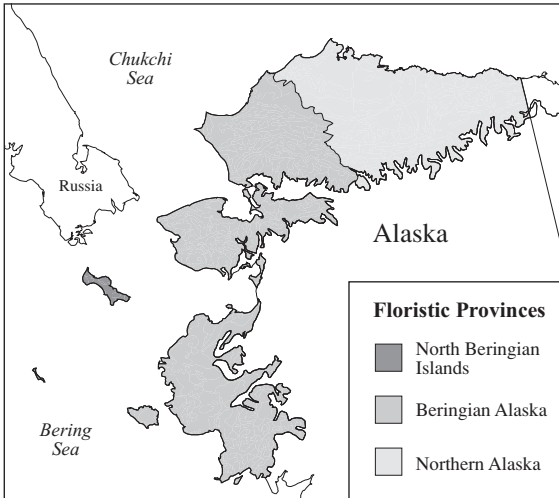


Fig. 3. Alaska floristic provinces (modified from CAVM TEAM 2003).

scriptions from two sources were similar and included similar dominant plant species, they were combined into one description with two literature citations. If two community descriptions had small differences, their appearance on the CAVM base image (CAVM Team 2003) was checked. If the communities could be distinguished on the image, they were mapped

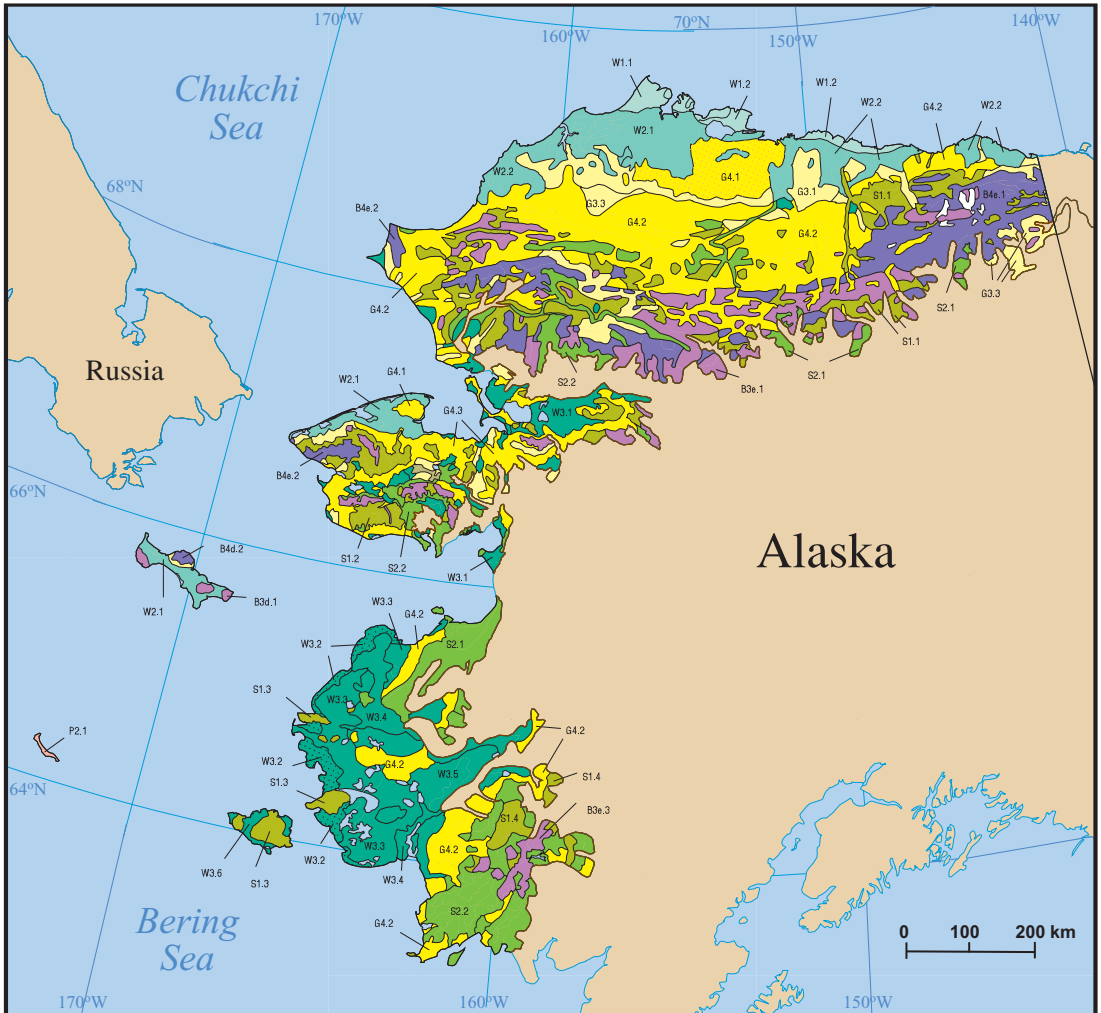


Fig. 4. Reduced map of arctic plant community types of Alaska. Refer to Table 1 for legend. 1 : 4 million-scale map with complete labeling available from the authors.

separately; if they could not, they were mapped as the same unit, with both community descriptions included in the table.

In practice, most of the polygon boundaries shown on the new map already existed in the CAVM data set. Some were not visible on the printed version of the map because adjacent polygons with similar physiognomy were mapped together when using the 15 units of the CAVM legend. These polygons could be coded differently using the 33 unit plant-community legend. In addition to re-coding existing CAVM polygons, the new map

Table 1. Legend for the map of dominant plant physiognomy of Alaska tundra plant communities.

Map unit	Dominant physiognomy and plant communities
B2.1	Lichen communities on recent lava flows. Complex of community 74 and unvegetated lava; in mosaic with areas not covered by lava (comm. 75, G3.3), Seward Peninsula.
B3d.1	Graminoid, prostrate dwarf-shrub communities (comm. 14), in complex with snowbeds, talus slopes and meadow communities, on frost-riven granite, St. Lawrence Island.
B3e.1	Prostrate dwarf-shrub, graminoid communities on acidic slopes (comm. 35, 36), in complex with snowbeds (comm. 62, 63), talus slopes and meadow communities, Brooks Range.
B3e.2	Prostrate dwarf-shrub, lichen communities on dry granitic slopes (comm. 39), in complex with snowbeds (comm. 64), talus slopes and meadow communities, Seward Peninsula and Northwestern Alaska.
B3e.3	Erect dwarf-shrub, lichen communities on dry acidic slopes (comm. 40), in complex with snowbeds, talus slopes and meadow communities, Kuskokwim Mountains.
B4d.1	Prostrate dwarf-shrub, forb, lichen communities (comm. 26) in complex with snowbeds (comm. 30, 31), talus slopes and meadow communities, on dry limestone slopes, York Mountains, Seward Peninsula.
B4d.2	Graminoid, dwarf-shrub communities (comm. 28) on moist areas of Pleistocene lava in the Kookooligit Range, St. Lawrence Island.
B4e.1	Prostrate dwarf-shrub, sedge communities (comm. 72) in complex with snowbeds (comm. 79, 80), talus slopes and meadow communities, on dry limestone slopes, Brooks Range.
B4e.2	Prostrate dwarf-shrub, forb, lichen communities (comm. 73) in complex with snowbeds (comm. 81), talus slopes and meadow communities, on dry limestone slopes, Seward Peninsula and Northwestern Alaska.
G3.1	Non-tussock sedge, dwarf-shrub, moss communities (comm. 27), on the mesic non-acidic portions of Subzone D northern Coastal Plain.
G3.2	Graminoid, prostrate dwarf-shrub, forb communities (comm. 18) on mesic areas of St. Lawrence Island.
G3.3	Non-tussock sedge, dwarf-shrub, forb, moss communities (comm. 75) on mesic, non-acidic loess portions of Subzone E, foothills of the Brooks Range and portions of the Seward Peninsula.
G4.1	Tussock sedge, dwarf-shrub, moss communities (comm. 16) on sand in Subzone D, in complex with lakes and wet tundra (comm. 20) northern Coastal Plain. ( <i>stippled</i> )
G4.2	Tussock sedge, dwarf-shrub, moss communities (comm. 41) on mesic, acidic loess. Occurs in foothills of the Brooks Range, Seward Peninsula, ice-rich permafrost areas of Yukon-Kuskokwim Delta, and foothills of the Kuskokwim Mountains.
G4.3	Graminoid, dwarf-shrub communities. Successional gradient of fire-dominated tussock sedge communities, ranging from grass-dominated (soon after fire, comm. 46) to communities similar to tussock tundra found to the north and south (comm. 41), to lichen-rich (long after fire, comm. 47), Seward Peninsula.

Table 1. (cont.)

P2.1	Prostrate dwarf-shrub lichen communities (comm. 15) on dry flats, slopes and ridges, with large areas of sedge, prostrate dwarf-shrub tundra (comm. 19), St. Matthew Island.
S1.1	Erect dwarf-shrub communities (comm. 42) on mesic sites in the foothills of the Brooks Range.
S1.2	Erect dwarf-shrub, lichen communities (comm. 48) on mesic sites in the foothills of the western Brooks Range and mountains of the Seward Peninsula.
S1.3	Erect and prostrate dwarf-shrub communities (comm. 49) on volcanic outcrops in the Yukon Delta area, commonly in complexes with rock outcrops and drainages dominated by alders (comm. 51).
S1.4	Erect dwarf-shrub, lichen communities (comm. 50) on the foothills of the Kuskokwim Mountains, commonly in complexes with rock outcrops and drainages dominated by alders (comm. 51).
S2.1	Low-shrub communities with open to closed canopies of willows or birch, or open alder (comm. 44, 45), in valleys and foothills of the Brooks Range, Seward Peninsula mountains, and Kuskokwim Mountains.
S2.2	Low-shrub communities with closed alder canopies (comm. 51) in drainages, valleys and foothills of the southern Brooks Range, Seward Peninsula mountains, and Kuskokwim Mountains.
W1.1	Wet graminoid, moss communities (comm. 4), with moist communities (comm. 2) on higher microsites, on acidic coastal areas in northern Alaska.
W1.2	Wet graminoid, moss communities (comm. 10), with moist communities (comm. 9) on higher microsites, on non-acidic coastal areas in northern Alaska.
W2.1	Wet sedge, moss communities (comm. 20), with moist communities (G4.1, comm. 16) on higher microsites, on acidic northern Coastal Plain, northern Seward Peninsula, and St. Lawrence Island.
W2.2	Wet sedge, moss communities (comm. 29), with moist communities (G3.1, comm. 27) on higher microsites, on non-acidic portions of the northern Coastal Plain, and lagoons and estuaries on the northern coast of the Seward Peninsula.
W3.1	Wet sedge, moss communities (comm. 54), with moist communities (G4.2, comm. 41) on higher microsites, on acidic areas of the Seward Peninsula and Selawik Basin.
W3.2	Wet sedge communities (comm. 55), in slightly saline coastal areas, in complex with water channels and lakes, along the coast of the Yukon-Kuskokwim Delta. ( <i>stippled</i> )
W3.3	Wet sedge communities (comm. 56), in complex with ponds, and drier lichen-ericaceous dwarf-shrub vegetation (S1.2, comm. 48) in central portions of the Yukon-Kuskokwim Delta.
W3.4	Wet sedge communities (comm. 57) in complex with shrub thickets (comm. 70) along rivers on the Yukon-Kuskokwim Delta.
W3.5	Wet sedge communities (comm. 59) in complex with lakes and drier tussock graminoid -shrub communities (G4.2, comm. 41) in interior portions of the Yukon-Kuskokwim Delta.
W3.6	Wet sedge, prostrate dwarf-shrub communities (comm. 61) on Nunivak Island.
W3.7	Wet sedge, moss communities (comm. 77) with moist communities (G3.3, comm. 75) on higher microsites, on non-acidic areas of the northern Coastal Plain and Seward Peninsula.

also included a few changes to polygon boundaries. These changes were relatively easy to make due to the digital format of the map. Corrections were made to some polygon locations in the eastern Brooks Range to improve the map's registration at the larger scale and on Nunivak Island to include information from additional studies. Data were compiled on the wetland plant communities in Southwestern Alaska, so that polygon boundaries could be added to subdivide the largest polygon on the CAVM map of Alaska, the wetlands of the Yukon-Kuskokwim Delta. Two map units were stippled to portray differences in edaphic characteristics: G4.1, tussock tundra on a sandy substrate on the Arctic Coastal Plain, and W3.2, slightly brackish wet sedge on the coast of the Yukon-Kuskokwim Delta. A numerical suffix denoting the dominant plant community was appended to the original CAVM map code for each polygon (Table 1), making the new legend hierarchical within the CAVM legend.

All maps are presented in Lambert Azimuthal projection. Plant nomenclature for the table in Appendix A follows the PLANTS Database (USDA, NRCS 2004).

## Results

The new plant community map is shown in Fig. 4. The legend for the map (Table 1) describes the map units, and references the appropriate plant communities in Appendix A. A total of 33 map units are now displayed for Alaska, compared to the original 13 units on the CAVM.

Map units B2.1, B3d.1 and P2.1 were unchanged from the units B2, B3 and P2 (respectively) on the CAVM. Acidic mountain complexes in bioclimate subzone E were divided into three units, differentiating between the mountains of the Brooks Range (B3e.1), those of the Seward Peninsula (B3e.2), and those of the Kuskokwim Mountains (B3e.3). Non-acidic mountain complexes were differentiated between the Seward Peninsula and St. Lawrence Island (subzone D, B4d.1 and B4d.2 respectively), and the Brooks Range and the Seward Peninsula (subzone E, B4e.1 and B4e.2 respectively). Non-acidic graminoid communities in subzone D were divided into three units, differentiating between communities of the northern Coastal Plain (G3.1), St. Lawrence Island (G3.2), and the Seward Peninsula (G3.3). Acidic graminoid communities in subzone E were divided into three units, differentiating between tussock sedge tundra on the sandy northern Coastal Plain (G4.1), tussock sedge tundra found throughout subzone E on ice-rich loess (G4.2), and fire-dominated successional communities of tussock sedge tundra on the Seward Peninsula (G4.3). Erect dwarf-shrub communities occurring in subzones D and E were divided into four units, differentiating communities found in the Brooks Range (S1.1), on the Seward Peninsula (more lichen dominated, S1.2), occurring on volcanic outcrops on the Yukon Delta (S1.3), and in the higher elevations of the Kuskokwim Mountains (S1.4). Low shrub communities in subzone E were divided into two units, separating out *Salix* and *Betula* communities (S2.1) from *Alnus*-dominated communities (S2.2). Wet sedge communities in subzones C and D were each divided into

two units, differentiating between acidic (W1.1, W2.1) and non-acidic wetlands (W1.2, W2.2). Wet sedge communities in subzone E were divided into 7 units: acidic and non-acidic (W3.1 and W3.7 respectively) wet sedge on the northern Coastal Plain and Seward Peninsula, wet sedge on Nunivak Island (W3.6) and four types on the Yukon-Kuskokwim Delta (W3.2 – W3.5). A slightly-brackish type (W3.2) occurs along much of the coast of the Delta. Farther inland, increases in the elevation and the age of the landscape, and changes in hydrologic characteristics are accompanied by changes in sedge species. Unit W3.3 has inclusions of uplifted ice-rich permafrost areas with drier lichen-shrub vegetation. The wetlands along the Yukon and Kuskokwim Rivers are a complex of productive wet sedge meadows and tall shrub thickets (W3.4), with a bright red color-infrared signature on the CAVM base image. The type that occurred farthest inland (W3.5) is most similar to wet sedge types in other parts of Subzone E. A conceptual diagram of these vegetation types is shown in Fig. 5.

Even at the 1 : 4 million scale, the map units are still heterogeneous, and only the dominant or characteristic plant community can be indicated. Each unit in the legend refers to one or more communities in Appendix A, which describes 85 common plant communities that occur along toposequences in the various subzones and floristic provinces. Appendix A lists the common or characteristic species by plant functional type: tall shrub, low shrub, erect dwarf shrub, prostrate dwarf shrub, graminoid (listed separately as sedge or grass if only one of these is important), forb, horsetail, moss and lichen. The community name used in the reference (Braun-Blanquet association if available), the literature citation, and the geographic location of the descriptions are also included in the table.

## Conclusions

One of the most important and unique aspects of this plant community map is the inclusion of the table with its literature citations and Braun-Blanquet associations. The link in the legend to the community number allows the user to read a more detailed description of the community type. A researcher needing additional details can use the literature citations and Braun-Blanquet associations to find the original community descriptions, which often contain more complete species lists, habitat descriptions, and in some cases, specific plot locations. This ability to return to the primary sources was invaluable in creating the combined table, and will be of great use to future researchers who use the plant community map of Alaska.

The digital format of the CAVM made it relatively easy to revise and build upon. It was possible to make corrections when new information was received, such as shifting polygon boundaries, or adding new polygons. The digital format also made it possible to develop a more detailed version of the map, building on the CAVM legend hierarchy.

Over 400 plant community types were described by the CAVM mappers in the circumpolar Arctic. Eighty-five of those occurred in Alaska, and were used to describe the 33 plant community types shown on the new



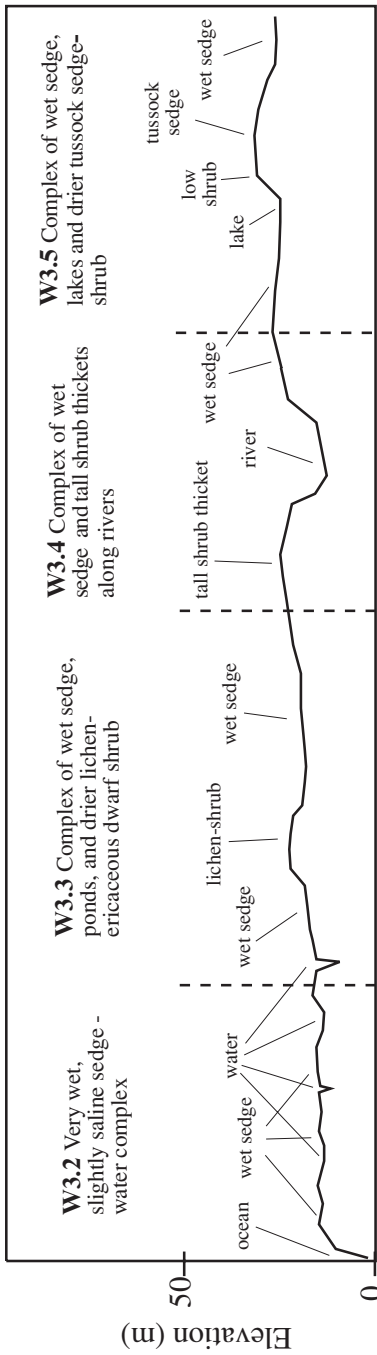


Fig. 5. Conceptual diagram of vegetation types of the Yukon-Kuskokwim Delta from the coast inland (left to right, approx. 150 km; although all areas have finer-scale heterogeneity, and the full gradient can be found within 30 km of the coast in some places).

map. Alaska is currently the only part of the Arctic where the source community types have been published, but lists of communities have been assembled into unpublished tables, by floristic province and bioclimate subzone, for most of the Arctic (Canada and Russia), and could be used to construct community-level maps similar to the one for Alaska. Application of this method to the circumpolar extent of the CAVM would result in valuable detailed information on regional variation in plant community composition within the 15 CAVM map units.

A 1 : 4 million-scale version of the plant community-level map of arctic Alaska is being produced, with the map (Fig. 4, larger scale and fully labeled) and legend (Table 1) on the front, and the plant community table (Appendix A) on the reverse side, and is available from the authors.

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**Appendix A:** Alaska plant communities along a toposequence on acidic and non-acidic substrates; in subzones C, D and E; in Northern Alaska, Beringian Alaska and Northern Beringian Island floristic provinces. Background color denotes floristic province: text on white is Northern Alaska floristic province, text on light gray is Beringian Alaska, and text on dark gray is Northern Beringian Islands. Dominant plant functional types and species are listed where data were available. Literature citations (in small font) include unit names, habitat, citation and location.

*Subzone C (Northern part of Arctic Coastal Plain)*

Habitat along the meso-topographic gradient	Acidic substrates (community # 1–7)	Non-acidic substrates (community # 8–12)
Dry exposed sites	1. Prostrate dwarf-shrub ( <i>Salix rotundifolia</i> ), lichen ( <i>Alectoria nigricans</i> , <i>Bryocaulon divergens</i> , <i>Dactylina arctica</i> ), rush ( <i>Luzula confusa</i> , <i>L. arctica</i> ), grass ( <i>Arctagrostis latifolia</i> ), forb ( <i>Potentilla nana</i> , <i>Pedicularis kanei</i> ), bryophyte ( <i>Polytrichum strictum</i> , <i>Dicranum elongatum</i> , <i>Gymnomitrium corallioides</i> ). Nodum II (Webber 1978); <i>Sphaerophorus globosus-Luzula confusa</i> comm., subtype <i>Salix rotundifolia</i> (Elias et al. 1996) (Barrow, dry beach and river terraces).	8. Prostrate dwarf-shrub ( <i>Dryas integrifolia</i> ), sedge ( <i>Carex rupestris</i> ), lichen ( <i>Lecanora epibryon</i> , <i>Thamnolia subuliformis</i> ). Type B12, coastal dry nonacidic gravelly sites (Walker 1985) (North Slope, Alaska).

Moist sites	<p>2. Sedge (<i>Carex aquatilis</i>, <i>Eriophorum angustifolium</i>), grass (<i>Poa arctica</i>, <i>Dupontia fisheri</i>), rush (<i>Luzula arctica</i>), prostrate dwarf-shrub (<i>Salix rotundifolia</i>), forb (<i>Saxifraga cernua</i>, <i>S. hieraciifolia</i>, <i>S. hirculus</i>, <i>Cardamine pratensis</i>, <i>Petasites frigidus</i>, <i>Ranunculus nivalis</i>), moss (<i>Oncophorus wahlenbergii</i>, <i>Sarmenthyppnum sarmentosum</i>, <i>Aulacomnium turgidum</i>). Nodum IV (Webber 1978); Type 6 and 7 (Walker et al. 1977); <i>Saxifraga cernua</i>-<i>Carex aquatilis</i> comm. (Elias et al. 1996) (Barrow, moist, fine-grained soils).</p> <p>3. Rush (<i>Luzula confusa</i>, <i>L. arctica</i>), grass (<i>Poa arctica</i>), forb (<i>Potentilla nana</i>, <i>Pedicularis kanei</i>), lichen (<i>Alectoria nigricans</i>, <i>Sphaerophorus globosus</i>, <i>Dactylina arctica</i>, <i>Cladonia</i> spp., <i>Ochrolechia frigida</i>), moss (<i>Polytrichastrum alpinum</i>, <i>Polytrichum strictum</i>, <i>Sarmenthyppnum sarmentosum</i>). Nodum 1 (Webber 1978); Type 5 (Walker et al. 1977); <i>Sphaerophorus globosus</i>-<i>Luzula confusa</i> comm., subtype <i>Saxifraga foliolosa</i> (Elias et al. 1996) (mesic high-centered polygons, zonal vegetation in Barrow area).</p>	<p>9. Sedge (<i>Carex aquatilis</i>), prostrate dwarf-shrub (<i>Salix pulchra</i>, <i>S. reticulata</i>, <i>Dryas integrifolia</i>), moss (<i>Tomentypnum nitens</i>, <i>Oncophorus wahlenbergii</i>, <i>Campylium stellatum</i>, <i>Distichium capillaceum</i>). Type U12, moist calcareous coastal meadows (Walker 1985) (North Slope, Alaska).</p>
Wet sites	<p>4. Sedge (<i>Eriophorum angustifolium</i>, <i>Carex aquatilis</i>), grass (<i>Dupontia fisheri</i>, <i>Arctophila fulva</i>), moss (<i>Sarmenthyppnum sarmentosum</i>, <i>Limprichtia revolvens</i>). Noda V and VI (Webber 1978); Types 9, 10, 12 and 13 (Walker et al. 1977); <i>Eriophorum angustifolium</i>-<i>Carex aquatilis</i> comm. (Elias et al. 1996) (Barrow, wet sites without standing water).</p>	<p>10. Sedge (<i>Carex aquatilis</i>, <i>Eriophorum angustifolium</i>), grass (<i>Dupontia fisheri</i>), moss (<i>Drepanocladus brevifolius</i>). Type M10, wet calcareous coastal meadows (Walker 1985) (North Slope, Alaska).</p>
Snow beds	<p>5. Prostrate dwarf shrub (<i>Salix rotundifolia</i>), lichen (<i>Cetrariella delisei</i>). <i>Salix rotundifolia</i>-<i>Cetraria delisei</i> comm. (Elias et al. 1996) (Barrow, early-melting snow beds).</p> <p>6. Grass (<i>Phippsia algida</i>, <i>Alopecurus alpinus</i>), forb (<i>Cochlearia groenlandica</i>, <i>Ranunculus pygmaeus</i>, <i>Stellaria humifusa</i>, <i>Saxifraga rivularis</i>). Nodum VIII (Webber 1978); Type 15 (Walker et al. 1977) (Barrow, late-melting snow beds).</p>	<p>11. No data. Probably similar to snowbeds in Subzone D.</p>

<b>Riparian areas</b>	<p>7. Grass (<i>Phippsia algida</i>, <i>Alopecurus alpinus</i>), forb (<i>Cochlearia officinalis</i>, <i>Ranunculus pygmaeus</i>, <i>Stellaria humifusa</i>, <i>Saxifraga rivularis</i>). Nodum VIII (Webber 1978); Type 15 (Walker et al. 1977) (Barrow, unstable stream margins).</p>	<p>12. Forb (<i>Epilobium latifolium</i>, <i>Artemisia arctica</i>, <i>A. campestris</i> ssp. <i>borealis</i>, <i>Papaver lapponicum</i>, <i>Polemonium boreale</i>, <i>Astragalus alpinus</i>, <i>Wilhelmsia physodes</i>, <i>Parrya nudicaulis</i>). Epilobio latifolii-Salicetum alaxensis ass. prov. (Schickhoff et al. 2002) (North Slope, coastal active floodplains).</p>
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*Subzone D (Arctic Coastal Plain, northern part of Seward Peninsula, St. Lawrence Island)*

<b>Habitat along meso-topographic gradient</b>	<b>Acidic substrates</b> (community # 13–23)	<b>Non-acidic substrates</b> (community # 24–34)
<b>Dry exposed sites</b>	<p>13. Prostrate dwarf-shrub (<i>Dryas integrifolia</i>, <i>Salix phlebophylla</i>, <i>Arctostaphylos rubra</i>, <i>Diapensia lapponica</i>), lichen (<i>Alectoria nigricans</i>). Map 2, Unit 6, evergreen dwarf shrub (Komárková and Webber 1980) (Atkasuk, dry stabilized sand dune crests).</p> <p>14. Graminoid (<i>Arctagrostis latifolia</i>, <i>Carex microchaeta</i> ssp. <i>nesophila</i>, <i>Hierochloë alpina</i>, <i>Trisetum spicatum</i>), prostrate dwarf-shrub (<i>Salix phlebophylla</i>, <i>Salix polaris</i>), forb (<i>Minuartia arctica</i>, <i>Potentilla</i> spp., <i>Oxytropis nigrescens</i>, <i>Pedicularis kanei</i>, <i>Artemisia</i> spp.). Vegetation of alpine areas and fell-fields (Young 1971) (St. Lawrence Island).</p> <p>15. Prostrate dwarf-shrub (<i>Salix ovalifolia</i>, <i>S. fuscescens</i>, <i>Dryas octopetala</i>), lichen (<i>Cladina stellaris</i>, <i>Sphaerophorus globosus</i>, <i>Flavocetraria cucullata</i>), graminoid (<i>Carex microchaeta</i> ssp. <i>nesophila</i>). Dry flats, ridge tops &amp; benches (Klein 1959) (St. Matthew Island).</p>	<p>24. Prostrate dwarf-shrub (<i>Dryas integrifolia</i>, <i>Salix reticulata</i>), sedge (<i>Carex rupestris</i>), forb (<i>Oxytropis nigrescens</i>), lichen (<i>Lecanora epibryon</i>, <i>Pertusaria</i> spp., <i>Thamnolia subuliformis</i>). Stand type B1 (Walker 1985); Stand type <i>Dryas integrifolis</i> – <i>Oxytropis nigrescens</i> (Walker 1990) (North Slope, dry calcareous gravelly soils).</p> <p>25. Prostrate dwarf-shrub (<i>Dryas integrifolia</i>), lichen. Devil's Upland (Jorgenson 2001) (Seward Peninsula).</p> <p>26. Prostrate dwarf-shrub (dry limestone slopes, York Mtns., Seward Peninsula). no data – probably similar to Subzone E, community 71, this table.</p>

## Moist sites

16. Tussock sedge (*Eriophorum vaginatum*), erect dwarf-shrub (*Ledum palustre* ssp. *decumbens*, *Vaccinium vitis-idaea*), lichen (*Cladina rangiferina*, *Ochrolechia frigida*), moss (*Dicranum* spp., *Sphagnum compactum*).  
Map 2, Unit 8, mesic stabilized sands (Kornárková and Webber 1980) (Atqasuk, Alaska).

17. Tussock sedge (*Eriophorum vaginatum*, *Carex bigelowii*), dwarf-shrub (*Ledum palustre* spp. *decumbens*), moss (*Polytrichum* spp., *Sphagnum* spp.), lichen (*Cetraria* spp., *Cladina* spp.).  
42B- low-shrub cottongrass tussock tundra (Swanson and Schuman 1985) (Seward Peninsula).

18. Graminoid (*Calamagrostis canadensis* var. *langsdorfii*, *Juncus castaneus*), prostrate dwarf-shrub (*Rubus arcticus*), forb (*Comarum palustre*, *Epilobium anagallidifolium*).  
Vegetation of mesic tundra (Young 1971) (St. Lawrence Island).

19. Sedge (*Carex microchaeta* ssp. *nesophila*, *Alopecurus alpinus*, *Arctagrostis latifolia*), prostrate dwarf-shrub (*Salix rotundifolia*, *S. reticulata*), forb.  
Moist well-drained meadows (Klein 1959) (St. Matthew Island).

27. Sedge (*Eriophorum angustifolium* ssp. *triste*, *Carex bigelowii*, *C. membranacea*, *C. aquatilis*), prostrate dwarf-shrub (*Dryas integrifolia*, *Salix reticulata*), erect dwarf-shrub (*Salix richardsonii*), forb (*Tephroses atropurpurea*, *Eutrema edwardsii*, *Papaver macounii*, *Leucanthemum integrifolium*, *Pedicularis kanei*, *Tofieldia pusilla*), moss (*Tomentypnum nitens*, *Drepanocladus brevifolius*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Hypnum bambergeri*), lichen (*Thamnia subuliformis*, *Flavocetraria cucullata*, *Cetraria islandica*).  
Stand Type U3, mesic nonacidic loess (Walker 1985) (Prudhoe Bay).

Map unit 42A – low-shrub water sedge tussock tundra (Swanson and Schuman 1985) (Seward Peninsula).

28. Graminoid (*Deschampsia caespitosa*, *Juncus biglumis*, *Luzula confusa*), shrub (*Salix phlebophylla*, *S. polaris*), forb (*Huperzia selago*, *Oxyria digyna*, *Saxifraga nelsoniana*, *Rhodiola integrifolia* ssp. *integrifolia*, *Cassiope tetragona*, *Primula tschuktschorum*, *Artemisia arctica*).

Vegetation of alpine areas and fell-fields (Young 1971) (St. Lawrence Island).

<p><b>Wet sites</b></p>	<p><b>20.</b> Sedge (<i>Carex aquatilis</i>, <i>Carex</i> spp., <i>Eriophorum angustifolium</i>), moss (<i>Drepanocladus</i> spp., <i>Sphagnum</i> spp.). Map 2, Unit 16. Atqasuk, wet marshes (Komárková and Webber 1980).</p> <p>Water sedge wet meadow (Racine and Anderson 1979); Map unit 55- cottongrass-water sedge (Swanson and Schuman 1985) (Seward Peninsula, low-centered polygons).</p> <p>Vegetation type – wet tundra (Young 1971) (St. Lawrence Island).</p>	<p><b>29.</b> Sedge (<i>Carex aquatilis</i>, <i>Eriophorum angustifolium</i>, <i>Carex</i> spp.), moss (<i>Drepanocladus brevifolius</i>, <i>Scorpidium scorpioides</i>, <i>Cinclidium latifolium</i>, <i>Meesia triquetra</i>, <i>Catoscopium nigratum</i>, <i>Distichium capillaceum</i>). Stand type M2, wet calcareous meadows, ice-wedge polygon centers, lake margins (Walker 1985) (Prudhoe Bay).</p>
<p><b>Snow beds</b></p>	<p><b>21.</b> Hemiprostrate dwarf shrub (<i>Cassiope tetragona</i>), forb (<i>Boykinia richardsonii</i>). <i>Boykinia richardsonii</i>-<i>Cassiope tetragona</i> comm. Map 2, Unit 11, early-melting snow beds, (Komárková and Webber 1980) (Atqasuk, Alaska).</p>	<p><b>30.</b> Hemiprostrate dwarf-shrub (<i>Cassiope tetragona</i>), prostrate dwarf-shrub (<i>Dryas integrifolia</i>, <i>Salix reticulata</i>), sedge (<i>Carex scirpoidea</i>), forb (<i>Pedicularis capitata</i>, <i>Polygonum viviparum</i>, <i>Silene acaulis</i>, <i>Papaver macounii</i>), moss (<i>Ditrichum flexicaule</i>, <i>Sanionia uncinata</i>, <i>Tomentypnum nitens</i>), lichen (<i>Flavocetraria cucullata</i>, <i>F. nivalis</i>, <i>Masonhalea richardsonii</i>, <i>Peltigera canina</i>). Stand type U6 (Walker 1985); Stand type <i>Cassiope tetragona</i> – <i>Dryas integrifolia</i> (Walker 1990) (Prudhoe Bay, early melting non-acidic snowbeds on pingos).</p> <p><b>31.</b> Prostrate dwarf-shrub (<i>Salix rotundifolia</i>), sedge (<i>Carex aquatilis</i>, <i>Eriophorum angustifolium</i> ssp. <i>triste</i>), horsetail (<i>Equisetum scirpoides</i>, <i>E. variegatum</i>), moss (<i>Distichium capillaceum</i>, <i>Ditrichum flexicaule</i>). Stand type U7 (Walker 1985); Facies <i>Salix rotundifolia</i> – <i>Eriophorum triste</i> (Walker 1990) (Prudhoe Bay, late-melting nonacidic snowbeds).</p>

## Riparian areas

22. Low-shrub (*Salix alaxensis*, *S. richardsonii*, *S. glauca*, *S. pulchra*). Map 2 Unit 17, streambank shrublands (Komárková and Webber 1980) (Atqasuk, Alaska).

23. Erect low-shrub (*Salix pulchra*), moss (*Hylocomium splendens*), lichen (*Cetraria islandica*, *Cladina* spp.). Low-medium willow shrub thicket (Racine and Anderson 1979); Map unit 34- low-shrub – floodplain (Swanson and Schuman 1985) (Seward Peninsula).

32. Forb (*Epilobium latifolium*, *Artemisia arctica*, *A. campestris* ssp. *borealis*, *Papaver lapponicum*, *Polemonium boreale*, *Astragalus alpinus*, *Wilhelmsia physodes*, *Parrya nudicaulis*, *Castilleja caudata*, *Hedysarum* spp.), dwarf-shrub (*Salix alaxensis*).

Stand type B4, active floodplains (Walker 1985) (Prudhoe Bay).

33. Low-shrub (*Salix lanata*, *S. alaxensis*, *S. glauca*), sedge (*Carex aquatilis*, *Eriophorum angustifolium*), forb (*Polemonium acutiflorum*, *Cardamine microphylla* ssp. *blaisdellii*, *Pedicularis sudetica*).

Stand type U8, moist streamsidings on fine grained soils (Walker 1985) (Prudhoe Bay).

34. Prostrate dwarf-shrub (*Dryas integrifolia*, *Arctostaphylos rubra*), erect dwarf-shrub (*Rhododendron lapponicum*, *Salix richardsonii*, *Vaccinium uliginosum*), forb (*Anemone parviflora*, *Polygonum viviparum*, *Castilleja caudata*, *Lupinus arcticus*, *Oxytropis campestris*, *Pedicularis capitata*), sedge (*Carex scirpoidea*, *C. rupestris*), horsetail (*Equisetum variegatum*), moss (*Rhytidium rugosum*), lichen (*Flavocetraria cucullata*, *F. nivalis*, *Cladonia pocillum*, *Dactylina arctica*, *Masonhalea richardsonii*, *Peltigera canina*, *Thamnolia subuliformis*).

*Dryas integrifolia* – *Lupinus arcticus* comm. (Walker et al. 1997) (Happy Valley, dry river terraces).



*Subzone E (Arctic Foothills, Seward Peninsula, and Yukon-Kuskokwim Delta region)*

Habitat along meso-topographic gradient	Acidic substrates (community # 35–70)	Non-acidic substrates (community # 71–85)
Dry exposed sites	<p><b>35.</b> Prostrate dwarf-shrub (<i>Vaccinium uliginosum</i>, <i>Salix phlebophylla</i>, <i>Loiseleuria procumbens</i>, <i>Vaccinium vitis-idaea</i>, <i>Dryas octopetala</i> ssp. <i>octopetala</i>), graminoid (<i>Hierochloë alpina</i>, <i>Carex microchaeta</i>), forb (<i>Androsace chamaejasme</i>), moss (<i>Racomitrium lanuginosum</i>). Vaccinio uliginosi-Salicetum phlebophyllae Assoc.43, prostrate vegetation of ridgetops on acidic soils (Cooper 1986) (Arrigetch Mtns.).</p> <p><b>36.</b> Prostrate dwarf-shrub (<i>Dryas octopetala</i>, <i>Vaccinium uliginosum</i>), graminoid (<i>Carex scirpoidea</i>, <i>C. microchaeta</i>, <i>Festuca altaica</i>), lichen (<i>Cladina</i> spp., <i>Flavocetraria</i> spp.). Carici scirpoideae-Vaccinietum uliginosi, Assoc. 18 (Cooper 1986) (Brooks Range).</p> <p><b>37.</b> Prostrate dwarf-shrub (<i>Dryas octopetala</i>, <i>D. drummondii</i>), forb (<i>Antennaria alpina</i>, <i>Minuartia obtusiloba</i>, <i>Oxytropis nigrescens</i>, <i>Artemisia arctica</i>), lichen (<i>Alectoria nigrescens</i>, <i>Bryocaulon divergens</i>, <i>Hypogymnia subobscura</i>, <i>Ochrolechia upsaliensis</i>), moss (<i>Polytrichum piliferum</i>, <i>Tortula ruralis</i>). Selaginello sibiricae-Dryadetum octopetalae (Walker et al. 1994) (Imnavait Creek, dry gravelly soils).</p>	<p><b>71.</b> Prostrate dwarf-shrub (<i>Dryas octopetala</i>, <i>D. drummondii</i>), forb (<i>Antennaria alpina</i>, <i>Minuartia obtusiloba</i>, <i>Oxytropis nigrescens</i>, <i>Smelowskia calycina</i>, <i>Artemisia arctica</i>), lichen (<i>Alectoria nigrescens</i>, <i>Bryocaulon divergens</i>, <i>Hypogymnia subobscura</i>, <i>Ochrolechia upsaliensis</i>), moss (<i>Polytrichum piliferum</i>, <i>Tortula ruralis</i>). Selaginello sibiricae-Dryadetum octopetalae (Walker et al. 1994) (Toolik Lake, dry gravelly soils).</p> <p><b>72.</b> Prostrate dwarf-shrub (<i>Dryas octopetala</i> ssp. <i>octopetala</i>, <i>Saxifraga oppositifolia</i>), sedge (<i>Carex scirpoidea</i>, <i>Carex rupestris</i>), lichen (<i>Thamnolia subuliformis</i>, <i>Dactylina beringica</i>, <i>Vulpicida tilesii</i>, <i>Flavocetraria nivalis</i>, <i>F. cucullata</i>, <i>Cetraria islandica</i>), moss (<i>Ditrichum flexicaule</i>). Caricetum scirpoideo-rupestris, Assoc.30, limestone slopes (Cooper 1986) (Arrigetch Mtns.).</p>

**38.** Prostrate dwarf-shrub (*Arctostaphylos alpina*, *Vaccinium vitis-idaea*, *V. uliginosum*, *Salix phlebophylla*), grass (*Hierochloë alpina*), lichen (*Flavocetraria cucullata*, *Sphaerophorus globosus*, *Alectoria ochroleuca*, *Cladina arbuscula*), moss (*Polytrichum strictum*, *Dicranum elongatum*).  
*Salix phlebophyllae*-*Arctoetum alpinae* (Walker et al. 1994) (Imnavait Creek, dry acidic organic soils).

**39.** Prostrate dwarf-shrub (*Loiseleuria procumbens*, *Arctostaphylos alpina*, *Empetrum nigrum*, *Rhododendron camtschaticum*, *Salix phlebophylla*), lichen (*Bryocaulon divergens*, *Pseudephebe pubescens*, *Cladina* spp., *Thamnia* spp.).  
 Map units 65 lichen slope and 70 lichen granitic slope (Swanson and Schuman 1985); Vegetation type – dwarf shrub tundra (Racine and Anderson 1979); Relevés C13, QC35, QC36 (Raynolds et al. 2002) (Seward Peninsula).

**40.** Prostrate and erect dwarf-shrub (*Dryas integrifolia*, *Empetrum nigrum*), lichen (*Cladina rangiferina*, *Cladina* spp., *Alectoria ochroleuca*).  
 Sites V1,4,5 (Talbot 1983); Map unit 4 (Talbot et al. 1985); description of Askinuk Mtns. (McCaffery and Harwood 1997); Map Units D1a, M11 (Tande and Jennings 1986), lowland moist low scrub (Jorgenson 2000) (Yukon-Kuskokwim Delta).

**73.** Prostrate dwarf-shrub (*Dryas octopetala*, *Rhododendron lapponicum*), sedge (*Carex nardina*), forb (*Artemisia senjavinensis*, *Saxifraga oppositifolia*, *Oxytropis nigrescens*), lichen (*Thamnia subuliformis*, *Cetraria islandica*).  
 Alpine Dryas stand (Hanson 1953); Map units 61 lichen meadow (mountain), 71 Dryas limestone slope, and 72 bald limestone slope (Swanson and Schuman 1985); Vegetation type – Dryas dwarf-shrub tundra (Racine and Anderson 1979); Relevés C5, C17, C-H (Raynolds et al. 2002) (Seward Peninsula).

**74.** Lichen (*Umbilicaria* spp., *Rhizocarpon geographicum*, *Cladonia stellaris*), dwarf-shrub (*Loiseleuria procumbens*).  
 Rock desert (Racine and Anderson 1979), Relevés Lava A,B,C (Raynolds et al. 2002) (Seward Peninsula).

## Moist sites

41. Tussock sedge (*Eriophorum vaginatum*, *Carex bigelowii*), erect dwarf-shrub (*Betula nana*, *Ledum palustre* ssp. *decumbens*, *Vaccinium vitis-idaea*, *Empetrum nigrum* ssp. *hermaphroditum*, *Cassiope tetragona*, *Rubus chamaemorus*), forb (*Pyrola grandiflora*, *Polygonum bistorta*, *Saxifraga nelsoniana*), moss (*Sphagnum* spp., *Hylocomium splendens*, *Aulacomnium turgidum*, *Dicranum* spp., *Polytrichum strictum*), lichen (*Cladonia* spp., *Cladonia amaurocraea*, *Cetraria* spp., *Dactylina arctica*). Sphagno-Eriophoretum vaginati, tussock tundra on acidic fine grained soils (Walker et al. 1994) (Imnavait Creek).

Cottongrass-sedge-dwarf heath shrub complex (Hanson 1953); tussock dwarf-shrub tundra (Racine and Anderson 1979); 42B- low shrub cottongrass tussock tundra, 60 – lichen tussock tundra (Swanson and Schuman 1985); Relevés C2,C8,C19,QC1,QC2,QC45 (Raynolds 2000) (Seward Peninsula). Map units M11, M14 (Tande and Jennings 1986), Map unit 71 – lowland moist low-scrub (Jorgenson 2000); Sites BB10–13, MM5,7 (Talbot 1983) (Yukon-Kuskokwim Delta).

42. Erect dwarf-shrub (*Betula nana*, *Salix pulchra*, *Ledum palustre* ssp. *decumbens*, *Vaccinium vitis-idaea*), tussock sedge (*Eriophorum vaginatum*), moss (*Sphagnum* spp., *Hylocomium splendens*, *Aulacomnium turgidum*, *Dicranum* spp.), lichen (*Cladonia* spp., *Cladonia amaurocraea*, *Flavocetraria* spp., *Peltigera aphthosa*). Sphagno-Eriophoretum vaginati, *Betula nana* and *Salix pulchra* subtypes, shrub-dominated tussock tundra (Walker et al. 1994, Walker & Walker 1996) (Imnavait Creek).

43. Erect dwarf-shrub (*Betula nana*, *Ledum palustre* ssp. *decumbens*), prostrate dwarf-shrub (*Rubus chamaemorus*, *Vaccinium vitis-idaea*), moss (*Sphagnum* spp.). Sphagno-Eriophoretum vaginati betuletosum nanae on palsas and high-centered polygons (Walker et al. 1994) (Imnavait Creek).

75. Sedges (*Carex bigelowii*, *Eriophorum angustifolium* ssp. *triste*, *C. membranacea*), prostrate dwarf-shrub (*Dryas integrifolia*, *Salix reticulata*, *Arctostaphylos rubra*), erect dwarf-shrub (*Salix richardsonii*, *S. glauca*, *Vaccinium uliginosum*, *Rhododendrum lapponicum*), forb (*Lupinus arcticus*, *Oxytropis maydelliana*, *Pedicularis capitata*, *Lagotis glauca*, *Eutrema edwardsii*, *Tephrosieris atropurpurea*, *Polygonum viviparum*, *Packera cymbalaria*, *Pedicularis kanei*, *Tofieldia pusilla*), horsetail (*Equisetum arvense*, *E. variegatum*), moss (*Tomentypnum nitens*, *Hylocomium splendens*, *Aulacomnium turgidum*), lichen (*Thamnia subuliformis*, *Flavocetraria* spp., *Dactylina arctica*). Dryado integrifoliae-Caricetum bigelowii, moist calcareous tundra (Walker et al. 1994) (Toolik Lake).

Vegetation type – sedge-moss marsh, cottongrass-sedge-dwarf heath shrub complex (Hanson 1953); Vegetation type Bigelow's sedge tussock dwarf-shrub tundra (Racine and Anderson 1979); Relevés R6,7a,33,37,57,58 (Raynolds et al. 2002) (Seward Peninsula).

76. Low-shrub (*Betula nana*, *Salix pulchra*, *Salix glauca*), moss (*Pleurozium schreberi*, *Hylocomium splendens*).

Map unit 44-shrub lichen upland (Swanson and Schuman 1985); Relevé C–C (Raynolds 2000) (Seward Peninsula).

44. Low-shrub (*Betula nana*, *Salix pulchra*), erect dwarf-shrub (*Ledum palustre* ssp. *decumbens*, *Rubus chamaemorus*), grass (*Calamagrostis canadensis*), moss (*Aulacomnium turgidum*, *Hylocomium splendens*).  
Sphagno-Eriophoretum vaginati betuletosum nanae (Walker et al. 1994) (Imnavait Creek, shrub tundra in warmer mesoclimatic oases of the foothills, also along water tracks and in basins).

Vegetation type – low-medium shrub thicket (Racine and Anderson 1979); Map Unit 35 shrub hillside (Swanson and Schuman 1985); Relevés C3, C16, QC3, C–C (Raynolds et al. 2002) (Seward Peninsula).  
Map unit 9 (Talbot et al. 1985); Map Unit M13 (Tande and Jennings 1986).

45. Low shrub (*Alnus viridis*, *Salix richardsonii*, *Spiraea stevenii*), erect dwarf-shrub (*Vaccinium uliginosum*, *V. vitis-idaea*, *Pyrola grandiflora*), grass (*Calamagrostis canadensis*), horsetail (*Equisetum arvense*), forb (*Boschniakia rossica*, *Valeriana capitata*), moss (*Climacium dendroides*, *Hylocomium splendens*, *Thuidium philibertii*, *Timmia austriaca*).  
*Climacium dendroides*-*Alnus viridis* comm. (Walker et al. 1997) (Happy Valley, open alder shrub in warmer mesoclimatic oases of the foothills).

46. Grass (*Calamagrostis canadensis*, *Arctagrostis latifolia*), tussock sedge (*Eriophorum vaginatum*), forb (*Epilobium latifolium*, *Senecio congestus*).  
Colonizing grasses and mosses on burned tussock tundra (Raynolds 2000) (Seward Peninsula).

47. Sedge (*Eriophorum vaginatum*), lichen (*Cladina rangiferina*, *C. mitis*, *C. arbuscula*, *Flavocetraria cucullata*, *Cetraria islandica*), erect dwarf-shrub (*Ledum palustre* ssp. *decumbens*, *Vaccinium vitis-idaea*, *Rubus chamaemorus*), moss (*Sphagnum* spp.).  
Map unit 60 lichen tussock tundra (Swanson and Schuman 1985) (Seward Peninsula).

**48.** Erect dwarf-shrub (*Betula nana*, *Ledum palustre* ssp. *decumbens*, *Empetrum nigrum*, *Loiseleuria procumbens*, *Vaccinium uliginosum*), lichen (*Cladina rangiferina*, *C. stygia*, *Stereocaulon tomentosum*), moss (*Sphagnum* spp., *Dicranum* spp.).  
Vegetation type – dwarf birch-heath-lichens (Hanson 1953); Vegetation type – birch dwarf-shrub tundra (Racine and Anderson 1979); Map units 32- mixed shrub tundra, 44 – shrub lichen upland (Swanson and Schuman 1985); Relevé C14 (Raynolds et al. 2002) (Seward Peninsula).  
Map unit M11 (Tande and Jennings 1986); Map unit 71, lowland moist low scrub (Jorgenson 2000) (Yukon-Kuskokwim Delta).

**49.** Erect and prostrate dwarf-shrub (*Betula nana*, *Salix fuscescens*, *Empetrum nigrum*, *Vaccinium vitis-idaea*), sedge (*Carex bigelowii*), lichen (*Cladina rangiferina*, *C. arbuscula*, *Cetraria islandica*).  
Sites 63, 32 (Swanson et al. 1986) (Nunivak Island).

**50.** Low-shrub (*Betula nana*), sedge (*Eriophorum vaginatum*), dwarf-shrub (*Ledum palustre* ssp. *decumbens*, *Rubus chamaemorus*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Empetrum nigrum*), moss (*Sphagnum* spp.), lichen (*Cladina* spp., *Cetraria* spp.).  
Map units 1,3 (Talbot et al. 1985); Map unit M12 (Tande and Jennings 1986) ; Map unit L3 (Wibbenmeyer et al. 1982) (Kuskokwim Mtns.).

**51.** Low-shrub (*Alnus viridis* ssp. *crispa*, *Spiraea stevenii*), grass (*Calamagrostis canadensis*), fern (*Dryopteris expansa*).  
Alder types (Hanson 1953); green alder shrub thicket (Racine and Anderson 1979); Map unit 22 -tall shrub hillside (Swanson and Schuman 1985); Relevés C15,C18,QC25 (Raynolds et al. 2002) (Seward Peninsula).  
Map unit 8, subalpine scrub (Talbot et al. 1985); Map units D2,D5,F1,F2 (Wibbenmeyer et al. 1982) (Yukon-Kuskokwim Delta).

## Wet sites

52. Sedge (*Carex rotundata*, *C. rariflora*, *C. chordorrhiza*, *Eriophorum scheuchzeri*), moss (*Sphagnum orientale*).

*Sphagnum orientale*-*Eriophorum scheuchzeri* comm. (Walker and Walker 1996) (Imnavait Creek, wet microsites in wet acidic tundra in foothills).

53. Sedge (*Carex rotundata*, *C. rariflora*), prostrate dwarf-shrub (*Salix fuscescens*, *Andromeda polifolia*, *Rubus chamaemorus*, *Betula nana*), moss (*Sphagnum lenense*, *Sphagnum* spp.).  
*Sphagnum lenense*-*Salix fuscescens* comm. (Walker and Walker 1996) (Imnavait Creek, raised microsites in acidic wetlands).

54. Sedge (*Carex aquatilis*, *Eriophorum scheuchzeri*), dwarf shrub (*Ledum palustre* ssp. *decumbens*), moss (*Sphagnum* spp.), lichen (*Cladonia* spp., *Cladonia* spp.).

Map unit 55- cottongrass-water sedge (low-centered polygons) (Swanson and Schuman 1985) (Seward Peninsula).

55. Sedge (*Carex ramenskii*, *C. rariflora*, *C. lyngbyei*), prostrate dwarf-shrub (*Salix fuscescens*), forb (*Comarum palustre*).

Map units W1, W8, W9, M9 (Tande and Jennings 1986); Map unit 24 slightly brackish wet sedge-shrub meadow (Jorgenson 2000) (Yukon-Kuskowkim Delta).

56. Graminoid (*Carex aquatilis*, *C. rariflora*, *Calamagrostis deschampsoides*), dwarf-shrub (*Empetrum nigrum*), moss (*Sphagnum* spp.).

Map unit W10 (Tande and Jennings 1986) (Yukon-Kuskowkim Delta).

57. Sedge (*Carex aquatilis*, *Eriophorum angustifolium*, *C. rostrata*), forb (*Comarum palustre*, *Menyanthes trifoliata*), moss (*Sphagnum* spp.).

Sites F1,H2,M2B (Talbot 1983); Map unit 61 – lowland wet sedge meadow (Jorgenson 2000); Map units W2e,W3e (Tande and Jennings 1986); Map units 5,18,22 (Talbot et al. 1985) (Yukon-Kuskowkim Delta).

77. Sedge (*Carex aquatilis*, *C. chordorrhiza* *Carex* spp., *Eriophorum angustifolium*), moss (*Drepanocladus brevifolius*, *Scorpidium scorpioides*, *Cinclidium latifolium*, *Meesia triquetra*, *Catoscopium nigratum*, *Distichium capillaceum*).  
*Eriophorum angustifolium*-*Carex aquatilis* comm. (Walker and Barry 1991) (Toolik Lake, non-acidic marshes).

78. Graminoid (*Puccinellia phryganodes*, *Carex ramenskii*).

Salt grass meadow (Racine and Anderson 1979); Map unit 51-tidal marsh (Swanson and Schuman 1985) (Seward Peninsula).

Map unit 14 (Talbot et al. 1985), Map unit M15 (Tande and Jennings 1986); Map unit 13 (Jorgenson 2000) (Yukon-Kuskowkim Delta).

	<p>58. Sedge (<i>Eriophorum russeolum</i>, <i>Carex aquatilis</i>), forb (<i>Comarum palustre</i>), moss (<i>Sphagnum</i> spp.). Map unit 21, 16 (Talbot et al. 1985); Map unit W3 (Tande and Jennings 1986) (Yukon-Kuskokwim Delta).</p> <p>59. Sedge (<i>Carex aquatilis</i>), erect dwarf-shrub (<i>Betula nana</i>, <i>Empetrum nigrum</i>, <i>Ledum palustre</i> ssp. <i>decumbens</i>, <i>Vaccinium uliginosum</i>), moss (<i>Sphagnum</i> spp.), lichen (<i>Cladina</i> spp., <i>Flavocetraria</i> spp.). Map units 5, 22 (Talbot et al. 1985); Map units W3e, W4. (Tande and Jennings 1986) (Yukon-Kuskokwim Delta).</p> <p>60. Erect dwarf-shrub (<i>Andromeda polifolia</i>), moss (<i>Sphagnum balticum</i>). Map unit 23 (Talbot et al. 1985) (Yukon-Kuskokwim Delta).</p> <p>61. Sedge (<i>Carex aquatilis</i>, <i>C. glareosa</i>), prostrate dwarf-shrub (<i>Salix fuscescens</i>), moss (<i>Sphagnum</i> spp.). Type 52 (Swanson et al. 1986) (Nunivak Island).</p>	
Snow beds	<p>62. Hemiprostrate dwarf-shrub (<i>Cassiope tetragona</i>), prostrate dwarf shrub (<i>Salix phlebophylla</i>, <i>Vaccinium vitis-idaea</i>, <i>Pyrola grandiflora</i>, <i>Diapensia lapponica</i>, <i>Ledum palustre</i> ssp. <i>decumbens</i>, <i>V. uliginosum</i>), sedge (<i>Carex microchaeta</i>), grass (<i>Hierochloë alpina</i>), moss (<i>Hylocomium splendens</i>, <i>Aulacomnium turgidum</i>, <i>Dicranum</i> spp.), lichen (<i>Flavocetraria cucullata</i>, <i>F. nivalis</i>, <i>Nephroma arcticum</i>, <i>Stereocaulon alpinum</i>, <i>Sphaerophorus globosus</i>). <i>Carex microchaeta</i>--<i>Cassiope tetragona</i> comm. (Walker et al. 1994) (Imnavait Creek, early-melting acidic snowbeds).</p> <p>63. Prostrate dwarf-shrub (<i>Salix rotundifolia</i>). [<i>Salix rotundifolia</i>-<i>Saxifraga nivalis</i> comm. (Walker et al. 1989) (Imnavait Creek, late-melting snow beds)].</p>	<p>79. Hemiprostrate dwarf-shrub (<i>Cassiope tetragona</i>), prostrate dwarf-shrub (<i>Dryas integrifolia</i>, <i>Salix reticulata</i>, <i>S. arctica</i>), sedge (<i>Carex scirpoidea</i>), forb (<i>Geum glaciale</i>, <i>Pedicularis kanei</i>, <i>P. oederi</i>, <i>Parrya nudicaulis</i>, <i>Papaver macounii</i>, <i>Silene acaulis</i>, <i>Polygonum bistorta</i>), moss (<i>Rhytidium rugosum</i>, <i>Aulacomnium turgidum</i>, <i>Tomentypnum nitens</i>, <i>Ptilidium ciliare</i>), lichen (<i>Flavocetraria cucullata</i>, <i>F. nivalis</i>, <i>Cladonia amaurocraea</i>, <i>Dactylina arctica</i>). <i>Dryas integrifolia</i>-<i>Cassiope tetragona</i> comm. (Walker et al. 1994) (Toolik Lake, early-melting nonacidic snow beds).</p>

**64.** Hemiprostrate dwarf-shrub (*Cassiope tetragona*, *Loiseleuria procumbens*, *Vaccinium uliginosum*), forb, lichen (*Alectoria nigricans*, *Sphaerophorus globosus*).  
Four-angled heather-blueberry type (Hanson 1953); Relevé CC (Raynolds 2000) (Seward Peninsula).

**80.** Prostrate dwarf-shrub (*Salix rotundifolia*), sedge (*Carex aquatilis*, *Eriophorum angustifolium* ssp. *triste*), horsetail (*Equisetum scirpoides*, *E. variegatum*), moss (*Distichium capillaceum*, *Ditrichum flexicaule*).  
*Salix rotundifolia*-*Saxifraga nivalis* comm. (Walker et al. 1989) (Toolik Lake, late-melting snow beds).

**81.** Dwarf-shrub (*Salix reticulata*, *S. richardsonii*), horsetail (*Equisetum arvense*), moss (*Tomentypnum nitens*).  
Relevé C-D (Raynolds 2000) (Seward Peninsula).



## Streamsides

65. Low-shrub (*Salix pulchra*, *Betula nana*), erect dwarf-shrub, sedge (*Eriophorum angustifolium*, *Carex membranacea*), forb (*Valeriana capitata*, *Anemone richardsonii*, *Polemonium acutiflorum*, *Dodecatheon frigidum*), moss (*Hylocomium splendens*, *Tomentypnum nitens*, *Sphagnum* spp., *Sanionia uncinatus*, *Aulacomnium palustre*, *Paludella squarrosa*).

*Valeriano capitatae*-Salicetum planifoliae ass. prov. (Schickhoff et al. 2002); *Eriophorum angustifolium*-*Salix pulchra* comm. (Walker et al. 1994) (Imnavait Creek, acidic to circumneutral water tracks, streamsides).

66. Tall-shrub (*Salix alaxensis*, *S. richardsonii*, *S. glauca*), prostrate dwarf-shrub (*Dryas integrifolia*, *Arctostaphylos rubra*), forb (*Hedysarum alpinum*, *Tofieldia pusilla*, *Parnassia kotzebuei*), horsetail (*Equisetum arvense*), moss (*Ditrichum flexicaule*, *Tomentypnum nitens*, *Distichium capillaceum*).

Salicetum glauco-richardsonii ass. prov. (Schickhoff et al. 2002) (Imnavait Creek, willow shrubland on stable floodplains).

67. Tall-shrub (*Alnus viridis*, *Salix richardsonii*), erect dwarf-shrub (*Vaccinium uliginosum*, *V. vitis-idaea*, *Pyrola grandiflora*), grass (*Calamagrostis canadensis*), horsetail (*Equisetum arvense*), forb (*Boschniakia rossica*, *Valeriana capitata*), moss (*Climacium dendroides*, *Hylocomium splendens*, *Thuidium philibertii*, *Timmia austriaca*).

*Climaceum dendroides*-*Alnus viridis* comm. (Walker et al. 1997) (Happy Valley, alder shrubland on floodplains).

82. Forb (*Castilleja caudata*, *Epilobium latifolium*, *Hedysarum alpinum*, *Eurybia sibirica*), low-shrub (*Salix alaxensis*).

*Epilobio latifolii*-Salicetum alaxensis prov. ass. (Schickhoff et al. 2002) (Toolik Lake, active floodplains).

83. Prostrate dwarf-shrub (*Dryas integrifolia*, *Arctostaphylos rubra*), erect dwarf-shrub (*Rhododendron lapponicum*, *Salix richardsonii*, *Vaccinium uliginosum*), forb (*Anemone parviflora*, *Polygonum viviparum*, *Castilleja caudata*, *Lupinus arcticus*, *Oxytropis campestris*, *Pedicularis capitata*), sedge (*Carex scirpoidea*, *C. rupestris*), horsetail (*Equisetum variegatum*), moss (*Rhytidium rugosum*), lichen (*Flavocetraria cucullata*, *F. nivalis*, *Cladonia pocillum*, *Dactylina arctica*, *Masonhalea richardsonii*, *Peltigera canina*, *Thamnolia subuliformis*).

*Dryas integrifolia* - *Lupinus arcticus* comm. (Walker et al. 1997) (Toolik Lake, dry river terraces).

84. Tall-shrub (*Salix alaxensis*, *S. richardsonii*, *S. glauca*), prostrate dwarf-shrub (*Dryas integrifolia*, *Arctostaphylos rubra*), forb (*Hedysarum alpinum*, *Tofieldia pusilla*, *Parnassia kotzebuei*), horsetail (*Equisetum arvense*), moss (*Ditrichum flexicaule*, *Tomentypnum nitens*, *Distichium capillaceum*).

Salicetum glauco-richardsonii ass. prov. (Schickhoff et al. 2002) (Toolik Lake, willow shrubland on stable floodplains).

68. Erect low-shrub (*Salix pulchra*), moss (*Hylocomium splendens*), lichen (*Cetraria islandica*, *Cladina* spp.). Map unit 34-low shrub – floodplain (Swanson and Schuman 1985) (Seward Peninsula).

69. Low- or tall-shrub (*Salix alaxensis*, *S. richardsonii*), forb (*Epilobium latifolium*), moss (*Sphagnum* spp.), lichen (*Thamnolia subuliformis*). Vegetation type – tall willow thicket (Racine and Anderson 1979); Map unit 82 – riverwash (Swanson and Schuman 1985) (Seward Peninsula).

70. Tall-shrub (*Salix arbusculoides*, *S. alaxensis*, *Alnus viridis* ssp. *crispa*), low-shrub (*Salix pulchra*), grass (*Calamagrostis canadensis*), moss (*Climacium dendroides*). Map unit W2e (Tande and Jennings 1986); Sites G-5,9,12,14; MM-6,005, V-3 (Talbot 1983) (Yukon-Kuskokwim Delta).

85. Tall-shrub (*Alnus viridis*), erect dwarf-shrub (*Vaccinium uliginosum*, *V. vitis-idaea*, *Pyrola grandiflora*), grass (*Calamagrostis canadensis*), horsetail (*Equisetum arvense*), forb (*Boschniakia rossica*, *Valeriana capitata*), moss (*Climacium dendroides*, *Hylocomium splendens*, *Thuidium philiberti*, *Timmia austriaca*). *Climacium dendroides*-*Alnus viridis* comm. (Walker et al. 1997) (Happy Valley, alder shrubland on floodplains).

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