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Natural Resource Program Center

An Ecological Survey for Landcover Mapping of Wrangell-St. Elias National Park and Preserve

Natural Resource Technical Report NPS/WRST/NRTR—2008/094

ON THE COVER
Top to bottom: Nabesna River, Disenchantment Bay, and Nizina Glacier
Photographs by: ABR, Inc

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March 2008

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Please cite this publication as:

Jorgenson, M. T., J. E. Roth, P. F. Loomis, E. R. Pullman, T. C. Cater, M. S. Duffy, W. A. Davis, and M. J. Macander, 2008. An ecological survey for landcover mapping of Wrangell-St. Elias National Park and Preserve. Natural Resource Technical Report NPS/WRST/NRTR—2008/094. National Park Service, Fort Collins, Colorado.

NPS D-100, March 2008

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ACKNOWLEDGMENTS

We thank Jess Grunblatt, Beth Koltun, and Sara Wesser of the National Park Service for their support and management of this project. Ken Stumpf, Geographic Resource Solutions, did the image processing for the mapping and produced an accompanying report. Mary Beth Cook and Carl Roland helped with floristic information from previous surveys. We appreciate the safe helicopter flying provided by Rick Swisher. Janet Kidd and Sue Bishop provided a technical review and Pam Odom produced the report.

INTRODUCTION

Ecological field surveys and landcover mapping are essential for evaluating land resources and developing management strategies that are appropriate to the varying conditions of the landscape. Specifically, land classification and mapping can be used to more efficiently allocate inventory and monitoring efforts; to partition ecological information for analysis of ecological relationships; to develop predictive ecological models; and to improve techniques for assessing and mitigating impacts. To satisfy this wide range of needs for Wrangell-St. Elias National Park and Preserve (WRST), the National Park Service (NPS) is pursuing an integrated approach of inventorying and classifying ecological characteristics from the "bottom up" and using satellite image processing and environmental modeling to differentiate the distribution of the landcover types (or "ecotypes" for local-scale ecosystems) from the "top down." The intensive inventory and classification work was completed by ABR, Inc.—Environmental Research & Services (ABR), Fairbanks, AK, while the satellite image processing was done by Geographic Resource Solutions (GRS), Arcata, California (Stumpf 2008).

To enhance the landcover mapping, which is based primarily on spectral characteristics, we used a multi-step process to better partition the variability in vegetation and other ecological characteristics. These included: (1) an integrated ecological land survey to characterize vegetation, soils, and other ecological characteristics; (2) classification of plant communities (floristic associations), soils, and local-scale ecosystems (termed "ecotypes") that integrate co-varying ecological properties; and (3) analysis of relationships among ecological components. Using this integrated ecological land survey approach results in an ecosystem map that has accompanying attributes for vegetation, soils, ecotypes, and a suite of environmental properties. In this report, we differentiate between the ecosystem maps based on rule-based modeling that we derived from the sprectrally based landcover map produced by GRS, because it provides the most discrete basis for organizing relationships among vegetation, soils, physiography, and other environmental properties.

The structure and function of natural ecosystems are regulated largely along gradients of energy, moisture, nutrients, and disturbance. These gradients are affected by climate, physiography, geomorphology, soils, hydrology, vegetation, and fauna, and are referred to as ecological components (in this report) or 'state factors' (Barnes et al. 1982, ECOMAP 1993, Bailey 1996). We used the state-factor approach (Jenny 1941, Van Cleve et al. 1990, Vitousek 1994, Bailey 1996, Ellert et al. 1997) to evaluate relationships among individual ecological components and to develop a reduced set of ecotypes (Figure 1).

An ecological land classification also involves organizing ecological components within a hierarchy of spatial and temporal scales (Wiken 1981, Allen and Starr 1982, O'Neil et al. 1986, Delcourt and Delcourt 1988, Klijn and Udo de Haes 1994, Forman 1995, Bailey 1996). Local-scale features (e.g., vegetation) are nested within regional-scale components, (e.g., climate and physiography) (Figure 1). Climate, particularly temperature and precipitation, accounts for the largest proportion of global variation in ecosystem structure and function (Walter 1979, Vitousek 1994, Bailey 1998). Within a given climatic zone, physiography (characteristic geologic substrate, surface shape, and relief) controls the rates and spatial arrangements of geomorphic processes and energy flow. These processes result in the formation of geomorphic units with characteristic lithologies, textures, and surface forms, which in turn affect soil properties and the movement of water (Wahrhaftig 1965, Swanson et al. 1988, Bailey 1996). Water movement through soil is a critical factor in determining the distribution of vegetation (Fitter and Hay 1987, Oberbauer et al. 1989), due to its influence on both water balance and nutrient availability for plants. Finally, vegetation provides structure and energy that affect the distribution of many wildlife species. The interrelated processes that operate across these components at the various scales can also be sources of disturbance that greatly influence the timing and development of ecosystems (Watt 1947, Pickett et al. 1989, Walker and Walker 1991, Forman 1995). Official systems for classifying ecosystems across scales have been developed for both the United States (ECOMAP 1993) and Canada (Wiken and Ironside 1977), while the

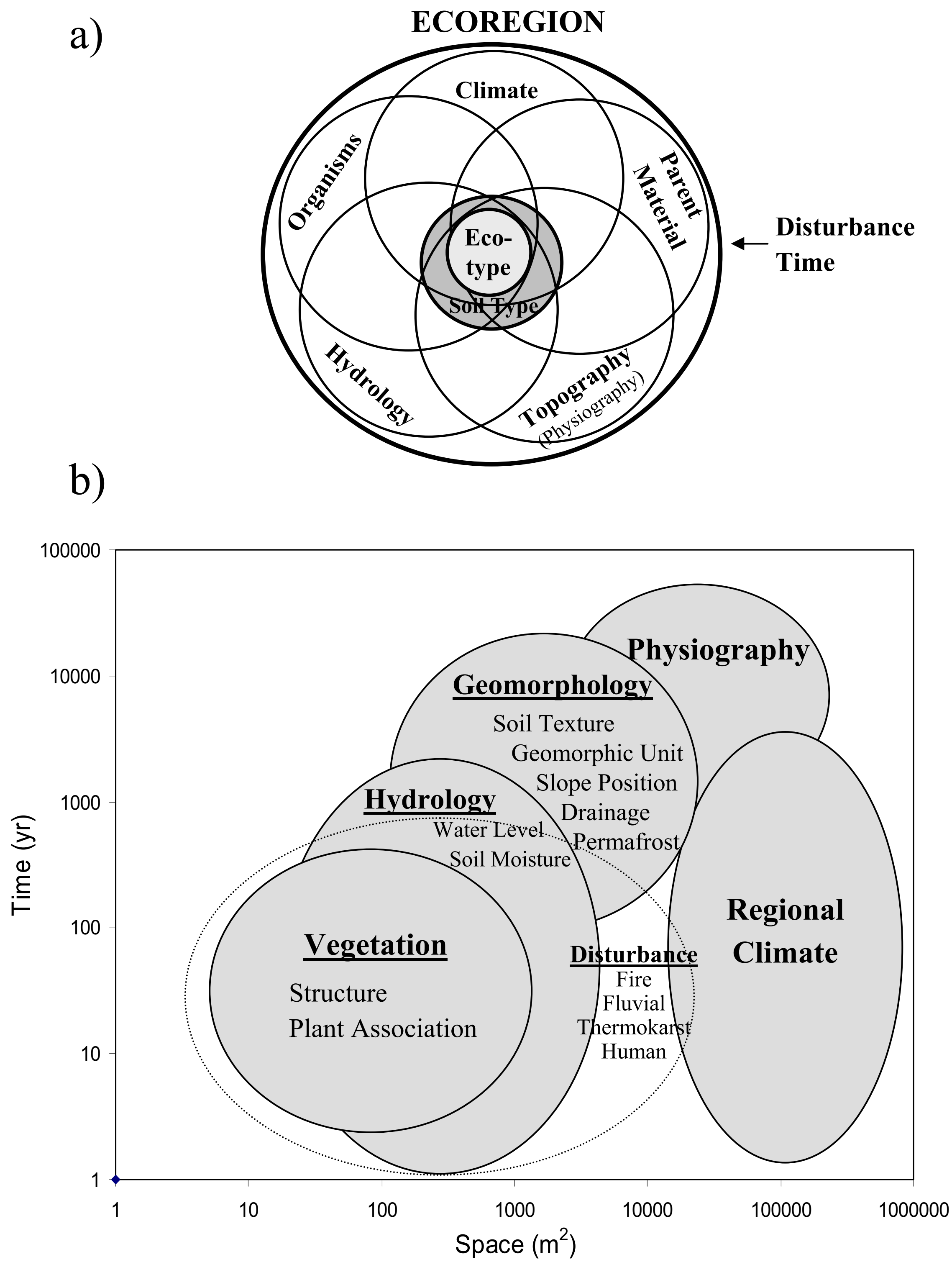


Figure 1. Interaction of interrelated state factors that control the structure and function of ecosystems and the scales at which they operate.

proposed system for Europe incorporates elements of both the U.S. and Canadian systems (Klijn and Udo de Haes 1994).

A hierarchical approach to mapping vegetation and land cover was developed for northern Alaska by Everett and Walker (Everett et al. 1978; Walker 1983, 1999). They also applied an integrated geobotanical approach to mapping ecosystem components in the Prudhoe Bay region, but did not group the integrated units hierarchically (Walker et al. 1980). Recently, an integrated-terrain-unit (ITU) approach was developed for large-scale mapping of ecosystems on the Arctic Coastal Plain (Jorgenson et al. 1997, Jorgenson et al. 2003a), the entire North Slope (Walker 1999, Jorgenson and Heiner 2003), Cape Krusenstern National Monument and Bering Land Bridge National Preserve (Jorgenson et al., 2004), Yukon-Kuskokwim Delta (Jorgenson 2000), interior Alaska (Jorgenson et al. 1999, Jorgenson et al. 2001), and south-central Alaska (Jorgenson et al. 2003b). The ITU approach also has been used for mapping circumpolar arctic vegetation (Walker et al. 2002).

To implement the ecological land classification portion of overall mapping effort, we used a simplified ITU approach that incorporates physiography, surface form, and vegetation; these features are readily mapped or modeled. The physiographic units are derived from the existing landscape-level ecological maps (subsections) for WRST (Swanson and Anderson 2001) and are closely related to surficial geology and geomorphology. The surface forms are derived from the digital elevation model (DEM) (primarily slope-related features). The vegetation classes are obtained from the landcover types developed by the spectral classification performed by GRS. This ITU approach, along with the landscape relationships developed from the analysis of the field survey information, allows us to develop an enhanced set of ecosystem types from remote sensing that essentially differentiate ecosystems at the site level ("ecotypes") of ecological land classification. This integrated approach has several benefits. First, it incorporates the important effects of geomorphic processes on natural disturbance regimes (e.g., flooding, thermokarst) and the flow of energy and material. Second, it preserves the diversity of environmental characteristics. Finally, it uses a systematic approach to classifying landscape features for applied analyses. To demonstrate one application of this approach, we analyzed the relationships among soil and ecotypes and used these relationships to develop a map of soil landscapes. Thus, the maps can serve as the spatial database with differing ecological components to aid resource managers evaluate ecological impacts and develop land management strategies appropriate for a diversity of landscape conditions.

Specific objectives of the project were to:

1. conduct field inventories of vegetation and environmental characteristics in WRST,
2. compile existing field-survey data for use in classification and mapping,
3. revise the existing subsection map to incorporate concerns of WRST staff and improve floodplain delineation,
4. classify ecotypes (local-scale ecosystems) based on analysis of vegetation characteristics and relationships among ecological components,
5. classify soil types based on field soil descriptions,
6. collaborate with GRS to map landcover types within WRST using satellite image processing,
7. develop ecotype and soil-landscape maps from the GRS landcover map using rule-based terrain modeling, and
8. document survey results for the users of the map.

METHODS

FIELD SURVEYS

We attained field-based, ecosystem component data in WRST over a three-year period. Field surveys were conducted during 2–6 and 16–22 July 2004, 9–17 July 2005, and 7–12 July 2006 (Figure 2). We used a gradient-directed sampling scheme (Austin and Heyligers 1989) to sample the range of ecological conditions and to provide the spatially-related data needed to

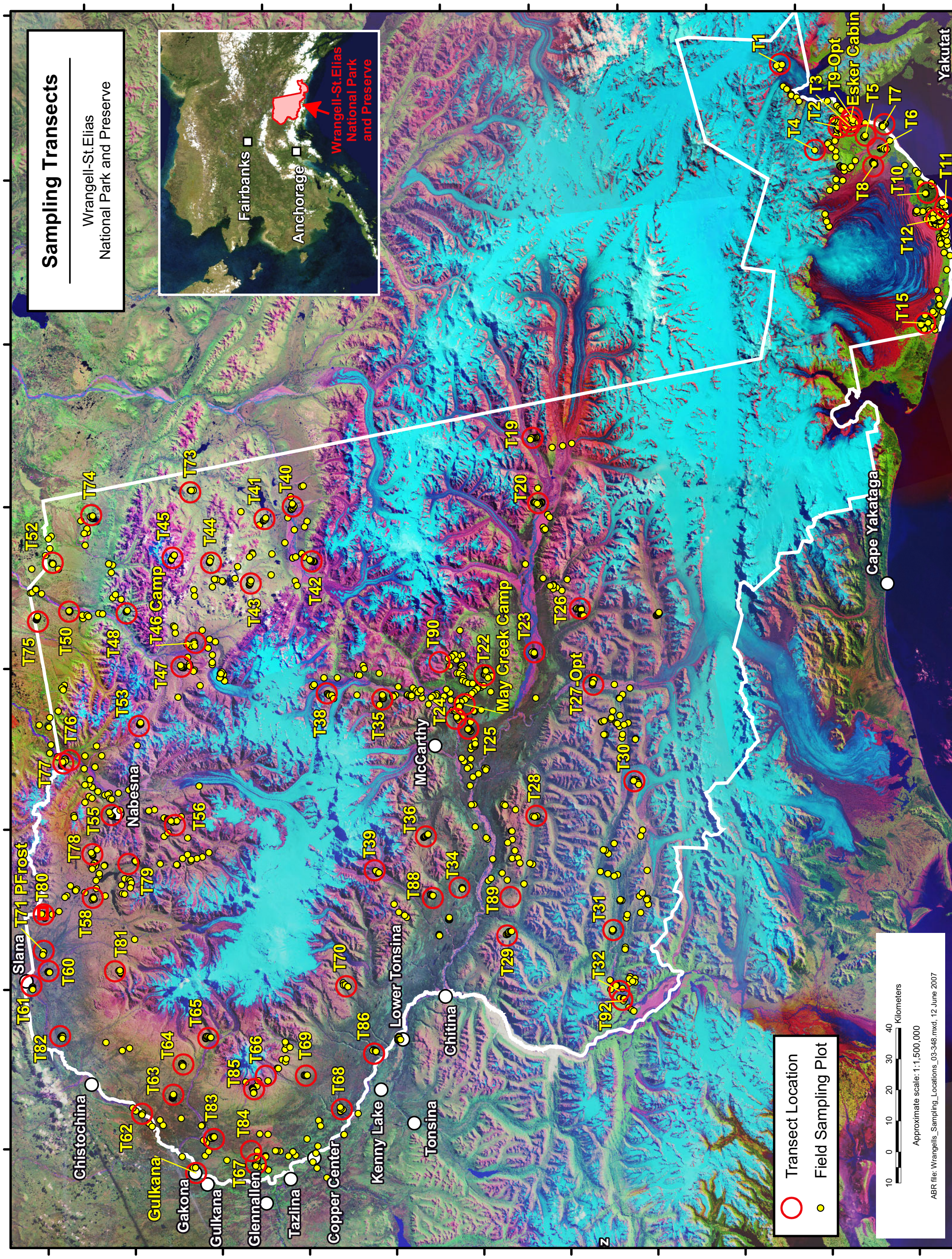


Figure 2. Sampling locations for the ecological land survey for Wrangell-St. Elias National Park and Preserve, southcentral Alaska.

interpret ecosystem development. Intensive sampling was done along toposequences (transects) located within major physiographic units, including coastal, riverine, lacustrine, lowland, upland, subalpine and alpine areas. Data were collected at 569 plots along 77 toposequences. Along each transect, 4–14 plots were sampled, each in a distinct vegetation type or spectral signature identifiable on aerial photographs. To obtain additional information on vegetation structure and dominant plant species within each unique photo signature, some verification sites were sampled off transects. All sample locations were located on aerial photographs, and coordinates (including approximate elevations) were obtained with a Global Positioning System (GPS) receiver (accuracy ±15 m). At each plot (~10-m radius), descriptions or measurements of geology, surface form (micro- and macrotopography), hydrology, soil stratigraphy, and vegetation cover were recorded (Appendix 1). Photos were taken at all sample locations. Data and photos are archived at ABR and NPS.

Geologic and surface-form variables recorded included physiography, surface geomorphic unit, slope, aspect, surface form, and height of microrelief. Hydrologic variables measured at each sampling site included depth of water above or below ground surface, depth to saturated soil, pH, and electrical conductivity (EC). Water depths were measured with a ruler and water-quality measurements (pH and EC) were made with Oakton or Cole-Palmer portable meters that were calibrated daily with standard solutions. These data are compiled in Appendices 2 and 3.

Soil stratigraphy was described from a shallow soil core or soil pit at each plot. Most soil profiles were limited to the seasonally thawed layer (~0.5–1 m) above the permafrost and were described from soil plugs dug with a shovel. For all intensive plots, the dominant mineral texture, the depth of surface organic matter, cumulative thickness of all organic horizons, depth to rock (>15% by volume), and depth of thaw were recorded. When water was not present, EC and pH were measured from a saturated soil paste. A single simplified texture (i.e., loamy, sandy, organic) was assigned to characterize the dominant texture in the top 40 cm at each plot for ecotype classification. A more complete soil stratigraphy was described at 417 plots using standard methods (SSDS 1993). Detailed soil horizon descriptions were summarized into more general lithofacies classes for the purposes of consolidating sites by depositional setting.

Vegetation composition and structure were assessed semi-quantitatively. If cover was <10% or >90%, then cover of each species was visually estimated to the nearest 1%; for cover of 10–90%, it was estimated to the nearest 5%. Isolated individuals or species with very low cover were assigned a cover value of 0.1%. A species list was compiled that included most vascular plants and the dominant nonvascular plants observed in the plot. Although we searched for infrequently occurring and rare species, this project was designed as a field survey and not a comprehensive plant inventory. Total cover of each plant growth form (e.g., tall shrub, dwarf shrub, lichens) was estimated independently of the cover estimates for individual species. Data were cross-checked to ensure that the summed cover of individual species within a growth form category was comparable to the total cover estimated for that growth form. Taxonomic nomenclature is based on Viereck and Little (1972) for shrubs and Hultén (1968) for other vascular plants. We also used floristic data complied by the park for guidance (provided by Mary Beth Cook, Park botanist). Unknown dominant vascular species were identified by Dave Murray and Carolyn Parker, University of Alaska Museum of the North Herbarium (ALA), Fairbanks. Nomenclature for bryophytes and lichens followed the National Plants Database (NRCS 2001). Identification of mosses and lichens during field sampling was limited to dominant, readily identifiable species. Dominant cryptogams that could not be identified in the field were collected and sent to Mikhail Zhurbenko and Olga Afonina, Komarov Botanical Institute, Russia, for identification. Plant species identified are listed in Appendices 4 and 5. We reported the ranking and status of rare plants according to the Alaska Natural Heritage Program, which monitors rare and endemic species in Alaska (http://aknhp.uaa.alaska.edu/botany/Botany_Home.htm).
Notable plant species, including taxa that are rare

within Alaska (Rank S3 or less) or that have limited distribution within WRST, are listed in Appendix 6.

CLASSIFICATION

Ecosystems were classified at two levels. First, individual ecological components were classified and coded using standard classification systems developed for Alaska. Second, these ecological components were integrated to classify ecotypes (local-scale ecosystems) that best partitioned the range of variation for all the measured components.

ECOLOGICAL COMPONENTS

Geomorphic units were classified according to a system based on landform-soil characteristics for Alaska, originally developed by Kreig and Reger (1982) and the Alaska Division of Geological and Geophysical Survey (1983), and modified for this study. We relied on previous landscape analysis of WRST (Swanson and Anderson 2001) as a guide to our identification of geomorphic and geologic units. We emphasized materials near the surface (<2 m) because they have the greatest influence on ecological processes. Within the geomorphic classification, we also classified waterbodies based on their depth, salinity, and genesis.

Surface forms (macrotopography) were classified according to a system modified from that of Schoeneberger et al. (1998). Microtopography was classified according to the periglacial system of Washburn (1973).

Vegetation generally was classified in the field to Level 4 of the Alaska Vegetation Classification (AVC) developed by Viereck et al. (1992). Additionally, plant associations were developed through numeric analyses to further identify plant communities after fieldwork was completed and unknown specimens identified. First, vegetation data (species cover by plot) were ordered into species groups using TWINSPAN (PCOrd 4.17, MjM Software). Second, sorted table analyses (Mueller-Dombois and Ellenberg 1974) were used to refine the groups and identify potential outlier plots. Finally, detrended correspondence analysis was used to chart the plots in species space to assess their dispersion and further identify outliers. After groups were finalized, each plant association was identified by dominant and characteristic species.

ECOTYPES

Classification of ecotypes was accomplished in three general steps: (1) the ecological components were individually classified for each detailed ground description, (2) relationships along transects were examined to illustrate trends across the landscape, and (3) contingency tables were used to identify the common relationships and central tendencies among ecological components. In developing the ecotype classes, we emphasized ecological characteristics (primarily geomorphology and vegetation structure) that could be interpreted from aerial photographs. We also developed a nomenclature for ecotypes that describes ecological characteristics (climate, physiography, soil chemistry, moisture, vegetation structure, and dominant species) using a terminology that can be easily understood.

To reduce the number of ecotype classes, we aggregated the field data for individual ecological components (e.g., soil stratigraphy and vegetation composition), using a hierarchical approach. Geomorphic units were assigned to physiographic settings based on their erosional or depositional processes. Surface-forms were aggregated into a reduced set of slope elements (crest, upper slope, lower slope, toe, and flat). For vegetation, we used the structural levels of the AVC (Viereck et al. 1992), because they are readily identifiable on aerial photographs and a typical species common name (e.g., White Spruce Forest). Frequently, we grouped textural classes because the vegetation associated with them was similar, and some vegetation structures (e.g., open and closed shrub) were grouped because their species composition was similar. Full ecotype names were then based on the aggregated ecological components and include climate, physiography, texture, soil moisture, chemistry, and vegetation (e.g., Boreal Riverine Gravelly Dry Circumalkaline Spruce–Poplar Forest).

Common relationships among ecosystem components were identified by use of contingency tables. The contingency tables sorted plots by climate, physiography, soil texture, geomorphic unit, slope position, drainage, soil chemistry (pH

and salinity), vegetation structure, and plant association. From these tables, common associations were identified and unusual associations either were lumped with those having similar characteristics or excluded as atypical (outliers). Finally, ecotype names were abbreviated to emphasize primary characteristics of the class and facilitate discussion (e.g., Boreal Riverine Spruce–Poplar Forest). The resulting final ecotypes were used for mapping and to summarize the ground data.

SOILS

Soils were classified to the soil subgroup level according to NRCS soil taxonomy, Ninth Edition (NRCS 2003). When data needed for the taxonomic keys were not available, a best guess was used when assigning classes. For example, it was difficult to determine if permafrost was present in rocky soils. Consequently, permafrost was assumed to be present in alpine environments assuming mean annual air temperatures were low. Similarly, differentiating eutrocryepts from dystrocryepts was based on a cutpoint of 5.5 for the pH reaction, although the actual diagnostic criteria is based on a cutpoint of 60% base saturation from laboratory analyses. The coding system we used for soil subgroups is listed in Appendix 7.

Soil-landscape associations, or soil landscapes, were developed to characterize and map broader relationships among soil type, physiography, and vegetation. The soil landscapes were developed by cross-tabulating ecotypes and soil subgroups to identify associations of similar ecotypes that group with similar soil subgroups. The resulting associations were named based on physiography, soil texture, and dominant vegetation structure (e.g., dwarf shrub, woodland forest).

ECOSYSTEM COMPONENTS SYNTHESIS

Ecosystem components were analyzed to identify responses to evolving landscapes comprising a wide variety of geomorphic processes associated with physiographic regimes within the park. Identification of the patterns associated with geomorphic units and vegetation, along with analysis of changes in soil properties within physiographic settings, helps identify processes (e.g., acidification, sedimentation) that affect the changing patterns on the landscape. Understanding these ecological relationships provided parameters to recode the ecotype map into a derived map of other ecological characteristics, such as a soils map or a lichen map (see Section on Soils).

The contingency table analysis also was used to evaluate how well these general relationships conformed to the data set, and how reliably they could be used to extrapolate trends across the landscape. During development of the relationships, 9% of the observations were excluded from the table because of inconsistencies among physiography, texture, geomorphology, drainage, soil chemistry, and vegetation. We excluded these points because our primary goal was to identify the most distinct and consistent trends. These sites may be transitional ecotones, or sites where vegetation and soils have been affected by historical factors (e.g., changes in water levels, disturbances) in ways that are not readily explainable based on current environmental conditions.

LANDCOVER AND ECOSYTEM MAPPING

The landcover map developed for WRST by GRS involved the following procedures (Stumpf 2008): (1) compiling 11 Landsat ETM scenes; (2) developing an unsupervised classification of the scenes to guide field surveys; (3) developing spectral training areas by describing vegetation from representative samples of large homogenous patches using aerial (helicopter) surveys; (4) developing a spectral database that included both spectral and vegetation characteristics; (5) evaluating similarities and differences among spectral signatures; (6) classifying vegetation type of each spectral signature using vegetation-base rules and the quantitative vegetation data associated with each signatures; (7) performing a supervised classification of all the scenes using the classified signatures; (8) and reducing errors in the resulting scenes using rule-based modeling with ancillary data. These data included a DEM, winter Landsat scenes, an ecosection map, and an ecosubsection map. For complete details, the reader is referred to the image processing report by GRS.

We developed a set of three ecosystem maps from the GRS landcover maps, based on rule-based modeling. First, a map of integrated terrain units (ITUs) for the WRST was developed by overlaying and combining the calc_class grid from the GRS landcover map and four terrain layers; climatic subregions (7 classes), physiography (floodplains, glaciers, coastal, and other), elevation (<800 m, 800–1000 m, and >1000 m), and slope (< 7° and >=7°). This generated a total of 6465 combinations, or ITUs. Second, we aggregated this large set of classes into a reduced set of 70 ecotype classes based in large part on terrain relationships identified in the landscape-relationships table (Tables 136 and 137). Third, we developed a soil landscapes map with 26 classes derived from aggregating similar ecotypes with similar soils based on relationships developed from the landscape-relationships analysis using field plot data. These maps are limited in extent to the boundaries of the WRST due to the extent of the subsection map (Swanson and Anderson 2001) used in mapping physiography.

RESULTS

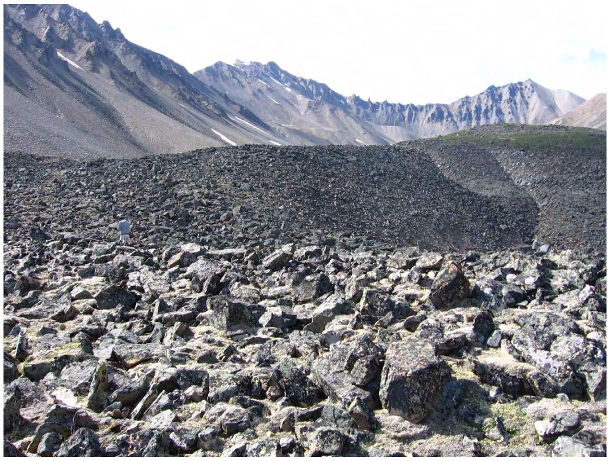
ECOTYPES AND PLANT ASSOCIATIONS

Descriptions of 68 ecotypes are presented for boreal and maritime climatic regions of WRST (Tables 1–131). They were defined by general distribution and landscape setting, plant associations, dominant plant species, dominant soil textures and chemistry, and hydrologic characteristics. For purposes of discussion, we grouped ecotypes into two broad categories, boreal ecotypes, and maritime and aquatic ecotypes. A key to these ecotypes is provided in Table 132. Most ecotypes correspond to a single plant association, however 4 ecotypes had multiple plant associations, and 8 plant associations were used to describe more than one ecotype. The overlap between plant associations and ecotypes occurred between ecotypes that were immediately adjacent in a successional sequence (e.g., Boreal Glaciated Barrens and Boreal Glaciated Dryas Dwarf Shrub) or had similar environmental constraints to plant establishment (e.g., Boreal Lacustrine Sedge Meadow and Boreal Lowland Sedge–Shrub Fen). There were a total of 67 plant associations. We did not describe or map an additional seven ecotypes that were either rare or limited in distribution.

CLASSIFICATION

BOREAL ECOTYPES

BOREAL ALPINE BARRENS



Geomorphology:

This ecotype is widespread throughout the park at high elevations. Vascular plants are sparse. Soils are blocky or rubbly, and parent material consists of hillside colluvium, talus or older moraine. The organic horizon is absent or thin, and depth to permafrost is variable. Sites are well to excessively drained, moist to dry, and circumneutral or, less frequently, acidic.

Plant Association:
Racomitrium sp.–*Carex microchaeta*

Total cover of vascular species is less than 30%, yet this ecotype is diverse in forb and lichen species (Table 1). It has the 5th highest total species count and the 11th highest number of species per plot of all ecotypes. Trees and shrubs taller than 20 cm are absent. Nonvascular species have greater total cover than vascular species, and plots with the vegetation class Dry Bryophyte are included in this ecotype. Common species include *Salix arctica, Salix polaris, Saxifraga bronchialis, Saxifraga oppositifolia, Poa arctica* and *Carex microchaeta.*

Boreal Alpine Barrens is most similar to Boreal Glaciated Barrens, but occurs at higher elevations and does not occur on young glaciated terrain. Many of the species present in Boreal Alpine Barrens also are present in the boreal alpine dwarf scrub communities; the primary difference is reduced species cover.

Table 1. Vegetation cover and frequency for Boreal Alpine Barrens (n=12). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	84.6	26.7	42
Total Vascular Cover	1.5	0.9	42
Total Evergreen Shrub Cover	1.3	2.7	58
Cassiope stelleriana	0.3	0.8	17
Cassiope tetragona	0.2	0.4	25
Dryas integrifolia	0.6	2.0	8
Dryas octopetala	0.0	0.0	25
Ledum decumbens	0.1	0.3	8
Luetkea pectinata	0.1	0.3	8
Total Deciduous Shrub Cover	1.2	2.2	67
Arctostaphylos rubra	0.1	0.3	8
Potentilla fruticosa	0.1	0.3	8
Salix arctica	0.4	1.4	33
Salix polaris	0.5	0.8	33
Salix rotundifolia	0.1	0.3	25
Total Forb Cover	1.6	1.6	92
Campanula uniflora	0.0	0.0	17
Cardamine bellidifolia	0.0	0.0	33
Cerastium beeringianum	0.0	0.0	33
Chrysosplenium wrightii	0.0	0.0	17
Draba sp.	0.0	0.1	25
Epilobium latifolium	0.0	0.0	33
Minuartia macrocarpa	0.0	0.0	33
Oxyria digyna	0.0	0.0	17
Polemonium boreale	0.0	0.0	25
Polygonum viviparum	0.1	0.3	8
Potentilla biflora	0.2	0.6	17
Potentilla hyparctica	0.1	0.3	25
Saussurea viscida var. *yukonensis*	0.0	0.1	25
Saxifraga bronchialis	0.0	0.1	42
Saxifraga flagellaris	0.0	0.0	17
Saxifraga foliolosa	0.0	0.0	17
Saxifraga nivalis	0.0	0.0	17
Saxifraga oppositifolia	0.1	0.3	33
Saxifraga serpyllifolia	0.0	0.0	33
Saxifraga tricuspidata	0.0	0.0	17
Senecio atropurpureus	0.1	0.3	8
Senecio resedifolius	0.0	0.0	25
Sibbaldia procumbens	0.1	0.3	8
Silene acaulis	0.1	0.1	50
Stellaria alaskana	0.0	0.0	25
Total Grass Cover	0.4	0.6	75
Poa alpigena	0.1	0.3	17
Poa arctica	0.0	0.1	42
Trisetum spicatum ssp. *spicatum*	0.0	0.0	25
Total Sedge & Rush Cover	0.6	1.1	83
Carex bigelowii	0.1	0.3	8
Carex microchaeta	0.0	0.0	33
Carex nardina	0.3	0.9	17
Luzula multiflora	0.0	0.0	25
Luzula parviflora	0.1	0.3	8
Luzula tundricola	0.0	0.0	17

Table 1. Continued.

	Cover Mean	SD	Freq %
Total Nonvascular Cover	83.1	26.3	42
Total Moss Cover	22.5	29.8	92
Andreaea rupestris	0.0	0.0	17
Racomitrium canescens	0.1	0.3	17
Racomitrium lanuginosum	17.6	29.2	50
Unknown moss	1.3	3.1	25
Total Lichen Cover	19.5	21.8	92
Alectoria nigricans	0.0	0.0	17
Alectoria ochroleuca	1.9	4.3	58
Cetraria islandica ssp. *islandica*	0.4	0.9	58
Cladina arbuscula	0.2	0.6	8
Cladina stellaris	0.7	1.6	17
Cladina stygia	1.8	4.4	25
Cladonia pocillum	0.1	0.3	17
Cladonia sp.	0.1	0.3	25
Dactylina arctica	0.0	0.0	33
Dactylina ramulosa	0.0	0.0	17
Flavocetraria cucullata	0.1	0.3	33
Flavocetraria nivalis	0.0	0.1	42
Pseudephebe minuscula	0.5	1.0	42
Rhizocarpon geographicum	0.1	0.3	33
Solorina crocea	0.6	1.4	33
Sphaerophorus sp.	0.1	0.3	17
Stereocaulon alpinum	0.2	0.4	17
Stereocaulon sp.	0.3	0.9	33
Thamnolia sp.	0.6	1.7	42
Thamnolia vermicularis	0.2	0.6	33
Umbilicaria proboscidea	3.8	11.5	42
Umbilicaria sp.	1.3	2.8	50
Unknown crustose lichen	5.8	14.6	33
Total Bare Ground	34.0	22.5	42
Soil	60.3	29.9	100

Soils

Soils typically are well to excessively drained, rocky, have very thin or nonexistent surface organic horizons and lack buried organic horizons (Table 2). An eolian silt cap is absent due to the high elevations and steep slopes, and rock fragments are abundant at the surface. Frost boils, or sorted and nonsorted circles, are lacking due to the lack of fine-grained soil. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be present below 1 m because of low air temperatures at the high elevations. Depth to water often could not be measured but is assumed to be at substantial depths below 1 m. Soil pH is circumneutral (5.6–7.3) and electrical conductivity is moderately low.

Table 2. Summary of soil characteristics for Boreal Alpine Barrens.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.0	2.5	10
Cumulative Org. in 40 cm (cm)	1.0	2.5	10
Loess Cap Thickness(cm)	0.1	0.3	10
Depth to Rocks (cm)	0.9	2.5	10
Surface Fragment Cover (%)	65.7	28.1	9
Frost Boil Cover (%)	0.2	0.4	6
Thaw Depth (cm)[a]	134.0	35.8	5
Site pH at 10-cm depth	6.2	0.7	8
Site EC at 10-cm depth (µS/cm)	133.8	143.0	8
Water Depth (cm, + above gnd)[a]	-131.9	30.3	10

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically (subgroup level) by Typic Gelorthents (poorly developed with permafrost below 1 m). Other common soils include Humic Dystrogelepts (acidic, well drained, a moderately thick organic-rich A horizon, frost below 1 m), Typic Dystrogelepts (acidic, well drained, moderately thin organic horizon, and permafrost below 1 m) and Typic Eutrogelepts (moist, nonacidic, partially developed with permafrost below 1 m).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Alpine Rocky Barrens and Scrub, which also includes Boreal Alpine Dryas Dwarf Shrub

BOREAL ALPINE DRYAS DWARF SHRUB

Geomorphology:

This ecotype commonly occurs at high elevations on slopes and crests. Blocky and rubbly soils overlain by thin organic horizons are most common, though soil texture is variable. Soil parent material varies among younger moraine, older moraine, and hillside colluvium. Sites are acidic to circumneutral, well to excessively drained, and moist to dry.

Plant Association:

Dryas octopetala–Hierochlöe alpina–Saussurea viscida

Evergreen dwarf shrubs, particularly *Dryas* spp., characterize this diverse, species-rich class (Table 3). This ecotype has the second highest number of species per plot and the third highest overall species count; many rare species, such as *Oxytropis huddelsonii*, occur here. Trees and tall shrubs are absent. Most species have less than 2% cover. Dominant species include *Dryas octopetala, Salix arctica, Hierochlöe alpina, Silene acaulis Saussurea viscida* and *Flavocetraria cucullata*.

This ecotype is similar to Boreal Alpine Ericaceous Dwarf Shrub in species composition and diversity, but *Dryas* is more prevalent than ericaceous species and is differentiated by the common occurrence of *Hierochlöe alpina*.

Table 3. Vegetation cover and frequency for Boreal Alpine Dryas Dwarf Shrub (n=17). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	118.7	14.7	35
Total Vascular Cover	71.0	21.7	35
Total Evergreen Shrub Cover	47.4	14.7	100
Cassiope tetragona	2.3	4.9	65
Diapensia lapponica	1.6	3.4	47
Dryas integrifolia	5.0	15.4	12
Dryas octopetala	34.7	21.8	82
Dryas octopetala ssp. *alaskensis*	1.8	7.3	12
Empetrum nigrum	0.1	0.3	24
Ledum decumbens	0.1	0.5	29
Rhododendron lapponicum	1.5	2.7	53
Vaccinium vitis-idaea	0.2	0.5	18
Total Deciduous Shrub Cover	13.0	12.4	100
Potentilla fruticosa	2.3	6.9	35
Salix arctica	4.1	5.1	88
Salix reticulata	2.0	5.2	35
Vaccinium uliginosum	3.8	6.6	65
Total Forb Cover	8.2	6.5	100
Anemone narcissiflora	0.6	0.9	59
Anemone parviflora	0.1	0.3	29
Artemisia arctica	0.1	0.2	24
Campanula lasiocarpa	0.0	0.0	35
Castilleja caudata	0.1	0.2	18
Castilleja elegans	0.0	0.0	24
Epilobium latifolium	0.2	0.7	24
Hedysarum alpinum	0.4	0.9	18
Lloydia serotina	0.0	0.0	29
Lupinus arcticus	0.5	1.4	24
Minuartia arctica	0.3	0.8	29
Minuartia obtusiloba	0.1	0.3	18
Oxytropis huddelsonii	0.1	0.3	18
Oxytropis nigrescens	0.7	1.7	53
Oxytropis scammaniana	0.1	0.5	18
Pedicularis capitata	0.2	0.5	47
Pedicularis sudetica	0.2	0.5	24
Polygonum bistorta	0.5	0.9	29
Polygonum viviparum	0.3	0.6	47
Potentilla biflora	0.4	1.3	18
Potentilla uniflora	0.2	0.5	29
Saussurea viscida var. *yukonensis*	0.1	0.2	47
Saxifraga bronchialis	0.3	0.5	59
Senecio resedifolius	0.0	0.0	24
Silene acaulis	0.3	0.4	76
Tofieldia coccinea	0.1	0.3	29
Zygadenus elegans	0.1	0.3	24
Total Grass Cover	3.8	3.3	100
Calamagrostis purpurascens	0.2	0.5	18
Festuca altaica	1.6	2.7	47
Festuca brachyphylla	0.1	0.5	18
Hierochlöe alpina	1.1	1.2	76
Poa alpina	0.4	1.2	24
Poa arctica	0.2	0.5	24

Table 3. Continued.

	Cover Mean	Cover SD	Freq %
Total Sedge & Rush Cover	4.9	6.7	94
Carex bigelowii	1.2	3.0	35
Carex microchaeta	0.5	1.7	18
Carex nesophila	1.0	2.6	29
Carex podocarpa	0.5	1.5	18
Carex scirpoidea	0.6	1.1	35
Kobresia myosuroides	0.5	1.4	24
Total Nonvascular Cover	47.8	22.7	35
Total Moss Cover	10.1	10.3	100
Bryum sp.	0.7	1.4	35
Dicranum sp.	1.0	2.6	29
Hylocomium splendens	0.1	0.2	12
Polytrichum sp.	0.5	0.8	53
Racomitrium sp.	1.2	2.7	29
Rhytidium rugosum	1.5	2.8	35
Unknown moss	4.1	8.1	29
Total Lichen Cover	23.0	19.5	100
Alectoria ochroleuca	0.6	1.5	18
Cetraria islandica ssp. *islandica*	0.1	0.3	29
Cladonia sp.	1.0	2.2	24
Dactylina arctica	0.0	0.0	29
Flavocetraria cucullata	1.3	1.5	76
Flavocetraria nivalis	1.9	1.9	65
Pertusaria sp.	0.5	0.9	29
Sphaerophorus sp.	0.1	0.3	35
Stereocaulon sp.	1.4	3.7	35
Thamnolia sp.	1.1	1.9	29
Thamnolia vermicularis	1.3	1.5	53
Umbilicaria proboscidea	0.2	1.0	18
Unknown crustose lichen	3.4	4.6	41
Unknown lichen	5.0	12.7	18
Vulpicida tilesii	0.1	0.5	18
Total Bare Ground	28.8	12.8	35
Soil	11.6	10.9	94
Litter Alone	12.9	7.5	100

Soils

Soils typically are rocky, well to excessively drained, have very thin surface organic horizons and lack buried organic horizons (Table 4). Occasionally a fine-grained horizon, derived from colluvial or eolian activity, occurs near the surface. Frost boils, or sorted and nonsorted circles, are relatively abundant. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be present below 1 m because of low air temperatures at the high elevations. Depth to water usually could not be measured but is assumed to be at substantial depths below 1 m. Soil pH is acidic to circumneutral, depending on bedrock, and electrical conductivity is low.

Table 4. Summary of soil characteristics for Boreal Alpine Dryas Dwarf Shrub

Property	Mean	SD	n
Surface Organics Depth (cm)	3.8	3.3	9
Cumulative Org. in 40 cm (cm)	3.8	3.3	9
Loess Cap Thickness(cm)	0.3	0.8	7
Depth to Rocks (cm)	14.0	18.4	9
Surface Fragment Cover (%)	23.2	28.9	10
Frost Boil Cover (%)	6.7	16.3	6
Thaw Depth (cm)[a]	150.0	0.0	2
Site pH at 10-cm depth	6.0	0.2	10
Site EC at 10-cm depth (µS/cm)	55.0	41.4	10
Water Depth (cm, + above gnd)[a]	-141.7	20.4	6

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically (subgroup) by Typic Dystrogelepts (acidic, well drained, moderately thin organic horizon, and permafrost below 1 m) and Typic Eutrogelepts (moist, nonacidic, partially developed with permafrost below 1 m). Humic Eutrogelepts (circumneutral, well drained, a moderately thick organic-rich A horizon, frost below 1 m) also are common.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Alpine Rocky Barrens and Scrub, which also includes Boreal Alpine Barrens and Boreal Alpine Ericaceous Dwarf Shrub.

BOREAL ALPINE ERICACEOUS DWARF SHRUB

Geomorphology:

This ecotype is widespread and occurs on upper slopes, especially in nivation hollows and other high elevation areas where snowmelt is late. Underlying terrain units include upland loess, hillside colluvium, kame and solifluction deposits, and older and younger moraine. Soil textures are loamy, blocky or rubbly, and occur under a thin organic horizon. Sites are moist, well-drained and mostly circumneutral (alkaline or acidic chemistry occurs infrequently). Depth to permafrost is variable.

Plant Associations:

Cassiope tetragona–Pedicularis capitata
Empetrum nigrum–Artemisia arctica

Cassiope, dwarf *Vaccinium,* and *mixed ericaceous* vegetation classes are included in this ecotype (Table 5). Additional common species are *Salix arctica, Anemone narcissiflora* and *Festuca altaica*. Nonvascular species have reduced cover relative to vascular species. Similar to all boreal alpine ecotypes, rare and notable species frequently occur here (Cook & Roland, 2002).

This ecotype is similar to Boreal Alpine Dryas Dwarf Shrub and Boreal Alpine Barrens as described previously, but differs in the dominance of either *Cassiope* or *Empetrum* dwarf shrubs.

Table 5. Vegetation cover and frequency for Boreal Alpine Ericaceous Dwarf Shrub (n=20). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	119.7	43.5	100
Total Vascular Cover	89.8	30.1	100
Total Evergreen Tree Cover	0.1	0.2	20
Picea glauca	0.1	0.2	20
Total Evergreen Shrub Cover	49.7	19.9	100
Arctostaphylos uva-ursi	0.7	2.3	15
Cassiope stelleriana	3.0	12.3	10
Cassiope tetragona	17.2	14.8	80
Diapensia lapponica	0.5	1.3	35
Dryas octopetala	11.1	10.8	65
Dryas octopetala ssp. *alaskensis*	1.1	3.5	15
Empetrum nigrum	5.6	8.6	50
Juniperus communis	0.2	0.5	15
Ledum decumbens	1.3	4.5	30
Loiseleuria procumbens	0.4	1.2	20
Rhododendron lapponicum	0.8	2.4	15
Vaccinium vitis-idaea	1.3	1.9	45
Total Deciduous Shrub Cover	25.9	23.2	100
Arctostaphylos alpina	1.7	4.0	20
Arctostaphylos rubra	1.3	3.6	20
Betula nana	1.7	6.7	20
Potentilla fruticosa	0.9	2.7	30
Salix arctica	0.8	1.5	45
Salix planifolia ssp. *pulchra*	0.1	0.3	20
Salix polaris	1.9	4.6	35
Salix reticulata	2.9	3.2	65
Vaccinium uliginosum	13.4	19.2	65
Total Forb Cover	9.2	6.8	100
Anemone narcissiflora	0.4	0.7	50
Anemone parviflora	0.2	0.4	15
Antennaria monocephala	0.1	0.3	30
Arnica lessingii	0.2	0.5	15
Artemisia arctica ssp. *arctica*	0.6	0.8	45
Astragalus umbellatus	0.1	0.4	30
Dodecatheon frigidum	0.3	1.1	25
Epilobium latifolium	0.5	1.3	35
Equisetum scirpoides	0.2	0.5	25
Gentiana glauca	0.0	0.0	15
Gentiana propinqua	0.0	0.0	15
Hedysarum alpinum	0.1	0.4	15
Lupinus arcticus	1.4	3.2	20
Lycopodium selago	0.1	0.4	35
Oxyria digyna	0.3	0.8	20
Oxytropis nigrescens	0.1	0.3	30
Pedicularis capitata	0.4	0.5	70
Polygonum bistorta	0.1	0.2	35
Polygonum viviparum	0.2	0.4	25
Pyrola grandiflora	0.2	0.5	20
Saussurea viscida var. *yukonensis*	0.2	0.4	20
Saxifraga bronchialis	0.1	0.3	30
Silene acaulis	0.6	1.5	35
Tofieldia coccinea	0.1	0.2	30
Zygadenus elegans	0.0	0.0	20

Table 5. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Total Grass Cover	2.7	3.0	90
Festuca altaica	1.8	2.6	70
Hierochlöe alpina	0.5	0.7	55
Poa arctica	0.0	0.0	20
Total Sedge & Rush Cover	2.4	2.4	85
Carex microchaeta	0.3	1.1	20
Carex nesophila	0.5	0.9	30
Carex podocarpa	0.3	0.7	25
Carex scirpoidea	0.5	1.0	40
Total Nonvascular Cover	29.8	25.6	90
Total Moss Cover	15.9	16.4	80
Aulacomnium turgidum	0.4	0.9	20
Dicranum sp.	1.9	2.7	45
Hylocomium splendens	2.7	5.7	45
Polytrichum sp.	0.3	0.6	25
Racomitrium sp.	0.8	1.7	20
Rhytidium rugosum	2.5	5.7	20
Tomentypnum nitens	1.7	3.7	20
Total Lichen Cover	13.9	13.5	85
Cetraria islandica ssp. *islandica*	1.2	2.3	45
Cladina mitis	0.7	1.4	25
Cladina sp.	0.9	2.1	25
Cladonia sp.	0.5	0.9	30
Dactylina arctica	0.5	0.7	50
Flavocetraria cucullata	1.7	2.7	45
Flavocetraria nivalis	1.3	2.5	40
Masonhalea richardsonii	0.1	0.4	25
Peltigera aphthosa	0.1	0.2	25
Peltigera sp.	0.0	0.0	25
Stereocaulon sp.	1.5	2.9	35
Thamnolia sp.	0.2	0.7	15
Thamnolia vermicularis	1.1	1.6	50
Unknown crustose lichen	1.5	3.0	30
Total Bare Ground	20.3	10.2	100
Soil	9.1	9.7	90
Litter Alone	11.2	8.4	100

Soils

Soils typically are rocky to loamy, well drained, have thin surface organic horizons, and rock fragments are common at the surface (Table 6). Occasionally a fine-grained horizon, derived from colluvial or eolian activity, occurs near the surface, causing rocks to occur at shallow depth below the surface. Frost boils, or sorted and nonsorted circles, are uncommon. Thaw depths could not be always be determined in the rocky soils, but permafrost was usually found at ~1 m depth. Depth to water frequently could not be measured but is assumed to be at substantial depths below 1 m. Soil pH is acidic to circumneutral, depending on bedrock, and electrical conductivity is low.

Table 6. Summary of soil characteristics for Boreal Alpine Ericaceous Dwarf Shrub.

Property	Mean	SD	n
Surface Organics Depth (cm)	4.2	4.8	14
Cumulative Org. in 40 cm (cm)	4.2	4.8	14
Loess Cap Thickness(cm)	2.4	6.4	11
Depth to Rocks (cm)	18.4	13.5	13
Surface Fragment Cover (%)	4.7	4.8	12
Frost Boil Cover (%)	2.6	3.6	7
Thaw Depth (cm)[a]	100.0	70.7	2
Site pH at 10-cm depth	5.7	0.5	14
Site EC at 10-cm depth (µS/cm)	85.0	124.6	14
Water Depth (cm, + above gnd)[a]	-133.3	25.0	10

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically (subgroup) by Typic Dystrogelepts (acidic, well drained, moderately thin organic horizon, and permafrost below 1 m) and Typic Eutrogelepts (circumneutral to alkaline, well drained, moderately thin organic horizon, and permafrost below 1 m). Humic Eutrogelepts (circumneutral, well drained, a moderately thick organic-rich A horizon, frost below 1 m) are uncommon.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Alpine Rocky Barrens and Scrub, which also includes Boreal Alpine Barrens and Boreal Alpine Dryas Dwarf Shrub.

BOREAL ALPINE SEDGE MEADOW

Geomorphology:

These sedge meadows are located on flats or in kettle basins on hillside colluvium, lacustrine and solifluction deposits, older moraine, and organic deposits above 1000 m elevation. These meadows commonly occur on high plateaus such as the Jaeger Mesa. Permafrost usually is present, and sites are wet to aquatic, and poorly drained to flooded. Soils range from circumneutral to acidic, and the dominant soil texture is peat or, less frequently, sand, loam or gravel. Litter alone comprises up to one-third of the total ground cover.

Plant Association:

Eriophorum angustifolium–Carex aquatilis–Salix pulchra

This ecotype is strongly dominated by the species in the plant association, though other sedges occasionally co-dominate (e.g. C. *stylosa*, C. *atrofusca*) (Table 7). Trees are absent. Common associated species include *Saxifraga hirculus and Polemonium acutiflorum.* The total species count is 7th highest overall. While vascular diversity at any individual site typically is low, moss diversity is high. On average we documented 25 species per plot.

This ecotype is similar to Boreal Alpine Tussock Meadow, but has <25% tussock cover. It is also similar to Boreal Alpine Sedge–Dwarf Willow Meadow, but Boreal Alpine Sedge Meadow is wetter and has less shrub cover.

Table 7. Vegetation cover and frequency for Boreal Alpine Sedge Meadow (n=12). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	105.9	45.1	100
Total Vascular Cover	68.7	35.0	100
Total Evergreen Shrub Cover	1.0	3.0	25
Andromeda polifolia	0.7	2.0	17
Empetrum nigrum	0.1	0.3	17
Ledum decumbens	0.0	0.0	17
Rhododendron lapponicum	0.2	0.6	17
Total Deciduous Shrub Cover	3.9	10.1	67
Arctostaphylos rubra	0.0	0.0	8
Salix planifolia ssp. *pulchra*	1.3	2.4	58
Salix reticulata	1.3	4.3	25
Vaccinium uliginosum	0.0	0.0	17
Total Forb Cover	2.2	2.5	92
Anemone parviflora	0.0	0.0	8
Anemone richardsonii	0.0	0.0	17
Antennaria monocephala	0.0	0.0	17
Caltha palustris	0.2	0.6	25
Cardamine bellidifolia	0.0	0.0	25
Chrysosplenium tetrandrum	0.0	0.0	17
Claytonia bostockii	0.0	0.0	25
Claytonia sarmentosa	0.0	0.0	8
Draba lactea	0.0	0.0	17
Equisetum arvense	0.5	1.2	33
Equisetum fluviatile	0.4	1.4	8
Eutrema edwardsii	0.0	0.0	25
Melandrium apetalum	0.0	0.0	25
Pedicularis langsdorffii ssp. *langsdorffii*	0.0	0.0	17
Pedicularis langsdorffii	0.0	0.0	17
Petasites frigidus	0.0	0.0	17
Polemonium acutiflorum	0.1	0.3	42
Polygonum viviparum	0.0	0.0	25
Potentilla hyparctica	0.0	0.0	25
Ranunculus nivalis	0.0	0.0	17
Saxifraga foliolosa	0.0	0.0	25
Saxifraga hirculus	0.0	0.1	42
Senecio atropurpureus	0.0	0.0	17
Stellaria monantha	0.0	0.0	17
Valeriana capitata	0.0	0.0	17
Total Grass Cover	0.3	0.6	58
Arctagrostis latifolia	0.2	0.6	25
Trisetum spicatum ssp. *spicatum*	0.0	0.0	17
Total Sedge & Rush Cover	61.4	30.4	100
Carex aquatilis ssp. *aquatilis*	20.6	20.2	83
Carex atrofusca	0.8	2.9	8
Carex bigelowii	1.7	5.8	8
Carex chordorrhiza	0.4	1.4	8
Carex holostoma	0.3	0.9	17
Carex membranacea	1.3	4.3	8
Carex misandra	0.0	0.0	17
Carex podocarpa	0.1	0.3	17
Carex rotundata	1.9	4.7	17
Carex scirpoidea	0.2	0.6	8
Carex stylosa	12.1	25.9	25
Eriophorum angustifolium	14.1	15.2	92

Table 7. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Eriophorum callitrix	0.0	0.0	17
Eriophorum russeolum	2.1	4.5	25
Eriophorum scheuchzeri	0.4	1.4	8
Eriophorum vaginatum	0.2	0.6	17
Juncus triglumis	0.0	0.0	17
Kobresia simpliciuscula	0.1	0.3	8
Trichophorum caespitosum	4.2	14.4	8
Total Nonvascular Cover	37.2	24.6	100
Total Moss Cover	36.0	24.2	100
Aulacomnium palustre	1.1	1.9	33
Aulacomnium turgidum	0.8	1.4	42
Calliergon stramineum	4.2	14.4	8
Campylium polygamum	0.3	0.9	8
Drepanocladus revolvens	0.7	1.6	17
Limprichtia cossoni	0.3	0.9	8
Loeskypnum badium	0.3	0.6	17
Meesia triquetra	3.4	11.5	17
Mnium sp.	2.3	7.2	25
Paludella squarrosa	0.9	1.9	33
Scorpidium scorpioides	0.5	1.4	17
Sphagnum fuscum	0.4	1.4	8
Sphagnum rubellum	0.1	0.3	8
Sphagnum warnstorfii	0.2	0.6	8
Tomentypnum nitens	2.9	6.2	25
Unknown moss	13.5	15.7	67
Warnstorfia sarmentosa	0.3	0.9	8
Total Lichen Cover	1.2	2.0	58
Cetraria islandica ssp. *islandica*	0.4	0.9	42
Cladina arbuscula	0.3	0.5	25
Cladonia sp.	0.3	0.4	50
Dactylina arctica	0.0	0.0	25
Flavocetraria cucullata	0.1	0.3	42
Total Bare Ground	45.0	31.2	100
Soil	2.5	4.4	50
Litter Alone	18.0	15.7	100
Water	24.5	27.6	92

Soils

Soils typically are poorly to very poorly drained, and have thick surface organic horizons. Rocks are found at substantial depth and rock fragments at the surface are uncommon (Table 8). Eolian loess caps are absent. Frost boils, or sorted and nonsorted circles, are uncommon. Thaw depths are moderately shallow and permafrost is always present. Soil water is found at very shallow depths. Soil pH is acidic to circumneutral, depending on bedrock, and electrical conductivity is low.

Table 8. Summary of soil characteristics for Boreal Alpine Sedge Meadow.

Property	Mean	SD	n
Surface Organics Depth (cm)	31.9	8.2	7
Cumulative Org. in 40 cm (cm)	31.5	8.2	6
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	78.0	58.1	4
Surface Fragment Cover (%)	0.3	0.6	6
Frost Boil Cover (%)	2.0	4.5	5
Thaw Depth (cm)[a]	41.0	26.9	6
Site pH at 10-cm depth	5.9	0.6	7
Site EC at 10-cm depth (µS/cm)	51.4	32.9	7
Water Depth (cm, + above gnd)[a]	-3.6	16.7	7

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically (subgroup) by Typic Fibristels (poorly decomposed organic horizon thicker than 40 cm, permafrost present). Less common soils include Typic Hemistels (moderately decomposed organic horizon thicker than 40 cm, permafrost present), Typic Historturbels (wet, organic-rich soil over permafrost with cryoturbation evident) and Typic Aquorthels (wet, mineral soil over permafrost lacking cryoturbation).

This ecotype and associated soils comprise the soil landscapes within Boreal Alpine Sedge Meadow. It is sufficiently unique that no other ecotypes are included in this class.

BOREAL ALPINE SEDGE–DWARF WILLOW MEADOW

Geomorphology:

This ecotype hosts a diverse array of plant species. Located at high elevations on plateaus and concave or planar slopes, terrain includes hillside colluvium, older and younger moraine, solifluction deposits, upland loess deposits, and alluvial fan abandoned deposits. Due to this variety, dominant soil textures can be rocky, loamy or organic. Sites are moist or wet and drainage is variable. Permafrost usually is present and soils range from circumneutral to acidic.

Plant Associations:

Carex bigelowii–Salix reticulata
Salix polaris–Artemisia arctica

This ecotype has the highest documented number of species per plot and the second highest species diversity overall (Table 9). Except for trees, every life form is well represented in this ecotype. Associated species include *Salix planifolia pulchra, Dryas* spp., *Polygonum viviparum*, and *Petasites frigidus*. Rare species that occur here include *Claytonia bostockii* and *Aphragmus eschscholtzianus* (NPS data).

This ecotype is similar to Boreal Alpine Sedge Meadow, but it has fewer aquatic sedges, higher shrub cover and a higher species count. Boreal Alpine Tussock Meadow has similar species composition but is dominated *Eriophorum vaginatum*.

Table 9. Vegetation cover and frequency for Boreal Alpine Sedge–Dwarf Willow Meadow (n=25). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	134.6	57.0	100
Total Vascular Cover	86.9	39.0	100
Total Evergreen Shrub Cover	10.6	12.7	79
Cassiope tetragona	0.9	2.4	25
Dryas integrifolia	2.6	7.0	17
Dryas octopetala	2.3	4.8	38
Empetrum nigrum	1.5	3.8	21
Ledum decumbens	0.4	1.2	21
Rhododendron lapponicum	0.2	0.5	25
Vaccinium vitis-idaea	0.7	1.7	25
Total Deciduous Shrub Cover	31.5	17.8	100
Betula nana	1.2	3.3	20
Potentilla fruticosa	0.2	0.5	24
Salix arctica	1.1	3.2	24
Salix planifolia ssp. *pulchra*	2.1	5.6	48
Salix polaris	6.0	12.0	52
Salix reticulata	14.9	13.0	80
Salix rotundifolia	2.6	8.4	16
Vaccinium uliginosum	1.2	3.2	32
Total Forb Cover	19.0	21.8	100
Anemone narcissiflora	0.3	0.9	38
Anemone parviflora	0.7	2.1	25
Anemone richardsonii	0.7	2.2	21
Antennaria monocephala	0.0	0.0	29
Artemisia arctica ssp. *arctica*	0.9	2.2	38
Campanula rotundifolia	0.1	0.2	17
Castilleja caudata	0.2	0.6	21
Claytonia bostockii	0.0	0.0	17
Claytonia sarmentosa	0.1	0.2	21
Dodecatheon frigidum	0.5	1.4	25
Epilobium latifolium	0.0	0.0	13
Equisetum arvense	7.1	16.3	42
Eutrema edwardsii	0.0	0.0	13
Lycopodium selago	0.1	0.2	17
Minuartia macrocarpa	0.0	0.0	17
Myosotis alpestris ssp. *asiatica*	0.1	0.3	13
Parnassia kotzebuei	0.0	0.0	17
Pedicularis capitata	0.1	0.3	33
Pedicularis kanei	0.2	0.4	25
Pedicularis langsdorffii	0.0	0.0	21
Petasites frigidus	2.1	5.4	46
Polemonium acutiflorum	0.1	0.2	21
Polygonum bistorta	0.4	0.8	50
Polygonum viviparum	0.3	0.4	75
Saussurea viscida var. yukonensis	0.6	1.7	33
Saxifraga bronchialis	0.1	0.2	17
Senecio atropurpureus ssp. *frigidus*	0.0	0.0	21
Senecio atropurpureus	0.2	1.0	17
Silene acaulis	0.0	0.0	33
Solidago multiradiata	0.2	0.6	25
Valeriana capitata	0.3	0.9	25
Total Grass Cover	4.8	6.3	88
Arctagrostis latifolia	0.6	1.2	33
Festuca altaica	2.2	4.8	33

Table 9. Continued.

	Cover Mean	Cover SD	Freq %
Hierochlöe alpina	0.1	0.3	33
Poa arctica	0.6	1.5	38
Trisetum spicatum ssp. *spicatum*	0.3	0.8	25
Total Sedge & Rush Cover	20.5	19.6	100
Carex bigelowii	10.3	16.4	58
Carex membranacea	0.3	1.0	17
Carex microchaeta	4.8	14.7	17
Carex misandra	0.4	1.5	17
Carex podocarpa	0.9	2.4	25
Carex scirpoidea	0.8	3.1	21
Eriophorum angustifolium	0.9	1.7	25
Total Nonvascular Cover	47.7	36.1	100
Total Moss Cover	36.3	33.1	100
Aulacomnium acuminatum	0.3	1.1	21
Aulacomnium palustre	3.4	5.1	42
Aulacomnium turgidum	0.2	0.5	21
Dicranum sp.	0.7	1.3	38
Hylocomium splendens	5.9	14.9	29
Polytrichum sp.	0.1	0.3	25
Racomitrium canescens	0.5	1.3	17
Racomitrium lanuginosum	3.1	8.7	21
Tomentypnum nitens	4.2	8.4	25
Unknown moss	11.5	18.4	33
Total Lichen Cover	11.4	15.1	92
Cetraria islandica ssp. *islandica*	0.8	1.8	33
Cladina mitis	0.3	1.0	17
Cladina sp.	1.6	4.4	17
Cladina stellaris	0.4	1.4	13
Cladonia sp.	0.5	1.0	38
Dactylina arctica	0.3	0.5	58
Flavocetraria cucullata	1.1	2.4	38
Flavocetraria nivalis	0.3	1.0	21
Peltigera aphthosa	0.1	0.2	21
Stereocaulon sp.	0.9	1.5	50
Total Bare Ground	19.9	17.3	100
Soil	6.8	15.6	67
Litter Alone	12.5	11.5	100
Water	0.6	1.1	33

Soils

Soils are highly variable but fall into two general categories; those that are moist and rocky and those that are wet and organic-rich. Overall, the soils typically have thin surface organic horizons, rocky soil horizons near the surface, and substantial exposed rock fragments (Table 10). Frost boils, or sorted and nonsorted circles, are uncommon, but the surface is often hummocky. Thaw depths over permafrost are moderately deep. Depth to water is moderately deep, but highly variable depending on drainage. Soil pH is acidic to circumneutral, depending on bedrock, and electrical conductivity is low.

Table 10. Summary of soil characteristics for Boreal Alpine Sedge–Dwarf Willow Shrub.

Property	Mean	SD	n
Surface Organics Depth (cm)	6.4	7.0	20
Cumulative Org. in 40 cm (cm)	7.2	6.9	20
Loess Cap Thickness(cm)	2.1	5.7	18
Depth to Rocks (cm)	16.2	14.4	15
Surface Fragment Cover (%)	19.4	28.4	20
Frost Boil Cover (%)	1.0	2.7	11
Thaw Depth (cm)[a]	62.1	41.4	10
Site pH at 10-cm depth	5.9	0.6	18
Site EC at 10-cm depth (µS/cm)	90.6	84.5	18
Water Depth (cm, + above gnd)[a]	-73.6	54.7	19

[a] Measurements >1 m indicate minimum depth, not true depth

Soils of moist, rocky sites are dominated taxonomically (subgroup) by Typic Dystrogelepts (acidic, well drained, moderately thin organic horizon, and permafrost below 1 m) and Typic Eutrogelepts (circumneutral to alkaline, well drained, moderately thin organic horizon, and permafrost below 1 m), with less frequent occurrences of Humic Dystrogelepts. Wetter, organic-rich sites are dominated by Typic Aquorthels (wet, mineral soil over permafrost lacking cryoturbation), Typic Histoturbels (wet, organic-rich soil over permafrost with cryoturbation), and Typic Aquiturbels (wet, mineral soil over permafrost with cryoturbation).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Alpine Rocky-Loamy Meadows. The other ecotype in this association is Boreal Alpine Tussock Meadow.

BOREAL ALPINE TUSSOCK MEADOW

Geomorphology:

These tussock-dominated meadows are located on plateaus or slopes comprised of hillside colluvium above 1200 m elevation. Permafrost occurs within 0.5 m of the surface. Soils have well developed organic horizons overlying loams or blocky material. These meadows are poorly to somewhat poorly drained, moist to wet, and circumneutral.

Plant Association:

Eriophorum vaginatum–Salix pulchra–Polygonum bistorta

This ecotype is characterized by the tussock-forming sedge *Eriophorum vaginatum* (Table 11). Dwarf shrubs, typically *Cassiope tetragona, Ledum decumbens, Vaccinium vitis-idaea* and *Salix reticulata*, are present and can be co-dominant. Trees are absent or <1% cover. Common species are *Salix pulchra, Polygonum bistorta*, *Polygonum viviparum* and *Flavocetraria cucullata*. This is the least diverse boreal alpine ecotype. It has only 87 documented species, whereas the remainder of the boreal alpine ecotypes each have >100 species.

This ecotype is similar to Boreal Alpine Sedge–Dwarf Willow Meadow, but with predominant tussocks. It is also similar to Boreal Lowland Tussock–Shrub Bog, which unlike the alpine class is frequently co-dominated by low shrubs, and occurs at lower elevation primarily on organic deposits.

Table 11. Vegetation cover and frequency for Boreal Alpine Tussock Meadow (n=4). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	127.3	19.9	100
Total Vascular Cover	97.6	14.8	100
Total Evergreen Tree Cover	0.0	0.1	25
Picea glauca	0.0	0.1	25
Total Evergreen Shrub Cover	15.1	19.2	50
Andromeda polifolia	0.0	0.1	25
Cassiope tetragona	1.8	2.4	50
Dryas integrifolia	1.3	2.5	25
Dryas octopetala ssp. *alaskensis*	3.8	7.5	25
Empetrum nigrum	2.5	5.0	25
Ledum decumbens	3.8	7.5	50
Vaccinium vitis-idaea	2.0	2.4	50
Total Deciduous Shrub Cover	24.1	19.1	100
Betula glandulosa	3.8	7.5	25
Betula nana	2.5	5.0	25
Salix arctica	0.3	0.5	25
Salix planifolia ssp. *pulchra*	7.6	9.5	100
Salix polaris	0.0	0.1	25
Salix reticulata	4.3	4.3	75
Salix rotundifolia	3.3	3.9	50
Vaccinium uliginosum	2.5	5.0	25
Total Forb Cover	1.5	1.6	100
Cardamine bellidifolia	0.1	0.1	50
Draba lactea	0.0	0.1	25
Equisetum scirpoides	0.0	0.1	25
Eutrema edwardsii	0.1	0.1	50
Pedicularis langsdorffii	0.1	0.1	50
Pedicularis oederi	0.0	0.1	25
Petasites frigidus	0.3	0.5	50
Polemonium acutiflorum	0.0	0.1	25
Polygonum bistorta	0.1	0.1	75
Polygonum viviparum	0.1	0.1	75
Potentilla hyparctica	0.1	0.1	50
Ranunculus nivalis	0.0	0.1	25
Saxifraga davurica	0.0	0.1	25
Saxifraga foliolosa	0.0	0.1	25
Saxifraga hieracifolia	0.0	0.1	25
Saxifraga hirculus	0.1	0.1	50
Senecio atropurpureus ssp. *frigidus*	0.0	0.1	25
Senecio atropurpureus	0.0	0.1	25
Stellaria monantha	0.1	0.1	50
Taraxacum alaskanum	0.0	0.1	25
Tofieldia pusilla	0.0	0.1	25
Valeriana capitata	0.1	0.1	50
Total Grass Cover	0.1	0.1	50
Poa sp.	0.1	0.1	50
Trisetum spicatum ssp. *spicatum*	0.0	0.1	25
Total Sedge & Rush Cover	56.9	23.9	100
Carex bigelowii	17.5	31.8	50
Carex membranacea	0.0	0.1	25
Carex microchaeta	0.0	0.1	25
Carex misandra	0.0	0.1	25
Carex stylosa	2.5	2.9	50
Carex vaginata	0.0	0.1	25

Table 11. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Eriophorum angustifolium	1.8	2.4	50
Eriophorum callitrix	0.0	0.1	25
Eriophorum vaginatum	35.0	24.8	100
Total Nonvascular Cover	29.7	6.1	100
Total Moss Cover	22.4	6.6	100
Aulacomnium turgidum	0.5	0.6	75
Hylocomium splendens	2.5	5.0	25
Polytrichum sp.	0.3	0.5	25
Ptilidium ciliare	0.8	1.5	25
Ptilidium pulcherrimum	0.5	1.0	25
Sphagnum sp.	1.3	1.5	75
Thuidium recognitum	1.3	2.5	25
Tomentypnum nitens	1.3	2.5	25
Unknown moss	13.5	10.8	75
Total Lichen Cover	7.3	7.7	100
Cetraria islandica ssp. *islandica*	1.0	0.8	75
Cladina arbuscula	0.5	0.6	75
Cladina rangiferina	1.3	2.5	25
Cladina sp.	1.3	2.5	25
Cladina stygia	0.8	1.0	50
Cladonia sp.	0.3	0.5	75
Dactylina arctica	0.3	0.5	100
Flavocetraria cucullata	1.8	2.3	100
Masonhalea richardsonii	0.0	0.1	25
Peltigera leucophlebia	0.0	0.1	25
Peltigera sp.	0.0	0.1	25
Thamnolia sp.	0.0	0.1	25
Total Bare Ground	23.0	19.9	100
Soil	1.5	2.4	50
Litter Alone	21.3	19.3	100
Water	0.3	0.5	25

Soils

Soils typically are somwhat poorly to poorly drained, and have moderately thick to thick surface organic horizons. Rocks are found at substantial depth and rock fragments at the surface are absent (Table 12). A thin eolian loess cap is common. Frost boils, or sorted and nonsorted circles, are uncommon. Thaw depths are moderately shallow and permafrost is always present. Soil water is found at moderately shallow depths. Soil pH is acidic to circumneutral, depending on bedrock, and electrical conductivity is low.

Table 12. Summary of soil characteristics for Boreal Alpine Tussock Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	15.3	0.6	3
Cumulative Org. in 40 cm (cm)	17.0	3.5	3
Loess Cap Thickness(cm)	6.5	2.1	2
Depth to Rocks (cm)	23.0		1
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)	0.2	0.3	3
Thaw Depth (cm)[a]	43.3	25.4	3
Site pH at 10-cm depth	6.3	0.6	3
Site EC at 10-cm depth (µS/cm)	43.3	20.8	3
Water Depth (cm, + above gnd)[a]	-25.7	16.9	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically (subgroup) by Typic Aquorthels (wet, mineral soil over permafrost lacking cryoturbation), Typic Aquiturbels (wet, mineral soil over permafrost with cryoturbation), and Typic Hemistels (wet, thick, moderately decomposed peat over permafrost).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Alpine Rocky-Loamy Meadows. The other ecotype in this association is Boreal Alpine Sedge-Dwarf Shrub Meadow.

BOREAL GLACIATED BARRENS

Geomorphology:

Boreal Glaciated Barrens occurs on young moraine at the terminuses of receding glaciers. The surface is dynamic and unstable. Soils are underlain by glacial ice and are poorly developed. The dominant soil texture is blocky and organic material is absent. Soil chemistry is alkaline. Drainage is excessive unless ice is close to the surface; soils typically are dry. Vegetative cover is <5% and plant litter and water are absent.

Plant Association:

Dryas drummondii–Shepherdia canadensis–Salix alaxensis

This ecotype is early successional and is sparsely vegetated by ruderal colonizers such as *Epilobium latifolium* (Table 13). Trees are absent, and all other life forms can be present with low total cover. The relatively high diversity of this ecotype probably reflects the variety of species available from local seed sources.

This ecotype is similar to the next successional stage: Boreal Glaciated Dryas Dwarf Shrub. Species cover and diversity are higher in the dwarf shrub class. Boreal Glaciated Barrens also is similar to Boreal Alpine Barrens but the glaciated class is restricted to young moraine.

Table 13. Vegetation cover and frequency for Boreal Glaciated Barrens (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	2.6	3.0	67
Total Vascular Cover	2.0	2.1	67
Total Evergreen Shrub Cover	0.4	0.6	67
Dryas drummondii	0.4	0.6	67
Dryas integrifolia	0.0	0.1	33
Total Deciduous Shrub Cover	0.6	0.7	67
Salix alaxensis	0.4	0.6	67
Salix arctica	0.0	0.1	33
Salix brachycarpa ssp. *niphoclada*	0.1	0.1	33
Salix glauca	0.0	0.1	33
Salix novae-angliae	0.0	0.1	33
Salix polaris	0.0	0.1	33
Salix reticulata	0.0	0.1	33
Total Forb Cover	0.9	0.8	67
Antennaria sp.	0.0	0.1	33
Astragalus alpinus	0.0	0.1	33
Braya sp.	0.0	0.1	33
Crepis elegans	0.3	0.6	33
Crepis nana	0.0	0.1	33
Draba sp.	0.0	0.1	33
Epilobium latifolium	0.1	0.1	67
Hedysarum alpinum	0.0	0.1	33
Papaver sp.	0.0	0.1	33
Saxifraga bronchialis	0.0	0.1	33
Saxifraga cernua	0.0	0.1	33
Saxifraga oppositifolia	0.0	0.1	33
Saxifraga tricuspidata	0.0	0.1	33
Silene acaulis	0.0	0.1	33
Stellaria sp.	0.0	0.1	33
Total Grass Cover	0.1	0.2	33
Festuca brachyphylla	0.0	0.1	33
Poa arctica	0.0	0.1	33
Trisetum spicatum ssp. *spicatum*	0.0	0.1	33
Total Sedge & Rush Cover	0.0	0.1	33
Carex sp.	0.0	0.1	33
Total Nonvascular Cover	0.6	1.0	33
Total Moss Cover	0.4	0.7	33
Ceratodon purpureus	0.0	0.1	33
Polytrichum sp.	0.0	0.1	33
Racomitrium canescens	0.3	0.6	33
Total Lichen Cover	0.1	0.2	33
Flavocetraria cucullata	0.0	0.1	33
Peltigera rufescens	0.0	0.1	33
Stereocaulon sp.	0.0	0.1	33
Total Bare Ground	98.7	1.5	100
Soil	98.7	1.5	100
Litter Alone	0.0	0.0	0
Water	0.0	0.0	0

Soils

Soils typically are well to excessively drained, rocky, and lack surface organic horizons (Table 14). Frost boils, or sorted and nonsorted circles, are lacking due to the lack of fine-grained soil. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be present below 1 m because of low air temperatures and likely presence of buried ice. Depth to water often could not be measured but is assumed to be greater than 1 m. Soil pH is alkaline and electrical conductivity is low.

Table 14. Summary of soil characteristics for Boreal Glaciated Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	2
Cumulative Org. in 40 cm (cm)	0.0	0.0	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	0.0	0.0	2
Surface Fragment Cover (%)	50.0	35.4	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	100.0		1
Site pH at 10-cm depth	8.0	0.8	2
Site EC at 10-cm depth (µS/cm)	70.0	28.3	2
Water Depth (cm, + above gnd)[a]	-125.0	35.4	2

[a] Measurements >1 m indicate minimum depth, not true depth

Taxonomically soils (subgroup level) are dominated by Typic Gelorthents (poorly developed with permafrost below 1 m).

This ecotype is part of the broader soil landscapes within Boreal Glaciated Rocky Barrens and Scrub, which also includes Boreal Glaciated Dryas Dwarf Shrub and Boreal Glaciated Willow Shrub.

BOREAL GLACIATED DRYAS SHRUB

Geomorphology:

This ecotype occurs on slopes on stabilized young moraine and is characterized by dwarf evergreen shrubs and an uneven blocky surface. Leaf litter (mostly *Dryas*) and bare soil cover approximately half the ground surface. Soils consist of blocky or bouldery material overlain by thin organic horizons. Sites are somewhat excessively to excessively drained, dry, and basic to circumneutral.

Plant Association:
Dryas drummondii–Sheperdia canadensis–Salix alaxensis

Dryas drummondii forms extensive mats and is the most abundant species (Table 15). Graminoids are absent, and nonvascular species are found in very low numbers. Tree seedlings may be present in trace amounts. This ecotype is not diverse; it has the second lowest species count of boreal ecotypes (4th overall), and has few species per plot.

This ecotype is similar to the previous and following successional stages. Boreal Glaciated Barrens has less vegetative cover and less soil structure. Boreal Glaciated Willow Shrub has less bare ground and greater cover of willows and soapberry (*Shepherdia canadensis*).

Table 15. Vegetation cover and frequency for Boreal Glaciated Dryas Dwarf Shrub (n=2). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	52.9	6.8	100
Total Vascular Cover	51.8	8.0	100
Total Evergreen Shrub Cover	45.6	6.4	100
Arctostaphylos uva-ursi	0.5	0.7	50
Dryas drummondii	45.0	7.1	100
Dryas integrifolia	0.1	0.1	50
Total Deciduous Tree Cover	0.5	0.7	50
Populus balsamifera	0.5	0.7	50
Total Deciduous Shrub Cover	5.7	0.9	100
Salix alaxensis	0.5	0.7	50
Salix arbusculoides	0.5	0.7	50
Salix barclayi	0.1	0.1	50
Salix bebbiana	0.5	0.7	50
Salix brachycarpa ssp. *niphoclada*	1.0	1.4	50
Salix commutata	0.1	0.1	50
Salix glauca	0.1	0.1	50
Shepherdia canadensis	3.0	2.8	100
Total Forb Cover	0.1	0.1	50
Epilobium latifolium	0.1	0.1	50
Total Nonvascular Cover	1.2	1.2	100
Total Moss Cover	0.6	0.6	100
Brachythecium sp.	0.1	0.1	50
Ceratodon purpureus	0.5	0.7	50
Sanionia uncinata	0.6	0.6	100
Total Lichen Cover	0.6	0.6	100
Unknown crustose lichen	0.5	0.7	50
Xanthoria sp.	0.1	0.1	50
Total Bare Ground	50.0	8.5	100
Soil	12.0	4.2	100
Litter Alone	38.0	4.2	100
Water	0.0	0.0	0

Soils

Soils typically are well to excessively drained, rocky, and have very thin surface organic horizons (Table 16). Frost boils, or sorted and nonsorted circles, are lacking due to the lack of fine-grained soil. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be present below 1 m because of low air temperatures and likely presence of buried ice. Depth to water often could not be measured but is assumed to be at substantial depths below 1 m. Soil pH is alkaline and electrical conductivity is low.

Table 16. Soil characteristics for Boreal Glaciated Dryas Dwarf Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	2.0	0.0	2
Cumulative Org. in 40 cm (cm)	2.0	0.0	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	1.0	1.4	2
Surface Fragment Cover (%)	17.5	10.6	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.6	0.6	2
Site EC at 10-cm depth (µS/cm)	140.0	99.0	2
Water Depth (cm, + above gnd)[a]	-175.0	35.4	2

[a] Measurements >1 m indicate minimum depth, not true depth

Taxonomically soils (subgroup level) are dominated by Typic Gelorthents (poorly developed with permafrost below 1 m).

This ecotype and associated soil are components of the broader soil landscapes within Boreal Glaciated Rocky Barrens and Scrub, which also includes Boreal Glaciated Barrens and Boreal Glaciated Willow Shrub.

BOREAL GLACIATED WILLOW SHRUB

Geomorphology:

Boreal Glaciated Willow Shrub consists of early successional willow communities located on young moraine. Surfaces are uneven, and sloped or flat. Soils are comprised of blocky or rubbly material with thin organic horizons. These sites are somewhat excessive to excessively well-drained, dry, and are alkaline to circumneutral.

Plant Association:

Salix alaxensis–Salix niphoclada–Arctostaphylos rubra

Willows occur in open to closed stands in this ecotype (Table 17). The understory is open with moss, bare soil, and litter comprising the groundcover. Trees are present as seedlings. Common species are *Salix alaxensis, Salix niphoclada, Arctostaphylos rubra, Shepherdia canadensis, Salix glauca*, *Dryas drummondii, Populus balsamifera* and *Ceratodon purpureus*. This ecotype is not species rich, with a median number of species per plot and a low total count.

This ecotype is similar to both Boreal Glaciated Dryas Dwarf Shrub and Boreal Glaciated Barrens. It is older than both of these ecotypes, resulting in a vegetative community with more structure and higher total cover.

Table 17. Vegetation cover and frequency for Boreal Glaciated Willow Shrub (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	119.9	20.0	100
Total Vascular Cover	94.2	14.8	100
Total Evergreen Tree Cover	0.4	0.6	67
Picea glauca	0.4	0.6	67
Total Evergreen Shrub Cover	12.3	8.7	100
Arctostaphylos uva-ursi	3.0	2.0	100
Dryas drummondii	9.0	9.6	100
Juniperus communis	0.3	0.6	33
Total Deciduous Tree Cover	0.4	0.5	100
Populus balsamifera	0.4	0.5	100
Total Deciduous Shrub Cover	80.7	13.1	100
Arctostaphylos alpina	0.3	0.6	33
Arctostaphylos rubra	1.0	1.0	67
Salix alaxensis	10.3	17.0	67
Salix arbusculoides	1.7	2.9	33
Salix bebbiana	6.7	7.6	67
Salix brachycarpa ssp. *niphoclada*	11.7	12.6	67
Salix glauca	8.7	7.1	100
Salix scouleriana	0.3	0.6	33
Shepherdia canadensis	40.0	8.7	100
Total Forb Cover	1.7	1.4	100
Epilobium angustifolium	0.0	0.1	33
Epilobium latifolium	0.0	0.1	33
Hedysarum alpinum	1.0	1.7	67
Minuartia sp.	0.0	0.1	33
Oxytropis campestris	0.0	0.1	33
Pyrola asarifolia	0.4	0.6	67
Pyrola grandiflora	0.0	0.1	33
Stellaria sp.	0.0	0.1	33
Total Grass Cover	0.1	0.1	33
Poa arctica	0.0	0.1	33
Trisetum spicatum ssp. *spicatum*	0.0	0.1	33
Total Sedge & Rush Cover	0.3	0.6	33
Carex concinna	0.3	0.6	33
Total Nonvascular Cover	25.7	15.5	100
Total Moss Cover	22.7	17.0	100
Brachythecium salebrosum	0.3	0.6	33
Ceratodon purpureus	6.0	3.6	100
Dicranum sp.	2.7	2.5	67
Drepanocladus sp.	0.7	1.2	33
Hypnum revolutum	8.3	10.4	67
Polytrichum sp.	0.3	0.6	33
Racomitrium lanuginosum	1.3	1.2	67
Sanionia uncinata	0.7	1.2	33
Tomentypnum nitens	2.3	2.5	67
Total Lichen Cover	3.0	1.7	100
Cladonia sp.	1.3	1.5	67
Stereocaulon sp.	0.3	0.6	33
Unknown crustose lichen	0.7	1.2	33
Xanthoria sp.	0.7	0.6	67
Total Bare Ground	19.3	5.1	100
Soil	10.3	5.5	100
Litter Alone	9.0	6.6	100

Soils

Soils typically are well to excessively drained, rocky, and have very thin surface organic horizons (Table 18). Frost boils, or sorted and nonsorted circles, are lacking due to the lack of fine-grained soil. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be present below 1 m because of low air temperatures and likely presence of buried ice. Depth to water often could not be measured but is assumed to be at substantial depths below 1 m. Soil pH is alkaline and electrical conductivity is low.

Table 18. Summary of soil characteristics for Boreal Glaciated Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	2.3	2.1	3
Cumulative Org. in 40 cm (cm)	2.3	2.1	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	2.3	2.1	3
Surface Fragment Cover (%)	20.0	8.7	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.8	0.4	3
Site EC at 10-cm depth (μS/cm)	156.7	83.9	3
Water Depth (cm, + above gnd)[a]	-125.0	43.3	3

[a] Measurements >1 m indicate minimum depth, not true depth

Taxonomically soils (subgroup level) are dominated by Typic Gelorthents (poorly developed with permafrost below 1 m).

This ecotype and associated soil are components of the broader soil landscapes within Boreal Glaciated Rocky Barrens and Scrub, which also includes Boreal Glaciated Barrens and Boreal Glaciated Dryas Dwarf Shrub.

BOREAL LACUSTRINE PONDLILY

Geomorphology:

This ecotype occurs in isolated moraine or kettle ponds of varying depths. Pond lilies are restricted to shallow margins when ponds are > 2 m deep. This ecotype is widespread throughout lowland areas in the park, particularly in the Jahathmund and Chitina Basins and on the Wrangell Forelands. These ponds have a circumneutral pH.

Plant Association:

Nuphar polysepalum–Sparganium angustifolium

The most common species is *Nuphar polysepalum*, although other aquatic forbs frequently occur (Table 19). These include *Sparganium angustifolium, Potamogeton alpinus* ssp. *tenuifolius* and *Potamogeton zosterifolius*. Aquatic sedges and mosses frequently are found in association with *Nuphar* in shallow water. We did not sample in deep water, resulting in an incomplete species list for aquatic forbs. Relative to other boreal ecotypes, Boreal Lacustrine Pondlily is low in total species, and has the 10th lowest species count per plot.

This ecotype is most similar to Lowland Lake, the primary difference being the presence of *Nuphar polysepalum*. It is not similar to any other ecotypes.

Table 19. Vegetation cover and frequency for Boreal Lacustrine Pondlily (n=2). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	61.3	29.8	100
Total Vascular Cover	55.3	21.4	100
Total Forb Cover	44.7	29.0	100
Isoetes sp.	0.1	0.1	50
Menyanthes trifoliata	0.1	0.1	50
Nuphar polysepalum	27.5	17.7	100
Potamogeton alpinus ssp. *tenuifolius*	0.5	0.7	50
Potamogeton zosterifolius	0.1	0.1	50
Ranunculus reptans	0.5	0.7	50
Sparganium angustifolium	2.5	3.5	50
Sparganium sp.	0.1	0.1	50
Subularia aquatica	1.0	1.4	50
Utricularia minor	7.5	10.6	50
Utricularia vulgaris ssp. *macrorhiza*	5.0	7.1	50
Total Sedge & Rush Cover	10.6	7.6	100
Carex aquatilis ssp. *aquatilis*	3.0	2.8	100
Carex diandra	0.1	0.1	50
Carex saxatilis	1.5	2.1	50
Eleocharis acicularis	2.5	3.5	50
Eleocharis palustris	1.1	1.3	100
Eriophorum angustifolium	2.5	3.5	50
Total Nonvascular Cover	6.0	8.5	50
Total Moss Cover	6.0	8.5	50
Calliergon sp.	2.5	3.5	50
Drepanocladus revolvens	3.5	4.9	50
Total Bare Ground	72.0	25.5	100
Soil	0.0	0.0	0
Litter Alone	0.0	0.0	0
Water	72.0	25.5	100

Soils

Flooded soils were not described. Water characteristics are listed in Table 20.

Table 20. Water characteristics for Boreal Lacustrine Pondlily.

Property	Mean	SD	n
Site pH at 10-cm depth	6.5	0.2	2
Site EC at 10-cm depth (µS/cm)	50.0	14.1	2
Water Depth (cm, + above gnd)[a]	90.0	14.1	2

[a] Measurements >1 m indicate minimum depth, not true depth

BOREAL LACUSTRINE SEDGE MEADOW

Geomorphology:

These productive meadows occur in fens, lacustrine deposits, and ice-poor thaw basin margins throughout lowland areas of the park. Soils primarily are peat; less frequently soils are loams or gravels overlain by moderately thin organic horizons. Sites are circumneutral to acidic, wet or flooded with very poor drainage. These communities are stable and are rich in graminoid species.

Plant Associations:

Carex saxatilis–Eriophorum angustifolium,
Carex utriculata–Potentilla palustris,
Carex aquatilis–Potentilla palustris–Salix pulchra

Sedges, particularly *Carex aquatilis*, dominate this ecotype (Table 21). Although it has a low number of species per plot, it has the 11th highest total number of species. The high variability among plots largely is determined by water depth and depth of peat accumulation. As a result, three distinct floristic classes exist for this ecotype. Lichens and trees are absent. Common species include *Epilobium palustre, Equisetum fluviatile* and *Scorpidium scorpioides*.

This ecotype is similar to Boreal Lowland Sedge–Shrub Fen, although the lowland ecotype has higher shrub cover, greater peat thickness and is not directly affected by lake water.

Table 21. Vegetation cover and frequency for Boreal Lacustrine Sedge Meadow (n=21). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	43.3	42.1	100
Total Vascular Cover	14.9	16.0	95
Total Evergreen Shrub Cover	1.2	3.0	24
Andromeda polifolia	0.9	2.4	14
Chamaedaphne calyculata	0.1	0.7	10
Oxycoccus microcarpus	0.2	0.5	14
Total Deciduous Shrub Cover	2.8	6.8	52
Betula glandulosa	0.1	0.2	10
Myrica gale	0.6	2.2	10
Potentilla fruticosa	0.2	1.1	5
Salix bebbiana	0.1	0.2	10
Salix fuscescens	0.5	2.2	10
Salix myrtillifolia	0.2	1.1	5
Salix novae-angliae	0.0	0.2	5
Salix planifolia ssp. *pulchra*	1.0	3.0	38
Total Forb Cover	8.9	7.5	95
Chrysosplenium tetrandrum	0.0	0.2	5
Drosera anglica	0.5	2.2	5
Drosera rotundifolia	0.0	0.2	5
Epilobium palustre	1.0	4.4	24
Equisetum arvense	0.5	1.5	14
Equisetum fluviatile	0.6	1.7	24
Equisetum sylvaticum	0.5	2.2	5
Galium brandegei	0.0	0.2	5
Galium trifidum ssp. *trifidum*	0.1	0.2	10
Geum macrophyllum ssp. *macrophyllum*	0.5	2.2	5
Hippuris vulgaris	0.0	0.0	10
Menyanthes trifoliata	0.6	2.2	24
Parnassia palustris	0.1	0.2	10
Potamogeton gramineus	0.1	0.3	14
Potentilla norvegica	0.1	0.2	14
Potentilla palustris	3.0	5.0	62
Ranunculus confervoides	0.1	0.4	5
Ranunculus gmelini	0.0	0.0	14
Rubus arcticus ssp. *arcticus*	0.2	1.1	5
Triglochin maritimum	0.3	1.5	5
Triglochin palustris	0.1	0.4	14
Utricularia minor	0.2	1.1	10
Utricularia vulgaris ssp. *macrorhiza*	0.1	0.7	5
Total Grass Cover	1.9	5.7	29
Alopecurus aequalis	0.2	1.1	5
Arctagrostis latifolia	0.1	0.4	5
Calamagrostis canadensis	1.2	5.5	10
Calamagrostis inexpansa	0.1	0.2	10
Deschampsia caespitosa	0.3	1.5	10
Total Sedge & Rush Cover	31.8	23.9	100
Carex aquatilis ssp. *aquatilis*	10.4	19.0	62
Carex atrofusca	0.2	1.1	5
Carex buxbaumii	0.1	0.2	10
Carex canescens	0.1	0.3	10
Carex chordorrhiza	0.5	1.8	14
Carex diandra	0.0	0.2	5
Carex limosa	0.2	0.7	14
Carex oederi ssp. *viridula*	0.1	0.4	10

Table 21. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Carex pluriflora	0.1	0.7	5
Carex rostrata	3.6	13.3	10
Carex rotundata	0.4	1.2	14
Carex saxatilis	2.3	5.4	43
Carex utriculata	6.8	17.6	43
Eleocharis acicularis	0.4	1.7	5
Eleocharis palustris	0.1	0.2	10
Eriophorum angustifolium	5.8	13.6	38
Eriophorum russeolum	0.0	0.2	5
Juncus arcticus	0.1	0.4	5
Luzula multiflora	0.1	0.4	5
Trichophorum alpinum	0.0	0.2	5
Total Nonvascular Cover	28.4	34.1	90
Total Moss Cover	28.4	34.1	90
Aulacomnium palustre	0.5	2.2	10
Bryum pseudotriquetrum	0.0	0.2	5
Calliergon giganteum	0.5	2.2	10
Calliergon sp.	0.9	2.4	19
Campylium polygamum	2.6	12.0	5
Campylium stellatum	0.3	1.1	10
Cinclidium stygium	1.7	5.8	10
Drepanocladus revolvens	1.0	3.0	14
Drepanocladus sp.	0.8	2.3	14
Limprichtia cossoni	2.4	10.9	5
Limprichtia revolvens	1.0	4.4	10
Mnium sp.	0.2	0.7	14
Paludella squarrosa	0.2	1.1	5
Pohlia sp.	0.0	0.2	5
Scorpidium scorpioides	7.2	14.8	38
Sphagnum lindbergii	0.2	1.1	5
Sphagnum platyphyllum	0.7	3.3	5
Sphagnum sp.	2.4	6.4	19
Sphagnum squarrosum	0.0	0.2	5
Sphagnum teres	1.0	4.4	5
Tomentypnum nitens	0.2	1.1	5
Unknown moss	4.3	15.3	19
Total Bare Ground	53.5	27.9	100
Soil	2.1	4.9	24
Litter Alone	31.7	28.6	100
Water	19.7	29.5	62

Soils

Soils are very poorly drained with thick accumulations of peat (Table 22). Depth to rocky soil horizons generally is more than 1 m and thin eolian silt layers are occasionally present. Rocky surface fragments and frost boils are absent. Permafrost may be present or absent. When present, thaw depths are moderately deep. Soil pH is circumneutral and electrical conductivity is moderately low.

Table 22. Summary of soil characteristics for Boreal Lacustrine Sedge Meadow.

Property	Mean	SD	n
Surface Organics Depth (cm)	51.4	37.7	17
Cumulative Org. in 40 cm (cm)	33.4	11.5	17
Loess Cap Thickness(cm)	6.1	12.0	13
Depth to Rocks (cm)	129.6	78.1	5
Surface Fragment Cover (%)	0.0	0.0	14
Frost Boil Cover (%)	0.0	0.0	10
Thaw Depth (cm)[a]	48.5	6.4	4
Site pH at 10-cm depth	5.9	0.6	16
Site EC at 10-cm depth (µS/cm)	135.6	113.4	16
Water Depth (cm, + above gnd)[a]	0.0	11.2	17

[a] Measurements >1 m indicate minimum depth, not true depth

Taxonomically soils (subgroup level) are dominated by the non-permafrost soil Typic Cryofibrist (wet, cold, thick, poorly decomposed peat) and the permafrost-affected soils Typic Fibristels (wet, thick, undecomposed peat with permafrost) and Terric Hemistels (wet, thick, poorly decomposed peat with permafrost with mineral soil within 1 m). Less common soils include Humic Dystrocryepts, Typic Dystrocryepts, Histic Cryaquepts, Typic Historthels, Typic Aquorthels, Terric Cryohemists, and Typic Cryaquents.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Lowland Organic-rich Meadows, which also includes Boreal Lowland Sedge-Fen.

BOREAL LOWLAND BLACK SPRUCE BOG

Geomorphology:

This ecotype is widespread, occurring on a variety of geomorphic types, including bogs, glaciofluvial outwash cover deposits, lowland loess, older moraine and hillside colluvium. Surface forms also are variable, including slopes, flats and basins. Despite this variability, all sites have substantial organic horizons, are somewhat poorly to poorly drained, moist to wet, and underlain by permafrost. Chemistry is circumneutral to acidic. Thaw depths typically are = 0.5 m.

Plant Association:

Picea mariana–Salix pulchra–Rubus chamaemorus

These black spruce stands are typified by species common to bogs, including *Rubus chamaemorus, Sphagnum* spp., and *Ledum decumbens* (Table 23). Sites are woodlands (10–24% cover) or open forest and trees frequently are stunted. Deciduous trees are infrequent, but all other life forms are common. Total species count is high and this is the 2nd most diverse lowland ecotype.

Ecotype characteristics are similar to Boreal Lowland Tussock–Shrub Bog, except for increased tree cover and fewer tussocks, and to Boreal Lowland Black Spruce Forest, which has fewer bog species, deeper ground water and less organic accumulation.

Table 23. Vegetation cover and frequency for Boreal Lowland Black Spruce Bog (n=15). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	186.6	54.7	100
Total Vascular Cover	105.9	25.6	100
Total Evergreen Tree Cover	24.6	9.3	100
Picea mariana	24.5	9.4	100
Total Evergreen Shrub Cover	30.6	13.4	100
Andromeda polifolia	0.7	1.5	40
Chamaedaphne calyculata	0.7	2.6	20
Empetrum hermaphroditum	1.1	2.8	20
Empetrum nigrum	3.9	5.0	53
Ledum decumbens	7.5	11.2	60
Ledum groenlandicum	6.7	9.5	60
Oxycoccus microcarpus	0.1	0.3	40
Vaccinium vitis-idaea	9.8	6.5	93
Total Deciduous Tree Cover	0.1	0.3	13
Betula papyrifera var. humilis	0.1	0.3	13
Total Deciduous Shrub Cover	31.0	13.9	100
Alnus crispa	0.8	2.6	20
Arctostaphylos rubra	5.1	6.9	67
Betula nana	8.5	10.2	53
Betula occidentalis	0.3	1.3	7
Myrica gale	0.7	2.6	7
Potentilla fruticosa	1.4	3.1	47
Rosa acicularis	0.9	3.1	27
Salix barclayi	0.1	0.3	7
Salix fuscescens	0.5	1.4	13
Salix glauca	1.3	1.8	53
Salix myrtillifolia	1.7	4.5	20
Salix planifolia ssp. *pulchra*	4.2	4.2	80
Vaccinium uliginosum	4.6	3.3	87
Total Forb Cover	9.7	7.5	100
Cornus canadensis	0.7	2.6	7
Equisetum arvense	0.7	1.2	40
Equisetum scirpoides	0.3	0.8	33
Equisetum sylvaticum	0.3	0.7	13
Geocaulon lividum	0.6	1.3	33
Hedysarum alpinum	0.1	0.3	7
Pedicularis labradorica	0.1	0.3	27
Pedicularis sudetica	0.1	0.3	7
Petasites frigidus	1.9	3.0	47
Pinguicula villosa	0.0	0.0	20
Pyrola secunda	0.0	0.0	20
Rubus arcticus	0.0	0.0	7
Rubus chamaemorus	4.9	4.8	80
Saussurea angustifolia	0.0	0.0	13
Valeriana capitata	0.0	0.0	13
Total Grass Cover	1.0	1.7	60
Arctagrostis latifolia	0.2	0.4	33
Calamagrostis canadensis	0.8	1.7	27
Total Sedge & Rush Cover	9.0	9.4	93
Carex aquatilis ssp. *aquatilis*	0.6	1.3	20
Carex bigelowii	0.6	1.3	20
Carex diandra	0.1	0.3	7
Carex livida	0.1	0.3	7
Carex vaginata	0.1	0.3	20

Table 23. Continued.

	Cover Mean	Cover SD	Freq %
Eriophorum angustifolium	0.9	3.1	13
Eriophorum brachyantherum	0.1	0.3	7
Eriophorum russeolum	0.1	0.5	7
Eriophorum vaginatum	6.4	9.1	60
Total Nonvascular Cover	80.6	50.8	100
Total Moss Cover	73.5	50.4	100
Aulacomnium acuminatum	0.3	1.3	7
Aulacomnium palustre	3.7	4.8	47
Aulacomnium turgidum	0.3	0.6	27
Dicranum sp.	1.1	1.8	47
Drepanocladus sp.	0.9	2.6	13
Hylocomium splendens	23.1	26.8	80
Hypnum sp.	0.3	1.3	7
Pleurozium schreberi	4.3	6.2	40
Polytrichum juniperinum	0.0	0.0	7
Polytrichum sp.	0.2	0.6	13
Rhytidium rugosum	0.2	0.8	7
Sphagnum fuscum	0.9	2.7	13
Sphagnum sp.	15.0	18.3	60
Sphagnum warnstorfii	0.0	0.0	7
Tomentypnum nitens	8.3	17.9	53
Unknown moss	13.7	32.1	33
Total Lichen Cover	7.1	6.8	100
Cladina arbuscula	0.3	0.9	27
Cladina mitis	0.2	0.8	13
Cladina rangiferina	1.8	1.7	67
Cladina sp.	2.0	3.5	53
Cladonia amaurocraea	0.4	1.3	13
Cladonia sp.	0.8	1.4	67
Flavocetraria cucullata	0.2	0.8	7
Peltigera aphthosa	0.5	0.8	60
Peltigera leucophlebia	0.3	1.3	7
Peltigera malacea	0.1	0.5	7
Peltigera sp.	0.2	0.6	20
Stereocaulon sp.	0.0	0.0	13
Total Bare Ground	8.3	10.3	87
Soil	0.1	0.5	7
Litter Alone	7.5	9.9	87
Water	0.7	1.4	27

Soils

Soils are very poorly drained with moderately thick accumulations of peat (Table 24). Depth to rocky soil horizons generally is >0.5 m and thin eolian silt layers are occasionally present. Rocky surface fragments and frost boils are absent. Permafrost is always present at shallow depths. Soil pH is acidic to circumneutral and electrical conductivity is moderately low. Water is nearly always present at moderately shallow depths.

Table 24. Soil characteristics for Boreal Lowland Black Spruce Bog.

Property	Mean	SD	n
Surface Organics Depth (cm)	29.8	6.4	10
Cumulative Org. in 40 cm (cm)	30.2	6.6	9
Loess Cap Thickness(cm)	2.4	6.0	10
Depth to Rocks (cm)	51.0	24.0	2
Surface Fragment Cover (%)	0.0	0.0	10
Frost Boil Cover (%)	0.0	0.0	9
Thaw Depth (cm)[a]	38.7	22.7	9
Site pH at 10-cm depth	5.7	0.8	10
Site EC at 10-cm depth (µS/cm)	87.0	95.9	10
Water Depth (cm, + above gnd)[a]	-22.3	11.2	10

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the permafrost-affected subgroups Typic Hemistels (wet, thick, partially decomposed peat), Terric Hemistels (wet, thick, partially decomposed peat with mineral soil within 1 m), and Typic Histoturbels (wet, moderately thick peat with turbated soil layers). Other, less common subgroups include Typic Aquorthels (wet mineral soil lacking turbated horizons), and Typic Historthels (wet organic-rich soil lacking turbated horizons).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Lowland Scrub and Forest Bogs, which also includes Boreal Lowland Black Spruce Forest and Lowland Tussock-Shrub Bog.

BOREAL LOWLAND BLACK SPRUCE FOREST

Geomorphology:

This late successional ecotype is common in all lowland areas north of the Bagley Icefield. It is found on older moraine, lowland loess, and glaciolacustrine and retransported deposits. Soils are loamy, infrequently sandy or rubbly, and are covered by thin to moderate organic horizons. Sites are moist to wet, somewhat poorly to well drained, acidic to circumneutral, and underlain by permafrost. These forests are prone to wildfire.

Plant Association:

Picea mariana–Salix glauca–Equisetum scirpoides

This ecotype is black spruce-dominated with substantial shrub and nonvascular components (Table 25). The forest canopy is open and the understory shrub canopy includes tall, low and dwarf shrubs. Mosses and lichens form a thick carpet. Common additional species are *Empetrum nigrum, Ledum groenlandicum, Arctostaphylos rubra, Vaccinium uliginosum, Vaccinium vitis-idaea* and *Hylocomium splendens*. It has the 3rd highest species count of boreal lowland types.

This ecotype is very similar to Boreal Lowland Black Spruce Bog but has loamy soils, greater depth to ground water and increased spruce height and cover.

Table 25. Vegetation cover and frequency for Boreal Lowland Black Spruce Forest (n=14). Cover of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	218.5	58.3	100
Total Vascular Cover	132.0	38.6	100
Total Evergreen Tree Cover	33.5	9.5	100
Picea glauca	2.9	6.4	36
Picea mariana	30.6	9.9	100
Total Evergreen Shrub Cover	45.8	25.5	100
Andromeda polifolia	0.1	0.5	7
Chamaedaphne calyculata	0.0	0.0	7
Empetrum nigrum	12.1	11.8	79
Ledum decumbens	1.0	2.8	14
Ledum groenlandicum	18.9	13.6	100
Linnaea borealis	1.1	2.9	21
Oxycoccus microcarpus	0.0	0.0	14
Vaccinium vitis-idaea	12.4	8.8	100
Total Deciduous Tree Cover	0.1	0.3	14
Betula papyrifera var. humilis	0.0	0.0	7
Populus tremuloides	0.1	0.3	7
Total Deciduous Shrub Cover	38.1	19.6	100
Alnus crispa	3.6	9.5	21
Arctostaphylos rubra	5.9	7.5	71
Betula glandulosa	1.1	2.9	21
Betula nana	3.4	6.5	36
Potentilla fruticosa	0.2	0.4	29
Ribes triste	0.0	0.0	7
Rosa acicularis	1.2	1.9	43
Salix arbusculoides	0.2	0.4	29
Salix barclayi	0.4	1.3	14
Salix bebbiana	2.4	4.5	50
Salix fuscescens	0.1	0.5	7
Salix glauca	3.9	4.3	71
Salix myrtillifolia	1.4	2.6	43
Salix planifolia ssp. *pulchra*	2.9	4.4	57
Salix scouleriana	0.4	1.3	21
Shepherdia canadensis	1.1	4.0	7
Spiraea beauverdiana	0.1	0.3	7
Vaccinium uliginosum	9.9	9.8	86
Total Forb Cover	10.5	6.8	100
Achillea borealis	0.0	0.0	7
Antennaria isolepis	0.0	0.0	7
Astragalus americanus	0.0	0.0	7
Barbarea orthoceras	0.0	0.0	7
Corallorrhiza trifida	0.0	0.0	7
Cornus canadensis	0.4	1.3	7
Epilobium angustifolium	0.1	0.3	21
Equisetum arvense	0.1	0.3	14
Equisetum scirpoides	0.8	1.1	71
Equisetum sylvaticum	1.9	6.7	14
Equisetum variegatum	0.1	0.3	7
Gentiana propinqua	0.0	0.0	7
Geocaulon lividum	3.2	4.7	64
Lupinus arcticus	0.1	0.3	7
Lycopodium complanatum	0.0	0.0	7
Moehringia lateriflora	0.0	0.0	7
Pedicularis labradorica	0.0	0.0	7

Table 25. Continued.

	Cover Mean	Cover SD	Freq %
Petasites frigidus	1.7	2.0	64
Pyrola secunda	0.0	0.0	21
Rorippa islandica ssp. *fernaldiana*	0.0	0.0	7
Rubus arcticus	0.0	0.0	21
Rubus chamaemorus	2.1	3.2	64
Saussurea angustifolia	0.1	0.3	21
Senecio lugens	0.0	0.0	14
Solidago multiradiata	0.0	0.0	7
Stellaria laeta	0.0	0.0	7
Valeriana capitata	0.0	0.0	7
Total Grass Cover	1.5	1.4	93
Arctagrostis latifolia	0.4	0.9	36
Calamagrostis canadensis	0.9	1.4	50
Festuca altaica	0.2	0.4	36
Total Sedge & Rush Cover	2.4	4.5	71
Carex bigelowii	1.4	4.5	29
Carex capillaris	0.0	0.0	7
Carex capitata	0.0	0.0	7
Carex vaginata	0.1	0.4	14
Eriophorum vaginatum	0.7	1.6	21
Total Nonvascular Cover	86.5	25.5	100
Total Moss Cover	74.7	22.1	100
Aulacomnium palustre	9.6	12.0	64
Aulacomnium sp.	0.7	1.8	14
Aulacomnium turgidum	1.1	2.9	14
Ceratodon purpureus	0.0	0.0	7
Dicranum polysetum	0.0	0.0	7
Dicranum sp.	1.0	2.7	36
Hylocomium splendens	39.7	23.1	93
Pleurozium schreberi	3.4	5.7	36
Polytrichum juniperinum	0.0	0.0	7
Polytrichum sp.	0.4	0.9	21
Polytrichum strictum	1.1	4.0	7
Ptilidium pulcherrimum	0.0	0.0	7
Rhytidium rugosum	2.2	6.6	21
Sphagnum fuscum	0.7	2.7	7
Sphagnum rubellum	0.4	1.3	7
Sphagnum sp.	2.5	7.0	21
Sphagnum warnstorfii	0.2	0.8	7
Tomentypnum nitens	3.9	7.6	29
Unknown moss	7.7	16.5	43
Total Lichen Cover	11.8	12.8	100
Cladina arbuscula	0.8	1.5	36
Cladina mitis	0.8	2.7	14
Cladina rangiferina	2.0	4.1	43
Cladina stygia	0.7	1.8	14
Cladonia amaurocraea	0.2	0.8	7
Cladonia sp.	1.3	1.6	71
Flavocetraria cucullata	1.1	2.9	21
Peltigera aphthosa	1.3	0.9	86
Peltigera canina	0.2	0.6	14
Stereocaulon sp.	0.5	1.3	29
Vulpicida pinastri	0.0	0.0	14
Total Bare Ground	4.0	2.3	93
Soil	0.2	0.4	14
Litter Alone	4.2	2.1	93
Water	0.0	0.0	0

Soils

Soils are very poorly drained with moderately thick accumulations of peat (Table 26). Depth to rocky soil horizons generally is >0.5 m and thin eolian silt layers are occasionally present. Rocky surface fragments and frost boils are absent. Permafrost is always present at shallow depths. Soil pH is acidic to circumneutral and electrical conductivity is moderately low. Water is nearly always present at moderately shallow depths.

Table 26. Soil characteristics for Boreal Lowland Black Spruce Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	13.3	9.1	13
Cumulative Org. in 40 cm (cm)	13.8	9.4	13
Loess Cap Thickness(cm)	11.1	17.1	13
Depth to Rocks (cm)	37.7	17.6	12
Surface Fragment Cover (%)	0.0	0.0	13
Frost Boil Cover (%)	0.0	0.0	4
Thaw Depth (cm)[a]	50.0	9.9	2
Site pH at 10-cm depth	5.0	0.8	13
Site EC at 10-cm depth (µS/cm)	92.3	36.1	13
Water Depth (cm, + above gnd)[a]	-108.3	25.0	9

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the permafrost-affected soils Typic Aquiturbels, Typic Aquorthels (wet mineral soil lacking turbated horizons) and Aquic Haploturbels (wet, mineral soil with turbated horizons). Less common soils include the non-permafrost Typic Dystrocryepts (moist, well developed, acidic mineral soil) and Typic Eutrocryepts (moist, well developed, circumneutral mineral soil).

This ecotype and associated soil are components of the broader soil landscapes within Boreal Lowland Scrub and Forest Bogs, which includes Boreal Lowland Black Spruce Bog, and Lowland Tussock-Shrub Bog.

BOREAL LOWLAND LOW BIRCH–WILLOW SHRUB

Geomorphology:

This ecotype is located in lowland areas throughout the park on lacustrine and loess deposits, older moraine, and retransported and glaciofluvial outwash abandoned cover deposits. Soils are predominantly loamy with thin to moderately thick surface organic horizons. Sites are poorly to moderately well drained, moist to wet, and acidic or circumneutral. Permafrost typically is within 1 m of the surface.

Plant Association:

Betula nana–Salix pulchra–Ledum decumbens

Deciduous shrubs characterize this ecotype, although every life form except deciduous trees may be present (Table 27). Shrubs typically are <1.5 m in height. Common species are *Betula nana, Salix pulchra, Ledum decumbens, Potentilla fruticosa, Salix reticulata, Vaccinium uliginosum, Festuca altaica,* and *Hylocomium splendens*. Nonvascular species have variable cover and litter is always present. This class has the 6th highest number of species per plot, but is not diverse overall.

This ecotype is similar to Boreal Lowland Tussock–Shrub Bog except that it is better drained, has higher shrub cover and fewer tussocks. It has some floristic similarity with Boreal Lowland Sedge–Shrub Fen due to the deciduous shrub component, but it does not occur on peatland.

Table 27. Vegetation cover and frequency for Boreal Lowland Low Birch–Willow Shrub (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	209.8	43.2	100
Total Vascular Cover	120.2	42.0	100
Total Evergreen Tree Cover	28.8	16.4	100
Picea glauca	26.3	13.7	100
Picea mariana	2.5	6.0	27
Total Evergreen Shrub Cover	27.3	23.4	100
Andromeda polifolia	0.9	3.0	9
Dryas integrifolia	0.9	3.0	9
Empetrum nigrum	7.3	13.5	27
Ledum decumbens	0.9	3.0	9
Ledum groenlandicum	4.5	8.2	55
Linnaea borealis	4.5	6.9	64
Vaccinium vitis-idaea	6.3	7.4	64
Total Deciduous Shrub Cover	37.2	24.7	100
Alnus crispa	7.0	14.0	55
Arctostaphylos rubra	5.4	6.1	73
Betula glandulosa	0.6	1.6	18
Betula nana	2.3	7.5	9
Betula occidentalis	0.5	1.5	9
Potentilla fruticosa	0.2	0.6	18
Ribes triste	0.3	0.9	18
Rosa acicularis	2.6	4.4	73
Salix barclayi	0.1	0.3	9
Salix bebbiana	3.6	9.1	36
Salix glauca	2.1	3.3	45
Salix lanata ssp. *richardsonii*	0.9	3.0	9
Salix planifolia ssp. *pulchra*	0.9	3.0	18
Salix reticulata	2.0	4.8	18
Salix scouleriana	1.5	3.2	27
Shepherdia canadensis	1.8	4.0	27
Vaccinium uliginosum	4.5	9.5	45
Viburnum edule	0.9	3.0	9
Total Forb Cover	19.9	17.2	100
Anemone parviflora	0.3	0.6	27
Epilobium angustifolium	0.3	0.9	36
Equisetum arvense	7.9	17.1	36
Equisetum pratense	0.0	0.0	9
Equisetum scirpoides	1.3	2.0	73
Equisetum sylvaticum	0.9	3.0	9
Gentiana propinqua	0.3	0.6	18
Geocaulon lividum	5.1	5.7	82
Hedysarum alpinum	0.9	3.0	36
Lupinus arcticus	0.4	0.7	45
Lycopodium annotinum	0.1	0.3	9
Mertensia paniculata	0.6	1.6	27
Moneses uniflora	0.1	0.3	18
Parnassia palustris	0.0	0.0	18
Polygonum viviparum	0.0	0.0	18
Pyrola asarifolia	0.0	0.0	18
Pyrola grandiflora	0.3	0.9	18
Pyrola secunda	0.0	0.1	45
Saussurea angustifolia	0.2	0.6	18
Senecio atropurpureus	0.0	0.0	18
Total Grass Cover	1.1	2.4	45

Table 27. Continued.

	Cover Mean	Cover SD	Freq %
Hierochlöe alpina	0.0	0.0	20
Poa alpigena	0.0	0.0	20
Poa arctica	0.2	0.4	40
Trisetum spicatum ssp. *spicatum*	0.0	0.0	20
Total Sedge & Rush Cover	12.5	13.4	100
Carex aquatilis ssp. *aquatilis*	2.4	4.3	40
Carex bigelowii	2.4	5.4	20
Carex canescens	0.0	0.0	20
Carex pluriflora	1.2	1.6	40
Carex scirpoidea	0.0	0.0	20
Carex sp.	0.0	0.0	20
Eriophorum angustifolium	6.0	10.8	40
Eriophorum vaginatum	0.4	0.9	20
Juncus sp.	0.0	0.1	20
Luzula sp.	0.0	0.0	20
Total Nonvascular Cover	66.1	54.4	100
Total Moss Cover	58.6	46.5	100
Aulacomnium acuminatum	2.0	4.5	20
Aulacomnium palustre	5.4	6.8	60
Aulacomnium turgidum	3.0	4.5	40
Bryum pseudotriquetrum	0.6	1.3	20
Calliergon giganteum	0.6	1.3	20
Calliergon stramineum	0.0	0.0	20
Campylium stellatum	0.6	1.3	20
Dicranum sp.	1.0	2.2	20
Drepanocladus sp.	4.6	5.1	60
Fissidens osmundioides	0.6	1.3	20
Hylocomium splendens	6.2	5.2	80
Myurella julacea	0.6	1.3	20
Pleurozium schreberi	3.0	6.7	20
Polytrichum sp.	0.4	0.9	20
Polytrichum strictum	2.0	2.7	40
Sphagnum fimbriatum	7.0	15.7	20
Sphagnum fuscum	5.0	11.2	20
Sphagnum lenense	1.0	2.2	20
Sphagnum rubellum	1.0	2.2	20
Sphagnum sp.	5.0	11.2	20
Sphagnum warnstorfii	7.0	15.7	20
Tomentypnum nitens	2.0	4.5	20
Total Lichen Cover	7.5	10.8	100
Cetraria islandica ssp. *islandica*	0.6	1.3	20
Cladina arbuscula	1.4	2.2	40
Cladina rangiferina	1.0	2.2	20
Cladina stygia	0.2	0.4	20
Cladonia sp.	1.0	1.0	80
Cladonia uncialis	0.8	1.1	40
Dactylina arctica	0.0	0.0	20
Flavocetraria cucullata	1.0	2.2	20
Peltigera aphthosa	0.5	0.8	100
Peltigera malacea	0.2	0.4	20
Stereocaulon sp.	0.6	0.9	40
Thamnolia vermicularis	0.2	0.4	20
Total Bare Ground	14.8	13.0	100
Soil	0.6	0.5	60
Litter Alone	14.2	12.9	100
Water	0.0	0.0	0

Soils

Soils are somewhat poorly drained with moderately thin surface organic accumulations (Table 28). Depth to rocky soil horizons generally is >0.5 m and thin eolian silt layers are occasionally present. Rocky surface fragments and frost boils are absent. Permafrost is sometimes present at greater depths. Soil pH is acidic and electrical conductivity is low, but higher than in other bog types. Water is present at shallow depths.

Table 28. Soil characteristics for Boreal Lowland Birch–Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	10.4	6.2	5
Cumulative Org. in 40 cm (cm)	17.6	13.8	5
Loess Cap Thickness(cm)	9.8	15.2	4
Depth to Rocks (cm)	80.0	55.9	4
Surface Fragment Cover (%)	0.0	0.0	5
Frost Boil Cover (%)	2.0		1
Thaw Depth (cm)[a]	83.0	31.1	2
Site pH at 10-cm depth	5.4	0.6	5
Site EC at 10-cm depth (µS/cm)	164.0	105.3	5
Water Depth (cm, + above gnd)[a]	-49.6	48.5	5

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the nonpermafrost soils Histic Cryaquepts (wet, organic-rich) and Typic Eutrocryepts (moist, well developed, circumneutral). A less common subgroup that occurs is Typic Aquiturbel (wet, mineral permafrost soil with turbated horizons).

This ecotype is part of the broader soil landscapes within Boreal Lowland Loamy Scrub and Forests, along with Boreal Lowland White Spruce Forest and Boreal Lowland Tall Willow Scrub.

BOREAL LOWLAND SEDGE–SHRUB FEN

Geomorphology:

This ecotype occurs on minerotrophic peaty soils and is taxonomically diverse, particularly in sedge and forb species. Surfaces are flat and the dominant soil texture is peat. Sites are wet, poorly to very poorly drained and mostly circumneutral, but sometimes acidic. Thaw depths are variable. Open water and litter are common. These communities are stable, and the most common disturbances are thermokarst events.

Plant Associations:

Carex aquatilis–Eriophorum angustifolium–Andromeda polifolia
Carex aquatilis–Potentilla palustris–Salix pulchra

Two distinct floristic classes exist for this ecotype, which is co-dominated by sedge and shrub species (Table 29). Two rare species that occur in the ecotype are *Carex adelostoma* and *Carex holostoma*. Of lowland ecotypes, this ecotype has the lowest number of species per plot but has the highest total species count. Total species count is the sixth highest for all ecotypes. Common species include *Carex aquatilis, Eriophorum angustifolium*, *Scorpidium scorpioides,* and *Andromeda polifolia.*

Similar ecotypes include Boreal Lacustrine Sedge Meadow, which is not as diverse, has lower shrub cover and is directly affected by lake water; and Boreal Lowland Tussock–Shrub Bog, which is defined by >25% cover of tussocks.

Table 29. Vegetation cover and frequency for Boreal Lowland Sedge–Shrub Fen (n=23). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	93.2	44.4	100
Total Vascular Cover	62.8	36.6	100
Total Evergreen Tree Cover	0.1	0.3	30
Picea glauca	0.1	0.2	22
Total Evergreen Shrub Cover	3.4	8.2	78
Andromeda polifolia	0.9	1.6	48
Chamaedaphne calyculata	2.2	8.3	30
Ledum groenlandicum	0.2	0.5	17
Oxycoccus microcarpus	0.1	0.3	9
Total Deciduous Shrub Cover	17.1	25.0	78
Betula glandulosa	0.5	2.1	17
Betula nana	0.3	0.5	26
Myrica gale	3.9	8.3	35
Potentilla fruticosa	2.2	3.8	48
Salix bebbiana	0.8	3.2	9
Salix planifolia pulchra	9.1	21.9	35
Vaccinium uliginosum	0.0	0.0	17
Total Forb Cover	7.5	8.6	96
Drosera rotundifolia	0.0	0.0	17
Epilobium palustre	0.7	3.1	17
Equisetum arvense	0.3	0.8	17
Equisetum fluviatile	0.2	0.6	9
Galium trifidum ssp. *trifidum*	0.1	0.2	13
Menyanthes trifoliata	0.3	0.6	17
Myriophyllum spicatum ssp. *exalbescens*	0.1	0.3	17
Oxytropis borealis	0.0	0.2	9
Parnassia palustris	0.2	0.4	30
Pedicularis sudetica	0.1	0.4	4
Petasites frigidus	0.4	1.9	4
Platanthera hyperborean	0.0	0.2	9
Potentilla palustris	4.1	7.8	52
Rubus arcticus	0.1	0.3	17
Selaginella selaginoides	0.0	0.0	9
Spiranthes romanzoffiana	0.0	0.0	17
Tofieldia glutinosa	0.3	0.9	9
Tofieldia pusilla	0.1	0.3	17
Triglochin maritimum	0.1	0.3	17
Utricularia minor	0.2	1.0	4
Total Grass Cover	1.4	3.3	39
Calamagrostis canadensis	1.3	3.3	26
Calamagrostis inexpansa	0.1	0.3	17
Total Sedge & Rush Cover	33.3	19.1	100
Carex adelostoma	0.7	3.3	4
Carex aquatilis ssp. *aquatilis*	13.0	17.4	78
Carex canescens	0.1	0.2	13
Carex capillaris	0.0	0.2	4
Carex capitata	0.1	0.4	4
Carex diandra	2.0	5.6	26
Carex dioica ssp. *gynocrates*	0.0	0.0	4
Carex garberi ssp. *bifaria*	0.0	0.0	4
Carex holostoma	0.2	1.0	4
Carex leptalea	0.0	0.0	9
Carex limosa	1.0	2.7	30
Carex misandra	0.1	0.4	4

Table 29. Continued.

	Cover Mean	Cover SD	Freq %
Carex pauciflora	0.0	0.2	4
Carex pluriflora	0.7	1.6	22
Carex rotundata	0.2	0.6	9
Carex saxatilis	0.1	0.6	9
Carex sitchensis	0.1	0.4	4
Carex utriculata	0.2	0.8	4
Carex vaginata	0.1	0.4	4
Eleocharis quinqueflora	0.4	2.1	4
Eriophorum angustifolium	8.3	16.9	61
Eriophorum russeolum	0.8	2.3	13
Eriophorum sp.	0.4	2.1	4
Eriophorum vaginatum	0.5	2.1	9
Trichophorum alpinum	0.4	2.1	4
Trichophorum caespitosum	3.5	7.1	26
Total Nonvascular Cover	30.4	24.8	100
Total Moss Cover	30.3	24.8	100
Aulacomnium palustre	2.4	4.4	39
Aulacomnium turgidum	0.5	1.6	9
Brachythecium coruscum	0.1	0.6	4
Bryum pseudotriquetrum	0.0	0.2	4
Calliergon giganteum	0.1	0.4	4
Calliergon sp.	2.2	8.4	13
Campylium stellatum	1.4	4.6	22
Drepanocladus revolvens	0.7	3.1	4
Drepanocladus sp.	1.0	3.3	22
Limprichtia revolvens	2.0	6.5	13
Pohlia cruda	0.1	0.6	4
Rhytidium rugosum	0.2	0.8	4
Scorpidium scorpioides	6.2	9.9	48
Sphagnum angustifolium	1.1	5.2	4
Sphagnum capillifolium	1.1	5.2	4
Sphagnum fallax	1.1	5.2	4
Sphagnum magellanicum	0.2	1.0	4
Sphagnum rubellum	1.1	5.2	4
Sphagnum sp.	2.2	5.1	30
Sphagnum squarrosum	0.7	3.1	4
Tomentypnum nitens	1.8	5.3	35
Unknown moss	2.7	8.7	22
Warnstorfia cf. *exannulata*	0.2	0.7	9
Total Lichen Cover	0.1	0.4	22
Peltigera aphthosa	0.0	0.0	4
Total Bare Ground	40.4	23.8	100
Soil	0.3	0.4	26
Litter Alone	22.0	17.8	87
Water	18.2	24.4	57

Soils

Soils are very poorly drained with thick accumulations of sedge-rich peat (Table 30). Depth to rocky soil horizons generally is >1.5 m and thin eolian silt layers are lacking. Rocky surface fragments and frost boils are absent. Permafrost is sometimes present within 1 m depth. Soil pH is circumneutral and moderate electrical conductivity values indicate ground-water input. Water is always present near the surface.

Table 30. Soil characteristics for Boreal Lowland Sedge–Shrub Fen.

Property	Mean	SD	n
Surface Organics Depth (cm)	73.2	38.1	18
Cumulative Org. in 40 cm (cm)	39.7	1.2	18
Loess Cap Thickness(cm)	0.0	0.0	16
Depth to Rocks (cm)	142.0	43.7	9
Surface Fragment Cover (%)	0.0	0.0	16
Frost Boil Cover (%)	0.0	0.0	11
Thaw Depth (cm)[a]	71.3	41.4	7
Site pH at 10-cm depth	6.3	0.5	17
Site EC at 10-cm depth (µS/cm)	230.6	208.0	17
Water Depth (cm, + above gnd)[a]	-5.6	8.1	18

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the nonpermafrost subgroup Typic Cryofibrists (wet, poorly decomposed peat) and, to a lesser extent, Terric Cryohemists (wet, moderately decomposed peat with mineral soil within 1 m) and Typic Cryohemists (wet, moderately decomposed peat). Less common subgroups include the permafrost-affected subgroups Typic Fibristels (wet, poorly decomposed peat), Typic Hemistels (wet, moderately decomposed peat), and Typic Historthels (wet, organic-rich mineral soil lacking turbated horizons).

This ecotype is included in the broader soil landscapes within Boreal Lowland Organic-rich Meadows, along with Boreal Lacustrine Sedge Meadow.

BOREAL LOWLAND TALL WILLOW SHRUB

Geomorphology:

Limited to post-disturbance (e.g. burned) areas, this uncommon ecotype occurs on lowland loess or older moraine. Surface forms include flats and slopes, and soils are moderately well to well drained, moist and circumneutral to acidic. Dominant texture is loamy but gravelly or organic textures also occur.

Plant Association:
Salix scouleriana–Salix barclayi–Rosa acicularis

Vegetation consists of willows taller than 1.5 m with an open canopy (Table 31). This ecotype is not diverse; it has the lowest number of species of all boreal lowland ecotypes. The understory consists of mosses, forbs and evergreen shrubs. Common species include *Salix scouleriana, Salix barclayi, Rosa acicularis*, *Picea glauca* (mostly seedlings), *Vaccinium vitis-idaea, Arctostaphylos rubra, Epilobium angustifolium,* and *Hylocomium splendens*. Graminoids often are present, but deciduous trees are absent.

This ecotype is not closely related to any other ecotype. The two riverine willow ecotypes occur on recent floodplain deposits and have different species compositions compared with the lowland class.

Table 31. Vegetation cover and frequency for Boreal Lowland Tall Willow Shrub (n=6). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	173.2	66.8	100
Total Vascular Cover	138.6	34.8	100
Total Evergreen Tree Cover	4.7	2.0	100
Picea glauca	4.7	2.0	100
Total Evergreen Shrub Cover	42.0	19.0	100
Empetrum nigrum	13.7	14.4	67
Ledum decumbens	0.2	0.4	17
Ledum groenlandicum	10.5	13.4	67
Linnaea borealis	2.0	4.0	33
Vaccinium vitis-idaea	15.7	29.1	100
Total Deciduous Shrub Cover	72.2	20.9	100
Arctostaphylos rubra	6.0	7.2	83
Betula glandulosa	0.3	0.8	17
Betula nana	2.5	6.1	17
Betula occidentalis	0.2	0.4	17
Potentilla fruticosa	0.5	1.2	17
Rosa acicularis	7.5	9.2	83
Salix arbusculoides	0.4	0.8	33
Salix barclayi	0.3	0.8	17
Salix bebbiana	10.8	13.6	50
Salix commutata	0.8	2.0	17
Salix myrtillifolia	0.5	1.2	17
Salix planifolia ssp. *pulchra*	5.8	14.3	17
Salix scouleriana	34.2	26.9	83
Vaccinium uliginosum	2.4	3.9	67
Total Forb Cover	16.8	9.4	100
Anemone parviflora	0.0	0.0	17
Cornus canadensis	0.8	1.3	33
Epilobium angustifolium	0.5	0.5	83
Equisetum arvense	0.2	0.4	33
Equisetum pratense	1.2	2.9	17
Equisetum scirpoides	1.5	2.1	50
Geocaulon lividum	5.5	8.1	50
Lupinus arcticus	0.0	0.0	17
Lycopodium alpinum	0.8	2.0	17
Lycopodium clavatum	0.8	2.0	17
Lycopodium complanatum	0.8	2.0	17
Mertensia paniculata	1.7	4.1	17
Petasites frigidus	1.0	2.0	33
Platanthera obtusata	0.2	0.4	17
Polemonium acutiflorum	0.0	0.0	17
Pyrola asarifolia	0.2	0.4	17
Pyrola grandiflora	0.2	0.4	17
Rubus chamaemorus	0.8	2.0	17
Solidago multiradiata	0.0	0.0	17
Stellaria calycantha	0.0	0.0	17
Valeriana capitata	0.5	1.2	17
Total Grass Cover	2.9	5.1	67
Calamagrostis canadensis	2.2	4.8	50
Calamagrostis lapponica	0.3	0.8	17
Festuca altaica	0.2	0.4	33
Poa alpina	0.0	0.0	17
Poa arctica	0.2	0.4	17
Total Sedge & Rush Cover	0.0	0.0	17

Table 31. Continued.

	Cover Mean	Cover SD	Freq %
Eriophorum vaginatum	0.0	0.0	17
Total Nonvascular Cover	34.7	58.1	100
Total Moss Cover	33.1	57.9	100
Aulacomnium palustre	3.4	4.1	67
Brachythecium sp.	0.3	0.8	17
Dicranum laevidens	0.8	2.0	17
Eurhynchium pulchellum	0.2	0.4	17
Hylocomium splendens	10.5	12.8	83
Pleurozium schreberi	4.3	10.1	33
Pohlia sp.	0.0	0.0	17
Polytrichum strictum	1.0	2.0	33
Sphagnum girgensohnii	10.0	24.5	17
Tomentypnum nitens	2.5	6.1	17
Total Lichen Cover	1.6	1.0	100
Cladina arbuscula	0.2	0.4	17
Cladina mitis	0.0	0.0	17
Cladina rangiferina	0.2	0.4	33
Cladonia ecmocyna	0.0	0.0	17
Cladonia sp.	0.0	0.1	33
Peltigera aphthosa	0.7	0.8	50
Peltigera canina	0.5	0.8	33
Total Bare Ground	3.7	4.3	50
Soil	0.0	0.0	0
Litter Alone	3.7	4.3	50

Soils

Soils are somewhat poorly drained with moderately thin surface organic accumulations (Table 32). Depth to rocky soil horizons generally is >1 m and thin eolian silt layers are lacking. Rocky surface fragments and frost boils are absent. Permafrost is infrequently present at depths > 1 m. Soil pH is acidic to circumneutral and electrical conductivity is low. Water is usually present within 1 m of the surface.

Table 32. Soil characteristics for Boreal Lowland Tall Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	2.0	0.0	2
Cumulative Org. in 40 cm (cm)	2.0	0.0	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	1.0	1.4	2
Surface Fragment Cover (%)	17.5	10.6	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.6	0.6	2
Site EC at 10-cm depth (µS/cm)	140.0	99.0	2
Water Depth (cm, + above gnd)[a]	-175.0	35.4	2

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost soils Typic Dystrocryepts (moist, acidic, well developed). Less common subgroups include Typic Haplocryods (moist, acidic, highly leached) and Humic Dystrogelepts (moist, organic-rich with permafrost below 1 m).

This ecotype is part of the broader soil landscapes within Boreal Lowland Loamy Scrub and Forests, along with Boreal Lowland White Spruce Forest and Boreal Lowland Low Birch-Willow Scrub.

BOREAL LOWLAND TUSSOCK–SHRUB BOG

Geomorphology:

This ecotype is widespread in lowland areas in the northern section of the park. Soils are circumneutral to acidic, somewhat to very poorly drained, wet or moist, and underlain by permafrost. There is a moderate to thick surface organic horizon underlain by loam or clay. At least 25% of the ground surface is covered by tussocks.

Plant Association:
Eriophorum vaginatum–Betula nana

Associated species common to plots in this ecotype are *Vaccinium vitis-idaea, Salix planifolia* ssp. *pulchra, Ledum decumbens, Vaccinium uliginosum, Sphagnum* spp., and *Hylocomium splendens* (Table 33). Trees usually are present only as seedlings or in dwarfed growth forms. Grasses are present infrequently. Mosses are diverse and well represented; and lichens are present in every plot, although they have low total cover.

This ecotype is similar to Boreal Alpine Tussock Meadow, except that it has higher cover of low shrubs and occurs at lower elevations. It is also similar to Boreal Lowland Sedge–Shrub Fen but unlike the fen class has >20% cover of tussocks.

Table 33. Vegetation cover and frequency for Boreal Lowland Tussock–Shrub Bog (n=11). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	112.6	32.9	100
Total Vascular Cover	68.6	24.3	100
Total Evergreen Tree Cover	2.4	3.5	64
Picea glauca	0.9	2.1	36
Picea mariana	1.5	3.2	27
Total Evergreen Shrub Cover	17.4	14.8	91
Andromeda polifolia	0.8	1.7	36
Chamaedaphne calyculata	0.5	1.5	9
Empetrum nigrum	3.7	4.6	45
Ledum decumbens	6.3	7.3	82
Ledum groenlandicum	1.5	2.7	36
Oxycoccus microcarpus	0.2	0.4	36
Vaccinium vitis-idaea	4.5	5.7	91
Total Deciduous Shrub Cover	29.6	11.4	100
Arctostaphylos alpina	0.9	3.0	9
Arctostaphylos rubra	0.1	0.3	27
Betula glandulosa	1.5	4.5	27
Betula nana	16.5	10.2	91
Potentilla fruticosa	0.1	0.3	18
Salix glauca	0.1	0.3	27
Salix myrtillifolia	0.5	1.5	18
Salix planifolia ssp. *pulchra*	4.3	5.7	91
Salix reticulata	0.2	0.6	9
Vaccinium uliginosum	5.5	4.2	91
Total Forb Cover	1.4	1.6	73
Pedicularis labradorica	0.0	0.0	27
Pedicularis langsdorffii	0.0	0.0	18
Petasites frigidus	0.0	0.0	9
Pinguicula villosa	0.0	0.0	18
Polygonum viviparum	0.1	0.3	9
Pyrola minor	0.0	0.0	9
Pyrola secunda	0.0	0.0	9
Rubus chamaemorus	1.0	1.4	55
Tofieldia pusilla	0.1	0.3	36
Valeriana capitata	0.0	0.0	9
Total Grass Cover	0.1	0.3	27
Arctagrostis latifolia	0.0	0.0	9
Calamagrostis inexpansa	0.0	0.0	9
Calamagrostis sp.	0.0	0.0	9
Festuca altaica	0.1	0.3	9
Total Sedge & Rush Cover	17.8	10.7	100
Carex aquatilis ssp. *aquatilis*	0.5	1.5	18
Carex bigelòwii	1.2	3.0	55
Carex membranacea	0.2	0.6	9
Eriophorum brachyantherum	3.6	12.1	9
Eriophorum vaginatum	12.2	7.6	91
Total Nonvascular Cover	44.0	16.0	100
Total Moss Cover	39.8	16.6	100
Aulacomnium palustre	2.0	4.0	45
Aulacomnium turgidum	2.1	3.3	64
Blepharostoma trichophyllum	0.0	0.0	9
Brachythecium sp.	0.5	1.5	18
Calliergon sp.	0.5	1.5	9
Dicranum elongatum	0.0	0.0	9

Table 33. Continued.

	Cover		Freq
	Mean	SD	%
Dicranum groenlandicum	0.5	1.5	9
Dicranum polysetum	0.1	0.3	18
Dicranum sp.	0.9	1.5	55
Hylocomium splendens	3.4	3.7	55
Hypnum holmenii	0.0	0.0	9
Hypnum sp.	1.4	4.5	9
Pleurozium schreberi	1.7	3.6	27
Pohlia nutans	0.1	0.3	9
Polytrichum juniperinum	0.1	0.3	9
Polytrichum sp.	0.0	0.0	27
Sanionia uncinata	0.0	0.0	18
Sphagnum fuscum	10.5	16.9	36
Sphagnum rubellum	0.0	0.0	9
Sphagnum sp.	11.9	11.4	73
Sphagnum subsecundum	0.0	0.0	9
Sphagnum warnstorfii	0.0	0.0	9
Tomentypnum nitens	1.4	3.2	27
Unknown moss	2.7	5.1	27
Total Lichen Cover	4.2	4.2	100
Cladina arbuscula	0.1	0.3	18
Cladina rangiferina	0.1	0.3	18
Cladina sp.	1.5	3.1	55
Cladonia sp.	0.8	1.2	55
Flavocetraria cucullata	0.5	1.5	18
Peltigera aphthosa	0.8	0.8	64
Peltigera leucophlebia	0.1	0.3	9
Peltigera malacea	0.2	0.6	9
Peltigera polydactylon	0.1	0.3	9
Total Bare Ground	13.8	17.2	100
Litter Alone	12.0	13.3	100
Water	1.8	6.0	9

Soils

Soils are poorly drained with moderately thick accumulations of peat (Table 34). Depth to rocky soil horizons is greater that the active-layer depth and rocky surface frag- ments are absent. Mod- erately thick eolian silt layers and frost boils are frequently present. Permafrost is always present at shallow depths. Soil pH is acidic to circumneutral and electrical conductivity is low. Water is always present at shallow depths.

Table 34. Soil characteristics for Boreal Lowland Tussock–Shrub Bog. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	29.8	6.4	10
Cumulative Org. in 40 cm (cm)	30.2	6.6	9
Loess Cap Thickness(cm)	2.4	6.0	10
Depth to Rocks (cm)	51.0	24.0	2
Surface Fragment Cover (%)	0.0	0.0	10
Frost Boil Cover (%)	0.0	0.0	9
Thaw Depth (cm)[a]	38.7	22.7	9
Site pH at 10-cm depth	5.7	0.8	10
Site EC at 10-cm depth (µS/cm)	87.0	95.9	10
Water Depth (cm, + above gnd)[a]	-22.3	11.2	10

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the permafrost-affected subgroups Typic Aquiturbels (wet mineral soil with turbated horizons), Typic Aquorthels (wet mineral soil lacking turbated horizons), Typic Historthels (wet, organic-rich soil lacking turbated horizons) and Typic Fibristels (wet, poorly decomposed thick peat). Less common subgroups include Typic Historturbels (wet, organic-rich soil with turbated horizons) and Sphagnic Fibristels (wet, Sphagnum-rich, poorly decomposed thick peat).

This ecotype and related soil association are components of the broader soil landscapes within Boreal Lowland Scrub and Forest Bogs, which includes Boreal Lowland Black Spruce Forest and Boreal Lowland Black Spruce Bog.

BOREAL LOWLAND WHITE SPRUCE FOREST

Geomorphology:

These late successional forests are located on flat or sloped surfaces throughout the park. They occur on a variety of surficial geomorphic types including older moraine, hillside colluvium, alluvial fans and abandoned deposits on floodplains and glaciofluvial outwash. Dominant soil textures include sands, loams, gravels and organic material. These forests are wet to moist, poorly to well drained and acidic to circumneutral. Permafrost usually is within 0.5 m of the surface.

Plant Association:

Picea glauca–Vaccinium uliginosum

White spruce characterizes this ecotype and stand densities vary from woodland to closed canopies (Table 35). Typical understory species are *Vaccinium uliginosum, Ledum groenlandicum, Vaccinium vitis-idaea, Arctostaphylos rubra*, and *Hylocomium splendens*. Mosses have high cover. This ecotype has a high number of species per plot and is the second most diverse lowland ecotype.

This ecotype is similar to Boreal Riverine White Spruce Forest but does not occur on recent floodplain deposits. It shares many understory species with Boreal Lowland Black Spruce Forest, but is dominated by white spruce.

Soils

Table 35. Vegetation cover and frequency for Boreal Lowland White Spruce Forest (n=11). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	222.3	52.2	100
Total Vascular Cover	143.7	41.6	100
Total Evergreen Tree Cover	25.0	6.6	100
Picea glauca	25.0	6.6	100
Total Evergreen Shrub Cover	49.2	31.5	100
Arctostaphylos uva-ursi	0.5	1.5	9
Empetrum nigrum	17.1	15.4	73
Ledum groenlandicum	12.7	13.4	82
Linnaea borealis	2.7	4.6	45
Vaccinium vitis-idaea	14.6	13.8	91
Total Deciduous Tree Cover	0.8	1.9	18
Populus balsamifera	0.4	1.2	18
Populus tremuloides	0.5	1.5	9
Total Deciduous Shrub Cover	36.4	26.6	100
Alnus crispa	1.0	3.0	18
Alnus sinuata	0.5	1.5	9
Alnus tenuifolia	5.2	10.2	36
Arctostaphylos rubra	6.2	8.2	91
Betula glandulosa	0.1	0.3	9
Betula nana	3.9	10.6	18
Potentilla fruticosa	0.2	0.4	27
Rosa acicularis	1.2	1.8	55
Salix alaxensis	0.5	1.5	18
Salix arbusculoides	0.6	1.5	27
Salix barclayi	1.0	3.0	18
Salix bebbiana	0.9	3.0	18
Salix glauca	5.4	8.0	64
Salix myrtillifolia	0.0	0.0	18
Salix planifolia ssp. *pulchra*	0.5	1.0	27
Salix reticulata	2.9	7.5	27
Salix scouleriana	0.6	1.5	27
Shepherdia canadensis	2.7	6.5	18
Vaccinium uliginosum	3.1	4.3	91
Viburnum edule	0.1	0.3	9
Total Forb Cover	28.9	30.1	100
Anemone richardsonii	0.0	0.0	18
Astragalus alpinus	0.1	0.3	9
Astragalus umbellatus	0.1	0.3	9
Cornus canadensis	3.6	12.1	9
Epilobium angustifolium	0.1	0.3	27
Equisetum arvense	18.3	29.7	45
Equisetum scirpoides	0.5	0.9	64
Galium trifidum ssp. *trifidum*	0.1	0.3	9
Geocaulon lividum	0.6	0.7	55
Hedysarum alpinum	0.3	0.6	55
Lupinus arcticus	2.0	6.0	18
Lupinus nootkatensis	0.1	0.3	9
Mertensia paniculata	0.3	0.9	36
Moneses uniflora	0.0	0.1	18
Pedicularis labradorica	0.2	0.4	36
Pedicularis sudetica	0.1	0.3	9
Petasites frigidus	0.1	0.3	18
Polygonum bistorta	0.1	0.3	9
Pyrola asarifolia	0.1	0.3	45

Table 35. Continued.

	Cover Mean	Cover SD	Freq %
Pyrola chlorantha	0.0	0.0	27
Pyrola grandiflora	0.4	0.7	27
Pyrola secunda	0.0	0.0	27
Rubus arcticus	0.5	1.5	9
Rubus chamaemorus	0.3	0.9	9
Saussurea angustifolia	0.1	0.3	18
Solidago multiradiata	0.5	1.2	27
Tofieldia pusilla	0.1	0.3	9
Trientalis europaea	0.0	0.0	9
Valeriana capitata	0.0	0.0	27
Viola epipsila ssp. *repens*	0.3	0.9	9
Total Grass Cover	1.4	2.1	82
Arctagrostis latifolia	0.1	0.3	27
Calamagrostis canadensis	0.6	1.5	27
Festuca altaica	0.7	1.6	36
Total Sedge & Rush Cover	1.9	3.7	73
Carex aquatilis ssp. *aquatilis*	0.0	0.0	9
Carex bigelòwii	0.5	1.0	27
Carex scirpoidea	0.2	0.6	9
Carex stylosa	0.9	3.0	9
Carex vaginata	0.1	0.3	9
Juncus castaneus ssp. *castaneus*	0.0	0.0	9
Total Nonvascular Cover	78.7	25.5	100
Total Moss Cover	72.4	18.8	100
Abietinella abietina	0.5	1.5	18
Aulacomnium palustre	2.3	4.5	36
Aulacomnium sp.	0.5	1.5	9
Aulacomnium turgidum	1.8	4.0	18
Campylium stellatum	0.2	0.6	9
Dicranum sp.	0.9	3.0	18
Drepanocladus sp.	1.8	4.6	18
Hylocomium splendens	46.4	24.2	100
Plagiomnium sp.	0.2	0.6	9
Pleurozium schreberi	6.5	12.2	45
Polytrichum sp.	0.9	2.0	18
Ptilium crista-castrensis	0.9	3.0	9
Rhytidium rugosum	0.5	1.5	18
Sanionia uncinata	0.1	0.3	9
Sphagnum rubellum	1.8	6.0	9
Tomentypnum nitens	6.5	10.0	45
Unknown moss	0.5	1.5	9
Total Lichen Cover	6.3	14.4	91
Bryoria sp.	0.0	0.0	18
Cetraria islandica ssp. *islandica*	0.2	0.6	9
Cladina sp.	2.3	7.5	18
Cladonia sp.	1.2	2.0	45
Flavocetraria nivalis	0.2	0.6	9
Hypogymnia cf	0.0	0.1	18
Masonhalea richardsonii	0.1	0.3	9
Parmelia sp.	0.0	0.0	18
Peltigera aphthosa	0.8	1.0	82
Stereocaulon paschale	1.4	4.5	9
Thamnolia vermicularis	0.1	0.3	9
Usnea sp.	0.0	0.0	18
Total Bare Ground	3.1	2.3	73
Litter Alone	3.0	2.1	73
Water	0.1	0.3	9

Soils are somewhat poorly drained with thin to moderately thick surface organic accumulations over loamy, sandy, or gravel mineral soils (Table 36). Depth to rocky soil horizons generally is >0.5 m and rocky surface fragments are lacking. Thin eolian silt layers are often present, but frost boils are absent. Permafrost is sometimes present at shallow depths. Soil pH is acidic to circumneutral and electrical conductivity is low. Water is often present within 1 m.

Table 36. Soil characteristics for Boreal Lowland White Spruce Forest.

Property	Mean	SD	n
Surface Organics Depth (cm)	20.2	10.4	10
Cumulative Org. in 40 cm (cm)	20.4	10.6	10
Loess Cap Thickness(cm)	5.4	10.5	8
Depth to Rocks (cm)	60.8	47.7	6
Surface Fragment Cover (%)	0.0	0.0	9
Frost Boil Cover (%)	0.0	0.0	7
Thaw Depth (cm)[a]	42.0	11.9	4
Site pH at 10-cm depth	5.6	1.0	8
Site EC at 10-cm depth (µS/cm)	105.0	63.0	8
Water Depth (cm, + above gnd)[a]	-80.4	61.3	10

[a] Measurements >1 m indicate minimum depth, not true depth

The most frequent soil subgroups are the non-permafrost soils Typic Dystrocryepts (moist, acidic, well developed) and the permafrost affected soils Typic Historthels (wet, organic-rich soil lacking turbated horizons). Other uncommon soils include Histic Cryaquepts, Humic Dystrocryepts, and Typic Eutrocryepts.

This ecotype is part of the soil landscapes within Boreal Lowland Loamy Scrub and Forests.

BOREAL RIVERINE ACIDIC BARRENS

Geomorphology:

These barren sites occur on active riverine channel deposits along the Tana River in the Granite Mountains section of the Chugach Range. Granitic parent material results in the acidic pH that distinguishes this ecotype. Soils consist of coarse, bouldery material; these sites are somewhat excessively drained and dry.

Plant Association:
Racomitrium sp.–*Festuca brachyphylla*

This ecotype is species-poor, with the lowest species count of all the boreal ecotypes, and the third lowest species count among all ecotypes (Table 37). *Racomitrium* moss frequently forms a mat over the ground surface. Forbs are the most common vascular life form, and are limited to ruderal colonizers such as *Epilobium latifolium*. Seedlings of *Picea glauca, Populus balsamifera* and *Salix alaxensis* frequently are present in these early successional sites.

This ecotype is most similar to Boreal Riverine Circumalkaline Barrens, but both pH and number of plant species are lower at the acidic sites. Species composition is well defined with low scatter compared to Boreal Riverine Circumalkaline Barrens (Figure 22A).

Table 37. Vegetation cover and frequency for Boreal Riverine Acidic Barrens (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	76.1	19.9	100
Total Vascular Cover	4.1	4.0	100
Total Evergreen Tree Cover	0.0	0.0	20
Picea glauca	0.0	0.0	20
Total Deciduous Tree Cover	0.0	0.0	20
Populus balsamifera	0.0	0.0	20
Total Deciduous Shrub Cover	0.4	0.9	40
Salix alaxensis	0.4	0.9	40
Total Forb Cover	3.3	3.8	100
Arabis holboellii	0.0	0.0	20
Arabis sp.	0.0	0.1	40
Epilobium latifolium	3.0	3.9	100
Oxytropis deflexa	0.2	0.4	60
Solidago multiradiata	0.0	0.0	20
Total Grass Cover	0.3	0.4	100
Festuca brachyphylla	0.3	0.4	100
Total Nonvascular Cover	72.1	19.3	100
Total Moss Cover	71.0	18.2	100
Polytrichum piliferum	1.0	2.2	20
Polytrichum sp.	12.0	11.5	60
Racomitrium canescens	58.0	16.0	100
Total Lichen Cover	1.1	2.2	60
Cladonia sp.	0.0	0.1	40
Stereocaulon alpinum	1.0	2.2	40
Total Bare Ground	23.4	21.8	100
Soil	22.8	21.8	100
Litter Alone	0.6	1.3	20
Water	0.0	0.0	0

Soils

Soils typically are well to excessively drained, rocky, and lack surface or buried organic horizons (Table 38). An eolian silt cap is absent and rock fragments are abundant at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is <1 m. Soil pH is acidic and electrical conductivity is low.

Table 38. Soil characteristics for Boreal Riverine Acidic Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	5
Cumulative Org. in 40 cm (cm)	0.0	0.0	5
Loess Cap Thickness(cm)	0.0	0.0	5
Depth to Rocks (cm)	0.0	0.0	5
Surface Fragment Cover (%)	52.0	21.1	5
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.2	0.4	5
Site EC at 10-cm depth (µS/cm)	38.0	38.3	5
Water Depth (cm, + above gnd)[a]	-80.0	11.2	5

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically (subgroup level) by the non-permafrost subgroups Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m) or Typic Cryorthents (moist, poorly developed soils).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Circumalkaline Barrens, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Sandy Willow Shrub, Boreal Riverine Loamy Willow Shrub, and Boreal Riverine Tall Alder Shrub.

BOREAL RIVERINE CIRCUMALKALINE BARRENS

Geomorphology:

Widespread along braided, active or inactive riverine channel deposits, this ecotype occurs along glacial rivers throughout the park. Soils are circumneutral to alkaline, and have predominantly gravelly or bouldery soil textures. Sites have <30% cover of vascular species, are somewhat excessively to moderately well drained, and are dry or moist. Riverine processes such as flooding or channel migration maintain this ecotype, which otherwise is replaced in the successional sequence by scrub ecotypes.

Plant Association:

Epilobium latifolium–Salix alaxensis

Despite being sparsely vegetated with a low species count per plot, this ecotype has the highest total species richness of all riverine ecotypes, and the 13th highest species count overall (Table 39). Forbs are the most common life form, followed by deciduous shrubs and grasses. Notable species that occur in this ecotype include *Lupinus kuschei* (G3S2), *Salix setchelliana* (G4S3) and *Puccinellia interior*.

This ecotype is similar to Boreal Riverine Acidic Barrens as discussed previously. Landscape characteristics are similar to Boreal Riverine Dryas Dwarf Shrub.

Table 39. Vegetation cover and frequency for Boreal Riverine Circumalkaline Barrens (n=8). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	19.4	27.5	100
Total Vascular Cover	14.0	16.9	100
Total Evergreen Tree Cover	0.0	0.1	38
Picea glauca	0.0	0.1	38
Total Evergreen Shrub Cover	3.3	6.9	50
Dryas drummondii	2.9	7.0	38
Empetrum nigrum	0.4	1.1	13
Total Deciduous Tree Cover	1.0	1.7	75
Populus balsamifera	1.0	1.7	75
Total Deciduous Shrub Cover	2.2	2.8	88
Alnus tenuifolia	0.9	1.8	38
Elaeagnus commutata	0.1	0.4	13
Ribes hudsonianum	0.0	0.0	13
Salix alaxensis	0.7	1.4	63
Salix hastata	0.0	0.0	13
Salix planifolia ssp. *pulchra*	0.1	0.4	25
Salix rotundifolia	0.1	0.4	13
Salix setchelliana	0.0	0.0	13
Vaccinium uliginosum	0.1	0.4	25
Total Forb Cover	5.6	6.9	100
Achillea borealis	0.0	0.0	25
Androsace septentrionalis	0.0	0.0	13
Antennaria isolepis	0.0	0.0	13
Arabis lyrata ssp. *kamchatica*	0.0	0.0	13
Artemisia tilesii	0.0	0.0	13
Astragalus bodinii	0.0	0.0	13
Astragalus nutzotinensis	0.0	0.0	13
Crepis elegans	0.0	0.1	38
Epilobium latifolium	2.6	3.9	100
Equisetum arvense	0.0	0.1	38
Equisetum variegatum	0.0	0.0	25
Erigeron acris	0.0	0.0	25
Erigeron lonchophyllus	0.0	0.0	13
Halimolobos mollis	0.0	0.0	13
Hedysarum alpinum	0.3	0.5	38
Hedysarum mackenzii	0.5	1.1	25
Lappula myosotis	0.0	0.0	13
Lupinus arcticus	0.0	0.0	13
Lupinus kuschei	0.0	0.0	13
Minuartia dawsonensis	0.0	0.0	13
Minuartia rubella	0.0	0.0	13
Oxytropis campestris	0.2	0.3	50
Oxytropis deflexa	0.2	0.3	38
Oxytropis viscida	0.0	0.0	13
Parnassia palustris	0.0	0.0	13
Polemonium boreale	0.0	0.0	13
Saxifraga cernua	0.0	0.0	13
Saxifraga oppositifolia	0.0	0.0	13
Senecio pauciflorus	0.1	0.4	13
Silene menziesii	0.0	0.0	13
Stellaria alaskana	0.1	0.4	13
Triglochin palustris	0.0	0.0	13
Viola epipsila ssp. *repens*	0.1	0.4	13
Wilhelmsia physodes	0.0	0.0	13

Table 39. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Total Grass Cover	1.2	2.2	88
Agropyron sp.	0.0	0.0	25
Agropyron violaceum ssp. *violaceum*	0.1	0.4	25
Agrostis scabra	0.1	0.4	13
Calamagrostis canadensis	0.6	1.8	13
Calamagrostis inexpansa	0.1	0.4	13
Calamagrostis lapponica	0.0	0.0	13
Deschampsia caespitosa	0.0	0.0	13
Festuca rubra	0.0	0.0	13
Hordeum jubatum	0.0	0.0	13
Poa alpigena	0.0	0.0	13
Poa glauca	0.0	0.0	13
Poa lanata	0.0	0.0	13
Puccinellia interior	0.0	0.0	13
Trisetum spicatum ssp. *spicatum*	0.0	0.0	25
Total Sedge & Rush Cover	0.6	1.5	50
Carex aquatilis ssp. *aquatilis*	0.0	0.0	13
Carex aurea	0.0	0.0	13
Carex canescens	0.0	0.0	13
Carex krausei	0.0	0.0	13
Carex maritime	0.0	0.0	13
Carex media	0.5	1.4	13
Carex microchaeta	0.0	0.0	13
Juncus arcticus	0.0	0.0	13
Luzula confuse	0.0	0.0	13
Total Nonvascular Cover	5.4	12.4	50
Total Moss Cover	3.5	7.2	50
Ceratodon purpureus	0.0	0.0	13
Hylocomium splendens	0.0	0.0	13
Racomitrium canescens	2.3	4.2	25
Total Lichen Cover	1.9	5.3	25
Peltigera sp.	0.6	1.8	13
Stereocaulon sp.	1.0	2.8	25
Total Bare Ground	85.0	23.6	100
Soil	83.3	23.7	100
Litter Alone	1.8	1.6	75

Soils

Soils typically are well to excessively drained, rocky, and lack surface or buried organic horizons (Table 40). An eolian silt cap is absent and rock fragments are abundant at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is <1 m. Soil pH is circumneutral to alkaline and electrical conductivity is low.

Table 40. Soil characteristics for Boreal Riverine Circumalkaline Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	6
Cumulative Org. in 40 cm (cm)	0.0	0.0	6
Loess Cap Thickness(cm)	0.0	0.0	6
Depth to Rocks (cm)	0.0	0.0	5
Surface Fragment Cover (%)	74.2	17.4	6
Frost Boil Cover (%)	0.0	0.0	4
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.3	0.6	6
Site EC at 10-cm depth (µS/cm)	143.3	112.5	6
Water Depth (cm, + above gnd)[a]	-76.7	40.2	6

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m) or Typic Cryorthents (moist, poorly developed soils).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Acidic Barrens, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Sandy Willow Shrub, Boreal Riverine Loamy Willow Shrub, and Boreal Riverine Tall Alder Shrub.

BOREAL RIVERINE DRYAS DWARF SHRUB

Geomorphology:

This ecotype occurs on coarse, active, braided channel deposits along glacial rivers and on moderately steep headwater floodplains throughout the boreal region of the park. Slope positions include point and lateral bars, flat banks, and interfluves.

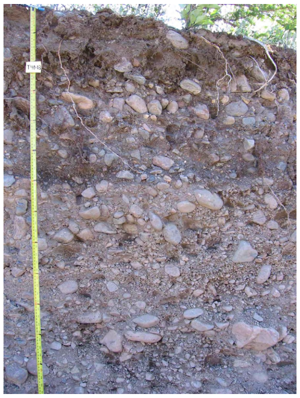
Plant Association:
Dryas drummondii–Oxytropis campestris

This ecotype is characterized by evergreen dwarf shrubs and is not particularly species rich (Table 41). Nonvascular species, deciduous species and forbs are present at all sites, while graminoids are less common with variable occurrences. Common species include *Dryas drummondii, Shepherdia canadensis, Populus balsamifera, Oxytropis campestris* and *Ceratodon purpureus*. Poplar, willow and silverberry often are present as seedlings, and these species determine the relative composition of following successional communities.

This ecotype is similar to Boreal Riverine Circumalkaline Barrens, although species diversity is lower and total cover is higher. Site characteristics are similar to those of later mid-successional stages, such as Boreal Riverine Gravelly Poplar Forest or Boreal Riverine Sandy Willow Shrub.

Table 41. Vegetation cover and frequency for Boreal Riverine Dryas Dwarf Shrub (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	78.2	21.2	100
Total Vascular Cover	67.9	25.4	100
Total Evergreen Tree Cover	1.3	1.5	67
Picea glauca	1.3	1.5	67
Total Evergreen Shrub Cover	50.0	18.0	100
Arctostaphylos uva-ursi	0.7	1.2	33
Dryas drummondii	49.3	18.3	100
Total Deciduous Tree Cover	3.0	2.0	100
Populus balsamifera	3.0	2.0	100
Total Deciduous Shrub Cover	5.1	6.9	100
Elaeagnus commutata	0.0	0.1	33
Salix alaxensis	0.7	0.6	67
Salix bebbiana	0.7	1.2	33
Shepherdia canadensis	3.7	5.5	100
Total Forb Cover	7.8	7.7	100
Achillea borealis	0.3	0.6	33
Arabis holboellii	0.3	0.6	33
Braya humilis	0.0	0.1	33
Hedysarum alpinum	0.0	0.1	33
Hedysarum mackenzii	0.3	0.6	33
Oxytropis campestris	4.3	3.1	100
Solidago decumbens var. *oreophila*	0.7	1.1	67
Taraxacum officinale	1.0	1.7	33
Taraxacum sp.	0.7	1.2	33
Total Grass Cover	0.7	1.3	33
Agropyron pauciflorum	0.0	0.1	33
Agropyron violaceum ssp. *violaceum*	0.3	0.6	33
Festuca brachyphylla	0.0	0.1	33
Festuca rubra	0.3	0.6	33
Total Nonvascular Cover	10.3	10.2	100
Total Moss Cover	8.6	10.1	100
Aulacomnium acuminatum	0.1	0.1	33
Aulacomnium sp.	0.0	0.1	33
Ceratodon purpureus	6.7	11.5	33
Racomitrium sp.	0.0	0.1	33
Sanionia uncinata	1.7	2.9	33
Unknown moss	0.1	0.2	33
Total Lichen Cover	1.7	0.6	100
Cladonia pocillum	0.7	1.2	33
Cladonia symphycarpia	0.7	1.2	33
Flavocetraria cucullata	0.0	0.1	33
Stereocaulon sp.	0.3	0.6	33
Vulpicida tilesii	0.0	0.1	33
Total Bare Ground	41.3	1.5	100
Soil	8.3	2.9	100
Litter Alone	33.0	3.0	100
Water	0.0	0.0	0



Soils

Soils typically are well to excessively drained, rocky, and have very thin surface organic horizons (Table 42). An eolian silt cap is absent and rock fragments are abundant at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is >1 m. Soil pH is alkaline and electrical conductivity is low.

Table 42. Soil characteristics for Boreal Riverine Dryas Dwarf Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.7	0.6	3
Cumulative Org. in 40 cm (cm)	0.7	0.6	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	0.7	0.6	3
Surface Fragment Cover (%)	13.4	18.9	3
Frost Boil Cover (%)	0.0		1
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.9	0.2	3
Site EC at 10-cm depth (µS/cm)	96.7	51.3	3
Water Depth (cm, + above gnd)[a]	-125.0	66.1	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m) or Typic Cryorthents (moist, poorly developed soils).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Acidic Barrens, Boreal Riverine Circumalkaline Barrens, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Sandy Willow Shrub, Boreal Riverine Loamy Willow Shrub, and Boreal Riverine Tall Alder Shrub.

BOREAL RIVERINE GRAVELLY POPLAR FOREST

Geomorphology:

These poplar forest communities are located on braided, active and inactive riverine channel deposits throughout the park. Soils are alkaline to circumneutral and consist of bouldery or gravelly sediments overlain by thin organic horizons. Sites are somewhat excessively drained and dry to moist. These communities are mid-successional and eventually transition into spruce forests.

Plant Association:

Populus balsamifera–Dryas drummondii–Oxytropis campestris

Poplar trees vary from dense stands of seedlings in early succession to mature, open canopies (Table 43). All life forms consistently are present except graminoids and lichens. Species richness is low. Common species include *Populus balsamifera, Dryas drummondii, Oxytropis campestris, Picea glauca, Salix alaxensis, Hedysarum mackenzii* and *Elaeagnus commutata*.

This ecotype is dominated by the same species as Boreal Riverine Loamy Poplar Forest, but the loamy ecotype is found on fine overbank deposits and has different associated understory species. It is also similar to Boreal Riverine Spruce–Poplar Forest, except that spruce trees are not co-dominant.

Table 43. Vegetation cover and frequency for Boreal Riverine Gravelly Poplar Forest (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	116.3	44.1	100
Total Vascular Cover	106.8	44.4	100
Total Evergreen Tree Cover	0.5	0.5	100
Picea glauca	0.5	0.5	100
Total Evergreen Shrub Cover	19.6	17.8	100
Arctostaphylos uva-ursi	3.0	6.7	20
Dryas drummondii	16.0	13.9	80
Linnaea borealis	0.6	1.3	20
Total Deciduous Tree Cover	31.4	9.6	100
Populus balsamifera	31.4	9.6	100
Total Deciduous Shrub Cover	42.9	27.8	100
Arctostaphylos rubra	0.2	0.4	20
Elaeagnus commutata	7.0	10.4	60
Rosa acicularis	1.0	2.2	20
Salix alaxensis	0.4	0.9	60
Salix bebbiana	0.2	0.4	40
Salix brachycarpa ssp. *niphoclada*	0.0	0.0	20
Shepherdia canadensis	33.0	26.4	100
Viburnum edule	1.0	2.2	20
Total Forb Cover	12.2	22.4	100
Achillea borealis	0.2	0.4	20
Artemisia tilesii	0.0	0.0	20
Aster sibiricus	5.0	11.2	20
Castilleja caudata	0.0	0.0	20
Epilobium angustifolium	0.6	1.3	40
Epilobium latifolium	0.6	0.9	40
Erigeron acris	0.0	0.0	20
Geocaulon lividum	3.0	6.7	20
Hedysarum alpinum	1.0	2.2	20
Hedysarum mackenzii	0.2	0.4	60
Moneses uniflora	0.2	0.4	20
Oxytropis campestris	0.6	0.5	80
Pyrola asarifolia	0.4	0.9	40
Pyrola grandiflora	0.2	0.4	40
Saxifraga tricuspidata	0.0	0.0	20
Solidago decumbens var. *oreophila*	0.0	0.0	20
Zygadenus elegans	0.0	0.0	20
Total Grass Cover	0.2	0.4	40
Agropyron violaceum ssp. *violaceum*	0.0	0.0	20
Calamagrostis sp.	0.2	0.4	20
Total Nonvascular Cover	9.5	7.1	100
Total Moss Cover	8.4	5.8	100
Abietinella abietina	1.0	2.2	20
Aulacomnium acuminatum	0.1	0.2	20
Brachythecium sp.	0.2	0.4	20
Bryum sp.	0.2	0.4	20
Ceratodon purpureus	0.2	0.4	20
Distichium sp.	0.0	0.0	20
Drepanocladus sp.	0.6	1.3	40
Hylocomium splendens	1.2	2.2	40
Pleurozium schreberi	2.6	3.2	60
Sanionia uncinata	1.4	3.1	20
Unknown moss	0.8	1.3	80
Total Lichen Cover	1.2	1.4	60

Table 43. Continued.

	Cover Mean	Cover SD	Freq %
Caloplaca jungermanniae	0.0	0.0	20
Cetraria aculeata	0.0	0.0	20
Cladonia chlorophaea	0.2	0.4	20
Cladonia pyxidata	0.2	0.4	20
Cladonia sp.	0.2	0.4	40
Peltigera rufescens	0.1	0.1	60
Stereocaulon sp.	0.0	0.0	20
Thamnolia vermicularis	0.0	0.0	20
Unknown crustose lichen	0.4	0.9	20
Total Bare Ground	22.4	14.6	100
Soil	5.2	11.1	40
Litter Alone	17.2	13.2	100
Water	0.0	0.0	0

Soils

Soils typically are well to excessively drained, gravelly, and have very thin surface organic horizons (Table 42). An eolian silt cap is absent and rock fragments are occasionally present at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is >1 m. Soil pH is alkaline and electrical conductivity is low.

Table 44. Soil characteristics for Boreal Riverine Gravelly Poplar Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.5	1.3	4
Cumulative Org. in 40 cm (cm)	1.5	1.3	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	3.8	4.2	4
Surface Fragment Cover (%)	1.3	2.5	4
Frost Boil Cover (%)	0.0		1
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.5	0.2	3
Site EC at 10-cm depth (µS/cm)	90.0	52.9	3
Water Depth (cm, + above gnd)[a]	-106.3	31.5	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Cryorthents (moist, poorly developed soils). Infrequently, Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m) occur.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Forests, which also includes the ecotypes Boreal Riverine Loamy Poplar Forest, Boreal Riverine Spruce-Poplar Forest and Boreal Riverine White Spruce Forest.

BOREAL RIVERINE LOAMY POPLAR FOREST

Geomorphology:

These mature poplar forests occur on braided active and inactive overbank riverine deposits throughout the study area. Soils are predominantly loamy and surface organic material is present; buried O horizons within the soil matrix are a common feature. Sites are alkaline to circumneutral, well-drained and moist.

Plant Association:

Populus balsamifera–Alnus tenuifolia–Equisetum arvense

These poplar forests usually are open stands, though closed canopies occur. Deciduous shrubs and forbs are the most common life forms in the understory (Table 45). Total nonvascular cover is low, and mosses or lichens may be absent. This ecotype is not diverse and has a below-average species count per plot. Common species are *Populus balsamifera, Alnus tenuifolia, Equisetum arvense, Rosa acicularis, Viburnum edule, Calamagrostis canadensis* and *Pyrola asarifolia*.

This ecotype is similar to Boreal Riverine Gravelly Poplar Forest except that it occurs on overbank deposits instead of channel deposits. This results in distinctly different understory species composition, though total species count is similar.

Table 45. Vegetation cover and frequency for Boreal Riverine Loamy Poplar Forest (n=7). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	127.3	41.2	100
Total Vascular Cover	126.8	41.0	100
Total Evergreen Tree Cover	1.0	2.2	71
Picea glauca	1.0	2.2	71
Total Evergreen Shrub Cover	0.2	0.4	43
Arctostaphylos uva-ursi	0.1	0.4	14
Empetrum nigrum	0.0	0.0	14
Linnaea borealis	0.0	0.0	29
Vaccinium vitis-idaea	0.0	0.0	14
Total Deciduous Tree Cover	51.1	15.3	100
Populus balsamifera	51.1	15.3	100
Total Deciduous Shrub Cover	52.7	31.8	100
Alnus tenuifolia	12.0	8.5	100
Arctostaphylos rubra	0.4	0.8	29
Cornus stolonifera	9.4	14.7	57
Elaeagnus commutata	0.0	0.0	14
Potentilla fruticosa	0.0	0.0	14
Rosa acicularis	15.7	15.7	86
Rubus idaeus	0.0	0.0	14
Salix alaxensis	0.3	0.8	14
Salix arbusculoides	0.4	1.1	14
Salix bebbiana	0.0	0.0	29
Salix monticola	0.7	1.9	14
Shepherdia canadensis	0.6	1.5	29
Viburnum edule	13.0	16.2	71
Total Forb Cover	20.9	18.3	100
Anemone multifida	0.0	0.0	14
Anemone parviflora	0.2	0.4	29
Aster sibiricus	0.2	0.4	57
Astragalus alpinus	0.0	0.0	29
Castilleja caudata	0.0	0.0	14
Epilobium angustifolium	0.3	0.7	57
Epilobium latifolium	0.1	0.4	14
Equisetum arvense	9.6	13.9	86
Equisetum pratense	0.6	0.8	43
Galium boreale	0.2	0.4	29
Geocaulon lividum	2.9	7.5	43
Hedysarum alpinum	1.1	1.3	57
Heracleum lanatum	0.1	0.4	14
Lupinus arcticus	0.0	0.0	29
Mertensia paniculata	1.7	3.1	43
Moneses uniflora	0.0	0.0	14
Polemonium acutiflorum	0.0	0.0	14
Pyrola asarifolia	1.5	3.8	57
Pyrola secunda	0.1	0.1	57
Rubus arcticus	2.1	5.7	14
Solidago multiradiata	0.0	0.0	14
Trientalis europaea	0.0	0.0	29
Total Grass Cover	0.9	1.8	86
Agrostis scabra	0.0	0.0	14
Bromus pumpellianus	0.0	0.1	43
Calamagrostis canadensis	0.8	1.9	57

Table 45. Continued.

	Cover Mean	Cover SD	Freq %
Festuca altaica	0.0	0.0	14
Festuca rubra	0.0	0.0	14
Poa sp.	0.0	0.0	14
Total Sedge & Rush Cover	0.0	0.0	29
Carex concinna	0.0	0.0	14
Total Nonvascular Cover	0.5	0.8	43
Total Moss Cover	0.4	0.8	43
Brachythecium sp.	0.3	0.8	29
Total Lichen Cover	0.0	0.0	29
Peltigera sp.	0.0	0.0	29
Total Bare Ground	10.0	7.3	100
Soil	0.1	0.4	14
Litter Alone	9.9	7.2	100
Water	0.0	0.0	0

Soils

Soils typically are well drained, have interbedded loamy to sandy textures, and have very thin surface organic horizons (Table 46). An eolian silt cap and rock fragments are absent at the surface. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is >1 m. Soil pH is circumneutral and electrical conductivity is low.

Table 46. Soil characteristics for Boreal Riverine Loamy Poplar Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	2.3	1.5	4
Cumulative Org. in 40 cm (cm)	10.0	3.4	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	71.7	56.6	3
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)	0.0	0.0	4
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.8	0.6	3
Site EC at 10-cm depth (µS/cm)	70.0	20.0	3
Water Depth (cm, + above gnd)[a]	-150.0	0.0	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Cryorthents (moist, poorly developed soils). No other soil subgroups occur.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Forests, which also includes the ecotypes Boreal Riverine Gravelly Poplar Forest, Boreal Riverine Spruce-Poplar Forest, and Boreal Riverine White Spruce Forest.

BOREAL RIVERINE LOAMY WILLOW SHRUB

Geomorphology:

These willow communities occur on active and inactive overbank riverine deposits and inactive channel deposits throughout the boreal region of the park. The dominant soil texture is loam and surface organic layers usually are present. Soils are somewhat poorly to well drained, moist, and acidic to circumneutral. These communities are early successional, and vegetative structure is not complex.

Plant Association:
Salix pulchra–Calamagrostis canadensis

Several species of willows occur in this ecotype but the most common species are *Salix planifolia* ssp. *pulchra, Salix barclayi* and *Salix arbusculoides* (Table 47). Willow canopy usually is open, and deciduous shrubs, forbs, grasses and mosses are the most common life forms in the understory. Common species in addition to willows include *Calamagrostis canadensis* and *Trientalis europaea*. Of boreal riverine ecotypes, this ecotype has the highest species count per plot; and variability in species composition among plots is low.

This ecotype is similar to Boreal Riverine Sandy Willow Shrub in that it also is dominated by willows and occurs along rivers, but has a different dominant soil texture, half the number of species and a distinct species composition.

Table 47. Vegetation cover and frequency for Boreal Riverine Loamy Willow Shrub (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	159.7	34.6	100
Total Vascular Cover	135.6	19.9	100
Total Evergreen Tree Cover	1.4	1.5	100
Picea glauca	1.4	1.5	100
Total Evergreen Shrub Cover	0.4	0.6	33
Empetrum nigrum	0.3	0.6	33
Ledum decumbens	0.0	0.1	33
Total Deciduous Tree Cover	1.0	1.0	67
Populus balsamifera	1.0	1.0	67
Total Deciduous Shrub Cover	61.1	30.9	100
Alnus tenuifolia	7.0	7.2	100
Myrica gale	3.0	4.4	67
Potentilla fruticosa	5.3	8.4	67
Ribes hudsonianum	1.7	2.9	33
Rosa acicularis	0.7	1.2	33
Rubus idaeus	0.3	0.6	33
Salix alaxensis	0.0	0.1	33
Salix arbusculoides	0.1	0.1	67
Salix barclayi	1.7	2.9	33
Salix bebbiana	1.0	1.7	33
Salix novae-angliae	1.7	2.9	33
Salix planifolia ssp. *Pulchra*	17.0	20.4	100
Vaccinium uliginosum	20.0	17.3	67
Viburnum edule	1.7	2.9	33
Total Forb Cover	24.9	24.4	100
Achillea borealis	0.7	1.2	33
Aconitum delphinifolium	1.7	2.9	33
Anemone richardsonii	0.3	0.6	33
Epilobium angustifolium	1.7	2.9	33
Epilobium palustre	0.0	0.1	33
Equisetum arvense	0.0	0.1	33
Galium boreale	5.0	8.7	33
Galium trifidum ssp. *Trifidum*	0.0	0.1	33
Hedysarum alpinum	1.7	2.9	33
Mertensia paniculata	0.3	0.6	33
Moehringia lateriflora	0.0	0.1	33
Parnassia palustris	0.4	0.6	67
Polemonium acutiflorum	0.4	0.6	67
Potentilla palustris	2.0	2.6	67
Pyrola asarifolia	0.0	0.1	33
Rubus arcticus	3.7	3.2	67
Senecio pauciflorus	0.7	1.2	33
Thalictrum alpinum	0.3	0.6	33
Trientalis europaea	3.4	5.7	67
Viola epipsila ssp. *Repens*	1.0	1.0	67
Viola sp.	1.7	2.9	33
Total Grass Cover	38.3	16.1	100
Calamagrostis canadensis	38.3	16.1	100
Total Sedge & Rush Cover	8.5	7.5	100
Carex aquatilis ssp. *Aquatilis*	0.1	0.1	67
Carex atrosquama	1.7	2.9	33
Carex canescens	1.7	2.8	100
Carex disperma	0.0	0.1	33
Carex media	5.0	8.6	67

Table 47. Continued.

	Cover Mean	Cover SD	Freq %
Total Nonvascular Cover	24.0	16.6	100
Total Moss Cover	23.3	17.6	100
Aulacomnium turgidum	0.7	1.2	33
Polytrichum sp.	1.0	1.7	33
Sphagnum sp.	1.7	2.9	33
Tomentypnum nitens	9.0	13.9	67
Unknown moss	11.0	11.5	67
Total Lichen Cover	0.7	1.1	67
Cladonia sp.	0.0	0.1	33
Peltigera sp.	0.7	1.2	33
Total Bare Ground	15.7	14.4	100
Soil	0.0	0.0	0
Litter Alone	15.7	14.4	100
Water	0.0	0.0	0

Soils

Soils typically are well drained, loamy to sandy, and have very thin surface organic horizons (Table 48). An eolian silt cap and rock fragments are absent at the surface. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is <1 m. Soil pH is mostly circumneutral and electrical conductivity is low.

Table 48. Soil characteristics for Boreal Riverine Loamy Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	4.0	3.6	3
Cumulative Org. in 40 cm (cm)	5.7	6.0	3
Loess Cap Thickness(cm)			
Depth to Rocks (cm)	98.0	73.5	2
Surface Fragment Cover (%)			
Frost Boil Cover (%)			
Thaw Depth (cm)[a]			
Site pH at 10-cm depth	6.0	0.9	3
Site EC at 10-cm depth (µS/cm)	146.7	81.4	3
Water Depth (cm, + above gnd)[a]	-63.3	33.3	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m). No other soil subgroups occur.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Acidic Barrens, Boreal Riverine Circumneutral Barrens, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Sandy Willow Shrub, and Boreal Riverine Tall Alder Shrub.

BOREAL RIVERINE LOW SILVERBERRY SHRUB

Geomorphology:

This distinctive ecotype is located on river bars in the southern half of the boreal zone in WRST, particularly in the Chitina River Basin. It occurs on braided, active and inactive channel deposits and inactive overbank deposits. Soils are predominantly sands or gravels, and surface organic layers are thin to nonexistent. Site conditions are alkaline, somewhat poorly to well drained, and moist to dry.

Plant Association:

Eleagnus commutata–Oxytropis campestris

Silverberry (*Elaeagnus commutata*) characterizes this ecotype, which also has high diversity of grasses (Table 49). Shrub canopy usually is open, and presence of nonvascular plants, grasses and evergreen species varies among plots. Trees are present as seedlings or saplings. Sedges are absent. Of boreal riverine ecotypes, this ecotype has the third highest species count per plot and substantial variability in species composition among plots. Common species are *Picea glauca, Aster sibiricus*, and *Solidago decumbens*.

In terms of vegetation structure and landscape position this ecotype is most similar to boreal riverine willow ecotypes. Floristically, it is closest to Boreal Riverine Dryas Dwarf Shrub.

Table 49. Vegetation cover and frequency for Boreal Riverine Low Silverberry Shrub (n=6). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	98.6	55.5	83
Total Vascular Cover	83.2	44.4	83
Total Evergreen Tree Cover	0.0	0.1	33
Picea glauca	0.0	0.1	33
Total Evergreen Shrub Cover	1.6	3.2	67
Arctostaphylos uva-ursi	1.0	2.0	50
Dryas drummondii	0.5	1.2	33
Total Deciduous Tree Cover	4.7	7.7	100
Populus balsamifera	4.7	7.7	100
Total Deciduous Shrub Cover	50.4	36.1	100
Elaeagnus commutata	44.5	35.0	100
Salix alaxensis	1.3	3.3	17
Salix barclayi	0.3	0.5	33
Salix brachycarpa ssp. *niphoclada*	0.9	2.0	33
Salix glauca	0.2	0.4	33
Salix setchelliana	0.5	1.2	17
Shepherdia canadensis	2.7	6.0	50
Total Forb Cover	17.4	7.4	100
Achillea borealis	1.7	2.6	67
Allium schoenoprasum	0.0	0.0	17
Androsace septentrionalis	0.0	0.0	17
Anemone multifida	0.0	0.1	33
Antennaria pulcherrima	0.2	0.4	17
Artemisia tilesii	0.0	0.1	33
Aster sibiricus	0.9	1.3	67
Castilleja caudata	0.0	0.1	33
Epilobium angustifolium	0.0	0.1	33
Epilobium latifolium	0.3	0.5	33
Equisetum arvense	0.3	0.8	17
Equisetum variegatum	0.4	0.5	50
Erigeron sp.	0.0	0.1	33
Galium boreale	0.2	0.4	33
Gentiana propinqua	0.0	0.0	17
Hedysarum alpinum	0.2	0.4	67
Hedysarum mackenzii	2.5	2.8	50
Lappula myosotis	0.2	0.4	17
Oxytropis campestris	1.5	1.8	100
Oxytropis deflexa	0.2	0.4	17
Plantago canescens	0.0	0.1	33
Polemonium pulcherrimum	1.2	2.8	33
Potentilla multifida	1.4	3.3	33
Pyrola grandiflora	2.7	6.1	33
Silene menziesii	0.0	0.0	17
Solidago decumbens var. *oreophila*	2.2	3.9	83
Solidago multiradiata var. *multiradiata*	0.0	0.0	17
Stellaria longipes	0.2	0.4	17
Taraxacum ceratophorum	0.0	0.1	33
Taraxacum officinale	0.8	2.0	17
Zygadenus elegans	0.0	0.1	33
Total Grass Cover	16.0	21.0	67
Agropyron pauciflorum ssp. *pauciflorum*	0.2	0.4	17
Agropyron violaceum ssp. *violaceum*	0.3	0.8	17
Arctagrostis latifolia	0.2	0.4	17
Bromus pumpellianus	4.5	8.1	33

Table 49. Continued.

	Cover Mean	Cover SD	Freq %
Calamagrostis canadensis	0.7	1.6	17
Calamagrostis lapponica	0.2	0.4	17
Calamagrostis purpurascens	0.5	1.2	17
Elymus trachycaulus	0.8	2.0	17
Festuca richardsonii	1.8	4.0	33
Festuca rubra	0.8	1.3	33
Hierochlöe odorata	5.3	12.1	33
Hordeum jubatum	0.0	0.0	17
Poa glauca	0.0	0.0	17
Trisetum spicatum ssp. *spicatum*	0.2	0.4	33
Total Nonvascular Cover	15.4	24.9	50
Total Moss Cover	14.8	24.5	50
Abietinella abietina	0.8	2.0	17
Brachythecium sp.	0.5	1.2	17
Bryum sp.	3.8	7.2	33
Ceratodon purpureus	5.5	7.8	50
Ditrichum flexicaule	2.5	6.1	17
Syntrichia ruralis	1.7	4.1	17
Total Lichen Cover	0.5	0.9	33
Cladonia sp.	0.2	0.4	17
Peltigera rufescens	0.2	0.4	17
Peltigera sp.	0.2	0.4	17
Total Bare Ground	38.2	35.0	83
Soil	21.7	31.3	50
Litter Alone	16.5	19.5	67
Water	0.0	0.0	0

Soils

Soils typically are well drained, loamy to gravelly, and have very thin surface organic horizons (Table 50). An eolian silt cap is absent and rock fragments are uncommon at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is <1 m. Soil pH is alkaline and electrical conductivity is low.

Table 50. Soil characteristics for Boreal Riverine Low Silverberry Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.2	1.3	5
Cumulative Org. in 40 cm (cm)	2.2	2.5	5
Loess Cap Thickness(cm)	0.0	0.0	5
Depth to Rocks (cm)	21.2	33.8	5
Surface Fragment Cover (%)	2.0	2.7	5
Frost Boil Cover (%)	0.0		1
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.7	0.3	5
Site EC at 10-cm depth (µS/cm)	176.0	237.2	5
Water Depth (cm, + above gnd)[a]	-77.8	23.4	5

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m of the surface) or Typic Cryorthents (moist, poorly developed soils).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Acidic Barrens, Boreal Riverine Circumneutral Barrens, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Sandy Willow Shrub, Boreal Riverine Loamy Willow Shrub and Boreal Riverine Tall Alder Shrub.

BOREAL RIVERINE SANDY WILLOW SHRUB

Geomorphology:

These early successional stands occur on braided, active overbank riverine deposits, especially in the Chitina River Basin. The dominant soil texture is sand, and surface organic material is absent, although buried O horizons often exist. Soils are alkaline, moist, and well drained. The most common disturbance is sedimentation during flood events. As a result, this ecotype is the 2nd least floristically diverse of all riverine ecotypes. Bare soil and litter alone are present in all plots.

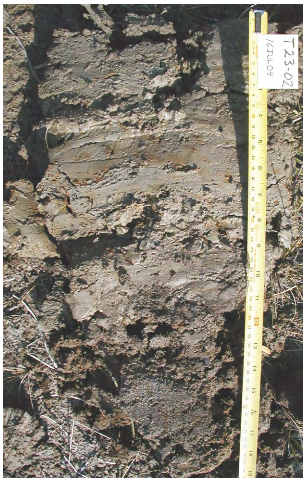
Plant Association:
Salix barclayi–Salix niphoclada–Eleagnus commutata

While willows comprise the majority of deciduous shrub cover, silverberry is a typical associate (Table 51). Trees are present as seedlings, and forbs always are present, while frequency of other life forms is variable. *Hedysarum alpinum, Salix glauca,* and *Oxytropis campestris* commonly occur.

This ecotype is similar to Boreal Riverine Loamy Willow Shrub, except that dominant soil texture varies and species count is much lower in the sandy ecotype. It is also similar to Boreal Riverine Low Silverberry Shrub, except willows are dominant and species composition is less diverse in the willow class.

Table 51. Vegetation cover and frequency for Boreal Riverine Sandy Willow Shrub (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	67.3	5.0	100
Total Vascular Cover	67.3	5.1	100
Total Evergreen Tree Cover	0.7	0.5	100
Picea glauca	0.7	0.5	100
Total Evergreen Shrub Cover	0.0	0.1	33
Arctostaphylos uva-ursi	0.0	0.1	33
Total Deciduous Tree Cover	1.0	1.0	100
Populus balsamifera	1.0	1.0	100
Total Deciduous Shrub Cover	56.4	5.0	100
Elaeagnus commutata	11.7	7.6	100
Potentilla fruticosa	0.3	0.6	33
Rosa acicularis	0.3	0.6	33
Salix barclayi	22.0	19.7	100
Salix brachycarpa ssp. *niphoclada*	3.7	5.5	67
Salix glauca	18.4	16.0	100
Total Forb Cover	8.7	3.7	100
Antennaria pulcherrima	0.0	0.1	33
Cypripedium sp.	0.3	0.6	33
Equisetum arvense	0.3	0.6	33
Equisetum variegatum	0.0	0.1	33
Erigeron acris	0.3	0.6	33
Hedysarum alpinum	2.4	2.5	100
Oxytropis campestris	3.3	2.5	100
Parnassia palustris	0.0	0.1	33
Pedicularis labradorica	0.0	0.1	33
Pyrola grandiflora	0.7	1.1	67
Solidago sp.	0.0	0.1	33
Spiranthes romanzoffiana	0.1	0.1	67
Tofieldia glutinosa	1.0	1.0	67
Tofieldia pusilla	0.0	0.1	33
Total Grass Cover	0.3	0.6	33
Calamagrostis sp.	0.3	0.6	33
Total Sedge & Rush Cover	0.1	0.1	67
Carex aurea	0.0	0.1	33
Carex eburnea	0.0	0.1	33
Carex scirpoidea	0.0	0.1	33
Total Nonvascular Cover	0.0	0.1	33
Total Moss Cover	0.0	0.1	33
Dicranum sp.	0.0	0.1	33
Total Bare Ground	28.3	11.4	100
Soil	18.3	18.9	100
Litter Alone	10.0	9.5	100
Water	0.0	0.0	0



Soils

Soils typically are well drained and sandy, and occasionally have very thin buried organic horizons (Table 52). An eolian silt cap and rock fragments at the surface are absent. Thaw depths could not be determined, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is >1 m. Soil pH is alkaline and electrical conductivity is moderately low.

Table 52. Soil characteristics for Boreal Riverine Sandy Willow Shrub. Blanks = no data.

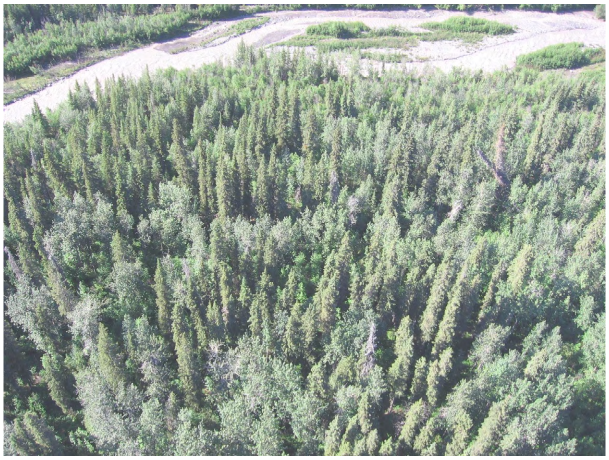
Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	3
Cumulative Org. in 40 cm (cm)	1.0	1.0	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	103.3	31.5	3
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	8.0	0.5	3
Site EC at 10-cm depth (µS/cm)	310.0	320.8	3
Water Depth (cm, + above gnd)[a]	-107.7	39.1	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m of the surface) or Typic Cryorthents (moist, poorly developed soils).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Acidic Barrens, Boreal Riverine Circumneutral Barrens, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Loamy Willow Shrub, and Boreal Riverine Tall Alder Shrub.

BOREAL RIVERINE SPRUCE–POPLAR FOREST



Geomorphology:

Mixed stands of spruce and poplar occur on braided, inactive riverine channel deposits. Soils are coarse, with a predominantly gravelly or bouldery texture, and are covered by thin but well-defined organic horizons. These mid-successional forests have alkaline to circumneutral soils that are somewhat excessively drained and dry.

Plant Association:

Populus balsamifera–Picea glauca–Oxytropis campestris

The tree canopy typically is open in this mixed-forest ecotype (Table 53). All life forms can be present, but shrubs and forbs are most prevalent. Common species include *Populus balsamifera, Picea glauca, Oxytropis campestris*, *Shepherdia canadensis* and *Solidago multiradiata*. This ecotype has a moderate number of species per plot; species diversity of the ecotype as a whole is similar to the boreal riverine poplar ecotypes.

Although similar to Boreal Riverine Gravelly Poplar Forest, this ecotype has greater cover of evergreen shrubs and trees, indicative of its later successional stage. It is also similar to Boreal Riverine White Spruce Forest, although with a co-dominant poplar component.

Table 53. Vegetation cover and frequency for Boreal Riverine Spruce–Poplar Forest (n=4). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	162.2	65.9	100
Total Vascular Cover	125.7	47.3	100
Total Evergreen Tree Cover	19.3	9.4	100
Picea glauca	19.0	9.0	100
Picea mariana	0.3	0.5	25
Total Evergreen Shrub Cover	9.8	3.7	100
Arctostaphylos uva-ursi	4.8	5.5	50
Dryas drummondii	1.5	2.4	50
Dryas integrifolia	2.5	5.0	25
Empetrum nigrum	0.8	1.5	25
Linnaea borealis	0.0	0.1	25
Vaccinium vitis-idaea	0.3	0.5	25
Total Deciduous Tree Cover	23.8	12.5	100
Populus balsamifera	23.8	12.5	100
Total Deciduous Shrub Cover	50.1	33.4	100
Arctostaphylos rubra	0.3	0.5	25
Elaeagnus commutata	8.3	14.6	50
Potentilla fruticosa	0.3	0.5	25
Rosa acicularis	2.3	2.6	50
Salix alaxensis	0.3	0.5	25
Salix bebbiana	0.3	0.5	50
Salix brachycarpa ssp. *niphoclada*	0.3	0.5	25
Salix scouleriana	0.0	0.1	25
Shepherdia canadensis	37.5	25.0	100
Viburnum edule	0.8	1.5	25
Total Forb Cover	21.9	29.4	100
Achillea borealis	0.3	0.5	25
Aster sibiricus	6.3	12.5	50
Castilleja caudata	0.0	0.1	25
Epilobium angustifolium	0.3	0.5	25
Geocaulon lividum	6.5	12.3	50
Hedysarum alpinum	0.8	1.0	50
Hedysarum mackenzii	1.3	2.5	25
Lupinus arcticus	0.3	0.5	25
Mertensia paniculata	0.0	0.1	25
Oxytropis campestris	4.5	7.0	75
Pyrola asarifolia	1.3	2.5	25
Pyrola minor	0.0	0.1	25
Pyrola secunda	0.0	0.1	25
Solidago multiradiata	0.6	1.0	75
Total Grass Cover	0.4	0.7	50
Agropyron boreale	0.0	0.1	25
Agropyron violaceum ssp. *violaceum*	0.0	0.1	25
Agrostis scabra	0.0	0.1	25
Calamagrostis lapponica	0.0	0.1	25
Festuca altaica	0.3	0.5	25
Trisetum spicatum ssp. *spicatum*	0.0	0.1	25
Total Sedge & Rush Cover	0.6	1.0	50
Carex concinna	0.0	0.1	25
Eriophorum angustifolium	0.0	0.1	25
Total Nonvascular Cover	30.2	14.6	100

Table 53. Continued.

	Cover		Freq
	Mean	SD	%
Total Moss Cover	28.1	17.3	100
Abietinella abietina	6.3	12.5	75
Brachythecium salebrosum	3.8	7.5	25
Brachythecium sp.	0.5	1.0	25
Ceratodon purpureus	0.3	0.5	25
Dicranum sp.	0.3	0.5	50
Ditrichum flexicaule	0.0	0.1	25
Hylocomium splendens	13.5	10.8	75
Rhytidium rugosum	0.3	0.5	25
Sanionia uncinata	0.8	1.5	50
Total Lichen Cover	2.0	2.8	50
Cladonia sp.	1.3	1.9	50
Peltigera aphthosa	0.3	0.5	25
Peltigera rufescens	0.3	0.5	25
Stereocaulon sp.	0.3	0.5	25
Total Bare Ground	7.0	1.4	100
Soil	1.0	2.0	25
Litter Alone	6.0	1.8	100

Soils

Soils typically are well drained, sandy textured, and have thin surface organic horizons (Table 54). A thin eolian silt cap may be present and rock fragments rarely occur at the surface. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is >1 m. Soil pH is circumneutral and electrical conductivity is low.

Table 54. Soil characteristics for Boreal Riverine Spruce—Poplar Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	3.8	1.3	4
Cumulative Org. in 40 cm (cm)	4.0	1.4	4
Loess Cap Thickness(cm)	1.5	3.0	4
Depth to Rocks (cm)	7.5	3.4	4
Surface Fragment Cover (%)	0.3	0.5	4
Frost Boil Cover (%)	0.0	0.0	2
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.0	1.1	4
Site EC at 10-cm depth (µS/cm)	115.0	47.3	4
Water Depth (cm, + above gnd)[a]	-125.0	28.9	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Cryorthents (moist, poorly developed soils). Also occurring infrequently are Typic Dystrocryepts (moist, well developed, acidic).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Forests, which also includes the ecotypes Boreal Riverine Gravelly Poplar Forest, Boreal Riverine Loamy Poplar Forest, and Boreal Riverine White Spruce Forest.

BOREAL RIVERINE TALL ALDER SHRUB

Geomorphology:

This early to mid- successional ecotype occurs on braided and meander active overbank deposits and on active and inactive channel deposits. Soil textures vary from loams to sands and gravels. Drainage varies from poorly to well drained, resulting in wet to moist soils. Site chemistry is either alkaline or circumneutral.

Plant Association:
Alnus tenuifolia–Calamagrostis canadensis

Although alder stands are not typically diverse, this ecotype has the second highest total species count of all riverine ecotypes (Table 55). Species composition among sites is quite variable though species count per plot is below average. The presence and proportion of life forms also varies among sites. Common species are *Alnus tenuifolia, Salix alaxensis, Calamagrostis canadensis, Rubus arcticus, Equisetum arvense* and *Artemisia tilesii*.

This ecotype is similar to Boreal Upland Tall Alder Shrub in that alder is dominant, although *Alnus crispa* is the main species present in upland sites. Within riverine ecotypes, site conditions are most similar to Boreal Riverine Sandy Willow Shrub, while floristics are most similar to Boreal Riverine White Spruce Forest.

Table 55. Vegetation cover and frequency for Boreal Riverine Tall Alder Shrub (n=9). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	119.4	35.2	100
Total Vascular Cover	117.6	31.3	100
Total Evergreen Tree Cover	0.6	1.7	44
Picea glauca	0.6	1.7	44
Total Evergreen Shrub Cover	0.0	0.1	33
Linnaea borealis	0.0	0.0	22
Total Deciduous Tree Cover	0.8	1.6	33
Populus balsamifera	0.8	1.6	33
Total Deciduous Shrub Cover	92.4	15.8	100
Alnus sinuata	23.3	41.2	33
Alnus tenuifolia	51.1	36.4	78
Cornus stolonifera	7.8	23.3	11
Elaeagnus commutata	0.0	0.0	11
Potentilla fruticosa	0.0	0.0	11
Ribes hudsonianum	0.2	0.7	11
Ribes triste	0.0	0.1	33
Rosa acicularis	0.0	0.0	11
Salix alaxensis	3.0	4.3	56
Salix arbusculoides	3.4	6.6	44
Salix barclayi	0.0	0.0	11
Salix bebbiana	1.7	2.5	44
Salix brachycarpa ssp. *niphoclada*	0.0	0.0	11
Salix lanata ssp. *richardsonii*	1.1	2.2	22
Salix monticola	0.6	1.7	11
Salix planifolia pulchra	0.0	0.0	11
Shepherdia canadensis	0.0	0.0	11
Vaccinium uliginosum	0.0	0.0	11
Viburnum edule	0.1	0.3	22
Total Forb Cover	15.8	16.1	89
Achillea borealis	0.0	0.1	33
Anemone richardsonii	0.0	0.0	11
Artemisia tilesii	0.9	1.7	56
Aster sibiricus	0.0	0.0	22
Corallorrhiza trifida	0.0	0.0	22
Cypripedium passerinum	0.0	0.0	11
Epilobium angustifolium	0.0	0.0	22
Epilobium latifolium	0.0	0.0	11
Equisetum arvense	5.3	9.5	56
Equisetum variegatum	0.0	0.0	22
Erigeron acris	0.0	0.0	22
Galium triflorum	0.0	0.0	11
Geocaulon lividum	0.0	0.0	11
Hedysarum alpinum	0.0	0.1	33
Lupinus arcticus	0.1	0.3	11
Mertensia paniculata	0.6	1.7	22
Moehringia lateriflora	0.4	1.0	33
Moneses uniflora	0.0	0.0	22
Parnassia kotzebuei	0.0	0.0	11
Parnassia palustris	0.0	0.0	11
Pedicularis sudetica	0.0	0.0	11
Platanthera hyperborea	0.0	0.0	11
Platanthera obtusata	0.0	0.0	11
Polemonium acutiflorum	0.0	0.0	11
Pyrola asarifolia	0.0	0.0	22

Table 55. Continued.

	Cover		Freq
	Mean	SD	%
Pyrola grandiflora	0.2	0.4	22
Pyrola secunda	0.1	0.3	33
Rorippa barbareaefolia	0.0	0.0	11
Rubus arcticus	3.9	7.8	56
Stellaria calycantha	0.0	0.0	11
Stellaria sp.	0.0	0.0	11
Trientalis europaea	3.4	10.0	22
Viola epipsila ssp. *repens*	0.4	1.3	11
Total Grass Cover	7.9	16.2	100
Agropyron violaceum ssp. *violaceum*	0.0	0.0	11
Agrostis scabra	0.0	0.0	11
Arctagrostis latifolia	0.3	0.7	22
Calamagrostis canadensis	7.3	16.3	67
Deschampsia caespitosa	0.0	0.0	11
Festuca richardsonii	0.0	0.0	11
Festuca rubra	0.0	0.0	11
Poa arctica	0.0	0.0	11
Poa sp.	0.1	0.3	22
Trisetum spicatum ssp. *spicatum*	0.0	0.0	22
Total Sedge & Rush Cover	0.0	0.0	11
Carex disperma	0.0	0.0	11
Carex media	0.0	0.1	11
Total Nonvascular Cover	1.9	5.1	56
Total Moss Cover	1.9	5.1	56
Brachythecium sp.	0.1	0.3	11
Dicranum sp.	0.0	0.1	33
Polytrichum sp.	0.0	0.0	11
Total Bare Ground	23.6	34.0	78
Soil	10.0	28.2	22
Litter Alone	5.8	7.3	56
Water	7.8	23.3	11

Soils

Soils typically are well drained to somewhat poorly drained, loamy to sandy, and occasionally have very thin surface organic horizons (Table 56). An eolian silt cap and rock fragments at the surface usually are absent. Thaw depths could not be determined, but permafrost is assumed to be absent because of surface disturbance and groundwater movement. Depth to water is <1 m. Soil pH is circumneutral and electrical conductivity is moderately low.

Table 56. Soil characteristics for Boreal Riverine Tall Alder Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.5	1.2	6
Cumulative Org. in 40 cm (cm)	2.5	1.6	6
Loess Cap Thickness(cm)	0.2	0.4	6
Depth to Rocks (cm)	53.7	32.4	6
Surface Fragment Cover (%)	0.4	0.9	5
Frost Boil Cover (%)	0.0	0.0	4
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.0	0.8	5
Site EC at 10-cm depth (µS/cm)	160.0	85.7	5
Water Depth (cm, + above gnd)[a]	-32.2	71.9	6

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Oxyaquic Cryorthents (moist, poorly developed soils saturated within 1 m of the surface). Less common soils include Typic Cryaquents (wet, poorly developed) and Typic Cryorthents (moist, poorly developed).

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Barrens and Scrub, which also includes the ecotypes Boreal Riverine Acidic Barrens, Boreal Riverine Circumneutral Barrens, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Loamy Willow Shrub and Boreal Riverine Sandy Willow Shrub.

BOREAL RIVERINE WHITE SPRUCE FOREST

Geomorphology:

These mature, open, late successional forests occur on inactive overbank riverine deposits. Dominant soil textures are loamy and organic; surface organic material is typical and buried O horizons are common. Sites are circumneutral to acidic, moist and well drained. Although a thick layer of moss covers the forest floor, these communities are relatively young and permafrost has not developed.

Plant Association:
Picea glauca–Hedysarum alpinum

Mature white spruce trees with an open canopy characterize this ecotype (Table 57). Forbs are the most common vascular life form in the understory. Mosses are conspicuous in all plots, particularly *Hylocomium splendens*, which frequently forms a nearly continuous carpet. Most deciduous shrubs have low stature, although remnant tall deciduous shrubs from earlier successional stages, such as *Salix bebbiana*, are present. Common species are *Hedysarum alpinum, Rosa acicularis* and *Geocaulon lividum*.

Boreal Upland White Spruce Forest also is dominated by *P. glauca*, but occurs on upland deposits and has a different species composition.

Table 57. Vegetation cover and frequency for Boreal Riverine White Spruce Forest (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	177.6	51.4	100
Total Vascular Cover	76.4	16.6	100
Total Evergreen Tree Cover	33.2	9.1	100
Picea glauca	33.2	9.1	100
Total Evergreen Shrub Cover	1.6	3.0	40
Juniperus communis	0.2	0.4	20
Linnaea borealis	1.4	3.1	20
Vaccinium vitis-idaea	0.0	0.0	20
Total Deciduous Tree Cover	0.4	0.9	40
Populus balsamifera	0.4	0.9	40
Total Deciduous Shrub Cover	6.7	7.7	100
Alnus tenuifolia	0.2	0.4	20
Arctostaphylos rubra	0.6	0.5	80
Cornus stolonifera	0.6	1.3	20
Rosa acicularis	1.2	1.3	80
Salix bebbiana	0.0	0.1	40
Salix scouleriana	0.0	0.0	20
Shepherdia canadensis	4.0	8.4	60
Viburnum edule	0.0	0.0	20
Total Forb Cover	33.6	27.6	100
Achillea borealis	0.0	0.1	40
Amerorchis rotundifolia	0.0	0.0	20
Artemisia tilesii	0.0	0.0	20
Aster sibiricus	0.0	0.1	40
Astragalus alpinus	1.7	3.5	80
Astragalus sp.	0.0	0.0	20
Calypso bulbosa	0.0	0.0	20
Corallorrhiza trifida	0.0	0.1	40
Cypripedium passerinum	0.0	0.0	20
Epilobium angustifolium	0.0	0.0	20
Equisetum arvense	0.0	0.0	20
Equisetum pratense	0.0	0.0	20
Equisetum scirpoides	0.2	0.4	20
Galium boreale	0.0	0.1	40
Gentiana propinqua	0.0	0.0	20
Geocaulon lividum	8.1	17.9	80
Hedysarum alpinum	7.8	4.6	100
Hedysarum mackenzii	0.0	0.1	40
Lupinus arcticus	14.8	27.6	80
Mertensia paniculata	0.0	0.0	20
Moehringia lateriflora	0.0	0.0	20
Moneses uniflora	0.1	0.1	60
Oxytropis borealis	0.0	0.0	20
Platanthera obtusata	0.0	0.0	20
Platanthera sp.	0.0	0.0	20
Pyrola asarifolia	0.2	0.4	40
Pyrola chlorantha	0.0	0.0	20
Pyrola grandiflora	0.0	0.1	40
Pyrola secunda	0.2	0.4	60
Senecio lugens	0.0	0.0	20
Taraxacum ceratophorum	0.0	0.0	20
Total Grass Cover	0.7	1.4	60
Arctagrostis latifolia	0.0	0.0	20
Calamagrostis canadensis	0.0	0.0	20

Table 57. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Calamagrostis sp.	0.0	0.0	20
Festuca rubra	0.6	1.3	40
Poa sp.	0.0	0.0	20
Total Sedge & Rush Cover	0.1	0.0	100
Carex concinna	0.1	0.0	80
Carex scirpoidea	0.0	0.0	20
Total Nonvascular Cover	101.1	57.8	100
Total Moss Cover	100.8	58.0	100
Abietinella abietina	0.4	0.5	40
Hylocomium splendens	54.8	35.8	80
Pleurozium schreberi	8.0	17.9	20
Polytrichum sp.	0.2	0.4	20
Sanionia uncinata	4.4	8.8	40
Tomentypnum nitens	1.0	2.2	20
Unknown moss	32.0	45.1	40
Total Lichen Cover	0.3	0.4	100
Cladonia sp.	0.0	0.0	20
Peltigera aphthosa	0.0	0.1	40
Peltigera canina	0.2	0.4	40
Peltigera rufescens	0.0	0.0	20
Peltigera sp.	0.0	0.0	20
Stereocaulon sp.	0.0	0.0	20
Total Bare Ground	2.6	3.4	60
Soil	0.0	0.0	0
Litter Alone	2.6	3.4	60
Water	0.0	0.0	0

Soils

Soils typically are well drained, with thick loamy horizons over gravel, and thin surface organic horizons (Table 58). A thin eolian silt cap may be present and rock fragments are absent at the surface. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent because of groundwater movement. Water was at >1 m depth and usually was not encountered. Soil pH is circumneutral and electrical conductivity is low.

Table 58. Soil characteristics for Boreal Riverine White Spruce Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	4.0	1.7	3
Cumulative Org. in 40 cm (cm)	7.3	2.5	3
Loess Cap Thickness(cm)	4.0	6.9	3
Depth to Rocks (cm)	56.3	6.4	3
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)	0.0	0.0	3
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.9	0.4	3
Site EC at 10-cm depth (µS/cm)	120.0	43.6	3
Water Depth (cm, + above gnd)[a]	-150.0		1

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Cryorthents (moist, poorly developed soils). Typic Eutrocryepts (moist, partially developed, circumneutral) also occur infrequently in this late successional stage.

This ecotype and associated soils are components of the broader soil landscapes within Boreal Riverine Rocky-loamy Forests, which also includes the ecotypes Boreal Riverine Gravelly Poplar Forest, Boreal Riverine Loamy Poplar Forest, and Boreal Riverine White Spruce-Poplar Forest.

BOREAL SUBALPINE FORB MEADOW

Geomorphology:

These productive, forb-rich meadows occur on mountain slopes comprised of hillside colluvium, solifluction, loess, abandoned alluvial fan deposits, and younger and older moraines. Soil textures are loamy or rubbly with a defined organic horizon. Sites are moist, acidic, and moderately to well-drained. Permafrost is absent or >1 m below the surface. These meadows also can be found on higher elevation upland deposits and upland as well as subalpine species are common.

Plant Association:

Artemisia arctica–Festuca altaica–Valeriana capitata

Forbs and grasses are the most common life forms in this ecotype (Table 59). Deciduous shrubs are present, but total shrub cover is < 25%. Evergreen shrub and sedge cover is variable. An uncommon species that occurs in this ecotype is *Carex spectabilis*. Common species include *Artemisia arctica, Festuca altaica, Valeriana capitata, Mertensia paniculata, Aconitum delphinifolium*, *Epilobium angustifolium* and *Petasites frigidus*.

There are no similar ecotypes to Boreal Subalpine Forb Meadow. Floristically it is close to Subalpine Birch and Willow Shrub, except for the lack of shrubs.

Table 59. Vegetation cover and frequency for Boreal Subalpine Forb Meadow (n=4). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	120.9	29.0	100
Total Vascular Cover	117.6	30.6	100
Total Evergreen Shrub Cover	6.3	7.5	50
Empetrum nigrum	5.0	5.8	50
Luetkea pectinata	1.3	2.5	25
Total Deciduous Shrub Cover	8.8	10.3	100
Salix arctica	3.8	7.5	25
Salix glauca	0.5	1.0	50
Salix planifolia ssp. *pulchra*	2.5	5.0	50
Salix polaris	0.3	0.5	25
Salix reticulata	1.5	2.4	50
Vaccinium uliginosum	0.3	0.5	25
Total Forb Cover	80.7	20.8	100
Aconitum delphinifolium	7.0	6.8	75
Anemone narcissiflora	1.8	2.4	50
Anemone parviflora	1.3	2.5	25
Anemone richardsonii	0.8	1.5	25
Anemone sp.	5.0	10.0	25
Angelica lucida	0.3	0.5	25
Artemisia arctica ssp. *arctica*	9.0	8.2	100
Castilleja caudata	0.8	1.5	25
Castilleja sp.	0.3	0.5	25
Claytonia sarmentosa	0.0	0.1	25
Epilobium anagallidifolium	0.0	0.1	25
Epilobium angustifolium	5.0	10.0	25
Epilobium hornemannii	0.3	0.5	25
Epilobium latifolium	3.8	7.5	25
Equisetum arvense	4.5	4.2	75
Erigeron lonchophyllus	0.3	0.5	25
Galium boreale	5.0	10.0	25
Gentiana propinqua	0.0	0.1	25
Heracleum lanatum	0.1	0.1	50
Lupinus arcticus	11.3	14.4	50
Mertensia paniculata	4.0	4.5	75
Myosotis alpestris ssp. *asiatica*	0.8	0.5	75
Pedicularis verticillata	0.3	0.5	25
Petasites frigidus	4.5	4.2	75
Polemonium acutiflorum	0.8	1.0	50
Rubus pedatus	0.8	1.5	25
Rumex arcticus	0.5	1.0	25
Sanguisorba officinalis	1.3	2.5	25
Saxifraga punctata	0.0	0.1	25
Senecio atropurpureus	0.0	0.1	25
Senecio lugens	2.0	2.4	50
Solidago multiradiata	0.8	0.5	75
Taraxacum sp.	0.0	0.1	25
Valeriana capitata	8.8	11.1	75
Veronica wormskjoldii	0.3	0.5	25
Total Grass Cover	11.5	7.9	100
Alopecurus alpinus	0.0	0.1	25
Calamagrostis canadensis	2.8	3.2	50
Festuca altaica	7.8	5.9	100
Poa arctica	0.5	0.6	50
Trisetum spicatum ssp. *spicatum*	0.5	0.6	50

Table 59. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Total Sedge & Rush Cover	10.3	10.9	75
Carex bigelowii	0.5	1.0	25
Carex macrochaeta	0.5	1.0	25
Carex nardina	0.0	0.1	25
Carex podocarpa	5.0	10.0	25
Carex spectabilis	3.8	7.5	25
Luzula parviflora	0.5	1.0	50
Total Nonvascular Cover	3.3	2.4	75
Total Moss Cover	2.8	2.7	75
Aulacomnium palustre	0.5	1.0	25
Brachythecium sp.	1.3	2.5	25
Ceratodon purpureus	0.0	0.1	25
Eurhynchium pulchellum	0.0	0.1	25
Polytrichum strictum	0.8	1.5	25
Unknown moss	0.3	0.5	25
Total Lichen Cover	0.5	1.0	25
Nephroma arcticum	0.3	0.5	25
Stereocaulon sp.	0.3	0.5	25
Total Bare Ground	8.5	8.5	75
Soil	0.3	0.5	25
Litter Alone	8.3	8.5	75
Water	0.0	0.0	0

Soils

Soils typically are well to somewhat poorly drained, have thick loamy horizons over rubble, and have thin surface organic horizons (Table 60). An eolian silt cap is absent and rock fragments are occasionally present at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be at depths > 1m or absent. Water was at >1 m depth and usually was not encountered. Soil pH is acidic and electrical conductivity is very low.

Table 60. Soil characteristics for Boreal Subalpine Forb Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	9.3	5.5	3
Cumulative Org. in 40 cm (cm)	9.3	5.5	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	70.7	50.8	3
Surface Fragment Cover (%)	0.7	1.2	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.2	0.2	3
Site EC at 10-cm depth (µS/cm)	53.3	35.1	3
Water Depth (cm, + above gnd)[a]	-91.7	14.4	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by Humic Dystrogelepts (moist, organic-rich, partially developed with permafrost below 1 m). Less common are Humic Dystrocryepts (moist, organic-rich, partially developed with no permafrost within 2 m), and Typic Dystrocryepts (moist, partially developed with no permafrost within 2 m).

This ecotype is an uncommon member of the broader soil landscapes within Boreal Subalpine Rocky Scrub and Woodlands. Other ecotypes in the association include Boreal Subalpine Willow & Birch Shrub, Boreal Subalpine Poplar Forest, and Boreal Subalpine Spruce Woodland.

BOREAL SUBALPINE POPLAR FOREST

Geomorphology:

These forests occur on colluvium or loess deposits and have limited distribution on subalpine hillsides in the park. Soil texture is loamy, sandy or rubbly. Site conditions co-vary with soil textures; moist and well drained conditions are most common, although dry, excessively drained soils occur on rubbly sites. Soil chemistry is variable.

Plant Association:

Populus balsamifera–Festuca altaica

Stands typically are open forests of mature balsam poplar, but dwarfed stands and woodlands also occur (Table 61). Deciduous shrubs, forbs and grasses typically are present, while the occurrence of other life forms is variable among sites. Nonvascular species usually are present but with little cover. Some litter alone usually is present. Common species include *Festuca altaica*, *Rosa acicularis, Mertensia paniculata* and *Epilobium angustifolium*.

This ecotype is similar to Boreal Upland Aspen Forest although poplar is dominant, and sites are closer to treeline. Although it shares the same dominant tree species as the riverine poplar ecotypes, these stands have distinctly different species composition and landscape position.

Table 61. Vegetation cover and frequency for Boreal Subalpine Poplar Forest (n=7). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	140.6	32.0	100
Total Vascular Cover	136.7	33.7	100
Total Evergreen Tree Cover	0.5	1.1	43
Picea glauca	0.5	1.1	43
Total Evergreen Shrub Cover	8.6	13.0	86
Arctostaphylos uva-ursi	5.0	13.2	14
Juniperus communis	1.6	2.9	43
Linnaea borealis	1.6	2.4	43
Vaccinium vitis-idaea	0.4	1.1	29
Total Deciduous Tree Cover	45.7	10.6	100
Populus balsamifera	45.7	10.6	100
Total Deciduous Shrub Cover	31.3	20.7	100
Arctostaphylos rubra	3.3	7.5	29
Betula nana	2.1	5.7	14
Potentilla fruticosa	3.1	3.8	57
Rosa acicularis	8.7	7.3	86
Salix barclayi	0.7	1.9	14
Salix bebbiana	0.7	1.9	14
Salix commutata	1.4	3.8	14
Salix glauca	2.9	7.6	14
Salix planifolia ssp. *pulchra*	0.7	1.9	14
Shepherdia canadensis	4.7	7.6	57
Viburnum edule	2.9	4.9	29
Total Forb Cover	42.1	19.4	100
Anemone parviflora	0.3	0.8	29
Anemone sp.	0.0	0.0	14
Arnica alpina ssp. *angustifolia*	0.0	0.0	14
Artemisia arctica ssp. *arctica*	0.3	0.5	29
Artemisia tilesii	0.3	0.8	14
Aster sibiricus	1.3	3.0	29
Castilleja elegans	0.3	0.8	29
Cornus canadensis	2.9	5.7	29
Delphinium glaucum	2.7	3.6	57
Epilobium angustifolium	9.3	7.3	86
Equisetum arvense	1.6	3.7	29
Equisetum scirpoides	0.1	0.4	14
Galium trifidum ssp. *trifidum*	0.4	0.8	29
Gentiana propinqua	0.0	0.0	29
Geocaulon lividum	4.3	11.3	14
Hedysarum alpinum	2.9	3.9	43
Heracleum lanatum	4.6	6.4	43
Lupinus arcticus	3.7	9.4	29
Mertensia paniculata	4.6	3.4	100
Moehringia lateriflora	0.0	0.0	14
Polemonium sp.	0.0	0.0	14
Pyrola sp.	0.0	0.0	14
Rubus arcticus ssp. *arcticus*	0.3	0.8	14
Saxifraga tricuspidata	0.1	0.4	14
Senecio lugens	0.7	1.0	43
Solidago multiradiata	0.1	0.4	14
Stellaria longipes	0.0	0.0	14
Zygadenus elegans	1.3	1.9	43
Total Grass Cover	8.4	9.0	100
Calamagrostis canadensis	3.7	9.4	57

Table 61. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Calamagrostis purpurascens	0.4	1.1	14
Festuca altaica	3.7	4.8	71
Poa arctica	0.0	0.0	14
Poa glauca	0.2	0.4	29
Poa palustris	0.1	0.4	14
Total Sedge & Rush Cover	0.1	0.4	14
Carex scirpoidea	0.1	0.4	14
Total Nonvascular Cover	3.9	5.3	86
Total Moss Cover	3.2	5.5	71
Abietinella abietina	0.3	0.8	14
Aulacomnium turgidum	0.6	1.5	14
Entodon concinnus	0.7	1.9	14
Eurhynchium pulchellum	0.0	0.0	14
Hylocomium splendens	0.1	0.4	14
Hypnum revolutum	0.7	1.9	14
Hypnum sp.	0.1	0.4	14
Rhytidium rugosum	0.4	1.1	14
Total Lichen Cover	0.7	1.9	43
Cladonia symphycarpia	0.0	0.0	14
Lepraria sp.	0.0	0.0	14
Peltigera sp.	0.7	1.9	14
Total Bare Ground	5.1	7.7	71
Soil	0.3	0.8	14
Litter Alone	4.9	7.0	71
Water	0.0	0.0	0

Soils

Soils typically are well drained, loamy to rubbly, and have thin surface organic horizons (Table 62). An eolian silt cap is absent and rock fragments are frequently present at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent. Water was at >1 m depth and usually was not encountered. Soil pH is circumneutral and electrical conductivity is low.

Table 62. Soil characteristics for Boreal Subalpine Poplar Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	8.8	4.2	4
Cumulative Org. in 40 cm (cm)	9.5	4.0	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	32.7	28.3	3
Surface Fragment Cover (%)	10.0	19.7	5
Frost Boil Cover (%)	0.0	0.0	2
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.8	0.7	5
Site EC at 10-cm depth (µS/cm)	88.0	43.8	5
Water Depth (cm, + above gnd)[a]	-137.5	47.9	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Eutrocryepts (moist, partially developed, circumneutral). Less common are Humic Dystrocryepts (moist, organic-rich, partially developed, acidic), Humic Eutrocryepts (moist, organic-rich, partially developed, nonacidic) and Typic Haplocryolls (moist, well developed with thick A horizon),

This ecotype is an uncommon member of the broader soil landscapes within Boreal Subalpine Rocky Scrub and Woodlands. Other ecotypes in the association include Boreal Subalpine Forb Meadow, Boreal Subalpine Willow & Birch Shrub, and Boreal Subalpine Spruce Woodland.

BOREAL SUBALPINE SPRUCE WOODLAND

Geomorphology:

These woodland stands form the treeline zone on mountain slopes, and occur on hillside colluvium or loess deposits. Soils are moist to dry, and well to excessively drained with rubbly or loamy textures. Soil chemistry is circumneutral to acidic. These woodlands are common throughout the mountainous regions of the park.

Plant Association:
Picea glauca–Vaccinium uliginosum

Although evergreen trees characterize these sites, deciduous shrubs have the greatest total cover (Table 63). All life forms are present except deciduous trees. Dominant species include *Picea glauca, Vaccinium uliginosum, Empetrum nigrum, Vaccinium vitis-idaea, Salix glauca, Festuca altaica* and *Hylocomium splenden*s. While this ecotype has a high species count per plot, the overall species count is moderate, and species composition is consistent among sites.

This ecotype is similar to Boreal Subalpine Birch and Willow Shrub, except trees have 10–25% total cover. It also is similar to Boreal Upland White Spruce Forest, except canopy is more open and shrub cover is greater.

Table 63. Vegetation cover and frequency for Boreal Subalpine Spruce Woodland (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	203.0	38.2	100
Total Vascular Cover	155.6	36.0	100
Total Evergreen Tree Cover	13.3	2.9	100
Picea glauca	13.3	2.9	100
Total Evergreen Shrub Cover	40.4	19.4	100
Andromeda polifolia	0.0	0.1	33
Arctostaphylos uva-ursi	1.0	1.7	33
Cassiope tetragona	3.3	5.8	33
Dryas integrifolia	3.0	5.2	33
Dryas octopetala ssp. *alaskensis*	2.0	3.5	33
Empetrum nigrum	7.3	4.6	100
Juniperus communis	3.3	5.8	33
Ledum decumbens	6.7	7.6	67
Ledum groenlandicum	2.7	2.5	67
Linnaea borealis	1.0	1.7	33
Rhododendron lapponicum	0.0	0.1	33
Vaccinium vitis-idaea	10.0	10.0	100
Total Deciduous Shrub Cover	65.8	32.1	100
Alnus crispa	3.3	5.8	33
Arctostaphylos rubra	4.0	4.6	67
Betula glandulosa	16.7	28.9	33
Betula nana	15.0	26.0	33
Potentilla fruticosa	2.3	2.5	67
Rosa acicularis	0.0	0.1	33
Salix glauca	10.0	14.8	100
Salix lanata ssp. *richardsonii*	0.0	0.1	33
Salix planifolia ssp. *pulchra*	6.7	11.5	33
Salix reticulata	2.0	2.6	67
Vaccinium uliginosum	5.7	4.0	100
Total Forb Cover	19.2	12.3	100
Artemisia tilesii	0.0	0.1	33
Cypripedium passerinum	0.3	0.6	33
Equisetum pratense	10.0	17.3	33
Equisetum scirpoides	0.1	0.1	67
Gentiana propinqua	0.0	0.1	33
Geocaulon lividum	5.0	8.7	33
Hedysarum alpinum	2.4	4.0	67
Mertensia paniculata	0.3	0.6	33
Parnassia palustris	0.0	0.1	33
Pedicularis capitata	0.0	0.1	33
Petasites frigidus	0.7	1.2	33
Polemonium acutiflorum	0.0	0.1	33
Polygonum bistorta	0.0	0.1	33
Silene acaulis	0.0	0.1	33
Tofieldia pusilla	0.0	0.1	33
Zygadenus elegans	0.0	0.1	33
Total Grass Cover	4.7	2.9	100
Calamagrostis canadensis	2.3	4.0	33
Calamagrostis purpurascens	0.0	0.1	33
Festuca altaica	2.3	1.2	100
Poa arctica	0.0	0.1	33
Total Sedge & Rush Cover	12.1	3.6	100
Carex bigelowii	5.0	8.7	33
Carex concinna	1.7	2.9	33

Table 63. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Carex obtusata	1.0	1.7	33
Carex podocarpa	0.7	1.2	33
Carex scirpoidea	3.3	2.9	67
Carex vaginata	0.0	0.1	33
Luzula spicata	0.0	0.1	33
Total Nonvascular Cover	47.4	15.8	100
Total Moss Cover	39.7	14.6	100
Aulacomnium sp.	2.7	4.6	33
Dicranum sp.	1.7	1.5	67
Hylocomium splendens	16.0	11.5	100
Pleurozium schreberi	8.7	10.3	67
Polytrichum sp.	0.7	1.2	33
Unknown moss	10.0	11.4	100
Total Lichen Cover	7.7	7.4	100
Cetraria islandica ssp. *islandica*	2.7	4.6	33
Cladina arbuscula	0.7	1.2	33
Cladina rangiferina	0.0	0.1	33
Cladina sp.	1.4	2.3	67
Cladonia sp.	1.7	2.9	67
Flavocetraria nivalis	0.0	0.1	33
Peltigera aphthosa	1.0	1.7	67
Stereocaulon sp.	0.1	0.1	67
Vulpicida pinastri	0.0	0.1	33
Total Bare Ground	4.0	1.7	100
Soil	0.0	0.0	0
Litter Alone	4.0	1.7	100

Soils

Soils typically are well drained, loamy to rubbly, and have thin surface organic horizons (Table 64). A thin eolian silt cap is often present and rock fragments are occasionally present at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is assumed to be frequently absent. Depth to water is <1 m. Soil pH is circumneutral and electrical conductivity is low.

Table 64. Soil characteristics for Boreal Subalpine Spruce Woodland. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	6.3	6.1	3
Cumulative Org. in 40 cm (cm)	7.3	6.5	3
Loess Cap Thickness(cm)	4.3	7.5	3
Depth to Rocks (cm)	19.5	7.8	2
Surface Fragment Cover (%)	1.0	1.7	3
Frost Boil Cover (%)	0.0	0.0	3
Thaw Depth (cm)[a]	63.0		1
Site pH at 10-cm depth	6.3	0.9	3
Site EC at 10-cm depth (µS/cm)	106.7	20.8	3
Water Depth (cm, + above gnd)[a]	-84.7	57.5	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Typic Eutrocryepts (moist, partially developed, circumneutral), and Aquic Eutrocryepts, (wet, partially developed, circumneutral). Also occurring is the permafrost subgroup Typic Haploturbels (moist, turbated soil horizons).

This ecotype is a common member of the broader soil landscapes within Boreal Subalpine Rocky Scrub and Woodlands. Other ecotypes in the association include Boreal Subalpine Forb Meadow, Boreal Subalpine Willow & Birch Shrub, and Boreal Subalpine Poplar Forest.

BOREAL SUBALPINE WILLOW AND BIRCH SHRUB

Geomorphology:

This common and widespread ecotype occurs on hillside colluvium, older moraine, retransported deposits, margins of high elevation thaw basins, loess deposits, inactive alluvial fan deposits, and lacustrine deposits. Soil textures are variable but most commonly are loamy, and overlain by organic horizons. Drainage is variable, typically well to somewhat poorly drained, and soils are moist to dry. Soil pH is circumneutral to acidic.

Plant Association:
Betula nana–Salix pulchra–Festuca altaica

Deciduous shrubs characterize this ecotype but dominant species vary (Table 65). This results in several low shrub vegetation classes being combined into the same ecotype. Species composition among plots is similar, but relative abundances of individual species are quite variable. Forbs are always present and overall species diversity is high. Transition zones, such as this one between alpine and upland habitats, frequently are species rich, containing plants that occur in both physiographic regions. Dominant species include *Betula nana, Salix lanata* ssp. *richardsonii, Vaccinium uliginosum, Vaccinium vitis-idaea, Epilobium angustifolium* and *Festuca altaica*.

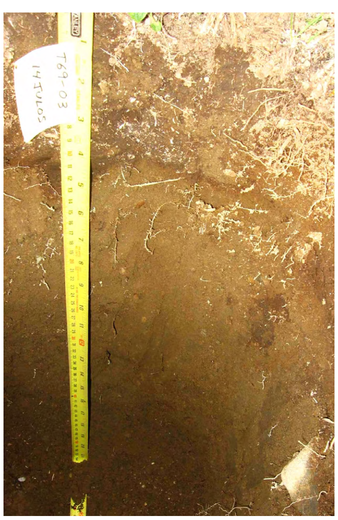
The most similar ecotype is Boreal Subalpine Spruce Woodland except that spruce is absent or infrequent in the shrub ecotype.

Table 65. Vegetation cover and frequency for Boreal Subalpine Willow and Birch Shrub (n=64). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	163.4	54.9	100
Total Vascular Cover	125.6	40.2	100
Total Evergreen Tree Cover	0.6	2.6	25
Picea glauca	0.5	2.5	25
Total Evergreen Shrub Cover	21.6	18.5	88
Arctostaphylos uva-ursi	2.5	6.9	22
Dryas integrifolia	1.0	2.8	19
Empetrum nigrum	8.3	12.6	58
Juniperus communis	0.3	0.8	16
Ledum decumbens	1.8	4.6	22
Ledum groenlandicum	0.7	2.9	11
Linnaea borealis	1.8	5.6	27
Rhododendron lapponicum	0.2	0.8	17
Vaccinium vitis-idaea	3.9	5.8	63
Total Deciduous Shrub Cover	78.9	32.6	100
Alnus crispa	0.3	0.9	11
Arctostaphylos rubra	1.8	6.1	25
Betula glandulosa	14.6	21.4	44
Betula nana	12.5	22.2	44
Potentilla fruticosa	1.8	5.1	42
Rosa acicularis	0.3	0.7	22
Salix barclayi	3.4	10.8	16
Salix glauca	10.6	15.4	56
Salix lanata ssp. *richardsonii*	1.0	4.2	11
Salix planifolia ssp. *pulchra*	11.8	17.3	64
Salix reticulata	4.4	8.9	41
Salix scouleriana	2.3	9.9	11
Vaccinium uliginosum	9.2	13.4	72
Total Forb Cover	13.0	14.8	100
Aconitum delphinifolium	0.1	0.4	34
Artemisia arctica ssp. *arctica*	0.7	1.6	31
Artemisia arctica	0.2	0.7	13
Cornus canadensis	2.1	7.2	22
Epilobium angustifolium	1.1	1.9	50
Equisetum arvense	0.8	3.4	14
Lupinus arcticus	0.7	1.9	25
Mertensia paniculata	0.9	1.5	44
Pedicularis capitata	0.1	0.3	20
Pedicularis labradorica	0.1	0.2	19
Petasites frigidus	0.8	2.0	23
Polemonium acutiflorum	0.1	0.6	14
Polygonum bistorta	0.4	1.1	23
Polygonum viviparum	0.2	0.5	20
Pyrola asarifolia	0.2	0.5	17
Pyrola grandiflora	0.1	0.3	17
Saussurea angustifolia	0.0	0.2	13
Saxifraga tricuspidata	0.1	0.2	16
Senecio lugens	0.2	0.9	11
Solidago multiradiata	0.2	0.5	23
Valeriana capitata	0.4	1.2	25
Total Grass Cover	4.8	4.7	92
Arctagrostis latifolia	0.1	0.2	11
Calamagrostis canadensis	1.0	2.8	30
Festuca altaica	3.3	4.1	69

Table 65. Continued.

	Cover Mean	Cover SD	Freq %
Hierochlöe alpina	0.1	0.4	17
Poa arctica	0.1	0.3	20
Total Sedge & Rush Cover	6.4	12.3	58
Carex bigelowii	5.3	11.9	31
Total Nonvascular Cover	37.7	37.5	88
Total Moss Cover	27.6	28.5	86
Aulacomnium palustre	1.4	3.3	20
Aulacomnium turgidum	1.2	3.1	28
Hylocomium splendens	6.0	11.6	42
Pleurozium schreberi	2.2	6.2	22
Polytrichum sp.	0.6	1.9	25
Polytrichum strictum	0.6	1.9	14
Rhytidium rugosum	1.8	4.9	17
Tomentypnum nitens	3.9	7.4	33
Unknown moss	4.6	14.3	20
Total Lichen Cover	10.1	20.5	73
Cetraria islandica ssp. *islandica*	0.2	0.8	16
Cladina arbuscula	0.6	2.4	19
Cladina rangiferina	0.5	2.3	14
Cladina sp.	1.1	3.2	19
Cladina stellaris	2.2	9.2	11
Cladina stygia	1.1	4.8	11
Cladonia sp.	0.7	1.5	36
Flavocetraria cucullata	0.5	1.4	30
Flavocetraria nivalis	0.1	0.4	11
Peltigera aphthosa	0.3	0.6	38
Peltigera sp.	0.1	0.2	16
Stereocaulon sp.	0.8	1.9	27
Total Bare Ground	10.3	13.4	89
Soil	3.0	10.8	27
Litter Alone	7.2	8.0	89



Soils

Soils typically are well to somewhat poorly drained, loamy to rubbly, and have thin surface organic horizons (Table 66). A thin eolian silt cap is often present and rock fragments are occasionally present at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is assumed to be present at nearly all sites. Water is present at most sites, but depth to water is highly variable. Soil pH usually is acidic and electrical conductivity is low.

Table 66. Soil characteristics for Boreal Subalpine Willow and Birch Shrub.

Property	Mean	SD	n
Surface Organics Depth (cm)	7.4	5.2	59
Cumulative Org. in 40 cm (cm)	7.9	5.6	59
Loess Cap Thickness(cm)	9.4	16.0	49
Depth to Rocks (cm)	43.9	35.2	47
Surface Fragment Cover (%)	2.4	11.9	57
Frost Boil Cover (%)	2.2	9.5	28
Thaw Depth (cm)[a]	59.2	28.3	14
Site pH at 10-cm depth	5.5	0.7	57
Site EC at 10-cm depth (µS/cm)	68.7	62.3	57
Water Depth (cm, + above gnd)[a]	-104.6	49.4	59

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Typic Dystrocryepts (moist, acidic, partially developed) and Typic Haplocryods (moist, acidic, highly leached, well developed) and the permafrost subgroups Typic Eutrogelepts (moist, nonacidic, partially developed) and Typic Aquorthels (wet, nonturbated). This ecotype, however, has a wide diversity of soils. Other common subgroups include Aquic Haploturbels, Humic Dystrocryepts, Humic Eutrocryepts, Spodic Dystrocryepts, Typic Aquiturbels, Typic Cryorthents, Typic Dystrogelepts, Typic Eutrocryepts, Typic Gelaquepts, Typic Gelorthents, Typic Haplocryolls, Typic Haploturbels, and Typic Humicryods. Uncommon subgroups include Humic Dystrogelepts, Typic Historthels, Typic Histoturbels, Andic Aquorthels and Aquic Haplorthels.

This ecotype is the dominant member of the broader soil landscapes within Boreal Subalpine Rocky Scrub and Woodlands. Other ecotypes in the association include Boreal Subalpine Forb Meadow, Boreal Subalpine White Spruce Woodland, and Boreal Subalpine Poplar Forest.

BOREAL UPLAND ASPEN FOREST

Geomorphology:

This ecotype is comprised of aspen forests on hillside colluvium, older moraine, upland loess, and talus bluffs. The ground is sloped, sites are well to excessively drained, and moist to dry. The dominant soil texture is loam, rubble or gravel, and an organic horizon typically is present. Site chemistry is circumneutral to alkaline, although acidic soils occur. These stands are prone to disturbance by fire.

Plant Association:

Populus tremuloides–Picea glauca–Rosa acicularis

Quaking aspen occurs in open to closed stands; spruce trees are present but comprise <25% of total tree cover (Table 67). Nonvascular cover is low or absent. Forbs and both evergreen and deciduous shrubs form the understory. This ecotype has a high number of species per plot, but overall is not diverse. Common species include *Populus tremuloides, Picea glauca, Rosa acicularis Arctostaphylos uva-ursi, Geocaulon lividum*, and *Pyrola secunda*.

No other ecotypes are similar. Boreal Upland Birch Forest and Boreal Upland Spruce–Birch Forest occur on similar terrain but have completely different floristics, those sites also are more likely to be acidic and are not as dry.

Table 67. Vegetation cover and frequency for Boreal Upland Aspen Forest (n=9). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	145.6	30.7	100
Total Vascular Cover	137.2	25.7	100
Total Evergreen Tree Cover	4.8	6.6	100
Picea glauca	4.6	6.6	100
Picea mariana	0.2	0.7	22
Total Evergreen Shrub Cover	30.7	33.7	100
Arctostaphylos uva-ursi	5.2	7.5	56
Empetrum nigrum	1.8	3.7	33
Juniperus communis	1.7	5.0	22
Juniperus horizontalis	6.9	19.9	33
Ledum groenlandicum	2.0	2.9	44
Linnaea borealis	6.1	11.1	44
Vaccinium vitis-idaea	7.0	10.7	56
Total Deciduous Tree Cover	52.1	16.2	100
Populus tremuloides	52.1	16.2	100
Total Deciduous Shrub Cover	28.8	20.0	100
Alnus crispa	1.7	5.0	22
Arctostaphylos rubra	0.9	1.7	44
Artemisia frigida	0.6	1.7	33
Rosa acicularis	17.9	24.7	100
Salix bebbiana	5.0	7.9	67
Salix myrtillifolia	0.0	0.0	22
Salix scouleriana	1.3	2.2	44
Shepherdia canadensis	1.1	2.3	67
Viburnum edule	0.1	0.3	11
Total Forb Cover	11.7	6.7	100
Achillea borealis	0.6	0.9	33
Androsace septentrionalis	0.0	0.0	22
Arabis holboellii	0.0	0.0	22
Aster sibiricus	0.4	0.9	22
Astragalus adsurgens	0.0	0.0	11
Astragalus alpinus	0.0	0.0	22
Castilleja caudata	0.0	0.1	44
Corallorrhiza trifida	0.0	0.0	22
Epilobium angustifolium	1.1	1.8	44
Galium boreale	1.1	1.8	33
Gentiana propinqua	0.0	0.0	11
Geocaulon lividum	2.7	4.9	67
Hedysarum alpinum	0.6	1.3	22
Hedysarum mackenzii	0.0	0.0	11
Lupinus arcticus	0.3	0.4	56
Lupinus nootkatensis	0.6	1.7	11
Lycopodium annotinum	0.1	0.3	11
Lycopodium complanatum	0.0	0.0	11
Melandrium taimyrense	0.0	0.0	11
Oxytropis campestris	1.2	2.3	33
Oxytropis campestris ssp. *varians*	0.2	0.7	11
Pedicularis labradorica	0.0	0.1	33
Plantago canescens	0.0	0.0	22
Polemonium pulcherrimum	0.1	0.3	33
Pulsatilla patens ssp. *multifida*	0.5	0.9	33
Pyrola asarifolia	1.0	1.7	33
Pyrola secunda	0.5	0.9	56
Solidago decumbens var. *oreophila*	0.5	0.7	44

Table 68. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Solidago multiradiata var. *multiradiata*	0.0	0.0	22
Total Grass Cover	8.1	16.5	78
Agropyron sp.	3.3	10.0	11
Bromus pumpellianus	0.8	2.3	22
Calamagrostis inexpansa	0.1	0.3	11
Calamagrostis lapponica	0.1	0.3	11
Calamagrostis purpurascens	0.5	0.7	44
Festuca altaica	0.0	0.0	11
Poa glauca	0.9	1.6	44
Poa pratensis	1.7	5.0	11
Total Sedge & Rush Cover	0.9	1.5	78
Carex concinna	0.6	1.3	33
Carex rossii	0.3	1.0	11
Total Nonvascular Cover	8.4	8.5	89
Total Moss Cover	7.4	8.1	78
Abietinella abietina	0.6	1.3	22
Brachythecium sp.	0.9	1.8	33
Dicranum sp.	0.3	0.7	33
Hylocomium splendens	1.7	3.2	44
Unknown moss	3.4	5.1	44
Total Lichen Cover	1.0	1.1	78
Cladonia sp.	0.3	0.4	56
Cladonia symphycarpia	0.3	1.0	11
Peltigera aphthosa	0.0	0.1	33
Peltigera sp.	0.2	0.4	33
Total Bare Ground	21.2	13.4	100
Soil	7.3	12.6	33
Litter Alone	13.9	9.2	100

Soils

Soils typically are well to somewhat excessively drained, loamy to rubbly, and have thin surface organic horizons (Table 68). A thin eolian silt cap is often present and rock fragments are occasionally present at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is assumed to be absent. Water was not evident within 1.5 m of the surface. Soil pH is circumneutral to alkaline and electrical conductivity is moderately low.

Table 68. Soil characteristics for Boreal Upland Aspen Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	3.6	2.7	8
Cumulative Org. in 40 cm (cm)	3.6	2.7	8
Loess Cap Thickness(cm)	9.8	9.3	8
Depth to Rocks (cm)	31.0	20.0	5
Surface Fragment Cover (%)	1.4	3.8	7
Frost Boil Cover (%)	0.0	0.0	6
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.0	1.0	7
Site EC at 10-cm depth (µS/cm)	266.1	344.1	8
Water Depth (cm, + above gnd)[a]	-150.0	50.0	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Ustic Eutrocryepts (dry, nonacidic, partially developed) and Typic Cryorthents (moist, poorly developed). Other common subgroups include Typic Dystrocryepts (moist, acidic, partially developed), Spodic Dystrocryepts (moist, acidic, partially developed and somewhat leached), Typic Eutrocryepts (moist, nonacidic, partially developed), and Typic Haplocryods (moist, acidic, well developed and highly leached).

This ecotype and associated soils are part of the broader soil landscapes within Boreal Upland Dry Scrub and Forests. The association also includes Boreal Upland Sagebrush Meadow.

BOREAL UPLAND BIRCH FOREST

Geomorphology:

These mature birch forests are located on well-drained slopes of hillside colluvium, older moraine, upland loess, or eolian inactive sand deposits. Although distribution is patchy, this ecotype is widespread throughout the boreal section of the park. Sites are moist and have circumneutral to acidic chemistry. Soils primarily are loamy, rubbly or sandy textured, with well developed surface organic horizons.

Plant Association:
Betula papyrifera–Ledum groenlandicum

Paper birch stands have open to closed canopies with an understory dominated by shrubs and grasses (Table 69). Nonvascular cover is variable, and sedges often are absent. Spruce trees are present in all plots but have low total cover. This ecotype has a moderate number of species per plot and a low diversity overall. Common species include *Ledum groenlandicum, Picea glauca, Alnus crispa, Rosa acicularis*, and *Calamagrostis canadensis*.

The most similar ecotype is Boreal Upland Spruce–Birch Forest, in which spruce and birch are co-dominant. Additionally, Boreal Upland Alder Shrub has floristic similarities with this ecotype.

Table 69. Vegetation cover and frequency for Boreal Upland Birch Forest (n=6). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	156.7	34.3	100
Total Vascular Cover	134.2	33.7	100
Total Evergreen Tree Cover	4.2	4.6	100
Picea glauca	3.9	4.8	83
Picea mariana	0.3	0.8	17
Total Evergreen Shrub Cover	37.0	23.6	83
Empetrum nigrum	1.7	4.1	17
Ledum groenlandicum	23.5	24.9	83
Linnaea borealis	3.5	8.1	33
Vaccinium vitis-idaea	8.3	9.3	67
Total Deciduous Tree Cover	54.5	16.1	100
Betula papyrifera var. *humilis*	54.5	16.1	100
Total Deciduous Shrub Cover	24.4	22.6	100
Alnus crispa	11.7	12.7	67
Betula glandulosa	1.7	4.1	17
Betula occidentalis	0.7	1.6	17
Ribes triste	0.7	1.2	33
Rosa acicularis	7.2	13.8	67
Rubus idaeus	0.0	0.0	17
Salix bebbiana	0.5	0.8	33
Salix glauca	1.0	1.5	33
Spiraea beauverdiana	0.2	0.4	33
Vaccinium uliginosum	0.8	2.0	17
Total Forb Cover	5.3	4.9	100
Aconitum delphinifolium	0.0	0.0	17
Epilobium angustifolium	0.2	0.4	33
Equisetum arvense	0.2	0.4	17
Equisetum sylvaticum	3.4	5.2	50
Geocaulon lividum	0.7	1.2	50
Lycopodium annotinum	0.0	0.0	17
Mertensia paniculata	0.5	1.2	17
Petasites frigidus	0.2	0.4	17
Stellaria longipes	0.2	0.4	17
Total Grass Cover	8.9	9.2	100
Calamagrostis canadensis	8.8	9.2	67
Festuca altaica	0.1	0.1	50
Total Sedge & Rush Cover	0.0	0.1	17
Carex media	0.0	0.0	17
Carex vaginata	0.0	0.0	17
Total Nonvascular Cover	22.4	24.6	83
Total Moss Cover	21.4	23.7	83
Brachythecium sp.	0.3	0.8	17
Dicranum sp.	0.5	0.8	50
Drepanocladus sp.	5.0	10.0	33
Hylocomium splendens	8.8	20.2	33
Pleurozium schreberi	0.7	1.6	17
Polytrichum juniperinum	0.0	0.0	17
Polytrichum sp.	0.5	0.8	33
Rhytidium rugosum	0.5	1.2	17
Thuidium sp.	2.5	6.1	17
Total Lichen Cover	1.1	1.1	67

Table 69. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Cladina arbuscula	0.2	0.4	17
Cladina rangiferina	0.0	0.0	17
Cladina sp.	0.4	0.8	33
Cladonia sp.	0.2	0.4	33
Peltigera aphthosa	0.2	0.4	17
Total Bare Ground	8.3	7.3	100
Soil	0.2	0.4	17
Litter Alone	8.2	7.0	100

Soils

Soils typically are moist, well drained, loamy to rubbly, and have thin surface organic horizons (Table 70). A thin eolian silt cap is often present and rock fragments are rarely present at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is assumed to be mostly absent. Water was not evident within 1.5 m of the surface. Soil pH is acidic and electrical conductivity is very low.

Table 70. Soil characteristics for Boreal Upland Birch Forest. Blanks = no data.

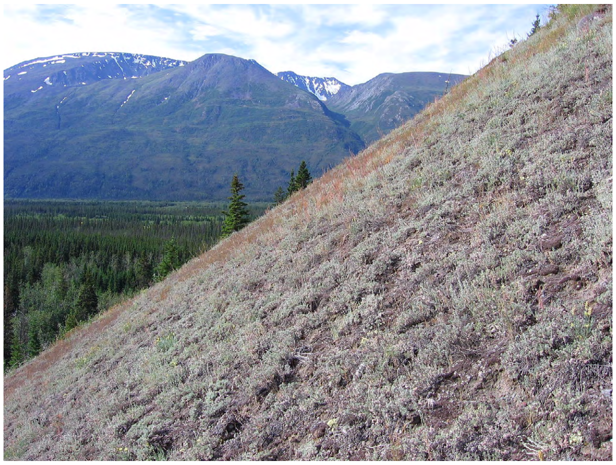
Property	Mean	SD	n
Surface Organics Depth (cm)	10.4	6.2	5
Cumulative Org. in 40 cm (cm)	12.8	8.8	5
Loess Cap Thickness(cm)	32.4	43.5	5
Depth to Rocks (cm)	28.3	3.5	3
Surface Fragment Cover (%)	0.2	0.4	5
Frost Boil Cover (%)	0.2	0.4	5
Thaw Depth (cm)[a]	43.0		1
Site pH at 10-cm depth	5.0	0.5	5
Site EC at 10-cm depth (µS/cm)	74.0	20.7	5
Water Depth (cm, + above gnd)[a]	-200.0	0.0	2

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Dystrocryepts (moist, acidic, partially developed). Less common subgroups include the non-permafrost soils Spodic Dystrocryepts (moist, acidic, partially developed and somewhat leached), Typic Haplocryods (moist, acidic, well developed and strongly leached), and the permafrost soil Typic Haploturbels (moist, turbated horizons).

This ecotype and associated soils comprise a mid-successional stage of the broader soil landscapes within Boreal Upland Rocky-loamy Scrub and Forests. Other ecotypes include Boreal Upland Tall Alder Shrub, Boreal Upland Spruce-Birch Forest and Boreal Upland White Spruce Forest.

BOREAL UPLAND SAGEBRUSH MEADOW



Geomorphology:

These meadows are restricted to steep, excessively drained slopes, usually bluffs. Terrain includes hillside colluvium, upland glaciolacustrine deposits (pro-glacial Lake Ahtna), and talus bluffs. Soils are excessively drained, dry and have basic chemistry, with dominant textures of loams, gravels or rubble. Organic material is absent, and exposed soil comprises at least 40% of the surface.

Plant Association:

Artemisia frigida–Calamagrostis purpurescens–Linum perenne

Sagebrush (*Artemisia frigida*) gives this ecotype its characteristic blue tint and strong odor (Table 71). Deciduous shrubs, forbs and grasses are the most prevalent life forms. Plant species in this ecotype have deep root systems and can withstand disturbance created by solifluction. This community type is stable and persistent, but is not species rich. Despite this, several rare species occur here, including *Juniperus horizontalis* (state rank S1S2), *Oxytropis campestris* ssp. *variens* (syn. *Oxytropis tananensis*) (S2S3), and *Agropyron yukonense* (syn. *Elymus calderi*) (S2S3).

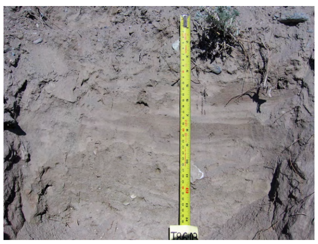
This ecotype is a relict of pro-glacial steppe; there are no similar ecotypes within the park.

Table 71. Vegetation cover and frequency for Boreal Upland Sagebrush Meadow (n=6). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	60.5	37.1	100
Total Vascular Cover	49.5	19.6	100
Total Evergreen Shrub Cover	4.2	10.2	67
Juniperus communis	0.0	0.0	17
Juniperus horizontalis	4.2	10.2	67
Total Deciduous Tree Cover	0.1	0.0	100
Populus balsamifera	0.0	0.0	17
Populus tremuloides	0.1	0.0	83
Total Deciduous Shrub Cover	32.6	21.4	100
Amelanchier alniflora	0.0	0.0	17
Artemisia frigida	25.0	15.2	100
Elaeagnus commutata	5.0	12.2	33
Rosa acicularis	2.5	2.9	83
Total Forb Cover	4.3	3.4	100
Androsace septentrionalis	0.2	0.4	33
Antennaria friesiana	0.0	0.0	17
Arabis divaricarpa	0.0	0.1	33
Arabis holboellii	0.4	0.8	50
Aster sibiricus	0.0	0.0	17
Epilobium latifolium	0.0	0.0	17
Erysimum inconspicuum	0.0	0.0	17
Galium boreale	0.0	0.1	33
Hedysarum alpinum	0.0	0.0	17
Hedysarum mackenzii	0.2	0.4	17
Lappula myosotis	0.7	1.2	67
Linum perenne	0.1	0.0	83
Oxytropis campestris	2.0	1.9	67
Oxytropis campestris ssp. *varians*	0.2	0.4	33
Plantago canescens	0.0	0.0	17
Polemonium pulcherrimum	0.0	0.0	17
Potentilla hookeriana	0.2	0.4	17
Potentilla pennsylvanica	0.2	0.4	17
Pulsatilla patens ssp. *multifida*	0.0	0.1	33
Saxifraga reflexa	0.0	0.0	17
Solidago multiradiata	0.0	0.0	17
Total Grass Cover	8.3	9.2	100
Agropyron sp.	6.2	9.5	100
Bromus pumpellianus	0.0	0.0	17
Calamagrostis purpurascens	1.7	4.1	67
Poa glauca	0.4	0.8	67
Agropyron pauciflorum ssp. *novae-angliae*	0.2	0.4	17
Agropyron yukonense	0.0	0.0	17
Total Nonvascular Cover	11.0	25.7	83
Total Moss Cover	9.7	23.8	17
Bryoerythrophyllum recurvirostrum	0.2	0.4	17
Bryum sp.	0.0	0.0	17
Ceratodon purpureus	0.2	0.4	17
Encalypta sp.	0.2	0.4	17
Hypnum vaucheri	0.0	0.0	17
Syntrichia ruralis	4.2	10.2	17
Unknown moss	5.0	12.2	17
Total Lichen Cover	1.2	2.0	83
Cladonia symphycarpia	0.8	2.0	17

Table 71. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Flavocetraria nivalis	0.0	0.0	17
Thamnolia sp.	0.0	0.0	17
Toninia sedifolia	0.2	0.4	17
Unknown lichen	0.2	0.4	50
Total Bare Ground	77.2	27.5	100
Soil	70.0	30.0	100
Litter Alone	7.2	5.0	100
Water	0.0	0.0	0



Soils

Soils typically are excessively drained, loamy to rubbly, and have thin surface organic horizons (Table 72). A thin eolian silt cap is often present and rock fragments are frequently present at the surface. Thaw depths frequently could not be determined, but permafrost is assumed to be absent. Water was not evident within 1.5 m of the surface. Soil pH is strongly alkaline and electrical conductivity is moderately low.

Table 72. Soil characteristics for Boreal Upland Sagebrush Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	5
Cumulative Org. in 40 cm (cm)	0.0	0.0	5
Loess Cap Thickness(cm)	2.0	4.5	5
Depth to Rocks (cm)	5.0	7.1	2
Surface Fragment Cover (%)	10.0	7.9	5
Frost Boil Cover (%)	0.0	0.0	5
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	8.1	0.1	5
Site EC at 10-cm depth (μS/cm)	258.0	212.4	5
Water Depth (cm, + above gnd)[a]			0

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroups Ustic Eutrocryepts (dry, nonacidic, partially developed) and Typic Cryorthents (dry to moist, poorly developed).

This ecotype and associated soils are part of the broader soil landscapes within Boreal Upland Dry Scrub and Forests. The association also includes Boreal Upland Aspen Forests.

BOREAL UPLAND SPRUCE–BIRCH FOREST

Geomorphology:

These mid- to late successional forests occur on slopes of older moraine or hillside colluvium. Soils are predominantly blocky, rubbly or loamy, resulting in drainage classes of well to somewhat poorly drained. Sites are moist to wet with acidic or circumneutral chemistry. Permafrost is absent or deeper than 1 m.

Plant Association:

Betula papyrifera–Picea glauca–Ribes triste

All life forms except sedges and lichens are present (Table 73). Deciduous shrubs and forbs characterize the understory, while moss frequently occurs in thick patches. Grasses are present but have little cover. This ecotype has a moderate number of species per plot and a low overall species diversity. Common species include *Vaccinium vitis-idaea, Mertensia paniculata, Calamagrostis canadensis*, and *Hylocomium splendens*.

The most closely related ecotype is Boreal Upland Birch Forest, which has similar species diversity, and is at a slightly earlier successional stage. Upland White Spruce Forest also is comparable but has higher species diversity, finer soil textures, and lacks a substantial birch component.

Table 73. Vegetation cover and frequency for Boreal Upland Spruce–Birch Forest (n=7). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	173.7	54.3	100
Total Vascular Cover	120.1	36.6	100
Total Evergreen Tree Cover	21.1	6.0	100
Picea glauca	20.4	7.3	100
Picea mariana	0.7	1.9	14
Total Evergreen Shrub Cover	36.5	36.0	100
Empetrum nigrum	1.4	3.8	14
Ledum groenlandicum	15.3	21.2	57
Linnaea borealis	2.6	4.1	71
Vaccinium vitis-idaea	17.1	17.7	100
Total Deciduous Tree Cover	27.9	9.5	100
Betula papyrifera var. *humilis*	27.9	9.5	100
Total Deciduous Shrub Cover	21.8	11.2	100
Alnus crispa	12.9	8.1	86
Ribes triste	3.9	3.7	100
Rosa acicularis	5.0	6.4	86
Spiraea beauverdiana	0.0	0.0	14
Total Forb Cover	8.8	7.4	100
Boschniakia rossica	0.0	0.0	14
Cornus canadensis	0.4	1.1	29
Delphinium glaucum	0.0	0.0	14
Epilobium angustifolium	0.0	0.0	14
Equisetum arvense	2.1	2.3	57
Equisetum scirpoides	0.0	0.0	29
Equisetum sylvaticum	3.0	7.5	43
Geocaulon lividum	0.2	0.4	71
Lycopodium annotinum	1.6	2.1	43
Mertensia paniculata	1.0	1.0	86
Petasites frigidus	0.2	0.4	29
Polemonium acutiflorum	0.0	0.0	14
Polygonum alaskanum	0.0	0.0	14
Pyrola secunda	0.2	0.4	43
Total Grass Cover	4.0	4.3	100
Calamagrostis canadensis	3.9	4.3	100
Festuca altaica	0.0	0.1	43
Total Sedge & Rush Cover	0.0	0.0	14
Carex scirpoidea	0.0	0.0	14
Total Nonvascular Cover	53.7	30.1	100
Total Moss Cover	53.0	29.5	100
Dicranum sp.	0.3	0.7	57
Hylocomium splendens	51.7	28.2	100
Rhytidium rugosum	0.2	0.4	29
Total Lichen Cover	0.6	1.1	86
Cladina arbuscula	0.0	0.0	14
Cladina sp.	0.1	0.1	43
Cladonia sp.	0.2	0.4	71
Peltigera aphthosa	0.3	0.7	43
Total Bare Ground	4.1	4.0	86
Soil	0.0	0.0	0
Litter Alone	4.1	4.0	86

Soils

Soils typically are moist, well drained, loamy to rubbly, and have thin surface organic horizons (Table 74). A thin eolian silt cap is often present and rock fragments are rarely present at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is assumed to be mostly absent. Water was not evident within 1.5 m of the surface. Soil pH is strongly acidic and electrical conductivity is very low.

Table 74. Soil characteristics for Boreal Upland Spruce—Birch Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	13.0	2.2	5
Cumulative Org. in 40 cm (cm)	13.8	3.2	5
Loess Cap Thickness(cm)	7.4	8.9	5
Depth to Rocks (cm)	19.0	8.3	4
Surface Fragment Cover (%)	0.0	0.0	5
Frost Boil Cover (%)	0.0	0.0	5
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	4.4	0.3	4
Site EC at 10-cm depth (µS/cm)	97.5	27.5	4
Water Depth (cm, + above gnd)[a]	-175.0	28.9	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Dystrocryepts (moist, acidic, partially developed). Less common subgroups include the non-permafrost soils Typic Haplocryods (moist, acidic, well developed and strongly leached), and the permafrost soils Typic Aquorthels (wet, non-turbated).

This ecotype and associated soils comprise a mid-successional stage of the broader soil landscapes within Boreal Upland Rocky-loamy Scrub and Forests. Other ecotypes include Boreal Upland Tall Alder Shrub, Boreal Upland Birch Forest and Boreal Upland White Spruce Forest.

BOREAL UPLAND TALL ALDER SHRUB

Geomorphology:

This ecotype consists of tall alder shrubs in patchy or continuous closed thickets on mountain slopes below the subalpine zone. Hillside deposits are upland loess or colluvium with variable surficial textures including organic, loamy, sandy or blocky. These sites are moist, well or moderately well drained, and have acidic or circumneutral chemistry.

Plant Association:
Alnus crispa–Ribes triste–Calamagrostis canadensis

Tall alder with mixed deciduous shrubs and forbs characterize this ecotype (Table 75). Common species include *Alnus crispa, Ribes triste, Calamagrostis canadensis, Epilobium angustifolium and Mertensia paniculata*. Of upland ecotypes, this class has the second lowest species count per plot but the third highest diversity; of all ecotypes it ranks 17th in total species count.

This ecotype is floristically similar to Boreal Upland Birch Forest, except that alder instead of birch dominates the canopy. Boreal Riverine Tall Alder Shrub is the only other alder-dominated boreal ecotype, but the alder species, physiography and site factors all are different.

Table 75. Vegetation cover and frequency for Boreal Upland Tall Alder Shrub (n=14). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	155.3	34.4	100
Total Vascular Cover	143.1	24.4	100
Total Evergreen Tree Cover	1.9	3.4	50
Picea glauca	1.9	3.5	43
Picea sitchensis	0.1	0.3	7
Total Evergreen Shrub Cover	10.2	17.5	57
Cassiope tetragona	0.1	0.5	7
Empetrum nigrum	1.3	3.1	21
Ledum decumbens	0.4	1.3	7
Ledum groenlandicum	3.7	10.6	36
Linnaea borealis	2.3	5.5	36
Vaccinium vitis-idaea	2.3	4.2	50
Total Deciduous Tree Cover	1.3	4.0	29
Betula papyrifera var. *humilis*	1.3	4.0	29
Total Deciduous Shrub Cover	103.3	27.7	100
Alnus crispa	37.2	36.0	57
Alnus sinuata	24.6	35.2	43
Arctostaphylos rubra	0.4	1.3	14
Ribes triste	12.9	19.5	86
Rosa acicularis	2.8	5.4	43
Rubus idaeus	0.4	1.3	14
Rubus spectabilis	0.4	1.3	7
Salix alaxensis	0.7	2.7	7
Salix barclayi	3.2	8.2	21
Salix planifolia ssp. *pulchra*	3.9	13.3	14
Salix scouleriana	3.7	9.3	29
Sambucus racemosa	0.4	1.3	14
Sorbus sitchensis	2.1	5.6	21
Spiraea beauverdiana	0.2	0.4	21
Vaccinium ovalifolium	4.1	14.7	21
Vaccinium uliginosum	4.7	15.9	29
Viburnum edule	1.4	4.1	14
Total Forb Cover	21.4	15.9	100
Aconitum delphinifolium	0.0	0.0	29
Artemisia arctica ssp. *arctica*	0.2	0.5	21
Artemisia tilesii	0.4	1.3	14
Athyrium filix-femina ssp. *cyclosorum*	0.4	1.3	14
Boschniakia rossica	0.1	0.3	14
Cornus canadensis	2.1	4.6	29
Delphinium glaucum	0.1	0.3	7
Dryopteris dilatata ssp. *americana*	1.7	5.3	29
Epilobium angustifolium	1.9	2.3	71
Equisetum arvense	2.1	4.6	36
Equisetum scirpoides	0.2	0.8	21
Galium boreale	0.2	0.4	21
Geocaulon lividum	0.2	0.8	7
Gymnocarpium dryopteris	5.1	9.0	43
Heracleum lanatum	0.1	0.3	7
Lycopodium annotinum	1.1	2.4	29
Lycopodium selago	0.1	0.3	14
Mertensia paniculata	1.4	1.7	64
Moehringia lateriflora	0.3	0.6	36
Petasites frigidus	0.4	1.2	14
Polemonium acutiflorum	0.0	0.0	14

Table 75. Continued.

	Cover Mean	Cover SD	Freq %
Pyrola grandiflora	0.2	0.6	21
Rubus arcticus ssp. *arcticus*	0.1	0.3	7
Rubus pedatus	1.4	4.1	21
Sanguisorba officinalis	0.4	1.3	14
Saxifraga tricuspidata	0.1	0.3	7
Senecio lugens	0.0	0.0	7
Streptopus amplexifolius	0.1	0.3	14
Trientalis europaea	0.3	0.6	21
Valeriana capitata	0.2	0.6	14
Total Grass Cover	4.9	6.3	86
Calamagrostis canadensis	4.9	6.3	86
Poa glauca	0.1	0.3	7
Total Sedge & Rush Cover	0.1	0.5	7
Carex sp.	0.1	0.5	7
Total Nonvascular Cover	12.2	15.6	93
Total Moss Cover	12.0	15.3	93
Brachythecium sp.	0.7	1.4	29
Dicranum sp.	0.9	1.8	36
Drepanocladus sp.	1.3	4.0	21
Eurhynchium pulchellum	0.2	0.4	29
Hylocomium splendens	3.9	7.2	43
Pleurozium schreberi	2.4	6.7	29
Polytrichum sp.	0.4	0.9	21
Tomentypnum nitens	0.4	1.3	7
Total Lichen Cover	0.2	0.4	29
Cladonia sp.	0.1	0.3	14
Cladonia uncialis	0.1	0.3	7
Total Bare Ground	3.9	4.7	57
Soil	0.5	1.3	14
Litter Alone	3.4	4.0	57

Soils

Soils typically are moist, well drained, loamy to rubbly, and have thin surface organic horizons (Table 76). A thin eolian silt cap is often present and rock fragments are rarely present at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is occasionally present. Water may be present within 1 m of the surface. Soil pH is acidic and electrical conductivity is very low.

Table 76. Soil characteristics for Boreal Upland Tall Alder Shrub.

Property	Mean	SD	n
Surface Organics Depth (cm)	13.3	9.1	13
Cumulative Org. in 40 cm (cm)	13.8	9.4	13
Loess Cap Thickness(cm)	11.1	17.1	13
Depth to Rocks (cm)	37.7	17.6	12
Surface Fragment Cover (%)	0.0	0.0	13
Frost Boil Cover (%)	0.0	0.0	4
Thaw Depth (cm)[a]	50.0	9.9	2
Site pH at 10-cm depth	5.0	0.8	13
Site EC at 10-cm depth (µS/cm)	92.3	36.1	13
Water Depth (cm, + above gnd)[a]	-108.3	25.0	9

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Humic Dystrocryepts (moist, acidic, organic-rich, partially developed), and to a lesser extent Typic Dystrocryepts (moist, acidic, partially developed) and Typic Haplocryolls (moist, organic-rich, well developed. Less common subgroups include the non-permafrost subgroups Humic Eutrocryepts (moist, nonacidic, organic-rich, partially developed), Typic Eutrocryepts (moist, nonacidic, organic-rich), Typic Humicryods (moist, acidic, well developed and highly leached), and the permafrost subgroups Typic Historthels (organic-rich, turbated) and Typic Umbrorthels (nonturbated with a thick A horizon).

This ecotype and associated soils comprise a mid-successional stage of the broader soil landscapes within Boreal Upland Rocky-loamy Scrub and Forests. Other ecotypes include Boreal Upland Birch Forest, Boreal Upland Spruce-Birch Forest and Boreal Upland White Spruce Forest.

BOREAL UPLAND WHITE SPRUCE FOREST

Geomorphology:

These upland forests occur on older moraine, upland loess or hillside colluvium throughout the park. Soils predominantly are loams overlain by well developed organic horizons. Blocky-textured soils also occur. These sites are moderately well to well drained, moist, and mostly circumneutral, although alkaline and acidic chemistry also occur.

Plant Association:

Picea glauca–Rosa acicularis

Needleleaf trees typically have 10–60% cover. All life forms are present except deciduous trees and graminoids (Table 77). Nonvascular species represent a substantial proportion of total cover. This is a late successional community and has the highest numer of species per plot and highest total species count of all upland ecotypes. Overall, Upland White Spruce Forest has the 9th highest species count. Common species include *Picea glauca, Rosa acicularis, Arctostaphylos rubra, Geocaulon lividum, Hylocomium splendens*, and *Cladonia* spp.

This ecotype is most similar to Boreal Subalpine White Spruce Forest, with which it intergrades at high elevations. It also is similar to Boreal Upland Spruce–Birch Forest.

Table 77. Vegetation cover and frequency for Boreal Upland White Spruce Forest (n=11). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	209.8	43.2	100
Total Vascular Cover	120.2	42.0	100
Total Evergreen Tree Cover	28.8	16.4	100
Picea glauca	26.3	13.7	100
Picea mariana	2.5	6.0	27
Total Evergreen Shrub Cover	27.3	23.4	100
Andromeda polifolia	0.9	3.0	9
Dryas integrifolia	0.9	3.0	9
Empetrum nigrum	7.3	13.5	27
Ledum decumbens	0.9	3.0	9
Ledum groenlandicum	4.5	8.2	55
Linnaea borealis	4.5	6.9	64
Vaccinium vitis-idaea	6.3	7.4	64
Total Deciduous Shrub Cover	37.2	24.7	100
Alnus crispa	7.0	14.0	55
Arctostaphylos rubra	5.4	6.1	73
Betula glandulosa	0.6	1.6	18
Betula nana	2.3	7.5	9
Betula occidentalis	0.5	1.5	9
Potentilla fruticosa	0.2	0.6	18
Ribes triste	0.3	0.9	18
Rosa acicularis	2.6	4.4	73
Salix barclayi	0.1	0.3	9
Salix bebbiana	3.6	9.1	36
Salix glauca	2.1	3.3	45
Salix lanata ssp. *richardsonii*	0.9	3.0	9
Salix planifolia ssp. *pulchra*	0.9	3.0	18
Salix reticulata	2.0	4.8	18
Salix scouleriana	1.5	3.2	27
Shepherdia canadensis	1.8	4.0	27
Vaccinium uliginosum	4.5	9.5	45
Viburnum edule	0.9	3.0	9
Total Forb Cover	19.9	17.2	100
Anemone parviflora	0.3	0.6	27
Epilobium angustifolium	0.3	0.9	36
Equisetum arvense	7.9	17.1	36
Equisetum pratense	0.0	0.0	9
Equisetum scirpoides	1.3	2.0	73
Equisetum sylvaticum	0.9	3.0	9
Gentiana propinqua	0.3	0.6	18
Geocaulon lividum	5.1	5.7	82
Hedysarum alpinum	0.9	3.0	36
Lupinus arcticus	0.4	0.7	45
Lycopodium annotinum	0.1	0.3	9
Mertensia paniculata	0.6	1.6	27
Moneses uniflora	0.1	0.3	18
Parnassia palustris	0.0	0.0	18
Polygonum viviparum	0.0	0.0	18
Pyrola asarifolia	0.0	0.0	18
Pyrola grandiflora	0.3	0.9	18
Pyrola secunda	0.0	0.1	45
Saussurea angustifolia	0.2	0.6	18
Senecio atropurpureus	0.0	0.0	18
Total Grass Cover	1.1	2.4	45

Table 77. Continued.

	Cover Mean	Cover SD	Freq %
Calamagrostis canadensis	0.6	1.0	36
Festuca altaica	0.6	1.5	36
Total Sedge & Rush Cover	2.3	3.9	55
Carex bigelowii	0.7	2.4	9
Carex concinna	0.1	0.3	36
Carex membranacea	0.7	2.4	9
Carex scirpoidea	0.6	1.6	18
Carex sp.	0.1	0.3	9
Total Nonvascular Cover	89.6	37.1	100
Total Moss Cover	83.8	37.1	100
Aulacomnium palustre	0.3	0.9	9
Aulacomnium turgidum	0.2	0.6	9
Bryum sp.	0.9	3.0	9
Dicranum sp.	0.8	1.7	36
Hylocomium splendens	44.5	20.2	100
Hypnum sp.	0.2	0.6	9
Pleurozium schreberi	6.8	10.6	36
Polytrichum sp.	0.3	0.9	18
Ptilium crista-castrensis	0.0	0.0	9
Sanionia uncinata	2.3	7.5	9
Sphagnum fuscum	1.4	4.5	9
Sphagnum sp.	0.9	3.0	9
Tomentypnum nitens	2.3	6.1	18
Unknown moss	22.9	32.4	55
Total Lichen Cover	5.9	7.2	100
Cetraria islandica ssp. *islandica*	0.2	0.6	18
Cladina arbuscula	0.3	0.9	9
Cladina rangiferina	0.4	0.9	27
Cladina sp.	0.4	1.2	27
Cladina stygia	0.2	0.6	9
Cladonia sp.	1.7	4.4	55
Peltigera aphthosa	0.8	1.3	36
Peltigera canina	0.2	0.6	36
Peltigera rufescens	0.2	0.6	9
Peltigera sp.	0.1	0.3	36
Stereocaulon sp.	0.5	1.5	9
Total Bare Ground	5.8	7.0	91
Litter Alone	5.8	7.0	91

Soils

Soils typically are moist, well drained, loamy to rubbly, and have thin surface organic horizons (Table 78). A thin to thick eolian silt cap is often present and rock fragments are absent at the surface. Thaw depths frequently could not be determined in the rocky soils, but permafrost is assumed to be mostly absent. Water was occasionally evident within 1.5 m of the surface. Soil pH is acidic to circumneutral and electrical conductivity is low.

Table 78. Soil characteristics for Boreal Upland White Spruce Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	6.9	4.4	8
Cumulative Org. in 40 cm (cm)	7.9	3.5	8
Loess Cap Thickness(cm)	18.0	14.9	8
Depth to Rocks (cm)	33.3	6.7	6
Surface Fragment Cover (%)	0.0	0.0	8
Frost Boil Cover (%)	0.0	0.0	5
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.1	0.8	8
Site EC at 10-cm depth (µS/cm)	161.3	166.3	8
Water Depth (cm, + above gnd)[a]	-90.8	44.6	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated taxonomically by the non-permafrost subgroup Typic Dystrocryepts (moist, acidic, partially developed) and Typic Eutrocryepts (moist, nonacidic, partially developed). Less common subgroups include the non-permafrost soils Typic Haplocryods (moist, acidic, well developed and strongly leached), Typic Haplocryolls (moist, nonacidic, organic-rich and well developed), and the permafrost soil Aquic Haplorthels (wet, non-turbated).

This ecotype and associated soils comprise a late successional stage of the broader soil landscapes within Boreal Upland Rocky-loamy Scrub and Forests. Other ecotypes include Boreal Upland Tall Alder Shrub, Boreal Upland Birch Forest and Boreal Upland White Spruce-Birch Forest.

MARITIME AND AQUATIC ECOTYPES

MARITIME ALPINE BARRENS

Geomorphology:

This ecotype occurs on slopes and ridges in the alpine zone above 810 m in the St. Elias Range. Terrain includes hillslope colluvium, noncarbonate metamorphic, and sedimentary bedrock. Slopes are unstable due to frost cracking, soil creep, and landslides.

Plant Association:

Cassiope stellariana–Luetkea pectinata

Total cover of vegetation is less than 30% in this ecotype (Table 79). The most common life form is dwarf shrubs, particularly evergreen shrubs. Dominant species include *Cassiope stelleriana, Luetkea pectinata*, and *Phyllodoce aleutica*. Cover of forbs, graminoids and nonvascular species generally is low, although all of these life forms usually are present to some degree. Commonly occurring species include *Carex nardina, Vaccinium uliginosum,* and *Luzula multiflora*.

This ecotype is most similar to Maritime Alpine Cassiope Dwarf Shrub, except that elevation and soil pH are higher for barren communities, and vegetation cover and species diversity are reduced.

Table 79. Vegetation cover and frequency for Maritime Alpine Barrens (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	26.2	24.4	100
Total Vascular Cover	16.4	13.0	100
Total Evergreen Shrub Cover	11.4	8.4	100
Cassiope stelleriana	1.7	1.5	100
Loiseleuria procumbens	0.1	0.1	67
Luetkea pectinata	7.7	10.7	100
Phyllodoce aleutica	1.7	1.5	67
Phyllodoce sp.	0.3	0.6	33
Total Deciduous Shrub Cover	0.1	0.1	67
Vaccinium uliginosum	0.1	0.1	67
Total Forb Cover	1.5	2.4	100
Antennaria sp.	0.3	0.6	33
Artemisia arctica ssp. *arctica*	0.3	0.6	33
Epilobium anagallidifolium	0.0	0.1	33
Epilobium latifolium	0.7	1.2	33
Minuartia sp.	0.0	0.1	33
Petasites frigidus	0.0	0.0	0
Saxifraga sp.	0.1	0.1	67
Sibbaldia procumbens	0.0	0.1	33
Total Grass Cover	1.0	1.7	33
Poa sp.	0.7	1.2	33
Trisetum spicatum ssp. *spicatum*	0.3	0.6	33
Total Sedge & Rush Cover	2.4	1.1	100
Carex nardina	0.7	1.1	67
Carex nigricans	0.0	0.1	33
Luzula arctica	0.3	0.6	33
Luzula multiflora	1.3	1.5	67
Total Nonvascular Cover	8.4	12.6	100
Total Moss Cover	7.4	10.9	100
Dicranum sp.	0.1	0.1	67
Racomitrium canescens	0.3	0.6	33
Racomitrium ericoides	0.3	0.6	33
Unknown liverwort	0.0	0.1	33
Unknown moss	6.7	11.5	33
Total Lichen Cover	1.1	1.9	33
Cetraria sp.	0.0	0.1	33
Solorina crocea	0.0	0.1	33
Stereocaulon sp.	1.0	1.7	33
Thamnolia vermicularis	0.0	0.1	33
Total Bare Ground	74.0	19.7	100
Soil	74.0	19.7	100

Soils

Soils are rubbly to blocky, excessively drained, and lack surface organic horizons (Table 80). Rock fragments cover most of the surface. Thaw depths could not be determined in the rocky soils, but permafrost is presumably present below 1 m because of low temperatures at high elevations. Soil pH is acidic and electrical conductivity is low.

Table 80. Soil characteristics for Maritime Alpine Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	3
Cumulative Org. in 40 cm (cm)	0.0	0.0	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	0.0	0.0	3
Surface Fragment Cover (%)	75.0	0.0	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	100.0		1
Site pH at 10-cm depth	5.2	0.4	3
Site EC at 10-cm depth (µS/cm)	33.3	25.2	3
Water Depth (cm, + above gnd)[a]	-166.7	28.9	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the permafrost subgroup Typic Dystrogelepts (well drained, acidic, partially developed soil with permafrost below 1 m) and the non-permafrost subgroup Typic Cryorthents (well drained, acidic, poorly developed soil without permafrost). Permafrost status, however, is difficult to determine.

This ecotype is part of the broader landtype association Maritime Alpine Rocky Barrens and Scrub. Also included is Maritime Alpine Cassiope Dwarf Shrub.

MARITIME ALPINE CASSIOPE DWARF SHRUB

Geomorphology:

Maritime Alpine Cassiope Dwarf Shrub occurs on upper mountain slopes, particularly in nivation hollows, in the St. Elias Range near the coast. Terrain includes hillslope colluvium, noncarbonate metamorphic, and sedimentary bedrock. Slopes are unstable due to frost cracking, soil creep, and landslides.This ecotype is most common on north-facing slopes.

Plant Association:

Cassiope stellariana–Luetkea pectinata

Vegetation is dominated by *Cassiope stelleriana, Luetkea pectinata, Phyllodoce aleutica,* and *Fauria crista-galli* (Table 81). While evergreen shrubs dominate the vegetative cover, together forbs and nonvascular species comprise one third of total live cover. Deciduous shrubs usually are present but do not contribute substantially to total vegetative cover. This ecotype has the highest species diversity of the Maritime Alpine classes.

This ecotype is similar to Maritime Alpine Barrens, although the *Cassiope* type occurs at lower elevations (~200 m lower), pH is more acidic and cover of vegetation is greater.

Table 81. Vegetation cover and frequency for Maritime Alpine Cassiope Dwarf Shrub (n=4).

	Cover		Freq
	Mean	SD	%
Total Live Cover	121.0	13.0	100
Total Vascular Cover	102.4	8.4	100
Total Evergreen Shrub Cover	84.3	24.0	100
Cassiope stelleriana	45.5	18.6	100
Loiseleuria procumbens	0.5	0.6	50
Luetkea pectinata	19.5	11.4	100
Phyllodoce aleutica	18.8	11.1	100
Total Deciduous Shrub Cover	0.7	1.0	75
Sorbus sitchensis	0.1	0.1	75
Vaccinium ovalifolium	0.5	1.0	25
Vaccinium sp.	0.0	0.1	25
Vaccinium uliginosum	0.1	0.1	50
Total Forb Cover	16.6	28.1	100
Anemone multifida	0.3	0.5	25
Anemone narcissiflora	0.8	1.5	25
Aster sp.	0.0	0.1	25
Fauria crista-galli	13.0	26.0	25
Heuchera glabra	0.3	0.5	50
Hippuris montana	0.5	1.0	25
Listera cordata	0.0	0.1	25
Lupinus nootkatensis	0.0	0.1	25
Lycopodium complanatum	1.3	2.5	50
Lycopodium selago	0.1	0.1	75
Potentilla sp.	0.1	0.1	50
Rubus pedatus	0.3	0.5	25
Streptopus amplexifolius	0.0	0.1	25
Valeriana sitchensis	0.0	0.1	25
Veratrum viride ssp. *eschscholtzii*	0.1	0.1	50
Total Grass Cover	0.1	0.1	50
Arctagrostis latifolia	0.1	0.1	50
Total Sedge & Rush Cover	0.8	0.9	100
Carex anthoxanthea	0.3	0.5	25
Carex sp.	0.3	0.5	75
Luzula multiflora	0.3	0.5	25
Total Nonvascular Cover	18.6	6.2	100
Total Moss Cover	15.6	8.8	100
Aulacomnium sp.	1.5	2.4	50
Campylopus flexuosus	0.0	0.1	25
Dicranum sp.	0.3	0.5	50
Dicranum spadiceum	3.3	3.9	50
Pleurozium schreberi	2.5	5.0	50
Racomitrium canescens	0.3	0.5	25
Rhytidiadelphus loreus	0.0	0.1	25
Rhytidiopsis robusta	2.5	5.0	25
Unknown liverwort	1.5	1.7	50
Unknown moss	3.8	7.5	25
Total Lichen Cover	3.0	3.1	100
Cetraria cf *islandica*	0.0	0.1	25
Cladina rangiferina	1.5	2.4	50
Cladonia coccifera	0.0	0.1	25
Flavocetraria nivalis	0.1	0.1	25
Peltigera aphthosa	1.3	2.5	25
Pertusaria geminipara	0.0	0.1	25
Thamnolia vermicularis	0.1	0.1	50
Total Bare Ground	1.8	2.2	75

Soils

Soils are rubbly, well to excessively drained, and have thin surface organic horizons (Table 82). Rock fragments are uncommon at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is presumably present below 1 m because of low temperatures at high elevations. Soil pH is acidic and electrical conductivity is low.

Table 82. Soil characteristics for Maritime Alpine Cassiope Dwarf Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	2.3	1.0	4
Cumulative Org. in 40 cm (cm)	2.3	1.0	4
Loess Cap Thickness(cm)	1.3	2.5	4
Depth to Rocks (cm)	6.3	5.4	4
Surface Fragment Cover (%)	0.5	1.0	4
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	4.8	0.5	4
Site EC at 10-cm depth (µS/cm)	60.0	18.3	4
Water Depth (cm, + above gnd)[a]	-150.0	0.0	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the non-permafrost subgroup Humic Dystrocryepts (well drained, acidic, organic-rich, partially developed soil). Less common subgroups include Typic Dystrogelepts (well drained, acidic, partially developed soil with permafrost below 1 m) and Typic Humicryods (well drained, acidic, well developed and highly leached).

This ecotype is part of the broader landtype association Maritime Alpine Rocky Barrens and Scrub. Also included is Maritime Alpine Barrens.

MARITIME COASTAL ANGELICA MEADOW

Geomorphology:

This ecotype commonly occurs along coastal beaches, primarily on gently sloping eolian sand deposits. The active dunes are modified by sand blowing off the beaches and are subject to storm surges.

Plant Association:
Lupinus nootkatensis–Angelica lucida

Dominant plant species in these productive meadows include *Angelica lucida, Lupinus nootkatensis, Heracleum lanatum, Castilleja* spp., *Epilobium* spp., and *Fragaria chiloensis* (Table 83). Evergreen shrubs are absent and deciduous shrubs are sparse. Mosses usually are present, although species diversity is low, while lichens generally are absent. Because of the rich diversity of forbs, this class has the highest species count of the coastal ecotypes.

This ecotype is similar to Maritime Coastal Elymus Meadow, except that soils have higher moisture content, higher pH and a greater dominance of forb species.

This ecotype represents high quality habitat for brown bears due to the high occurrence of *Angelica* and *Heracleum*, both of which are important forage species for bears.

Table 83. Vegetation cover and frequency for Maritime Coastal Angelica Meadow (n=4). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	199.8	39.1	100
Total Vascular Cover	163.5	28.6	100
Total Evergreen Tree Cover	0.3	0.5	50
Picea sitchensis	0.3	0.5	50
Total Deciduous Shrub Cover	0.1	0.1	50
Alnus sinuata	0.0	0.1	25
Myrica gale	0.0	0.1	25
Salix alaxensis	0.0	0.1	25
Total Forb Cover	142.3	39.3	100
Achillea borealis	18.8	9.5	100
Actaea rubra	0.3	0.5	25
Angelica lucida	17.5	6.5	100
Arabis sp.	0.0	0.1	25
Castilleja chrymactis	0.9	0.6	100
Castilleja unalaschcensis	0.8	1.5	25
Conioselinum chinense	5.8	3.0	100
Epilobium angustifolium	5.0	7.1	50
Epilobium ciliatum	0.5	1.0	25
Epilobium glandulosum	1.8	2.4	50
Equisetum arvense	1.3	2.5	25
Fragaria chiloensis	28.8	24.6	75
Fritillaria camschatcensis	0.8	1.5	50
Galium trifidum trifidum	0.0	0.1	25
Heracleum lanatum	14.3	18.4	75
Iris setosa	0.0	0.1	25
Lathyrus maritimus ssp. *maritimus*	6.3	12.5	25
Ligusticum scoticum	2.0	1.4	75
Lupinus nootkatensis	26.3	11.8	100
Moehringia lateriflora	0.0	0.1	25
Platanthera dilatata	0.3	0.5	25
Polygonum viviparum	1.0	1.4	50
Potentilla egedii	7.5	15.0	25
Ranunculus bongardi	0.8	1.5	50
Rhinanthus minor ssp. *borealis*	1.0	1.2	50
Stellaria sitchana var. *bongardiana*	0.3	0.5	25
Stellaria sp.	0.1	0.1	50
Trientalis europaea	0.8	1.0	50
Total Grass Cover	20.0	17.0	100
Calamagrostis canadensis	1.3	2.5	25
Deschampsia beringensis	3.0	6.0	50
Elymus arenarius ssp. *mollis*	7.5	5.0	100
Festuca rubra	6.5	6.0	100
Hordeum brachyantherum	1.3	2.5	25
Phleum sp.	0.5	1.0	25
Total Sedge & Rush Cover	0.8	1.0	50
Carex sp.	0.8	1.0	50
Luzula multiflora	0.1	0.1	25
Total Nonvascular Cover	36.3	28.1	75
Total Moss Cover	36.3	28.1	75
Rhytidiadelphus squarrosus	36.3	28.1	75
Total Bare Ground	1.5	0.6	100
Soil	0.3	0.5	25
Litter Alone	1.3	1.0	75

Soils

Soils are sandy, moist, excessively drained and have little or no surface organics (Table 84). Rock fragments are absent at the surface, but rocky horizons occasionally occur at depth. Soil pH is circumneutral and electrical conductivity is low. Permafrost is absent in this coastal ecotype.

Table 84. Soil characteristics for Maritime Coastal Angelica Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.8	2.1	4
Cumulative Org. in 40 cm (cm)	1.8	2.1	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	107.5	56.8	4
Surface Fragment Cover (%)	0.0	0.0	4
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.5	0.2	4
Site EC at 10-cm depth (µS/cm)	115.0	40.4	4
Water Depth (cm, + above gnd)[a]	-76.0	55.4	5

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the subgroups Typic Cryopsamments (well drained, sandy, poorly developed) and Oxyaquic Cryopsamments (somewhat poorly drained, sandy, poorly developed).

This ecotype and associated soils are part of the broader landtype association Maritime Coastal Barrens and Meadows. Also included are Maritime Coastal Elymus Meadow and Maritime Coastal Barrens.

MARITIME COASTAL BARRENS

Geomorphology:

This ecotype occurs on active marine beaches. Soils are sands or gravels that are moist, somewhat excessively drained, and saline. Wave action and storm surges frequently scour the surface.

Plant Association:

Elymus mollis–Lathyrus maritimus

Vegetation is sparse to non-existent (Table 85). Dominant plants include *Elymus arenarius* ssp. *mollis*, *Lathyrus maritimus* ssp. *maritimus*; *Conioselinum chinense* and *Honckenya peploides*. Species diversity is low. The species present in this ecotype are colonizers that can withstand frequent scouring by wind and sand, and inundation by seawater.

This ecotype is most similar to Maritime Coastal Elymus Meadow, although vegetation cover is greatly reduced, soil pH is higher and salinity is higher in barren communities. As the regularity of disturbance abates, this community is succeeded by Maritime Coastal Elymus Meadow.

Table 85. Vegetation cover and frequency for Maritime Coastal Barrens (n=2). Cover 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	6.4	9.1	50
Total Vascular Cover	6.4	9.1	50
Total Deciduous Tree Cover	0.1	0.1	50
Populus trichocarpa	0.1	0.1	50
Total Forb Cover	0.7	0.9	50
Conioselinum chinense	0.1	0.1	50
Honckenya peploides	0.1	0.1	50
Lathyrus maritimus ssp. *maritimus*	0.5	0.7	50
Senecio pseudoarnica	0.1	0.1	50
Total Grass Cover	2.5	3.5	50
Elymus arenarius ssp. *mollis*	2.5	3.5	50
Total Nonvascular Cover	0	0	0
Total Bare Ground	100	0	100
Soil	97.5	3.5	100
Litter Alone	2.5	3.5	50

Soils

Soils are sandy to gravelly, wet to dry, poorly to excessively drained, and lack surface organics (Table 86). Rock fragments at the surface are common in higher-energy wave environments, and gravelly horizons are common at depth. Soil pH is alkaline and electrical conductivity is variable depending on slope position. Saline conditions prevail.

Table 86. Soil characteristics for Maritime Coastal Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	2
Cumulative Org. in 40 cm (cm)	0.0	0.0	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	50.0	70.7	2
Surface Fragment Cover (%)	12.5	17.7	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	150.0		1
Site pH at 10-cm depth	8.3	0.0	2
Site EC at 10-cm depth (µS/cm)	380.0	452.5	2
Water Depth (cm, + above gnd)[a]	-100.0	0.0	2

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the subgroups Typic Cryopsamments (well drained, sandy, poorly developed) or Typic Cryorthents (well drained, rocky, poorly developed).

This ecotype and associated soils are part of the broader landtype association Maritime Coastal Barrens and Meadows. Also included are Maritime Coastal Angelica Meadow and Maritime Coastal Elymus Meadow.

MARITIME COASTAL ELYMUS MEADOW

Geomorphology:

This ecotype is located along the coastal section of the Malaspina Forelands. It occurs on eolian active sand deposits. Soils are sandy with no surface organic material. Drainage is somewhat excessive and soils are dry to moist. *Elymus* communities occur early in succession in these coastal areas and are subject to disturbance. The plant community composition and structure are maintained by sand displacement due to wind and periodic inundation by storm surges.

Plant Association:
Elymus mollis–Lathyrus maritimus

Dominant plants include *Elymus arenarius* ssp. *mollis*, *Lathyrus maritimus* ssp. *maritimus*, *Fragaria chiloensis*, *Castilleja* spp. and *Lupinus nootkatensis* (Table 87). Vascular plant diversity is low because species in this community must be salt-tolerant; nonvascular species are absent. Primary productivity is high, due to the predominance of forbs and grasses.

This ecotype is similar to Maritime Coastal Barrens (see above). It is also similar to Maritime Coastal Angelica Meadow, except that it has fewer forbs, increased drainage and higher soil pH.

Table 87. Vegetation cover and frequency for Maritime Coastal Elymus Meadow (n=4). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	83.2	18.3	100
Total Vascular Cover	83.2	18.3	100
Total Deciduous Tree Cover	0.0	0.1	25
Populus trichocarpa	0.0	0.1	25
Total Deciduous Shrub Cover	2.1	4.0	75
Alnus sinuata	0.1	0.1	50
Alnus tenuifolia	0.0	0.1	25
Salix alaxensis	0.8	1.5	25
Salix sitchensis	1.3	2.5	25
Total Forb Cover	64.1	14.4	100
Achillea borealis	2.8	2.6	75
Angelica lucida	0.5	1.0	25
Castilleja chrymactis	2.8	4.8	75
Castilleja miniata	0.0	0.1	25
Castilleja unalaschcensis	1.0	1.4	75
Conioselinum chinense	1.5	2.4	50
Equisetum arvense	0.0	0.1	25
Equisetum variegatum	1.3	2.5	25
Fragaria chiloensis	15.5	29.7	50
Lathyrus maritimus ssp. *maritimus*	30.0	21.6	100
Ligusticum scoticum	0.8	1.5	25
Lupinus nootkatensis	8.0	14.7	50
Total Grass Cover	17.0	5.9	100
Deschampsia beringensis	0.3	0.5	25
Elymus arenarius ssp. *mollis*	15.0	7.1	100
Festuca rubra	1.8	1.3	75
Total Nonvascular Cover	0.0	0.0	0
Total Bare Ground	29.5	20.9	100
Soil	25.8	24.2	100
Litter Alone	3.8	4.8	25

Soils

Soils are sandy, dry, excessively drained and have little or no surface organics (Table 88). Rock fragments are absent at the surface, but rocky horizons occasionally occur at depth. Soil pH is alkaline and electrical conductivity is low. Water is occasionally found at depths near 1 m.

Table 88. Soil characteristics for Maritime Coastal Elymus Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	4
Cumulative Org. in 40 cm (cm)	0.0	0.0	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	119.3	36.7	4
Surface Fragment Cover (%)	0.0	0.0	4
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.7	0.4	4
Site EC at 10-cm depth (µS/cm)	107.5	33.0	4
Water Depth (cm, + above gnd)[a]	-87.5	14.4	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the subgroups Typic Cryopsamments (well drained, sandy, poorly developed) and Oxyaquic Cryopsamments (somewhat poorly drained, sandy, poorly developed).

This ecotype and associated soils are part of the broader landtype association Maritime Coastal Barrens and Meadows. Also included are Maritime Coastal Angelica Meadows and Maritime Coastal Barrens.

MARITIME COASTAL SEDGE MEADOW

Geomorphology:

This ecotype occurs on tidally inundated flats along the coast of the Gulf of Alaska. Terrain includes active and inactive tidal flats and tidal ponds. Salinity ranges from brackish in actively flooded areas to near fresh toward the upper margins of the flats.

Plant Association:

Carex lyngbyaei–Triglochin maritimum

Plant community composition is restricted to halophytic species (Table 89). Vegetation is dominated by *Carex lyngbyaei, Triglochin maritimum*, and *Eriophorum angustifolium*. Sedges and forbs are predominant, while trees, shrubs and nonvascular species are absent. Bare ground always is present. Maritime Coastal Sedge Meadow has the lowest species count of the fully vegetated coastal ecotypes.

This ecotype is similar in landscape position to unvegetated tidal flats (Coastal Wet Barrens, rare and not described). No other ecotype class occurs on fine, salt affected sediments.

Table 89. Vegetation cover and frequency for Maritime Coastal Sedge Meadow (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	33.1	5.7	100
Total Vascular Cover	33.1	5.7	100
Total Forb Cover	5.1	4.3	100
Cicuta mackenzieana	0.0	0.1	33
Equisetum palustre	1.0	1.7	33
Potentilla egedii	0.0	0.1	33
Triglochin maritimum	4.0	5.3	67
Total Sedge & Rush Cover	28.0	7.9	100
Carex canescens	0.7	1.2	33
Carex lyngbyaei	25.0	8.7	100
Eleocharis palustris	0.7	1.2	33
Eriophorum angustifolium	1.7	2.9	33
Total Nonvascular Cover	0.0	0.0	0
Total Bare Ground	87.7	9.3	100
Soil	0.0	0.0	0
Litter Alone	20.0	30.4	67
Water	67.7	38.0	100

Soils

Soils are silty to clayey, poorly drained and have thin surface organic horizons (Table 90). Rock fragments are absent at the surface, but rocky horizons occasionally occur at depth. Soil pH is circumneutral and electrical conductivity is fresh to slightly brackish. Standing water occurs slightly above or below the surface.

Table 90. Soil characteristics for Maritime Coastal Sedge Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	4.0	3.6	3
Cumulative Org. in 40 cm (cm)	5.7	5.1	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	95.7	7.5	3
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.1	0.3	3
Site EC at 10-cm depth (µS/cm)	613.3	405.6	3
Water Depth (cm, + above gnd)[a]	10.3	8.5	3

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroup is Typic Cryaquents (poorly drained, poorly developed). They are primarily brackish, but sometimes fresh. No other subgroups occur.

This ecotype and associated soils are part of the broader landtype association Maritime Coastal Wet Barrens. Also included is Maritime Coastal Wet Barrens (not described).

MARITIME GLACIATED BARRENS

Geomorphology:

This ecotype occurs on young moraine on terminal glaciers, and is widespread throughout the maritime zone of the park. The surface is irregular due to discontinuous thawing of the underlying ice layer. Extensive areas of barren or recently vegetated moraine occur across the forelands near the coast.

Plant Association:
Alnus sinuata–Sorbus scopulina

Plant cover is very low and species occurrence varies among sites (Table 91). Deciduous shrub and forb species occur most frequently. Trees and lichens are absent. Aquatic species sometimes occur in small, poorly-drained depressions.

As the surface stabilizes, this ecotype is succeeded by Maritime Glaciated Tall Alder–Willow Shrub, with which it shares species composition and some soil characteristics. Barrens have thinner surface organic horizons, more surface fragments and higher pH and EC than Maritime Glaciated Tall–Alder Willow Shrub.

Table 91. Vegetation cover and frequency for Maritime Glaciated Barrens (n=2). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	5.1	1.4	100
Total Vascular Cover	4.9	1.1	100
Total Deciduous Shrub Cover	2.0	2.8	50
Alnus sinuata	1.0	1.4	50
Salix sitchensis	1.0	1.4	50
Total Forb Cover	1.8	2.3	100
Epilobium angustifolium	0.1	0.1	50
Equisetum fluviatile	0.1	0.1	50
Equisetum variegatum	0.1	0.1	50
Hippuris vulgaris	0.1	0.1	50
Potamogeton perfoliatus ssp. *richardsonii*	0.1	0.1	50
Ranunculus sp.	0.5	0.7	50
Sparganium angustifolium	1.0	1.4	50
Total Grass Cover	0.6	0.8	50
Arctophila fulva	0.1	0.1	50
Phleum pratense	0.5	0.7	50
Phleum sp.	0.1	0.1	50
Total Sedge & Rush Cover	0.5	0.7	50
Carex kelloggii	0.5	0.7	50
Total Nonvascular Cover	0.3	0.4	50
Total Moss Cover	0.3	0.4	50
Brachythecium salebrosum	0.1	0.1	50
Brachythecium sp.	0.1	0.1	50
Ceratodon purpureus	0.1	0.1	50
Racomitrium ericoides	0.1	0.1	50
Schistidium papillosum	0.1	0.1	50
Total Bare Ground	96.5	0.7	100
Soil	95.0	0.0	100
Litter Alone	0.0	0.0	0
Water	1.5	0.7	100

Soils

Soils are well to poorly drained, rubbly or blocky, and lack surface organic horizons. Rock fragments are abundant at the surface (Table 92). Thaw depths could not be measured, but permafrost is assumed to be prevalent due to buried glacial ice. Soil pH is alkaline and electrical conductivity is moderately low.

Table 92. Soil characteristics for Maritime Glaciated Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	2
Cumulative Org. in 40 cm (cm)	0.5	0.7	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	4.0	5.7	2
Surface Fragment Cover (%)	42.5	46.0	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	150.0		1
Site pH at 10-cm depth	7.5	0.5	2
Site EC at 10-cm depth (µS/cm)	200.0	113.1	2
Water Depth (cm, + above gnd)[a]			

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by Typic Cryorthents (well drained, rocky, poorly developed). Also common are Oxyaquic Cryorthents (moderately well drained, rocky, poorly developed) and Typic Cryaquents (poorly drained, rocky, poorly developed).

This ecotype and associated soils are part of the broader landtype association Maritime Glaciated Barrens and Shrub. Also included is Maritime Glaciated Tall Alder-Willow Shrub.

MARITIME GLACIATED TALL ALDER–WILLOW SHRUB

Geomorphology:

This ecotype occurs on young moraine where the surface has been stable long enough to support the growth of shrubs. The ground surface has substantial microtopographic variation due to its recent deglaciation. Glacial ice is still present beneath the surface at some sites.

Plant Association:
Alnus sinuata–Sorbus scopulina

Shrubs, especially *Alnus sinuata* and *Salix sitchensis*, characterize this ecotype (Table 93). Shrub canopy cover typically is closed but open canopies occur. Common understory species include *Oplopanax horridus, Streptopus amplexifolius*, and *Epilobium angustifolium*. Deciduous shrubs, forbs and nonvascular species are more common than deciduous trees, evergreen trees and graminoids. Some bare soil is present.

This ecotype is most similar to Maritime Glaciated Barrens (see above). It also is floristically similar to Maritime Lowland Tall Alder–Willow Shrub, but the lowland type occurs on old moraine.

Table 93. Vegetation cover and frequency for Maritime Glaciated Tall Alder–Willow Shrub (n=6). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	143.4	65.4	100
Total Vascular Cover	131.3	59.0	100
Total Evergreen Tree Cover	0.2	0.4	33
Picea glauca	0.2	0.4	17
Picea sitchensis	0.0	0.0	17
Total Deciduous Tree Cover	1.0	2.0	33
Populus trichocarpa	1.0	2.0	33
Total Deciduous Shrub Cover	99.5	36.0	100
Alnus sinuata	51.7	33.9	100
Oplopanax horridus	10.2	24.4	33
Ribes bracteosum	1.3	3.3	17
Rubus spectabilis	7.5	16.0	33
Salix barclayi	10.0	24.5	17
Salix scouleriana	3.3	8.2	17
Salix sitchensis	10.8	12.0	50
Sorbus scopulina	4.7	7.7	33
Total Forb Cover	30.4	40.0	100
Actaea rubra	0.3	0.5	33
Aruncus sylvester	0.0	0.0	17
Athyrium filix-femina ssp. *cyclosorum*	3.3	6.1	33
Boschniakia rossica	0.0	0.0	0
Cicuta sp.	0.2	0.4	17
Cornus canadensis	0.3	0.8	17
Dryopteris dilatata ssp. *americana*	6.7	16.3	17
Epilobium angustifolium	1.7	2.6	67
Equisetum arvense	15.2	36.7	50
Equisetum palustre	0.8	2.0	17
Equisetum variegatum	0.8	2.0	17
Fauria crista-galli	0.2	0.4	17
Gymnocarpium dryopteris	0.4	0.8	33
Platanthera saccata	0.0	0.0	17
Pyrola asarifolia	0.2	0.4	17
Sanguisorba stipulata	0.0	0.0	17
Stellaria sp.	0.0	0.0	17
Streptopus amplexifolius	0.1	0.1	50
Tiarella trifoliata	0.0	0.0	17
Viola sp.	0.2	0.4	17
Total Grass Cover	0.2	0.4	33
Calamagrostis canadensis	0.2	0.4	33
Total Sedge & Rush Cover	0.0	0.0	17
Luzula sp.	0.0	0.0	17
Total Nonvascular Cover	12.1	12.2	100
Total Moss Cover	11.9	12.1	100
Antitrichia curtipendula	0.0	0.0	17
Eurhynchium pulchellum	1.7	4.1	17
Hylocomium splendens	0.5	1.2	17
Pogonatum urnigerum	0.8	2.0	17
Racomitrium canescens	0.3	0.8	17
Racomitrium sp.	1.3	2.2	33
Rhizomnium nudum	5.0	12.2	17
Rhytidiadelphus loreus	1.3	3.3	17
Rhytidiadelphus squarrosus	0.2	0.4	17
Sanionia uncinata	0.0	0.0	17
Unknown liverwort	0.7	1.6	17
Total Lichen Cover	0.3	0.5	67

Table 93. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Cladonia chlorophaea	0.2	0.4	17
Cladonia gracilis ssp. *elongata*	0.0	0.0	17
Parmelia sulcata	0.0	0.0	17
Peltigera aphthosa	0.0	0.1	33
Peltigera neopolydactyla	0.0	0.0	17
Total Bare Ground	13.7	23.4	83
Soil	10.8	21.8	50
Litter Alone	2.0	2.1	67
Water	0.8	2.0	17

Soils

Soils are well to poorly drained, sandy to blocky, and have thin surface organic horizons. Rock fragments are abundant at the surface (Table 94). Thaw depths could not be measured, but permafrost is assumed to be prevalent due to buried glacial ice. Soil pH is circumneutral and electrical conductivity is moderately low.

Table 94. Soil characteristics for Maritime Glaciated Tall Alder–Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.0	0.0	4
Cumulative Org. in 40 cm (cm)	0.0	0.0	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	119.3	36.7	4
Surface Fragment Cover (%)	0.0	0.0	4
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	7.7	0.4	4
Site EC at 10-cm depth (µS/cm)	107.5	33.0	4
Water Depth (cm, + above gnd)[a]	-87.5	14.4	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by Typic Cryorthents (well drained, rocky, poorly developed) and Typic Cryopsamments (well drained, sandy, poorly developed). Less common are the better developed soils Typic Dystrocrepts (well drained, acidic, partially developed) and Histic Cryaquepts (wet, organic-rich, partially developed).

This ecotype and associated soils are part of the broader landtype association Maritime Glaciated Barrens and Shrub. Also included is Maritime Glaciated Barrens.

MARITIME LOWLAND COTTONWOOD FOREST

Geomorphology:

This ecotype occurs on flat to hilly terrain at low elevations (<100 m) in the Malaspina Forelands. It occurs in lowland areas on glacial moraine or abandoned cover deposits of glaciofluvial outwash.

Plant Association:

Populus trichocarpa–Alnus sinuata–Picea sitchensis

Maritime Lowland Cottonwood Forest consists of an open canopy of black cottonwood (*Populus trichocarpa*) with an understory dominated by deciduous shrubs (Table 95). Common understory species are *Alnus sinuata, Oplopanax horridus, Rubus spectabilis*, and *Equisetum arvense*. Spruce trees are present but do not contribute more than 25% of total tree cover. Mosses are common and lichen cover is sparse.

This ecotype is similar to Maritime Lowland Cottonwood–Spruce Forest except that it lacks a co-dominant spruce component in the canopy. It also is similar to Maritime Riverine Cottonwood Forest, but the riverine community occurs on fluvial deposits and there are some floristic differences.

Table 95. Vegetation cover and frequency for Maritime Lowland Cottonwood Forest (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	241.3	114.1	100
Total Vascular Cover	195.9	79.9	100
Total Evergreen Tree Cover	3.7	5.5	100
Picea glauca	0.3	0.6	33
Picea sitchensis	0.0	0.1	33
Tsuga heterophylla	3.3	5.8	33
Total Deciduous Tree Cover	46.7	10.4	100
Populus trichocarpa	46.7	10.4	100
Total Deciduous Shrub Cover	95.7	58.4	100
Alnus sinuata	40.0	18.0	100
Oplopanax horridus	27.7	45.3	67
Ribes bracteosum	0.0	0.1	33
Rubus spectabilis	20.0	22.9	67
Salix scouleriana	3.7	4.0	67
Salix sitchensis	1.7	2.9	33
Sorbus scopulina	2.7	4.6	33
Total Forb Cover	49.4	25.7	100
Angelica lucida	0.3	0.6	33
Athyrium filix-femina ssp.*cyclosorum*	6.3	7.8	67
Circaea alpina	1.0	1.7	33
Cornus canadensis	1.7	2.9	33
Dryopteris dilatata ssp. *americana*	3.3	5.8	33
Epilobium angustifolium	0.7	1.1	67
Equisetum arvense	7.7	10.8	67
Gymnocarpium dryopteris	2.3	2.3	100
Lycopodium annotinum	5.0	8.7	33
Pyrola asarifolia	10.7	16.8	67
Streptopus amplexifolius	5.3	8.4	67
Tiarella trifoliata	3.4	5.7	67
Trientalis europaea	1.7	2.9	33
Total Grass Cover	0.4	0.6	67
Calamagrostis canadensis	0.0	0.1	33
Glyceria pulchella	0.3	0.6	33
Total Nonvascular Cover	45.4	34.4	100
Total Moss Cover	45.4	34.4	100
Brachythecium erythrorrhizon	1.7	2.9	33
Brachythecium rutabulum	5.0	8.7	33
Dicranum scoparium	1.3	1.5	67
Eurhynchium pulchellum	3.3	5.8	33
Eurhynchium stokesii	5.0	8.7	33
Hylocomium splendens	3.3	5.8	33
Plagiomnium insigne	0.0	0.1	33
Plagiomnium medium	1.7	2.9	33
Pleurozium schreberi	7.0	11.3	67
Rhytidiadelphus loreus	15.0	5.0	100
Sanionia uncinata	0.0	0.1	33
Tomentypnum nitens	0.3	0.6	33
Unknown liverwort	1.7	2.9	33
Total Lichen Cover	0.0	0.1	33
Cladonia sp.	0.0	0.1	33
Total Bare Ground	3.7	5.5	67
Soil	0.0	0.0	0
Litter Alone	3.7	5.5	67
Water	0.0	0.0	0

Soils

Soils are well to poorly drained, sandy to blocky, and have thin surface organic horizons. Rock fragments are abundant at the surface (Table 96). Thaw depths could not be measured, but permafrost is assumed to be absent. Soil pH is circumneutral and electrical conductivity is low.

Table 96. Soil characteristics for Maritime Lowland Cottonwood Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	7.3	3.5	3
Cumulative Org. in 40 cm (cm)	7.3	3.5	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	11.0	9.6	3
Surface Fragment Cover (%)	0.0	0.0	0
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.9	0.8	3
Site EC at 10-cm depth (µS/cm)	93.3	32.1	3
Water Depth (cm, + above gnd)[a]	-100.0	0.0	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by Typic Cryorthents (well drained, rocky, poorly developed) and Typic Dystrocrepts (well drained, acidic, partially developed).

This ecotype and associated soils are part of the broader landtype association Maritime Lowland Gravelly Shrub and Forests. Also included are Maritime Lowland Cottonwood–Spruce Forest, Maritime Lowland Tall Alder–Willow Shrub and Maritime Lowland Sitka Spruce Forest.

MARITIME LOWLAND COTTONWOOD–SPRUCE FOREST

Geomorphology:

This ecotype occurs in lowlands on inactive and abandoned glaciofluvial outwash cover deposits of the Malaspina Forelands. The surface generally is flat. Soils are gravelly with thin organic layers. These sites are well to moderately well drained, moist, and acidic to circumneutral.

Plant Association:

Populus trichocarpa–Alnus sinuata–Picea sitchensis

Common species are *Populus trichocarpa, Picea sitchensis, Alnus sinuata, Oplopanax horridus, Rubus spectabilis*, and *Hylocomium splendens* (Table 97). Tree canopy cover is open, and the understory canopy varies from densely closed to open. Evergreen shrubs and lichens are absent and graminoids are present in trace amounts. This ecotype is not species-rich.

This ecotype is similar to Maritime Lowland Cottonwood Forest and shares a floristic class. Spruce trees contribute >25% of total tree cover and forbs have reduced total cover in the mixed forest class. This ecotype also is floristically similar to Maritime Riverine Cottonwood–Spruce Forest which occurs on fluvial deposits.

Table 97. Vegetation cover and frequency for Maritime Lowland Cottonwood–Spruce Forest (n=4). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	186.8	21.8	100
Total Vascular Cover	148.7	20.1	100
Total Evergreen Tree Cover	17.5	5.4	100
Picea sitchensis	12.0	8.4	100
Tsuga heterophylla	5.5	9.7	50
Total Deciduous Tree Cover	22.0	8.1	100
Populus trichocarpa	22.0	8.1	100
Total Deciduous Shrub Cover	90.0	38.7	100
Alnus sinuata	53.8	20.2	100
Oplopanax horridus	19.5	21.7	100
Rubus spectabilis	12.8	15.0	100
Salix scouleriana	4.0	2.0	100
Total Forb Cover	19.2	9.5	100
Athyrium filix-femina ssp. *cyclosorum*	2.5	3.3	50
Boschniakia rossica	0.3	0.5	50
Dryopteris dilatata ssp. *americana*	2.3	2.1	75
Equisetum arvense	5.8	7.8	75
Equisetum variegatum	1.0	1.2	50
Gymnocarpium dryopteris	1.5	1.9	50
Listera caurina	0.5	0.6	50
Moneses uniflora	0.5	1.0	25
Pyrola asarifolia	3.8	4.8	50
Rubus pedatus	0.0	0.1	25
Streptopus amplexifolius	0.3	0.5	100
Tiarella trifoliata	0.5	1.0	50
Trientalis europaea	0.3	0.5	25
Total Grass Cover	0.0	0.1	25
Calamagrostis canadensis	0.0	0.1	25
Total Sedge & Rush Cover	0.0	0.1	25
Carex sp.	0.0	0.1	25
Total Nonvascular Cover	38.1	34.6	100
Total Moss Cover	38.1	34.6	100
Antitrichia curtipendula	0.0	0.1	25
Dicranum fragilifolium	0.0	0.1	25
Hylocomium splendens	8.8	8.5	75
Pleurozium schreberi	11.3	13.1	50
Porella platyphylla	0.0	0.1	25
Rhytidiadelphus loreus	3.8	7.5	25
Rhytidium rugosum	13.8	17.0	50
Unknown fungus	0.0	0.1	25
Unknown liverwort	0.5	1.0	25
Total Bare Ground	4.5	4.2	75
Litter Alone	4.5	4.2	75

Soils

Soils are well drained, blocky, and have thin surface organic horizons. Rock fragments are abundant at the surface (Table 98). Thaw depths could not be measured, but permafrost is assumed to be absent. Soil pH is circum-neutral and electrical conductivity is low.

Table 98. Soil characteristics for Maritime Lowland Cottonwood–Spruce Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	9.5	5.2	4
Cumulative Org. in 40 cm (cm)	9.5	5.2	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	12.0	6.5	4
Surface Fragment Cover (%)	0.0	0.0	4
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.0	0.8	4
Site EC at 10-cm depth (µS/cm)	92.5	32.0	4
Water Depth (cm, + above gnd)[a]	-125.0	28.9	4

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by Typic Dystrocryepts (well drained, acidic, partially developed soil). Less common subgroups include Spodic Dystrocryepts (well drained, acidic, partially developed and moderately leached) and Typic Eutrocryepts (well drained, nonacidic, partially developed soil).

This ecotype and associated soils are part of the broader landtype association Maritime Lowland Gravelly Shrub and Forests. Also included are Maritime Lowland Cottonwood Forest, Maritime Lowland Tall Alder–Willow Shrub and Maritime Lowland Sitka Spruce Forest.

MARITIME LOWLAND FORB–WILLOW MEADOW

Geomorphology:

This ecotype occurs on very poorly drained low-elevation flats near the coast. Geomorphic classes include fens and abandoned channel deposits. This ecotype is not prone to natural disturbance.

Plant Association:

Equisetum variegatum–Salix barclayi–Tofieldia glutinosa

This ecotype is species-rich, with all life forms present (Table 99). Cover values for individual species are not high; forbs and deciduous shrubs have the highest total vascular cover and mosses comprise a substantial portion of ground cover. Common species include *Equisetum variegatum, Equisetum palustre, Salix barclayi, Salix sitchensis, Limprichtia revolvens*, and *Campylium stellatum*. Some bare soil and surface water may be present but most nonliving cover is plant litter.

Maritime Lowland Wet Forb–Willow Meadow has somewhat similar species composition to Maritime Riverine Horsetail Meadow, but shrubs are nearly absent in the riverine class and geomorphology and dominant soil textures are different.

Table 99. Vegetation cover and frequency for Maritime Lowland Forb–Willow Meadow (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	129.1	46.0	100
Total Vascular Cover	59.4	16.2	100
Total Evergreen Tree Cover	2.0	3.4	67
Picea sitchensis	2.0	3.4	67
Total Evergreen Shrub Cover	0.0	0.1	33
Andromeda polifolia	0.0	0.1	33
Total Deciduous Tree Cover	0.0	0.1	33
Populus trichocarpa	0.0	0.1	33
Total Deciduous Shrub Cover	18.0	14.9	100
Alnus sinuata	0.7	1.1	67
Salix barclayi	6.7	7.6	67
Salix commutata	3.3	5.8	33
Salix glauca	0.3	0.6	33
Salix hookeriana	0.7	1.2	33
Salix sitchensis	3.7	5.5	67
Salix sp.	1.3	2.3	33
Vaccinium uliginosum	1.3	2.3	33
Total Forb Cover	25.2	3.5	100
Drosera rotundifolia	2.3	2.5	67
Epilobium palustre	0.0	0.1	33
Equisetum palustre	5.0	5.0	67
Equisetum variegatum	11.7	5.8	100
Gentiana sp.	0.0	0.1	33
Parnassia palustris	0.3	0.6	33
Pedicularis capitata	0.0	0.1	33
Pedicularis langsdorffii ssp. *arctica*	0.1	0.1	67
Petasites frigidus	1.7	2.9	33
Platanthera dilatata	1.0	0.0	100
Polygonum bistorta	0.3	0.6	33
Rubus chamaemorus	0.3	0.6	33
Tofieldia glutinosa	0.7	1.1	67
Total Grass Cover	3.3	5.8	33
Arctagrostis latifolia	1.7	2.9	33
Festuca rubra	1.7	2.9	33
Total Sedge & Rush Cover	10.8	9.0	100
Carex capillaris	1.7	2.9	33
Carex capitata	0.0	0.1	33
Carex macrochaeta	1.7	2.9	33
Carex oederi ssp. *viridula*	3.3	5.8	33
Carex rostrata	0.4	0.6	67
Eriophorum russeolum	0.4	0.6	67
Juncus arcticus	3.3	5.8	33
Total Nonvascular Cover	69.7	51.6	100
Total Moss Cover	67.4	48.6	100
Aulacomnium palustre	5.7	8.1	67
Bryum pseudotriquetrum	8.3	14.4	33
Campylium stellatum	8.3	14.4	33
Cinclidium stygium	0.0	0.1	33
Hylocomium splendens	0.7	1.2	33
Limprichtia revolvens	16.7	20.8	67
Meesia triquetra	1.7	2.9	33
Philonotis fontana	8.3	14.4	33
Pleurozium schreberi	0.3	0.6	33
Rhizomnium sp.	1.7	2.9	33

Table 99. Continued.

	Cover		Freq
	Mean	**SD**	**%**
Rhytidium rugosum	5.0	8.7	33
Sanionia uncinata	6.7	11.5	33
Tomentypnum nitens	1.7	2.9	33
Unknown liverwort	2.3	2.5	67
Total Lichen Cover	2.3	3.2	67
Peltigera aphthosa	1.0	1.0	67
Peltigera canina	0.7	1.2	33
Peltigera leucophlebia	0.7	1.2	33
Total Bare Ground	17.3	15.4	100
Soil	3.3	5.8	33
Litter Alone	11.7	7.6	100
Water	2.3	2.5	67

Soils

Soils are poorly drained, gravelly to organic-rich, and have moderately thin surface organic horizons. Rock fragments are absent at the surface (Table 100) but are common at shallow depths. Thaw depths could not be measured, but permafrost is assumed to be absent. Soil pH is circumneutral and electrical conductivity is moderately low, but indicative of minerotrophic conditions. Water is present near the surface.

Table 100. Soil characteristics for Maritime Lowland Forb—Willow Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	11.5	2.1	2
Cumulative Org. in 40 cm (cm)	11.5	2.1	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	15.5	3.5	2
Surface Fragment Cover (%)	0.0	0.0	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.4	0.3	2
Site EC at 10-cm depth (µS/cm)	335.0	21.2	2
Water Depth (cm, + above gnd)[a]	-5.0	1.4	2

[a] Measurements >1 m indicate minimum depth, not true depth

Soil include subgroups with varying levels of organic matter accumulation: Typic Cryaquepts (wet, partially developed), Humic Cryaquepts (wet, partially developed with moderately thick A horizon) and Terric Cryofibrists (wet, peaty, with mineral soil within 1 m).

This ecotype and associated soils are part of the broader landtype association Maritime Lowland Bogs and Fens. Also include is Maritime Lowland Sedge–Blueberry Bog.

MARITIME LOWLAND SEDGE–BLUEBERRY BOG

Geomorphology:

Maritime Lowland Sedge–Blueberry Bog is located at <50 m elevation on the Malaspina Forelands. This ecotype occurs in kettle basins or on glaciofluvial outwash (abandoned cover deposits). These bogs consist of very poorly to poorly drained soils that are circumneutral to acidic. Peat accumulation results in a surface organic layer =40 cm.

Plant Association:

Vaccinium uliginosum–Carex pluriflora

Shrubs and forbs characterize this ecotype and a thick layer of moss is present, mostly *Sphagnum teres* (Table 101). Only species tolerant of wet soils occur in this ecotype. Trees, evergreen shrubs and lichens are absent. Dominant vascular species are *Vaccinium uliginosum, Carex pluriflora, Eriophorum russeolum*, *Carex lyngbyaei,* and *Polygonum viviparum*. This class is not diverse.

This ecotype is not similar to any other ecotype. Maritime Lowland Forb–Willow Meadow, has somewhat similar vegetation structure but is not a bog and has different dominant species. Unlike lowland bog ecotypes in the boreal zone, tussocks are absent from this ecotype and the plant community includes maritime species.

Table 101. Vegetation cover and frequency for Maritime Lowland Sedge–Blueberry Bog (n=2). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	165.4	18.0	100
Total Vascular Cover	67.8	14.4	100
Total Deciduous Shrub Cover	23.5	9.2	100
Salix planifolia ssp. *pulchra*	0.5	0.7	50
Salix sitchensis	0.5	0.7	50
Vaccinium uliginosum	22.5	10.6	100
Total Forb Cover	8.8	4.5	100
Cicuta sp.	0.1	0.1	50
Drosera rotundifolia	0.5	0.7	50
Equisetum fluviatile	3.0	1.4	100
Hedysarum mackenzii	0.6	0.6	100
Hippuris sp.	2.0	2.8	50
Platanthera saccata	0.6	0.6	100
Polygonum viviparum	1.0	0.0	100
Pyrola asarifolia	0.1	0.1	50
Sanguisorba stipulata	1.0	1.4	50
Tiarella trifoliata	0.1	0.1	50
Viola sp.	0.1	0.1	50
Total Grass Cover	3.0	2.8	100
Calamagrostis canadensis	0.5	0.7	50
Calamagrostis sp.	2.5	3.5	50
Total Sedge & Rush Cover	32.5	3.5	100
Carex lyngbyaei	7.5	3.5	100
Carex pluriflora	12.5	3.5	100
Eriophorum russeolum	12.5	10.6	100
Total Nonvascular Cover	97.6	3.6	100
Total Moss Cover	97.6	3.6	100
Aulacomnium palustre	2.5	3.5	50
Calliergon stramineum	0.1	0.1	50
Sphagnum teres	47.5	67.2	50
Unknown moss	47.5	67.2	50
Total Bare Ground	2.5	3.5	50
Litter Alone	2.5	3.5	50

Soils

Soils are poorly drained peats (Table 102) Rock fragments are absent at the surface, but are occasionally found below 1 m. Thaw depths could not be measured, but permafrost is assumed to be absent. Soil pH is circumneutral and electrical conductivity is low. Water is present near the surface.

Table 102. Soil characteristics for Maritime Lowland Sedge–Blueberry Bog. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	48.0	17.0	2
Cumulative Org. in 40 cm (cm)	38.0	2.8	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	125.0	35.4	2
Surface Fragment Cover (%)	0.0	0.0	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	150.0	0.0	2
Site pH at 10-cm depth	5.5	1.3	2
Site EC at 10-cm depth (µS/cm)	110.0		1
Water Depth (cm, + above gnd)[a]	-22.5	10.6	2

[a] Measurements >1 m indicate minimum depth, not true depth

Soils include subgroups with varying levels of organic matter accumulation: Histic Cryaquepts (wet, 20-40 cm surface organics, with a B horizon) and Terric Cryofibrists (wet, peaty, with mineral soil within 1 m).

This ecotype and associated soils are part of the broader landtype association Maritime Lowland Bogs and Fens. Also included is Maritime Lowland Forb–Willow Meadow.

MARITIME LOWLAND SITKA SPRUCE FOREST

Geomorphology:

These spruce forests occur on flat, abandoned floodplains at low elevations in the Malaspina Forelands. This is a late successional ecotype and is limited in distribution. Soils are acidic, well drained, and consist of gravels overlain by organic horizons. Soil stratigraphy data are incomplete because only one comprehensive plot was sampled in this ecotype.

Plant Association:
Picea sitchensis–Vaccinium ovalifolium

Tree canopy is either open or closed. The dominant species is *Picea sitchensis* (Table 103). Associated species include *Oplopanax horridus, Vaccinium ovalifolium, Rubus pedatus, Carex macrochaeta,* and feather mosses. Information on cover of nonvascular plants is incomplete. Most likely, lichens and evergreen shrubs are absent.

This ecotype is similar to Maritime Upland Sitka Spruce Forest, except that the lowland type occurs on lowland flats instead of upland slopes and has substantially lower cover of shrubs and forbs.

Table 103. Vegetation cover and frequency for Maritime Lowland Sitka Spruce Forest (n=7[1]). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	115.4	66.1	100
Total Vascular Cover	97.4	35.3	100
Total Evergreen Tree Cover	54.3	14.8	100
Picea sitchensis	54.3	14.8	100
Total Deciduous Shrub Cover	34.3	18.4	100
Alnus sinuata	5.1	5.6	71
Oplopanax horridus	17.6	13.2	100
Rubus spectabilis	3.6	3.8	57
Sorbus scopulina	0.1	0.4	14
Vaccinium alaskensis	4.3	11.3	14
Vaccinium ovalifolium	4.2	5.8	43
Total Forb Cover	8.6	20.5	43
Lycopodium selago	0.1	0.4	14
Rubus pedatus	7.9	18.6	43
Streptopus amplexifolius	0.4	1.1	14
Tiarella trifoliata	0.1	0.4	14
Total Sedge & Rush Cover	2.0	0.0	100
Carex macrochaeta	2.0	0.0	100
Total Nonvascular Cover[2]	91.0		
Total Moss Cover	91.0		
Antitrichia curtipendula	5.0		
Dicranum sp.	1.0		
Hylocomium splendens	30.0		
Pleurozium schreberi	55.0		
Total Bare Ground	0.0	0.0	0

[1]Data: ABR n=1, GRS n=6.
[2]ABR data only

Soils

Soils are gravelly and have thin surface organic horizons (Table 104). Eolian silt caps and rock fragments are absent at the surface. Thaw depths could not be measured, but permafrost is assumed to be absent. Soil pH is acidic and electrical conductivity is low. Depth to water is > 1m.

Table 104. Soil characteristics for Maritime Lowland Sitka Spruce Forest. Standard deviations could not be calculated because n=1. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	7.0		1
Cumulative Org. in 40 cm (cm)	7.0		1
Loess Cap Thickness(cm)	0.0		1
Depth to Rocks (cm)	11.0		1
Surface Fragment Cover (%)	0.0		1
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	4.2		1
Site EC at 10-cm depth (µS/cm)	60.0		1
Water Depth (cm, + above gnd)[a]	-150.0		1

[a] Measurements >1 m indicate minimum depth, not true depth

The soil subgroup association described for this ecotype is Typic Haplocryods (moist, acidic, highly leached). Other soil subgroups may occur but data are limited due to low sample size.

This ecotype and associated soils are part of the broader landtype association Maritime Lowland Gravelly Scrub and Forests. Also included are Maritime Lowland Cottonwood Forest, Maritime Lowland Cottonwood–Spruce Forest, and Maritime Lowland Tall Alder–Willow Shrub.

MARITIME LOWLAND TALL ALDER–WILLOW SHRUB

Geomorphology:

This early successional ecotype occurs on abandoned or inactive glaciofluvial cover deposits near the coast (elevations <30 m). Large expanses of these outwash flats occur below the terminus of the Malaspina Glacier, and presumably are being revegetated since stabilization of the glacial moraine a century ago. The surface is flat and soils generally are well drained. Soils are gravelly with some peat accumulation at the surface. Soil chemistry is circumneutral.

Plant Association:

Alnus sinuata–Salix barclayi–Athyrium filix-femina

These tall alder–willow communities typically have closed canopies, although open canopies occur (Table 105). The understory canopy typically is closed. Dominant vegetation includes *Alnus sinuata, Salix scouleriana, Salix sitchensis, Rubus spectabilis,* and *Equisetum arvense*. Tree species are present with low cover, and evergreen shrubs and lichens are absent. Mosses are present, although total nonvascular cover is variable.

This ecotype is similar to Maritime Riverine Tall Alder–Willow Shrub except for differences in geomorphology, organic layer depth, and soil chemistry. It also is similar to Maritime Glaciated Tall Alder–Willow Shrub which has a different floristic association.

Table 105. Vegetation cover and frequency for Maritime Lowland Tall Alder–Willow Shrub (n=2). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	190.1	19.2	100
Total Vascular Cover	160.1	12.0	100
Total Evergreen Tree Cover	2.1	1.3	100
Picea sitchensis	1.6	2.1	100
Tsuga heterophylla	0.5	0.7	50
Total Deciduous Tree Cover	5.1	7.0	100
Populus trichocarpa	5.1	7.0	100
Total Deciduous Shrub Cover	107.1	15.5	100
Alnus sinuata	37.5	17.7	100
Oplopanax horridus	6.1	8.4	100
Rubus spectabilis	23.0	31.1	100
Salix barclayi	5.0	7.1	50
Salix scouleriana	17.5	10.6	100
Salix sitchensis	17.5	24.7	50
Sorbus scopulina	0.5	0.7	50
Total Forb Cover	43.3	8.3	100
Actaea rubra	0.6	0.6	100
Athyrium filix-femina ssp. *cyclosorum*	8.5	9.2	100
Epilobium ciliatum	0.5	0.7	50
Equisetum arvense	16.0	19.8	100
Equisetum variegatum	1.0	1.4	50
Geum macrophyllum ssp. *macrophyllum*	0.1	0.1	50
Gymnocarpium dryopteris	10.0	14.1	50
Heracleum lanatum	1.0	1.4	50
Platanthera dilatata	0.6	0.8	50
Polysticum sp.	0.1	0.1	50
Pyrola asarifolia	1.5	2.1	50
Ranunculus bongardi	0.5	0.7	50
Ranunculus hyperboreus	0.5	0.7	50
Stellaria sp.	0.1	0.1	50
Streptopus amplexifolius	2.6	3.5	100
Total Grass Cover	1.6	2.1	100
Calamagrostis canadensis	0.1	0.0	100
Glyceria pulchella	1.0	1.4	50
Poa pratensis	0.5	0.7	50
Total Sedge & Rush Cover	1.0	1.4	50
Carex disperma	1.0	1.4	50
Total Nonvascular Cover	30.0	31.1	100
Total Moss Cover	30.0	31.1	100
Calliergon giganteum	1.0	1.4	50
Hylocomium splendens	7.5	10.6	50
Rhytidiadelphus loreus	2.5	3.5	50
Rhytidium rugosum	17.5	24.7	50
Unknown liverwort	1.5	2.1	50
Total Bare Ground	2.0	1.4	100
Soil	0.0	0.0	0
Litter Alone	0.5	0.7	50
Water	1.5	2.1	50

Soils

Soils are gravelly and have moderately thick surface organic horizons (Table 106). Eolian silt caps and rock fragments are absent at the surface. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent. Soil pH is circumneutral and electrical conductivity is moderately low. Depth to water is typically < 1m.

Table 106. Soil characteristics for Maritime Lowland Tall Alder–Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	14.5	10.6	2
Cumulative Org. in 40 cm (cm)	19.5	17.7	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	33.0	24.0	2
Surface Fragment Cover (%)	0.0	0.0	2
Frost Boil Cover (%)			
Thaw Depth (cm)[a]			
Site pH at 10-cm depth	6.5	0.9	2
Site EC at 10-cm depth (µS/cm)	180.0	198.0	2
Water Depth (cm, + above gnd)[a]	-50.5	70.0	2

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroup is Typic Cryorthents (well drained, poorly developed horizons). Also common are Aquic Cryofluvents (poorly drained, stratified with buried O horizon and redox depletions).

This ecotype and associated soils are part of the broader landtype association Maritime Lowland Gravelly Scrub and Forests. Also included are Maritime Lowland Cottonwood Forest, Maritime Lowland Cottonwood–Spruce Forest, and Maritime Lowland Sitka Spruce Forest.

MARITIME RIVERINE BARRENS

Geomorphology:

This ecotype occurs on barren channel deposits in riverine corridors on the Malaspina Forelands at low elevations. Channels are braided and are both active and inactive. Soils are gravelly or bouldery with little to no surface organics. These sites are well to extremely well drained, moist to dry, and have basic chemistry. Frequent disturbance from water movement or flood events prevents vegetation from becoming established and maintains this ecotype.

Plant Association:

Racomitrium spp.–*Epilobium latifolium*

Although total vegetative cover is variable, mosses are dominant, particularly *Racomitrium* spp. (Table 107). Vascular cover typically is <15%. Among vascular species, *Epilobium latifolium, Lupinus nootkatensis*, and *Alnus sinuata* are most common. Tree seedlings and forbs are present in limited quantities. Sedges are absent and trace amounts of grasses are present.

This ecotype is similar floristically to Maritime Riverine Tall–Alder Willow, which replaces it in the successional sequence. These ecotypes typically are adjacent. Maritime Riverine Barrens also is similar to Boreal Riverine Circumalkaline Barrens, except for the presence of maritime species, such as *Salix sitchensis* and *Alnus sinuata*.

Table 107. Vegetation cover and frequency for Maritime Riverine Barrens (n=7). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	45.2	40.8	100
Total Vascular Cover	7.2	6.5	100
Total Evergreen Tree Cover	0.1	0.1	57
Picea glauca	0.0	0.0	29
Picea sitchensis	0.0	0.0	29
Total Deciduous Tree Cover	1.6	1.5	71
Populus trichocarpa	1.6	1.5	71
Total Deciduous Shrub Cover	4.6	5.5	100
Alnus sinuata	3.1	4.1	71
Salix alaxensis	0.1	0.1	57
Salix barclayi	0.0	0.0	14
Salix bebbiana	0.0	0.0	14
Salix hookeriana	0.0	0.0	14
Salix scouleriana	0.1	0.4	14
Salix sitchensis	0.0	0.1	43
Salix sp.	1.2	1.7	57
Total Forb Cover	1.0	1.4	100
Epilobium angustifolium	0.0	0.0	14
Epilobium latifolium	0.6	1.1	71
Equisetum sylvaticum	0.0	0.0	14
Equisetum variegatum	0.1	0.0	71
Lupinus nootkatensis	0.3	0.8	29
Total Grass Cover	0.0	0.0	14
Calamagrostis canadensis	0.0	0.0	14
Total Nonvascular Cover	37.9	35.4	86
Total Moss Cover	34.7	35.8	86
Ceratodon purpureus	0.7	1.9	29
Pogonatum urnigerum	1.1	2.0	29
Racomitrium canescens	15.7	30.5	29
Racomitrium panschii	11.4	30.2	14
Racomitrium sp.	5.7	9.8	29
Unknown moss	0.0	0.0	14
Total Lichen Cover	3.2	5.5	57
Cladonia chlorophaea	0.0	0.0	14
Peltigera leucophlebia	0.0	0.0	29
Psoroma hypnorum	0.3	0.5	29
Stereocaulon alpinum	2.9	5.7	29
Total Bare Ground	55.4	40.2	86
Soil	54.1	38.6	86
Litter Alone	0.7	1.9	14
Water	0.6	1.0	29

Soils

Soils are gravelly to bouldery (Table 108). Surface organics and eolian silt caps are absent at the surface. Surface fragments are prevalent. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent due to sub-surface groundwater flow and proximity to the coast. Soil pH is circumneutral to basic and electrical conductivity is moderate. Depth to water is typically < 1.5 m.

Table 108. Soil characteristics for Maritime Riverine Barrens. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	0.3	0.5	7
Cumulative Org. in 40 cm (cm)	0.3	0.5	7
Loess Cap Thickness(cm)	0.3	0.8	7
Depth to Rocks (cm)	2.1	2.5	7
Surface Fragment Cover (%)	42.1	31.3	7
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	150.0		1
Site pH at 10-cm depth	7.5	0.4	7
Site EC at 10-cm depth (µS/cm)	161.4	41.8	7
Water Depth (cm, + above gnd)[a]	-112.7	77.9	7

[a] Measurements >1 m indicate minimum depth, not true depth

The most common soil subgroups for this ecotype are Typic Cryorthents (well drained, poorly developed soils) and Typic Cryaquents (wet, fine sediments). Oxyaquic Cryorthents (moderately well drained, poorly developed soils saturated within 1 m) occur less commonly.

This ecotype and associated soils are part of the broader landtype association Maritime Riverine Gravelly Barrens and Scrub. Also included is Maritime Riverine Tall Alder–Willow Shrub.

MARITIME RIVERINE COTTONWOOD FOREST

Geomorphology:

These mid- to late-successional cottonwood forests occur on braided, coarse, inactive riverine channel deposits. Surfaces are flat, and dominant soil texture varies from gravelly to bouldery. Soils are acidic, moist and somewhat excessively drained. Thin surface organic horizons are present.

Plant Association:

Populus trichocarpa–Alnus sinuata–Picea sitchensis

Maritime Riverine Cottonwood Forest has an open canopy dominated by black cottonwood (Table 109). In the understory, deciduous shrubs and forbs are common. Dominant species include *Populus trichocarpa*, *Alnus sinuata, Oplopanax horridus, Rubus spectabilis, Dryopteris dilatata* ssp. *americana*, and *Pyrola asarifolia*. The evergreen tree *Picea sitchensis* is common in the understory. Cover of litter is high, and mosses are present, although their occurrence often is patchy.

This ecotype is similar to Maritime Riverine Cottonwood–Spruce Forest, except that needleleaf trees are not co-dominant in the canopy. It also is similar to Maritime Lowland Cottonwood Forest but occurs on riverine deposits, has a different soil association, and has less surface organic material.

Table 109. Vegetation cover and frequency for Maritime Riverine Cottonwood Forest (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	119.3	5.9	100
Total Vascular Cover	110.1	13.8	100
Total Evergreen Tree Cover	4.4	4.5	100
Picea sitchensis	4.0	4.0	100
Tsuga heterophylla	0.3	0.6	33
Total Deciduous Tree Cover	34.0	3.6	100
Populus trichocarpa	34.0	3.6	100
Total Deciduous Shrub Cover	53.4	9.1	100
Alnus sinuata	28.0	1.7	100
Oplopanax horridus	7.0	4.4	100
Ribes sp.	1.0	1.7	33
Rubus spectabilis	11.3	4.0	100
Salix alaxensis	1.0	1.7	33
Salix bebbiana	2.7	4.6	33
Salix scouleriana	1.7	1.2	100
Vaccinium ovalifolium	0.7	1.1	67
Viburnum edule	0.1	0.1	67
Total Forb Cover	18.1	7.2	100
Actaea rubra	0.4	0.5	100
Athyrium filix-femina ssp. *cyclosorum*	0.0	0.1	33
Dryopteris dilatata ssp. *americana*	5.7	3.8	100
Epilobium angustifolium	0.0	0.1	33
Epilobium sp.	0.1	0.0	100
Equisetum variegatum	0.1	0.0	100
Geum macrophyllum ssp. *macrophyllum*	0.1	0.1	67
Gymnocarpium dryopteris	0.7	0.5	100
Listera caurina	0.0	0.1	33
Listera cordata	0.0	0.1	33
Lycopodium annotinum	0.0	0.1	33
Platanthera saccata	0.0	0.1	33
Polysticum sp.	0.0	0.1	33
Pyrola asarifolia	5.0	6.1	100
Rubus pedatus	5.0	5.0	67
Streptopus amplexifolius	0.4	0.5	100
Tiarella trifoliata	0.4	0.5	100
Total Grass Cover	0.0	0.1	33
Unknown grass	0.0	0.1	33
Total Sedge & Rush Cover	0.1	0.1	67
Luzula sp.	0.1	0.1	67
Total Nonvascular Cover	9.2	8.0	100
Total Moss Cover	9.2	8.0	100
Hylocomiastrum umbratum	0.0	0.1	33
Hylocomium splendens	5.0	8.7	33
Pseudoleskea baileyi	0.0	0.1	33
Rhytidiadelphus loreus	1.7	2.9	33
Rhytidiadelphus triquetrus	1.0	1.7	33
Sanionia uncinata	0.1	0.1	67
Unknown fungus	0.0	0.1	33
Unknown liverwort	0.0	0.1	33
Unknown moss	1.3	2.3	33
Total Bare Ground	9.0	3.6	100
Litter Alone	9.0	3.6	100

Soils

Soils are gravelly to bouldery and are overlain by thin silt caps (Table 110). Thin surface organic horizons are present, but buried organic layers are absent, as are surface fragments. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent due to sub-surface groundwater flow and proximity to the coast. Soil pH is acidic and electrical conductivity is low. Depth to water is typically > 1.5 m.

Table 110. Soil characteristics for Maritime Riverine Cottonwood Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	3.3	1.5	3
Cumulative Org. in 40 cm (cm)	3.3	1.5	3
Loess Cap Thickness(cm)	5.7	1.5	3
Depth to Rocks (cm)	9.3	1.2	3
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.0	0.4	3
Site EC at 10-cm depth (µS/cm)	53.3	15.3	3
Water Depth (cm, + above gnd)[a]	-150.0	0.0	3

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the subgroup Typic Cryorthents (well drained, rocky, poorly developed). Spodic Dystrocryepts (well drained, acidic, partially developed and moderately leached) occur less commonly.

This ecotype and associated soils are part of the broader landtype association Maritime Riverine Gravelly Forests. Also included is Maritime Riverine Cottonwood–Spruce Forest.

MARITIME RIVERINE COTTONWOOD–SPRUCE FOREST

Geomorphology:

This ecotype consists of mid-successional mixed forests that occur on inactive, braided riverine overbank deposits or on glaciofluvial outwash abandoned cover deposits. Soils are sands or gravels overlain by a thin layers of organic material. Sites are located on flat surfaces, are well to moderately well drained, moist, and have acidic chemistry.

Plant Association:

Populus trichocarpa–Alnus sinuata–Picea sitchensis

Vegetation is dominated by cottonwood, with spruce comprising about one-third of total tree cover (Table 111). Dominant species include *Populus trichocarpa, Picea sitchensis, Alnus sinuata, Rubus spectabilis, Streptopus amplexifolius*, and the ferns *Athyrium filix-femina* ssp. *cyclosorum,* and *Gymnocarpium dryopteris*. Graminoid cover usually is low, and lichens typically are absent.

This ecotype is similar to Maritime Riverine Cottonwood Forest, except that spruce trees are co-dominant, and moss cover is higher. It also is floristically similar to Maritime Lowland Cottonwood–Spruce Forest which occurs on different geomorphic deposits.

Table 111. Vegetation cover and frequency for Maritime Riverine Gravelly Moist Cottonwood–Spruce Forest (n=2). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	168.6	104.0	100
Total Vascular Cover	129.6	74.3	100
Total Evergreen Tree Cover	12.5	0.7	100
Picea sitchensis	11.0	1.4	100
Tsuga heterophylla	1.5	2.1	50
Total Deciduous Tree Cover	22.5	10.6	100
Populus trichocarpa	22.5	10.6	100
Total Deciduous Shrub Cover	66.7	54.2	100
Alnus sinuata	42.5	24.7	100
Oplopanax horridus	4.0	1.4	100
Rubus spectabilis	20.1	28.2	100
Vaccinium ovalifolium	0.1	0.1	50
Viburnum edule	0.1	0.1	50
Total Forb Cover	26.9	28.6	100
Actaea rubra	0.1	0.1	50
Angelica lucida	5.0	7.1	50
Athyrium filix-femina ssp. *cyclosorum*	9.0	8.5	100
Epilobium angustifolium	0.6	0.6	100
Epilobium ciliatum	1.0	1.4	50
Geum macrophyllum ssp. *macrophyllum*	0.1	0.1	50
Gymnocarpium dryopteris	3.0	2.8	100
Heracleum lanatum	2.5	3.5	50
Platanthera dilatata	0.5	0.7	50
Prenanthes alata	1.0	1.4	50
Pyrola asarifolia	0.1	0.1	50
Ranunculus bongardi	0.5	0.7	50
Rubus pedatus	1.0	1.4	50
Stellaria sp.	0.1	0.1	50
Streptopus amplexifolius	1.1	1.3	100
Tiarella trifoliata	1.5	2.1	50
Viola sp.	0.1	0.1	50
Total Grass Cover	0.6	0.6	100
Calamagrostis canadensis	0.5	0.7	50
Unknown grass	0.1	0.1	50
Total Sedge & Rush Cover	0.5	0.7	50
Carex sitchensis	0.5	0.7	50
Total Nonvascular Cover	39.0	29.7	100
Total Moss Cover	39.0	29.7	100
Hylocomiastrum umbratum	5.0	7.1	50
Pleurozium schreberi	7.5	10.6	50
Rhizomnium sp.	2.5	3.5	50
Rhytidiadelphus triquetrus	4.0	5.7	50
Rhytidium rugosum	20.0	28.3	50
Total Bare Ground	10.0	14.1	50
Litter Alone	10.0	14.1	50

Soils

Soils are sandy to gravelly and are overlain by thin organic horizons (Table 112). Silt caps, buried organic layers and surface fragments are absent. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent due to sub-surface groundwater flow and proximity to the coast. Soil pH is acidic and electrical conductivity is low. Depth to water is typically <1 m.

Table 112. Soil characteristics for Maritime Riverine Cottonwood—Spruce Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	4.5	0.7	2
Cumulative Org. in 40 cm (cm)	4.5	0.7	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	15.0	14.1	2
Surface Fragment Cover (%)	0.0	0.0	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.3	0.3	2
Site EC at 10-cm depth (µS/cm)	75.0	35.4	2
Water Depth (cm, + above gnd)[a]	-75.0	35.4	2

[a] Measurements >1 m indicate minimum depth, not true depth

Soils are dominated by the subgroup Oxyaquic Cryorthents (moderately well drained, poorly developed soils saturated within 1 m). No other subgroups are present.

This ecotype and associated soils are part of the broader landtype association Maritime Riverine Gravelly Forests. Also included is Maritime Riverine Cottonwood Forest.

MARITIME RIVERINE HORSETAIL MEADOW

Geomorphology:

These productive communities occur on braided or meander active overbank deposits in riverine corridors. Surface forms include interfluves, river banks, and flood basins. Bare ground and surface water are common features. Soils are loams or silts and organic horizons are thin or absent. Buried organic horizons may be present as a result of flooding and sedimentation.

Plant Association:

Equisetum arvense–Eriophorum angustifolium

Forbs characterize this ecotype, while trees and shrubs are absent or have minimal cover (Table 113). Graminoids or rushes are present but have low total cover. Mosses frequently are found but lichens are absent. Dominant species include *Equisetum arvense, Equisetum variegatum*, *Eriophorum angustifolium*, and the mosses *Rhytidiadelphus squarrosus, Sanionia uncinata* and *Drepanocladus* sp.

This ecotype is unique among the maritime ecotypes. It shares some floristic similarity to Maritime Lowland Forb–Willow Meadow, but willows are not characteristic.

Table 113. Vegetation cover and frequency for Maritime Riverine Horsetail Meadow (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	60.8	16.8	100
Total Vascular Cover	33.4	26.7	100
Total Deciduous Shrub Cover	0.1	0.1	100
Salix alaxensis	0.0	0.1	33
Salix hookeriana	0.0	0.1	33
Salix sp.	0.1	0.1	67
Total Forb Cover	30.1	21.7	100
Equisetum arvense	6.0	5.2	67
Equisetum palustre	18.3	31.8	33
Equisetum variegatum	5.7	5.5	67
Platanthera dilatata	0.1	0.1	67
Total Grass Cover	0.3	0.6	33
Deschampsia beringensis	0.3	0.6	33
Total Sedge & Rush Cover	2.8	4.5	100
Carex lyngbyaei	0.4	0.6	67
Eriophorum angustifolium	0.1	0.1	67
Eriophorum russeolum	0.1	0.1	67
Juncus arcticus	0.7	1.2	33
Juncus triglumis	1.7	2.9	33
Total Nonvascular Cover	27.4	30.5	67
Total Moss Cover	27.4	30.5	67
Brachythecium sp.	0.0	0.1	33
Drepanocladus sp.	7.3	11.0	67
Helodium blandowii	2.7	2.5	67
Philonotis fontana	5.0	5.0	67
Rhizomnium pseudopunctatum	0.0	0.1	33
Rhytidiadelphus squarrosus	5.0	8.7	33
Sanionia uncinata	4.3	5.1	67
Unknown liverwort	3.0	3.6	67
Total Bare Ground	59.7	14.7	100
Soil	23.3	40.4	33
Litter Alone	23.7	20.3	100
Water	12.7	19.4	67

Soils

Soils are loams or silts and are overlain by thin organic horizons (Table 114). Buried organic horizons are frequently present. Eolian silt caps and surface fragments are absent. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent due to sub-surface groundwater

flow and proximity to the coast. Soil pH is cirumneutral and electrical conductivity is moderate indicating minerotrophic conditions. Groundwater is typically present just below the surface.

Table 114. Soil characteristics for Maritime Riverine Horsetail Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.0	1.4	2
Cumulative Org. in 40 cm (cm)	1.5	2.1	2
Loess Cap Thickness(cm)	0.0	0.0	2
Depth to Rocks (cm)	200.0	0.0	2
Surface Fragment Cover (%)	0.0	0.0	2
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	6.9	0.3	2
Site EC at 10-cm depth (µS/cm)	355.0	35.4	2
Water Depth (cm, + above gnd)[a]	-2.0	1.4	2

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroups include Aquic Cryofluvents (poorly drained, stratified with buried O horizon and redox depletions) and Typic Cryaquents (poorly drained, rocky, poorly developed). No other soil subgroups occur in this unique ecotype.

This ecotype and associated soils are part of the broader landtype association Maritime Riverine Loamy Meadows. Also included is Maritime Riverine Tall Willow Shrub, a rare ecotype that is not described.

MARITIME RIVERINE TALL ALDER–WILLOW SHRUB

Geomorphology:

These early successional plant communities occur on active overbank and channel deposits in meander and braided riverine corridors. Soils are composed of interbedded sands, gravels, and boulders overlain by thin organic layers; buried O horizons also can be present. Sites are acidic, moderately to somewhat excessively drained, and moist.

Plant Association:
Alnus sinuata–Salix barclayi–Equisetum variegatum

Stands are dominated by alder with a minor, but typical component of willows, primarily *Salix barclayi, Salix scouleriana*, and *Salix sitchensis* (Table 115). The canopies are open or closed. The understory is dominated by *Equisetum arvense, Rubus spectabilis*, and moss species. Forbs are common, while graminoids are scarce. This ecotype is early successional, and, in the absence of disturbance, cottonwood forest eventually becomes established on these sites.

This ecotype is similar to Maritime Lowland Tall Alder–Willow Shrub, except that soils are coarser and better drained, while thicker organic horizons occur in the lowland class. Total cover of plant species is lower in the riverine communities.

Table 115. Vegetation cover and frequency for Maritime Riverine Tall Alder-Willow Shrub (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	119.7	64.8	100
Total Vascular Cover	107.1	57.8	100
Total Deciduous Tree Cover	1.2	2.7	20
Populus trichocarpa	1.2	2.7	20
Total Deciduous Shrub Cover	93.2	41.9	100
Alnus sinuata	54.6	13.1	100
Oplopanax horridus	0.0	0.0	20
Rubus spectabilis	16.0	35.8	40
Salix alaxensis	1.6	2.3	40
Salix barclayi	9.4	9.8	80
Salix bebbiana	2.0	2.7	40
Salix scouleriana	6.4	4.2	80
Salix sitchensis	3.0	2.7	60
Sorbus scopulina	0.2	0.4	20
Total Forb Cover	12.4	16.5	100
Angelica lucida	1.0	2.2	20
Aruncus sylvester	0.0	0.0	20
Athyrium filix-femina ssp. *cyclosorum*	1.0	2.2	20
Boschniakia rossica	0.0	0.0	20
Conioselinum chinense	0.4	0.9	20
Epilobium angustifolium	0.4	0.9	20
Epilobium latifolium	0.0	0.0	20
Equisetum arvense	4.0	3.9	60
Equisetum variegatum	1.0	1.7	80
Geum macrophyllum ssp. *macrophyllum*	0.0	0.0	20
Heracleum lanatum	2.0	4.5	20
Lupinus nootkatensis	0.0	0.0	20
Petasites hyperboreus	0.2	0.4	20
Platanthera dilatata	0.2	0.4	60
Pyrola asarifolia	0.0	0.0	20
Ranunculus bongardi	0.2	0.4	20
Sanguisorba stipulata	0.2	0.4	20
Streptopus amplexifolius	0.2	0.4	20
Tiarella trifoliata	1.0	2.2	20
Trientalis europaea	0.4	0.9	20
Total Grass Cover	0.2	0.4	60
Calamagrostis canadensis	0.2	0.4	20
Unknown grass	0.0	0.1	40
Total Nonvascular Cover	12.6	12.4	80
Total Moss Cover	12.4	12.3	80
Brachythecium rutabulum	1.0	2.2	20
Brachythecium sp.	5.0	11.2	20
Pogonatum urnigerum	0.2	0.4	20
Racomitrium ericoides	5.0	11.2	40
Rhytidiadelphus loreus	0.4	0.9	20
Sanionia uncinata	0.4	0.9	20
Unknown liverwort	0.4	0.9	20
Total Lichen Cover	0.1	0.1	60
Peltigera canina	0.0	0.0	20
Peltigera membranacea	0.0	0.0	20
Stereocaulon tomentosum	0.0	0.0	20
Total Bare Ground	12.2	8.8	100
Soil	0.2	0.4	20
Litter Alone	12.0	9.1	80

Soils

Soils are sandy to bouldery and are overlain by thin organic horizons (Table 116). Buried organic horizons frequently are present. Surface fragments are common, and rocks often are present within 1 m of the surface. Thaw depths could not be determined in these rocky soils, but permafrost is assumed to be absent. Soil pH is acidic and electrical conductivity is moderately low. Depth to groundwater is commonly > 1 m.

Table 116. Soil characteristics for Maritime Riverine Tall Alder–Willow Shrub. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	1.8	1.3	4
Cumulative Org. in 40 cm (cm)	2.3	2.1	4
Loess Cap Thickness(cm)	0.0	0.0	4
Depth to Rocks (cm)	80.3	90.6	4
Surface Fragment Cover (%)	0.5	1.0	4
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	5.3	0.3	4
Site EC at 10-cm depth (µS/cm)	120.0	54.8	4
Water Depth (cm, + above gnd)[a]	-75.3	52.3	4

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soils are Typic Cryaquents (poorly drained, rocky, poorly developed) and Typic Cryorthents (well drained, rocky, poorly developed). A less common subgroup is Oxyaquic Cryorthent (moderately well drained, rocky, poorly developed).

This ecotype and associated soils are part of the landtype association Maritime Riverine Gravelly Barrens and Scrub. Also included in this landtype is Maritime Riverine Barrens.

MARITIME SUBALPINE LOW BLUEBERRY SHRUB

Geomorphology:

These open meadows occur on steep, south-facing mountain slopes in the southern extent of the St. Elias Mountains. Terrain includes hillside colluvium and young moraine deposits. Soils consist of rubbly or blocky colluvium overlain by thin organic horizons. This terrain is fairly stable and is not prone to disturbance.

Plant Association:

Vaccinium ovalifolium–Luetkia pectinata

Low, deciduous shrubs characterize this ecotype, and while closed canopies are most common, open canopies also occur (Table 117). Forbs and evergreen shrubs are well represented in this ecotype, while trees are absent. Graminoids and lichens have low total cover. Dominant species include *Vaccinium ovalifolium, Luetkia pectinata, Vaccinium alaskensis, Phyllodoce aleutica, Gymnocarpium dryopteris,* and the moss *Pseudoleskea baileyi*.

This ecotype has similar site conditions to Maritime Subalpine Lupine Meadow. Floristically however, these ecotypes are quite different, with this ecotype dominated by shrubs and Maritime Subalpine Lupine Meadow dominated by forbs. This ecotype is also similar to Maritime Alpine Cassiope Dwarf Shrub, except that it occurs at lower elevations and deciduous shrubs are characteristic rather than evergreen shrubs.

Table 117. Vegetation Cover and Frequency for Maritime Subalpine Low Blueberry Shrub (n=3). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	157.8	55.3	100
Total Vascular Cover	118.8	21.3	100
Total Evergreen Shrub Cover	7.3	4.7	100
Luetkea pectinata	2.7	3.8	67
Phyllodoce aleutica	4.7	4.6	100
Total Deciduous Shrub Cover	87.4	23.6	100
Rosa sp.	0.0	0.1	33
Rubus spectabilis	0.7	1.2	33
Sorbus sitchensis	1.7	2.9	33
Vaccinium alaskensis	33.3	57.7	33
Vaccinium ovalifolium	51.7	50.1	67
Total Forb Cover	23.7	7.5	100
Anemone multifida	1.3	2.3	33
Arnica cordifolia	0.7	1.2	33
Athyrium filix-femina ssp. *cyclosorum*	0.7	1.2	33
Cornus canadensis	3.7	5.5	67
Dryopteris dilatata ssp. *americana*	0.3	0.6	33
Epilobium angustifolium	0.7	1.1	67
Gymnocarpium dryopteris	9.7	9.1	100
Potentilla sp.	1.0	1.7	33
Rubus pedatus	2.0	2.6	67
Sanguisorba stipulata	0.3	0.6	33
Valeriana sitchensis	3.0	4.4	67
Veratrum viride ssp. *eschscholtzii*	0.3	0.6	33
Viola sp.	0.0	0.1	33
Total Sedge & Rush Cover	0.4	0.6	67
Carex sp.	0.4	0.6	67
Total Nonvascular Cover	39.0	45.6	100
Total Moss Cover	38.7	45.9	100
Aulacomnium palustre	0.3	0.6	33
Dicranum spadiceum	1.7	2.9	33
Pleurozium schreberi	1.7	2.9	33
Pseudoleskea baileyi	30.0	47.7	67
Unknown moss	5.0	8.7	33
Total Lichen Cover	0.3	0.6	33
Cetraria cf. *islandica*	0.3	0.6	33
Total Bare Ground	5.0	8.7	33
Litter Alone	5.0	8.7	33

Soils

Soils are rubbly, well drained and are overlain by thin organic horizons (Table 118). Eolian silt caps and surface fragments are absent. Rocks are present just below the surface. Thaw depths

could not be determined in the rocky soils, but permafrost is assumed to be absent. Soil pH is acidic and electrical conductivity is low. Depth to groundwater is commonly > 1 m.

Table 118. Soil characteristics for Maritime Subalpine Low Blueberry Shrub. Blanks = no data.

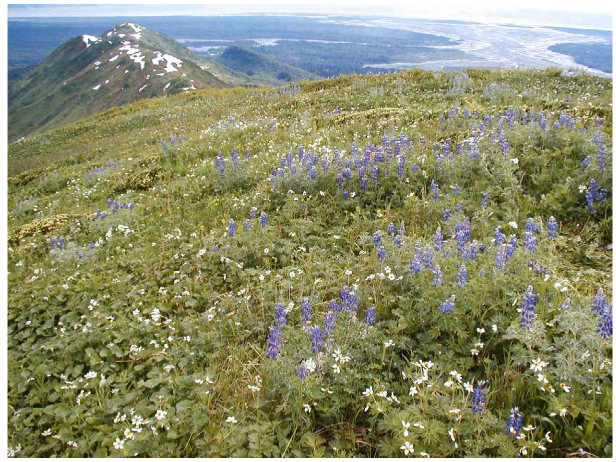
Property	Mean	SD	n
Surface Organics Depth (cm)	2.7	0.6	3
Cumulative Org. in 40 cm (cm)	2.7	0.6	3
Loess Cap Thickness(cm)	0.0	0.0	3
Depth to Rocks (cm)	4.0	2.6	3
Surface Fragment Cover (%)	0.0	0.0	3
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]			0
Site pH at 10-cm depth	4.0	0.2	3
Site EC at 10-cm depth (µS/cm)	126.7	11.5	3
Water Depth (cm, + above gnd)[a]	-125.0	43.3	3

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroups for this ecotype are Humic Dystrocryepts (well drained, acidic, organic-rich, partially developed soil), Typic Dystrocryepts (well drained, acidic, partially developed soil), and Typic Haplocryods (well drained, acidic, highly leached with well developed horizons).

This ecotype and associated soils are part of the broader landtype association Maritime Subalpine Rocky Meadows and Scrub. Also included is Maritime Subalpine Lupine Meadow.

MARITIME SUBALPINE LUPINE MEADOW



Geomorphology:

This forb-dominated ecotype occurs on younger moraines or hillside colluvium, on upper slopes in the subalpine zone of the St. Elias Mountains. Soils are blocky and occur with thin organic horizons. These sites are well drained, moist and acidic. They are fairly stable, although solifluction contributes to some soil instability.

Plant Association:

Lupinus nootkatensis–Valeriana sitchensis

These productive subalpine meadows are unique in the park, and flourish in the wet, maritime climate (Table 119). This ecotype has high diversity of vascular species, characterized by forbs, though graminoids and mosses also are well represented. Trees are absent and shrubs have low cover. Dominant species vary among sites and may include *Fauria crista-galli*, *Lupinus nootkatensis, Athyrium filix-femina* ssp. *cyclosorum*, *Valeriana sitchensis, Epilobium angustifolium*, and *Veratrum viride* ssp. *eschscholtzii*.

Maritime Subalpine Lupine Meadow is similar to Maritime Subalpine Low Blueberry Shrub except that forbs, not low shrubs, are dominant. This ecotype also is similar to Boreal Subalpine Forb Meadow, but the maritime ecotype has distinctly different species composition.

Table 119. Vegetation Cover and Frequency for Maritime Subalpine Lupine Meadow (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	97.6	28.0	100
Total Vascular Cover	83.6	21.3	100
Total Evergreen Shrub Cover	2.8	6.2	40
Cassiope stelleriana	0.4	0.9	20
Empetrum nigrum	0.4	0.9	20
Luetkea pectinata	1.0	2.2	40
Phyllodoce aleutica	1.0	2.2	20
Total Deciduous Shrub Cover	0.8	1.2	40
Rubus spectabilis	0.2	0.4	20
Salix barclayi	0.2	0.4	20
Vaccinium ovalifolium	0.4	0.9	40
Total Forb Cover	75.5	17.3	100
Anemone multifida	0.8	1.8	20
Anemone narcissiflora	2.0	4.5	20
Anemone sp.	0.2	0.4	20
Arnica cordifolia	0.6	1.3	20
Arnica latifolia	1.0	2.2	20
Artemisia arctica ssp. *arctica*	0.4	0.9	20
Aruncus sylvester	0.6	1.3	20
Athyrium filix-femina ssp. *cyclosorum*	1.8	1.6	100
Caltha leptosepala	0.2	0.4	20
Castilleja miniata	0.0	0.0	20
Castilleja sp.	4.2	8.8	40
Epilobium anagallidifolium	0.2	0.4	20
Epilobium angustifolium	1.4	1.3	80
Erigeron peregrinus	2.0	4.5	20
Fauria crista-galli	20.0	42.0	40
Geranium erianthum	0.2	0.4	20
Heracleum lanatum	1.0	1.2	60
Heuchera glabra	0.2	0.4	20
Listera cordata	0.0	0.0	20
Lupinus nootkatensis	9.4	4.9	100
Lycopodium clavatum	0.0	0.0	20
Myosotis alpestris ssp. *asiatica*	0.0	0.0	20
Osmorhiza purpurea	0.0	0.0	20
Petasites frigidus	0.2	0.4	20
Prenanthes alata	2.6	3.7	40
Ranunculus cooleyae	1.2	2.2	40
Ranunculus occidentalis	1.4	3.1	20
Rubus pedatus	0.4	0.9	40
Sanguisorba stipulata	2.4	4.3	40
Streptopus amplexifolius	0.4	0.9	20
Tellima grandiflora	0.0	0.0	20
Tiarella trifoliata	0.0	0.0	20
Trientalis europaea ssp. *arctica*	0.6	1.3	20
Valeriana sitchensis	6.4	5.4	80
Veratrum viride ssp. *eschscholtzii*	10.8	10.0	100
Veronica wormskjoldii	0.0	0.0	20
Total Grass Cover	1.2	1.3	60
Arctagrostis latifolia	0.6	0.9	40
Festuca sp.	0.6	1.3	20
Total Sedge & Rush Cover	3.2	4.1	100
Carex anthoxanthea	0.2	0.4	20

Table 119. Continued.

	Cover		Freq
	Mean	SD	%
Carex macrochaeta	2.8	4.2	60
Carex sp.	0.2	0.4	40
Total Nonvascular Cover	14.1	15.1	60
Total Moss Cover	14.0	15.2	80
Aulacomnium turgidum	0.4	0.9	20
Brachythecium erythrorrhizon	1.0	2.2	20
Dicranum sp.	1.0	2.2	20
Drepanocladus sp.	2.0	4.5	20
Plagiomnium insigne	1.0	2.2	20
Pleurozium schreberi	0.2	0.4	20
Polytrichum juniperinum	0.2	0.4	20
Polytrichum sp.	0.4	0.9	20
Pseudoleskea baileyi	1.0	2.2	20
Rhizomnium sp.	0.4	0.9	20
Rhytidiadelphus squarrosus	5.0	11.2	40
Sanionia uncinata	0.6	1.3	20
Unknown liverwort	0.8	1.8	20
Total Lichen Cover	0.0	0.1	40
Cladonia ecmocyna	0.0	0.0	20
Peltigera sp.	0.0	0.0	20
Total Bare Ground	17.8	17.7	100
Soil	4.2	8.8	40
Litter Alone	13.6	18.4	80

Soils

Soils are blocky and have thin organic horizons (Table 120). An eolian silt cap is sometimes present. There are few rock fragments at the surface, although depth to rocks is shallow. Thaw depths could not be determined in the rocky soils, but permafrost is assumed to be absent. Soil pH is acidic and electrical conductivity is low. Depth to groundwater is > 1 m in these well drained soils.

Table 120. Soil characteristics for Maritime Subalpine Lupine Meadow. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	2.2	1.6	5
Cumulative Org. in 40 cm (cm)	2.2	1.6	5
Loess Cap Thickness(cm)	1.6	3.6	5
Depth to Rocks (cm)	3.0	1.9	5
Surface Fragment Cover (%)	0.8	1.1	5
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	100.0		1
Site pH at 10-cm depth	4.4	0.1	5
Site EC at 10-cm depth (µS/cm)	108.0	35.6	5
Water Depth (cm, + above gnd)[a]	-135.0	33.5	5

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroup association is Humic Dystrocryepts (well drained, acidic, organic-rich, partially developed horizons). Infrequently, Typic Humicryods (well drained, acidic, well developed horizons, highly leached) also occur.

This ecotype and associated soils are part of the broader landtype association Maritime Subalpine Rocky Meadows and Scrub. Also included is Maritime Subalpine Blueberry Shrub.

MARITIME UPLAND SITKA SPRUCE FOREST

Geomorphology:

These spruce forests occur on upper slopes on hillside colluvium, younger moraine and eolian inactive coastal sand deposits. Soils are variable, including loam, sands, and blocky material. Surface organic horizons range from thin to well developed.

Plant Association:
Picea sitchensis–Vaccinium ovalifolium

The Sitka spruce canopy usually is open, but may be closed, and low shrubs create a closed understory (Table 121). Mosses and shade-tolerant forbs are well represented, while graminoids are absent and lichens are present only in trace quantities. Common species are *Picea sitchensis, Oplopanax horridus, Vaccinium ovalifolium, Rubus pedatus, Gymnocarpium dryopteris,* and *Rhytidiadelphus loreus*.

This ecotype is similar to Maritime Lowland Sitka Spruce Forest, except that it occurs on upland terrain and consequently supports a different species assemblage.

Table 121. Vegetation Cover and Frequency for Maritime Upland Sitka Spruce Forest (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	214.3	61.4	100
Total Vascular Cover	150.3	53.7	100
Total Evergreen Tree Cover	50.0	25.0	100
Picea sitchensis	39.0	11.4	100
Tsuga heterophylla	11.0	24.6	20
Total Deciduous Tree Cover	2.8	4.2	60
Populus trichocarpa	2.8	4.2	60
Total Deciduous Shrub Cover	60.4	40.6	100
Alnus sinuata	7.2	12.9	60
Oplopanax horridus	25.6	21.2	80
Rubus spectabilis	1.6	3.6	20
Salix scouleriana	4.0	8.9	20
Sorbus scopulina	0.0	0.0	20
Vaccinium alaskensis	7.0	15.7	20
Vaccinium ovalifolium	15.0	20.6	60
Total Forb Cover	37.0	34.0	80
Athyrium filix-femina ssp. *cyclosorum*	0.8	1.8	20
Cornus canadensis	0.2	0.4	20
Dryopteris dilatata ssp. *americana*	6.8	12.6	60
Equisetum arvense	0.0	0.0	20
Gymnocarpium dryopteris	13.2	15.8	80
Listera caurina	0.0	0.0	20
Listera cordata	0.0	0.1	40
Lycopodium annotinum	2.0	3.5	40
Pyrola asarifolia	0.0	0.0	20
Rubus pedatus	13.0	14.0	60
Streptopus amplexifolius	0.4	0.5	80
Tiarella trifoliata	0.4	0.5	60
Trientalis europaea	0.0	0.0	20
Total Nonvascular Cover	64.1	24.5	100
Total Moss Cover	63.6	24.3	100
Antitrichia curtipendula	0.2	0.4	20
Dicranum scoparium	13.0	29.1	20
Dicranum sp.	0.4	0.9	20
Hylocomiastrum umbratum	2.0	4.5	20
Hylocomium splendens	6.0	6.5	60
Plagiothecium undulatum	0.0	0.0	20
Polytrichum sp.	0.2	0.4	20
Rhizomnium glabrescens	5.0	11.2	20
Rhizomnium nudum	2.0	4.5	40
Rhytidiadelphus loreus	23.2	19.1	100
Rhytidiadelphus triquetrus	4.0	8.9	20
Unknown liverwort	7.6	12.2	40
Total Lichen Cover	0.4	0.5	60
Hypogymnia enteromorpha	0.0	0.0	20
Peltigera canina	0.2	0.4	20
Unknown lichen	0.2	0.4	20
Total Bare Ground	2.6	4.8	40
Soil	0.2	0.4	20
Litter Alone	2.4	4.3	40
Water	0.0	0.0	0

Soils

Soils are loamy to rocky, with moderately thin organic horizons (Table 122). Eolian silt caps and surface fragments are absent. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent. Soil pH is acidic and electrical conductivity is low. Depth to groundwater is > 1 m in these well drained soils.

Table 122. Soil characteristics for Maritime Upland Sitka Spruce Forest. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	16.0	14.1	5
Cumulative Org. in 40 cm (cm)	16.2	13.9	5
Loess Cap Thickness(cm)	0.0	0.0	5
Depth to Rocks (cm)	71.4	57.5	5
Surface Fragment Cover (%)	0.0	0.0	5
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	150.0	0.0	2
Site pH at 10-cm depth	4.7	0.6	5
Site EC at 10-cm depth (µS/cm)	80.0	18.7	5
Water Depth (cm, + above gnd)[a]	-120.0	27.4	5

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroup is Typic Dystrocryepts (well drained, acidic, partially developed). Less common soils include Humic Dystrocryepts (well drained, acidic, organic-rich, partially developed) and Typic Cryopsamments (well drained, sandy, poorly developed).

This ecotype and associated soils are part of the broader landtype association Maritime Upland Rocky-sandy Scrub and Forests. Also included is Maritime Upland Tall Alder.

MARITIME UPLAND TALL ALDER

Geomorphology:

This ecotype occurs on steep slopes on hillside colluvium below the subalpine zone in the St. Elias Mountains and on younger moraines on the Malaspina Forelands. Soils are blocky and well drained.

Plant Association:

Alnus sinuata–Rubus spectabilis–Sambucus Racemosa

This ecotype is early to mid-successional and is not species-rich (Table 123). A high density of alder creates a closed or nearly closed canopy. Trees, evergreen shrubs and graminoids have trace cover or are absent. Complete data are not available for nonvascular species, but cover values for both mosses and lichens probably are low. Common vascular species are *Alnus sinuata, Oplopanax horridus, Rubus spectabilis, Heracleum lanatum and Athyrium filix-femina.*

Other tall shrub ecotypes in the maritime zone include Maritime Lowland Tall Alder–Willow Shrub and Maritime Riverine Tall Alder–Willow Shrub. The upland ecotype differs in that it occurs on steep hillsides and willow is not co-dominant.

Table 123. Vegetation Cover and Frequency for Maritime Upland Tall Alder Shrub (n=6[1]). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	SD	%
Total Live Cover	96.4	41.8	100
Total Vascular Cover	96.1	41.0	100
Total Evergreen Tree Cover	0.0	0.0	17
Picea sitchensis	0.0	0.0	17
Total Deciduous Tree Cover	0.0	0.0	17
Populus trichocarpa	0.0	0.0	17
Total Deciduous Shrub Cover	90.7	39.0	100
Alnus sinuata	56.7	16.0	100
Oplopanax horridus	3.7	2.1	100
Rubus spectabilis	27.5	29.4	100
Sambucus racemosa	1.5	2.0	83
Salix sitchensis	1.6	2.3	33
Total Forb Cover	5.3	3.8	100
Athyrium filix-femina ssp. *cyclosorum*	2.7	2.6	67
Dryopteris dilatata ssp. *americana*	1.0	2.0	33
Heracleum lanatum	1.7	1.5	67
Total Nonvascular Cover[2]	2.0		
Total Moss Cover*	2.0		
Brachythecium sp.	1.0		
Hypnum sp.	1.0		
Total Bare Ground	2.5	3.9	50
Soil	2.2	4.0	33
Litter Alone[2]	2.0		
Water	0.0		

[1]Data: ABR n=1, GRS n=5.
[2]ABR data only

Soils

Soils are blocky, well drained, and have moderately thin organic horizons (Table 124). Eolian silt caps and surface fragments are absent. Thaw depths could not be determined in these soils, but permafrost is assumed to be absent. Soil pH is acidic and electrical conductivity is low. Depth to groundwater is > 1 m in these well drained soils. Soil sampling for this ecotype was limited to one site.

Table 124. Soil characteristics for Maritime Upland Tall Alder Shrub. Standard Deviations could not be calculated dune to n=1. Blanks = no data.

Property	Mean	SD	n
Surface Organics Depth (cm)	10.0		1
Cumulative Org. in 40 cm (cm)	10.0		1
Loess Cap Thickness(cm)			0
Depth to Rocks (cm)	20.0		1
Surface Fragment Cover (%)	0.1		1
Frost Boil Cover (%)			0
Thaw Depth (cm)[a]	100.0		1
Site pH at 10-cm depth	3.4		1
Site EC at 10-cm depth (µS/cm)	150.0		1
Water Depth (cm, + above gnd)[a]	-100.0		1

[a] Measurements >1 m indicate minimum depth, not true depth

The dominant soil subgroup association is Humic Dystrocryepts (well drained, acidic, organic-rich, partially developed horizons). No other soil subgroup associations occur.

This ecotype and associated soils are part of the broader landtype association Maritime Upland Rocky-sandy Scrub and Forests. Also included is Maritime Upland Sitka Spruce Forest.

ALPINE LAKE

Geomorphology:

Alpine lakes occur in substantial depressions formed in glacial moraine or by thawing of permafrost. These lakes mostly are circumneutral, although pH can vary from acidic to basic. Vegetation usually is present and there may be live cover as well as plant litter along the shoreline.

Floristic classes were not developed for lake ecotypes. Plant species in alpine lakes include mosses, sedges, or aquatic forbs. Typical shoreline emergent species are *Eriophorum angustifolium, Carex aquatilis,* and *Menyanthes trifoliata. Potamogeton* species are the most common aquatics (Table 125).

Table 125. Vegetation cover and frequency for Alpine Lake (n=5). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	34.3	56.8	100
Total Vascular Cover	27.9	43.7	100
Total Forb Cover	3.4	6.6	80
Equisetum arvense	0.0	0.0	20
Isoetes sp.	0.0	0.0	20
Menyanthes trifoliata	3.0	6.7	20
Potamogeton gramineus	0.0	0.0	20
Potamogeton sp.	0.0	0.0	20
Ranunculus reptans	0.0	0.0	20
Ranunculus trichophyllus	0.0	0.0	20
Sparganium angustifolium	0.0	0.0	20
Sparganium sp.	0.2	0.4	40
Total Grass Cover	0.0	0.0	20
Arctagrostis latifolia	0.0	0.0	20

Table 125. Continued.

	Cover Mean	SD	Freq %
Total Sedge & Rush Cover	24.5	45.4	80
Carex aquatilis ssp. *aquatilis*	6.2	8.8	60
Carex limosa	0.2	0.4	20
Carex membranacea	0.2	0.4	20
Carex saxatilis	0.0	0.0	20
Carex stylosa	1.0	2.2	20
Eleocharis acicularis	0.4	0.9	20
Eriophorum angustifolium	16.4	35.6	40
Eriophorum scheuchzeri	0.0	0.0	20
Eriophorum vaginatum	0.0	0.0	20
Juncus alpinus	0.0	0.0	20
Total Nonvascular Cover	6.4	13.2	60
Total Moss Cover	6.4	13.2	60
Scorpidium scorpioides	0.4	0.9	40
Unknown moss	6.0	13.4	20
Total Bare Ground	92.8	12.9	100
Soil	1.0	2.2	20
Litter Alone	3.0	6.7	20
Water	88.8	13.2	100

Soils

Flooded soils were not described. Water characteristics are listed in Table 126.

Table 126. Summary of water chemistry and depth for Alpine Lake.

Property	Mean	SD	n
Site pH	6.4	0.3	7
Site EC(µS/cm)	30.0	15.3	7
Water Depth (cm, + above gnd)[a]	109.2	77.6	6

[a] Measurements >1 m indicate minimum depth, not true depth

NEARSHORE WATER

Geomorphology:

Nearshore Water includes the saline waters of Yakutat Bay, Disenchantment Bay, Icy Bay, and the Gulf of Alaska.

Soils

Flooded soils were not described. Water characteristics are listed in Table 127.

Table 127. Summary of water chemistry and depth for Nearshore Water.

Property	Mean	SD	n
Site pH	8.0	0.1	2
Site EC (µS/cm)	37500.0	3535.5	2
Water Depth (cm, + above gnd)[a]	>200.0	0.0	2

[a] Measurements >1 m indicate minimum depth, not true depth

GLACIAL LAKE

Geomorphology:

Glacial Lakes occur in isolated young morainal kettles and basins below the alpine zone. Aquatic vegetation is absent and water chemistry is basic.

Glacial lakes differentiated from Alpine Lakes and Lowland Lakes by their occurrence within younger moraines. Active glacial thermokarst leads to higher turbidity and alkalinity. Lowland Lakes on older moraines have well-vegetated margins and clearer, humic-rich water.

Soils

Flooded soils were not described. Water characteristics are listed in Table 128.

Table 128. Summary of water chemistry and depth for Glacial Lake.

Property	Mean	SD	n
Site pH	8.7		1
Site EC(μS/cm)	350.0		1
Water Depth (cm, + above gnd)[a]	300.0		1

[a] Measurements >1 m indicate minimum depth, not true depth

GLACIAL RIVER

Geomorphology:

Glacial Rivers are common throughout the park and are hydrologically linked to discharge from melting glaciers. These rivers are highly turbid, alkaline, and have peak discharge in July. Examples include the Chitina, Nabesna, Chisana, Bremner, White, and Nizina Rivers. Nearly all the large, mappable rivers in the park are Glacial Rivers; Nonglacial Rivers were not sampled in our work and were differentiated for mapping.

Soils

Flooded soils were not described. Water characteristics are listed in Table 129.

Table 129. Summary of water chemistry and depth for Glacial River.

Property	Mean	SD	n
Site pH	7.7	0.7	6
Site EC (μS/cm)	181.7	105.2	6
Water Depth (cm, + above gnd)[a]	60.0	31.6	6

[a] Measurements >1 m indicate minimum depth, not true depth

LOWLAND LAKE

Geomorphology:

Lowland lakes are common throughout the study area. This ecotype occupies both deep and shallow kettle and thermokarst depressions. Beaver ponds are also a component of this ecotype. These lakes have a circumneutral or basic pH.

Plant Association:

No plant associations were developed for Lowland Lakes. However, two types of associations appear prevalent (Table 130). One is dominated by the pondlily *Nuphar polysepalum*, while the other is dominated by the pondweek Potamogeton spp. (where pondlily is not present). The ecotype has the highest species richness of all water ecotypes. Other common species include *Hippuris vulgaris*, *Utricularia* spp., and *Myriophyllum* spp.

Table 130. Vegetation cover and frequency for Lowland Lake (n=14). Cover values of 0.0 = <0.1%.

	Cover		Freq
	Mean	**SD**	**%**
Total Live Cover	12.3	22.0	86
Total Vascular Cover	7.8	14.1	86
Total Forb Cover	7.5	14.1	86
Epilobium palustre	0.0	0.0	7
Equisetum fluviatile	0.0	0.0	7
Hippuris vulgaris	0.6	1.3	36
Menyanthes trifoliata	0.4	1.3	14
Myriophyllum sp.	1.1	4.0	7
Myriophyllum spicatum	0.0	0.0	7
Nuphar polysepalum	1.0	2.4	21
Potamogeton alpinus ssp. *tenuifolius*	0.4	1.2	14
Potamogeton gramineus	0.0	0.0	7
Potamogeton perfoliatus ssp. *richardsonii*	0.0	0.0	7
Potamogeton sp.	3.2	9.4	43
Potentilla palustris	0.1	0.3	7
Ranunculus sp.	0.4	1.3	7
Ranunculus trichophyllus	0.0	0.0	7
Sparganium angustifolium	0.1	0.3	14
Sparganium sp.	0.1	0.3	7
Utricularia intermedia	0.1	0.3	7
Utricularia minor	0.0	0.0	7
Utricularia vulgaris ssp. *macrorhiza*	0.0	0.0	14
Sparganium minimum	0.1	0.3	7
Total Grass Cover	0.2	0.8	7
Arctophila fulva	0.2	0.8	7
Total Sedge & Rush Cover	0.1	0.3	21
Carex leptalea	0.0	0.0	7
Carex utriculata	0.1	0.3	7
Eleocharis acicularis	0.0	0.0	7
Eleocharis palustris	0.0	0.0	7
Total Nonvascular Cover	4.5	16.0	14
Scorpidium scorpioides	0.2	0.8	7
Warnstorfia cf. *exannulata*	4.3	16.0	7
Total Bare Ground	99.3	2.7	100
Bare Soil	0.0	0.0	0
Litter Alone	0.1	0.3	7
Water	99.2	2.7	100

Soils

Flooded soils were not described. Water characteristics are listed in Table 131.

Table 131. Summary of water chemistry and depth for Lowland Lake.

Property	Mean	SD	n
Site pH at 10-cm depth	7.3	0.9	14
Site EC at 10-cm depth (μS/cm)	150.7	98.3	14
Water Depth (cm, + above gnd)[a]	121.7	75.3	15

[a] Measurements >1 m indicate minimum depth, not true depth

SNOW/GLACIERS

Geomorphology:

Snowfields and glaciers are abundant at high elevations throughout the park. In areas of particularly heavy snowfall along the coastal ranges, the glaciers extent down mountain valleys and occasionally into lowland areas.

Soils

No soils are associated with the snow and ice, although rocks and fine-grained debris can accumulate on the glacial surface at lower elevations.

Plant Association:

No vegetation is present on the snow and ice surfaces.

Table 132. Key to ecotypes for Wrangell-St. Elias National Park and Preserve, southcentral Alaska.[1 2]

1a. Permanent waterbody (water typically >10 cm deep) 2
  2a. Waterbody with ≥ 10% cover of emergent vegetation.............Boreal Lacustrine Pondlily
  2b. Waterbody with ≤ 10% cover of emergent vegetation...3
    3a. Site has saline or brackish water (>800 µS/cm) and is near the coast....Nearshore Water
    3b. Site does not have saline or brackish water...4
      4a. Site is a perennial river...Glacial River
      4b. Site is a lake..5
        5a. Lake is glacial, occurring on young moraine.............................Glacial Lake
        5b. Lake is otherwise................. 6
          6a. Lake occurs at ≥ 900 m elevation.......................................Alpine Lake
          6b. Lake occurs at ≤ 900 m elevation..................................Lowland Lake
1b. Not a permanent waterbody..7
  7a. Barren or partially vegetated land where total vascular plant cover <30%........................8
    8a. Site occurs on young glacial moraine...9
      9a. Site occurs in maritime areas south of Bagley Ice Field.......................................
      ....Maritime Glaciated Barrens
      9b. Site occurs in boreal areas north of Bagley Ice Field...
      ....Boreal Glaciated Barrens
    8b. Site occurs on other geomorphic types...10
      10a. Site occurs in maritime areas..11
        11a. Site occurs in salt affected coastal areas.............Maritime Coastal Barrens
        11b. Site occurs in riverine corridors........................Maritime Riverine Barrens
        11c. Site occurs in alpine areas above 800 m elevation......................................
        ....Maritime Alpine Barrens
      10b. Site occurs in boreal areas...12
        12a. Site occurs in riverine corridors............................Boreal Riverine Barrens
        12b. Site occurs in alpine areas.......................................Boreal Alpine Barrens
  7b. Vegetation cover ≥30%..13
13a. Trees have a canopy ≥10% 14
  14a. Needleleaf tree cover is 75-100% of total tree cover..15
  14b. Needleleaf tree cover is 0- 74% of total tree cover...20
13b. Trees have a canopy <10% 28
15a. Site is located in maritime zone...16
  16a. Forest is on flat surface on gravelly soils............Maritime Lowland Sitka Spruce Forest
  16b. Forest is on slopes; soil texture is variable............ Maritime Upland Sitka Spruce Forest
15b. Site is located in boreal zone..17
  17a. Dominant tree species is black spruce (*Picea mariana*)..18
    18a. Soils are organic or peat-dominated; site is frequently located in a bog ....Boreal Lowland Black Spruce Bog
    18b. Soils are loamy, rocky or sandy; site occurs on slopes or flatlands ....Boreal Lowland Black Spruce Forest
  17b. Dominant tree species is white spruce (*Picea glauca*)..19

Table 132. Continued.

19a. Site occurs on inactive overbank deposits in riverine corridors........................ ....Boreal Riverine White Spruce Forest
19b. Site occurs on abandoned deposits or flat planes or terraces........................... ....Boreal Lowland White Spruce Forest
19c. Site occurs on slopes in the subalpine zone, often at treeline; forest is a woodland (10-24% cover)....................................... ....Boreal Subalpine Spruce Woodland
19d. Site occurs on upland slopes; does not occur near treeline; forest is open (25-59%) or woodland..Boreal Upland White Spruce Forest
20a. Broadleaf trees comprise >75% of total tree cover...21
21a. Dominant tree species is paper birch (*Betula papyrifera*)......Boreal Upland Birch Forest
21b. Dominant tree species is aspen (*Populus tremuloides*).........Boreal Upland Aspen Forest
21c. Dominant tree species is balsam poplar (*Populus balsamifera*)....................................22
22a. Occurs on well drained slopes in the boreal zone.....Boreal Subalpine Poplar Forest
22b.Occurs in riverine corridors..23
23a. Occurs on overbank deposits; soils are loamy, well drained and moist.............. ....Boreal Riverine Loamy Poplar Forest
23b. Occurs on channel deposits; soils are coarser and somewhat excessively drained...Boreal Riverine Gravelly Poplar Forest
21d. Dominant tree species is black cottonwood (*Populus trichocarpa*)..............................24
24a. Occurs on inactive riverine channel deposits.. ....Maritime Riverine Cottonwood Forest
24b. Occurs on young moraine or glaciofluvial deposits... ....Maritime Lowland Cottonwood Forest
20b. Stand consists of a mix of broadleaf and needleleaf species, with neither one having >75% of total tree cover...25
25a. Dominant deciduous tree species is paper birch........Boreal Upland Spruce–Birch Forest
25b. Dominant deciduous tree species is poplar...26
26a. Dominant needleleaf tree species is white spruce.. ....Boreal Riverine Spruce–Poplar Forest
26b. Dominant needleleaf tree species is Sitka spruce (*Picea sitchensis*) or occasionally hemlock (*Tsuga heterophylla*)...27
27a. Occurs on inactive deposits in riverine areas.. ....Maritime Riverine Cottonwood–Spruce Forest
27b. Occurs on abandoned cover deposits in lowland areas....................................... ....Maritime Lowland Cottonwood–Spruce Forest
28a. Shrub canopy cover is ≥25 %, shrub height is ≥ 0.2 m tall, and tussock cover is <25%.......29
28b. Shrub canopy cover is ≥25 %, shrub height is < 0.2 m tall, and tussock cover is <25%......39
28c. Shrub canopy cover is ≥25 % and tussock cover is ≥25 %.. ....Boreal Lowland Tussock–Shrub Bog
28d. Shrub canopy cover is <25 %..44
29a. Occurs on young moraine; early successional species are present................................30
30a. Occurs in the boreal zone; common species include *Salix glauca* and *Salix niphoclada*..Boreal Glaciated Willow Shrub
30b. Occurs in maritime areas; common species include *Alnus sinuata* and *Salix sitchensis*...Maritime Glaciated Tall Alder–Willow Shrub
29b. Does not occur on young moraine..31

Table 132. Continued.

31a. Occurs primarily on upper slopes or on well drained lower slopes........................32
32a. Blueberry (*Vaccinium ovalifolium* or *V. alaskensis*) is the dominant species present..Maritime Subalpine Low Blueberry Shrub
32b. Alder (*Alnus* spp.) is the dominant species present..33
33a. Occurs in the boreal zone on well drained slopes.. ....Boreal Upland Tall Alder Shrub
33b. Occurs in the maritime zone on well drained slopes.................................... ....Maritime Upland Tall Alder Shrub
32c. Alder or blueberry may be present but are not the dominant species................. ....Boreal Subalpine Willow–Birch Shrub
31b. Occurs on flatlands, riverine corridors, or on poorly drained slopes......................34
34a. Site is in an organic fen..................Boreal Lowland Sedge–Shrub Fen (*in part*)
34b. Site is on older moraine, loess deposits or abandoned cover deposits............35
35a. Shrubs are <1.5 m tall.............Boreal Lowland Low Birch–Willow Shrub
35b. Shrubs are ≥1.5 m tall; site is in the boreal zone and is dominated by willow species..Boreal Lowland Tall Willow Shrub
35c. Shrubs are ≥1.5 m tall; site is in the maritime zone and is co-dominated by alder and willow species..............Maritime Lowland Tall Alder–Willow Shrub
34c. Site is on overbank or channel deposits in riverine corridors.........................36
36a. Occurs in maritime zone........Maritime Riverine Tall Alder–Willow Shrub
36b. Occurs in boreal zone..37
37a. Dominant shrub species is silverberry (*Eleagnus commutata*)............ ....Boreal Riverine Low Silverberry Shrub
37b. Dominant shrub species is alder.......Boreal Riverine Tall Alder Shrub
37c. Dominant shrub species is willow...38
38a. Soils are loamy and somewhat poorly drained; pH <7.4.............. ....Boreal Riverine Loamy Willow Shrub
38b. Soils are sandy and well drained; pH ≥ 7.4.................................. ....Boreal Riverine Sandy Willow Shrub
39a. The most common shrub species present is mountain-avens (*Dryas* spp.)..........................40
40a. *Dryas octopetala* or *Dryas integrifolia* are the dominant species; site is >1200 m elevation ....Boreal Alpine Dryas Dwarf Shrub
40b. *Dryas drummondii* is the dominant species; site is <1200 m elevation........................41
41a. Site is on young moraine.................................Boreal Glaciated Dryas Dwarf Shrub
40a. Site is in riverine areas.....................................Boreal Riverine Dryas Dwarf Shrub
39b. The most common shrub species present is not mountain-avens..42
42a. Sagebrush (*Artemisia* spp.) is dominant; site is dry....Boreal Upland Sagebrush Meadow
42b. Dwarf willows are dominant; site is moist or wet.. ....Boreal Alpine Sedge–Dwarf Willow Meadow
42c. Ericaceous species are dominant; site is moist...43
43a. Site is in the maritime zone........................Maritime Alpine Cassiope Dwarf Shrub
43b. Site is in the boreal zone..............................Boreal Alpine Ericaceous Dwarf Shrub
44a. Vegetation is dominated by forbs..45
44b. Vegetation is dominated by graminoids...47
45a. Site is in boreal zone..Boreal Subalpine Forb Meadow
45b. Site is in maritime zone...46

Table 132. Continued.

46a. Occurs in coastal areas, dominated by cow parsnip (*Angelica lucida*)..Maritime Coastal Angelica Meadow
46b. Occurs in riverine areas at <100 m elevation; dominated by horsetails (*Equisetum spp.*)..Maritime Riverine Horsetail Meadow
46c. Occurs on flat abandoned channel or cover deposits, or organic fens at < 100 m elevation; horsetails are present but not dominant and willows are present..Maritime Lowland Forb-Willow Meadow
46d. Occurs >100 m elevation; dominated by lupine (*Lupinus nootkatensis*)...Maritime Subalpine Lupine Meadow
47a. Site elevation is >1000 m..48
48a. Tussocks are absent..Boreal Alpine Sedge Meadow
48b. Tussocks are present (usually >25% cover)..................Boreal Alpine Tussock Meadow
47b. Site elevation is ≤ 1000 m..49
49a. Site is in salt-affected coastal areas..50
50a. Occurs on active sand deposits; soils are dry or moist...Maritime Coastal Elymus Meadow
50b. Occurs on tidal flats; soils are wet or flooded.......Maritime Coastal Sedge Meadow
49b. Site is not in salt-affected coastal areas..51
51a. Site is in maritime zone.......................Maritime Coastal Sedge–Blueberry Meadow
51b. Site is in the boreal zone..52
52a. Although graminoids are dominant, shrubs are also present..Boreal Lowland Sedge–Shrub Fen (*in part*)
52b. Graminoids are the dominant lifeform; shrubs are mostly absent..Boreal Lacustrine Sedge Meadow

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Note:

1. Shrub cover cutpoints represent general guidelines and classification decisions should also rely on dominant indicator species and landscape position.

2. Rare ecotypes were not included in mapping and analysis. These include Boreal Alpine Alkaline Barrens, Boreal Alpine Alkaline Dryas Dwarf Shrub, Boreal Subalpine Sagebrush Meadow, Boreal Upland Tall Willow Shrub, Maritime Coastal Brackish Barrens, Maritime Riverine Tall Willow Shrub, and Maritime Subalpine Fauria Meadow.

SOIL LANDSCAPES

CLASSIFICATION AND DESCRIPTION OF SOIL LANDSCAPES

The widely varying soils and associated vegetation were aggregated into 25 soil landscapes, or landtype associations, based on the frequency of occurrence of each soil type and ecotype (Tables 133–134). Five of the soil landscapes are waterbody types and glaciers. The cross-tabulation identifies similar soils (subgroup level) that were most frequently associated with similar ecotypes. The associations are grouped within the black boxes in the tables. The association of specific soil subgroups with each aggregated soil landscape is provided in Table 135.

This aggregation reduces the complexity of the landscape into a set of landscape-level ecosystems that are useful for analysis of broad ecological patterns, natural resource management, and mapping. The soils and vegetation that are grouped within each soil landscape are highly related. Species composition is highly similar and often varies only in the percent cover of the dominant species. Soils also vary only slightly within an association. Often, small differences in characteristics can place soils on opposite sides of a cutpoint used for classification. For example, a pH difference of 5.4 versus 5.6 is sufficient to differentiate Dystrocryepts from Eutrocryepts. Similarly, small differences in organic horizon thickness between 19 and 21 cm distinguish two soil subgroups. Aggregation into soil landscapes avoids this splitting based on minor differences.

The generalized characteristics of each soil landscape are provided below. For more detail, the reader can refer to the descriptions of the individual ecotypes (see section on Ecotype Descriptions) associated with each soil landscape. Brief, generalized characteristics are included in parentheses for the dominant soil types. These soil landscapes have been mapped by recoding the ecotype map (see Mapping section).

BOREAL ALPINE ROCKY BARRENS AND SCRUB

This soil landscape is comprised of three ecotypes: Boreal Alpine Barrens, Boreal Dryas Dwarf Shrub, and Boreal Ericaceous Dwarf Shrub. It is common at high elevations on steep to flat terrain on a wide range of intrusive, metamorphic, and sedimentary bedrock types, hillslope colluvium, talus, and older and younger moraines.

Soils are mostly rocky, excessively to well drained, and dry to moist. Soil pH ranges from acidic on non-carbonate bedrock to alkaline on carbonate rocks, such as limestone. Well developed B horizons are often present beneath thin organic layers. Permafrost probably is present below 1 m because of the high elevations, but is difficult to verify because of the rocky soils Groundwater is too deep to affect soils and plant growth. Soils are dominated by three soil subgroups: Typic Dystrogelepts, Typic Eutrogelepts, and Humic Eutrogelepts. Less common soil types include Typic Gelorthents, Humic Dystrocryepts, Typic Haplorthels, and Typic Aquiturbels.

Vegetation is dominated by dwarf shrubs (Dryas octopetala, Dryas integrifolia, Salix polaris, Salix reticulata, Cassiope tetragona, Vaccinium uliginosum, Empetrum nigrum), with only minor amounts of forbs (Oxytropis nigrescens, Pedicularis capitata), grasses (Hierochloe alpine, Festuca altaica), mosses (Hylocomium *splendens Racomitrium* sp.), and lichens (*Stereocaulon* sp.). Barren or partially vegetated areas have similar species, but with greatly reduced coverage.

BOREAL ALPINE ROCKY-LOAMY MEADOWS

This soil landscape is dominated by Boreal Alpine Sedge-dwarf Shrub Meadow, while Boreal Alpine Tussock Meadow is occasionally present in the northern portion of the park. It occurs at high elevations on moderately steep to flat terrain that includes hillside colluvium, older and younger moraine, solifluction deposits, upland loess deposits, and alluvial fan abandoned deposits.

Soils range from moderately well to poorly drained, moist to wet, rocky to loamy, and from circumneutral to acidic. Permafrost is always present. Soils are dominated by four soil subgroups. Better drained sites with Boreal Alpine Sedge-dwarf Shrub Meadows are dominated by Typic Dystrogelepts and Typic Eutrogelepts, depending on soil pH associated with bedrock chemistry. Poorly drained sites with Boreal Alpine Tussock Meadows are dominated by the wet permafrost-affected soils Typic Aquiturbels and Typic Aquorthels. Less common soils, with thicker

Table 133. Soil landscapes (highlight in boxes) identified by cross-tabulation of similar soil subgroups (soil associations) with closely associated boreal ecotypes. Bolded values indicate soil subgroups mostly closely associated with each ecotype.

Soil Class	B. Glaciated Barrens	B. Glac. Dryas Dwarf Shrub	B. Glaciated Willow Shrub	B. Alpine Barrens	B. Alpine Dryas Dwarf Shrub	B. Alpine Ericaceous Dwarf Shrub	Bor. Alp. Sedge-Dwarf Willow Meadow	B. Alpine Tussock Meadow	B. Alpine Sedge Meadow	B. Subalpine Forb Meadow	B. Subalp. Willow & Birch Shr.	B. Subalpine Poplar Forest	B. Subalpine Spruce Woodland	B. Upland Sagebrush Meadow	B. Upland Aspen Forest	B. Upland Tall Alder Shrub	B. Upland Birch Forest	B. Upland Spruce-Birch Forest	B. Upland White Spruce Forest	B. Lowland White Spruce Forest	B. Lowland Tall Willow Shrub	B. Lowl. Low Birch-Willow Shr.	B. Lowland Black Spruce Forest	B. Lowland Tussock-Shrub Bog	B. Lowland Black Spruce Bog	B. Lowland Sedge-Shrub Fen	B. Lacustrine Sedge Meadow	B. Rive. Circumalkaline Barrens	B. Riverine Acidic Barrens	B. Riverine Low Silverberry Shrub	B. Riverine Dryas Dwarf Shrub	B. Riverine Sandy Willow Shrub	B. Riverine Loamy Willow Shr.	B. Riverine Tall Alder Shrub	B. Riverine Gravelly Poplar Forest	B. Riverine Loamy Poplar Forest	B. Riverine Spruce-Poplar Forest	B. Riverine White Spruce Forest	Grand Total
Typic Gelorthents	**2**	**2**	**3**	**4**							1																												12
Rubble				2																																			2
Humic Eutrogelepts					**3**	2																																	5
Typic Dystrogelepts				1	**5**	**5**	**4**				3																												18
Typic Eutrogelepts				1	**7**	**7**	**5**				5																												25
Humic Dystrogelepts				2		1	2			**2**	1										1																		9
Ustic Eutrocryepts														**2**	**3**																								5
Humic Eutrocryepts											3	1				1																							5
Spodic dystrocryepts											4				1		1																						6
Typic Haplocryods											**8**				1		1	1	1		1																		13
Typic Haplocryolls											2	1				2			1																				6
Humic dystrocryepts										1	2	1				**5**				1							2												12
Typic dystrocryepts										1	**9**				1	2	**3**	**4**	**3**	**2**	**3**		1				1										1		31
Typic Eutrocryepts											4	**3**	**1**		1	1			**4**	1		1	1															1	18
Histic Cryaquepts																				1		**2**					1												4
Typic Historthels							1				1					1				**2**				**3**	1	1	1												11
Aquic Haploturbels											2												3																5
Typic Aquiturbels					1	1	1	2			2											1	**3**	2															13
Typic Aquorthels							**5**	**1**	1		5							1					**4**	2	1		1												21
Typic Histoturbels							2		1		1													1	**4**														9
Terric Hemistels																									**4**		2												6
Typic Hemistels								1	**1**																**3**	2													7
Typic Fibristels									**6**															2		3	**2**												13
Typic Cryofibrists																										**10**	**6**												16
Typic Cryohemist																										**3**													3
Terric Cryohemist																										**3**	1												4
Typic Cryaquents																											1							**3**					4
Oxyaquic Cryorth.																												**6**	**4**	**4**	1	**2**	**2**	**4**	1				24
Typic Cryorthent											2			**4**	**2**													2	1	2	**2**	1		2	**4**	**6**	**3**	**4**	35
Grand Total	2	2	3	10	16	16	20	4	9	4	55	6	1	6	9	12	5	6	9	7	5	4	12	10	13	22	18	8	5	6	3	3	2	9	5	6	4	5	342
Total count within box			7			37	20		7				57		11				25		8				31		31							36				17	289
Total count within columns			7			42	24		9				66		15				32		12				35		44							36				20	342
Percent of box within columns			100			88	83		78				86		73				78		67				89		70							100				85	85

Table 134. Soil landscapes (highlight in boxes) identified by cross-tabulation of similar soil subgroups (soil associations) with closely associated maritime ecotypes. Bolded values indicate soil subgroups mostly closely associated with each ecotype.

	Maritime Alpine Rocky Dry Acidic Barrens	Maritime Alpine Rocky Moist Acidic Cassiope Dwarf Shrub	Maritime Subalpine Rocky Moist Lupine Meadow	Maritime Subalpine Rocky Moist Low Blueberry Shrub	Maritime Upland Rocky Moist Cottonwood Forest	Maritime Upland Rocky Moist Tall Alder Shrub	Maritime Upland Moist Spruce Forest	Maritime Lowland Gravelly Moist Cottonwood–Spruce Forest	Maritime Lowland Gravelly Moist Spruce Forest	Maritime Lowland Gravelly Moist Cottonwood Forest	Maritime Lowland Gravelly Moist Tall Alder–Willow Shrub	Maritime Lowland Wet Forb–Willow Meadow	Maritime Lowland Sedge–Blueberry Bog	Maritime Glaciated Gravelly Moist Barrens	Maritime Glaciated Rocky Moist Tall Alder-Willow Shrub	Maritime Riverine Gravelly Moist Barrens	Maritime Riverine Gravelly Moist Tall Alder–Willow Shrub	Maritime Riverine Gravelly Moist Cottonwood Forest	Maritime Riverine Gravelly Moist Cottonwood–Spruce Forest	Maritime Riverine Loamy Wet Horsetail Meadow	Maritime Coastal Sandy Moist Angelica Meadow	Maritime Coastal Sandy Dry Elymus Meadow	Mar. Coastal Gravelly Moist Saline Barrens	Maritime Coastal Loamy Wet Brackish Sedge Meadow	Grand Total
Typic Dystrogelepts	1	1																							2
Typic Humicryods		1																							2
Humic dystrocryepts		2	3	1		1	1																		8
Typic dystrocryepts				1			3	2		1					1										9
Typic Haplocryods				1					1																2
Spodic dystrocryepts								1										1							2
Typic Eutrocryepts								1																	1
Typic cryaquepts												1													1
Histic Cryaquepts													1		1										2
Humic Cryaquepts												1													2
Terric Cryofibrist												1	1												3
Typic Cryorthent	1				1					1	1				2	4	2	2					1		1
Oxyaquic Cryorthents																1	1		2						4
Typic Cryaquents														2		2	2			1				2	1
Aquic Cryofluvent											1									2					3
Oxyaquic Cryofluvent																									1
Typic Cryopsamments							1								2						2	2	1		8
Oxyaquic Cryopsamments																					2	2			4
Typic Cryaquents (brackish)																								1	2
Grand Total	2	4	3	3	1	1	4	4	1	2	2	3	2	2	6	7	5	3	2	3	4	4	2	3	8

Table 135. Crosswalk of soil subgroups and their equivalent soil landscape, Wrangell-St. Elias National Park and Preserve.

Soil_Class	Boreal Glaciated Rocky Barrens and Scrub	Maritime Alpine Rocky Barrens and Scrub	Boreal Alpine Rocky Barrens and Scrub	Boreal Alpine Rocky-Loamy Meadows	Boreal Subalpine Rocky Scrub and Woodlands	Boreal Upland Rocky-loamy Scrub and Forests	Boreal Lowland Loamy Scrub and Forests	Boreal Lowland Scrub and Forest Bogs	Boreal Lowland Organic-rich Meadows	Boreal Alpine Organic-rich Meadows	Maritime Subalpine Rocky Meadows and Scrub	Maritime Upland Rocky-sandy Scrub and Forests	Maritime Lowland Gravelly Scrub and Forests	Maritime Lowland Bogs and Fens	Boreal Riverine Rocky-loamy Barrens and Scrub	Maritime Riverine Gravelly Barrens and Scrub	Boreal Riverine Rocky-loamy Forests	Maritime Riverine Gravelly Forests	Marine Glaciated Rocky Barrens and Scrub	Maritime Coastal Barrens and Meadows	Grand Total
Typic Gelorthents	**7**		**4**		1																12
Humic Eutrogelepts			**5**																		5
Typic Eutrogelepts			**15**	**5**	**5**																25
Typic Dystrogelepts		**2**	**11**	**4**	3																20
Humic Dystrogelepts			3	2	3		1														9
Typic Haploturbels			2		2	1															5
Typic Aquiturbels			2	**3**	2			**6**													13
Typic Histoturbels				2	1			**5**		1											9
Aquic Haploturbels					2			3													5
Humic Eutrocryepts					**4**																4
Ustic Eutrocryepts						**5**															5
Typic Eutrocryepts					**8**	**6**	1	2					1				1				19
Spodic dystrocryepts					**4**	2							1					1			8
Typic Humicryods		1			2	1					1										5
Typic Haplocryods					**8**	**4**	1				**1**		**1**								15
Typic dystrocryepts					**10**	**13**	**5**	1	1		**1**	**3**	**3**				1		1		39
Humic dystrocryepts		**2**			**4**	3	1		2		**4**	**2**									18
Typic cryaquepts						1	1		1					**1**							4
Histic Cryaquepts							**1**	2	1					**1**					1		6
Typic Gelaquepts					1				1	**2**											4
Aquic Haplorthels					1	2		1													4
Typic Historthels				1	1	1	**2**	**4**	**2**												11
Typic Aquorthels				**5**	**5**	1		**7**	1	**2**											21
Terric Hemistels								**4**	2												6
Typic Hemistels				1				**3**	2	1											7
Typic Fibristels								2	**5**	**6**											13
Typic Cryofibrists									**16**												16
Typic Cryohemist									**3**												3
Terric Cryofibrists									**4**					**2**							6
Oxyaquic Cryorthents															**22**	2	1	**2**			27
Typic Cryaquents									1						3	**5**			**2**	**2**	13
Typic Cryorthent		**1**			2	**6**							**3**		**10**	**6**	**17**	**2**	**2**	1	50
Typic Cryopsamments												1					1		**2**	**5**	9
Oxyaquic Cryopsam.															1					**4**	5
Subtotals	7	6	42	23	69	46	13	40	42	12	7	6	9	4	36	13	21	5	8	12	421

organic horizons, include Humic Dystrogelepts, Typic Historthels, Typic Histurbels, and Typic Hemistels.

Vegetation of Boreal Alpine Sedge-dwarf Shrub Meadows is dominated by sedges (*Carex aquatilis, C. bigelowii*) and dwarf shrubs (*Salix planifolia* ssp. *pulchra, Drya*s spp.). Forbs (*Polygonum viviparum*, and *Petasites frigidus*) contribute minor cover. Tussock meadows are dominated by tussock-forming sedges (*Eriophorum vaginatum*), dwarf shrubs (*Cassiope tetragona, Ledum decumbens, Vaccinium vitis-idaea*, *Salix reticulata*), and mosses. Forbs (*Polygonum viviparum*) and lichens (*Flavocetraria cucullata*) contribute little cover.

BOREAL ALPINE ORGANIC-RICH MEADOWS

Only one ecotype, Boreal Alpine Sedge Meadow, is included in this soil landscape, indicating its unique properties. The terrain includes drainages, swales, and lake margins at elevations above 900 m. Geomorphic deposits include hillside colluvium, lacustrine and solifluction deposits, older moraine, and organic fens. This soil landscape is uncommon and has distinctly different soils and vegetation from other soil landscapes.

Soils are wet, circumneutral to acidic, and have thick surface organic horizons. Permafrost is always found at shallow depths. Soils are dominated by one soil subgroup, Typic Fibristels, which have >40 cm of poorly decomposed peat. Less common soils include the wet permafrost-affected soils Typic Hemistels, Typic Histoturbels, and Typic Aquorthels, with varying levels of organic matter accumulation.

Vegetation is dominated by sedges (*Eriophorum angustifolium, Carex aquatilis, C. stylosa, C. atrofusca*), and low shrubs (*Salix pulchra*). Forbs (*Saxifraga hirculis, Polemonium acutiflorum*) are common.

BOREAL SUBALPINE ROCKY SCRUB AND WOODLANDS

This diverse soil landscape is dominated by Boreal Subalpine Willow and Birch Shrub. Boreal Subalpine Forb Meadow, Boreal Subalpine Poplar Forest, and Boreal Subalpine Spruce Woodland occur as scattered patches or narrow transition zones between forested uplands and dwarf-shrub tundra in higher alpine areas. Terrain includes hillside colluvium, loess deposits, older moraine, retransported deposits, margins of high elevation thaw basins, inactive alluvial fan deposits, and lacustrine deposits.

Soils are predominantly sandy to rubbly, somewhat excessively to somewhat poorly drained, and circumneutral to acidic. Permafrost status is usually difficult to determine in the rocky soils. A high diversity of soil types is associated with the wide ranging terrain conditions, although the most common on well drained sites are Typic Haplocryods, Typic Dystrocryepts, and Typic Eutrogelepts. Less common soil types, found on well drained sites, include Typic Dystrogelepts, Humic Eutrocryepts, Typic Haplocryolls, Humic Dystrocryepts, and Typic Eutrocryepts. Steep, unstable sites have Typic Cryorthents and Typic Gelorthents. Poorly drained sites usually have permafrost soils, including Typic Aquorthels, Aquic Haploturbels, and Typic Aquiturbels.

Vegetation is dominated by a range of growth forms from forbs to low shrubs to needleleaf forests. Forb meadows are dominated by forbs (*Valeriana capitata, Epilobium angustifolium, Mertensia paniculata, Aconitum delphinifolium, Petasites frigidus*), dwarf shrubs (*Artemisia arctica*), and grasses (*Festuca altaica*). Low shrub communities have similar forbs, but are dominated by low and dwarf shrubs (*Betula nana, Salix pulchra, S. glauca, Vaccinium vitis-idaea*). White spruce woodlands have a more cover of dwarf shrubs (*Vaccinium uliginosum, Empetrum nigrum, Vaccinium vitis-idaea*) and mosses (*Hylocomium splendens*), whereas balsam poplar forests have more low shrubs (*Rosa acicularis*) and forbs (*Mertensia paniculata, Epilobium angustifolium*).

BOREAL GLACIATED ROCKY BARRENS AND SCRUB

This soil landscape consists of Boreal Glaciated Barrens, Boreal Glaciated Dryas Dwarf Shrub and Boreal Glaciated Willow Shrub. It occurs on undulating moraine complexes, crests and slopes on younger moraine below 1500 m elevation throughout the park.

Soils are dry, well to excessively drained, and lack surface organic matter horizons. Textures are predominantly blocky, rubbly or bouldery. Permafrost is commonly present. Soil pH is alkaline. Soils consist of one soil subgroup, Typic Gelorthents, which undergo active sediment deposition and have permafrost at >100cm depth.

Vegetation ranges from barrens to several shrub types, depending on successional age since deglaciation. Older sites are occupied by open low and tall willow canopies (Salix alaxensis, Salix niphoclada) with evergreen shrubs (Arctostaphylos uva-ursi, Dryas drummondii), and mosses (Ceratodon purpureus) in the understory. Intermediate-aged sites are occupied by dwarf shrubs (Dryas drummondii) with some low shrubs (*Sheperdia canadensis, Salix alaxensis*) present. The youngest sites are barren with <5% vegetation. Species present are similar to those in the shrub communities.

BOREAL UPLAND ROCKY-LOAMY SCRUB AND FORESTS

This soil landscape is prevalent on slopes under 1000 m elevation on hillslope colluvium, upland loess, older moraine, upland glaciolacustrine deposits, talus bluffs, and landslide deposits. Several ecotypes are included, of which Boreal Upland Tall Alder Shrub and Boreal Upland White Spruce Forest are the most common. Boreal Upland Birch Forest and Boreal Upland Spruce-Paper Birch Forest are less prevalent and form patches on acidic soils.

Soils are well to moderately drained and vary from loamy to gravelly, sandy, rubbly or blocky. Permafrost generally is absent. Soil pH is acidic to circumneutral. Typic Dystrocryepts (pH < 5.5, well drained with a developed B horizon) are the most common soils and occur in all communities. Typic Haplocryods (well drained, acidic, well-developed horizons, and highly leached) also occur across a wide range of terrain. Less common soil types include Typic Humicryods, Spodic Dystrocryepts, Typic Cryaquepts, Typic Haplorthels, Typic Aquorthels and Typic Historthels.

Vegetation is primarily forest or tall shrub. In white spruce forests, low shrubs (Rosa acicularis), forbs (Equisetum scirpiodes, Geocaulon lividum), mosses (Hylocomium splendens), and lichens (Cladonia spp.) characterize the understory. Paper birch and spruce-birch forests have greater cover of forbs (Equisetum arvense, Mertensia paniculata) and grasses (Calamagrostis canadensis), with less moss cover (Hylocomium splendens). Tall shrub communities are predominantly alder (Alnus crispa, Alnus sinuata) with low shrubs (Ribes triste), forbs (Epilobium angustifolium, Mertensia paniculata), and graminoids (Calamagrostis canadensis) in the understory.

Two dry ecotypes are included in this soil landscape; Boreal Upland Aspen Forest and Boreal Upland Sagebrush Meadow. They are restricted to dry, steep, typically south-facing bluffs or banks adjacent to river floodplains, mostly below 1000 m elevation. Terrain includes upland glaciolacustrine deposits, hillslope colluvium, upland loess, older moraine, talus bluffs, and landslide deposits.

Soils are well to excessively drained and textures varies from loamy to rubbly. Permafrost is absent. Soil pH is alkaline to circumneutral. The most prevalent soil subgroup is Ustic Eutrocryept (circumneutral, well drained, permafrost free soils). Additional, less common subgroups include Typic Cryorthents, Spodic Dystrocryepts, Typic Haplocryods, Typic Eutrocryepts and Typic Dystrocryepts.

Vegetation consists of sagebrush meadows on bluffs interspersed with patches of open aspen forest. Sagebrush meadows have a distinct vegetation composition. Low deciduous shrubs (*Artemisia frigida*) are predominant, while grasses (*Calamagrostis purpurescens, Bromus pumpellianus*) and forbs (*Linum perenne, Oxytropis campestris*) contribute minor cover. Aspen forests have fewer grasses (*Calamagrostis purpurascens*) but greatly increased cover of other life forms, especially deciduous trees (*Populus tremuloides*), low shrubs (*Rosa acicularis, Sheperdia canadensis*), and forbs (*Geocaulon lividum*), as well as a minor component of mosses and lichens (*Brachythecium* sp., *Peltigera* spp.).

BOREAL LOWLAND LOAMY SCRUB AND FORESTS

This soil landscape consists of Boreal Lowland White Spruce Forest and Boreal Lowland Tall Willow Shrub communities on slopes and flatlands. It commonly occurs at <1000 m

elevation on a variety of terrain, including older moraine, lowland loess, retransported deposits, abandoned floodplain overbank deposits, lowland glaciolacustrine deposits, braided abandoned overbank deposits, glaciofluvial outwash, and lacustrine deposits.

Soils are primarily well to moderately well drained, loamy, and circumneutral to acidic. Permafrost is typically at 50 cm to >1 m depth. Soils are dominated by two soil subgroups; Typic Historthels (permafrost present, > 30% organics in top 50 cm) and Typic Dystrocryepts (well drained, acidic, permafrost absent). Soil subgroups that occur less commonly include Histic Cryaquepts, Typic Cryaquepts, Typic Haplocryods, Typic Eutrocryepts, and Humic Dystrocryepts.

Forests in this soil landscape have an understory consisting mainly of evergreen shrubs (Empetrum nigrum, *Ledum groenlandicum*), deciduous shrubs (*Arctostaphylos rubra, Salix glauca*), and mosses (*Hylocomium splendens*). In contrast, scrub communities that have developed after fire have few trees, more deciduous shrubs (*Salix scouleriana, Salix barclayi*), more forbs (*Geocaulon lividum, Epilobium angustifolium*) and fewer nonvascular plant species.

BOREAL LOWLAND SCRUB AND FOREST BOGS

This widespread soil landscape consists of a mosaic of Boreal Lowland Black Spruce Bog, Boreal Lowland Black Spruce Forest, Boreal Lowland Low Birch-Willow Shrub and Boreal Lowland Tussock-Shrub Bog. These communities occur on lower or toe slopes, flats, kettle basins and depressions. Terrain units typically are fine-grained and organic-rich and include older moraine, lowland loess, retransported deposits, braided abandoned overbank deposits, glaciofluvial outwash abandoned cover deposits, lowland glaciolacustrine deposits, lacustrine deposits, or organic bogs.

Soils are primarily organic, infrequently peats or loams. Drainage is moderately well to very poor and soil pH is circumneutral to acidic. Groundwater is typically within 0.5 m of the surface and permafrost is usually present, resulting in wet, frequently cryoturbated soils. Soil subgroups vary across this widely distributed soil landscape. Permafrost-affected soils predominate; Typic Aquorthels (wet, nonturbated), Typic Aquiturbels (wet, cryoturbated), Typic Histoturbels (wet, organic-rich, cryoturbated), Typic Historthels (wet, organic-rich, nonturbated) and Terric Hemistels (wet, partially decomposed thick peat with mineral soil within 1 m) are the most common. Less common permafrost-affected soil types include Typic Hemistels, Typic Fibristels, Aquic Haploturbels, and Aquic Haplorthels. Non-permafrost soils are rare, but include Typic Eutrocryepts, Typic Dystrocryepts, and Histic Cryaquepts.

This soil landscape consists of late successional plant communities. Black spruce forests have a preponderance of low evergreen shrubs (*Ledum groenlandicum, Vaccinium vitis-idaea*), deciduous shrubs (*Salix glauca, Salix pulchra*), few forbs (*Rubus chamaemorus, Petasites frigidus*), and typically > 60% cover of nonvascular species (*Hylocomium splendens, Aulacomnium palustre, Peltigera aphthosa*). Black spruce bogs are more open with stunted trees and greater cover of low shrubs (*Betula nana, Potentilla fruticosa, Ledum decumbens*), while mixed shrub and tussock communities have few or no trees, higher sedge cover (*Carex bigelowii, Eriophorum vaginatum*), and increased total cover of shrubs.

BOREAL LOWLAND ORGANIC-RICH MEADOWS

This soil landscape is restricted to two productive ecotypes, Boreal Lacustrine Sedge Meadow and Boreal Lowland Sedge-Shrub Fen. It occurs at low elevations on flats, basins and lake margins on lacustrine deposits and organic fens, where groundwater movement and associated nutrient inputs are relatively high.

Soils usually are thick peats, although lacustrine meadows infrequently have loams or organic soils. Drainage is always poor or very poor and soil pH is circumneutral to acidic. Permafrost often is present and easy to detect with a thaw probe, but surface expression is lacking. The most common soil subgroups are the permafrost-free Typic Cryofibrists (wet, poorly decomposed peat), Terric Cryofibrists (wet, poorly decomposed peat with a mineral layer within 100 cm of the surface

surface) and Typic Cryohemists (wet, partially decomposed peat), and the permafrost-affected Typic Fibristels (wet, poorly decomposed thick peat). Less common soil subgroups include Typic Hemistels, Terric Hemistels, Typic Historthels, Typic Cryaquepts, Histic Cryaquepts, Histic Cryaquepts, Typic Gelaquepts, Typic Aquorthels, and Typic Cryaquents. Two well drained soils (Humic Dystrocryepts and Typic Dystrocryepts) have been observed in rare instances along the margins of drained lake basins.

Vegetation in these meadows is dominated by sedges (Carex aquatilis, Carex saxatilis, Eriophorum angustifolium, *Carex utriculata*). Low deciduous and evergreen shrubs (*Myrica gale, Salix fuscescens, Andromeda polifolia*) are more prevalent in sedge-shrub meadows, but with <25% total cover. Forbs (*Potentilla palustris, Parnassia palustris*) and mosses (*Scorpidium scorpioides, Calliergon giganteum*) are typically present with relatively low cover.

BOREAL RIVERINE ROCKY-LOAMY BARRENS AND SCRUB

This widespread soil landscape includes the open unvegetated areas and shrub communities on active river floodplains and encompasses several ecotypes. These include Boreal Riverine Acidic Barrens, Boreal Riverine Circumalkaline Barrens, Boreal Riverine Dryas Dwarf Shrub, Boreal Riverine Low Silverberry Shrub, Boreal Riverine Loamy Willow Shrub, Boreal Riverine Sandy Willow Shrub, and Boreal Riverine Tall Alder Shrub. These communities develop on braided coarse active channels, braided coarse active and inactive channel deposits, braided active and inactive overbank deposits, and moderately steep headwater floodplains.

Soils are coarse, typically bouldery, gravelly and sandy textured, with excessive drainage. Less frequently, moderately drained, loamy soils occur. Soil pH varies depending on parent material. Permafrost is typically absent or not detected due to the difficulty of sampling in rocky soils. Soils consistently belong to two subgroups; Oxyaquic Cryorthents (moderately well drained, gravelly, poorly developed horizons) and Typic Cryorthents (well drained, gravelly, poorly developed horizons). Typic Cryaquents (wet, poorly developed horizons) occur infrequently.

Vegetation varies widely with successional age. Younger sites are barren, or dominated by dwarf shrubs (Dryas drummondii) or low shrubs (*Eleagnus commutata, Salix niphoclada*). Forbs (*Epilobium latifolium, Hedysarum alpinum, Oxytropis campestris*) and grasses (*Bromus pumpellianus, Festuca brachyphylla*) are common. Older sites have tall willow and alder communities, with a greater cover of deciduous shrubs (*Salix pulchra, Salix barclayi, Alnus tenuifolia, Vaccinium uliginosum*) and graminoids (*Calamagrostis canadensis, Festuca rubra*). Forb (*Rubus arcticus, Artemisia tilesii, Equisetum arvense*) cover also typically is higher on older sites.

BOREAL RIVERINE ROCKY-LOAMY FORESTS

This soil landscape is comprised of the mid- to late successional ecotypes Boreal Riverine Loamy Poplar Forest, Boreal Riverine Gravelly Poplar Forest, Boreal Riverine Spruce-Poplar Forest, and Boreal Riverine White Spruce Forest. These balsam poplar and white spruce forests occur on flat banks, interfluves, and river bars on braided coarse inactive channel deposits, braided active and inactive overbank deposits, and meander inactive overbank deposits.

Soils are dry, basic to circumneutral and gravelly on younger sites or moist, circumneutral and loamy to organic on older sites. Permafrost is absent and groundwater is typically present at >1m depth. Soils are well drained and cold, with thin to absent A horizons. The predominant soil subgroup is Typic Cryorthents (well drained, poorly developed horizons). Soil subgroups that occur less frequently are Oxyaquic Cryorthents at mid-successional stages, and Typic Dystrocryepts and Typic Eutrocryepts at late successional stages.

Vegetation is dominated by trees, with minor components of shrubs, forbs and grasses. Poplar forests have a greater proportion of shrubs (*Alnus tenuifolia, Rosa acicularis, Viburnum edule*), while spruce forests have increased forb (*Hedysarum alpinum, Geocaulon lividum, Lupinus arcticus*) and nonvascular (*Hylocomium splendens, Sanionia uncinata, Peltigera* spp.) cover.

MARITIME ALPINE ROCKY BARRENS AND SCRUB

This soil landscape is comprised of Maritime Alpine Barrens and Maritime Alpine Cassiope Dwarf Shrub. It occurs at elevations >600 m in the coastal St. Elias Mountains, on steep slopes and nivation hollows on noncarbonate hillslope colluvium and metamorphic sedimentary rocks.

Soils are rocky, acidic and excessively to well drained. Soils generally lack an A horizon, and have little or no surface organic matter. Groundwater is at > 1 m depth, and permafrost is > 1m depth or unknown. Soil subgroups are commonly either Typic Dystrogelepts (well drained, acidic, permafrost present below 1 m) or Humic Dystrocryepts (well drained, acidic, organic-rich). Less common soil types include Typic Cryorthents and Typic Humicryods.

Vegetation is dominated by ericaceous dwarf shrubs (Cassiope stelleriana, Luetkea pectinata, Phyllodoce aleutica) and some forbs (Fauria crista-galli, Anemone narcissiflora). Trees are absent, while low deciduous shrubs have a minor presence, as do some mosses and sedges. Barren and partially vegetated sites have a similar species composition but with sparse coverage.

MARITIME SUBALPINE ROCKY MEADOWS AND SCRUB

This soil landscape is comprised of Maritime Subalpine Low Blueberry Shrub and Maritime Subalpine Lupine Meadow and is widespread along the coast above 400 m elevation. These productive forb and shrub meadows occur on slopes and in nivation hollows on hillslope colluvium and older moraine. This soil landscape impressed the original explorers to the region, who were seeking to climb Mt. Cook, and caused them to bestow geographical features with names such as ìFloral Passî and ìBlossom Islandî.

Soils are rocky, well drained and acidic. Soils are cold and permafrost-free with thin A horizons under thin organic horizons. The most prevalent soil subgroups are Humic Dystrocryepts (well drained, acidic, organic-rich) and Typic Dystrocryepts (well drained, acidic, partially developed horizons). Less frequently present are Typic Haplocryods, and Typic Humicryods.

These meadows consist of low vegetation with no trees or tall shrubs. Forbs (Lupinus nootkatensis, Athyrium filix-femina, Valeriana sitchensis, Epilobium angustifolium, Veratrum viride) are prevalent, although to a lesser degree in meadows dominated by shrubs (*Vaccinium ovalifolium, Vaccinium alaskensis, Phyllodoce aleutica*). Shrub meadows have greater amounts of mosses and lichens (*Pseudoleskea baileyi, Cetraria* sp.) while forb meadows have greater amounts of sedges (*Carex macrochaeta*).

MARINE GLACIATED ROCKY BARRENS AND SCRUB

Maritime Glaciated Barrens and Maritime Glaciated Tall Alder-Willow Shrub comprise this locally abundant soil landscape, which is prevalent across the Malaspina forelands near the Gulf of Alaska. This soil landscape occurs on slopes and undulating surfaces on young moraine at low elevations. The young moraines are underlain by glacial ice and kettles and collapse features are abundant.

Soils are blocky, rubbly and bouldery, well drained and circumneutral. Permafrost is restricted to areas with sub-surface glacial ice and is typically > 2 m depth. The most common soil subgroups are Typic Cryaquents (poorly drained with poorly developed horizons), Typic Cryorthents (well drained with poorly developed horizons) and Typic Cryopsamments (well drained, sandy). Histic Cryaquepts and Typic Dystrocryepts occur less frequently.

Where present, vegetation is open and consists primarily of shrubs (Alnus sinuata, Salix sitchensis, Oplopanax horridus). Trees and graminoids are only infrequently present. Forbs (Equisetum arvense, *Epilobium angustifolium, Streptopus amplexifolius*) and mosses (*Racomitrium* sp.) are the main understory components of this soil landscape. Barrens have a similar floristic composition with typically < 5% total cover.

MARITIME UPLAND ROCKY-SANDY SCRUB AND FORESTS

This soil landscape consists of a mosaic of spruce forest and alder scrub, and is comprised of Maritime Upland Sitka Spruce Forest and

Maritime Upland Tall Alder Shrub. It occurs on slopes below 400 m elevation on older and younger moraine, hillslope colluvium, noncarbonate metamorphic and sedimentary rock, and eolian inactive coastal sand deposits.

Soils are acidic with blocky or sandy (infrequently organic) textures, and are well to somewhat poorly drained. Soils typically are cold with thin A horizons, and permafrost is absent. Soil subgroups include Typic Dystrocryepts and Humic Dystrocryepts, and occasionally Typic Cryopsamments (deep water table).

Vegetation comunities in this soil landscape consist of early successional tall alder (Alnus sinuata) thickets and late successional Sitka spruce (Picea sitchensis) forests. The understory of shrub communities consists primarily of low shrubs (Rubus spectabilis) and forbs (Athyrium filix-femina). The forest understory also has a dense layer of low shrubs (Oplopanax horridus), forbs (Gymnocarium *dryopteris, Dryopteris dilatata*), but with increased cover of mosses (*Rhytidiadelphus loreus, Hylocomium splendens*).

MARITIME LOWLAND GRAVELLY SCRUB AND FORESTS

Several ecotypes comprise this soil landscape, including Maritime Lowland Cottonwood-Spruce Forest, Maritime Lowland Cottonwood Forest, Maritime Lowland Tall Alder-Willow Shrub and Maritime Lowland Sitka Spruce Forest. These communities occur from 0 to 50 m elevation on the Malaspina forelands, on flat surfaces comprised of glaciofluvial outwash abandoned and inactive cover deposits, braided abandoned channel deposits and young moraine.

Soils are well to moderately well drained, rocky, and circumneutral to acidic. They typically are cold with a thin A horizon. Permafrost is absent and groundwater is >50 cm below the surface, commonly > 1m. The most common soil subgroups are Typic Dystrocryepts and Typic Cryorthents. Less frequent are the highly leached Typic Haplocryods, Spodic Dystrocryepts and the more mineral-rich Typic Eutrocryepts.

Younger surfaces in this soil landscape support open shrub communities dominated by tall shrubs (Alnus sinuata, Salix barclayi) with high cover of low shrubs (Oplopanax horridus, Rubus spectabilis) and forbs (*Equisetum arvense*, *Gymnocarium dryopteris*), and some mosses (*Rhytidium rugosum*) in the understory. Sites of intermediate age consist of open cottonwood (*Populus trichocarpa*) forest with similar understory coverage of shrubs, forbs and mosses. The oldest sites are occupied by spruce forest with greater cover of mosses and reduced cover of shrubs and forbs.

MARITIME LOWLAND BOGS AND FENS

This soil landscape is restricted to wet sites on flat, lowland areas near the coast, and is uncommon. It is comprised of only two ecotypes; Maritime Lowland Forb-Willow Meadow and Maritime Lowland Sedge-Blueberry Bog. It occurs on organic bogs, glaciofluvial outwash inactive and abandoned cover deposits, braided abandoned channel deposits, and younger moraine.

Soils are peats, organic-rich or gravelly, and are wet and cold. Drainage is poor to very poor and soil pH is circumneutral to acidic. Permafrost is absent or undetectable. Soil subgroups consist of Terric Cryofibrists (wet, poorly decomposed peat with mineral layer within 1 m), Histic Cryaquepts (wet, organic-rich) and Typic Cryaquepts (wet, poorly developed horizons).

Vegetation in this soil landscape is primarily dominated by sedges, forbs or low shrubs, although species composition differs between minerotrophic fens and oligiotrophic bogs. Trees are infrequently present (as seedlings), and evergreen shrubs and lichens are sparse. Sedge-blueberry bogs have high cover of *Sphagnum* moss, unlike forb-willow meadows. Species common in forb-willow meadows include *Equisetum variegatum, Salix barclayi, Platanthera dilatata*, and *Limprichtia revolvens,* while species common in sedge-blueberry bogs include *Sphagnum teres, Vaccinium uliginosum, Carex pluriflora, Eriophorum russeolum*, and *Carex lyngbyaei*.

MARITIME RIVERINE GRAVELLY BARRENS AND SCRUB

This soil landscape includes the early successional ecotypes Maritime Riverine Barrens and Maritime Riverine Tall Alder-Willow Shrub. It is widespread on floodplains near the Gulf of Alaska. Terrain units include braided coarse active

and inactive channels, glaciofluvial outwash active cover deposits, and meander active channel deposits.

Soils are rocky or sandy, and well drained. Soil pH is acidic and permafrost is absent. Soil subgroup association consist of Typic Cryorthents (well drained, poorly developed horizons) and Typic Cryaquents (wet, poorly developed horizons). Oxyaquic Cryorthents (moderately well drained, poorly developed horizons) occur uncommonly.

Vegetation consists of a mosaic of shrub communities on older sites and barrens in areas within the active floodplain. Tall shrub (Alnus sinuata, Salix barclayi) communities have primarily low shrubs (*Rubus spectabilis*), forbs (*Equisetum arvense, Tiarella trifoliata*) and mosses (*Brachythecium* sp, *Racomitrium ericoides*) in the understory. Barrens have a comparable species composition but little vascular cover.

MARITIME RIVERINE GRAVELLY FORESTS

This soil landscape has limited distribution and includes the mid- to late successional ecotypes Maritime Riverine Cottonwood Forest and Maritime Riverine Cottonwood-Spruce Forest. It occurs on interfluves or flat banks on braided coarse inactive channels, braided inactive overbank deposits and glaciofluvial outwash inactive cover deposits.

Soils are excessively to moderately well drained due to the bouldery and gravelly textures common for this association. Soil pH is acidic. Permafrost is absent. Two soil subgroups are common; Oxyaquic Cryorthents (moderately well drained, poorly developed horizons) and Typic Cryorthents (well drained, poorly developed horizons). Spodic Dystrocryepts (well drained, acidic, and highly leached) occur infrequently.

These mature forests have a dense understory of tall and low deciduous shrubs (Alnus sinuata, Rubus spectabilis, Oplopanax horridus) and forbs (Athyrium filix-femina, Gymnocarpium dryopteris, Streptopus amplexifolius), with a minor component of graminoids (Calamagrostis canadensis) and variable moss cover (Pleurozium schreberi, Rhytidium rugosum). Lichens and evergreen shrubs are absent. Spruce cover varies from trace values to 12%.

Also included in this landscape are Maritime Riverine Horsetail Meadow and Maritime Riverine Tall Willow Shrub. Soils are loamy to sandy and very poorly drained. Soil pH is circumneutral. Permafrost is absent.

Soil subgroup association consist of Typic Cryaquents (poorly drained, poorly developed horizons) and Aquic Cryofluvents (poorly drained, stratified with buried O horizons). Less commonly, Oxyaquic Cryofluvents (moderately well drained, stratified, with buried O horizons) occur.

Vegetation consists of patches of early successional willow stands, and wet forb meadows. These deciduous shrub communities consist of an open canopy of tall willows (Salix commutata, S. hookeriana), with an understory predominantly of mosses (Drepanocladus sp., Brachythecium sp.). Forbs (Equisetum arvense), sedges and lichens (Peltigera canina) comprise a minor component, while trees and evergreen shrubs are absent. Forb meadows are predominantly covered by forbs (Equis*etum palustre, Equisetum variegatum*) with some sedges (*Carex lyngbyaei*) and mosses (*Drepanocladus* sp. and *Helodium blandowii*).

MARITIME COASTAL BARRENS AND MEADOWS

This soil landscape occurs on salt-affected areas adjacent to the Gulf of Alaska and includes Maritime Coastal Sedge Meadow and Maritime Coastal Brackish Barrens (a rare ecotype that is not described in the section on ecotypes). It occurs on active and inactive tidal flats.

Soils are loams or clays, and are very poorly drained or flooded. Soil chemistry is brackish in areas directly affected by marine water but becomes fresher (<800 µS/cm) inland. The typical soil subgroup is brackish Typic Cryaquents (poorly drained, brackish, poorly developed horizons). No other soil subgroups are common.

Vegetation in this coastal soil landscape is strongly affected by marine water. Inactive tidal flats are occupied by salt-tolerant sedges (Carex lyngbyaei), and forbs (Triglochin maritimum). Areas that are frequently scoured by the tide are barren.

Also included in this landscape are Maritime Coastal Barrens, Maritime Coastal Elymus Meadow, and Maritime Coastal Angelica Meadow. They occurs on slopes, flats and dunes. Terrain units include eolian active and inactive coastal sand deposits and active and inactive marine beaches.

Unvegetated beaches and forb or graminoid meadows have sandy to gravelly soils that are somewhat excessively drained. Soils are circumneutral or basic. Permafrost is absent. Soil subgroups are commonly Typic Cryopsamments (well drained, sandy, poorly developed horizons), or Oxyaquic Cryopsamments (moderately well drained, sandy, poorly developed horizons). Typic Cryorthents (well drained, poorly developed horizons) occur less frequently.

Vegetation primarily consists of grass or forb meadows, both of which have little to no coverage of deciduous shrubs and trees, and no lichens. Elymus meadows occur adjacent to barrens where disturbance from eolian sand input and flooding is high, and consist predominantly of graminoids (Elymus arenarius ssp. mollis) and forbs (Fragaria chiloensis, Castilleja chrymactis). Angelica meadows are dominated by forbs (Angelica lucida, Heracleum lanatum, Lupinus nootkatensis), with smaller components of graminoids (*Festuca rubra*, *Elymus arenarius* ssp. *mollis*) and mosses (*Rhytidiadelphus squarrosus*). Coastal barrens have only trace cover of vegetation.

COASTAL NEARSHORE WATER

Nearshore Water includes the saline waters of Yakutat Bay, Disenchantment Bay, Icy Bay, and the Gulf of Alaska. The marine water is differentiated from rivers and lakes because of its high salinity.

RIVERS

Rivers, both glacial and non-glacial, are common throughout the park and are hydrologically linked to discharge from melting glaciers. The glacial rivers are highly turbid, alkaline, and have peak discharge in July. Examples include the Chitina, Nabesna, Chisana, Bremner, White, and Nizina Rivers. Nearly all the large, mappable rivers in the park are Glacial Rivers. Non-glacial Rivers are relatively uncommon in the park, and typically are small headwater streams.

LOWLAND LAKES

Lowland Lakes are common throughout the study area and occupy both deep and shallow kettle and thermokarst depressions. Beaver ponds also are included in this ecotype. These lakes have a circumneutral or basic pH.

ALPINE LAKES

Alpine lakes occur in substantial depressions formed in glacial moraine or by thawing of permafrost. These lakes are mostly circumneutral, although pH can vary from acidic to basic. Vegetation usually is present and there may be live plant cover as well as litter along the shoreline. Glacial Lakes occur in isolated young morainal kettles and basins below the alpine zone. Aquatic vegetation is absent and water chemistry is basic.

GLACIERS

Snowfields and glaciers are abundant at high elevations throughout the park. In areas of particularly heavy snowfall along the coastal ranges, the glaciers extend down mountain valleys and occasionally into lowland areas.

RELATIONSHIPS AMONG ECOLOGICAL COMPONENTS

LANDSCAPE RELATIONSHIPS

We developed hierarchical relationships among ecological components by successively grouping data from the 569 intensive plots by physiography, soil texture, geomorphology, slope position, surface form, drainage, soil chemistry, vegetation structure, and plant association (Tables 136 and 137). Successive aggregations based on environmental characteristics and vegetation structure resulted in 68 ecotype classes. Thirty-nine ecotypes were described from the boreal climatic zone, 23 from the maritime zone, and an additional six water and snow/ice classes were not given a climatic zone in the abbreviated ecotype aggregation. Tabular associations and statistical ordinations were used to differentiate sets of associated characteristics and refine classifications for individual plots.

Toposequences and cross-tabulation of plot data revealed consistent associations among soil texture, geomorphic units that denote depositional environments, slope position, hydrology, and vegetation structure (Tables 136 and 137). The hierarchical organization of the ecological components reveals how tightly or loosely the components are linked. For example, some physiographic settings included several geomorphic units with similar soil textures. Similarly, most vegetation types occurred on several geomorphic units, depending on surface form characteristics and hydrology. In contrast, some geomorphic units (e.g. coarse active channel deposits, tidal flats) were associated only with a few distinct vegetation types.

ENVIRONMENTAL CHARACTERISTICS

Boreal Ecotypes: Single-factor Comparisons by Ecotype

We charted six environmental parameters for comparison among boreal ecotypes. These parameters were: surface organic horizon thickness, depth to rock, depth of thaw, pH, electrical conductivity, and depth to groundwater.

The thickness of the surface organic horizon varied greatly among sites (Figure 3). Ecotypes where surface organic accumulations were absent included high elevation areas with severe climate and soil conditions, such as Boreal Alpine Barrens, newly exposed surfaces on recently deglaciated areas, such as Boreal Glaciated Barrens, and areas with frequent sediment deposition, such as Boreal Riverine Acidic Barrens. The thickest surface organic accumulations were found in the Lowland Sedge–Shrub Fen and Boreal Lacustrine Sedge Meadow ecotypes. These peatland ecotypes are typical of older landscapes where sedimentation events are rare or absent.

Mean depth to rocks (soils with >15% rocks) was greatest at sites with high rates of fine mineral deposition or peat accumulation (Figure 3). Ecotypes with thick peat deposits included Boreal Lowland Sedge–Shrub Fen and Boreal Lacustrine Sedge Meadow (Figure 3). Ecotypes with rock depths >100 cm represent an estimated minimum depth. Ecotypes with a shallow rock depth occurred on alpine ridges and crests (e.g., Boreal Alpine Barrens), on young moraines (e.g. Boreal Glaciated Barrens), and on active riverine channel deposits (Riverine Circumalkaline Barrens).

Permafrost likely was present in all physiographic types except riverine and some upland types (Figure 3). It was not possible to determine thaw depths at some rocky sites, however, such as active riverine channel deposits and many alpine areas. Within alpine and subalpine areas, sites with fine-grained soils had the shallowest mean thaw depths. On riverine deposits, permafrost was assumed absent or at depths greater than 1.5 m. The permafrost status of some rocky sites, particularly on south-facing slopes, is unknown. Permafrost was present within 50 cm of the surface in forested upland sites where the surface was shaded, with the exception of Boreal Upland Aspen Forest, and was absent in the remainder of upland ecotypes. In glaciated ecotypes, thaw depths were mostly unknown due to rocky soils, or were greater than 1 m.

Mean pH values encompassed a wide range (3.9 to 8.3) among ecotypes, but was the most consistent environmental parameter (in terms of comparable values) within each physiographic type (Figure 4). With the exception of very dry, south-facing slopes, upland communities had the most acidic soils, whereas recently de-glaciated and riverine ecotype soils were the most alkaline. Alpine soils mostly were circumneutral to acidic. Overall the ecotype with the lowest mean pH was

Table 136. Landscape relationships for Boreal Ecotypes, Wrangell-St. Elias National Park and Preserve, 2004–2006.

Physiography	Soil Texture	Geomorphic Units	Slope	Drainage	Soil-water Chemistry	Vegetation Types (Level IV)	Ecotype
Alpine	Blocky, Rubbly, Bouldery	Intrusive, Felsic, Volcanic, Mafic, Younger, Noncarbonate Metamorphic, Noncarbonate Sedimentary, Hillslope Colluvium, Talus, Older Moraine, Younger Moraine	Crest, Slope, Flats	Excessive to Well	Circum-neutral-Acidic	Barrens (<5% veg.), Partially Vegetated (5-30% Vegetated), Dry Bryophyte	Boreal Alpine Barrens
						Dryas- Lichen Dwarf Shrub, Dryas-Sedge Dwarf Shrub, Dryas Dwarf Shrub Tundra	Boreal Alpine Dryas Dwarf Shrub
	Blocky-Rubbly-Loamy	Hillslope Colluvium, Older Moraine, Younger Moraine, Alluvial Fan Abandoned Deposit, Kame Deposit, Solifluction, Upland Loess	Slopes, Nivation Hollows,	Well	Circum-neutral-Acidic	Cassiope, Crowberry, Ericaceous and Vaccinium Dwarf Shrub Tundras	Boreal Alpine Ericaceous Dwarf Shrub
	Blocky-Rubbly-Loamy-Organic	Hillslope Colluvium, Older Moraine, Younger Moraine, Alluvial Fan Abandoned Deposit, Kame Deposit, Solifluction Deposits, Upland Loess	Crest, Slopes, Nivation Hollows, Lake Margins	Well to Somewhat Poor	Circum-neutral-Acidic	Midgrass-Herb	Boreal Alpine Sedge-Dwarf Willow Meadow
						Moist Sedge-Grass Tundra Moist Sedge-Shrub Tundra Moist Sedge-Willow Tundra Wet Sedge-Willow Tundra Dryas-Forb Dwarf Shrub Tundra, Willow Dwarf Shrub	Boreal Alpine Sedge-Dwarf Willow Meadow
	Loamy-Organic	Hillslope Colluvium, Older Moraine, Younger Moraine, Alluvial Fan Abandoned Dep., Kame, Solifluction, Loess	Shoulder, Slopes	Somewhat Poor to Poor	Circum-neutral	Tussock Tundra, Open Mixed-Shrub Tussock Tundra	Boreal Alpine Tussock Meadow
	Organic-Peat	Organic Fens, Lacustrine, Solifluction Deposits	Basins, Flat, Concave Upper Slope	Poor to Very poor	Circum-neutral-Acidic	Wet Sedge Meadow Tundra	Boreal Alpine Sedge Meadow
	NA	Snow and Glaciers	Variable	NA	NA	Barren	Snow and Glaciers
	Water	Shallow & Deep Isolated Morainal Lakes	Waterbodies, Kettle Basins	Flooded	Circum-neutral	Water	Alpine Lake
Subalpine	Blocky-Rubbly-Bouldery-Gravelly-Sandy-Loamy	Hillslope Colluvium, Older Moraine, Upland Loess, Alluvial Fan Abandoned Deposit Alluvial Fan Inactive Deposit	Crest, Plateau, Shoulder, Slopes, Toe Slope, Flat, Kettle Basin, Nivation Hollows	Somewhat Excessive to Somewhat Poor	Circum-neutral-Acidic	Ericaceous-Lichen Dwarf Shrub Tundra, Low Closed Birch-Willow, Low Closed Willow, Open Shrub Birch-Ericaceous Shrub, Closed Low Shrub Birch-Willow, Open Low Willow, Closed Tall Shrub Birch, Closed Tall Willow, Open Tall Willow	Boreal Subalpine Willow and Birch Shrub
	Loamy	Hillslope Colluvium, Older Moraine, Upland Loess,	Slope, Nivation Hollows	Well to Mod. Well	Acidic	Mixed Herbs	Boreal Subalpine Forb Meadow

Table 136. Continued.

Physiography	Soil Texture	Geomorphic Units	Slope	Drainage	Soil-water Chemistry	Vegetation Types (Level IV)	Ecotype
Subalpine		Alluvial Fan Inactive Deposit, Alluvial Fan Abandoned Dep.					
	Rubbly-Loamy	Hillslope Colluvium, Older Moraine, Alluvial Fan Inactive Deposit, Alluvial Fan Abandoned Deposit, Upland Loess	Slopes	Somewhat Excessive to Well	Circum-neutral-Basic	Closed Balsam Poplar Forest Open Balsam Poplar For, Open Dwarf Balsam Poplar Forest	Boreal Subalpine Poplar Forest
				Well to Moderately Well	Circum-neutral	White Spruce Woodland	Boreal Subalpine Spruce Woodland
Glacial	Blocky-Rubbly-Bouldery	Younger Moraine	Crest, Upper Slope, Undulating Moraine Complex	Excessive to Well	Basic	Barrens (<5% Vegetated)	Boreal Glaciated Barrens
						Dryas Dwarf Shrub Tundra	Boreal Glaciated Dryas Dwarf Shrub
						Low Closed Willow	Boreal Glaciated Willow Shrub
						Open Low Willow	
						Open Tall Willow	
	Water	Isolated Morainal Lakes	Waterbodies	Flooded	Basic	Water	Glacial Lake
Upland	Blocky-Rubbly-Sandy-Loamy	Hillslope Colluvium, Upland Loess, Older Moraine	Slopes	Well to Moderately Well	Acidic	Closed Paper Birch Forest	Boreal Upland Birch Forest
						Open Paper Birch Forest	
						Open Spruce- Paper Birch Forest	Boreal Upland Spruce-Birch Forest
	Rubbly-Gravelly-Loamy	Upland Glaciolacustrine Deposit, Hillslope Colluvium, Talus Bluff, Landslide Deposit	Bluffs or Banks, often steep, south facing	Excessive	Basic	Open Low Silverberry Shrub	Boreal Upland Sagebrush Meadow
						Open Sagebrush- Grass	
						Open Sagebrush- Juniper	
		Hillslope Colluvium, Talus Bluff, Upland Loess, Older Moraine	Upper Slopes Bluffs, Banks, S-facing	Somewhat Excessive, to Well	Circum-neutral-Basic	Closed Quaking Aspen Forest	Boreal Upland Aspen Forest
						Open Quaking Aspen Forest	
	Loamy	Hillslope Colluvium, Upland Loess, Older Moraine	Crest, Plateau, Slopes, Toe Slope	Well to Moderately Well	Circum-neutral-Acidic	Open Spruce- Balsam Poplar Forest	Boreal Upland White Spruce Forest
						Open White Spruce Forest	
						White Spruce Woodland	
	Loamy-Organic	Hillslope Colluvium, Upland Loess, Older Moraine	Slopes	Well to Moderately Well	Circum-neutral-Acidic	White Spruce Woodland, Closed Tall Alder, Standing Dead Closed Tall Alder, Closed Tall Alder-Willow, Standing Dead Closed Tall Alder-Willow, Open Tall Alder	Boreal Upland Tall Alder Shrub
Lowland	Gravelly-Sandy-Loamy-Organic	Older Moraine, Lowland Loess, Retransported Deposit, Braided Abandoned Overbank Dep., Glaciofluvial Outwash Abandoned Cover Dep., Lowland Glaciolacustrine Deposit, Lacustrine	Interfluve, Flat Bank, Flat, Crest or Terrace	Well to Poor	Circum-neutral-Acidic	Open White Spruce Forest	Boreal Lowland White Spruce Forest
						White Spruce Woodland	
						Dwarf White Spruce Woodland	

Table 136. Continued.

Physio-graphy	Soil Texture	Geomorphic Units	Slope	Drainage	Soil-water Chemistry	Vegetation Types (Level IV)	Ecotype
	Loamy	Older Moraine, Lowland Loess, Retransported Deposit, Braided Abandoned Overbank Deposit, Glaciofluvial Outwash Abandoned Cover Deposit, Lowland Glaciolacustrine Deposit, Lacustrine	Flat or Fluvial, Crest, Convex & Concave	Well to Moderately Well	Circum-neutral-Acidic	Closed Tall Willow	Boreal Lowland Tall Willow Shrub
						Open Tall Willow	
			Lower Slopes, Planar Upper & Lower Slopes	Well to Somewhat Poor	Circum-neutral-Acidic	Open Black Spruce Forest	Boreal Lowland Black Spruce Forest
						Open Black Spruce- White Spruce Forest	
						Open Dwarf Black Spruce Forest	
						Dwarf Black Spruce Woodland	
	Loamy-Organic	Older Moraine, Lowland Loess, Retransported Deposit, Braided Abandoned Overbank Deposit, Glaciofluvial Outwash, Abandoned Cover Deposit, Lowland Glaciolacustrine Deposit, Lacustrine	Toe Slope, Planar Lower Slope, Flat Lake Margin, Kettle Basin or Depressions	Moderately Well to Poor	Circum-neutral-Acidic	Low Closed Birch-Willow	Boreal Lowland Low Birch-Willow Shrub
						Open Shrub Birch- Ericaceous Shrub Bog	
						Open Shrub Birch-Ericaceous Shrub	
						Closed Low Shrub Birch-Willow	
						Open Low Willow	
	Organic-Peat	Organic Bogs, Lowland Loess, Lacustrine, Retransported Deposit, Older Moraine	Shoulder, Slopes, Toe Slope, Flat, Kettle Basin, Drainage-Way	Somewhat Poor to Very Poor	Circum-neutral-Acidic	Open Black Spruce Forest, Black Spruce Woodland, Dwarf Black Spruce Woodland	Boreal Lowland Black Spruce Bog
						Tussock Tundra	Boreal Lowland Tussock-Shrub Bog
						Open Mixed Shrub Tussock Bog	
						Open Mixed Shrub Tussock Tundra	
	Peat	Organic Fens	Concave Lower Slope, Flat, Kettle Basin, Drained Basin, Depressions, Lake Margin	Poor to Very poor	Circum-neutral	Subarctic Lowland Sedge Bog Meadow, Subarctic Lowland Sedge Wet Meadow, Subarctic Lowland Sedge-Shrub Wet Meadow, Open Sweetgale-Graminoid Bog, Open Low Willow- Graminoid Shrub Bog	Boreal Lowland Sedge-Shrub Fen
Lacustrine	Loamy-Organic-Peat	Organic Fens, Lacustrine	Basins & Lake Margins	Poor to Very poor	Circum-neutral-Acidic	Fresh Herb Marsh, Fresh Sedge Marsh, Subarctic Lowland Sedge Wet Meadow, Subarctic Lowland Sedge-Shrub Wet Meadow, Wet Sedge Meadow	Boreal Lacustrine Sedge Meadow
	Water	Isolated Morainal Lakes, Shallow Connected & Isolated Beaver Ponds, Isolated Thaw Lakes	Waterbodies, Kettle Basins, Lake Margins	Flooded	Circum-neutral-Basic	Fresh Pondweed	Lowland Lake
						Water	
					Circum-neutral	Pondlily	Boreal Lacustrine Pondlily

Table 136. Continued.

Physiography	Soil Texture	Geomorphic Units	Slope	Drainage	Soil-water Chemistry	Vegetation Types (Level IV)	Ecotype
Riverine	Bouldery-Gravelly	Braided Coarse Active Channel, Moderately Steep Headwater Floodplain	Bar, Lateral Bar, Interfluve, Flat Bank, Point Bar	Somewhat Excessive, Moderately Well	Circum-neutral-Basic	Barrens (<5% Vegetated)	Boreal Riverine Circumalkaline Barrens
						Partially Vegetated (5-30% Vegetated)	
					Acidic	Dry Bryophyte	Boreal Riverine Acidic Barrens
		Braided Coarse Active Channel, Braided Coarse Inactive Channel Deposit		Somewhat Excessive	Basic	Dryas- Lichen Dwarf Shrub, Dryas Dwarf Shrub Tundra	Boreal Riverine Dryas Dwarf Shrub
						Open Balsam Poplar Forest	Boreal Riverine Gravelly Poplar Forest
						Dwarf Balsam Poplar Woodland	
					Circum-neutral-Basic	Open Spruce- Balsam Poplar Forest	Boreal Riverine Spruce-Poplar Forest
	Bouldery-Gravelly-Sandy	Braided Coarse Active Channel, Braided Coarse Inactive Channel Deposit	Interfluve, Flat Bank, Mid-Channel Bar	Somewhat Excessive, Moderately Well	Basic	Balsam Poplar Woodland	Boreal Riverine Low Silverberry Shrub
						Seral Herbs	
						Closed Low Silverberry Shrub	
						Open Low Silverberry Shrub	
	Gravelly-Sandy-Loamy	Braided Active Overbank Deposit, Braided Coarse Active Channel, Braided Coarse Inactive Channel Deposit, Braided Fine Active Channel Deposit, Braided Fine Inactive Channel Deposit	Interfluve, Flat Bank, Levee	Well to Moderately Well	Basic	Open Low Willow	Boreal Riverine Sandy Willow Shrub
						Open Tall Willow	
						Standing Dead Open Tall Willow	
				Well to Somewhat Poor	Circum-neutral-Basic	Closed Tall Alder	Boreal Riverine Tall Alder Shrub
						Closed Tall Alder-Willow	
						Open Tall Alder	
						Open Tall Alder- Willow	
	Loamy	Braided Active & Inactive Overbank Deposit, Braided Coarse Inactive Channel Dep.	Flat Bank or Interfluve	Well to Somewhat Poor	Circum-neutral-Acidic	Open Low Willow	Boreal Riverine Loamy Willow Shrub
		Braided Inactive & Meander Inactive Overbank Deposits	Flat Bank or Interfluve	Well	Circum-neutral	Open Balsam Poplar Forest	Boreal Riverine Loamy Poplar Forest
	Loamy-Organic	Braided & Meander Inactive Overbank Deposits	Interfluve of Flat Bank	Well	Circum-neutral	Open White Spruce Forest	Boreal Riverine White Spruce Forest
						White Spruce Woodland	
	Water	Upper Perennial, Glacial	Waterbodies, Shallow Runs	Flooded	Circum-neutral-Basic	Water	Glacial River

Table 137. Landscape relationships for Maritime Ecotypes, Wrangell-St. Elias National Park & Preserve, 2004–2006.

Physiography	Soil Texture	Geomorphic Units	Slope	Drainage	Site pH	Vegetation Types (Level IV)	Ecotype
Alpine	Blocky-Rubbly-Bouldery	Hillslope Colluvium, Noncarbonate Metamorphic, Noncarbonate Sedimentary	Crest, Nivation Hollows, Slopes	Excessive to Well	Acidic	Partially Vegetated (5–30%)	Maritime Alpine Barrens
						Cassiope Dwarf Shrub Tundra	Maritime Alpine Cassiope Dwarf Shrub
Subalpine	Blocky-Rubbly-Bouldery	Hillslope Colluvium, Older Moraine	Upper Slopes Lower Slope, Nivation Hollows	Well	Acidic	Mixed Herbs	Maritime Subalpine Lupine Meadow
						Closed and Low Ericaceous Shrub,	Maritime Subalpine Low Blueberry Shrub
Glacial	Blocky-Rubbly-Bouldery	Younger Moraine	Upper Slope, Lower Slope, Undulating Moraine	Well	Circum-neutral	Closed Tall Alder	Maritime Glaciated Tall Alder-Willow Shrub
						Closed Tall Alder- Willow	Maritime Glaciated Tall Alder-Willow Shrub
						Open Low Alder–Willow	Maritime Glaciated Tall Alder-Willow Shrub
Upland	Blocky-Sandy-Organic	Older Moraine, Younger Moraine, Eolian Inactive Coastal Sand Deposit	Crest, Planar Upper Slope	Well to Somewhat Poor	Acidic	Closed Sitka Spruce-Western Hemlock Forest	Maritime Upland Sitka Spruce Forest
						Open Sitka Spruce Forest	Maritime Upland Sitka Spruce Forest
	Blocky	Hillslope Colluvium, Noncarbonate Metamorphic, Noncarbonate Sedimentary	Convex Upper Slope	Well to Somewhat Poor	Acidic	Closed Tall Alder	Maritime Upland Tall Alder Shrub
Lowland	Bouldery-Gravelly	Glaciofluvial Outwash Inactive, cover Deposit, Glaciofluvial Outwash Abandoned, Cover Deposit Braided Abandoned Channel Deposit, Younger Moraine	Flat or Fluvial Related	Well to Moderately Well	Circum-neutral-Acidic	Open Black Cottonwood Forest	Maritime Lowland Cottonwood Forest
						Open Black Cottonwood-Sitka Spruce, Open Black Cottonwood-Western Hemlock, Black Cottonwood-Sitka Spruce Woodl.	Maritime Lowland Cottonwood–Spruce Forest
					Acidic	Open Sitka Spruce Forest	Maritime Lowland Sitka Spruce Forest
	Organic-Peat	Organic Bog, Glaciofluvial Outwash Abandoned, Cover Deposit	Kettle Basin, Flat	Poor to Very Poor	Circum-neutral-Acidic	Subarctic Lowland Sedge-Moss Bog Meadow	Maritime Lowland Sedge–Blueberry Bog
						Open Low Ericaceous Shrub Bog	Maritime Lowland Sedge–Blueberry Bog
	Gravelly	Glaciofluvial Outwash Inactive Cover, Younger Moraine, Glaciofluvial Outwash Abandoned Cover Dep., Braided Abandoned Channel Deposit	Flat, Braided Channels Interfluves	Well to Moderately Well, Poor to Very Poor	Circum-neutral	Closed Tall Alder-Willow	Maritime Lowland Tall Alder–Willow Shrub
						Open Low Alder–Willow	Maritime Lowland Tall Alder–Willow Shrub
						Subarctic Lowland Herb Wet Meadow	Maritime Lowland Forb–Willow Meadow
Lacustrine	Water	Deep and Shallow Isolated Morainal Lakes, Deep Connected Morainal Lake, Shallow Beaver Pond	Water-bodies	Flooded	Circum-neutral-Basic	Water	Lowland Lake

Table 137. Continued.

Physiography	Soil Texture	Geomorphic Units	Slope	Drainage	Site pH	Vegetation Types (Level IV)	Ecotype
Riverine	Bouldery-Gravelly	Braided Coarse Active Channel, Braided Coarse Inactive Channel, Glaciofluvial Outwash Active Cover Deposit	Bar, Interfluve or Flat Bank	Excessive to Moderately Well	Circum-neutral-Basic	Subarctic Lowland Herb Wet Meadow	Maritime Riverine Barrens
						Partially Vegetated (5–30%)	Maritime Riverine Barrens
						Dry Bryophyte	Maritime Riverine Barrens
	Bouldery-Gravelly	Braided Coarse Inactive Channel, Braided Inactive Overbank, Glaciofluvial Outwash Inactive Cover	Interfluve or Flat Bank	Somewhat Excessive, Moderately Well	Acidic	Open Black Cottonwood Forest	Maritime Riverine Cottonwood Forest
	Bouldery-Gravelly-Sandy	Braided Coarse Active Channel, Braided Active Overbank, Meander Coarse Active Channel Deposit	Levee, Interfluve or Flat Bank	Somewhat Excessive, Moderately Well	Acidic	Closed Tall Alder-Willow	Maritime Riverine Tall Alder–Willow Shrub
						Open Low Alder–Willow	Maritime Riverine Tall Alder–Willow Shrub
		Braided Coarse Inactive Channel, Braided Inactive Overbank, Glaciofluvial Outwash Inactive Cover	Interfluve or Flat Bank	Somewhat Excessive, Moderately Well	Acidic	Open Black Cottonwood-Sitka Spruce Forest	Maritime Riverine Cottonwood–Spruce Forest
	Loamy	Braided Active Overbank Deposit	Flood Basin	Very Poor	Circum-neutral	Subarctic Lowland Herb Wet Meadow	Maritime Riverine Horsetail Meadow
	Water	Upper Perennial Glacial	Shal. Run		Basic	Water	Glacial River
Coastal	Sandy	Eolian Active Coastal Sand Deposit, Eolian Inactive Coastal Sand Deposit	Crest, Upper Slope, Concave Lower Slope, Flat	Somewhat Excessive	Circum-neutral-Basic	Seral Herbs	Maritime Coastal Elymus Meadow
						Elymus, Mixed Herbs	Maritime Coastal Elymus Meadow
					Circum-neutral	Mixed Herbs, Large Umbel	Maritime Coastal Angelica Meadow
	Loamy-Clayey	Active Tidal Flat, Inactive Tidal Flat	Flat or Fluvial Related	Very Poor to Flooded	Brackish-	Fresh Sedge Marsh	Maritime Coastal Sedge Meadow
					Circum-neutral	Halophytic Sedge Wet Meadow, brackish Subarctic Lowland Sedge Wet Meadow	Maritime Coastal Sedge Meadow
	Rubbly-Sandy	Active Marine Beach, Inactive Marine Beach	Wave Cut Bench, Flat	Somewhat Excessive	Brackish	Subarctic Lowland Herb Wet Meadow, Part. Veg. (5–30%)	Maritime Coastal Barrens
	Water	Nearshore Water	Waterbodies	Very Poor Flooded	Saline	Water	Nearshore Water

Figure 3. Mean (± SD) thickness of surface organic layer, depth to rock (>15% coarse fragments) and depth of thaw for boreal ecotypes in Wrangell-St. Elias National Park and Preserve, 2004–2006. Outliers have been excluded. Sample sizes are in parentheses.

Figure 4. Mean (± SD) pH, electrical conductivity (EC) and water depth for boreal ecotypes in Wrangell-St. Elias National Park and Preserve, 2004–2006. Outliers have been excluded. Sample sizes are in parentheses.

Boreal Subalpine Forb Meadow and the most alkaline ecotype was Boreal Glaciated Barrens.

Electrical conductivity (EC) measurements indicated that all ecotypes were nonsaline (Figure 4). Mean EC values varied from 38–230 µs/cm and was lowest in alpine, subalpine, and lacustrine ecotypes. Classes with high mean EC also had relatively high mean pH and included Boreal Upland Aspen Forest, Boreal Upland Sagebrush Meadow, and Boreal Riverine Sandy Willow Shrub.

Mean water depths were below the soil surface for all boreal ecotypes except Boreal Lacustrine Pondlily. Lakes are discussed with Maritime ecotypes below. Generally, the shallowest water tables were found for lacustrine and lowland ecotypes and were deepest in upland and riverine ecotypes (Figure 4). For three ecotypes, the water table was at or near the surface: Boreal Alpine Sedge Meadow, Boreal Lowland Sedge–Shrub Fen, and Boreal Lacustrine Sedge Meadow. Ecotypes with the deepest water tables were found in alpine areas with rocky soils (e.g., Boreal Alpine Ericaceous Dwarf Shrub), upland areas on steep slopes (e.g., Boreal Upland Sagebrush Meadow) and in riverine coarse channel deposits (e.g., Riverine Dryas Dwarf Shrub). Values >100 cm represent minimum, estimated depths.

Boreal Ecotypes: Single-factor Comparisons by Plant Species

To understand the correlation between environmental characteristics and distribution of individual plant and cryptogam species in the boreal zone, we selected 99 species and calculated the mean value of the six environmental parameters for sites where those species occurred. Species were selected if they occurred with > 60% frequency and had >5% cover in an ecotype, or were components of a plant association.

Mean surface organic horizons ranged from 0–69 cm. Plant species associated with thin surface organic horizons included *Linum perenne* (mean organic horizon = 0 cm), *Artemisia frigida* (1 cm), *Oxytropis campestris* (1 cm) and *Racomitrium canescens* (1 cm) (Figure 5). These species typically occurred in excessively-drained environments such as Boreal Upland Sagebrush Meadow; rocky, exposed environments like Boreal Alpine Barrens; or in well-drained early successional ecotypes, such as riverine barrens. Species characteristic of sites with thick surface organic accumulations included *Eriophorum angustifolium* (38 cm), *Carex utriculata* (39 cm), *Carex aquatilis* (42 cm), *Potentilla palustris* (45 cm), *Andromeda polifolia* (47 cm), and *Myrica gale* (69 cm). These species typically were associated with ecotypes with wet soils such as Boreal Lowland Sedge–Shrub Fen and Boreal Lacustrine Sedge Meadow.

Mean depth to rocks also was highly variable (0–157 cm) among plant species associations (Figure 5). Species commonly associated with rock or gravels near the surface included *Dryas drummondii* (mean depth to rock = 3 cm), *Racomitrium canescens* (4 cm), *Salix rotundifolia* (8 cm), and *Oxytropis nigrescens* (13 cm). Specifically, these species were primarily of alpine or riverine habitats. Species commonly found on peat or fine mineral deposits included *Alnus tenuifolia* (72 cm), *Salix myrtillifolia* (75 cm), *Eleocharis palustris* (111 cm), *Carex utriculata* (129 cm), and *Myrica gale* (157 cm).

Mean thaw depths ranged from 33–150 cm (Figure 5), and in some cases, permafrost was absent or beyond our detection limits. Plant species associated with these areas included *Artemisia frigida, Populus tremuloides, Hedysarum mackenzii,* and *Oxytropis campestris*. These species typically occur on coarse soils on slopes, alpine meadows, or early successional riverine sites. Species generally found on sites with shallow thaw depths included *Ribes triste* (mean thaw depth = 33 cm), *Alnus crispa* (36 cm), *Populus balsamifera* (41 cm), *Pleurozium schreberi* (42 cm), *Picea mariana* (47 cm), and *Rubus chamaemorus* (47 cm). These species are associated with high depositional environments or late successional communities where peat and fine mineral material insulate the soil.

Most species in the park occur on sites with circumneutral pH (5.6–7.3), although many taxa had a broad tolerance resulting in high intra-specific variation in pH associated with many species (Figure 6). Species occurring in strongly acidic soils included *Alnus sinuata* (mean pH = 5.3), *Carex media* (5.4), *Aconitum delphinifolium* (5.4), *Ribes triste* (5.4), and *Betula papyrifera* var. *humilis* (5.4). Species associated with alkaline soils

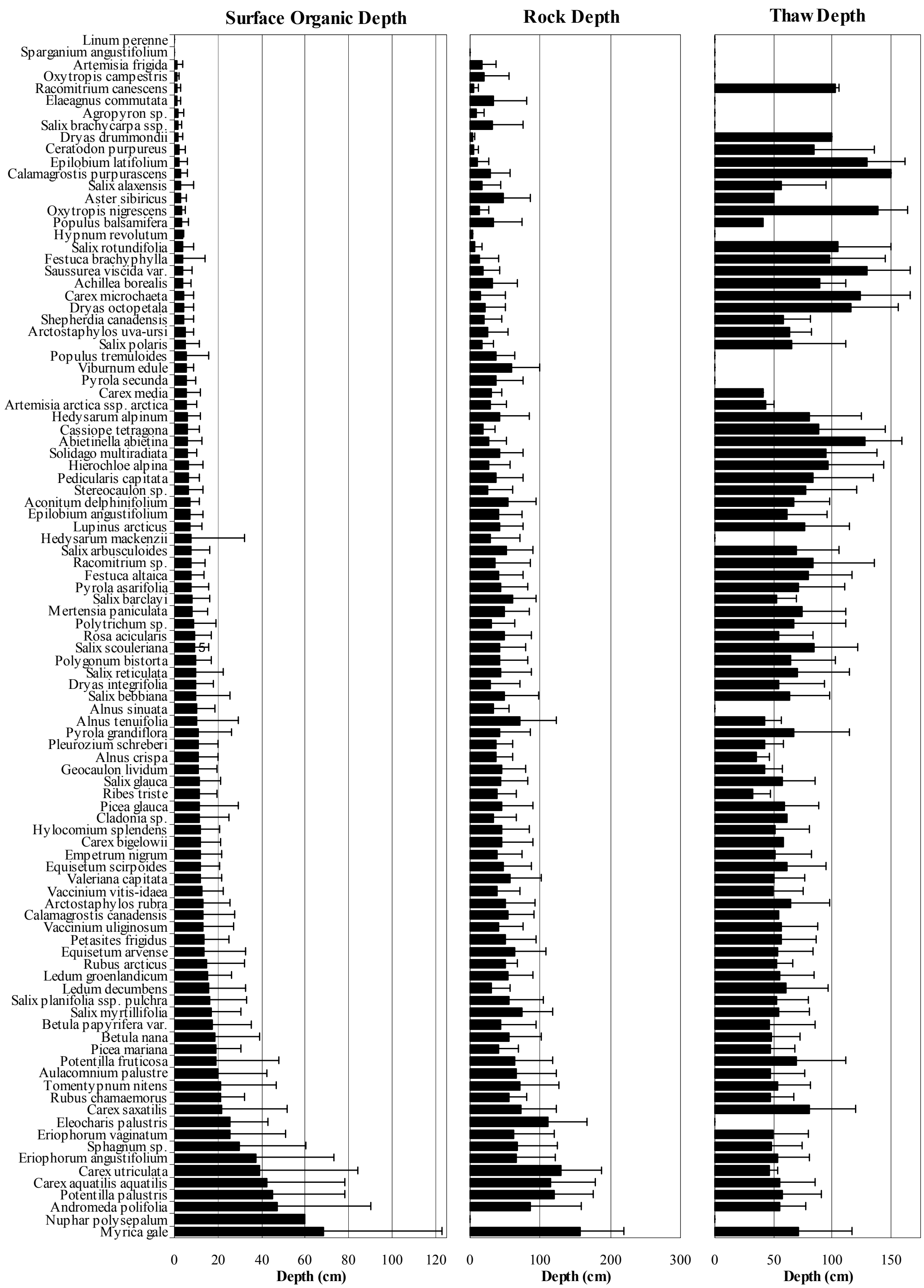


Figure 5. Mean (± SD) thickness of surface organic layer, depth to rock (>15% coarse fragments) and depth of thaw for boreal plant and cryptogam species in Wrangell-St. Elias National Park and Preserve, 2004–2006.

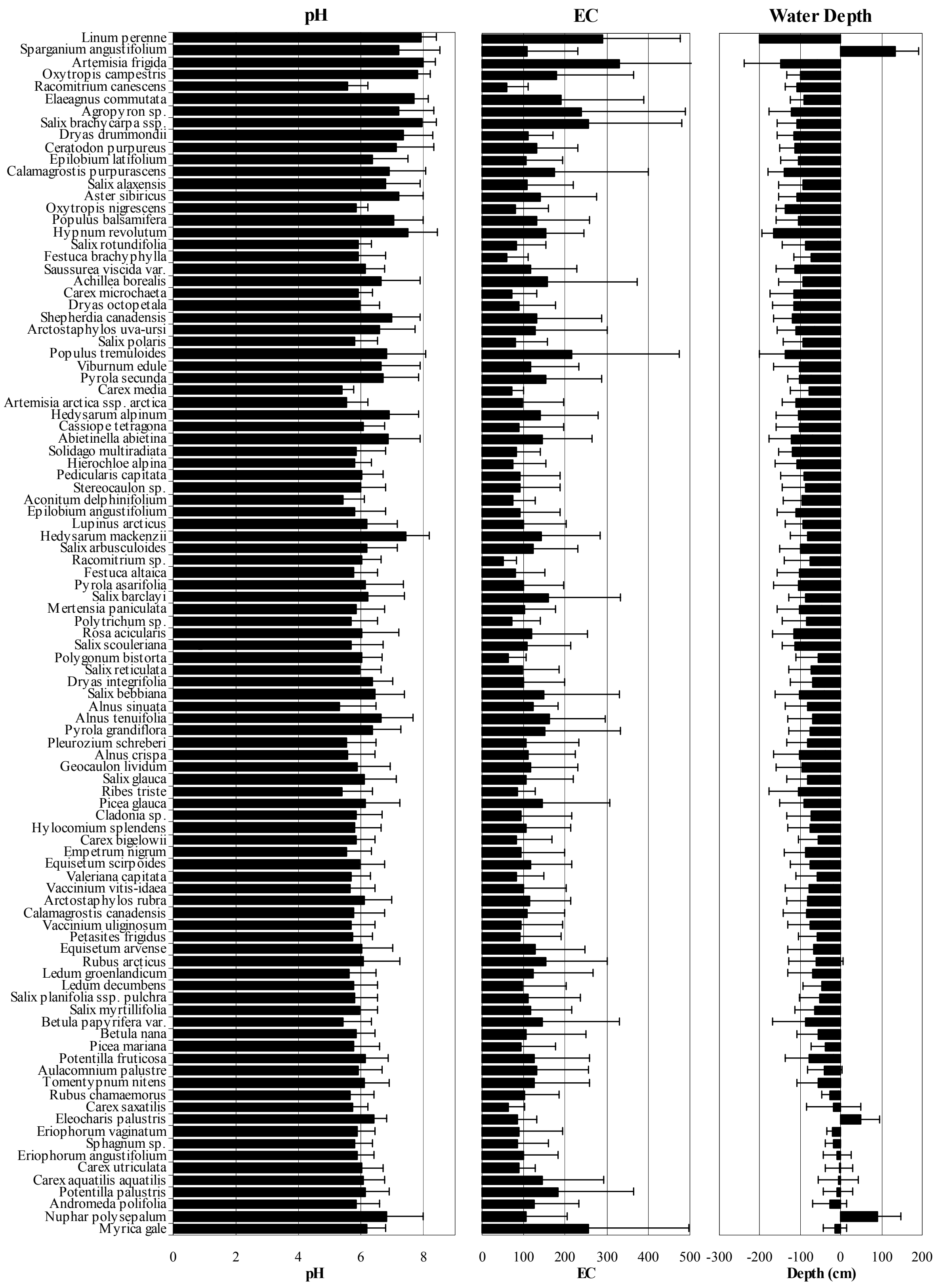


Figure 6. Mean (± SD) pH, electrical conductivity (EC) and water depth for boreal plant and cryptogam species in Wrangell-St. Elias National Park and Preserve, 2004–2006.

included *Artemisia frigida* (mean pH = 8.0), *Linum perenne* (7.9), *Salix brachycarpa* ssp. *niphoclada* (7.9), *Oxytropis campestris* (7.8), and *Hypnum revolutum* (7.5). The latter group typically was associated with soils on glaciolacustrine deposits, minerotrophic fens, or on riverine areas with high sedimentation. Species associated with low pH soils occurred on volcanic material, older moraine and loess. Species common in bog communities also occur frequently in other settings and their mean pH is circumneutral, while many rare or endemic species occur specifically on alkaline sites (Lipkin and Murray, 1997).

EC values were low for most species (50–329 µS/cm), indicating that we sampled no salt-affected sites in the boreal region of the park (Figure 6). With a narrow range of values and high standard deviations it is clear that EC is not an important variable in determining species distributions. Species on sites with the lowest EC values were *Festuca brachyphylla* (59 µS/cm), *Racomitrium canescens* (61 µS/cm), *Polygonum bistorta* (61 µS/cm), and *Carex saxatilis* (64 µS/cm). Species with the highest EC values were *Artemisia frigida* (329 µS/cm), *Linum perenne* (290 µS/cm), *Myrica gale* (256 µS/cm), and *Salix brachycarpa* ssp. *niphoclada* (256 µS/cm).

Plant species occurred on sites with widely variable depth to groundwater (above or belowground) (Figure 6). Aquatic species occurred in depths > 1m above the surface, while species on bluffs and riverbars had estimated groundwater depths > 2 m below the soil surface. Species associated with the greatest water depths above or near the surface were *Sparganium angustifolium* (133 cm), *Nuphar polysepalum* (90 cm), *Eleocharis palustris* (49 cm), and *Carex aquatilis* (-7 cm [below the soil surface]). Species associated with the greatest depths to below ground groundwater included *Linum perenne (~-200 cm), Artemisia frigida, Hypnum revolutum, Populus tremuloides* and *Calamagrostis purpurascens*. Most of the species within these boreal ecotypes occurred where water was between 30 and 100 cm below the surface.

Maritime and Aquatic Ecotypes: Single-factor Comparisons by Ecotype

Six environmental parameters (surface organic-horizon thickness, cumulative organic-horizon thickness, thaw depth, depth to groundwater, pH, and electrical conductivity) were charted for comparison among maritime and aquatic ecotypes.

Although the thickness of the surface organic-horizon was relatively consistent within each physiographic group, it was highly variable among ecotypes (Figure 7). Similar to boreal ecotypes, ecotypes where surface organic accumulations were absent included sites with severe climate and soil conditions, (i.e., Maritime Alpine Barrens), sites that were recently deglaciated, (i.e., Maritime Glaciated Barrens), and sites with frequent sediment deposition (i.e., Maritime Riverine Barrens and Maritime Riverine Horsetail Meadow). Ecotypes with the thickest surface organic horizons were Maritime Lowland Sedge—Blueberry Meadow and Maritime Lowland Forb—Willow Meadow, indicating that these ecotypes were older landscapes with low rates of disturbance.

Depth to rock was shallowest on sites with less than 30% vegetative cover, including Maritime Alpine Barrens, Maritime Glaciated Barrens, and Maritime Riverine Barrens (Figure 7). Ecotypes with the greatest depths to rocky soils occurred on sandy beaches and on fine-grained deposits, including Maritime Riverine Horsetail Meadow, Maritime Coastal Elymus Meadow and Maritime Lowland Sedge—Blueberry Bog. Ecotypes with rock depths >100 cm represent an estimated minimum depth.

In the maritime zone, thaw depths were all greater than our detection limit of 100 cm (Figure 7). At depths >100 cm, we assumed that permafrost was absent, except in areas where vegetation was growing on young moraine that was still underlain with ice, which occurred on the edges of the piedmont-type Malaspina glacier. At high elevation sites, permafrost status was unknown.

Soil pH values for maritime ecotypes were more variable than for boreal ecotypes, and ranged from 3.4–8.3 (Figure 8). Ecotypes with the lowest (most acidic) pH values occurred in subalpine meadows (e.g., Maritime Subalpine Low Blueberry Shrub or Maritime Subalpine Lupine Meadow). Ecotypes with the highest pH values occurred in coastal areas with frequent mineral sedimentation, such as Maritime Coastal Barrens

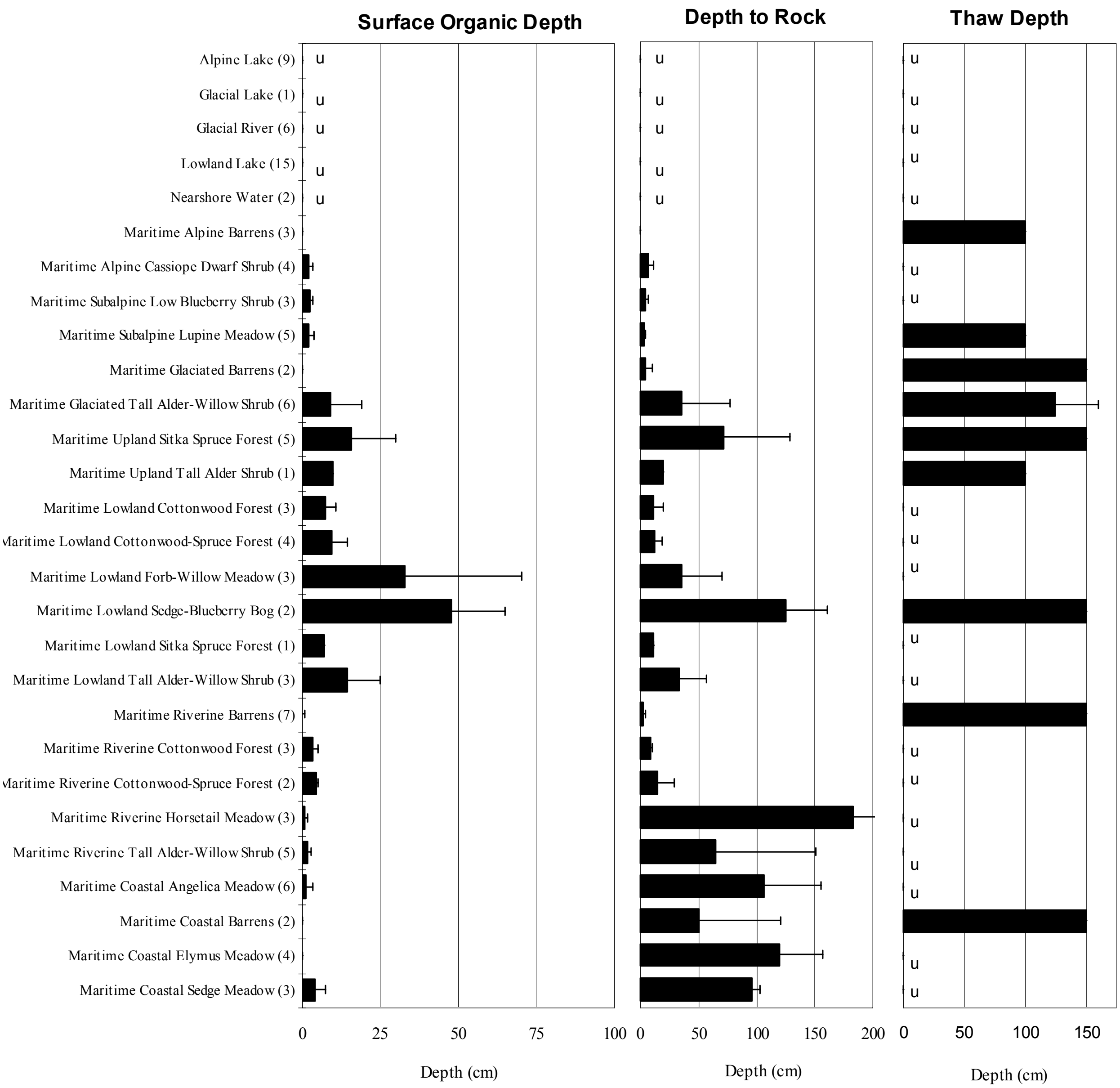


Figure 7. Mean (± SD) thickness of surface organic layer, depth to rock (>15% coarse fragments) and depth of thaw for maritime and water ecotypes in Wrangell-St. Elias National Park and Preserve, 2004–2006. Outliers have been excluded. Sample sizes are in parentheses.

and Maritime Coastal Elymus Meadow. Aquatic ecotypes were mostly circumneutral. Nearshore waster and Glacial River had the highest pH values and Alpine Lake had the lowest.

Most maritime and aquatic ecotypes were nonsaline (<800 µS/cm), except for Nearshore Water and some plots in Maritime Coastal Sedge Meadow and Maritime Coastal Barrens (Figure 8). EC values typically <300 µS/cm in all other ecotypes. Of all aquatic ecotypes, Alpine Lake had the lowest EC values.

Depth to groundwater was > 50 cm for the majority of maritime ecotypes, and above the ground surface for three of these; water depth was at least 1 m above the surface for all aquatic ecotypes (Figure 8). Maritime ecotypes with the deepest water tables were located in alpine and subalpine physiographies. Those with the

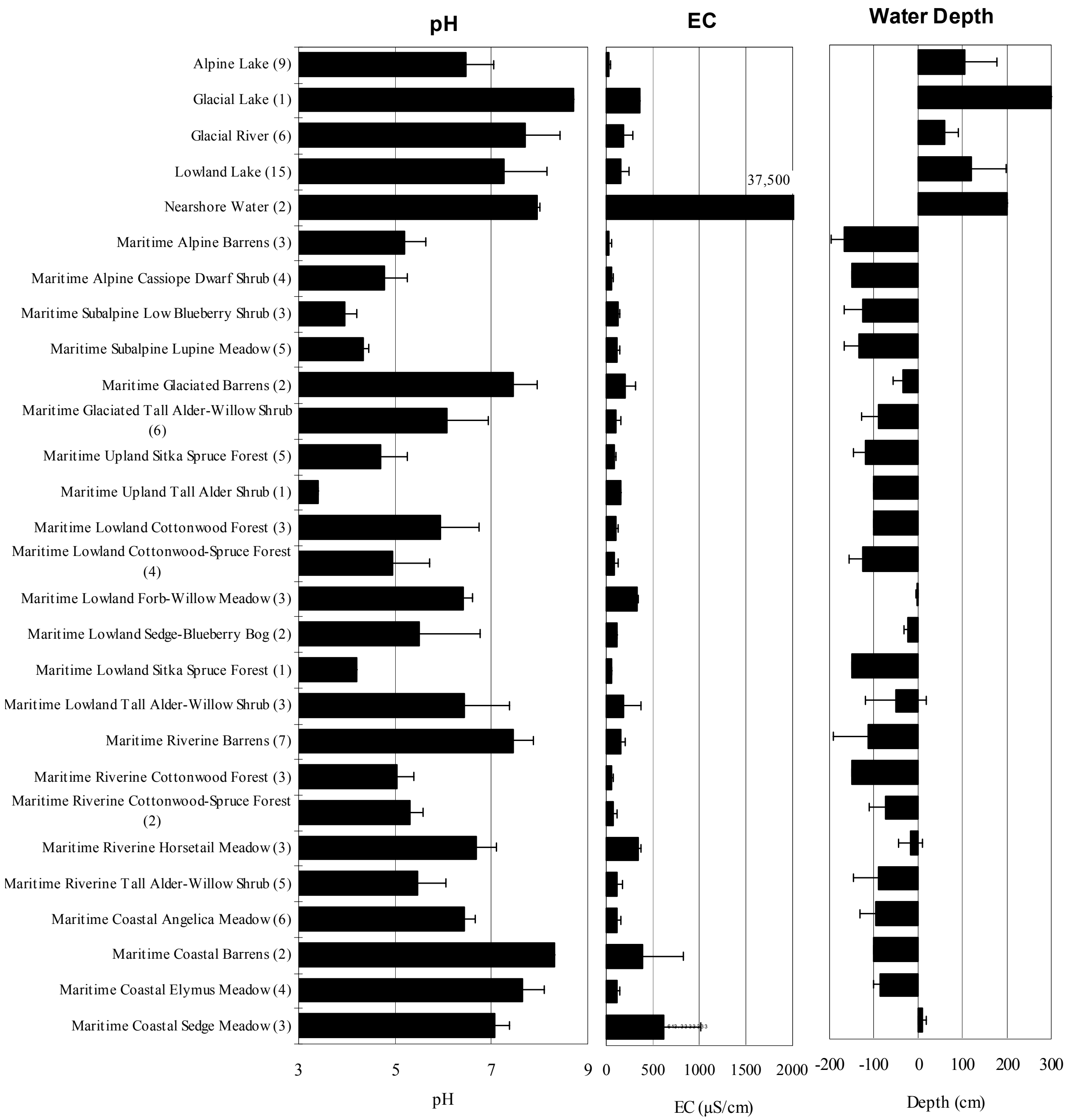


Figure 8. Mean (± SD) pH, electrical conductivity (EC) and water depth for maritime and water ecotypes in Wrangell-St. Elias National Park and Preserve, 2004–2006. Outliers have been excluded. Sample sizes are in parentheses.

shallowest water tables were Maritime Coastal Sedge Meadow, Maritime Riverine Sedge Meadow and Maritime Lowland Forb—Willow Meadow. Values >100 cm represent minimum estimated depths.

Maritime and Aquatic Ecotypes: Single-factor Comparisons by Plant Species

To determine how the environmental parameters measured influenced the distribution of individual plant and cryptogam species in the maritime zone and for aquatic ecotypes, we

calculated the mean value of six parameters for locations where 69 common species occurred.

Species associations and the thickness of the soil surface organic horizon was highly variable both among and within species (Figure 9). Species typically encountered on sites with thin (< 5 cm) organic surface horizons included *Epilobium latifolium, Lathyrus maritimus, Luzula multiflora, Elymus arenarius* ssp. *mollis* and *Castilleja chrymactis*. These soils (and plant species were typically associated with ecotypes subject to frequent fluvial or eolian deposition. Taxa that commonly occurred on sites with thick (> 20 cm) surface organic horizons included *Hedysarum mackenzii, Carex pluriflora, Tofieldia glutinosa, Equisetum fluviatile* and *Eriophorum russeolum*. These soils were commonly wet and subject to little or no disturbance.

Similar to the thickness of the surface organic horizon, species associations and depth to rock (>15% soil volume) were highly variable (Figure 9). Species commonly associated with rocks near the surface were *Epilobium latifolium, Luetkea pectinata, Phyllodoce aleutica, Festuca rubra,* and *Dicranum scoparium*. Species that occurred at sites where depth to rock was greatest included *Castilleja unalaschcensis, Lathyrus maritimus, Eriophorum angustifolium, Eriophorum russeolum*, and *Carex pluriflora*.

Thaw depths were greater than 1 m at all sites (Figure 9); we did not detect permafrost at any site. Permafrost was assumed to be absent at sites with rocky soils.

Most species occurred on sites were pH was acidic to circumneutral, although many species occurred within a wide pH range (Figure 10). Species generally associated with acidic (pH 5.5) sites included *Valeriana sitchensis, Pseudoleskea baileyi, Luetkea pectinata, Cassiope stelleriana* and *Cornus canadensis*. Species associated with alkaline (pH 7.4) soils included *Lathyrus maritimus, Castilleja unalaschcensis, Ligusticum scoticum* and *Elymus arenarius* ssp. *mollis*. Soils in the latter group had a coastal influence and were subject to frequent sedimentation events.

EC values were low for most species, indicating nonsaline conditions (Figure 10). Two species associated with brackish conditions (EC 800–16000 µS/cm) included *Triglochin maritimum* and *Carex lyngbyaei*. EC values were typically, however, < 200 µS/cm.

The degree of soil saturation or inundation is an important factor in determining soil oxygen and thus, plant distribution (Figure 10). For most species, depth to water was > 50 cm below the surface. Common species associated with ecotypes having surface water were *Eriophorum angustifolium, Triglochin maritimum, Carex lyngbyaei* and *Equisetum fluviatile*.

VEGETATION COMPOSITION

Species Summary

There were 39 boreal ecotypes, consisting of 80 AVC vegetation classes at the plot level and 43 plant associations (Table 138). There were 23 maritime , with 17 plant associations and 28 AVC vegetation classes at the plot level (Table 139). There were six water and ice classes. A crosswalk of AVC classes by ecotype further illustrates the hierarchical association (Table 140). Species diversity varied among ecotypes by a factor of 47, and by plot, it varied by a factor of ten (Table 141). The ecotypes with the highest species richness (total number) per plot occurred in alpine or subalpine physiographies. Ecotypes with the highest species richness included Boreal Subalpine Birch and Willow Shrub (289), Boreal Alpine Sedge-Dwarf Willow Meadow (281), and Boreal Alpine Ericaceous Dwarf Shrub (208), although this is in part influenced by the number of plots sampled per ecotype. Predictably, the ecotypes with the lowest species counts were those where the AVC vegetation class was barren (e.g., Maritime Coastal Barrens [6]), or for lakes, such as Lowland Lake (27). In general, ecotypes where the landscape was young and disturbance events occurred more frequently (such as riverine, glaciated or coastal ecotypes), were less diverse, and ecotypes with old landscapes that were less frequently disturbed (alpine, subalpine and upper-successional lowland ecotypes) were more diverse. For example, Boreal Lowland Sedge-Shrub Fen and Boreal Lowland White Spruce Forest had the 6th and 7th highest total species count, respectively. Both these ecotypes are upper successional and have a low frequency of disturbance; fire is the major source of disturbance for these ecosystems. Species counts (Table 141)

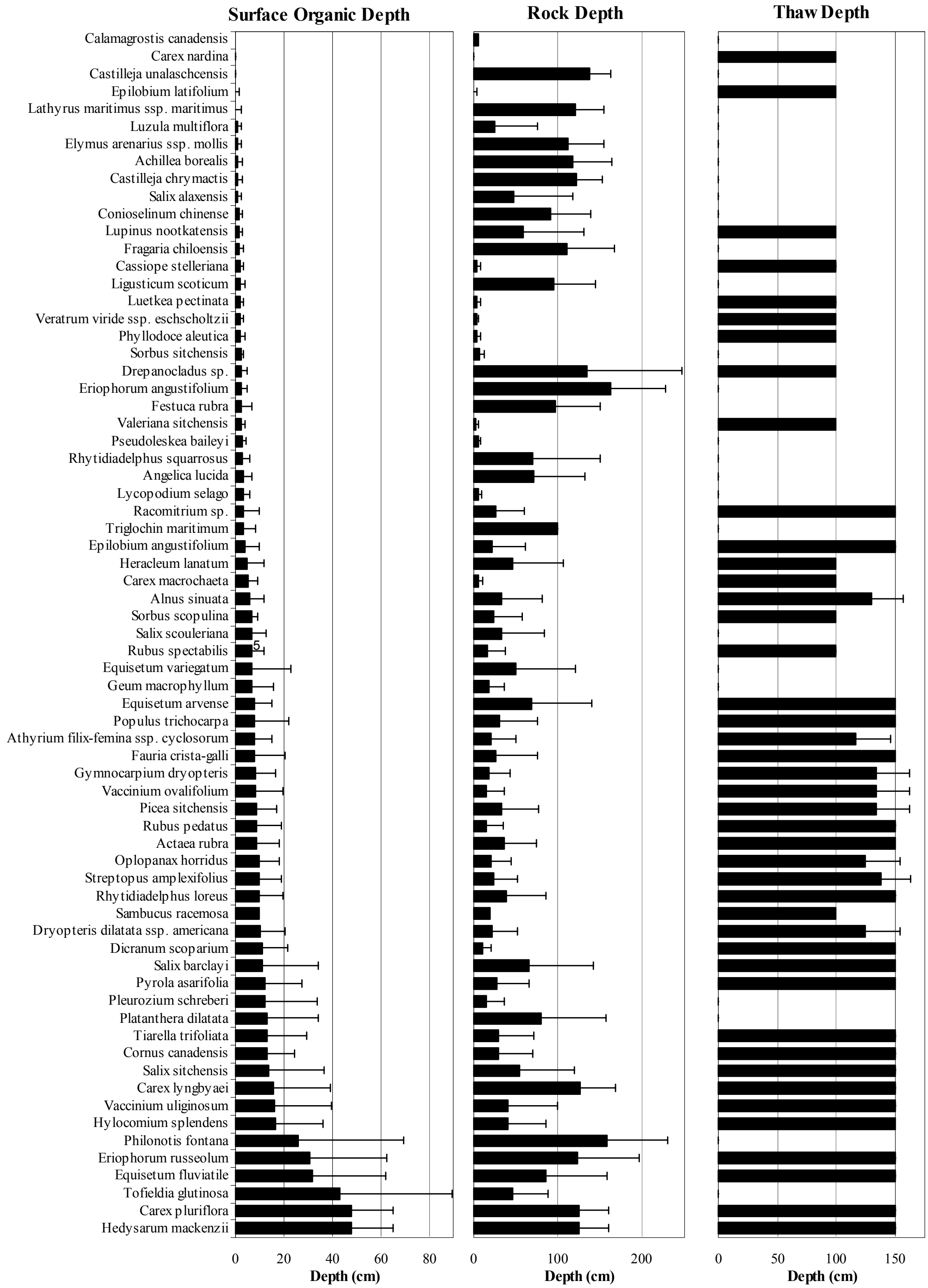


Figure 9. Mean (± SD) thickness of surface organic layer, depth to rock (>15% coarse fragments) and depth of thaw for maritime plant and cryptogam species in Wrangell-St. Elias National Park and Preserve, 2004–2006.

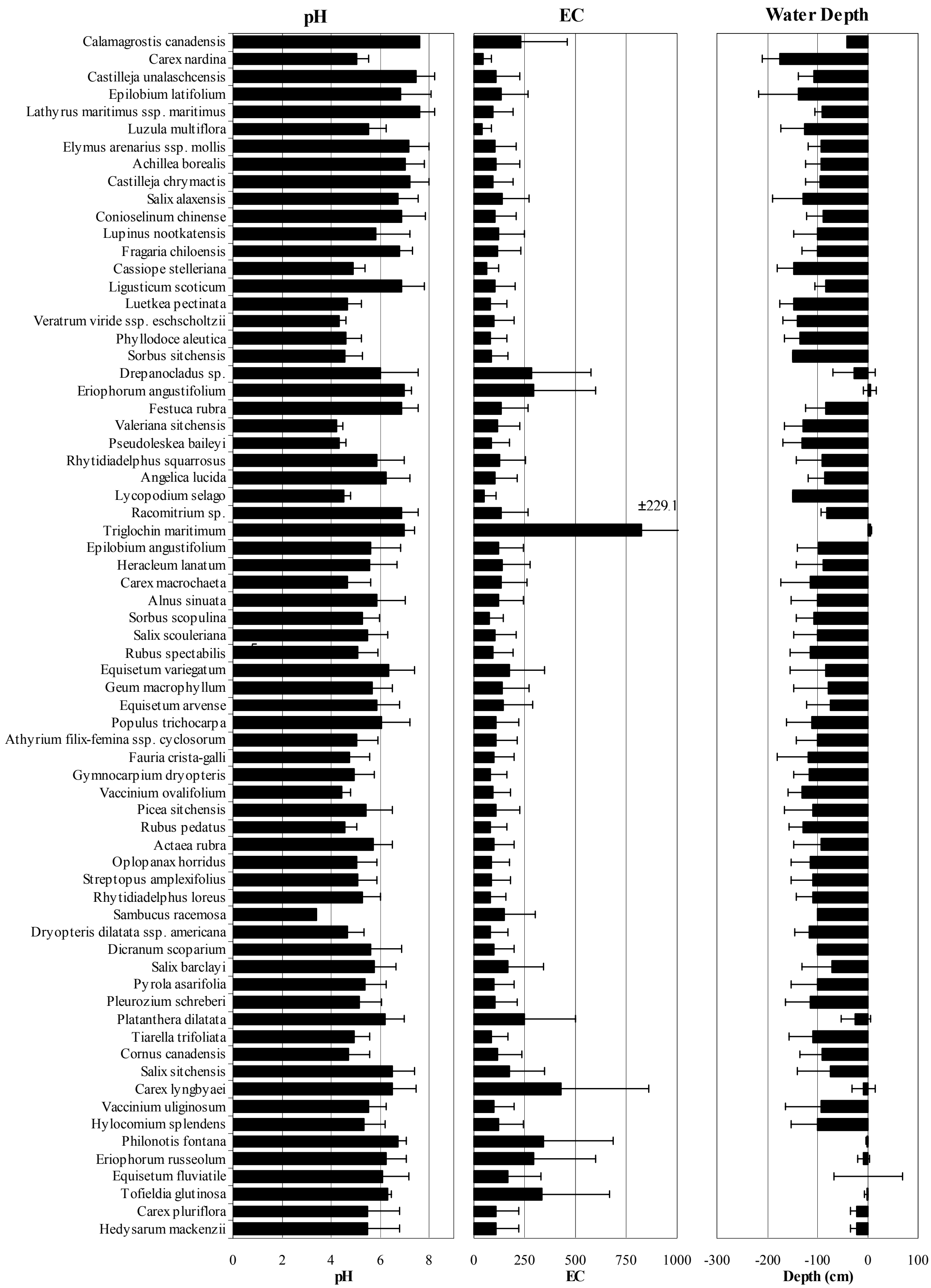


Figure 10. Mean (± SD) pH, electrical conductivity (EC) and water depth for maritime plant and cryptogam species in Wrangell-St. Elias National Park and Preserve, 2004–2006.

Table 138. Crosswalk of boreal ecotypes with component floristic and vegetation classes (Viereck level 4, Viereck et al. 1992), Wrangell-St. Elias National Park and Preserve.

Ecotype Class	Floristic Class	Vegetation Class
Boreal Alpine Barrens	*Dryas integrifolia-Oxytropis nigrescens-Arctostaphylos rubra*	Partially Vegetated
	Racomitrium sp.-Carex microchaeta	Barren
		Partially Vegetated
		Dry Bryophyte
	Salix polaris-Artemisia arctica arctica	Barren
		Partially Vegetated
Boreal Alpine Dryas Dwarf Shrub	*Dryas integrifolia-Oxytropis nigrescens-Arctostaphylos rubra*	Dryas–Lichen Dwarf Shrub Tundra
		Dryas Dwarf Shrub Tundra
	Dryas octopetala-Hierochlöe alpina-Saussurea viscida var. yukonensis	Dryas–Lichen Dwarf Shrub Tundra
		Dryas Dwarf Shrub Tundra
		Dryas–Sedge Dwarf Shrub Tundra
		Open Low Mesic Ericaceous Shrub
Boreal Alpine Ericaceous Dwarf Shrub	*Cassiope tetragona-Pedicularis capitata*	Ericaceous Dwarf Shrub Tundra
		Cassiope Dwarf Shrub Tundra
		Vaccinium Dwarf Shrub Tundra
	Empetrum nigrum-Artemisia arctica arctica	Ericaceous Dwarf Shrub Tundra
		Crowberry Dwarf Shrub Tundra
		Vaccinium Dwarf Shrub Tundra
Boreal Alpine Sedge-Dwarf Willow Meadow	*Carex bigelowii-Salix reticulata*	Dryas–Forb Dwarf Shrub Tundra
		Moist Sedge–Dryas Tundra
		Moist Sedge–Shrub Tundra
		Open Low Willow
		Wet Sedge–Willow Tundra
		Midgrass–Herb
		Moist Sedge–Grass Meadow Tundra
		Moist Sedge–Willow Tundra
		Willow Dwarf Shrub Tundra
	Carex microchaeta-Salix rotundifolia	Moist Sedge–Shrub Tundra
		Moist Sedge–Willow Tundra
	Salix polaris-Artemisia arctica arctica	Willow Dwarf Shrub Tundra
Boreal Alpine Tussock Meadow	*Eriophorum vaginatum-Salix planifolia pulchra-Polygonum bistorta*	Tussock Tundra
		Open Mixed Low Shrub–Sedge Tussock Tundra

Table 138. Continued.

Ecotype Class	Floristic Class	Vegetation Class
Boreal Alpine Sedge Meadow	*Eriophorum angustifolium-Carex aquatilis aquatilis-Salix planifolia pulchra*	Subarctic Lowland Sedge Bog Meadow
		Wet Sedge Meadow Tundra
		Wet Sedge–Willow Tundra
Boreal Subalpine Forb Meadow	*Artemisia arctica arctica-Festuca altaica-Valeriana capitata*	Mixed Herbs
Boreal Subalpine Willow and Birch Shrub	*Betula nana-Salix planifolia pulchra-Festuca altaica*	Open Low Mesic Shrub Birch–Ericaceous Shrub
		Open Low Shrub Birch–Willow
		Closed Low Shrub Birch
		Closed Low Shrub Birch–Willow
		Open Low Willow
		Open Tall Willow
		Closed Low Willow
		Closed Tall Willow
		Ericaceous–Lichen Dwarf Shrub Tundra
		Closed Tall Shrub Birch
Boreal Subalpine Poplar Forest	*Populus balsamifera-Festuca altaica*	Open Balsam Poplar Forest
		Closed Balsam Poplar Forest
		Open Dwarf Balsam Poplar
Boreal Subalpine Spruce Woodland	*Picea glauca-Vaccinium uliginosum*	White Spruce Woodland
Boreal Upland Aspen Forest	*Populus tremuloides-Picea glauca-Rosa acicularis*	Closed Quaking Aspen Forest
		Open Quaking Aspen Forest
		Open Quaking Aspen–Spruce Forest
Boreal Upland Birch Forest	*Betula papyrifera var. humilis-Ledum groenlandicum*	Closed Paper Birch Forest
		Open Paper Birch Forest
Boreal Upland Spruce-Birch Forest	*Betula papyrifera var. Humilis-Picea glauca-Ribes triste*	Open Spruce–Paper Birch Forest
Boreal Upland White Spruce Forest	*Picea glauca-Rosa acicularis*	Open White Spruce Forest
		White Spruce Woodland
		Open Spruce–Balsam Poplar Forest
Boreal Upland Tall Alder Shrub	*Alnus crispa-Ribes triste-Calamagrostis canadensis*	Open Tall Alder
		Closed Tall Alder–Willow
		Closed Tall Alder
		White Spruce Woodland
Boreal Upland Sagebrush Meadow	*Artemisia frigida-Calamagrostis purpurascens-Linum perenne*	Open Low Silverberry Shrub
		Open Sagebrush–Grass
		Open Sagebrush–Juniper
Boreal Glaciated Barrens	*Dryas drummondii-Shepherdia canadensis-Salix alaxensis*	Barren
Boreal Glaciated Dryas Dwarf Shrub	*Dryas drummondii-Shepherdia canadensis-Salix alaxensis*	Dryas Dwarf Shrub Tundra

Table 138. Continued.

Ecotype Class	Floristic Class	Vegetation Class
Boreal Glaciated Willow Shrub	*Salix alaxensis-Salix brachycarpa niphoclada-Arctostaphylos rubra*	Open Low Willow
		Open Tall Willow
		Closed Low Willow
Boreal Lacustrine Pondlily	*Nuphar polysepalum-Sparganium angustifolium*	Pondlily
Boreal Lacustrine Sedge Meadow	*Carex aquatilis aquatilis-Potentilla palustris-Salix planifolia pulchra*	Wet Sedge Meadow Tundra
		Fresh Sedge Marsh
		Subarctic Lowland Sedge Wet Meadow
		Subarctic Lowland Sedge–Shrub Wet Meadow
	Carex saxatilis SL-Eriophorum angustifolium	Wet Sedge Meadow Tundra
		Fresh Sedge Marsh
		Moist Sedge–Grass Meadow Tundra
		Subarctic Lowland Sedge Wet Meadow
	Carex utriculata-Potentilla palustris	Wet Sedge Meadow Tundra
		Fresh Herb Marsh
		Subarctic Lowland Sedge Wet Meadow
Boreal Lowland Low Birch-Willow Shrub	*Betula nana-Salix planifolia pulchra-Ledum decumbens*	Open Low Mesic Shrub Birch–Ericaceous Shrub
		Open Low Shrub Birch–Ericaceous Shrub Bog
		Open Low Shrub Birch–Willow
		Closed Low Shrub Birch–Willow
		Open Low Willow
Boreal Lowland Sedge-Shrub Fen	*Carex aquatilis aquatilis-Eriophorum angustifolium-Andromeda polifolia*	Subarctic Lowland Sedge Bog Meadow
		Subarctic Lowland Sedge–Moss Bog Meadow
		Subarctic Lowland Sedge Wet Meadow
		Subarctic Lowland Sedge–Shrub Wet Meadow
		Open Low Sweetgale–Graminoid Bog
		Open Low Willow–Graminoid Shrub Bog
	Carex aquatilis aquatilis-Potentilla palustris-Salix planifolia pulchra	Subarctic Lowland Sedge Wet Meadow
		Open Low Sweetgale–Graminoid Bog
		Open Low Willow–Graminoid Shrub Bog
Boreal Lowland Tall Willow Shrub	*Salix scouleriana-Salix barclayi-Rosa acicularis*	Open Tall Willow
		Closed Tall Willow

Table 138. Continued.

Ecotype Class	Floristic Class	Vegetation Class
Boreal Lowland Tussock-Shrub Bog	*Eriophorum vaginatum-Betula nana*	Tussock Tundra
		Open Mixed Low Shrub–Sedge Tussock Tundra
		Open Mixed Low Shrub–Sedge Tussock Bog Meadow
Boreal Lowland Black Spruce Bog	*Picea mariana-Salix glauca-Equisetum scirpoides*	Black Spruce Woodland
	Picea mariana-Salix planifolia pulchra-Rubus chamaemorus	Open Black Spruce Forest
		Black Spruce Woodland
		Open Dwarf Black Spruce
		Dwarf Black Spruce Woodland
Boreal Lowland Black Spruce Forest	*Picea mariana-Salix glauca-Equisetum scirpoides*	Open Black Spruce Forest
		Open Black Spruce–White Spruce Forest
		Open Dwarf Black Spruce
		Dwarf Black Spruce Woodland
	Picea mariana-Salix planifolia pulchra-Rubus chamaemorus	Open Black Spruce Forest
Boreal Lowland White Spruce Forest	*Picea glauca-Vaccinium uliginosum*	Open White Spruce Forest
		White Spruce Woodland
		Dwarf White Spruce Woodland
Boreal Riverine Acidic Barrens	*Racomitrium sp.-Festuca brachyphylla*	Dry Bryophyte
Boreal Riverine Circumalkaline Barrens	*Epilobium latifolium-Salix alaxensis*	Barren
		Partially Vegetated
Boreal Riverine Dryas Dwarf Shrub	*Dryas drummondii-Oxytropis campestris*	Dryas–Lichen Dwarf Shrub Tundra
		Dryas Dwarf Shrub Tundra
Boreal Riverine Low Silverberry Shrub	*Elaeagnus □inuate□e-Oxytropis campestris*	Balsam Poplar Woodland
		Seral Herbs
		Closed Low Silverberry Shrub
		Open Low Silverberry Shrub
Boreal Riverine Sandy Willow Shrub	*Salix barclayi-Salix brachycarpa niphoclada-Elaeagnus commutata*	Open Low Willow
		Open Tall Willow
Boreal Riverine Loamy Willow Shrub	*Salix planifolia pulchra-Calamagrostis canadensis*	Open Low Willow
		Bluejoint–Shrub
		Open Low Mesic Ericaceous Shrub
Boreal Riverine Tall Alder Shrub	*Alnus □inuate-Pyrola grandiflora*	Closed Tall Alder
	Alnus tenuifolia-Calamagrostis canadensis	Open Tall Alder–Willow
		Open Tall Alder
		Closed Tall Alder–Willow
		Closed Tall Alder
Boreal Riverine Gravelly Poplar Forest	*Populus balsamifera-Dryas drummondii-Oxytropis campestris*	Open Balsam Poplar Forest
		Dwarf Balsam Poplar Woodland
Boreal Riverine Loamy Poplar Forest	*Populus balsamifera-Alnus tenuifolia-Equisetum arvense*	Open Balsam Poplar Forest
		Closed Balsam Poplar Forest

Table 138. Continued.

Ecotype Class	**Floristic Class**	**Vegetation Class**
Boreal Riverine Spruce-Poplar Forest	*Populus balsamifera-Picea glauca-Oxytropis campestris*	Open Spruce–Balsam Poplar Forest
Boreal Riverine White Spruce Forest	*Picea glauca-Hedysarum alpinum*	Open White Spruce Forest
		White Spruce Woodland
Alpine Lake	water	Water
		Fresh Herb Marsh
Glacial Lake	water	Water
Glacial River	water	Water
Lowland Lake	water	Water
		Fresh Pondweed

should be considered a point for comparison among ecotypes rather than an absolute number, due to our sampling methods and the fact that we could have overlooked species. We recorded 563 vascular species (excluding subspecies), whereas Park staff recorded 832 species. Cataloguing all plant species present in the park, however, was beyond the scope of this project.

Ordination of Vegetation

In addition to the single-factor comparisons, we used detrended correspondence analysis (DCA) to demonstrate the separation of plots by species composition. The combined effects of physiography and various environmental variables were assessed by superimposing the ecotype class for each plot on the ordination. To improve the readability of these figures, boreal and maritime ecotypes are plotted separately; boreal ecotypes are further grouped by physiographic type (Figures 11–13). Coastal ecosystems are not plotted, but are distinct from other physiographic groups due to the effects of salinity.

There was some overlap within boreal alpine and subalpine ecotypes (Figure 12). Ecotypes with a barren vegetation (<30% plant cover) were floristically similar to dwarf shrub types and these had close proximity along the X axis. Similarly, Boreal Alpine Sedge-Dwarf Willow and Boreal Alpine Tussock overlapped, although Alpine Sedge Meadow was distinct and tightly grouped.

In contrast to these distinct ecotypes located around the margins of the DCA plot, several ecotypes in the center show substantial overlap. The barrens and Dryas shrub ecotypes in the alpine are highly similar in composition, when separated by alkaline and nonalkaline soil chemistry, and vary principally in the amount vegetation present. Similarly, the mid-successional ecotype Boreal Upland Spruce-Birch Forest, shows substantial compositional lap with the mid-successional Boreal Upland Birch Forest and the late-successional ecotype Boreal Upland White Spruce Forest.

Sorted Tables

Sorted vegetation tables (Tables 142–146) were constructed to provide a more direct means of comparing the floristic composition of closely associated ecotypes (horizontal order) and for evaluating the association of species along environmental gradients (vertical order). The tables, however, only include species that are abundant or of relatively high frequency within each ecotype. These tables associate assemblages of common species within an ecotype. Similarities and differences in species composition on the sorted tables are consistent with the DCA results (Figures 11–13).

SOIL CHARACTERISTICS

Overall, 53 soil subgroups were identified during field sampling (n = 423) (Table 133–134), although 15 soil subgroups were rare and therefore, excluded from the analysis and mapping. The most common subgroups overall were Typic Cryorthents (12%), Typic Dystrocryepts (9%), Oxyaquic

Table 139. Crosswalk of maritime ecotypes with component floristic and vegetation classes (Viereck level 4, Viereck et al. 1992), Wrangell-St. Elias National Park and Preserve.

Ecotype Class	Floristic Class	Vegetation Class
Maritime Alpine Barrens	*Cassiope stelleriana-Luetkea pectinata*	Partially Vegetated
Maritime Alpine Cassiope Dwarf Shrub	*Cassiope stelleriana-Luetkea pectinata*	Cassiope Dwarf Shrub Tundra
Maritime Subalpine Lupine Meadow	*Lupinus nootkatensis-Fauria crista-galli-Veratrum viride eschscholtzii*	Mixed Herbs
Maritime Subalpine Low Blueberry Shrub	*Vaccinium ovalifolium-Luetkea pectinata*	Closed Low Mesic Ericaceous Shrub
		Open Low Mesic Ericaceous Shrub
Maritime Upland Tall Alder Shrub	*Alnus sinuata-Rubus spectabilis-Sambucus racemosa*	Closed Tall Alder
Maritime Upland Sitka Spruce Forest	*Picea sitchensis-Vaccinium ovalifolium*	Closed Sitka Spruce–Western Hemlock Forest
		Open Sitka Spruce Forest
Maritime Glaciated Barrens	*Alnus sinuata-Sorbus scopulina*	Barren
	Arctophila fulva-Equisetum fluviatile	Barren
Maritime Glaciated Tall Alder-Willow Shrub	*Alnus sinuata-Salix barclayi-Athyrium filix-femina cyclosorum*	Closed Tall Alder–Willow
	Alnus sinuata-Sorbus scopulina	Open Tall Alder–Willow
		Open Tall Alder
		Closed Tall Alder–Willow
		Closed Tall Alder
Maritime Lowland Forb-Willow Meadow	*Equisetum variegatum-Salix barclayi-Tofieldia glutinosa*	Open Low Willow
		Subarctic Lowland Herb Wet Meadow
Maritime Lowland Sedge-Blueberry Bog	*Vaccinium uliginosum-Carex pluriflora*	Open Low Ericaceous Shrub Bog
		Subarctic Lowland Sedge–Moss Bog Meadow
Maritime Lowland Tall Alder-Willow Shrub	*Alnus sinuata-Salix barclayi-Athyrium filix-femina cyclosorum*	Open Tall Alder–Willow
		Closed Tall Alder–Willow
Maritime Lowland Cottonwood Forest	*Alnus sinuata-Sorbus scopulina*	Open Black Cottonwood Forest
	Populus trichocarpa-Alnus sinuata-Picea sitchensis	Open Black Cottonwood Forest
Maritime Lowland Cottonwood-Spruce Forest	*Populus trichocarpa-Alnus sinuata-Picea sitchensis*	Open Black Cottonwood–Sitka Spruce Forest
		Open Black Cottonwood–Western Hemlock Forest
		Black Cottonwood–Sitka Spruce Woodland
Maritime Lowland Sitka Spruce Forest	*Picea sitchensis-Vaccinium ovalifolium*	Open Sitka Spruce Forest
Maritime Riverine Barrens	*Racomitrium* sp.-*Epilobium latifolium*	Barren
		Partially Vegetated
		Dry Bryophyte

Table 139. Continued.

Ecotype Class	Floristic Class	Vegetation Class
Maritime Riverine Horsetail Meadow	*Equisetum arvense-Eriophorum angustifolium*	Subarctic Lowland Herb Wet Meadow
Maritime Riverine Tall Alder-Willow Shrub	*Alnus sinuata-Salix barclayi-Equisetum variegatum*	Open Tall Alder–Willow
		Open Tall Alder
Maritime Riverine Cottonwood Forest	*Populus trichocarpa-Alnus sinuata-Picea sitchensis*	Open Black Cottonwood Forest
Maritime Riverine Cottonwood-Spruce Forest	*Populus trichocarpa-Alnus sinuata-Picea sitchensis*	Open Black Cottonwood–Sitka Spruce Forest
		Closed Tall Alder–Willow
Maritime Coastal Barrens	*Elymus arenarius mollis-Lathyrus maritimus maritimus*	Barren
		Partially Vegetated
Maritime Coastal Elymus Meadow	*Elymus arenarius mollis-Lathyrus maritimus maritimus*	Elymus
		Seral Herbs
		Mixed Herbs
Maritime Coastal Angelica Meadow	*Lupinus nootkatensis-Angelica lucida*	Mixed Herbs
		Large Umbel
Maritime Coastal Sedge Meadow	*Carex lyngbyaei-Triglochin maritimum*	Halophytic Sedge Wet Meadow, brackish
		Fresh Sedge Marsh
		Subarctic Lowland Sedge Wet Meadow
Nearshore Water	Water	Water
Alpine Lake	Water	Water
Glacial River	Water	Water
Lowland Lake	Water	Water

Cryorthents (7%), Typic Eutrogelepts (6%), and Typic Aquorthels (5%).

In the boreal zone we documented 29 soil subgroups (n = 342). The most common subgroups were Typic Cryorthents (10%), Typic Dystrocryepts (9%), Typic Eutrogelepts (7%), Oxyaquic Cryorthents (7%), and Typic Aquorthels (6%). Of these soil subgroups, 41% were in the order Inceptisol, which includes weakly developed soils with deep thaw depths. These most frequently occurred in rocky alpine and subalpine environments. Gelisols, which had permafrost near the surface (<1 m), comprised 25% of soil subgroups. These were primarily located in alpine and lowland environments. Entisols, which includes poorly developed soils with deep thaw depths, comprised 22% of the soil subgroups. These were associated with active riverine environments. Histosols, with a > 40 cm thick layer of organic material, comprised 7% of the subgroups. These were associated with lowland and lacustrine areas. Spodosols, which are well developed soils from leaching of organics, aluminum and iron, comprised 4% of soil subgroups, and were associated with subalpine areas. Mollisols, which are permafrost free with thick A horizons, comprised 2% of the subgroups and were associated with upland and subalpine environments.

In the maritime zone we documented 19 different soil subgroups. The most common subgroups were Typic Cryorthents (19% of 81 observations), Typic Cryaquents (12%), Typic Dystrocryepts (11%), Humic Dystrocryepts (10%) and Typic Cryopsamments (10%). The order Entisol, which included poorly developed soils with deep thaw depths, comprised 58% of the soil subgroups and were associated with active riverine and coastal environments. Inceptisols, which include weakly developed soils with deep thaw

Table 140. Crosswalk of abbreviated ecotypes with original ecotypes and Viereck level IV vegetation classes, Wrangell-St. Elias National Park and Preserve.

Ecotype (short name)	Ecotype (long name)	Vegetation Class
Alpine Lake	Boreal Alpine Circumneutral Lake	Fresh Herb Marsh
		Water
Boreal Alpine Barrens	Boreal Alpine Rocky Dry Circumacidic Barrens	Barren
		Dry Bryophyte
		Partially Vegetated
Boreal Alpine Dryas Dwarf Shrub	Boreal Alpine Rocky Dry Circumacidic Dryas Dwarf Shrub	Dryas Dwarf Shrub Tundra
		Dryas-Lichen Dwarf Shrub Tundra
		Dryas–Sedge Dwarf Shrub Tundra
		Open Low Ericaceous Shrub
Boreal Alpine Ericaceous Dwarf Shrub	Boreal Alpine Rocky-loamy Moist Circumacidic Ericaceous Dwarf Shrub	Cassiope Dwarf Shrub Tundra
		Crowberry Dwarf Shrub Tundra
		Ericaceous Dwarf Shrub Tundra
		Vaccinium Dwarf Shrub Tundra
Boreal Alpine Sedge Meadow	Boreal Alpine Organic-rich Wet Circumacidic Sedge Meadow	Subarctic Lowland Sedge Bog Meadow
		Wet Sedge Meadow Tundra
		Wet Sedge–Willow Tundra
Boreal Alpine Sedge-Dwarf Willow Meadow	Boreal Alpine Mixed-textured Moist Circumacidic Sedge-Dwarf Willow Meadow	Dryas–Forb Dwarf Shrub Tundra
		Midgrass–Herb
		Moist Sedge–Dryas Tundra
		Moist Sedge-Grass Meadow Tundra
		Moist Sedge–Shrub Tundra
		Moist Sedge–Willow Tundra
		Open Low Willow
		Wet Sedge–Willow Tundra
		Willow Dwarf Shrub Tundra
Boreal Alpine Tussock Meadow	Boreal Alpine Organic-rich Moist Circumneutral Tussock Meadow	Open Mixed Low Shrub–Sedge Tussock Tundra
		Tussock Tundra
Boreal Glaciated Barrens	Boreal Glaciated Rocky Dry Alkaline Barrens	Barren
Boreal Glaciated Dryas Dwarf Shrub	Boreal Glaciated Rocky Dry Alkaline Dryas Dwarf Shrub	Dryas Dwarf Shrub Tundra
Boreal Glaciated Willow Shrub	Boreal Glaciated Rocky Dry Alkaline Low and Tall Willow Shrub	Closed Low Willow
		Open Low Willow
		Open Tall Willow
Boreal Lacustrine Pondlily	Boreal Lacustrine Aquatic Circumneutral Pondlily	Pondlily
Boreal Lacustrine Sedge Meadow	Boreal Lacustrine Organic-rich Wet Circumacidic Sedge Meadow	Fresh Herb Marsh
		Fresh Sedge Marsh
		Moist Sedge-Grass Meadow Tundra
		Subarctic Lowland Sedge-Shrub Wet Meadow
		Subarctic Lowland Sedge Wet Meadow
		Wet Sedge Meadow Tundra
Boreal Lowland Black Spruce Bog	Boreal Lowland Circumacidic Black Spruce Bog	Black Spruce Woodland
		Dwarf Black Spruce Woodland
		Open Black Spruce Forest
		Open Dwarf Black Spruce
Boreal Lowland Black Spruce Forest	Boreal Lowland Loamy Moist Circumacidic Black Spruce Forest	Dwarf Black Spruce Woodland
		Open Black Spruce Forest

Table 140. Continued.

Ecotype (short name)	Ecotype (long name)	Vegetation Class
		Open Black Spruce–White Spruce
		Open Dwarf Black Spruce
Boreal Lowland Low Birch-Willow Shrub	Boreal Lowland Organic-rich Moist Circumacidic Low Birch-Willow Shrub	Closed Low Shrub Birch-Willow
		Open Low Mesic Shrub Birch-Ericaceous Shrub
		Open Low Shrub Birch-Ericaceous Shrub Bog
		Open Low Shrub Birch-Willow
		Open Low Willow
Boreal Lowland Sedge-Shrub Fen	Boreal Lowland Circumneutral Sedge-Shrub Fen	Open Low Sweetgale-Graminoid Bog
		Open Low Willow–Graminoid Shrub Bog
		Subarctic Lowland Sedge-Shrub Wet Meadow
		Subarctic Lowland Sedge Bog Meadow
		Subarctic Lowland Sedge Wet Meadow
		Subarctic Lowland Sedge-Moss Bog Meadow
Boreal Lowland Tall Willow Shrub	Boreal Lowland Loamy Moist Circumacidic Tall Willow Shrub	Closed Tall Willow
		Open Tall Willow
Boreal Lowland Tussock-Shrub Bog	Boreal Lowland Circumacidic Tussock-Low Shrub Bog	Open Mixed Low Shrub–Sedge Tussock Bog Meadow
		Open Mixed Low Shrub–Sedge Tussock Tundra
		Tussock Tundra
Boreal Lowland White Spruce Forest	Boreal Lowland Mixed-textured Moist Circumacidic White Spruce Forest	Dwarf White Spruce Woodland
		Open White Spruce Forest
		White Spruce Woodland
Boreal Riverine Acidic Barrens	Boreal Riverine Gravelly Dry Acidic Barrens	Dry Bryophyte
Boreal Riverine Circumalkaline Barrens	Boreal Riverine Gravelly Dry Circumalkaline Barrens	Barren
		Partially Vegetated
Boreal Riverine Dryas Dwarf Shrub	Boreal Riverine Gravelly Dry Alkaline Dryas Dwarf Shrub	Dryas Dwarf Shrub Tundra
		Dryas-Lichen Dwarf Shrub Tundra
Boreal Riverine Gravelly Poplar Forest	Boreal Riverine Gravelly Dry Alkaline Poplar Forest	Dwarf Balsam Poplar Woodland
		Open Balsam Poplar Forest
Boreal Riverine Loamy Poplar Forest	Boreal Riverine Loamy Moist Circumneutral Poplar Forest	Closed Balsam Poplar
		Open Balsam Poplar Forest
Boreal Riverine Loamy Willow Shrub	Boreal Riverine Loamy Moist Circumacidic Low and Tall Willow Shrub	Bluejoint-Shrub
		Open Low Ericaceous Shrub
		Open Low Willow
Boreal Riverine Low Silverberry Shrub	Boreal Riverine Gravelly Moist Alkaline Low Silverberry Shrub	Balsam Poplar Woodland
		Closed Low Silverberry Shrub
		Open Low Silverberry Shrub
		Seral Herbs
Boreal Riverine Sandy Willow Shrub	Boreal Riverine Sandy Moist Alkaline Low and Tall Willow Shrub	Open Low Willow
		Open Tall Willow
Boreal Riverine Spruce-Poplar Forest	Boreal Riverine Gravelly Dry Circumalkaline Spruce-Poplar Forest	Open Spruce-Balsam Poplar Forest
Boreal Riverine Tall Alder Shrub	Boreal Riverine Mixed-textured Moist Circumalkaline Tall Alder Shrub	Closed Tall Alder
		Closed Tall Alder-Willow

Table 140. Continued.

Ecotype (short name)	Ecotype (long name)	Vegetation Class
		Open Tall Alder
		Open Tall Alder-Willow
Boreal Riverine White Spruce Forest	Boreal Riverine Loamy Moist Circumneutral White Spruce Forest	Open White Spruce Forest
		White Spruce Woodland
Boreal Subalpine Forb Meadow	Boreal Subalpine Loamy Moist Acidic Forb Meadow	Mixed Herbs
Boreal Subalpine Poplar Forest	Boreal Subalpine Rocky-loamy Moist Circumalkaline Poplar Forest	Closed Balsam Poplar
		Open Balsam Poplar Forest
		Open Dwarf Balsam Poplar
Boreal Subalpine Spruce Woodland	Boreal Subalpine Rocky-loamy Moist Circumneutral Spruce Woodland	White Spruce Woodland
Boreal Subalpine Willow and Birch Shrub	Boreal Subalpine Mixed-textured Moist Circumacidic Willow and Low Birch Shrub	Closed Low Shrub Birch
		Closed Low Shrub Birch-Willow
		Closed Low Willow
		Closed Tall Shrub Birch
		Closed Tall Willow
		Ericaceous Dwarf Shrub–Lichen Tundra
		Open Low Mesic Shrub Birch-Ericaceous Shrub
		Open Low Shrub Birch-Willow
		Open Low Willow
		Open Tall Willow
Boreal Upland Aspen Forest	Boreal Upland Rocky-loamy Dry Circumalkaline Aspen Forest	Closed Quaking Aspen
		Open Quaking Aspen Forest
		Open Quaking Aspen–Spruce
Boreal Upland Birch Forest	Boreal Upland Mixed-textured Moist Acidic Paper Birch Forest	Closed Paper Birch
		Open Paper Birch
Boreal Upland Sagebrush Meadow	Boreal Upland Rocky-loamy Dry Alkaline Sagebrush Meadow	Open Low Silverberry Shrub
		Open Sagebrush–Grass
		Open Sagebrush–Juniper
Boreal Upland Spruce-Birch Forest	Boreal Upland Mixed-textured Moist Acidic Spruce-Paper Birch Forest	Open Spruce–Paper Birch
Boreal Upland Tall Alder Shrub	Boreal Upland Mixed-textured Moist Circumacidic Tall Alder Shrub	Closed Tall Alder
		Closed Tall Alder-Willow
		Open Tall Alder
		White Spruce Woodland
Boreal Upland White Spruce Forest	Boreal Upland Loamy Moist Circumacidic White Spruce Forest	Open Spruce-Balsam Poplar Forest
		Open White Spruce Forest
		White Spruce Woodland
Glacial Lake	Boreal Glacial Alkaline Lake	Water
Glacial River	Boreal Glacial Circumalkaline River	Water
	Maritime Alkaline Glacial River	Water
Lowland Lake	Boreal Lowland Circumalkaline Lake	Fresh Pondweed
		Water
	Maritime Lowland Circumalkaline Lake	Water
Maritime Alpine Barrens	Maritime Alpine Rocky Dry Acidic Barrens	Partially Vegetated
Maritime Alpine Cassiope Dwarf Shrub	Maritime Alpine Rocky Moist Acidic Cassiope Dwarf Shrub	Cassiope Dwarf Shrub Tundra
Maritime Coastal Angelica Meadow	Maritime Coastal Sandy Moist Circumneutral Angelica Meadow	Large Umbel

Table 140. Continued.

Ecotype (short name)	Ecotype (long name)	Vegetation Class
		Mixed Herbs
Maritime Coastal Barrens	Maritime Coastal Gravelly Moist Saline Barrens	Barren
		Partially Vegetated
Maritime Coastal Elymus Meadow	Maritime Coastal Sandy Dry Circumalkaline Elymus Meadow	Elymus
		Mixed Herbs
		Seral Herbs
Maritime Coastal Sedge Meadow	Maritime Coastal Loamy Wet Brackish Sedge Meadow	Fresh Sedge Marsh
		Halophytic Sedge Wet Meadow, brackish
		Subarctic Lowland Sedge Wet Meadow
Maritime Glaciated Barrens	Maritime Glaciated Gravelly Moist Circumalkaline Barrens	Barren
Maritime Glaciated Tall Alder-Willow Shrub	Maritime Glaciated Rocky Moist Circumneutral Tall Alder-Willow Shrub	Closed Tall Alder
		Closed Tall Alder-Willow
		Open Tall Alder
		Open Tall Alder-Willow
Maritime Lowland Cottonwood Forest	Maritime Lowland Gravelly Moist Circumacidic Cottonwood Forest	Open Black Cottonwood Forest
Maritime Lowland Cottonwood-Spruce Forest	Maritime Lowland Gravelly Moist Circumacidic Cottonwood–Spruce Forest	Black Cottonwood-Sitka Spruce Woodland
		Open Black Cottonwood-Sitka Spruce Forest
		Open Black Cottonwood-Western Hemlock Forest
Maritime Lowland Forb-Willow Meadow	Maritime Lowland Gravelly Wet Circumacidic Forb–Willow Meadow	Open Low Willow
		Subarctic Lowland Herb Wet Meadow
Maritime Lowland Sedge-Blueberry Bog	Maritime Lowland Circumacidic Sedge–Blueberry Bog	Open Low Ericaceous Shrub Bog
		Subarctic Lowland Sedge-Moss Bog Meadow
Maritime Lowland Sitka Spruce Forest	Maritime Lowland Gravelly Moist Acidic Sitka Spruce Forest	Open Sitka Spruce Forest
Maritime Lowland Tall Alder-Willow Shrub	Maritime Lowland Gravelly Moist Circumneutral Tall Alder–Willow Shrub	Closed Tall Alder-Willow
		Open Tall Alder-Willow
Maritime Riverine Barrens	Maritime Riverine Gravelly Moist Circumalkaline Barrens	Barren
		Dry Bryophyte
		Partially Vegetated
Maritime Riverine Cottonwood Forest	Maritime Riverine Gravelly Moist Acidic Cottonwood Forest	Open Black Cottonwood Forest
Maritime Riverine Cottonwood-Spruce Forest	Maritime Riverine Gravelly Moist Acidic Cottonwood–Spruce Forest	Open Black Cottonwood-Sitka Spruce Forest
Maritime Riverine Horsetail Meadow	Maritime Riverine Loamy Wet Circumneutral Horsetail Meadow	Subarctic Lowland Herb Wet Meadow
Maritime Riverine Tall Alder-Willow Shrub	Maritime Riverine Gravelly Moist Acidic Tall Alder–Willow Shrub	Closed Tall Alder-Willow
		Open Tall Alder
		Open Tall Alder-Willow
Maritime Subalpine Low Blueberry Shrub	Maritime Subalpine Rocky Moist Acidic Low Blueberry Shrub	Closed Low Ericaceous Shrub
		Open Low Ericaceous Shrub
Maritime Subalpine Lupine Meadow	Maritime Subalpine Rocky Moist Acidic Lupine Meadow	Mixed Herbs
Maritime Upland Sitka Spruce Forest	Maritime Upland Mixed-textured Acidic Moist Sitka Spruce Forest	Closed Sitka Spruce-Western Hemlock Forest
		Open Sitka Spruce Forest
Maritime Upland Tall Alder Shrub	Mar. Upland Rocky Moist Acidic Tall Alder Shrub	Closed Tall Alder
Nearshore Water	Maritime Coastal Nearshore Water	Water

Table 141. Mean count of species per individual plot and total species occurrences per ecotype, Wrangell-St. Elias National Park and Preserve, 2004–2006.

Ecotype	Plot Mean	SD	Total†	*n*
Maritime Coastal Sedge Meadow	4	1	8	3
Lowland Lake	5	4	27	14
Alpine Lake	5	3	21	5
Maritime Coastal Barrens	6		6	2
Boreal Riverine Acidic Barrens	7	2	14	5
Maritime Riverine Barrens	9	4	26	7
Maritime Glaciated Barrens	9	8	18	2
Maritime Coastal Elymus Meadow	10	3	20	4
Boreal Glaciated Dryas Dwarf Shrub	10	1	17	2
Boreal Lacustrine Pondlily	11	1	19	2
Maritime Riverine Horsetail Meadow	11	5	20	3
Boreal Lacustrine Sedge Meadow	12	6	111	21
Maritime Glaciated Tall Alder-Willow Shrub	12	6	48	6
Maritime Subalpine Low Blueberry Shrub	13	3	26	3
Maritime Alpine Barrens	13	5	27	3
Maritime Riverine Tall Alder-Willow Shrub	14	6	42	5
Boreal Riverine Sandy Willow Shrub	15	7	28	3
Boreal Riverine Dryas Dwarf Shrub	15	6	31	3
Boreal Upland Birch Forest	15	6	45	6
Maritime Upland Sitka Spruce Forest	15	4	37	5
Maritime Lowland Sedge-Blueberry Bog	16	1	22	2
Boreal Upland Sagebrush Meadow	16	7	43	6
Boreal Lowland Sedge-Shrub Fen	16	6	135	23
Boreal Riverine Tall Alder Shrub	17	10	76	9
Maritime Lowland Cottonwood-Spruce Forest	17	4	29	4
Boreal Riverine Loamy Poplar Forest	18	6	50	7
Boreal Riverine Gravelly Poplar Forest	18	6	50	5
Boreal Subalpine Poplar Forest	19	5	63	7
Boreal Upland Tall Alder Shrub	19	6	85	14
Boreal Riverine Circumalkaline Barrens	19	14	99	8
Maritime Alpine Cassiope Dwarf Shrub	20	6	44	4
Boreal Glaciated Barrens	20	14	34	3
Maritime Lowland Cottonwood Forest	20	5	40	3
Boreal Upland Spruce-Birch Forest	20	6	44	7
Maritime Coastal Angelica Meadow	20	5	41	4
Maritime Subalpine Lupine Meadow	21	5	67	5
Maritime Riverine Cottonwood-Spruce Forest	21	3	32	4
Boreal Lowland Tall Willow Shrub	22	8	65	6
Boreal Glaciated Willow Shrub	22	2	37	3
Boreal Riverine Spruce-Poplar Forest	22	10	54	4
Boreal Lowland Tussock-Shrub Bog	22	4	81	11
Maritime Lowland Forb-Willow Meadow	22	8	50	3
Boreal Riverine White Spruce Forest	23	9	63	5
Maritime Lowland Tall Alder-Willow Shrub	23	7	33	2
Boreal Riverine Low Silverberry Shrub	24	9	75	6
Boreal Subalpine Forb Meadow	25	3	61	4
Boreal Alpine Sedge Meadow	25	12	131	12
Maritime Riverine Cottonwood Forest	25	4	37	3
Boreal Riverine Loamy Willow Shrub	26	7	51	3
Boreal Lowland Black Spruce Bog	26	5	108	15
Boreal Upland Aspen Forest	27	9	89	9
Boreal Alpine Barrens*	27	14	155	12
Boreal Upland White Spruce Forest	28	11	126	11
Boreal Subalpine Willow and Birch Shrub*	29	9	289	64
Boreal Lowland Black Spruce Forest	29	7	111	14
Boreal Lowland White Spruce Forest	30	9	131	11
Boreal Lowland Low Birch-Willow Shrub	31	8	95	5
Boreal Alpine Ericaceous Dwarf Shrub*	34	12	208	20
Boreal Alpine Tussock Meadow	35	12	87	4
Boreal Subalpine Spruce Woodland	36	8	72	3
Boreal Alpine Dryas Dwarf Shrub*	37	12	209	17
Boreal Alpine Sedge-Dwarf Willow Meadow*	38	11	281	25

† Total number of species per ecotype; *Top five highest occurrences per ecotype; *n* = sample size

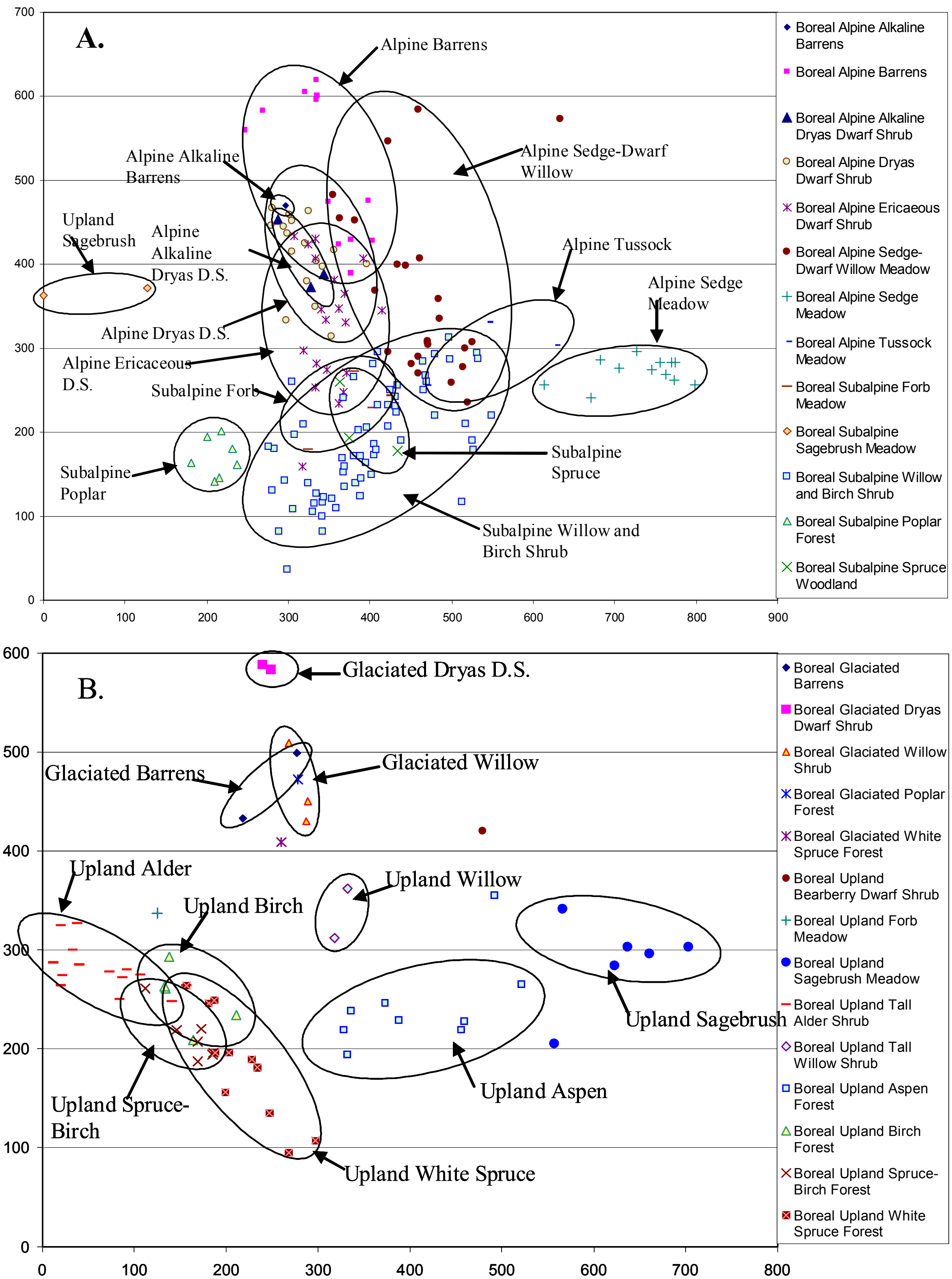


Figure 11. Detrended correspondense analysis of species composition in boreal alpine and subalpine ecotypes (A) and boreal glaciated and upland ecotypes (B) in Wrangell St.-Elias National Park and Preserve, 2004–2006. Outliers have been excluded.

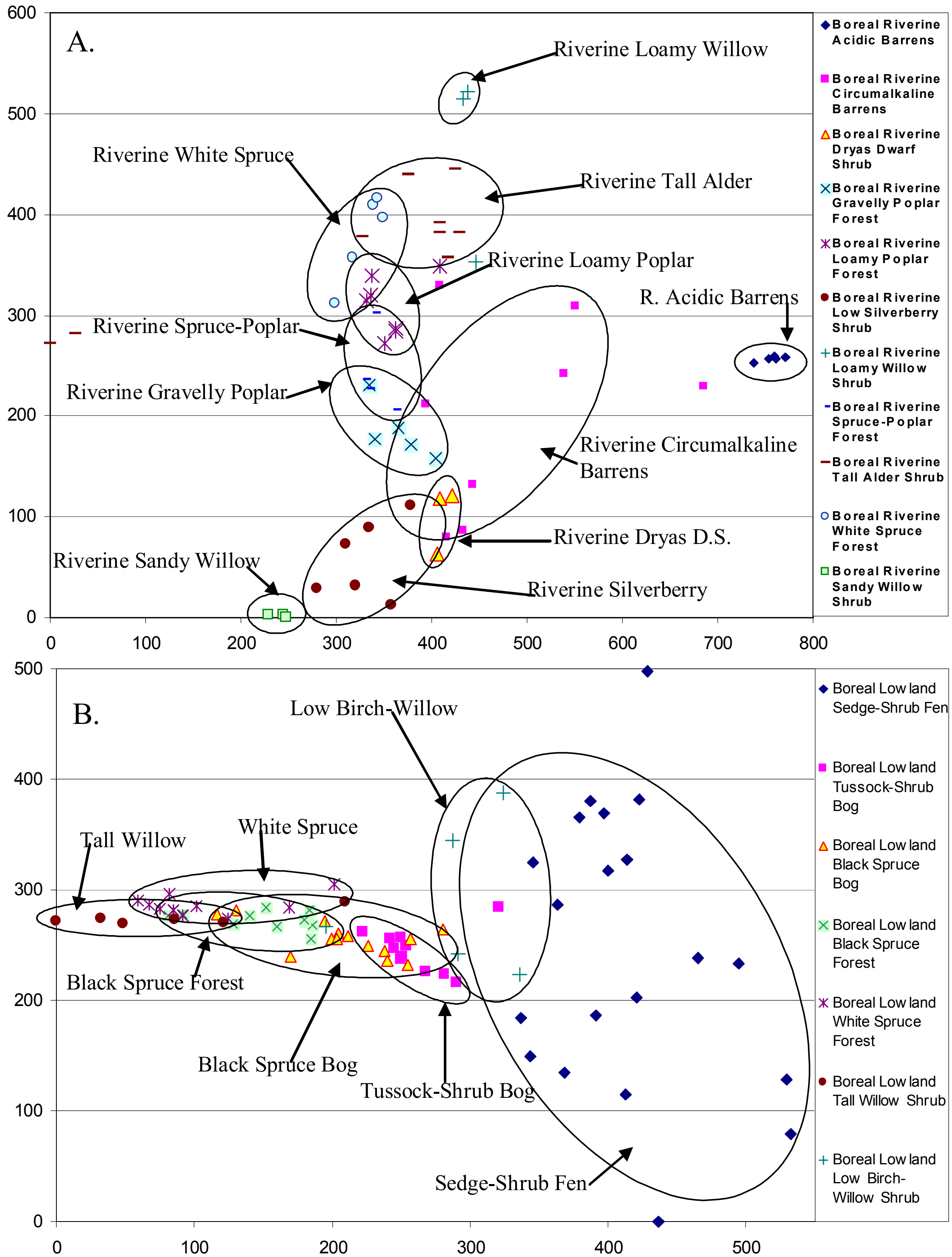


Figure 12. Detrended correspondense analysis of species composition for boreal riverine ecotypes (A) and boreal lowland ecotypes (B) in Wrangell St.-Elias National Park and Preserve, 2004–2006.

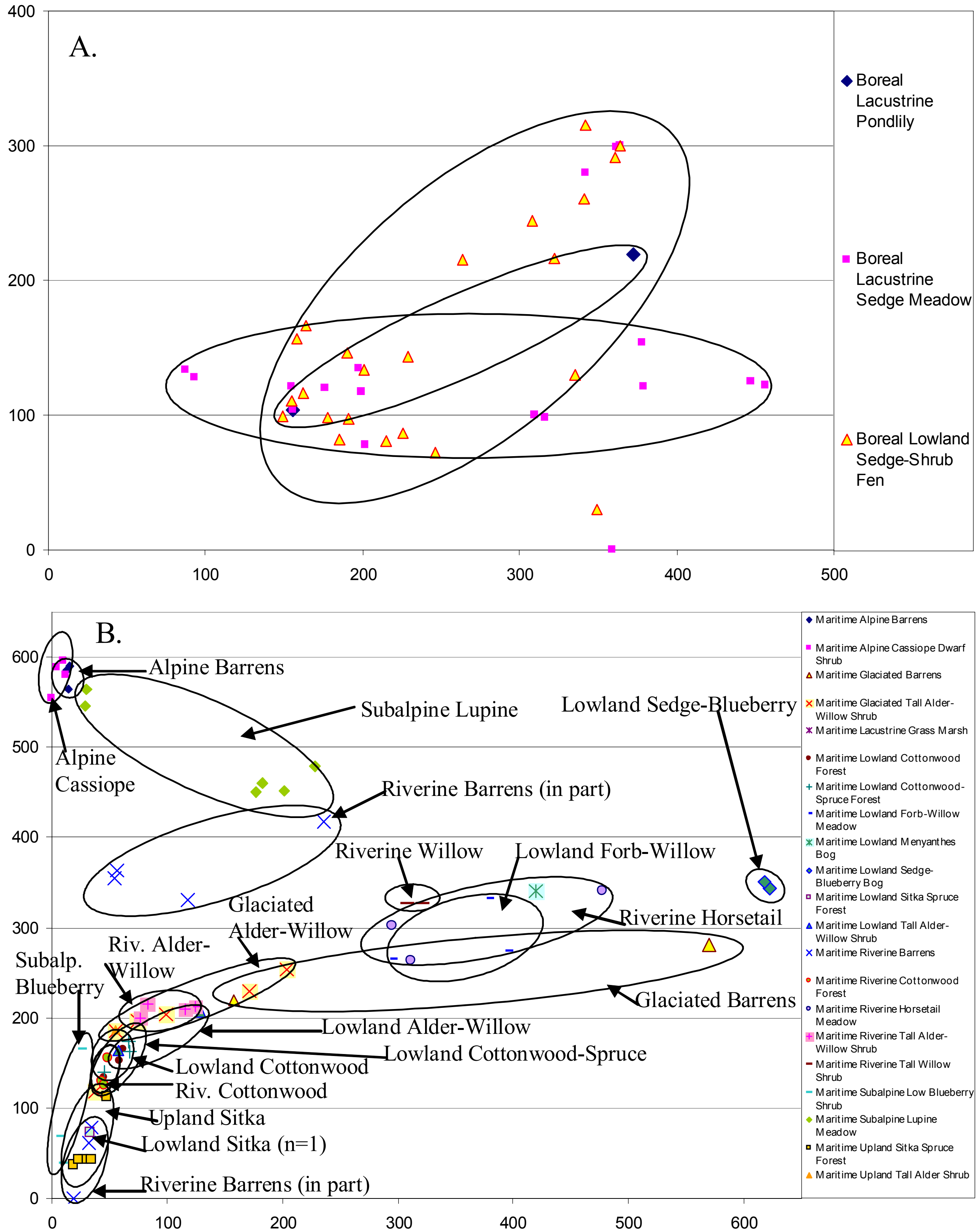


Figure 13. Detrended correspondense analysis of species composition for boreal lacustrine ecotypes (A) and maritime ecotypes (B) in Wrangell St.-Elias National Parklands, 2004–2006. Coastal ecotypes were excluded.

Table 142. Plant cover (%) by boreal alpine and subalpine ecotypes within Wrangell-St. Elias National Park and Preserve. Bold values indicate >60% frequency within an ecotype. Values of 0 have <0.5 % cover. Underlined values indicate the dominant or characteristic species for the floristic class associated with the ecotype.

Taxon	Boreal Glaciated Barrens	Boreal Alpine Barrens	Boreal Alpine Dryas Dwarf Shrub	Boreal Alpine Ericaceous Dwarf Shrub	Boreal Alpine Sedge-Dwarf Willow Meadow	Boreal Alpine Sedge Meadow	Boreal Alpine Tussock Meadow	Boreal Subalpine Willow and Birch Shrub	Boreal Subalpine Spruce Woodland	Boreal Subalpine Forb Meadow	Boreal Subalpine Poplar Forest
Dryas drummondii	**0**			1	0						
Salix alaxensis	**0**	0			0			1			
Trisetum spicatum ssp. *spicatum*	0	0	0	0	0	0	0	0		1	
Epilobium latifolium	**0**	0	0	1	0			0		4	
Racomitrium sp.		3	1	1	0			0			
Salix polaris	0	1	0	2	6	0	0	0		0	
Stereocaulon sp.	0	0	1	2	1	0		1	**0**	0	
Dryas octopetala		0	**35**	**11**	2			1			
Hierochloe alpina			**1**	1	0			0			
Cassiope tetragona		0	**2**	**17**	1		2	0	3		
Vaccinium uliginosum			**4**	**13**	1	0	3	**9**	**6**	0	
Dryas integrifolia	0	1	5	2	3	0	1	1	3		
Salix reticulata	0	0	2	**3**	**15**	1	**4**	4	**2**	2	
Potentilla fruticosa		0	2	1	0	0		2	**2**		3
Oxytropis nigrescens		0	1	0	0						
Pedicularis capitata			0	**0**	0			0	0		
Lycopodium selago			0	0	0			0			
Saussurea viscida var. *yukonensis*		**0**	0	0	1			0			
Lycopodium alpinum		0		0	0						
Carex microchaeta		0	0	0	5		0	0			
Polygonum bistorta			0	0	0		**0**	0	0		
Salix rotundifolia		0	0	0	3		3				
Eriophorum angustifolium				0	2	**14**	2	0			
Carex aquatilis ssp. *aquatilis*					2	**21**		0			
Trichophorum caespitosum						4					
Eriophorum vaginatum					0	0	**35**	0			
Saxifraga hirculus		0			0	0	0	0			
Carex bigelowii		0	1	0	10	2	18	5	5	1	
Salix planifolia ssp. *pulchra*		0	0	0	2	1	**8**	**12**	7	3	1
Ledum decumbens		0	0	1	0	0	4	2	**7**		
Empetrum nigrum			0	6	1		3	8	**7**	5	
Hylocomium splendens			0	3	6		3	6	**16**		0
Vaccinium vitis-idaea			0	1	1	0	2	**4**	**10**		0
Betula glandulosa			0	0	0	1	4	15	17		
Arctostaphylos rubra		0		1	1	0		2	**4**		3
Salix glauca	0		0	0	0			11	**10**	1	3
Betula nana			0	2	1	0	3	12	15		2
Pleurozium schreberi			0	0	4			2	**9**		
Picea glauca			0	0	0		0	1	**13**		0
Festuca altaica			2	**2**	2	0		**3**	**2**	**8**	**4**
Petasites frigidus		0	0	0	2	0	0	1	1	**5**	
Salix lanata ssp. *richardsonii*			0	0	0	0		1	0		
Salix barclayi				0				3			1
Andromeda polifolia					0	1	0	0	0		
Pyrola secunda				0				0			
Geocaulon lividum								0	5		4
Artemisia arctica ssp. *arctica*		0	0	1	1			1		**9**	0
Valeriana capitata			0	0	0	0	0	0		**9**	
Aconitum delphinifolium			0		0			0		**7**	
Solidago multiradiata			0	0	0			0		**1**	0
Mertensia paniculata			0	0				1	0	**4**	**5**
Epilobium angustifolium			0	0	0			1	0	5	**9**
Shepherdia canadensis				0				1	0		5
Delphinium glaucum								0			3
Salix commutata								2			1
Rosa acicularis								0	0		**9**
Populus balsamifera								0			**46**
Sample Size	3	12	17	20	25	12	4	64	3	4	7

Table 143. Plant cover (%) by boreal glaciated and riverine ecotypes within Wrangell-St. Elias National Park and Preserve. Bold values indicate >60% frequency within an ecotype. Values of 0 have <0.5 % cover. Underlined values indicate the dominant or characteristic species for the floristic class associated with the ecotype.

Taxon	Boreal Upland Sagebrush Meadow	Boreal Upland Tall Alder Shrub	Boreal Glaciated Willow Shrub	Boreal Glaciated Dryas Dwarf Shrub	Boreal Riverine Dryas Dwarf Shrub	Boreal Riverine Gravelly Poplar Forest	Boreal Riverine Spruce-Poplar Forest	Boreal Riverine Loamy Poplar Forest	Boreal Riverine White Spruce Forest	Boreal Riverine Circumalkaline Barrens	Boreal Riverine Low Silverberry Shrub	Boreal Riverine Sandy Willow Shrub	Boreal Riverine Loamy Willow Shrub	Boreal Riverine Tall Alder Shrub	Boreal Riverine Acidic Barrens
Linum perenne	**0**														
Artemisia frigida	**25**										0				
Agropyron sp.	**6**									0					
Juniperus horizontalis	4										0				
Calamagrostis purpurescens	**2**										1				
Alnus crispa		37													
Ribes triste		**13**												0	
Alnus sinuata		25												23	
Hypnum revolutum			**8**												
Salix brachycarpa ssp. *niphoclada*			**12**	1		0	0				1	**4**		0	
Salix bebbiana			**7**	1	1	0	0	0	0				1	2	
Ceratodon purpureus	0		**6**	1	7	0	0			0	6				
Cladonia sp.		0	**1**			0	1		0	0	0		0		0
Arabis holboellii	0				0						0				0
Linnaea borealis		2				1	0	0	1					0	
Epilobium angustifolium		**2**	0			1	0	0	0	0	0		2	0	
Arctostaphylos rubra		0	**1**			0	0	0	**1**						
Pyrola asarifolia		0	**0**			0	1	1	0				0	0	
Salix alaxensis		1	**10**	1	**1**	**0**	0	0		**1**	1		0	3	0
Arctostaphylos uva-ursi			**3**	1	1	3	5	0		0	1	0		0	
Shepherdia canadensis			**40**	**3**	**4**	**33**	**38**	1	**4**		3			0	
Dryas drummondii			**9**	**45**	**49**	**16**	2			3	1				
Oxytropis campestris	**2**		0		**4**	**1**	**5**			0	**2**	**3**			
Populus balsamifera	0		**0**	1	**3**	**31**	**24**	**51**	0	**1**	**5**	**1**	**1**	1	0
Picea glauca		2	**0**		**1**	**0**	**19**	**1**	**33**	0	0	**1**	**1**	1	0
Hedysarum alpinum	0		**1**		0	1	1	1	**8**	0	**0**	**2**	2	0	
Aster sibiricus	0					5	6	0	0	0	**1**			0	
Abietinella abietina						1	**6**		0		1				
Hylocomium splendens		4				1	**14**		**55**	0					
Rosa acicularis	**3**	3				1	2	**16**	**1**	0		0	1	0	
Viburnum edule		1				1	1	**13**	0				2	0	
Geocaulon lividum		0				3	7	3	**8**					0	
Solidago multiradiata	0						1	0							0
Mertensia paniculata		**1**					0	2	0				0	1	
Equisetum arvense		2						**10**	0	0	0	0	0	5	
Pyrola secunda							0	0	**0**					0	
Lupinus arcticus							0	0	**15**	0				0	
Hedysarum mackenzii	0				0	**0**	1		0	1	3				
Festuca rubra					0			0	1	0	1			0	
Achillea borealis					0	0	0		0	0	**2**		1	0	
Elaeagnus commutata	5				0	**7**	8	0		0	**45**	**12**		0	
Salix glauca			**9**	0						0	0	**18**			
Salix barclayi		3		0							0	**22**	2	0	
Pyrola grandiflora		0	0			0			0		3	**1**		0	
Galium boreale	0	0						0	0		0		5		
Potentilla fruticosa							0	0		0		0	**5**	0	
Tomentypnum nitens		0	**2**						1				**9**		
Carex media										1			**5**	0	
Salix planifolia ssp. *pulchra*										0			**17**		
Vaccinium uliginosum		5								0			**20**	0	
Calamagrostis canadensis		**5**						1	0	1	1		**38**	**7**	
Rubus arcticus								2		1			**4**	4	
Alnus tenuifolia								**12**	0	1			**7**	**51**	
Salix arbusculoides		0	2	1				0		0			**0**	3	
Epilobium latifolium	0	0	0	0		1		0		**3**	0			0	**3**
Polytrichum sp.		0	0						0	1			1	0	**12**
Racomitrium canescens										2					**58**
Festuca brachyphylla					0										**0**
Sample Size	6	14	3	2	3	5	4	7	5	8	6	3	3	9	5

Table 144. Plant cover (%) by boreal upland and lowland ecotypes within Wrangell-St. Elias National Park and Preserve. Bold values indicate >60% frequency within ecotype. Values of 0 have <0.5 % cover. Underlined values indicate the dominant or characteristic species for the floristic class associated with the ecotype.

Taxon	Boreal Upland Aspen Forest	Boreal Upland Birch Forest	Boreal Upland Spruce-Birch Forest	Boreal Upland White Spruce Forest	Boreal Lowland White Spruce Forest	Boreal Lowland Black Spruce Forest	Boreal Lowland Black Spruce Bog	Boreal Lowland Tall Willow Shrub	Boreal Lowland Low Birch-Willow Shrub	Boreal Lowland Tussock-Shrub Bog	Boreal Lowland Sedge-Shrub Fen	Boreal Lacustrine Sedge Meadow	Boreal Lacustrine Pondlily
Populus tremuloides	**52**				0	0							
Arctostaphylos uva-ursi	5				0	0							
Rosa acicularis	**18**	**7**	**5**	3	1	1	1	**8**					
Linnaea borealis	6	4	3	5	3	1		2					
Alnus crispa	2	**12**	**13**	7	1	4	1						
Betula papyrifera var. *humilis*		**55**	**28**			0	0						
Calamagrostis canadensis		**9**	**4**	1	1	1	1	2	2		1	1	
Ribes triste	0	1	**4**	0	0	0							
Pyrola secunda	0		0	0	0	0	0			0			
Festuca altaica	0	0	0	1	1	0	0	0	**4**	0			
Salix glauca		1		2	**5**	**4**	1			0	0		
Equisetum scirpoides			0	**1**	**0**	**1**	0	2	0				
Geocaulon lividum	**3**	1	**0**	**5**	**1**	**3**	1	6					
Salix bebbiana	**5**	1		4	1	2		11			1	0	
Picea glauca	**5**	**4**	**20**	**26**	**25**	3	0	**5**	**1**	1	0	0	
Ledum groenlandicum	2	**24**	15	4	**13**	**19**	**7**	**11**	0	1	0		
Vaccinium vitis-idaea	7	**8**	**17**	**6**	**15**	**12**	**10**	**16**	**5**	**4**	0		
Hylocomium splendens	2	9	**52**	**45**	**46**	**40**	**23**	**11**	**6**	3			
Empetrum nigrum	2	2	1	7	**17**	**12**	4	**14**	**6**	4			
Arctostaphylos rubra	1			**5**	**6**	**6**	**5**	**6**	5	0		0	
Pleurozium schreberi	0	1	0	7	6	3	4	4	3	2			
Epilobium angustifolium	1	0	0	0	0	0		**1**	2				
Vaccinium uliginosum	0	1		5	**3**	**10**	**5**	**2**	**3**	**5**	0	0	
Picea mariana	0	0	1	3		**31**	**24**			1	0		
Rubus chamaemorus				0	0	**2**	**5**	1	3	1	0		
Aulacomnium palustre	0			0	2	**10**	4	**3**	**5**	2	2	1	
Tomentypnum nitens	0			2	6	4	8	3	2	1	2	0	
Sphagnum sp.			0	1		3	**15**		5	**12**	2	2	
Salix scouleriana	1			1	1	0		**34**					
Salix planifolia ssp. *pulchra*				1	0	3	**4**	6	**18**	**4**	9	1	
Betula nana				2	4	3	9	3	**12**	**17**	0		
Ledum decumbens				1		1	**7**	0	**5**	**6**	0		
Eriophorum vaginatum					0	1	**6**	0	0	**12**	1		
Salix barclayi				0	1	0	0	0	1				
Salix myrtillifolia	0				0	1	2	1	**8**	0	0	0	
Potentilla fruticosa				0	0	0	1	1	**3**	0	2	0	
Arctagrostis latifolia					0	0	0			0		0	
Rubus arcticus					0	0	0				0		
Andromeda polifolia				1		0	1		1	1	1	1	
Carex aquatilis ssp. *aquatilis*					0	0	1		2	0	**13**	**10**	**3**
Eriophorum angustifolium							1		6		8	6	3
Chamaedaphne calyculata						0	1			0	2	0	
Myrica gale							1				4	1	
Potentilla palustris									0		4	**3**	
Calamagrostis inexpansa	0									0	0	0	
Equisetum fluviatile											0	1	
Carex rotundata											0	0	
Scorpidium scorpioides											6	7	
Carex utriculata											0	7	
Carex saxatilis											0	2	2
Carex rostrata												4	
Utricularia minor											0	0	8
Eleocharis palustris												0	**1**
Sparganium angustifolium													3
Nuphar polysepalum												0	**28**
Sample Size	9	6	7	11	11	14	15	6	5	11	23	21	2

Table 145. Plant cover (%) by maritime alpine to lowland ecotypes within Wrangell-St. Elias National Park and Preserve. Bold values indicate >60% frequency within an ecotype. Values of 0 have <0.5 % cover. Underlined values indicate the dominant or characteristic species for the floristic class associated with the ecotype.

Taxon	Maritime Alpine Barrens	Maritime Alpine Cassiope Dwarf Shrub	Maritime Subalpine Lupine Meadow	Maritime Subalpine Low Blueberry Shrub	Maritime Upland Sitka Spruce Forest	Maritime Lowland Sitka Spruce Forest	Maritime Lowland Cottonwood–Spruce Forest	Maritime Lowland Cottonwood Forest	Maritime Glaciated Tall Alder-Willow Shrub	Maritime Lowland Tall Alder-Willow Shrub	Maritime Upland Tall Alder Shrub	Maritime Lowland Forb-Willow Meadow	Maritime Lowland Sedge–Blueberry Bog	Maritime Glaciated Barrens
Carex nardina	**1**													
Luzula multiflora	**1**	0												
Sorbus sitchensis		**0**		2										
Lycopodium selago		**0**				0								
Cassiope stelleriana	**2**	**46**	0											
Luetkea pectinata	**8**	**20**	1	**3**										
Phyllodoce aleutica	**2**	**19**	1	**5**										
Fauria crista-galli		13	20						0					
Lupinus nootkatensis		0	**9**											
Valeriana sitchensis		0	**6**	**3**										
Veratrum viride ssp. *eschscholtzii*		0	**11**	0										
Pseudoleskea baileyi			1	**30**										
Carex macrochaeta			**3**			**2**						2		
Cornus canadensis				**4**	0			2	0					
Vaccinium alaskensis				33	7	4								
Vaccinium ovalifolium		1	0	**52**	**15**	4								
Rubus pedatus		0	0	**2**	**13**	8	0							
Gymnocarpium dryopteris				**10**	**13**		2	**2**	0	10				
Epilobium angustifolium			**1**	**1**				**1**	**2**					0
Tsuga heterophylla					11		6	3		1				
Dicranum scoparium					13			**1**						
Rhytidiadelphus loreus		0			**23**		4	**15**	1	3				
Dryopteris dilatata ssp. *americana*				0	**7**		**2**	3	7		1			
Pleurozium schreberi		3	0	2		55	11	**7**				0		
Tiarella trifoliata			0		**0**	0	1	**3**	0				0	
Picea sitchensis					**39**	**54**	**12**	0	0	**2**	0	2		
Oplopanax horridus					**26**	**18**	**20**	**28**	10	**6**	**4**			
Alnus sinuata			0		**7**	**5**	**54**	**40**	**52**	**38**	**57**	1		1
Rubus spectabilis			0	1	2	4	**13**	**20**	8	**23**	**28**			
Hylocomium splendens					**6**	30	**9**	3	1	8		1		
Populus trichocarpa					**3**		**22**	**47**	1	**5**	0	0		
Pyrola asarifolia					0		4	**11**	0	2			0	
Streptopus amplexifolius		0	0		**0**	0	**0**	**5**	0	**3**				
Salix scouleriana					4		**4**	**4**	3	**18**				
Athyrium filix-femina ssp. *cyclosorum*			**2**	1			3	**6**	3	**9**	**3**			
Equisetum arvense					0		**6**	**8**	15	**16**				
Sorbus scopulina					0	0		3	5	1				
Salix sitchensis								2	11	18	2	4	1	1
Salix barclayi			0						10	5		7		
Calamagrostis canadensis							0	0	0	**0**			1	
Actaea rubra									0	**1**				
Heracleum lanatum			**1**							1	**2**			
Sambucus racemosa											**2**			
Equisetum variegatum							1		1	1		**12**		0
Limprichtia revolvens												17		
Tofieldia glutinosa												1		
Eriophorum russeolum												0	**13**	
Vaccinium uliginosum	**0**	0										1	**23**	
Sphagnum teres													48	
Carex pluriflora													**13**	
Carex lyngbyaei													**8**	
Hedysarum mackenzii													**1**	
Equisetum fluviatile													**3**	0
Carex kelloggii														1
Arctophila fulva														0
Phleum pratense														1
Sample Size	3	4	5	3	5	7*	4	3	6	2	6*	3	2	2

**GRS data added where ABR data (n=1)*

Table 146. Plant cover (%) by maritime coastal and riverine ecotypes within Wrangell-St. Elias National Park and Preserve. Bold values indicate >60% frequency within an ecotype. Values of 0 have <0.5 % cover. Underlined values indicate the dominant or characteristic species for the floristic class associated with the ecotype.

Taxon	Lowland Lake	Alpine Lake	Maritime Coastal Sedge Meadow	Maritime Coastal Barrens	Maritime Coastal Elymus Meadow	Maritime Coastal Angelica Meadow	Maritime Riverine Cottonwood–Spruce Forest	Maritime Riverine Cottonwood Forest	Maritime Riverine Tall Alder-Willow Shrub	Maritime Riverine Horsetail Meadow	Maritime Riverine Barrens
Hippuris vulgaris	1										
Utricularia vulgaris ssp. *macrorhiza*	0										
Utricularia intermedia	0										
Potamogeton alpinus ssp. *tenuifolius*	0										
Sparganium angustifolium	0	0									
Potamogeton sp.	3	0									
Scorpidium scorpioides	0	0									
Carex aquatilis ssp. *aquatilis*		**6**									
Eriophorum angustifolium		16	2							**0**	
Cicuta mackenzieana			0								
Eleocharis palustris	0		1								
Triglochin maritimum			**4**								
Carex lyngbyaei			**25**							**0**	
Honckenya peploides				0							
Lathyrus maritimus ssp. *maritimus*				1	**30**	6					
Elymus arenarius ssp. *mollis*				3	**15**	**8**					
Conioselinum chinense				0	2	**6**			0		
Castilleja chrymactis					**3**	**1**					
Castilleja unalaschcensis					**1**	1					
Ligusticum scoticum					1	**2**					
Deschampsia beringensis					0	3				0	
Festuca rubra					**2**	**7**					
Achillea borealis					**3**	**19**					
Fragaria chiloensis					16	**29**					
Lupinus nootkatensis					8	**26**			0		0
Potentilla egedii			0			8					
Rhytidiadelphus squarrosus						**36**				5	
Angelica lucida					1	**18**	5		1		
Heracleum lanatum						**14**	3		2		
Calamagrostis canadensis						1	1		0		0
Ranunculus bongardi						1	1		0		
Epilobium angustifolium						5	**1**	0	0		0
Actaea rubra						0	0	**0**			
Picea sitchensis						0	**11**	**4**			0
Alnus sinuata					0	0	**43**	**28**	**55**		**3**
Populus trichocarpa				0	0		**23**	**34**	1		**2**
Rubus spectabilis							**20**	**11**	**16**		
Oplopanax horridus							**4**	**7**	0		
Athyrium filix-femina ssp. *cyclosorum*							**9**	0	1		
Streptopus amplexifolius							1	**0**	0		
Geum macrophyllum							0	**0**	0		
Tiarella trifoliata							2	**0**	1		
Rubus pedatus							1	**5**			
Pyrola asarifolia							0	**5**	0		
Dryopteris dilatata ssp. *americana*								**6**			
Salix scouleriana								**2**	**6**		0
Salix alaxensis					1	0		1	2	0	0
Salix barclayi									**9**		0
Salix sitchensis					1				**3**		0
Racomitrium ericoides									5		
Platanthera dilatata						0	1		**0**	**0**	
Equisetum variegatum					1			**0**	**1**	**6**	**0**
Equisetum arvense		0			0	1			**4**	**6**	
Equisetum palustre			1							18	
Philonotis fontana										**5**	
Drepanocladus sp.										**7**	
Salix hookeriana										0	0
Epilobium latifolium									0		**1**
Racomitrium sp.											6
Racomitrium canescens											16
Sample Size	14	5	3	2	4	4	3	3	5	3	7

depths, comprised 33% of the soil subgroups and were associated with rocky lowland, upland and subalpine environments. Spodosols, which are well developed soils, comprised 5% of observations and occurred mostly in subalpine and alpine environments. The remaining 4% of soils were Histosols, which occurred in lowland bogs and fens.

The soil classification was effective at partitioning the variability of numerous soil properties because the classification is based in large part on thaw depths, depth to water, organic thickness, and base saturation status as inferred from pH (Figures 14 and 15). For example, soils with measurable thaw depths were associated with the Gelisol order and non-permafrost soils with organic horizons >40 cm thick were associated with the Histosol order. Rock depths <20 cm were commonly associated with the Cryorthents and Gelorthents great groups of the Entisol order of poorly developed soils, and Eutrocryepts, Eutrogelepts, and Dystrogelepts great groups of the Inceptisol order. Water depths within 30 cm of the surface were associated with the great groups Cryaquepts, Cryohemist, and Cryofibrists. Soil pH values <5.5 were associated with the Dystrocryepts great group of the Inceptisol order and the Haplocryods and Humicryods great groups of the Spodosol order. Electrical conductivity values >200 µS/cm were associated with the Cryofluvents great group of the Entisols order, and with the wet soils of the Cryaquepts and Cryohemist great groups. Finally, the pH gradients from 10–30 cm depths were highest for the Haplocryod and Dystrocryept great groups, indicating substantial leaching and translocation of cations.

In a few instances, the use of the newly revised Gelisol order did not separate some soils with distinctly different characteristics. For example, alkaline (euic) and acidic (dysic) soils were included in the Typic Haploturbel subgroup, even though A-horizon development and species composition in these soils was very different. In contrast, little difference in soil properties and vegetation relationships was evident between Typic Haplorthels and Typic Haploturbels. There also was little difference in the properties among Typic Historthels, Typic Aquiturbels, and Typic Aquorthels.

MAPPING

Two sets of map products were developed by the mapping effort: a set of landcover maps (similar to Levels 2, 3, and 4 of the Alaska Vegetation Classification) developed through spectral analysis and processing by GRS (Stumpf 2008), and a set of ecosystem maps (integrated-terrain-units, ecotypes, and soil landscapes) developed through rule-base modeling using the spectrally derived landcover map and other terrain maps. These are described separately below.

GRS LANDCOVER MAPS

The GRS-produced landcover map has numerous fields, including: (1) a highly differentiated level of the landcover classification called "calc_class" (123 classes) based predominantly on the Level 4 of the AVC, (2) a more generalized classification called "GridClVal" (23 classes) similar to Level 3 of the AVC, and a simplified classification based predominantly on Level 2 called "Major_Class" (11 classes). We also made slight revisions to the GRS Major_Class to make it fully compatible with AVC Level 2 and added a field called "Vegetation Structure" (14 classes, including non-vegetated classes). Descriptions of the GRS landcover classification is reproduced in Appendix 8, the various levels are cross-walked in Appendix 9 and a decision tree for classifying landcover classes is provided in Appendix 10.

The highly differentiated landcover classes (calc_class), which were calculated directly from the spectral database, is intended for users that need to examine very specific vegetation structures and dominant species, with the recognition that the accuracy is relatively low given the high number of classes. The classes are dominated by Snow/Glaciers (28.5% of area), Barrens (23.8%), Sparse Vegetation (6.2%), Open White Spruce Forest (3.8%), Dwarf Shrub (2.6%), Low Open Willow-Birch Shrub (2.3%), White Spruce Woodland (2.3%), and Open Mixed Deciduous-Coniferous Forest (2.1%).

The aggregated landcover map that emphasizes vegetation structure was produced from the Vegetation Structure field in the GRS landcover file is provided in Figure 16. This simplified classification is intended for users

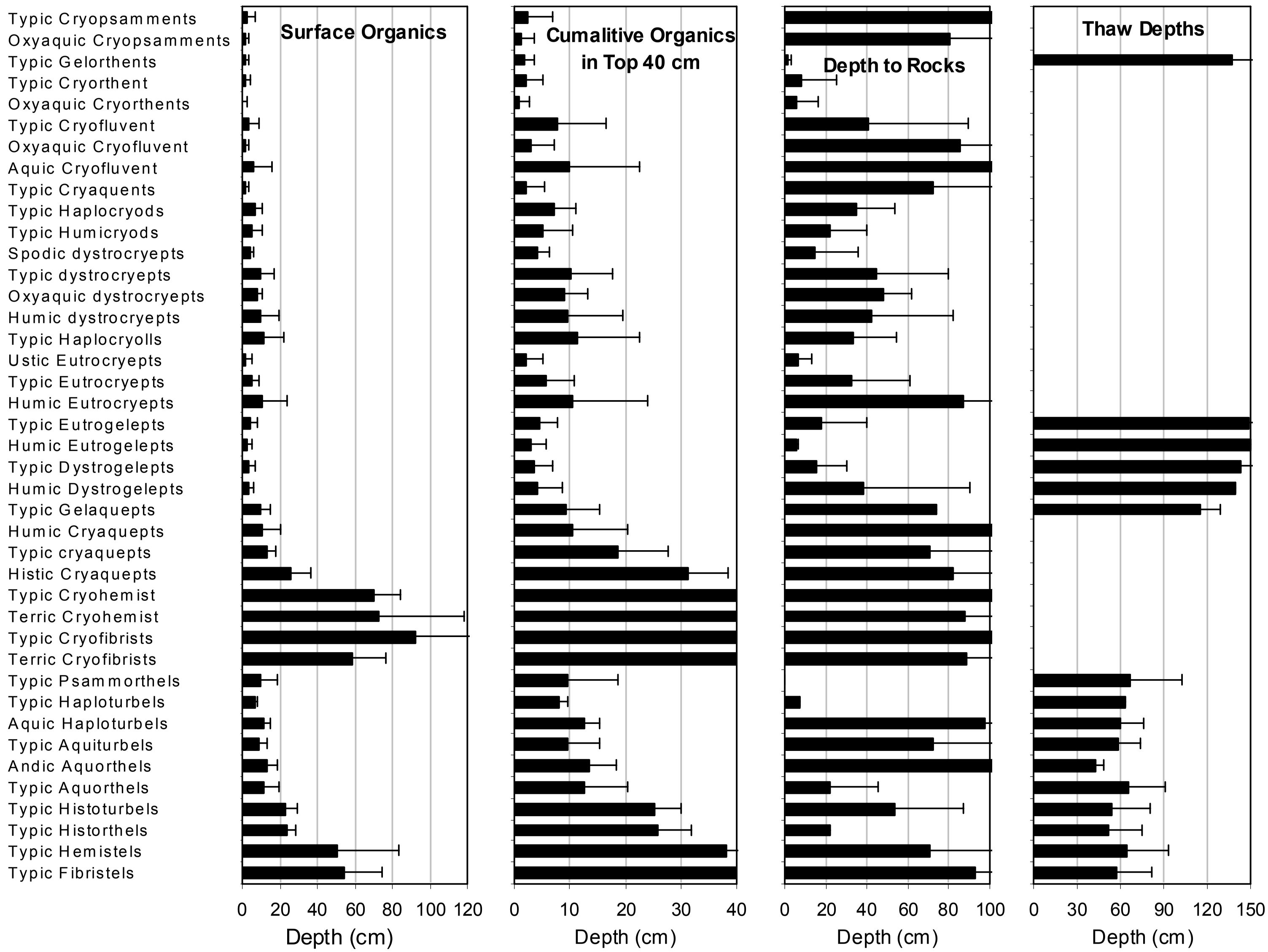


Figure 14. Mean (± SD) thickness of surface organic layer, cumulative organic thickness within the top 40 cm, depth to rock (>15% coarse fragments) and depth of thaw for common soil subgroups in the Wrangell-St. Elias National Park and Preserve, 2004–2006.

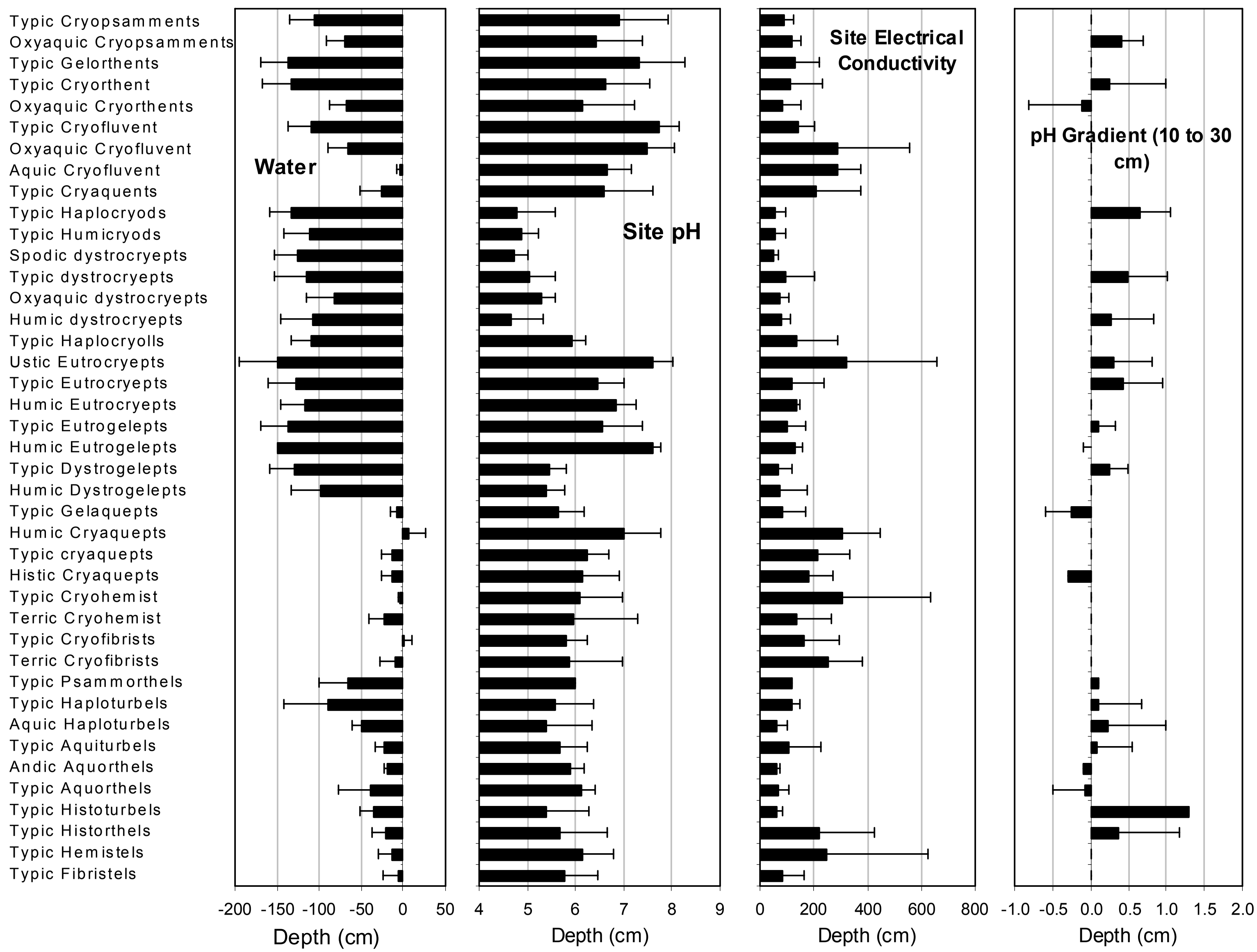
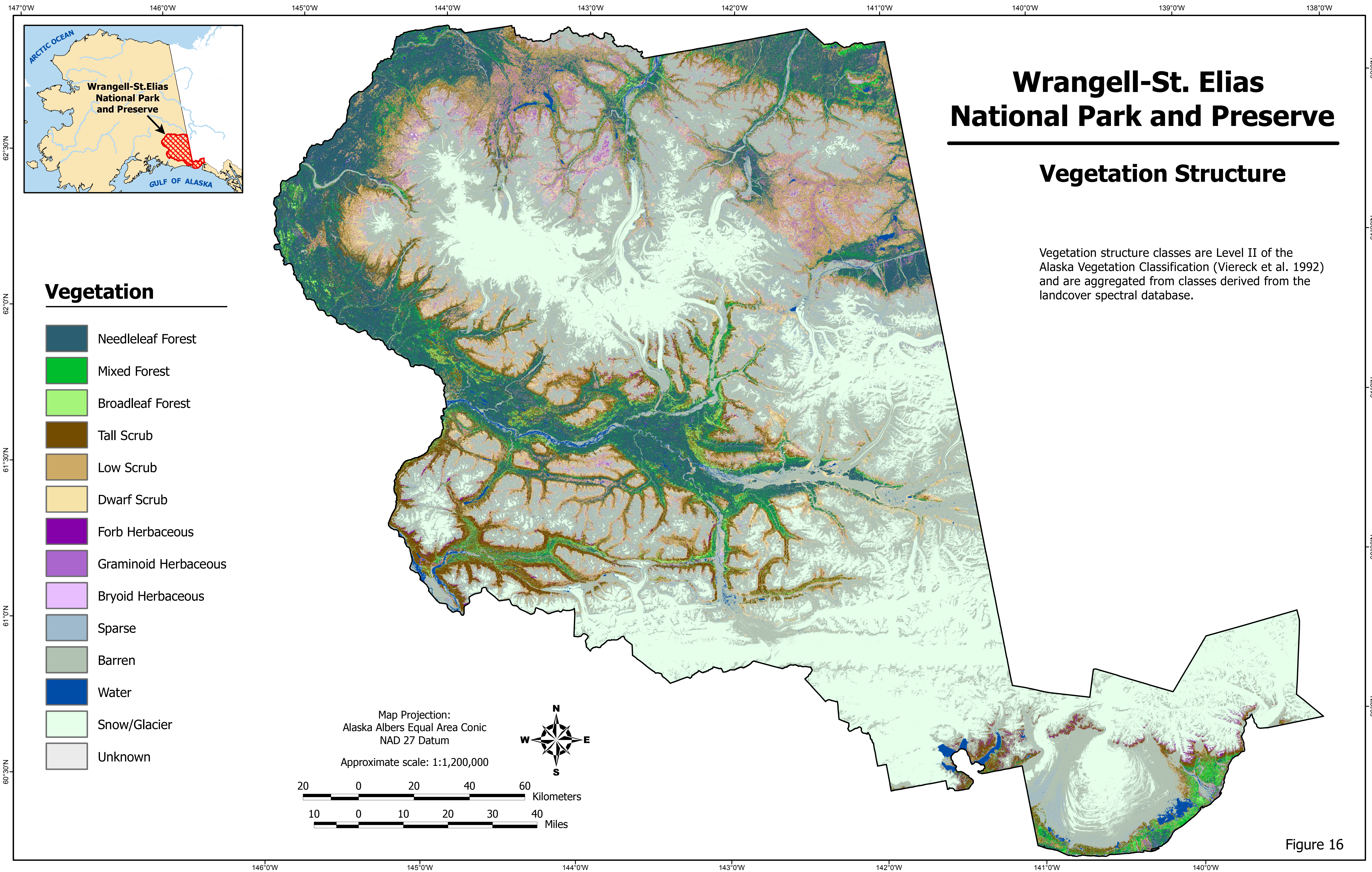
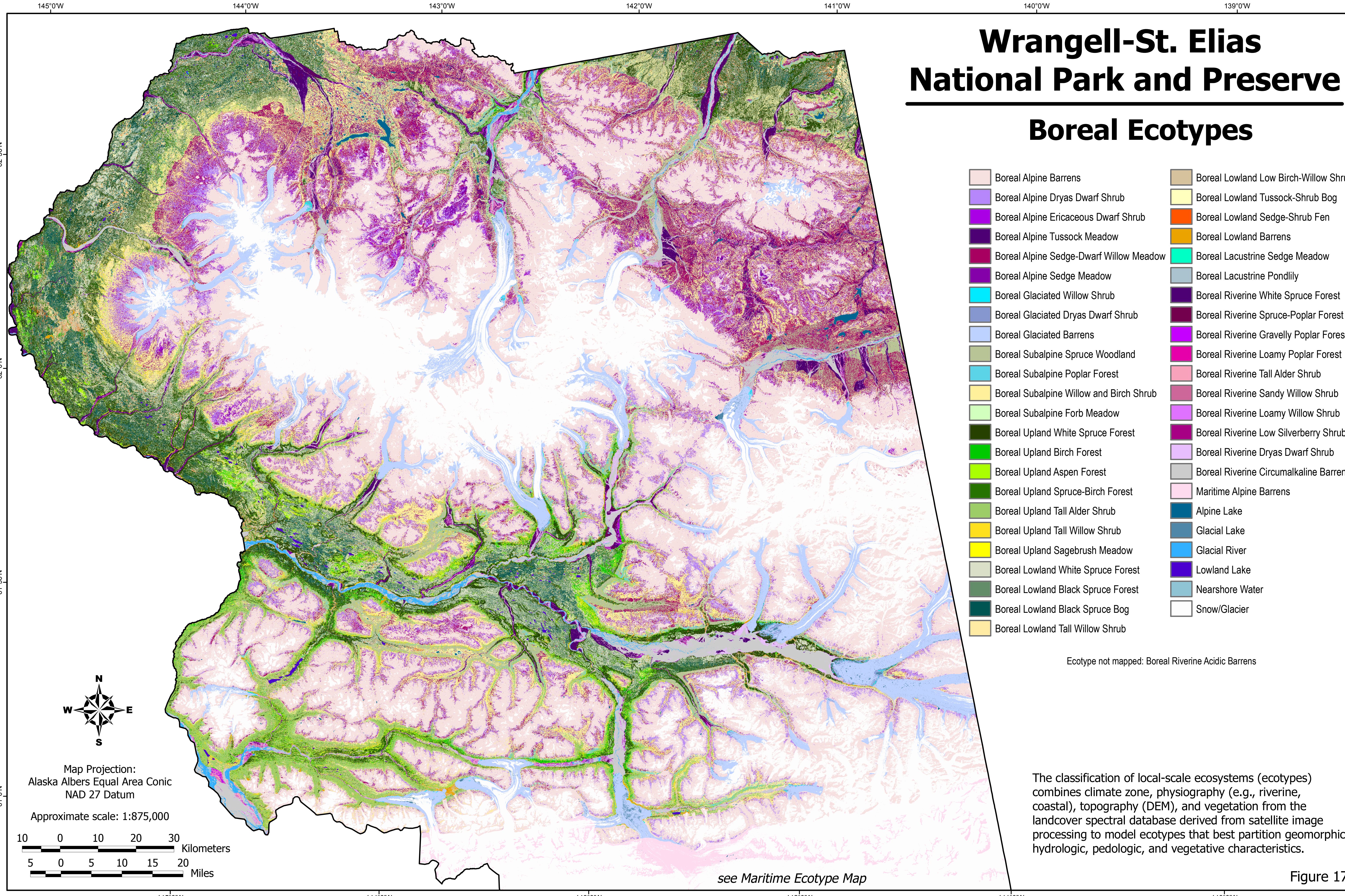


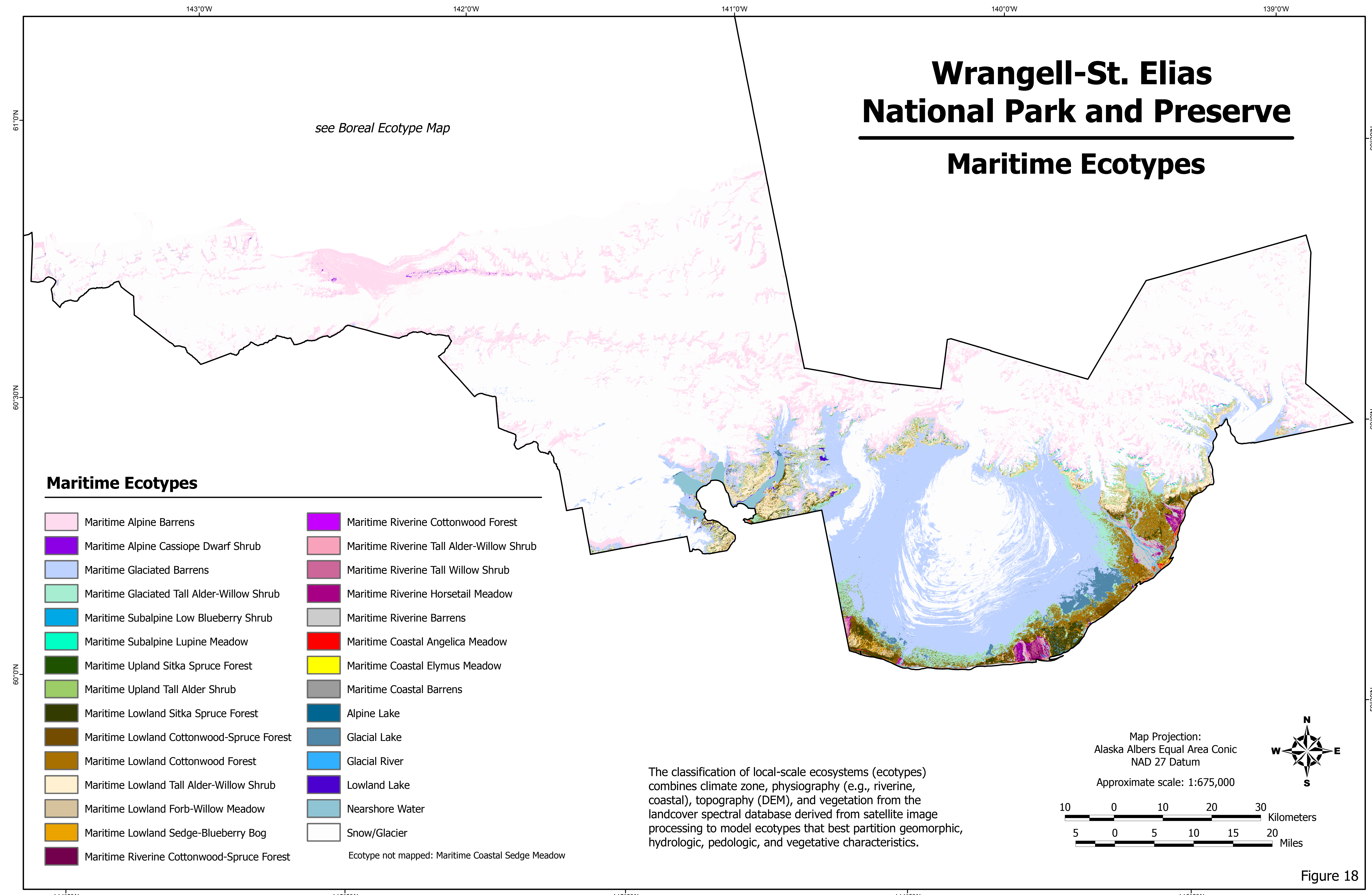
Figure 15. Mean (± SD) water depth above or below the ground surface, site pH (soil water or saturated paste), electrical conductivity (EC) and pH gradient (pH at 10 cm minus pH at 30 cm, positive indicates leaching) for common soil subgroups in Wrangell-St. Elias National Park and Preserve, 2004–2006.


Wrangell-St. Elias National Park and Preserve
Vegetation Structure
Vegetation structure classes are Level II of the Alaska Vegetation Classification (Viereck et al. 1992) and are aggregated from classes derived from the landcover spectral database.
ARCTIC OCEAN
GULF OF ALASKA
Wrangell-St.Elias National Park and Preserve
Vegetation
Needleleaf Forest
Mixed Forest
Broadleaf Forest
Tall Scrub
Low Scrub
Dwarf Scrub
Forb Herbaceous
Graminoid Herbaceous
Bryoid Herbaceous
Sparse
Barren
Water
Snow/Glacier
Unknown
Map Projection:
Alaska Albers Equal Area Conic
NAD 27 Datum
Approximate scale: 1:1,200,000
20 0 20 40 60 Kilometers
10 0 10 20 30 40 Miles
N
S
E
W
147°0'W
146°0'W
145°0'W
144°0'W
143°0'W
142°0'W
141°0'W
140°0'W
139°0'W
138°0'W
62°30'N
62°0'N
61°30'N
61°0'N
60°30'N
61°30'N
61°0'N
60°30'N
60°0'N
Figure 16



The classification of local-scale ecosystems (ecotypes) combines climate zone, physiography (e.g., riverine, coastal), topography (DEM), and vegetation from the landcover spectral database derived from satellite image processing to model ecotypes that best partition geomorphic, hydrologic, pedologic, and vegetative characteristics.

Figure 17


Wrangell-St. Elias
National Park and Preserve
Maritime Ecotypes
see Boreal Ecotype Map
Maritime Ecotypes
Maritime Alpine Barrens
Maritime Alpine Cassiope Dwarf Shrub
Maritime Glaciated Barrens
Maritime Glaciated Tall Alder-Willow Shrub
Maritime Subalpine Low Blueberry Shrub
Maritime Subalpine Lupine Meadow
Maritime Upland Sitka Spruce Forest
Maritime Upland Tall Alder Shrub
Maritime Lowland Sitka Spruce Forest
Maritime Lowland Cottonwood-Spruce Forest
Maritime Lowland Cottonwood Forest
Maritime Lowland Tall Alder-Willow Shrub
Maritime Lowland Forb-Willow Meadow
Maritime Lowland Sedge-Blueberry Bog
Maritime Riverine Cottonwood-Spruce Forest
Maritime Riverine Cottonwood Forest
Maritime Riverine Tall Alder-Willow Shrub
Maritime Riverine Tall Willow Shrub
Maritime Riverine Horsetail Meadow
Maritime Riverine Barrens
Maritime Coastal Angelica Meadow
Maritime Coastal Elymus Meadow
Maritime Coastal Barrens
Alpine Lake
Glacial Lake
Glacial River
Lowland Lake
Nearshore Water
Snow/Glacier
Ecotype not mapped: Maritime Coastal Sedge Meadow
The classification of local-scale ecosystems (ecotypes) combines climate zone, physiography (e.g., riverine, coastal), topography (DEM), and vegetation from the landcover spectral database derived from satellite image processing to model ecotypes that best partition geomorphic, hydrologic, pedologic, and vegetative characteristics.
Map Projection:
Alaska Albers Equal Area Conic
NAD 27 Datum
Approximate scale: 1:675,000
10 0 10 20 30 Kilometers
5 0 5 10 15 20 Miles
N
W
E
S
143°0'W
142°0'W
141°0'W
140°0'W
139°0'W
144°0'W
143°0'W
142°0'W
141°0'W
140°0'W
61°0'N
60°30'N
60°0'N
60°30'N
60°0'N
59°30'N
Figure 18

interested in vegetation structure and shrub height; it is a more accurate map with fewer classes. Predominant classes include Snow/Glaciers (28.4%), Barrens (24.8%), Open Low Shrub (7.6%), Open Coniferous Forest (7.1%), Sparse Vegetation (6.2%), Dwarf Shrub (5.2%), and Woodland Conifer (5.0%). Descriptions of these general vegetation structures can be obtained from Viereck et al. (1992).

ECOSYSTEM MAPS DERIVED FROM THE GRS LANDCOVER MAPS

We developed a set of three ecosystem maps from the GRS landcover maps that included an Integrated-Terrain-Unit (ITU) map, an ecotype map, and a soil-landscapes map. The ITU map was developed by overlaying and combining the calc_class grid from the GRS landcover map and four terrain layers; climatic subregions (7 classes), physiography (floodplains, glaciers, coastal, and other), elevation (<800 m, 800–1000 m, and >1000 m), and slope (< 7° and >=7°). This generated a total of 6465 combinations, or ITUs. We then aggregated this large set of classes into a reduced set of 69 ecotype classes based in large part on terrain relationships identified in the landscape-relationships table (Tables 136 and 137).

The map of ecotypes (from "ecotype" field) integrates physiography, soils, and vegetation composition and structure into 69 classes (Figures 17 and 18). This layer is intended for users that need to differentiate a broad suite of associated ecological characteristics, while recognizing that the accuracy among closely related groups is reduced. The dominant classes include Glaciers (28.4% of area), Boreal Alpine Barrens (21.4%), Boreal Subalpine Willow and Birch Shrub (7.1%), Boreal Alpine Sedge-Dwarf Willow Meadow (4.1%), Boreal Alpine Dryas Dwarf Shrub (4.0%), Boreal Glaciated Barrens (3.7%) and Boreal Upland White Spruce Forest (2.9%) (Tables 147 and 148). A cross-tabulation of ecotypes by spectral classes ("calc-class") is in Appendix 10. Note that we classified 68 ecotypes from our field data, but added one ecotype class (Boreal Lowland Barrens) for the mapping based on a prominent barren class in GRS landcover map for which we had no field data.

The map of soil landscapes (from "soiltype" field) which aggregates ecotypes into a reduced set of 25 closely related soils and ecotypes (Figure 19). This layer is intended for users that want a reduced set of classes that are particularly relevant to the management of a wide range of natural resources, with relatively high map accuracy. Accuracy is presumed to be high because closely related classes within physiographic regions, which tend to be highly interspersed spatially, are grouped. The dominant soil landscapes are Snow/Glaciers (28.4%), Boreal Alpine Rocky Barrens and Scrub (25.9%), Boreal Subalpine Rocky Scrub and Woodlands (10.8%), Boreal Upland Rocky-loamy Scrub and Forests (7.9%), Boreal Alpine Rocky-loamy Meadows (4.5%), Boreal Glaciated Rocky Barrens and Scrub (3.9%), and Boreal Lowland Scrub and Forest Bogs (3.8%) (Table 149).

FACTORS AFFECTING LANDSCAPE EVOLUTION AND ECOSYSTEM DEVELOPMENT

The structure and function of ecosystems are regulated largely along gradients of energy, moisture, nutrients, and disturbance. These gradients are affected by climate, tectonic effects on physiography, and parent material as controlled by bedrock geology and geomorphology (Swanson et al. 1988, ECOMAP 1993, Bailey 1996). Thus, these large-scale ecosystem components can be viewed as state factors that affect ecological organization (Jenny 1941, Van Cleve et al. 1990, Vitousek 1994, Bailey 1996). Information on how these landscape components have affected ecosystem patterns and processes in WRST were synthesized from our results and relevant literature.

CLIMATE

Climate is the dominant factor affecting ecosystem distribution globally (Walters 1979). Long-term weather stations surrounding WRST reveal strong gradients in temperature and precipitation. Mean annual air temperature ranges from 4.1°C at Yakutat (1949–2006) in the south, to –1.1°C at McCarthy (1968–2006), –2.0°C at Chitina (1950-2006), –2.9°C at Gulkana (1949–2006), and –4.1°C at Nabesna (1967–2006) in the northern part of the park (Western Regional Climate Center, 2007). Mean annual precipitation ranged from 369.4 cm at Yakutat in the south, to 41.7 cm at McCarthy, 27.2 cm at Chitina, 27.9 cm

Table 147. Areal extent of ecotypes within the six boreal climatic subregions of Wrangell-St. Elias National Park and Preserve. Total percent of area is equal to % of total park area.

	Chitina Mountains		Chugach Mountain Transition		Copper River Basin		Kluane Mountains		Northern Wrangell Mountains		Yukon Boreal		Ecotype Total	
ECOTYPE	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Boreal Alpine Barrens	562450	10.5	33488	0.6	301	0	184317	3.5	359761	6.7	1105	0	1141422	21.4
Boreal Alpine Dryas Dwarf Shrub	103601	1.9	5012	0.1	350	0	44384	0.8	61210	1.1	191	0	214748	4.0
Boreal Alpine Ericaceous Dwarf Shrub	7002	0.1	237	0	14	0	5790	0.1	11407	0.2	5	0	24456	0.5
Boreal Alpine Sedge Meadow		0		0		0	7403	0.1	11232	0.2		0	18635	0.3
Boreal Alpine Sedge-Dwarf Willow Meadow	41704	0.8	1668	0	1177	0	106618	2	64151	1.2	3986	0.1	219304	4.1
Boreal Alpine Tussock Meadow	3879	0.1	223	0	503	0	18242	0.3	12816	0.2	730	0	36394	0.7
Boreal Glaciated Barrens	80954	1.5	10737	0.2		0	6492	0.1	100997	1.9		0	199179	3.7
Boreal Glaciated Dryas Dwarf Shrub	3441	0.1	152	0		0	80	0	1022	0		0	4695	0.1
Boreal Glaciated Willow Shrub	759	0	260	0		0	84	0	963	0		0	2067	0.0
Boreal Subalpine Forb Meadow	3362	0.1	750	0	458	0	169	0	726	0	689	0	6153	0.1
Boreal Subalpine Poplar Forest	19942	0.4	309	0	1399	0	8235	0.2	7713	0.1	2546	0	40144	0.8
Boreal Subalpine Spruce Woodland	44605	0.8	815	0	20372	0.4	33584	0.6	26218	0.5	24437	0.5	150030	2.8
Boreal Subalpine Willow and Birch Shrub	147670	2.8	11031	0.2	12069	0.2	99066	1.9	98294	1.8	11561	0.2	379692	7.1
Boreal Upland Aspen Forest	12440	0.2	3910	0.1	4347	0.1	254	0	82	0	216	0	21250	0.4
Boreal Upland Birch Forest	16672	0.3	2297	0	2499	0	455	0	78	0	318	0	22319	0.4
Boreal Upland Sagebrush Meadow	719	0		0	502	0		0	1	0		0	1221	0.0
Boreal Upland Spruce-Birch Forest	37374	0.7	4704	0.1	30006	0.6	1016	0	2819	0.1	5561	0.1	81480	1.5
Boreal Upland Tall Alder Shrub	63993	1.2	26140	0.5	3026	0.1	1583	0	3986	0.1	954	0	99682	1.9
Boreal Upland Tall Willow Shrub	29329	0.6	4767	0.1	3728	0.1	419	0	4295	0.1	179	0	42717	0.8
Boreal Upland White Spruce Forest	49251	0.9	5122	0.1	69581	1.3	781	0	4951	0.1	22626	0.4	152312	2.9
Boreal Lowland Barrens*	6107	0.1	1221	0	3207	0.1	98	0	128	0	220	0	10980	0.2
Boreal Lowland Black Spruce Bog	16621	0.3	2	0	37781	0.7	303	0	295	0	7791	0.1	62792	1.2
Boreal Lowland Black Spruce Forest	32791	0.6	4	0	34238	0.6	499	0	181	0	6863	0.1	74577	1.4
Boreal Lowland Low Birch-Willow Shrub	17755	0.3	4915	0.1	14662	0.3	255	0	343	0	7096	0.1	45027	0.8
Boreal Lowland Sedge-Shrub Fen	1685	0	67	0	4518	0.1	285	0	3294	0.1	2578	0	12426	0.2
Boreal Lowland Tall Willow Shrub	8263	0.2	1434	0	7065	0.1	16	0	39	0	219	0	17035	0.3
Boreal Lowland Tussock-Shrub Bog	259	0	64	0	6389	0.1	40	0	7960	0.1	3161	0.1	17873	0.3
Boreal Lowland White Spruce Forest	58837	1.1	1850	0	66471	1.2	1869	0	436	0	7777	0.1	137240	2.6
Boreal Lacustrine Pondlily	518	0	52	0	505	0	0	0	3	0	8	0	1085	0.0
Boreal Lacustrine Sedge Meadow	1233	0		0	877	0		0		0		0	2110	0.0

Table 147. Continued.

	Chitina Mountains		Chugach Mountain Transition		Copper River Basin		Kluane Mountains		Northern Wrangell Mountains		Yukon Boreal		Ecotype Total	
ECOTYPE	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Boreal Riverine Circumalkaline Barrens	46914	0.9	9053	0.2	5366	0.1	21253	0.4	11989	0.2	3150	0.1	97724	1.8
Boreal Riverine Dryas Dwarf Shrub	7967	0.1	631	0	566	0	1976	0	2492	0	160	0	13792	0.3
Boreal Riverine Gravelly Poplar Forest	1946	0	584	0		0	1125	0	1147	0		0	4802	0.1
Boreal Riverine Loamy Poplar Forest		0		0	1138	0		0		0	522	0	1661	0.0
Boreal Riverine Loamy Willow Shrub	1817	0	949	0	1985	0	1692	0	1279	0	560	0	8280	0.2
Boreal Riverine Low Silverberry Shrub	898	0	16	0	1	0	390	0	28	0		0	1334	0.0
Boreal Riverine Sandy Willow Shrub	1495	0	481	0		0	3892	0.1	4042	0.1		0	9910	0.2
Boreal Riverine Spruce-Poplar Forest	3704	0.1	270	0	2233	0	1710	0	1101	0	1654	0	10672	0.2
Boreal Riverine Tall Alder Shrub	1357	0	1265	0	689	0	1533	0	1636	0	152	0	6631	0.1
Boreal Riverine White Spruce Forest	11923	0.2	386	0	12097	0.2	10347	0.2	6093	0.1	5293	0.1	46140	0.9
Alpine Lake	809	0	20	0	106	0	2754	0.1	3582	0.1	381	0	7694	0.1
Glacial Lake	2129	0	326	0		0		0	909	0		0	10961	0.2
Glacial River	8295	0.2	3943	0.1	644	0	2187	0	1074	0	461	0	17236	0.3
Lowland Lake	3258	0.1	364	0	1738	0	108	0	29	0	243	0	6409	0.1
Snow/Glacier	341948	6.4	29239	0.5		0	26093	0.5	361766	6.8		0	1517564	28.4
Grand Total	1807678	33.9	168759	3.2	352604	6.6	597399	11.2	1182567	22.2	123393	2.3	4999856	93.7

* Ecotype not described, mapped only.

at Gulkana and 30.0 cm at Nabesna in the north. All stations follow similar seasonal patterns: summers are short (June through August), winters are long, and most of the precipitation falls during July, August, and September. This strong climatic gradient from the maritime zone strongly impacts vegetation composition. In addition, climate at high elevations tends to be cooler annually and have windier conditions, both in terms of intensity and frequency.

These strong climatic gradients have resulted in a wide range of ecological responses evident on the ecotype maps. The climates and associated ecoregions have been divided into three main domains, the Maritime, Coastal Mountain Transition, and Boreal domains (Nowacki et al. 2002). We further subdivided the park into seven climatic zones for the purposes of mapping and analysis. These zones encompass a latitudinal gradient affected by large mountain ranges that span a range in mean annual air temperatures of 8.2 °C and in mean annual precipitation of 342 cm. These data, however, are from lower elevation stations. The climate zones were also differentiated into lowland and mountains zones to capture the elevation gradient that affects both temperatures and precipitation. These zones differentiate the fundamental break between the warmer, wetter, maritime ecosystems of the North Pacific Maritime zone and the colder, drier, boreal ecosystems of the five northernmost zones. One zone, the Chugach Maritime Transition has floristic elements of both maritime and boreal ecosystems.

Climatic conditions also have varied considerably over time. Stable isotope analysis of ice cores from Greenland and Antarctica reveal numerous large, rapid shifts in climate during the Pleistocene (Bradley 1999). These changes resulted in multiple episodes of glaciation, associated loess deposition, and sea-level fluctuations (Hopkins 1982). At the end of the Pleistocene ~11 ky BP, air temperatures were as much as 20°C colder than present (ACIA 2005) and nearly the entire park was covered by a large ice sheet (Coulter et al. 1965). More recently, historical records and analyses of proxy indicators

Table 148. Areal extent of ecotypes within the maritime climatic subregion of Wrangell-St. Elias National Park and Preserve. Percent of area is equal to % of total park area.

	North Pacific Maritime	
ECOTYPE	Area (ha)	%
Maritime Alpine Barrens	94901	1.78
Maritime Alpine Cassiope Dwarf Shrub	475	0.01
Maritime Glaciated Barrens	150107	2.81
Maritime Glaciated Tall Alder-Willow Shrub	17398	0.33
Maritime Subalpine Low Blueberry Shrub	779	0.01
Maritime Subalpine Lupine Meadow	719	0.01
Maritime Upland Sitka Spruce Forest	1108	0.02
Maritime Upland Tall Alder Shrub	5859	0.11
Maritime Lowland Cottonwood Forest	16836	0.32
Maritime Lowland Cottonwood-Spruce Forest	5393	0.10
Maritime Lowland Forb-Willow Meadow	4030	0.08
Maritime Lowland Sedge-Blueberry Bog	2271	0.04
Maritime Lowland Sitka Spruce Forest	6686	0.13
Maritime Lowland Tall Alder-Willow Shrub	18097	0.34
Maritime Riverine Barrens	3669	0.07
Maritime Riverine Cottonwood Forest	575	0.01
Maritime Riverine Cottonwood-Spruce Forest	1389	0.03
Maritime Riverine Horsetail Meadow	754	0.01
Maritime Riverine Tall Alder-Willow Shrub	2200	0.04
Maritime Coastal Angelica Meadow	543	0.01
Maritime Coastal Barrens	909	0.02
Maritime Coastal Elymus Meadow	287	0.01
Alpine Lake	43	0.00
Glacial Lake	7598	0.14
Glacial River	632	0.01
Lowland Lake	668	0.01
Nearshore Water	455	0.01
Snow/Glacier	758517	14.22
Grand Total	1,102,897	20.67

indicate that mean annual temperatures for the Northern Hemisphere were substantially lower (~1 ºC) during the Little Ice Age (ending around 1850) than at present, and that temperatures during the last decade (1990–2000) were the warmest in the last 400 years (Overpeck et al. 1997). This recent warming probably has enhanced tree growth near treeline in the boreal region and allowed some expansion of spruce forest into the alpine tundra zone (Suarez et al. 1999). In addition, the warmer temperatures have aided population growth of spruce bark beetles and aspen leaf miner and increased forest damage (Snyder and Lundquist 2007). Future temperature increases expected as a result of global warming likely will lead to further glacial retreat, permafrost thawing, and expansion of forests and shrublands.

OCEANOGRAPHY

The circulation of water in the Gulf of Alaska provides important controls on air temperatures and precipitation in the maritime region of the park (Mundy 2005, Spies 2006). Circulation in the central Gulf of Alaska is dominated by a counterclockwise gyre formed in part by the North Pacific Current, flowing eastward from Asia (Weingartner 2005). When the North Pacific Current reaches the west coast of North America it splits to form a southward-flowing California Current and a northward-flowing Alaska Current.

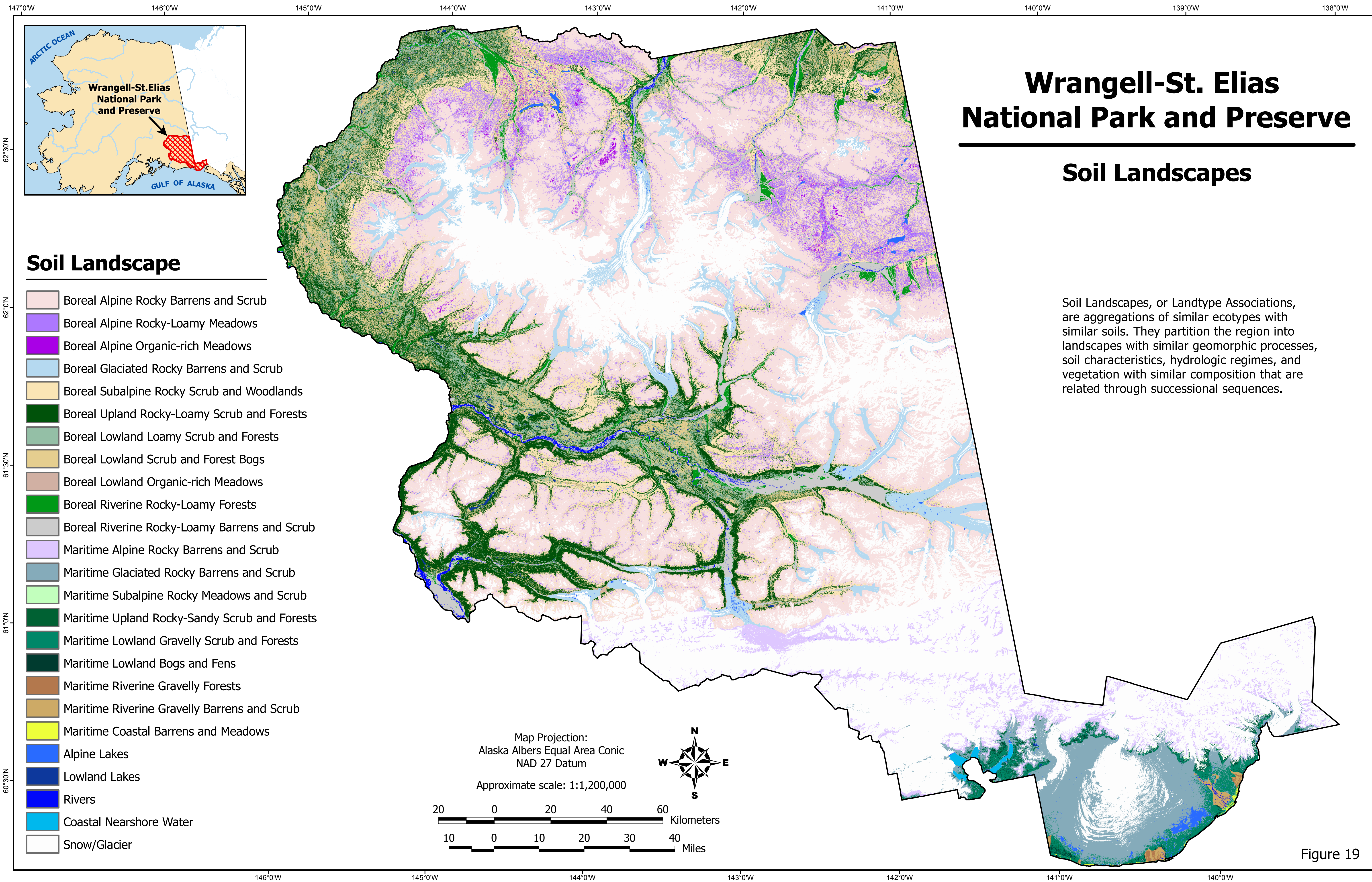

Wrangell-St. Elias
National Park and Preserve
Soil Landscapes
ARCTIC OCEAN
Wrangell-St.Elias
National Park
and Preserve
GULF OF ALASKA
Soil Landscape
Boreal Alpine Rocky Barrens and Scrub
Boreal Alpine Rocky-Loamy Meadows
Boreal Alpine Organic-rich Meadows
Boreal Glaciated Rocky Barrens and Scrub
Boreal Subalpine Rocky Scrub and Woodlands
Boreal Upland Rocky-Loamy Scrub and Forests
Boreal Lowland Loamy Scrub and Forests
Boreal Lowland Scrub and Forest Bogs
Boreal Lowland Organic-rich Meadows
Boreal Riverine Rocky-Loamy Forests
Boreal Riverine Rocky-Loamy Barrens and Scrub
Maritime Alpine Rocky Barrens and Scrub
Maritime Glaciated Rocky Barrens and Scrub
Maritime Subalpine Rocky Meadows and Scrub
Maritime Upland Rocky-Sandy Scrub and Forests
Maritime Lowland Gravelly Scrub and Forests
Maritime Lowland Bogs and Fens
Maritime Riverine Gravelly Forests
Maritime Riverine Gravelly Barrens and Scrub
Maritime Coastal Barrens and Meadows
Alpine Lakes
Lowland Lakes
Rivers
Coastal Nearshore Water
Snow/Glacier
Soil Landscapes, or Landtype Associations, are aggregations of similar ecotypes with similar soils. They partition the region into landscapes with similar geomorphic processes, soil characteristics, hydrologic regimes, and vegetation with similar composition that are related through successional sequences.
Map Projection:
Alaska Albers Equal Area Conic
NAD 27 Datum
Approximate scale: 1:1,200,000
20 0 20 40 60 Kilometers
10 0 10 20 30 40 Miles
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Figure 19

Table 149. Areal extent of soil-landscapes (landtype associations) within Wrangell-St. Elias National Park and Preserve.

Soil Landscape	Area (ha)	% of Area
Alpine Lakes	18,656	0.35
Boreal Alpine Organic-rich Meadows	18,635	0.35
Boreal Alpine Rocky Barrens and Scrub	1,380,625	25.88
Boreal Alpine Rocky-Loamy Meadows	255,698	4.79
Boreal Glaciated Rocky Barrens and Scrub	206,467	3.86
Boreal Lowland Loamy Scrub and Forests	154,276	2.89
Boreal Lowland Organic-rich Meadows	25,515	0.48
Boreal Lowland Scrub and Forest Bogs	200,269	3.75
Boreal Riverine Rocky-loamy Barrens and Scrub	137,672	2.58
Boreal Riverine Rocky-loamy Forests	63,275	1.19
Boreal Subalpine Rocky Scrub and Woodlands	575,493	10.79
Boreal Upland Rocky-loamy Scrub and Forests	420,981	7.89
Coastal Nearshore Water	455	0.01
Lowland Lakes	7,494	0.14
Maritime Alpine Rocky Barrens and Scrub	95,376	1.79
Maritime Coastal Barrens and Meadows	1,739	0.03
Maritime Glaciated Rocky Barrens and Scrub	167,504	3.14
Maritime Lowland Bogs and Fens	6,301	0.12
Maritime Lowland Gravelly Scrub and Forests	47,012	0.88
Maritime Riverine Gravelly Barrens and Scrub	6,623	0.12
Maritime Riverine Gravelly Forests	1,964	0.04
Maritime Subalpine Rocky Meadows and Scrub	1,498	0.03
Maritime Upland Rocky-sandy Scrub and Forests	6,967	0.13
Rivers	17,236	0.32
Snow/Glacier	1,517,564	28.44
Grand Total	5,335,296	100

The Alaska Current brings warm water from the south into the northern Gulf of Alaska and plays an important role in the regional heat budget of the ocean, increases air temperatures in the nearby coastal regions, and provides an abundant source of moisture for precipitation.

The coastal areas also are affected by the strong seasonality in storm intensity and frequency and by high freshwater input to coastal waters. During the winter, intense alongshore winds cause downwelling and increased water transport around the perimeter of the Alaskan Gyre. In the summer, the Eastern Pacific High Pressure system expands into the Gulf of Alaska and the associated weak and variable winds cause a relaxation in downwelling, and occasional divergences and upwelling along the coast, particularly in the western Gulf of Alaska. Freshwater input from the coastal mountain range varies seasonally with maximum discharge in the fall and minimum discharge in winter, when much of the precipitation is stored as snow. Superimposed on these cross-shelf gradients is considerable mesoscale variability resulting from eddies and meanders in the boundary currents (Okkonen et al. 2003).

TECTONIC SETTING AND PHYSIOGRAPHY

The rugged and volcanically active terrain of WRST is a consequence of the ongoing subduction of dense oceanic crust and lithosphere of the Pacific Plate beneath the lighter continental crust, which is occurring at a rate of about 5–8 cm/yr (Winkler 2000). A relatively buoyant fragment of continental crust, the Yakutat Terrane, is attached to the Pacific plate and is being thrust beneath the continental crust. Because it has about the same density as the terrane along the Chugach–St. Elias fault system, the subduction is forceful and causes

extreme uplift of the Chugach and St. Elias mountains. The consequences of this tectonic collision are extensively described by Winkler's (2000) geologic guide to the Wrangell–Saint Elias area and we briefly summarize some of his main points regarding earthquakes, volcanism, and terranes.

The southern Alaska margin of the Pacific plate is one of the most active seismic regions in the world and the currently accreting terrain will lead to ongoing seismic activity (Winkler 2000). Major earthquakes, such as those in 1899 and 1958 along a portion of the boundary between Lituya Bay and Yakutat Bay ruptured land surfaces, elevated shorelines, triggered landslides, and caused tsunamis. The Great Alaska Earthquake of 1964, centered near the east end of the Aleutian trench, caused large-scale vertical displacements over much of the Gulf Coast of Alaska and created a 100-km wide deformation zone of complex compressional folds and faults along the Yakutat terrane. This deformation continues today and still leads to major seismic events such as the St. Elias earthquake of 1979.

Subduction of terranes along the margin of the Pacific plate has caused widespread volcanic activity from the Wrangells to the Aleutians. At a depth of about 100 km, heating of the subducting crust, as well as overlying materials, creates magma that rises and penetrates through the overlying crustal plates. The magma may reach the surface to be erupted in a volcano or may cool and crystallize underground to form a pluton. In the Wrangells region, the subduction zone dips northward at a lower angle than areas to the west, causing the volcanic area to form further inland. Mountains created by the volcanic field that transcends the Wrangell area dominate the landscape, including Mt. Sanford (4949 m), Mt. Drum (3661 m), Mt. Wrangell (4317 m) and Mt. Blackburn (4996 m). At least 12 eruptive centers occur within the park (Neal et al. 2001). Although no lava-producing eruptions have been observed in the last 200 yrs, Mt. Wrangell still has active fumaroles and occasionally ejects ash. In addition, three mud "volcanoes" produce warm, saline mud that is thought to be caused by degassing from deep-seated magma below (Nichols and Yehle 1959).

The geology of the Wrangells is a complex amalgam of geologically distinctive crustal fragments, or terranes, which were formed elsewhere and transported to the present position by the motion of crustal plates. These fragments differ greatly in their constituent rocks and the structural modification that the rocks have undergone. Their diverse makeup includes both pieces of old continental crust and oceanic crust. Most appear to have been derived from distant regions during the early period of the formation of the Pacific Basin and have traveled hundreds to thousands of miles. In total, the region includes parts of six major terranes, plus one belt of sedimentary and volcanic rocks that formed between to adjacent terranes (Figure 20). Starting from the north, the Windy (Yukon-Tanana) terrane accreted to the continental margin around 180 m.y. ago. The Wrangellia composite terrane, amalgamated from the Wrangellia, Alexander, and Peninsular terranes formed at earlier times, were accreted as a unit ~110 m. y. ago. The oldest parts of the Chugach terrane were accreted to the southern margin of the Wrangellia complex beginning in the early Mesozoic time and continued to accrete until ~50 m. y. ago. The Prince William terrane accreted rapidly during the end of that same period. The Chugach and Prince William terranes show repeated episodes of rock formation related to crustal convergence and together form a composite terrane about as large as the Wrangellia composite terrane. The Yakutat Terrane, the last to arrive, began to collide with the Chugach and Prince William terranes by ~26 m. y. ago and continues to be propelled northward to this day.

The tectonic history of terrane accretion, uplift, and volcanism has set the stage for controlling the distribution of the diverse ecosystems in the park. The extreme uplift of rugged mountains along the Pacific margin creates an extreme climatic gradient from the warmer, very wet maritime region of the southern portion of the park to the relatively cold and dry continental climate of the northern region. The collision of Pacific air masses with these mountains creates heavy snow loads and is responsible for the largest ice sheets and glaciers in North America. Beyond these contemporary glaciers, the expansion and contraction of mountain glaciers over time has affected nearly the entire park. The increased

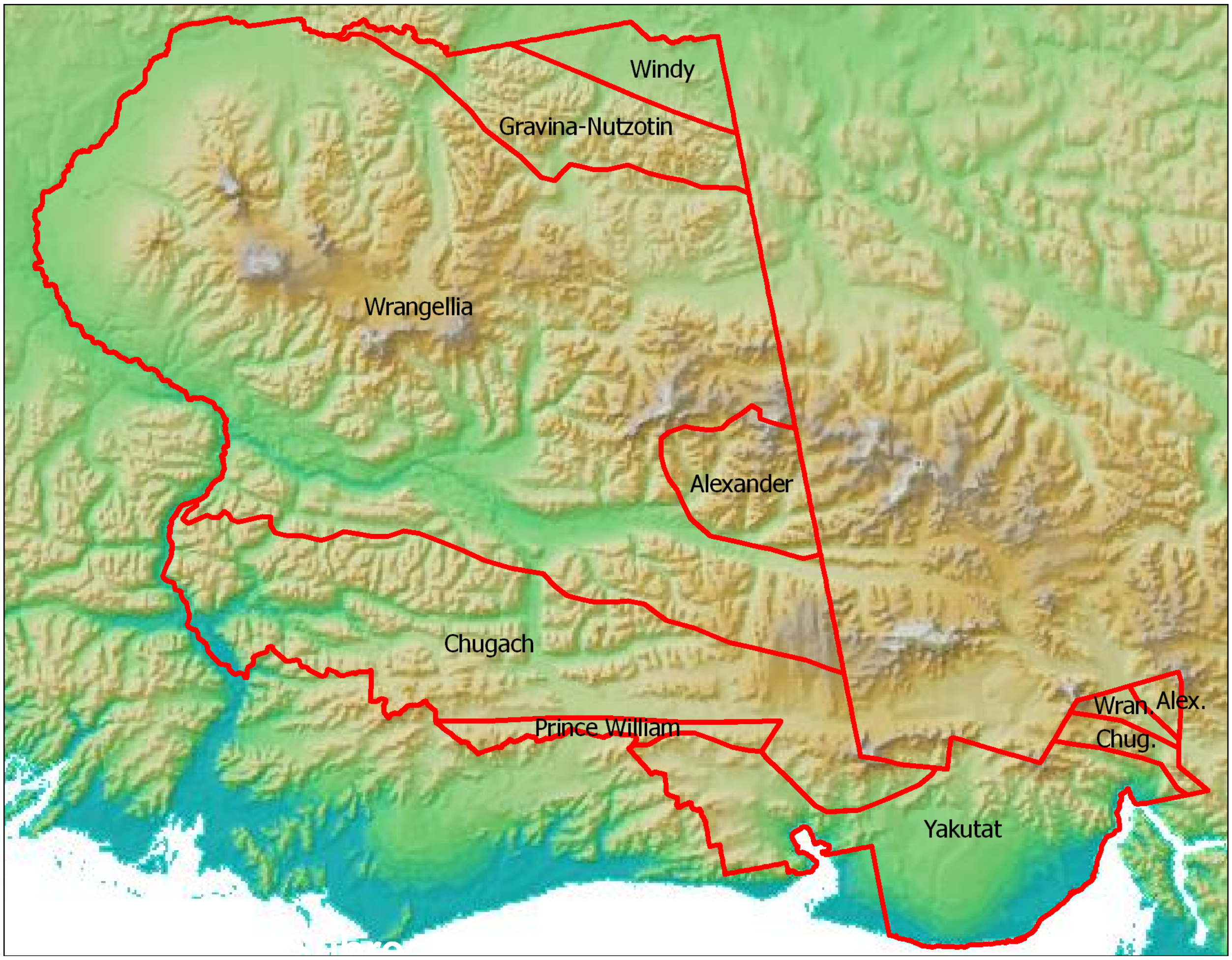

Figure 20. Map of lithotectonic terraines within the Wrangell-St. Elias National Park and Preserve, southcentral Alaska (adapted from Winkler 2000).

precipitation, steep topographic gradient, and heavy sediment load associated with glacial scouring has created the greatest concentration of glacial outwash and braided floodplains of any landscape in North America. The Copper River is especially notable for the enormous discharge of glacial sediments into the Gulf of Alaska. Finally, the high mountains create a strong elevational gradient that supports a wide diversity of ecosystems ranging from lowland bogs to alpine barrens.

BEDROCK GEOLOGY

The bedrock geology within WRST is highly complex and includes a wide variety of sedimentary, metamorphic, volcanic, and intrusive rocks (Moffit 1938, Black 1958, MacKevett 1978, Miller 1971, Winkler 2000). We grouped this diversity into the six major terranes (Figure 20). The Windy terrane is dominated by mafic volcanic and volcaniclastic rocks, and metamorphic phyllite and greenstone. The Gravina-Nutzotin terrane is dominated by marine sedimentary and volcanic rocks. The Wrangellia terrane is dominated by thick basaltic flows, termed the Nikolai Greenstone, as well as carbonate sedimentary rock. The Alexander terrane is dominated by metamorphic schistose marble, and to a lesser extent noncarbonate metamorphic and volcanic rocks, including greenstone, greywacke, phyllite, and argillite. The Chugach and Prince William terranes are dominated by schist, basalt, and

fragmental volcanic rocks. The Yakutat terrane is dominated by weakly metamorphosed flysch, basalt, and schist, similar to those of the Chugach terrane.

This complexity and interspersion of rock types greatly influence the diverse range of high-elevation ecotypes identified in this study. In addition, vegetation composition varies greatly among areas with different bedrock types, due to differences in soil pH and the potentially phytotoxic effects of soluble metals. Acidic soils, typically associated with noncarbonate sedimentary and metamorphic rocks, usually are dominated by acid tolerant plants such as *Betula nana, Dryas octopetala, Empetrum nigrum, Eriophorum vaginatum, Ledum decumbens, Rubus chamaemorus, Salix planifolia pulchra, Sphagnum* spp., and *Vaccinium uliginosum* (Hanson 1953, Young 1974, Walker et al. 1994). In contrast, common plants on alkaline soils typically include *Dryas drummondii, Equisetum scirpoides, Lupinus arcticus, Parrya nudicaulis, Salix arctica, S. lanata richardsonii, S. reticulata*, and *Sheperdia canadensis* (Young 1974, Walker et al. 1994). Some of the principal differences among carbonate, noncarbonate, felsic-intrusive, and mafic extrusive (volcanic) rocks, and their influence on soil and vegetation, are described below.

Carbonate or calcareous rocks, such as limestone, marble, and calcareous schists are relatively common in some regions of the park. Some notable areas include small limestone patches in the Windy Terrane, the Nizina and Chitistone Limestones of the Wrangellia Terrane, and the marble of the Alexander terrane. The relatively high pH and abundance of calcium in the alkaline soils formed by these rocks result in reduced availability of phosphorus and poor absorption and utilization of phosphorus by plants (Bohn et al. 1985). Low nutrient availability may explain the lower plant cover apparent on satellite imagery for carbonate rock regions in WRST. Alkaline soils also tend to be rich in humus.

Noncarbonate sedimentary (mostly shale, chert, sandstone, and conglomerate) and metamorphic (mostly schist) rocks are common throughout the study area. Topography generally is gentler on shales than other rock types in WRST. Because of reduced carbonate and calcium concentrations in the soil, the soils tend to be strongly acidic. Vegetation cover is distinctly greater on these rocks than either carbonate sedimentary rocks or ultramafic igneous rocks.

Felsic intrusive igneous rocks are uncommon within the park. Notable areas include the Klein Creek and Chisana granitic plutons, and the granitic plutons that intrude the older rocks of the Wrangellia and Alexander terranes, which are most evident between Granite Peak and the Gilihina River north of the Chinitna Valley. Felsic igneous rocks are absent from the southern portion of the park. These granitic rocks are dominated by light-colored minerals, such as quartz, alkali feldspars (orthoclase), and muscovite mica, and are rich in aluminum silicates, with little to no calcium, magnesium, and iron. The high aluminum and low calcium–magnesium content contributes to development of strongly acidic soils and high soluble aluminum concentrations. The elevated aluminum, in turn, can lead to plant growth problems because root growth can be stopped by Al concentrations as low as 1 mg/l (Bohn et al. 1985). Phosphorus predominantly is fixed as aluminum and iron phosphates in the acid soils, but is still more available than in alkaline soils. To reduce aluminum toxicity, many plants generate organic acids, such as tannins, that act as chelating agents in the rhizosphere for protection (Rendig and Taylor 1989). Thus, ericaceous plants, which are better adapted to these conditions, tend to dominate.

Mafic volcanic rocks are prevalent throughout the park, indicative of its active tectonic and accretionary history. Most notable are the Triassic basal flows, termed the Nikolai Greenstone, which achieves an aggregate thickness of 1000 m in places and covers large tracts of the northern and southern flanks of the Wrangell Mountains. The Windy and Gravina-Nutzotin terranes also have localized occurrences of mafic volcanic flows, tuffs, and volcanoclastic rocks. Mafic volcanic rocks are rich in iron and magnesium, and low in calcium and phosphorus. Soils tend to be circumneutral.

Ultramafic rocks with their characteristic rusty brown cooler are rare within the park. Small outcrops occur on Benard Mountain near Tonsina, Carden Hills, and in the McHugh Complex in the eastern Chugach Mountains. Ultramafic rocks tend

to be devoid of vegetation, due in part to the lack of phosphorus and to the frequent presence of high-concentrations of phytotoxic metals such as selenium.

GEOMORPHOLOGY

Glacial expansion and contraction has been the predominant surficial process in the park due to the prevalence of high mountains and their interception of moisture-laden storm systems moving inland from the Gulf of Alaska (Benson 1961, Denton 1974, Molnia 1986, Winkler 2000). During the Quaternary (last ~1.6 m. y.), the Cordilleran ice sheet expanded and contracted episodically and during its maximum extent the ice sheet covered the entire Wrangell–Saint Elias region (Coulter et al. 1965). The maximum extent may have occurred about ~400,000 yrs ago, as indicated by deposits left by intense ice-rafting into the Gulf of Alaska during that period (Molnia 1986). Much of the record of early glaciations in the park, however, was destroyed by the last major glaciation, the Wisconsin, that ended about 10,000 yrs ago. In the northern portion of the park, extensive ice advances filled the Copper River Basin to depths of 300 m or more. Blocking of the Copper River by the ice led to the formation of large, ice-damned lakes. Lake Ahtna is the most recent glacial lake dammed by the Wisconsin glaciation (Ferrians 1989).

Eolian activity during dry, full glacial periods has deposited thick beds of eolian silt (loess) over much of the low-lying area (Péwé 1968, Wiles et al. 2003). The braided floodplains of the Chitina River are famous among dipnetters for the frequent, wind-blown silt in the air. The thick silt deposits that accumulate in river valleys are particularly prone to permafrost formation and aggradation of ground ice. While the frozen loess beneath the active layer of modern soils tends to remain alkaline, surface organic horizons usually are strongly acidic, presumably due to leaching and paludification under the present, wetter climatic regime.

The long, gentle slopes of the hills and low mountains in the park are extensively mantled by thin to thick blankets of colluvium. Fractured bedrock and fine-grained soil developed from weathering of bedrock moves downslope under gravity. These down-slope movements of materials over varying bedrock types, leaching, and weathering can substantially modify the geochemistry of the colluvium relative to the original bedrock composition. In permafrost areas, saturated colluvial material can flow downslope in large lobes (Washburn 1973). Gelifluction lobes are visible on many rather steep, vegetated mountain slopes in WRST.

Alluvial processes in narrow mountain and broad lowland valleys in the parks have created a dynamic landscape characterized by active erosion and deposition. Channel migration erodes and recycles surficial deposits, while deposition follows a predictable sequence from gravelly deposits in active channels, to sandy active floodplains adjacent to the active channel, to peat-covered loamy soils on inactive floodplains (Binkley et al. 1995, Jorgenson et al. 1998). In higher gradient streams in the mountains, bedrock control and heavy bedload result in confined headwaters and gravelly braided floodplains. Lower gradient streams in lowland areas are uncommon in WRST because of the mountain-dominated landscape. The floodplains provide connectivity between regions, because water is a conduit for the movement of sediments and nutrients, as well as for fish, invertebrates, and plant materials.

Permafrost distribution is discontinuous (25–90%) in the boreal region and sporadic (<25%) in the maritime region because of low air temperatures and high elevations, and is >100m thick at its maximum (Brown et al. 1997). Permafrost in the Copper River Basin generally is extremely ice-rich due to the thick loess and glaciolacustrine deposits and long period of development (Shur 1988). In contrast, bedrock-controlled upland areas have little ground ice as indicated by the lack of thermokarst features. Ice-wedge development, which occurs in areas where mean annual air temperatures were <-6°C (Péwé 1975) during the Holocene, are mostly absent. With the onset of a warmer and moister climate during the early Holocene, thermokarst of the ice-rich terrain resulted in a few areas with abundant thaw lakes. These occur in the lowlands, particularly near Gakona and Slana, and in the northeast corner of the park. In the southern, maritime region of the park, permafrost is limited to alpine areas, glaciers, and ice-cored moraines.

The ice-cored moraine of the Malaspina Glacier, formed during colder temperatures of the Little Ice age, shows extensive thawing and collapse.

Permafrost also greatly affects ecosystem development by altering soil processes. First, permafrost forms an impermeable layer beneath the active layer, causing the surface soils to become saturated in low-lying areas and on gentle slopes (Ford and Bedford 1987). Soil saturation, in turn, reduces soil oxygen and microbial decomposition and thereby increases organic matter accumulation. Second, the impermeable layer eliminates subsurface leaching, resulting in the protracted and lateral removal of solutes. This lateral movement through the active layer creates distinct branching pattern of "water-tracks" on slopes and enhances plant growth in the drainages (Kane et al. 1992). Finally, freezing and thawing processes associated with permafrost contribute to cryoturbation (mixing of soil horizons) and development of patterned ground features, such as frost boils and ice-wedge polygons, which provide a range of wet and moist microsites. These processes all alter the composition of vegetation that can grow on the cold, saturated soils.

FIRE

Fire is a frequent and widespread disturbance in interior Alaska that causes well-documented stages of vegetation succession (Lutz 1956, Viereck 1973, Van Cleve et al. 1983). In the WRST, however, historical reports and remote

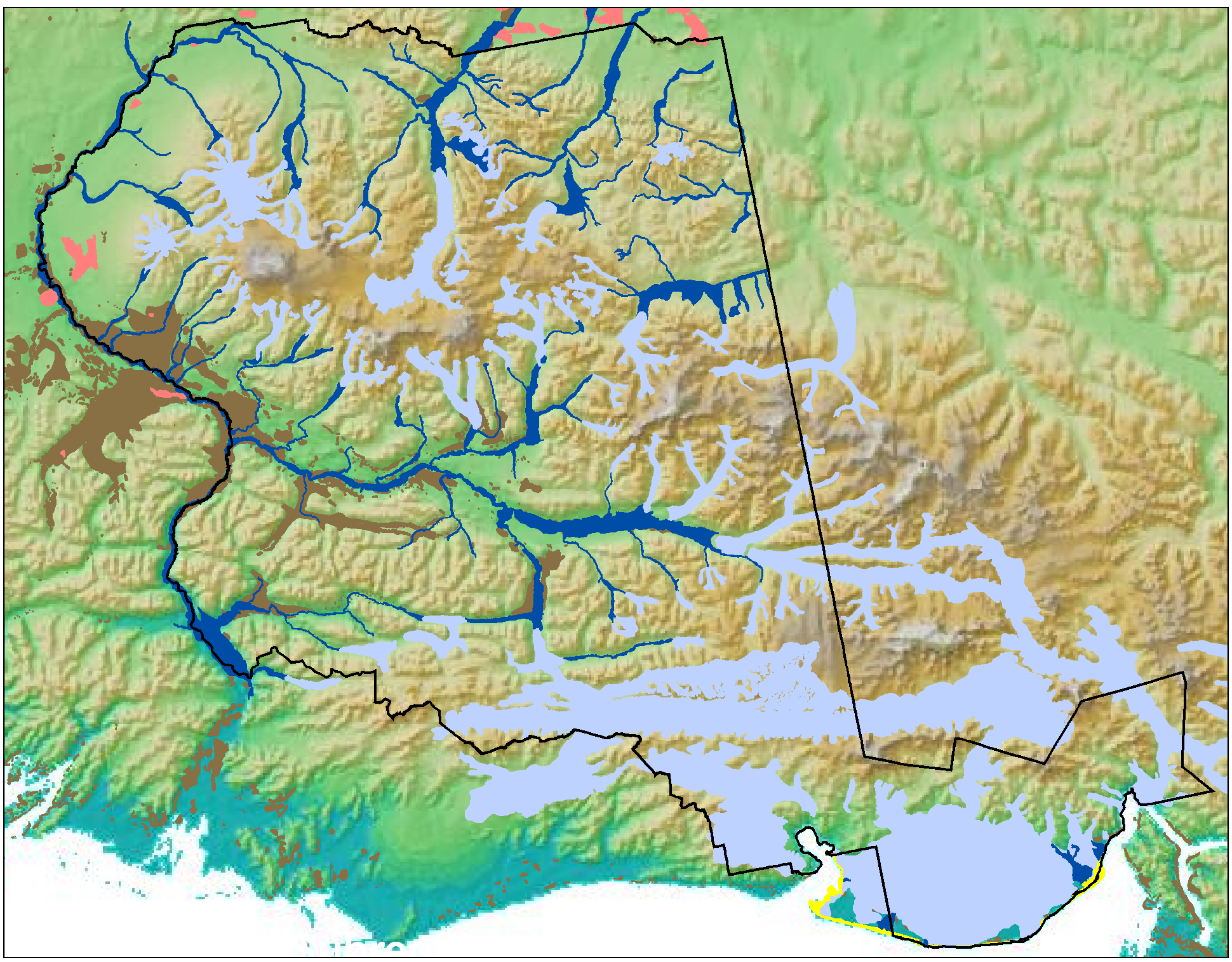

Figure 21. Map of major disturbance factors, including major fires from 1950 to 2005 (in red), spruce beetle infestations from 1989 to 2005 (in brown), rivers (dark blue), and glaciers (light blue). (Sources: major fires, Alaska Fire Service; beetle infestations, Alaska Division of Forestry.)

sensing analysis by the Alaska Fire Service reveals that <1% of the area has been burned since 1950 (Figure 21). Most of the burned area is attributed to a 1981 fire (7515 ha) in the Copper River Basin and a 1954 fire (4359 ha) in the northwest corner of the park. No fires have been documented in the maritime region of the park.

Effects of fire on ecosystem development depends on the nature of the ecosystem (i.e., species, life-history characteristics, soils), and the severity and frequency of fire (Viereck 1973, Van Cleve et al. 1983). Fire severity will affect how much of the organic matter on the forest floor is burned and subsequent regeneration pathways. In general, forest stands are replaced by the same tree species (Viereck 1973, Van Cleve et al. 1983). On moist upland sites (white spruce sites), Foote (1983) identified six distinct successional stages: (1) newly burned stage during 0–3 yrs; (2) herb-tree stage when fast growing mosses, herbs, and tree seedlings become established after 3–10 yrs; (3) tall shrub-sapling stage occurring 3–30 yrs after fire; (4) dense tree stage of mostly birch, aspen, but also some white spruce after 15–30 yrs; (5) mature hardwood stage with quaking aspen and paper birch after 50–150 yrs, and (6) the spruce stage after 100–200 yrs. The successional sequence on black spruce sites is similar in structure but varies in species composition: (1) newly burned stage with resprouting ericaceous shrubs during 0–1 yrs; (2) moss-herb stage when fast growing mosses, herbs, and tree seedling become established after 1–5 yrs; (3) tall shrub-sapling stage occurring 5–30 yrs after fire; (4) dense tree stage of mostly birch, aspen, and black spruce after 30–55 yrs; (5) mixed hardwood-spruce stage with black spruce, paper birch and quaking aspen after 55–90 yrs; and (6) the spruce stage with black spruce and *Sphagnum* mosses after 90–200+ yrs.

INSECTS

From 1989 to 2003, a widespread outbreak of spruce beetles (*Dendroctonus rufipennis*) in the Copper River Basin, Alaska, infested over 275,000 ha of forests in the region (Figure 21). The Copper River Valley is the second major area of south central Alaska (behind the Kenai Peninsula) heavily impacted by the spruce beetle epidemic of the 1990s. Spruce beetle activity in the Copper River Valley is concentrated in the southern portion of the Copper River Basin and in the Chitina Valley and associated tributaries (Allen et al. 2006). By 2006, beetle damage was reduced to 1400 ha, mostly in the Kennicott River Valley near McCarthy (Snyder and Lundquist 2007).

Spruce beetle damage in the park primarily occurred to medium-to-large white spruce, while black spruce and small-diameter white spruce were infrequently attacked and killed (Allen et al. 2006). This selective attack of mature white spruce caused stands to revert to an earlier successional stage or caused mixed forest stands to lose their white spruce and become more deciduous in overstory composition. Effects on the understory composition were negligible.

The spruce bark beetle is typically present throughout its range at low population levels and it facilitates regeneration of spruce by creating small disturbances in the overstory tree canopy. These small populations typically attack severely stressed or recently killed trees, such as those affected by blow-down events, droughts and floods, and disease. In contrast, large populations are capable of mounting mass attacks and overcome the defenses of healthy trees (Garbutt et al. 2006). Typically, the beetle attacks and kills the largest trees in a stand and moves to smaller trees as an infestation worsens. Occasionally, up to 100% of the mature spruce trees in a forest stand can be killed. Many factors affect spruce beetle infestations, including elevation and variation in mean temperature during July and August; forest age; maximum wind speed; winter mortality of beetles; high densities of susceptible trees; and site quality (Werner et al. 2006). Natural controls on beetle populations include low winter temperatures, cold wet weather, woodpeckers, and vigorous growth. Few studies have been done in the boreal forest to reconstruct a detailed history of spruce bark beetle outbreaks, but researchers have reconstructed the history of beetle outbreaks in Kenai Peninsula forests of southeast Alaska for the past 250 years (Berg et al. 2006).

SUMMARY AND CONCLUSIONS

This report presents the results of an ecological land survey (ELS) effort that inventoried, and classified ecosystems in the Wrangell-St. Elias National Park and Preserve. By analyzing the dynamic physical processes associated with coastal, riverine, lowland, glacial, hillside and mountainous environments, and the abundance and distribution of their diverse ecological resources, this study contributes to ecosystem management in national parklands in Alaska.

Through field surveys at 569 intensive plots during 2004–2006, we collected information on the geomorphic, topographic, hydrologic, pedologic, and vegetative characteristics of ecosystems across the entire range of environmental gradients across the park. Individual ecological components (e.g., geomorphic unit, AVC vegetation type) were determined using standard classification schemes for Alaska, but modified when necessary to differentiate unique characteristics in the study area. We developed 67 plant associations through multivariate classification techniques. We used the hierarchical relationships among ecological components to develop 68 ecotypes (local-scale ecosystems) that best partition the variation in ecological characteristics across the entire range of aquatic and terrestrial environments.

Soils described at 423 plots were classified into 53 soil types (subgroup level), of which 15 were rare occurrences and not used in the analysis of soil-vegetation relationships. The most common types observed were Typic Cryorthents (8% of 423 observations), Typic Dystrocryepts (7%), Typic Eutrogelepts (6%), Oxyaquic Cryorthents (6%), and Typic Aquorthels (5%). The classification was effective at partitioning the variability of numerous soil properties, including organic-layer thickness, depth to rocks, thaw depths, depth to water, pH, and EC.

Landtype associations, or soil landscapes, were developed by cross-tabulating soils with the ecotypes assigned for each plot. The cross-tabulation revealed that 2–5 closely related soil types usually were associated with 2–3 ecotypes. These groupings were used to identify 21 terrestrial and 5 water and glacier landscapes that provide a reduced set of 26 classes with broad application for resource management.

Multiple environmental site factors contributed to the distribution of ecotypes and their associated plant species, resulting in large differences among ecotypes. Mean surface organic-horizon thickness, an indicator of land surface age and anaerobic soil conditions and disturbance, ranged from 0 cm in alpine, coastal and riverine barrens to 150 cm in boreal lowland sedge-shrub fens and boreal lacustrine sedge meadows. Mean depth to rock, an indicator of surficial deposit depth and drainage, ranged from 0 cm in alpine barrens to >200 cm in numerous ecotypes that occurred on thick, eolian surficial deposits. Permafrost presence varied in the boreal zone. Areas where permafrost was at >1.5 m depth, or was absent, included upland, subalpine, younger riverine, and lacustrine fens. In other lacustrine, lowland and alpine areas, permafrost was usually present at 50–100 cm depth, with a minimum depth of 15 cm. Permafrost was absent in the maritime zone, except for high elevation mountainous areas and areas underlain by glacial ice. Mean water depth (negative when below ground) for terrestrial ecotypes ranged from >-2 m in Boreal Upland Sagebrush Meadow to 10 cm in Maritime Coastal Sedge Meadow. Mean pH, which affects nutrient availability and ion exchange, ranged from 3.4 in Maritime Upland Tall Alder Shrub to 8.3 in Maritime Coastal Barrens. Mean electrical conductivity (EC), important for osmotic regulation in plants, ranged from 30 S/cm in Alpine Lake to 37,500 S/cm in Nearshore Water (terrestrial EC values ranged from 33 S/cm in Maritime Alpine Barrens to 613 S/cm in Maritime Coastal Sedge Meadow).

Ecotype distribution was greatly affected by numerous landscape-level factors. Tectonics and regional mountain building have created barriers to atmospheric movement and topographic climate gradients, resulting in strong differences between boreal and maritime ecotypes. Oceanographic conditions have resulted in the occurrence of salt-affected ecotypes along the coast and the prevalence of lowland ecotypes on the coastal plain. Soil pH and nutrient status are strongly affected by underlying bedrock types and

geomorphology. Geomorphic environments associated with sediment erosion and deposition create a wide range of soil conditions and disturbance regimes. Areas underlain by permafrost have impeded subsurface drainage, and the varying volumes of ground ice result in varying degrees of permafrost degradation. Fires are a strong modifier of ecosystem dynamics, particularly in interior areas primarily vegetated by black spruce. Finally, recent spruce beetle infestations have severely damaged large areas of spruce forest.

Two types of maps products were developed: landcover maps produced by Geographic Resource Solutions that use vegetation classes similar to the AVC classification and ecosystem maps derived from landcover maps through rule-based modeling with ancillary maps. A landcover map was developed through classification of spectral characteristics of 11 Landsat scenes that covered the area. The process involved: (1) compiling and preprocessing 11 Landsat ETM scenes; (2) developing an unsupervised classification of the scenes to guide field surveys; (3) developing spectral training areas by sampling spectrally homogenous patches by helicopter; (4) developing a spectral database that included both spectral and vegetation characteristics; (5) evaluating similarities and differences among spectral signatures; (6) classifying the vegetation type of each spectral signature using cut-point rules from the AVC and the quantitative vegetation data; (7) performing a supervised classification of all the scenes using the classified signatures; (8) and reducing errors in the resulting scenes through rule-based modeling with ancillary data. These data included a DEM, winter Landsat scenes, and an ecosection map to help with regional differences. The resulting landcover map has four levels of classification (123 “calc_class”, 23 GridClVal, 14 “Vegetation Structure”, and 11 “Major_Class”).

We developed a set of three ecosystem maps from the GRS landcover maps, based on rule-based modeling. First, a map of integrated terrain units (ITUs) for the WRST was developed by overlaying and combining the calc_class grid (123 classes) from the GRS landcover map and four terrain layers; climatic subregions (7 classes), physiography (floodplains, glaciers, coastal, and other), elevation (<800 m, 800–1000 m, and >1000 m), and slope (< 7° and >=7°). This generated a total of 6465 combinations, or ITUs. Second, we aggregated this large set of classes into a reduced set of 69 ecotype map classes based in large part on terrain relationships identified in the landscape-relationships table (Tables 136 and 137). Third, we developed a soil-landscapes map with 25 classes derived from aggregating similar ecotypes with similar soils, based on relationships developed from the landscape-relationships analysis using field plot data. These maps are limited in extent to the boundaries of the WRST due to the extent of the subsection map (Swanson and Anderson 2001) used in mapping physiography.

Three main benefits are derived from an ecological land survey approach to understanding landscape processes and their influence on ecosystem functions. First, it analyzes landscapes as ecological systems with functionally related parts and recognizes the importance that geomorphic and hydrologic processes have on disturbance regimes, the flow of energy and material, and ecosystem development. This hierarchical approach, which incorporates numerous ecological components into ecotypes with co-varying properties, allows users to partition the variability of a wide range of ecological characteristics. Second, developing a spectral database for landcover mapping that integrates spectral and field vegetation information for use in satellite image processing facilitates the analysis of vegetation distribution across the landscape. Finally, the linkage of landcover maps to climatic, physiographic, and topographic variables to develop ecosystem maps improves our ability to predict the response of ecosystems to human impacts and facilitates the production of thematic maps for resource management applications and analyses.

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Appendix 1. Coding system for characterizing ecological characteristics of field plots.

TERRAIN UNITS	
Bxw	**Bedrock, weathered (undiffer.)**
If	Intrusive-felsic
Ii	Intrusive-intermediate
Im	Intrusive-mafic
Iu	Intrusive ultra mafic
Vfy	Volcanic-felsic-younger
Vfo	Volcanic-felsic-older
Viy	Volcanic-intermediate, younger
Vio	Volcanic-intermediate, older
Vmy	Volcanic-mafic-younger
Vmo	Volcanic-mafic-older
Vp	Volcanic-pyroclastics
Sc	Sedimentary, carbonate
Sn	Sedimentary, noncarbonate
Nc	Metamorphic-carbonate
Nn	Metamorphic-noncarbonate
C	**Colluvial Deposits**
Ch	Hillslope Colluvium
Cl	Landslide Deposit
Cs	Solifluction Deposits
Ct	Talus
Ell	**Lowland Loess**
Elu	Upland Loess
Esa	Eolian Active Sand
Esi	Eolian Inactive Sand
Fdr	**Delta Channel Deposit**
Fdo	Delta Overbank Deposit
Fmrac	**Meand Coarse Active Channel**
Fmric	Meand Coarse Inactv Chan. Dep.
Fmraf	Meander Fine Active Chan Dep.
Fmrif	Meander Fine Inactive Chan Dep.
Fmo	Meander Overbank Deposit
Fmoa	Meander Active Overbank Dep
Fmoi	Meander Inactive Overbank Dep
Fmob	Mean. Abandoned Overbank Dep
Fbrac	**Braided Coarse Active Chanl**
Fbric	Braided Coarse Inact. ChanDep.
Fboa	Braided Active Overbank Deposit
Fboi	Braided Inactive Overbank Dep
Fbob	Braided Abandoned Ovrbank Dep
Fhl	**Headwater Lowland Floodplain**
Fhm	Mod Steep Headwater Fldplain
Fhmo	Mod Steep Headwtr Overbnk Dep
Fto	**Old Terrace** (lower terraces)
Ff	**Alluvial Fan**
Ffi	Alluvial Fan Inactive Deposit
Ffb	Alluvial Fan Abandoned Deposit
Gmo	**Older Moraine**
Gmy	Younger Moraine
Gto	Older Till Sheet
Gty	Younger Till Sheet
GFo	**Glaciofluvial Outwash**
GFoo	Glacfluvial Outwsh, Older
GFk	Kame Deposits
GFt	Glacflvl Outwsh, Terrace
GL	**Glaciolacustrine Deposits**
L	**LACUSTRINE DEPOSITS**
Ldnc	**Drained Basin, Ice-poor center**
Ldnm	Drained Basin, Ice-poor margin
Ldnu	Drained basin, Ice-poor undiff
Ldic	Drained Basin, Ice-rich center
Ldim	Drained Basin, Ice-rich margin
Ldiu	Drained basin, Ice-rich undiff
Ldip	Drained Basin Pngo
Of	**Organic Fens (0rg >40cm)**
Ob	Bogs
Wrhm	**Mountain Headwater Stream**
Wrln	Lower Perennial, non-glacial
Wrlg	Lower Perennial, glacial
Wrun	Upper Perennial, Non-glacial
Wrug	Upper Perennial, Glacial
Wldc	**Deep Connected Lake**
Wldcm	Deep Connected Lake, Morainal
Wldir	Deep Isolated Lake, Riverine
Wldit	Deep Isolated Lake, Thaw
Wldim	Deep Isolated Lake, Morainal
Wlsc	Shallow Connected Lake
Wlscv	Shallow Connected Beaver Pnd
Wlsi	Shallow Isolated Lake
Wlsir	Shallow Isolated Lake, Riverine
Wlsit	Shallow Isolated Lake, Thaw
Wlsim	Shallow Iso Lake, Morainal

MACROTOPOGRAPHY:	
C	**Top, Crest, Summit Or Ridge**
Fh	**Plateau (High Flats)**
Fpp	Permafrost Plateau
Sh	**Shoulder Slope**
Steep Slopes	
Sb	Bluff or Bank (unconsolidated)
Sbs	Steep bluff south facing
Sc	Cliff (rocky)
Su	**UPPER SLOPE** (convex, creep)
Suc	Concave (water gathering)
Suv	Convex (water shedding)
Suvs	Convex, south-facing
Sup	Plane
Sl	**LOWER SLOPE** (concave)
Slc	Concave (water gathering)
Slch	Nivation hollows, Snowbanks,
Slv	Convex (water shedding)
Slp	Plane
T	**TOE Slope**
D	**Drainage** or Water Track
B	**BASINS OR DEPRESSIONS**
Bd	Drained Basin
Bk	Kettle
F	**FLAT/FLUVIAL RELATED**
Fn	Nonpatterned
Fm	Flats margins (transition)
Fc	Channel, swale or gut,
Fi	Interfluv or flat bank
Fl	Levee
Fb	Bar (undifferentiated)
Fbp	Point Bar
Fs	Crevasse splay
Ft	Terrace
Ff	Flood Basin (behind levee)
W	**WATERBODIES**
Wi	Islands Present
Lm	Lake Margins
Lb	Wave cut bench (shore)
R	**RIVER OR STREAM**
Rp	Deep Pools (>1.5 m)
Rs	Shallow Runs (<1.5 m)
Ri	Riffles,
Rr	Rapids
XC	**CHANNEL COMPLEX**
Xp	Pingo
Xm	Morraine Complx, undulating
E	**Eolian Patterns**
H	**Human modified**

MICROTOPOGRAPHY:	
N	**NONPATTERNED**
FROST FEATURES	
Fh	Hummocks (mineral cored)
Fr	Reticulate
Ff	Frost Scars and Boils
Fc	Circles (non-sorted, sorted)
Fs	Stripes (non-sorted, sorted)
Fn	Nets (non-sorted, sorted)
Ft	Steps (non-sorted, sorted)
MOUNDS (ice and peat related)	
Mi	Ice-cored mounds
Mpm	Peat mounds
Ms	String (strang)
Mg	Gelifluction lobes (saturated flow)
Mrb	Rocks, Blockfields
Mrm	Rocky Mounds/Outcrops
Mrs	Soil covered rocks
Mw	Mounds caused by wildlife
Ml	Tree mounds (dwnd logs/root balls)
Mu	Undifferentiated mounds (distinct)
DRAINAGE or EROSION RELATED	
Dt	Water tracks (non-incised)
Dr	Ripples
Dc	Riverbed cobbles, boulders
Ds	Scour channels-ridges
EOLIAN RELATED	
Es	Small dune
POLYGONS (ice aggradation)	
Pd	Disjunct polygon rims
Phh	High-centered polygons, high-relief
Phl	High-centered polygons, low-relief (and flat centered)
Plll	Low-center., Low relief, low-dens.
Tm	Mixed pits and polygons
W	**WATER**
Wi	Islands present
Lp	Polygonized margin (>10%)

ECOTYPE VEG STRUCT Code:	
BP	barrens or Partially vegetated
FA	Aquatic Forb
SE	Sedge Emergent (Marsh)
GE	Graminoid Emergent (Marsh)
FE	Forb Emergent (Marsh)
SM	Sedge Meadow
GM	Grass Meadow
FM	Forb Meadow
TM	Tussock Meadow
KM	Salt-killed Meadow
DS	dwarf scrub (<20cm)
LS	low scrub (20–150cm)
TS	tall scrub (>150cm)
BF	broadleaf forest
MF	mixed forest
NF	needleleaf forest
RW	River (flowing water)
LW	Lake (still water)
CW	Coastal (saline)

VEGETATION CLASSES (IV):	
Bbg	Barrens (<5% veg)
Bpv	Partially Vegetated (5–30)
Fbcb	Closed Paper Birch Forest
Fbcba	Closed Paper Birch-Aspen Forest
Fboa	Open Quaking Aspen Forest
Fbob	Open Paper Birch Forest
Fbop	Open Balsam Poplar Forest
Fbwb	Paper Birch Woodland
Fbwp	Balsam Poplar Woodland
Fbwt	Broadleaf–Tall Scrub Woodland
Fmcas	Closed Quaking Aspen-Spruce
Fmcsb	Closed Spruce-Paper Birch Forest
Fmoas	Open Quaking Aspen-Spruce
Fmosb	Open Spruce-Paper Birch Forest
Fmosp	Open Spruce-Balsam Poplar
Fncbs	Closed Black Spruce
Fnobs	Open Black Spruce Forest
Fnows	Open White Spruce Forest
Fnwbs	Black Spruce Woodland
Fnwws	White Spruce Woodland
Sfobs	Open Dwarf Black Spruce
Sfows	Open Dwarf White Spruce
Hafm	Common Marestail
Hafp	Fresh Pondweed
Hbbd	Dry Bryophyte
Hbl	Lichen
Hfmm	Mixed Herbs
Hfwhb	Subarc Lowlnd Herb Bog Mead.
Hgmb	Bluejoint Meadow
Hgmbh	Bluejoint-Herb
Hgmbs	Bluejoint-Shrub
Hgmsd	Moist Sedge-Dryas Tundra
Hgmsgt	Moist Sedge-Grass .Tundra
Hgmss	Moist Sedge-Shrub Tundra
Hgmswt	Moist Sedge-Willow Tundra
Hgmt	Tussock Tundra
Hgwfg	Fresh Grass Marsh
Hgwfs	Fresh Sedge Marsh
Hgwsb	Subarc Lowlnd Sedge Bog Mead
Hgwsbt	Wet Sedge-Birch Tundra
Hgwsl	Subarc Lowlnd Sedge Wet Mead
Hgwsmb	Sub Lowl Sedge-Moss Bog Mea
Hgwss	Sub Lowl Sedge-Shrub Wet Mead
Hgwst	Wet Sedge Meadow Tundra
Hgwswt	Wet Sedge-Willow Tundra
Sddf	Dryas-Forb Dwarf Shrub Tundra
Sddl	Dryas-Lichen Dwarf Shrb Tundra
Sdds	Dryas-Sedge Dwarf Shrub Tundra
Sddt	Dryas Dwarf Shrub Tundra
Sdeb	Bearberry Dwarf Shrub Tundra
Sdec	Cassiope Dwarf Shrub Tundra
Sdee	Crowberry Dwarf Shrub Tundra
Sdel	Ericaceous-Lichen Dwf ShrbTund
Sdet	Ericaceous Dwarf Shrub Tundra
Sdev	Vaccinium Dwarf Shrub Tundra
Sdwt	Willow Dwarf Shrub Tundra
Slcb	Closed Low Shrub Birch
Slcbe	Closed Shrub Birch-Ericaceous
Slcbw	Closed Low Shrub Birch-Willow
Slce	Closed Low Ericaceous Shrub
Slcw	Closed Low Willow
Sloaw	Open Low Alder-Willow
Slobb	Open Shrub Birch-Eric Shrb Bog
Slobe	Open Mesic Shrub Birch-Ericac
Slobw	Open Low Shrub Birch-Willow
Slocg	Open Sweetgale-Graminoid Bog
Sloe	Open Low Ericaceous Shrub
Sloeb	Open Low Ericaceous Shrub Bog
Slol	Open Low Silverberry Shrub
Slotb	Open Mixed Shrub Tussock Bog
Slott	Open Mixed Shrub Tussk Tundra
Slow	Open Low Willow
Stca	Closed Tall Alder
Stcaw	Closed Tall Alder-Willow
Stcbw	Closed Tall Shrub Birch-Willow
Stcw	Closed Tall Willow
Stoa	Open Tall Alder
Stoaw	Open Tall Alder-Willow
Stow	Open Tall Willow
W	Water
nd	no data

DISTURBANCE CLASS LEV2	
A	**ABSENT (mature vegetation)**
N	**Naturally occurring**
Nf	Fire
Ng	Geomorphic Process
Nw	Weather Processes (e.g. wind)
H	**Human generated**
Hd	Human Developed Sites (urban complex)
Hf	Fill
He	Excavation/Pits (undifferentiated)
Hc	Clearings (Non-agricultural or undifferentiated)
Ha	Agricultural Field
Ht	Trail
Hs	Structures and Debris
Hw	Waterbodies, Man-made
Hp	Pollutants/Contaminants
DC	Disturbance complex
nd	no data

Appendix 1. Continued.

ENVIRONMENTAL PLOT DATA

NoData=999

PLotID: Unique Identifier
Date: mm/dd/yy (ck)
Observers: Initials of Observer
Plot Photos: Camera Name
(Photos:verticle, oblique, soil)
GeogLandMark: river, mountain, etc
PinPrick: enter "y" after marked
PlotRadius(m): Usually 10
Physiography:
A Alpine
S Subalpine
U Upland
L Lowland
G Glacial
P Lacustrine (ponded)
R Riverine
C Coastal
H Human
SurfGeomorph: see Terrain Unit codes
SubGeomorph: see Terrain Unit codes
Slope(deg):
Aspect(deg):
Macrotopography: see codes
Microtopog: see codes
Microrelief (cm):
NWI Water Regime:
U Upland
Ts Subtidal
Te Irregularly exposed
Tr Regularly flooded
Ti Irregularly flooded
Np Permanently flooded
Nei Intermittently exposed
Nsp Semipermanently flooded
Nse Seasonally flooded
Nsa Saturated (S)
Nt Temporarily flooded
Ni Intermittently flooded
Na Artificially flooded
WaterDep: (+/-, or >pit depth)
A/B soilSurf : water above or below
Saturat<30: y,n,u (unknown)
WaterPH: to 0.1 pH units
WaterEC: (uS/cm)
Drainage:
E Excessively drained
Es Somewhat excess. drained
W Well drained
Wm Moderately well drained
Ps Somewhat poorly drained
P Poorly drained
Pv Very poorly drained
F Flooded

SoilMoist: **D**ry, **M**oist, **W**et (field cap. to sat.), **A**quatic (>10cm, perm water)
LowMottDep: depth cm to chr=2 or less
LowMatrDepth: depth cm to chr=1, no mottling, full gley
HydricSoil: y, n, u (unknown)
Permfrst: y, n, u (unknown)
Drained Depth (cm):
CryoTurb: **P**resent, **A**bsent, unknown
SurfOrg: depth of top Org layer (cm)
CumOrg40: total org in top 40
Loess Thick (cm): eolian silt thickness
DomMineral40: dominant mineral text. in top 40 cm
K Blocky (angular, >76 mm, >15%)
B Boldery (rounded, >76 mm, >15%)
R Rubbly (angl, 15-60% , 2-76 mm)
G Gravelly (rounded, 15-60%, 2-76 mm)
S Sandy (grSa to l Sa; <15% gravel)
L Loamy (CL to SL)
C Clayey (SC to C)
P Peat (if no mineral, ~40 cm thick)
DomText40: dominant text. top 40cm, as above, + O = organic (<40cm thick)
Frost Boils (%):
SurfaceFrag: coarse frags on soil surf (%)
RockDepth: depth to coarse frags >15%
RootDepth: cm, dep. to common rt (1-5/cm^2 for fine (1-2 mm); 1-5/dm^2 for medium (2-5 mm); >5/m^2 for coarse
SoilPH10: to 0.1 units in paste (10 cm)
SoilPH30: to 0.1 units in paste (30 cm)
SoilEC: uS/cm from paste (10cm)
Soil Strat: form done? (y/n/u)
SampMeth (Sampling Method):
Pit p**L**ug **Auger**
Corer bank **E**xposure
Surface **M**etal probe
LM plug + probe **LA** plug + auger
MaxObsDepth: Max depth plug/probe
SoilClass: NRCS 9th ed
Veg Completeness: **C**omplete, **P**artial , **D**ominants only, **nd**
VegClass4: Viereck Level IV
AltVeg: cutpoint veg class, if applicable
EcoType: sequencial coding for Physiograph, DomTex40, SoilMoist, Soil Chemisty (circumneut pH=5.6-7.3, brackish (e)>800uS), Veg Structure
DstbClass2: Disturbance Class, see codes
GPS X-Y-Z: enter UTM, verifies data
NOTES: record codes not on drop lists

SOIL PROFILE FORM

Lithofacies:
B Blocky (angular>380 mm, >60%)
R Rubble (angular, 2-380 mm, >60%)
S Stony (rounded, >250 mm, >60%)
Gm Gravel (rounded, massive, >60%)
Gfm Gravel, with fine, massive,15-60%
Gsm Gravel, with sand, massive
Gl Gravel (2-250 mm), layered
Sm Sands, massive
Si Sands, inclined
Sl Sands, layerd
Soi Sands with org, inclined
Sr Sands, rippled
Sor – sands with org, inclined
Sgm Sands w/tr gravel, massive
Sgmt Sands w/tr gravel, turbated
Om Organic, massive
Ol Organic, layered (> 10% organic)
Olt Organic, layered, turbated
Oa Organic, limnic
Fm Fines massive
Fom Fines with organics, massive
Fomt Fines with organics, massive, turbated
Fgm Fines w/tr gravel (tr-15% gravel)
Fl Fines, layered
Fr Fines, rippled
For Fines with organics, rippled
Fcm Fines with clay, massive
Fcl Fines with clay, layered
Fa Fines with algae, limnic
TopDepth; cm from surf (exc live moss)
BotDepth: cm
Horizon: used NRCS codes
Master horizon:O, A, AB, AE, A/B, A/E,A/C, AC, E, E/A, BA B, BC, B/C, C, L, W, R,
Horizon suffixes
a, b, c, co, d, di, e, f, ff, g, h, i, j, jj, k, m, ma, n, o, p, q, r, s, ss, t, v, w, y, z,

Boundary: (combine, e.g. As)
Distinctness:
Abrupt (<2 cm); **C**lear (2–5 cm)
Gradual (5–15 cm) **D**iffuse (>15 cm)
Topography:
Smooth **W**avy
Irregular (deeper than wide) **B**roken
Coarse fragment content class:
Combine content + size (sgr, xby)
0%, no crs frag modifier
s trace to 15 % (grssil)
15 to 35 %; no content modifier
v 35 to 60 % (cbssil)
x 60-90 % (grxSiL)
>90%; use crs frg alone (eg. gr)
Crse fragment size class (>2mm); largest
fl flagstones (flat, 150-380 mm)
cn channery (flat, 2-150 mm)
by boulder (round, > 600 mm)
st stone (round, 250 – 600 mm)
cb cobble (round, 75 – 250 mm)
gr gravel (round, 2 – 75 mm)
Fine fraction codes
s sand
vcos very coarse sand (1–2 mm)
cos coarse sand (0.5–1 mm)
ms medium sand (0.25-0.5 mm)
fs fine sand (0.1–-.25 mm)
vfs very fine sand (0.05–0.1 mm)
lcos loamy coarse sand
ls loamy sand
lfs loamy fine sand
lvfs loamy very fine sand
cosl coarse sandy loam
sl sandy loam
fsl fine sandy loam
vfsl very fine sandy loam
l loam
sil silt loam
si silt (0.002–0.05 mm)
scl sandy clay loam
cl clay loam
sicl silty clay loam
sc sandy clay loac
sic silty clay
c clay (<0.02 mm)
Organic Soils
Oi slightly decomposed
Oe intermediate decomposition.
Oa highly decomposed
mk mucky peat (>10% OM,<17% fibers
Coarse Fragment Content: %
Coarse Fragment Size: maximum (mm)
Coarse Fragment Shape:
Av very angular,
A angular,
As subangular
Rs subrounded,
R rounded
Rw well rounded
Peat Types (Peat):
G Graminoid or sedge
Gf Gramin., fine (<2 mm wide)
Gc Gram, coarse (>2 mm wide)
H Herbaceous
A Allochtonous (drifted)
Mf feathermoss
Ms Sphag
Md dicranum/Polytrichum
Ml Live mosses
W Woody
S Sedimentary (algal, coprogen.)
ColorMatrix: Munsell chart
Mottles (combine.g., ffd)
Abundance:
n none
f few (< 2% area)
c common (2 – 20 %)
m many (> 20 % area)
Size:
f fine (< 2 mm)
m medium (2 to 5 mm)
c coarse (5 - 20 mm)
v very coarse (20 – 76 mm)
e extremely coarse (>76 mm)
Contrast: (change in value, chroma)
f faint (hue, chroma similar)
d distinct (value 2-4, >1 chroma)
p prominent (value > 4)
Redox Kind:
Reduced matrix; redox **d**epletions; concentration-**m**asses; concentration **n**odules; concentration-**c**oncretions; **s**urface coats
Structure:
Grade
g structureless (single-**g**rained)
w weak (barely visible)
m moderate (easily observable)
s strongly
Size (mm)
vf very fine (g-p <1; c-r-p <10; a-s <5mm)
f fine (g-p 1–2; c-r-p 10–20; a-s 5–10)
m med. (g-p 2–5; c-r-p 20–50; a-s 10–20)
co crse (g-p 5–10/c-r-p 50–100/a-s 20–50)
vc very crse g-p >10/c-r-p 100–500/a-s>50
ec extr. coarse (c-r-p >500 mm)
Type (shape)
g granular; p platy
r prismatic c columnar
a angular blocky
s subangular blocky
w wedge g single grained
m massive l c**l**ods
Rupture Resistance: (moist)
l loose
fr friable vfr very friable
fi firm vfi very firm
efi extremely firm sr slightly rigid
r rigid vr very rigid
Stickiness and Plasticity::
None **S**lightly **M**oderately **V**ery

VEGETATION STRUCTURE

Crown Class
O overtopping; D Dominant
C Codominant I Intermediate
U Understory
Size Class (typical)
Seedling; s**A**pling (<5cm DBH)
Pole(5-15) **T**imber (15-30)
Large timber (>30cm)

Appendix 2. Data file listing of ecological components of ground reference and verification plots in Wrangell-St. Elias National Park and Preserve, southcentral Alaska, 2004–2006.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_G57_01_2005	7/13/2005	62.5840	-143.5566	L	0	0	Ell	Fh	20	Slotb	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	carbig-leddec-vacvit-betnan-aulpal-plesch
WRST_T02_01_2004	7/2/2004	59.9474	-139.7576	S	5	300	Gmo	fh	40	Hfmm	Maritime Subalpine Lupine Meadow	lupnoo-faucri-vervir	casti-vervir-valsit-drepa-carmer-sansti
WRST_T02_02_2004	7/2/2004	59.9474	-139.7579	A	0		Wlsim	W	0	W	Alpine Lake		water
WRST_T02_03_2004	7/2/2004	59.9439	-139.7506	U	30	110	Ch	N	10	Stca	Maritime Upland Tall Alder Shrub	alnsin-rubspe-samrac	rubspe-alnsin-athfil-drydil-echhor-hypnu
WRST_T02_05_2004	7/6/2004	59.9557	-139.7893	A	25	10	Ch	Mrm	30	Sdec	Maritime Alpine Cassiope Dwarf Shrub	casste-luepec	casste-luepec-phyale-moss-moss-moss
WRST_T02_06_2004	7/6/2004	59.9553	-139.7899	S	45	240	Ch	N	10	Hfmm	Maritime Subalpine Lupine Meadow	lupnoo-faucri-vervir	lupnoo-valsit-vervir-forb-moss-artem
WRST_T02_07_2004	7/6/2004	59.9550	-139.7878	S	30	110	Ch	Mg	10	Sloe	Maritime Subalpine Low Blueberry Shrub	vacova-luepec	vacova-moss-valsit-luepec-gymdry-moss
WRST_T02_08_2004	7/6/2004	59.9497	-139.7836	A	38	40	Ch	Mg	30	Sdec	Maritime Alpine Cassiope Dwarf Shrub	casste-luepec	faucri-casste-luepec-moss-moss-phyale
WRST_T02_09_2004	7/6/2004	59.9496	-139.7790	S	38	350	Ch	Mg	20	Hfmm	Maritime Subalpine Lupine Meadow	lupnoo-faucri-vervir	faucri-liver-athfil-casste-vacova-valsit
WRST_T02_10_2004	7/6/2004	59.9507	-139.7728	S	20	190	Gmo	N	10	Hfmm	Maritime Subalpine Lupine Meadow	lupnoo-faucri-vervir	vervir-lupnoo-forb-ranniv-athfil-herlan
WRST_T03_01_2004	7/6/2004	59.9082	-139.7891	L	0		Fbrb	N	30	Fnoss	Maritime Lowland Sitka Spruce Forest	picsit-vacova	picsit-plesch-rubped-hylspl-vacala-echhor
WRST_T03_02_2004	7/6/2004	59.9074	-139.7876	L	3	110	Fbrb	N	15	Hfwhlm	Maritime Lowland Forb-Willow Meadow	equvar-salbar1-tofglu	equvar-aulpal-junarc-picsit-fesrub-petfri
WRST_T04_01_2004	7/2/2004	60.0308	-139.8750	A	4	190	Ch	N	40	Bpv	Maritime Alpine Barrens	casste-luepec	luepec-moss-stere-poa-carnar-epilat
WRST_T05_01_2004	7/2/2004	59.8843	-139.8613	P	0		Wldcm	W	0	W	Lowland Lake		potalp
WRST_T05_02_2004	7/2/2004	59.8843	-139.8613	P	0		L	W	0	Hgwfg	Maritime Lacustrine Grass Marsh	arcful-equflu	arcful-calpal1-equflu-alnsin-echhor-drydil
WRST_T05_03_2004	7/2/2004	59.8828	-139.8632	G	5	105	Gmy	Mrm	50	Stoa	Maritime Glaciated Tall Alder-Willow Shrub	alnsin-sorsco	alnsin-echhor-drydil-sorsco-rubspe-gymdry
WRST_T05_04_2004	7/2/2004	59.8833	-139.8591	U	3	200	Gmy	Mrm	200	Fnoss	Maritime Upland Sitka Spruce Forest	picsit-vacova	picsit-liver-rubped-echhor-vacova-moss
WRST_T05_05_2004	7/2/2004	59.8794	-139.8531	L	0		Gfoi	Ds	100	Fmwcss	Maritime Lowland Cottonwood-Spruce Forest	poptri-alnsin-picsit	alnsin-echhor-rubspe-poptri-picsit-drydil
WRST_T06_01_2004	7/4/2004	59.8441	-139.9445	R	0		Wrug	W	0	W	Glacial River		water
WRST_T06_02_2004	7/4/2004	59.8437	-139.9451	R	0		Fbrac	Ds	30	Bbg	Maritime Riverine Barrens	racom-epilat	moss-equvar-epilat-equsyl-lupnoo-salix
WRST_T06_03_2004	7/4/2004	59.8442	-139.9462	R	0		Fbrac	Ds	20	Bpv	Maritime Riverine Barrens	racom-epilat	alnsin-lupnoo-epilat-salsco-salala-equvar
WRST_T06_04_2004	7/4/2004	59.8415	-139.9439	R	0		Fboa	N	5	Stow	Maritime Riverine Tall Willow Shrub	salhoo-equarv	drepa-sanunc-brach-salcom-equvar-salbar1
WRST_T06_05_2004	7/4/2004	59.8410	-139.9442	R	0		Fboa	N	15	Hfwhlm	Maritime Riverine Horsetail Meadow	equarv-eriang	drepa-brarut-rhysqu-sanunc-phifon-equarv
WRST_T06_06_2004	7/4/2004	59.8409	-139.9463	R	0		Fboa	N	5	Stcaw	Maritime Riverine Tall Alder-Willow Shrub	alnsin-salbar1-equvar	alnsin-salbar1-salix-salsco-equpal-salsit
WRST_T06_07_2004	7/4/2004	59.8401	-139.9452	R	0		Fboa	N	10	Hfwhlm	Maritime Riverine Horsetail Meadow	equarv-eriang	equvar-equpal-liver-moss-moss-moss
WRST_T06_08_2004	7/4/2004	59.8394	-139.9454	R	0		Fboi	N	10	Stow	Maritime Riverine Tall Willow Shrub	salhoo-equarv	drepa-salix-salix-sallan-moss-moss
WRST_T06_09_2004	7/4/2004	59.8377	-139.9488	R	0		Fboa	N	5	Stcaw	Maritime Riverine Tall Alder-Willow Shrub	alnsin-salbar1-equvar	alnsin-salbar1-equarv-salsco-moss-liver
WRST_T06_10_2004	7/4/2004	59.8334	-139.9541	R	0		Fboi	N	5	Fmocss	Maritime Riverine Cottonwood-Spruce Forest	poptri-alnsin-picsit	poptri-alnsin-picsit-moss-moss-athfil
WRST_T07_01_2004	7/4/2004	59.8151	-139.8119	C	0		Wmn	W	0	W	Nearshore Water		water
WRST_T07_02_2004	7/4/2004	59.8160	-139.8135	C	0		Mba	N	0	Bpv	Maritime Coastal Barrens	elymol-latmar	elymol-latmar-conchi-honpep-poptri-senpse
WRST_T07_03_2004	7/4/2004	59.8172	-139.8142	C	0		Esac	N	0	Hfds	Maritime Coastal Elymus Meadow	elymol-latmar	latmar-elymol-achmil-casmin-casti-casuna
WRST_T07_04_2004	7/4/2004	59.8212	-139.8192	C	0		Esic	Es	30	Hfmm	Maritime Coastal Angelica Meadow	lupnoo-angluc	campy-frachi-latmar-lupnoo-achmil-elymo

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T07_05_2004	7/4/2004	59.8259	-139.8188	C	0		Mta	N	0	Hgwhsb	Maritime Coastal Sedge Meadow	carlyn-trimar	carlyn-trimar-elepal
WRST_T07_06_2004	7/4/2004	59.8251	-139.8169	C	0		Mta	N	0	Bpv	Maritime Coastal Brackish Barrens	carlyn-trimar	carlyn-elepal
WRST_T07_07_2004	7/4/2004	59.8247	-139.8246	C	0		Esac	Es	20	Hfmm	Maritime Coastal Angelica Meadow	lupnoo-angluc	campy-potege-achmil-fesrub-angluc-desbe
WRST_T07_08_2004	7/4/2004	59.8248	-139.8252	C	0		Mti	N	0	Hgwsl	Maritime Coastal Sedge Meadow	carlyn-trimar	carlyn-carcan-trimar-cicmac-potege
WRST_T08_01_2004	7/4/2004	59.8728	-140.0157	R	1	180	Wrug	W	0	W	Glacial River		water-soil
WRST_T08_02_2004	7/4/2004	59.8732	-140.0145	R	1	180	Gfoac	N	3	Bpv	Maritime Riverine Barrens	racom-epilat	raccan-stealp-alnsin-poptri-equvar-picgla
WRST_T08_03_2004	7/4/2004	59.8752	-140.0176	G	8	110	Gmy	nd	75	Stcaw	Maritime Glaciated Tall Alder-Willow Shrub	alnsin-sorsco	alnsin-salsit-eurpul-polyt-raccan-ortsec
WRST_T08_04_2004	7/4/2004	59.8745	-140.0192	G	12	120	Gmy	N	15	Stoaw	Maritime Glaciated Tall Alder-Willow Shrub	alnsin-sorsco	salsit-alnsin-equvar-epiang-raccan-equarv
WRST_T08_05_2004	7/4/2004	59.8739	-140.0201	R	5	200	Gfoac	N	50	Bpv	Maritime Riverine Barrens	racom-epilat	raccan-stealp-alnsin-popbal-epiang-picgla
WRST_T08_06_2004	7/4/2004	59.8717	-140.0246	G	5	50	Gmy	N		Bbg	Maritime Glaciated Barrens	alnsin-sorsco	alnsin-salsit-epiang
WRST_T08_07_2004	7/4/2004	59.8727	-140.0299	G	10	280	Gmy	N	15	Stca	Maritime Glaciated Tall Alder-Willow Shrub	alnsin-sorsco	alnsin-equpal-raccan-ortsec-epiang-bosros
WRST_T08_08_2004	7/4/2004	59.8701	-140.0291	P	0		Wldim	W	0	W	Lowland Lake		water
WRST_T08_09_2004	7/4/2004	59.8704	-140.0146	L	8	290	Gmy	N		Fboc	Maritime Lowland Cottonwood Forest	poptri-alnsin-picsit	alnsin-poptri-pyrasa-eurpul-rhytil-salsit
WRST_T08_10_2004	7/4/2004	59.8703	-140.0091	P	0		Wldim	W		W	Lowland Lake		water
WRST_T09_01_2004	7/6/2004	59.8924	-139.7503	C	5	100	Esac	Es	5	Hgdl	Maritime Coastal Elymus Meadow	elymol-latmar	frachi-elymol-latmar-conchi-fesrub-lupnoc
WRST_T09_02_2004	7/6/2004	59.8919	-139.7515	C	5	280	Esac	Es	5	Hfmm	Maritime Coastal Angelica Meadow	lupnoo-angluc	frachi-lupnoo-campy-achmil-angluc-epiang
WRST_T09_03_2004	7/6/2004	59.8905	-139.7558	C	0		Mti	N	0	Hgwfs	Maritime Coastal Sedge Meadow	carlyn-trimar	carlyn-eriang-equpal
WRST_T09_04_2004	7/6/2004	59.8900	-139.7569	R	0		Fmrac	N	0	Stcaw	Maritime Riverine Tall Alder-Willow Shrub	alnsin-salbar1-equvar	rubspe-alnsin-brach-herlan-angluc-athfil
WRST_T09_05_2004	7/6/2004	59.8912	-139.7548	R	0		Fmoa	N	0	Hfwhlm	Maritime Riverine Horsetail Meadow	equarv-eriang	equpal-juntri-junarc-carlyn-desber-salala
WRST_T09_06_2004	7/6/2004	59.8923	-139.7579	R	2	10	Gfoi	N	2	Fmocss	Maritime Riverine Cottonwood-Spruce Forest	poptri-alnsin-picsit	alnsin-rubspe-rhyrug-plesch-athfil-poptri
WRST_T10_01_2004	7/3/2004	59.7421	-140.2555	L	0		Ob	N	3	Hgwsmb	Maritime Lowland Sedge-Blueberry Bog	vaculi-carplu	vaculi-carplu-carlyn-erirus-calam-rubarc
WRST_T10_02_2004	7/3/2004	59.7426	-140.2578	U	12	70	Gmy	N	60	Fnoss	Maritime Upland Sitka Spruce Forest	picsit-vacova	dicsco-echhor-vacala-rubped-gymdry-picsit
WRST_T10_03_2004	7/3/2004	59.7431	-140.2566	U	14	80	Gmy	N	25	Fnoss	Maritime Upland Sitka Spruce Forest	picsit-vacova	picsit-rhyti1-vacova-echhor-gymdry-drydi
WRST_T10_04_2004	7/3/2004	59.7432	-140.2556	G	0		Gmy	N	30	Stcaw	Maritime Glaciated Tall Alder-Willow Shrub	alnsin-salbar1-athfil	equarv-salbar1-mnium-alnsin-salsit-athfil
WRST_T10_05_2004	7/3/2004	59.7418	-140.2518	L	0		Gfob	N	10	Sloeb	Maritime Lowland Sedge-Blueberry Bog	vaculi-carplu	sphag-vaculi-erirus-carex-aulpal-carsax
WRST_T10_06_2004	7/3/2004	59.7436	-140.2525	P	0		Wldim	W	3	W	Lowland Lake		nuppol-equflu
WRST_T11_01_2004	7/3/2004	59.6952	-140.3463	C	0		Wmn	W		W	Nearshore Water		water
WRST_T11_02_2004	7/3/2004	59.6956	-140.3461	C	3	180	Mba	N	0	Bbg	Maritime Coastal Barrens	elymol-latmar	soil
WRST_T11_03_2004	7/3/2004	59.6962	-140.3455	C	2	180	Esac	Es	0	Hgdl	Maritime Coastal Elymus Meadow	elymol-latmar	latmar-elymol-achmil-casuna-casmin-cast
WRST_T11_04_2004	7/3/2004	59.6977	-140.3461	C	0		Esac	N	0	Hfmm	Maritime Coastal Elymus Meadow	elymol-latmar	latmar-lupnoo-elymol-equvar-salsco-salala
WRST_T11_05_2004	7/3/2004	59.6968	-140.3462	U	0		Esic	Mu	5	Fncsswh	Maritime Upland Sitka Spruce Forest	picsit-vacova	tsuhet-picsit-rhylor-rhizo1-rhyti1-hylspl
WRST_T11_06_2004	7/3/2004	59.6968	-140.3550	C	0		Esic	N	0	Hfmu	Maritime Coastal Angelica Meadow	lupnoo-angluc	herlan-lupnoo-angluc-frachi-achmil-conch
WRST_T12_01_2004	7/3/2004	59.7354	-140.4126	R	0		Wrug	W	0	W	Glacial River		water
WRST_T12_02_2004	7/3/2004	59.7349	-140.4133	R	0		Fbrac	N	10	Hbbd	Maritime Riverine Barrens	racom-epilat	raccan-cerpur-epilat-poptri-salix-salala

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T12_03_2004	7/3/2004	59.7345	-140.4161	R	0		Fbrac	N	5	Stoa	Maritime Riverine Tall Alder-Willow Shrub	alnsin-salbar1-equvar	alnsin-moss-poptri-salbeb-salsco-salala
WRST_T12_04_2004	7/3/2004	59.7309	-140.4136	R	0		Fbric	N	5	Hbbd	Maritime Riverine Barrens	racom-epilat	raccan-alnsin-poptri-moss-salix-stere
WRST_T12_05_2004	7/3/2004	59.7318	-140.4169	R	0		Fbric	N	5	Fboc	Maritime Riverine Cottonwood Forest	poptri-alnsin-picsit	poptri-alnsin-rubspe-pyrasa-salbeb-echhor
WRST_T12_06_2004	7/3/2004	59.7317	-140.4181	R	0		Fbric	N	5	Fboc	Maritime Riverine Cottonwood Forest	poptri-alnsin-picsit	poptri-alnsin-echhor-rubspe-drydil-rubped
WRST_T12_07_2004	7/3/2004	59.7302	-140.4199	R	0		Fbric	N	5	Fboc	Maritime Riverine Cottonwood Forest	poptri-alnsin-picsit	alnsin-poptri-moss-picsit-rubspe-rubped
WRST_T12_08_2004	7/3/2004	59.7309	-140.4161	R	0		Fbrac	N	5	Stoaw	Maritime Riverine Tall Alder-Willow Shrub	alnsin-salbar1-equvar	alnsin-salsco-salala-salbar1-salbeb-pyrsec
WRST_T12_09_2004	7/3/2004	59.7294	-140.4137	R	0		Fbric	Mrm	20	Hbbd	Maritime Riverine Barrens	racom-epilat	raccan-alnsin-moss-poptri-salix-stere
WRST_T13_01_2004	7/5/2004	59.9695	-139.9955	A	28	350	Ch	N	10	Bpv	Maritime Alpine Barrens	casste-luepec	phyemp-casste-luepec-racom-luzmul-carnar
WRST_T13_02_2004	7/5/2004	59.9696	-139.9982	A	0		Ch	Ft	20	Bpv	Maritime Alpine Barrens	casste-luepec	casste-luzmul-phyemp-luepec-raccan-carnar
WRST_T13_03_2004	7/5/2004	59.9686	-139.9981	A	28	20	Ch	N	10	Sdec	Maritime Alpine Cassiope Dwarf Shrub	casste-luepec	casste-phyemp-luepec-aulac-pelapt-lyccom
WRST_T13_04_2004	7/5/2004	59.9683	-139.9987	S	36	210	Ch	N	10	Slce	Maritime Subalpine Low Blueberry Shrub	vacova-luepec	vacala-gymdry-eurpul-rubped-epiang-phyemp
WRST_T13_05_2004	7/5/2004	59.9656	-140.0046	A	28	56	Ch	N	10	Sdec	Maritime Alpine Cassiope Dwarf Shrub	casste-luepec	casste-phyemp-plesch-claran-luepec-aulac
WRST_T13_06_2004	7/5/2004	59.9617	-140.0059	S	40	165	Ch	N	10	Slce	Maritime Subalpine Low Blueberry Shrub	vacova-luepec	vacova-eurpul-corcan-phyemp-plesch-gymdry
WRST_T13_07_2004	7/5/2004	59.9596	-140.0072	S	10	70	Ch	N	20	Hfmm	Maritime Subalpine Lupine Meadow	lupnoo-faucri-vervir	campy-astalp-anemo-lupnoo-viola-dicra1
WRST_T13_08_2004	7/5/2004	59.9589	-140.0069	S	24	145	Ch	Mg	20	Hfmm	Maritime Subalpine Lupine Meadow	lupnoo-faucri-vervir	faucri-eurpul-mnium-epiang-lupnoo-anemo
WRST_T14_01_2004	7/5/2004	59.7886	-140.9496	L	0		Of	Mpm	20	Slow	Maritime Lowland Forb-Willow Meadow	equvar-salbar1-tofglu	moss-moss-moss-rhyrug-salbar1-drepa
WRST_T14_02_2004	7/5/2004	59.7899	-140.9474	L	0		Gfob	Mpm	30	Stcaw	Maritime Lowland Tall Alder-Willow Shrub	alnsin-salbar1-athfil	alnsin-rhyrug-salsit-equarv-hylspl-salsco
WRST_T14_03_2004	7/5/2004	59.7910	-140.9509	L	2	180	Gfob	Ml	25	Fmocwh	Maritime Lowland Cottonwood-Spruce Forest	poptri-alnsin-picsit	alnsin-plesch-rhyrug-tsuhet-poptri-hylsp
WRST_T14_04_2004	7/5/2004	59.7904	-140.9496	L	0		Gfob	Mpm	15	Hfwhlm	Maritime Lowland Forb-Willow Meadow	equvar-salbar1-tofglu	drerev-dreunc-equvar-carvir-drorot-equpal
WRST_T14_05_2004	7/5/2004	59.7940	-140.9510	L	0		Gfob	Ml	20	Fboc	Maritime Lowland Cottonwood Forest	poptri-alnsin-picsit	echhor-rubspe-alnsin-poptri-plesch-rhyrug
WRST_T14_06_2004	7/5/2004	59.7936	-140.9467	L	0		Gfob	Ml	30	Fmocss	Maritime Lowland Cottonwood-Spruce Forest	poptri-alnsin-picsit	alnsin-rhyrug-popbal-plesch-hylspl-picsi
WRST_T14_07_2004	7/5/2004	59.7867	-140.9439	L	0		Of	N		Hfwhb	Maritime Lowland Menyanthes Bog	mentri-tofglu	mentri-dreunc-campy-tomnit-aulpal-drorot
WRST_T15_01_2004	7/5/2004	59.8313	-140.9824	P	0		Wldim	W		W	Lowland Lake		hipvul-potric-spaang-spaang
WRST_T15_02_2004	7/5/2004	59.8312	-140.9820	G	5	80	Gmy	Mrb	55	Bbg	Maritime Glaciated Barrens	arcful-equflu	spaang-carkel-ranun-moss-equvar-hipvul
WRST_T15_03_2004	7/5/2004	59.8311	-140.9837	L	4	40	Gmy	N	20	Fboc	Maritime Lowland Cottonwood Forest	alnsin-sorsco	poptri-alnsin-equarv-rubspe-rhylor-drydil
WRST_T15_04_2004	7/5/2004	59.8314	-140.9864	G	7	130	Gmy	N	35	Stoaw	Maritime Glaciated Tall Alder-Willow Shrub	alnsin-sorsco	alnsin-rubspe-salsco-sorsco-athfil-plesch cf
WRST_T15_05_2004	7/5/2004	59.8302	-140.9902	U	3	200	Gmy	N	15	Fnoss	Maritime Upland Sitka Spruce Forest	picsit-vacova	picsit-alnsin-salsco-plesch cf-echhor-plesch cf
WRST_T15_06_2004	7/5/2004	59.8312	-140.9919	L	0		Gfob	Ml	58	Fmocss	Maritime Lowland Cottonwood-Spruce Forest	poptri-alnsin-picsit	echhor-poptri-alnsin-equarv-picsit-plesch cf
WRST_T15_07_2004	7/5/2004	59.8321	-140.9894	L	0		Gfoi	N	25	Stoaw	Maritime Lowland Tall Alder-Willow Shrub	alnsin-salbar1-athfil	rubspe-alnsin-salsco-gymdry-athfil-echhor
WRST_T19_01_2004	7/17/2004	60.9869	-141.2028	G	0		Gmy	Mrb	15	Bbg	Boreal Glaciated Barrens	drydru-shecan-salala	salala-drydru-raccan-astalp-salpol-trispi
WRST_T19_02_2004	7/17/2004	60.9914	-141.2035	A	25	355	Gmo	Fh	30	Sdec	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	dryint-castet-stere-vaculi-hylspl-salret
WRST_T19_03_2004	7/17/2004	60.9953	-141.2035	S	23	350	Ffi	Ds	50	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salgla-shecan-salala-dryint-empnig-salcom
WRST_T19_04_2004	7/17/2004	60.9970	-141.2020	S	28	20	Ffb	Fh	20	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	hylspl-vaculi-salgla-salpul-dicra1-betnan
WRST_T19_05_2004	7/17/2004	61.0006	-141.2014	G	8	353	Gmy	Mrb	40	Stow	Boreal Glaciated Willow Shrub	salala-salnip-arcrub	shecan-salala-drydru-cerpur-clado-sanunc

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T19_06_2004	7/17/2004	61.0014	-141.1999	G	4	260	Gmy	Mrb	40	Sddt	Boreal Glaciated Dryas Dwarf Shrub	drydru-shecan-salala	drydru-shecan-salala-popbal-dryint-salgla
WRST_T19_07_2004	7/17/2004	61.0043	-141.2081	G	0		Gmy	Mrb	75	Bbg	Boreal Glaciated Barrens	drydru-shecan-salala	soil
WRST_T20_01_2004	7/17/2004	61.0286	-141.5826	S	15	230	Ch	Mu	20	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	arcrub-betgla-salcom-salgla-salcom-arcuva
WRST_T20_02_2004	7/17/2004	61.0280	-141.5830	S	12	200	Ch	Mu	5	Stcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salgla-equarv-arcrub-epiang-linbor-merpan
WRST_T20_03_2004	7/17/2004	61.0274	-141.5829	S	12	210	Ch	Mu	5	Fbop	Boreal Subalpine Poplar Forest	popbal-fesalt	popbal-geoliv-luparc-arcrub-salgla-rosaci
WRST_T20_04_2004	7/17/2004	61.0263	-141.5836	U	15	205	Ch	Mu	30	Fnows	Boreal Upland White Spruce Forest	picgla-rosaci	hylspl-picgla-dreunc-linbor-bryum-arcrub
WRST_T20_05_2004	7/17/2004	61.0240	-141.5859	U	38	180	Ch	Mu	10	Fboa	Boreal Upland Aspen Forest	poptre-picgla-rosaci	junhor-poptre-arcuva-juncom-oxycam-shecan
WRST_T20_06_2004	7/17/2004	61.0198	-141.5929	U	24	190	Ch	N	0	Sdeb	Boreal Upland Bearberry Dwarf Shrub	arcuva-junhor	arcuva-junhor-oxycam-poptre-soldec-carrup
WRST_T20_10_2004	7/22/2004	61.0057	-141.5887	G	0		Gmy	Mrb	40	Bbg	Boreal Glaciated Barrens	drydru-shecan-salala	creele-braya-crenan-drydru-epilat-hedalp
WRST_T20_11_2004	7/22/2004	61.0067	-141.5945	G	20	150	Gmy	Mrb	100	Sddt	Boreal Glaciated Dryas Dwarf Shrub	drydru-shecan-salala	drydru-salgla-lichc-arcuva-cerpur-salbeb
WRST_T20_12_2004	7/22/2004	61.0078	-141.5935	G	0		Gmy	Mrb	50	Slcw	Boreal Glaciated Willow Shrub	salala-salnip-arcrub	shecan-salnip-hyprev-salbeb-salgla-dicra1
WRST_T20_13_2004	7/22/2004	61.0118	-141.5948	G	15	180	Gmy	Mrb	30	Slow	Boreal Glaciated Willow Shrub	salala-salnip-arcrub	shecan-salgla-salnip-cerpur-salbeb-arcuva-drydru
WRST_T20_14_2004	7/22/2004	61.0121	-141.5970	G	15	160	Gmy	Mrb	30	Fbop	Boreal Glaciated Poplar Forest	popbal-racom	shecan-popbal-cerpur-dicra1-drepa-salgla
WRST_T20_15_2004	7/22/2004	61.0139	-141.5961	G	0		Gmy	Mrb	50	Fnwws	Boreal Glaciated White Spruce Forest	picgla-salsco-drydru	drepa-shecan-salgla-picgla-dicra1-tomnit
WRST_T20_16_2004	7/22/2004	61.0146	-141.5983	G	0		Wldim	W	0	W	Glacial Lake		water-algae
WRST_T20_17_2004	7/22/2004	61.0170	-141.6023	U	5	350	Elu	Mrm	150	Fnows	Boreal Upland White Spruce Forest	picgla-rosaci	arcrub-plesch-shecan-thuid-picgla-drepa
WRST_T22_01_2004	7/16/2004	61.2590	-142.5471	A	3	350	Ch	Fh	10	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	hylspl-salret-tomnit-aulpal-carbig-senatr
WRST_T22_02_2004	7/16/2004	61.2581	-142.5494	S	7	190	Ch	Fh	15	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	hylspl-salret-salpul-stetom-tomnit-carbig
WRST_T22_03_2004	7/16/2004	61.2576	-142.5480	S	5	190	Ch	Fh	15	Hfmm	Boreal Subalpine Forb Meadow	artarc1-fesalt-valcap	artarc1-anemo-carpod-acodel-valcap-brach
WRST_T22_04_2004	7/16/2004	61.2567	-142.5506	S	10	200	Ch	Fh	15	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salpul-salret-petfri-astumb-raclan-anepar
WRST_T22_05_2004	7/16/2004	61.2561	-142.5518	S	5	245	Ch	N	15	Hfmm	Boreal Subalpine Forb Meadow	artarc1-fesalt-valcap	galbor-luparc-carpet1-fesalt-salpul-artarc1
WRST_T22_06_2004	7/16/2004	61.2523	-142.5560	S	8	260	Ch	Fh	20	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-salpul-hylspl-salret-tomnit-vaculi
WRST_T23_01_2004	7/16/2004	61.1062	-142.4850	R	0		Fbrac	N	10	Hfds	Boreal Riverine Dryas Dwarf Shrub	elacom-oxycam	oxycam-salbra-dryoct-elacom-bryum-creele
WRST_T23_02_2004	7/16/2004	61.1061	-142.4832	R	0		Fboa	N	10	Slow	Boreal Riverine Sandy Willow Shrub	salbar1-salnip-elacom	salbar1-elacom-hedalp-oxycam-tofglu-salbra
WRST_T23_03_2004	7/16/2004	61.1049	-142.4784	R	0		Fbric	N	20	Slcl	Boreal Riverine Low Silverberry Shrub	elacom-oxycam	elacom-pyrgra-salbra-equarv-oxycam-equvar
WRST_T23_04_2004	7/16/2004	61.1057	-142.4723	R	0		Fboa	N	20	Stow	Boreal Riverine Sandy Willow Shrub	salbar1-salnip-elacom	salgla-elacom-salbra-oxycam-hedalp-pyrgra
WRST_T23_05_2004	7/16/2004	61.1054	-142.4703	R	0		Fboi	N	20	Fnwws	Boreal Riverine White Spruce Forest	picgla-hedalp	geoliv-plesch-picgla-hedalp-luparc-pelapt
WRST_T23_06_2004	7/16/2004	61.1057	-142.4639	R	0		Fboa	N	30	Stow_dt	Boreal Riverine Sandy Willow Shrub	salbar1-salnip-elacom	salgla-salbar1-salbar1-elacom-rubarc-popbal
WRST_T23_07_2004	7/16/2004	61.1087	-142.4658	R	0		Fbric	N	10	Fbwp	Boreal Riverine Low Silverberry Shrub	elacom-oxycam	elacom-popbal-hedmac-equvar-hedalp-salgla
WRST_T23_08_2004	7/16/2004	61.1115	-142.4648	R	0		Fbric	N	10	Fbwp	Boreal Riverine Gravelly Poplar Forest	popbal-drydru-oxycam	bryum-oxycam-popbal-epila
WRST_T24_01_2004	7/18/2004	61.3590	-142.7679	R	2	280	Fbrac	N	0	Bpv	Boreal Riverine Circumalkaline Barrens	epilat-salala	drydru-epilat-alnten-popbal-oxydef-hedalp
WRST_T24_02_2004	7/18/2004	61.3581	-142.7711	R	0		Fbrac	N		Sddt	Boreal Riverine Dryas Dwarf Shrub	drydru-oxycam	drydru-cerpur-oxycam-taroff-clasym-soldec
WRST_T24_03_2004	7/18/2004	61.3575	-142.7733	R	0		Fbric	N		Fmosp	Boreal Riverine Spruce-Poplar Forest	popbal-picgla-oxycam	shecan-moss-astsib-geoliv-popbal-arcuva
WRST_T24_04_2004	7/18/2004	61.3572	-142.7795	R	0		Fbric	N		Fbop	Boreal Riverine Gravelly Poplar Forest	popbal-drydru-oxycam	shecan-popbal-astsib-geoliv-elacom-hedalp

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T24_05_2004	7/18/2004	61.3546	-142.7879	R	0		Fboi	N	50	Hgmbs	Boreal Riverine Loamy Willow Shrub	salpul-calcan	rubarc-calcan-galbor-trieur3-acodel-alnten
WRST_T24_06_2004	7/18/2004	61.3551	-142.7909	R	0		Fboi	N	5	Fbop	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-rosaci-vibedu-geoliv-alnten-pyrasa
WRST_T24_07_2004	7/18/2004	61.3577	-142.7793	R	0		Fbric	N	10	Slol	Boreal Riverine Low Silverberry Shrub	elacom-oxycam	elacom-shecan-soldec-cerpur-arcuva-moss
WRST_T25_01_2004	7/21/2004	61.3265	-142.8671	P	0		Wldim	W	0	W	Lowland Lake		nuppol-ranun-scosco-hipvul-potam-potam
WRST_T25_02_2004	7/21/2004	61.3264	-142.8691	P	0		Of	N	15	Hgwsl	Boreal Lacustrine Sedge Meadow	carutr-potpal	scosco-carutr-droang-andpol-carrar-carcho
WRST_T25_03_2004	7/21/2004	61.3264	-142.8707	L	0		Ell	Fh	30	Fnwbs	Boreal Lowland Black Spruce Bog	picmar-salgla-equsci	hylspl-empnig-picmar-plesch-ledgro-vacvit
WRST_T25_04_2004	7/21/2004	61.3242	-142.8688	U	0		Gmo	Fh	30	Fnwws	Boreal Upland White Spruce Forest	picgla-rosaci	hylspl-empnig-plesch-picgla-geoliv-salsco
WRST_T25_05_2004	7/21/2004	61.3259	-142.8590	P	0		Of	N	20	Hgwss	Boreal Lacustrine Sedge Meadow	caraqu-potpal-salpul	drepa-caraqu-mnium-aulpal-salpul-potpal
WRST_T25_06_2004	7/21/2004	61.3276	-142.8540	L	0		Gmo	N	20	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	hylspl-empnig-picmar-aulpal-arcrub-ledgro
WRST_T25_07_2004	7/21/2004	61.3297	-142.8514	L	o		Gmo	N	15	Stcw	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	salsco-empnig-salbeb-arcrub-geoliv-hylsp
WRST_T25_08_2004	7/21/2004	61.3313	-142.8570	L	0		Of	N	15	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	carutr-caraqu-potpal-camste1-equflu-mentri
WRST_T25_09_2004	7/21/2004	61.3324	-142.8573	L	0		Of	N	20	Slocg	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	scosco-myrgal-tricae-drerev-potfru-andpol-carrar
WRST_T25_10_2004	7/21/2004	61.3319	-142.8558	L	0		Of	Ms	30	Slocg	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	myrgal-drerev-tricae-potfru-camste1-scosco
WRST_T26_01_2004	7/16/2004	60.9636	-142.2550	A	18	130	Ct	Mrb	30	Hbbd	Boreal Alpine Barrens	racom-carmic1	umbil-lichc-saxopp-raclan-polpul-trispi
WRST_T26_02_2004	7/16/2004	60.9612	-142.2527	A	24	150	Ch	Fs	30	Hgmsgt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	carbig-poaarc-raclan-poalan-trispi-salpol
WRST_T26_03_2004	7/16/2004	60.9565	-142.2585	A	30	200	Ct	Mrb	40	Bbg	Boreal Alpine Barrens	racom-carmic1	poaarc-saxhir-lichc-cocoff-dryoct-epilat
WRST_T26_04_2004	7/16/2004	60.9525	-142.2583	A	20	195	Ch	Mg	50	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	salret-empnig-carbig-casste-fesalt-anemo-trispi
WRST_T26_05_2004	7/16/2004	61.3062	-142.2591	A	36	210	Ch	Fh	20	Sdee	Boreal Alpine Ericaceous Dwarf Shrub	empnig-artarc1	empnig-salret-drydru-fesalt-vaculi-dryoct
WRST_T26_06_2004	7/16/2004	60.9487	-142.2584	G	12	270	Gmy	N	10	Slcw	Boreal Glaciated Willow Shrub	salala-salnip-arcrub	salbar1-astalp-salric-salret-eripur-salala
WRST_T26_07_2004	7/16/2004	60.9487	-142.2645	S	8	260	Gmy	N	10	Slcb	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-empnig-fesalt-artarc1-epiang-salala
WRST_T26_08_2004	7/16/2004	60.9494	-142.2643	A	150	260	Elu	Fh	20	Sdec	Boreal Alpine Ericaceous Dwarf Shrub	castet-pedcap	castet-empnig-casste-salpol-salret-trispi
WRST_T26_10_2004	7/19/2004	60.9534	-142.2956	S	18	225	Ch	N	25	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	empnig-betgla-salgla-luparc-festu-artarc1
WRST_T26_11_2004	7/19/2004	60.9508	-142.2976	S	18	234	Ch	N	10	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-empnig-salsco-corcan-salbeb-salgla
WRST_T26_12_2004	7/19/2004	60.9491	-142.3010	S	11	230	Elu	N	10	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salsco-vaculi-empnig-corcan-betgla-shecan
WRST_T26_13_2004	7/19/2004	60.9460	-142.3039	L	0		Of	N	15	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	caraqu-epipal-eriang-carex-potfru-scosco
WRST_T27_01_2004	7/17/2004	60.9550	-142.7195	R	0		Fbrac	N	5	Hbbd	Boreal Riverine Acidic Barrens	racom-fesbra	raccan-epilat-oxydef-salala-arabi-fesbra
WRST_T27_02_2004	7/17/2004	60.9556	-142.7169	R	0		Fboa	N	20	Stca	Boreal Riverine Tall Alder Shrub	alnten-calcan	alnten-alnsin-alnten-salbeb-calcan-dicra1
WRST_T27_03_2004	7/17/2004	60.9539	-142.7100	R	0		Fbric	N	15	Stca	Boreal Riverine Tall Alder Shrub	alnsin-pyrgra	alnsin-salbeb-poa-pyrgra-dicra1-galtri2
WRST_T27_04_2004	7/17/2004	60.9537	-142.7085	R	0		Fbrac	N	5	Hbbd	Boreal Riverine Acidic Barrens	racom-fesbra	raccan-polyt-stealp-epilat-arabi-fesbra
WRST_T27_05_2004	7/17/2004	60.9531	-142.7078	R	0		Fbrac	N	5	Stow	Boreal Riverine Circumalkaline Barrens	epilat-salala	salala-stealp-luparc-raccan-achmil-arttil
WRST_T27_06_2004	7/17/2004	60.9524	-142.7046	R	0		Fbrac	N	5	Hbbd	Boreal Riverine Acidic Barrens	racom-fesbra	raccan-polyt-salala-epilat-oxydef-fesbra
WRST_T27_07_2004	7/17/2004	60.9518	-142.7028	R	0		Fbrac	N	2	Hbbd	Boreal Riverine Acidic Barrens	racom-fesbra	raccan-polyt-epilat-oxydef-clado-fesbra
WRST_T27_08_2004	7/17/2004	60.9535	-142.6977	R	0		Fbrac	N	10	Hbbd	Boreal Riverine Acidic Barrens	racom-fesbra	raccan-polyt-epilat-clado-fesbra-grami
WRST_T27_09_2004	7/17/2004	60.9521	-142.6904	R	0		Wlsir	W	0	W	Riverine Lake		water

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T27_10_2004	7/17/2004	60.9485	-142.6912	R	0		Fbric	N	24	Stca	Boreal Riverine Tall Alder Shrub	alnsin-pyrgra	alnsin-picgla-salbeb-luparc-pyrgra-ortsec
WRST_T28_01_2004	7/19/2004	61.1758	-143.4452	L	3	10	Ell	Tm	30	Stow_dt	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	sphagg-salpul-hylspl-empnig-plesch-sphag
WRST_T28_02_2004	7/19/2004	61.1763	-143.4445	L	1	10	Ell	Fh	30	Slcbw	Boreal Lowland Low Birch-Willow Shrub	betnan-salpul-leddec	salpul-salbar2-valcap-betgla-drepa-hylspl
WRST_T28_03_2004	7/19/2004	61.1756	-143.4408	P	0		L	N	10	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	drerev-carsax-aloaeq-equflu-sedge-junarc
WRST_T28_04_2004	7/19/2004	61.1817	-143.4444	S	0		Gmo	Mu	40	Slobe	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-claste-clasty-polyt-plesch-fesalt
WRST_T28_05_2004	7/19/2004	61.1825	-143.4438	S	0	0	Gmo	Mrm	30	Slobe	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	claste-stepas-betgla-clasty-empnig-leddec
WRST_T28_06_2004	7/19/2004	61.1836	-143.4414	L	0		L	Mpm	40	Slobb	Boreal Lowland Low Birch-Willow Shrub	betnan-salpul-leddec	sphwar-sphfus-leddec-betnan-sphrip-sphag
WRST_T28_07_2004	7/19/2004	61.1848	-143.4425	L	0		Of	N	0	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	scosco-eriang-carrar-drerev-caraqu-carsax
WRST_T28_08_2004	7/19/2004	61.1870	-143.4387	P	0		Wldim	W	0	W	Lowland Lake		potam
WRST_T29_01_2004	7/21/2004	61.3149	-144.1187	A	38	140	Ch	N	10	Sdee	Boreal Alpine Ericaeous Dwarf Shrub	empnig-artarc1	empnig-vaculi-arcuva-vacvit-artarc1-epiang
WRST_T29_02_2004	7/21/2004	61.3107	-144.1172	S	9	78	Ch	N	20	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-empnig-salcom-salpul-arcrub-vacul
WRST_T29_03_2004	7/21/2004	61.3092	-144.1137	S	10	150	Ch	N	20	Slcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salbar1-salcom-betnan-herlan-eurpul-linbor
WRST_T29_04_2004	7/21/2004	61.3084	-144.1114	S	9	160	Ch	N	15	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salbar1-betnan-salpul-empnig-merpan-artarc1
WRST_T29_05_2004	7/21/2004	61.3062	-144.1043	S	8	178	Ch	Mu	10	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	empnig-salsco-arcuva-betnan-vaculi-salbar1
WRST_T29_06_2004	7/21/2004	61.3017	-144.1043	U	22	232	Ch	N	20	Stcaw	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alnsin-salsco-ribtri-gymdry-rubida-merpar
WRST_T29_07_2004	7/21/2004	61.2990	-144.1040	L	8	85	Gmo	Ml	25	Stow	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	salsco-empnig-betnan-vaculi-arcrub-lycalp
WRST_T30_01_2004	7/19/2004	60.8835	-143.3241	A	0		Ch	Mrb		Bbg	Boreal Alpine Barrens	racom-carmic1	umbil-salpol-castet-leddec-cetra-raccan
WRST_T30_02_2004	7/19/2004	60.8815	-143.3170	A	18	150	Ch	Mg	25	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	salpol-artarc1	luepec-salpol-luzpar-casste-carnar-moss
WRST_T30_03_2004	7/19/2004	60.8757	-143.3229	A	0		Wldim	W		W	Alpine Lake		water
WRST_T30_04_2004	7/19/2004	60.8755	-143.3234	A	8	210	Ch	Mu		Bpv	Boreal Alpine Barrens	salpol-artarc1	salarc-carnar-salpol-calop-casste-castet
WRST_T30_05_2004	7/19/2004	60.8738	-143.3334	A	7	190	Ch	Fh	20	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	salpol-artarc1	salret-salarc-salpol-aulpal-petfri-polstr
WRST_T30_06_2004	7/19/2004	60.8729	-143.3377	S	20	190	Ch	Fh	10	Slcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salbar1-salcom-salpul-arcuva-arcrub-artarc1
WRST_T30_07_2004	7/19/2004	60.8714	-143.3412	S	6	210	Ch	Fh	15	Hfmm	Boreal Subalpine Forb Meadow	artarc1-fesalt-valcap	luparc-valcap-salarc-empnig-salret-luepec
WRST_T30_08_2004	7/19/2004	60.8709	-143.3516	S	12	190	Ch	Fh	20	Slcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salbar2-salcom-sanoff-epiang-herlan-acodel
WRST_T31_01_2004	7/21/2004	61.0072	-144.1863	U	0		Ch	Mu	25	Stoa_dt	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	vaculi-vacova-alnsin-plesch-rubped-empnig
WRST_T31_02_2004	7/21/2004	61.0081	-144.1862	S	0		Ch	N	0	Sdel	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	claste-vaculi-plesch-cetisl1-lyccom-raclan
WRST_T31_03_2004	7/21/2004	61.0083	-144.1855	U	22	30	Ch	N	0	Stca	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alnsin-gymdry-drydil-athfil-rubped-bracl
WRST_T31_04_2004	7/21/2004	61.0089	-144.1844	U	25	210	Ch	N	0	Hgmbh	Boreal Upland Forb Meadow	calcan-epiang-gereri	calcan-epiang-rubspe-gereri-gymdry-sansti
WRST_T31_05_2004	7/21/2004	61.0104	-144.1922	P	0		Wldim	W	0	W	Lowland Lake		potam-mentri
WRST_T31_06_2004	7/21/2004	61.0099	-144.1848	U	15	200	Ch	N	0	Stcaw	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	salsco-gymdry-sorsit-bethum-vibedu-alnsin
WRST_T31_07_2004	7/21/2004	61.0110	-144.1929	U	0		Ch	Mu	15	Fnwws	Boreal Upland White Spruce Forest	picgla-rosaci	vacova-gymdry-salsco-vibedu-picgla-dicra1
WRST_T31_08_2004	7/21/2004	61.0104	-144.1897	L	0		Of	N		Hgwsmb	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	sphag-eriang-caraqu-andpol-carrar-carsit
WRST_T32_01_2004	7/22/2004	61.4742	-142.5948	R	0		Fbrac	N	5	Bpv	Boreal Riverine Circumalkaline Barrens	epilat-salala	drydru-hedmac-oxydef-agrvio-astnut-epilat
WRST_T32_02_2004	7/22/2004	61.4753	-142.5961	R	0		Fbrac	N	10	Sddt	Boreal Riverine Dryas Dwarf Shrub	drydru-oxycam	drydru-shecan-oxycam-popbal-picgla-cladc

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T32_03_2004	7/22/2004	61.4761	-142.5947	R	0		Fbrac	N	10	Fbop	Boreal Riverine Gravelly Poplar Forest	popbal-drydru-oxycam	popbal-elacom-plesch-drydru-shecan-moss
WRST_T32_04_2004	7/22/2004	61.4775	-142.6015	R	0		Fbrac	N	10	Fbop	Boreal Riverine Gravelly Poplar Forest	popbal-drydru-oxycam	shecan-popbal-drydru-plesch cf-plesch-elacom
WRST_T32_05_2004	7/22/2004	61.4821	-142.5964	R	0		Fbric	N	5	Fmosp	Boreal Riverine Spruce-Poplar Forest	popbal-picgla-oxycam	shecan-elacom-hylspl-picgla-plesch cf-popba
WRST_T32_06_2004	7/22/2004	61.4824	-142.6016	U	0		Cl	N	30	Sfwp	Boreal Upland Tall Willow Shrub	salbeb-shecan	salala-shecan-popbal-pyrgra-drydru-potfru
WRST_T32_07_2004	7/22/2004	61.4834	-142.5971	U	d rock		Elu	Mrm	300	Fmosp	Boreal Upland White Spruce Forest	picgla-rosaci	hylspl-picgla-alncri-popbal-shecan-vibedu
WRST_T32_08_2004	7/22/2004	61.4869	-142.5876	U	d rock		Elu	Mrm	300	Fnows	Boreal Upland White Spruce Forest	picgla-rosaci	hylspl-picgla-shecan-alncri-pyrgra-geoliv
WRST_T32_09_2004	7/22/2004	61.4892	-142.5902	R	0		Fbrac	N	5	Sfwp	Boreal Riverine Gravelly Poplar Forest	popbal-drydru-oxycam	drydru-popbal-shecan-epilat-salala-oxycam
WRST_T34_01_2004	7/22/2004	61.4217	-143.7973	L	0		Ob	N	2	Bbg	Boreal Lowland Barrens	caraqu-potpal-salpul	caraqu
WRST_T34_02_2004	7/22/2004	61.4210	-143.7977	L	0		Ell	Fh	70	Stcw	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	salsco-ledgro-rosaci-hylspl-equpra-vacvit
WRST_T34_03_2004	7/22/2004	61.4218	-143.7991	L	0		Of	N	50	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	caraqu-moss-aulpal-potpal-scosco-calcan
WRST_T34_04_2004	7/22/2004	61.4216	-143.8001	L	2	19	Ell	N	50	Stow	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	ledgro-salbeb-aulpal-hylspl-arcrub-vacvit
WRST_T34_05_2004	7/22/2004	61.4223	-143.8031	L	1	25	Ob	Fh	45	Fnwbs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	hylspl-arcrub-vacvit-vaculi-chacal-myrgal
WRST_T34_06_2004	7/22/2004	61.4219	-143.8042	P	0		Wldim	W	0	W	Lowland Lake		spaang
WRST_T34_07_2004	7/22/2004	61.4211	-143.8054	L	0		Of	N	10	Slowg	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	caraqu-cardia-salbeb-myrgal-aultur-potpal
WRST_T35_01_2004	7/18/2004	61.5608	-142.5853	S	28	170	Ch	N	10	Sfop	Boreal Subalpine Poplar Forest	popbal-fesalt	popbal-epiang-herlan-equarv-delgla-salcom
WRST_T35_02_2004	7/18/2004	61.5582	-142.5858	S	20	160	Elu	N	15	Sfop	Boreal Subalpine Poplar Forest	popbal-fesalt	popbal-betnan-vibedu-agrsca-corcan-epiang
WRST_T35_03_2004	7/18/2004	61.5580	-142.5833	U	30	115	Elu	N	25	Stca	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-ribtri-moelat-equarv-epiang-eurpul
WRST_T35_04_2004	7/18/2004	61.5583	-142.5815	U	36	111	Elu	N	25	Stca	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-ribtri-calcan-salbar1-vibedu-artarc1
WRST_T35_05_2004	7/18/2004	61.5581	-142.5729	U	9	120	Elu	Ml	30	Fmosp	Boreal Upland White Spruce Forest	picgla-rosaci	equpra-picgla-popbal-alnten-petfri-calcan
WRST_T35_06_2004	7/18/2004	61.5591	-142.5624	L	0		Of	Ms	25	Hgwsb	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	elepal-eriop-tomnit-scosco-sphmag-equarv
WRST_T35_07_2004	7/18/2004	61.5590	-142.5639	P	0		Wlsim	W		Hafp	Lowland Lake		potam-myrio-carlep
WRST_T36_01_2004	7/20/2004	61.5089	-143.4602	S	6	220	Elu	Fh	30	Slcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salbar1-salret-salpul-equarv-betnan-salcom
WRST_T36_02_2004	7/20/2004	61.5064	-143.4569	S	8	220	Elu	Fh	30	Stcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salbar1-corcan-salbeb-salpul-sanoff-artarc1
WRST_T36_03_2004	7/20/2004	61.5044	-143.4544	U	15	200	Elu	Fh	30	Stcaw_dt	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alnsin-salbar1-equarv-corcan-arttil-merpan
WRST_T36_04_2004	7/20/2004	61.5026	-143.4531	U	20	200	Elu	Mt	30	Stca_dt	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alnsin-corcan-ribtri-salbar1-hylspl-picgla
WRST_T36_05_2004	7/20/2004	61.4987	-143.4516	L	18	180	Ch	Mu	40	Fnwws	Boreal Lowland White Spruce Forest	picgla-vaculi	equarv-tomnit-hylspl-sphag-arcrub-picgla
WRST_T36_06_2004	7/20/2004	61.4967	-143.4496	L	4	30	Of	Tm	40	Slowg	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	salpul-potpal-sphag-betgla-caraqu-potfru
WRST_T36_07_2004	7/20/2004	61.4952	-143.4448	P	0		L	Tm	40	Hgmb	Boreal Lacustrine Sedge Meadow	caraqu-potpal-salpul	calcan-equflu-caraqu-rhizo1-trieur3-viola
WRST_T36_08_2004	7/20/2004	61.4953	-143.4453	P	0		Wlscv	W	0	W	Lowland Lake		hipvul-utrvul
WRST_T37_01_2004	7/20/2004	60.7388	-142.3776	S	3	135	Elu	N	25	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	empnig-salpul-betgla-vaculi-calcan-gymdry
WRST_T37_02_2004	7/20/2004	60.7363	-142.3737	U	24	162	Ch	N	15	Stcaw	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	salpul-alncri-gymdry-ribtri-salala-actrub
WRST_T37_03_2004	7/20/2004	60.7355	-142.3735	S	25	215	Ch	N	20	Stcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salpul-valcap-betgla-calcan-gymdry-sansti
WRST_T37_04_2004	7/20/2004	60.7327	-142.3731	L	0		Of	N	10	Hgwst	Boreal Lacustrine Sedge Meadow	carsax-eriang	eriang-epipal-andpol-moss-sphag
WRST_T37_05_2004	7/20/2004	60.7325	-142.3726	L	0		Fs	N	35	Slobb	Boreal Lowland Low Birch-Willow Shrub	betnan-salpul-leddec	sphag-vaculi-empnig-betgla-salpul-rubcha

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T37_06_2004	7/20/2004	60.7303	-142.3681	S	24	230	Ch	Mrm	20	Slobe	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	arcuva-empnig-betgla-vaculi-stere-juncom
WRST_T37_07_2004	7/20/2004	60.7303	-142.3632	S	nd		Gmo	N	10	Slobe	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	arcuva-betgla-racom-stere-vaculi-empnig
WRST_T38_01_2004	7/18/2004	61.7147	-142.4982	A	29	225	Ct	Mrb	25	Bbg	Boreal Alpine Barrens	salpol-artarc1	salpol-salala-trispi-saxbro-salarc-poaarc
WRST_T38_02_2004	7/18/2004	61.7144	-142.4989	A	24	260	Ch	Mrm	30	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	salpol-artarc1	salpol-stere-cetisl1-lichc-dryoct-dicra1
WRST_T38_03_2004	7/18/2004	61.7122	-142.5054	A	18	222	Ffb	Mrm	60	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	salpol-artarc1	salpol-lichc-cetisl1-carex-clado-dicra1
WRST_T38_04_2004	7/18/2004	61.7103	-142.5113	A	10	225	Elu	Fh	80	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	salpol-artarc1	salpol-aneric-artarc1-aulpal-poten-trispi
WRST_T38_05_2004	7/18/2004	61.7032	-142.5174	A	1	305	L	N	5	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	calli-meetri-caraqu-equflu-potpal-calli
WRST_T38_06_2004	7/18/2004	61.7031	-142.5119	S	3	270	Ffi	Fh	10	Hfmm	Boreal Subalpine Forb Meadow	artarc1-fesalt-valcap	epiang-epilat-equarv-empnig-fesalt-artarc1
WRST_T39_01_2004	7/20/2004	61.6607	-143.6154	A	25	190	Ch	Mrb	0	Bpv	Boreal Alpine Barrens	dryint-oxynig-arcrub	dryint-casste-thaver-salpol-alect-calpur
WRST_T39_02_2004	7/20/2004	61.6585	-143.6174	A	25	200	Ch	Mrb	0	Sddl	Boreal Alpine Dryas Dwarf Shrub	dryint-oxynig-arcrub	dryint-vaculi-potfru-rhyrug-fesalt-panna
WRST_T39_03_2004	7/20/2004	61.6576	-143.6194	A	32	250	Ch	Fh	30	Sdec	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	castet-dryoct-vaculi-empnig-salret-cladi
WRST_T39_04_2004	7/20/2004	61.6564	-143.6225	S	17	225	Ch	Fh	15	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-salgla-linbor-vaculi-fesalt-vaculi
WRST_T39_05_2004	7/20/2004	61.6574	-143.6270	S	28	240	Ch	Mu	30	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-empnig-salgla-salpul-vaculi-plesch
WRST_T39_06_2004	7/20/2004	61.6571	-143.6316	L	0		Gfob	N	0	Slow	Boreal Lowland Low Birch-Willow Shrub	betnan-salpul-leddec	salmyr-aulpal-fesalt-salpul-epiang-hylsp
WRST_T40_01_2005	7/11/2005	61.7223	-141.3468	R	0	0	Wrug	W	0	W	Glacial River		Water
WRST_T40_02_2005	7/11/2005	61.7220	-141.3482	R	0	0	Fbrac	Ds	30	Bbg	Boreal Riverine Circumalkaline Barrens	epilat-salala	popbal-salala-hedalp-salgla-luparc-agrop
WRST_T40_03_2005	7/11/2005	61.7195	-141.3481	R	0	0	Fbrac	N	5	Sddl	Boreal Riverine Dryas Dwarf Shrub	drydru-oxycam	drydru-sanunc-popbal-arcuva-salala-stere
WRST_T40_04_2005	7/11/2005	61.7201	-141.3446	R	0	0	Fbric	N	10	Fmosp	Boreal Riverine Spruce-Poplar Forest	popbal-picgla-oxycam	popbal-picgla-oxycam-shecan-arcuva-hedmac
WRST_T40_05_2005	7/11/2005	61.7152	-141.3396	R	0	0	Fbric	Ds	40	Fbop	Boreal Riverine Gravelly Poplar Forest	popbal-drydru-oxycam	shecan-popbal-drydru-arcuva-thuidium-cladc
WRST_T40_06_2005	7/11/2005	61.7120	-141.3303	R	0	0	Fmoi	N	10	Fnows	Boreal Riverine White Spruce Forest	picgla-hedalp	hylspl-luparc-picgla-hedalp-arcrub-pyrsec1
WRST_T40_07_2005	7/11/2005	61.7164	-141.3228	R	0	0	Fboi	N	10	Fnows	Boreal Riverine White Spruce Forest	picgla-hedalp	hylspl-picgla-shecan-hedalp-luparc-arcrub
WRST_T40_08_2005	7/11/2005	61.7159	-141.3180	L	0	0	Fbob	Ml	40	Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-picgla-empnig-vacvit-thuidium-vacul
WRST_T40_09_2005	7/11/2005	61.7155	-141.3150	L	0	0	Ell	Fh	20	Fnwws	Boreal Lowland White Spruce Forest	picgla-vaculi	tomnit-aulpal-picgla-erivag-betnan-rubcha-vacvit
WRST_T41_01_2005	7/11/2005	61.8067	-141.3843	S	12	140	Ch	N		Hgdgs	Boreal Subalpine Sagebrush Meadow	artfri-calpur-linper	eriper-potuni-oxyvis-artfri-oxynig-artem
WRST_T41_02_2005	7/11/2005	61.8069	-141.3837	S	12	120	Ch	Mrs	5	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-salgla-vacvit-arcrub-tomnit-vaculi
WRST_T41_03_2005	7/11/2005	61.8065	-141.3823	S	30	110	Ch	N		Fbop	Boreal Subalpine Poplar Forest	popbal-fesalt	arcuva-popbal-epiang-shecan-rosaci-astsib
WRST_T41_04_2005	7/11/2005	61.8047	-141.3793	L	2	190	Ffb	Mpm	30	Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-ledgro-picgla-arcrub-tomnit-stere
WRST_T41_05_2005	7/11/2005	61.8008	-141.3788	L	0	0	Gmo	Mpm	25	Sfwws	Boreal Lowland White Spruce Forest	picgla-vaculi	betnan-picgla-salret-tomnit-hylspl-drepa
WRST_T41_06_2005	7/11/2005	61.7986	-141.3698	L	0	0	Ell	N		Slott	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	erivag-betnan-salpul-hypnu-tomnit-aulpa
WRST_T41_07_2005	7/11/2005	61.7994	-141.3698	U	18	170	Gmo	N		Stow	Boreal Upland Tall Willow Shrub	salbeb-shecan	arcuva-epiang-salbeb-arcrub-salgla-fesalt
WRST_T42_01_2005	7/10/2005	61.6840	-141.6884	A	36	115	Ct		20	Bpv	Boreal Alpine Barrens	racom-carmic1	potbif-poa-draba-sauvis-fesrub-trispi
WRST_T42_02_2005	7/10/2005	61.6847	-141.6874	A	10	130	Ch	Mrb	10	Sddl	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-bryum-poa-saxbro-salarc-thaver
WRST_T42_03_2005	7/10/2005	61.6872	-141.6838	A	15	55	Ch	Fh	30	Sdec	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	castet-salpol-dryala-dryoct-dicra1-empnig
WRST_T42_04_2005	7/10/2005	61.6920	-141.6799	A	34	28	Ch	Mg	30	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryala-castet-carpod-epilat-poa-anepar

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T42_05_2005	7/10/2005	61.6940	-141.6794	S	17	50	Ffi	Ds	150	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salala-empnig-shecan-dryoct-salgla-salric
WRST_T42_06_2005	7/10/2005	61.6950	-141.6771	S	2	195	Fs	N	10	Slcb	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-empnig-salpul-hylspl-fesalt-hedalp
WRST_T42_07_2005	7/10/2005	61.6967	-141.6713	A	5	180	Ch		30	Hgmsd	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	tomnit-dryoct-rhyti1-salret-carbig-equarv
WRST_T43_01_2005	7/10/2005	61.8813	-141.7526	A	22	50	Ch	Fh	15	Sdec	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	castet-dryoct-tomnit-stere-vaculi-brach
WRST_T43_02_2005	7/10/2005	61.8813	-141.7553	S	4	350	Ch	Fh	22	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salret-salpul-ditfle-carbig-tomnit-aultur
WRST_T43_03_2005	7/10/2005	61.8804	-141.7531	A	8	190	Ch	Mrs	10	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryint-oxynig-arcrub	dryint-salarc-lichc-stere-hedalp-thaver
WRST_T43_04_2005	7/10/2005	61.8786	-141.7480	S	5	100	Ch	Fh	20	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	tomnit-salret-betnan-carbig-drepa-hylspl
WRST_T43_05_2005	7/10/2005	61.8773	-141.7430	S	8	110	Ch	Fh	25	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	vaculi-salgla-tomnit-betnan-drepa-salret
WRST_T43_06_2005	7/10/2005	61.8749	-141.7318	A	0	0	Of	Fh	15	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	caraqu-caratr1-eriang-scosco-carbig-aultur
WRST_T43_07_2005	7/10/2005	61.8760	-141.7279	S	0	0	Ltnm	Mpm	20	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-bryum-dicra1-tomnit-carbig-sphag
WRST_T43_08_2005	7/10/2005	61.8772	-141.7260	A	0	0	Wlsit	W		W	Alpine Lake		Water
WRST_T44_01_2005	7/9/2005	61.9826	-141.5755	A	5	348	Ch	N	20	Hgmss	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	raclan-moss-salret-carbig-fesalt-kobmyo
WRST_T44_02_2005	7/9/2005	61.9827	-141.5713	S	290	2	Ch	Fh	40	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	carbig-salpul-moss-salret-aultur-betgla
WRST_T44_03_2005	7/9/2005	61.9810	-141.5670	A	5	147	Ch	Mrs	45	Sdds	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-moss-liche-raclan-fesalt-flaniv
WRST_T44_04_2005	7/9/2005	61.9789	-141.5586	S	12	98	Ch	N	20	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-moss-carbig-salret-vaculi-salgla
WRST_T44_05_2005	7/9/2005	61.9770	-141.5498	S	8	130	Ch	N	60	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	carbig-betgla-moss-salpul-vacvit-salgla
WRST_T45_01_2005	7/11/2005	62.0906	-141.5162	A	6	270	Ct	N	10	Hbbd	Boreal Alpine Barrens	racom-carmic1	lichc-raclan-solcro-umbpro-aleoch-moss
WRST_T45_02_2005	7/11/2005	62.0893	-141.5142	A	0	76	Ch	N	10	Hbbd	Boreal Alpine Barrens	racom-carmic1	racom-thamn-lichc-moss-clado-alooch
WRST_T45_03_2005	7/11/2005	62.0889	-141.5107	A	25	230	Ch	Mrb		Hgmswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carmic1-salrot	carmic1-salrot-raclan-oxynig-kobmyo-oxysca
WRST_T45_04_2005	7/11/2005	62.0878	-141.5078	A	2	185	Ch	N	10	Hgmswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carmic1-salrot	carmic1-salrot-sauvis-eriang-saxdav-raclan
WRST_T45_05_2005	7/11/2005	62.0839	-141.4956	A	13	170	Ch	Mrs	80	Sdds	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-stere-racom-carmic1-thamn-kobmyo
WRST_T45_06_2005	7/11/2005	62.0818	-141.4959	R	0	0	Fhm	Dc	20	Bpv	Boreal Riverine Circumalkaline Barrens	epilat-salala	epilat-raccan-salrot-steala-salala-trispi
WRST_T45_07_2005	7/11/2005	62.0797	-141.4894	A	0	0	Ct	Mrb	50	Hbbd	Boreal Alpine Barrens	racom-carmic1	raclan-stere-claste-clasty-psemin-umbil
WRST_T45_08_2005	7/11/2005	62.0788	-141.4883	G	8	120	Gmy	Mrb	70	Sddt	Boreal Glaciated Dryas Dwarf Shrub	dryoct-hiealp-sauvis	raclan-dryoct-salrot-carmic1-clamit-aleoch
WRST_T46_01_2005	7/13/2005	62.0686	-142.0411	P	0	0	L	N		Hgwsl	Boreal Lacustrine Sedge Meadow	carutr-potpal	carsax-carutr-caratr1-calli-carvir-juncu
WRST_T46_02_2005	7/13/2005	62.0682	-142.0392	L	1	290	Gmo	Mpm	10	Slobw	Boreal Lowland Low Birch-Willow Shrub	betnan-salpul-leddec	eriang-betnan-salpul-moss-aulpal-salmyr
WRST_T46_03_2005	7/13/2005	62.0683	-142.0485	L	0	0	Gfob	N		Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-picgla-luparc-shecan-plesch-arcrub
WRST_T47_01_2005	7/10/2005	62.1109	-142.1858	S	9	278	Gmo	Mu	30	slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-salgla-moss-arcuva-arcrub-vacvit
WRST_T47_02_2005	7/10/2005	62.1121	-142.1829	A	1	240	Gmo	N	20	Hgwswt	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	caraqu-carbig-salret-betgla-tomnit-carsax
WRST_T47_03_2005	7/10/2005	62.1126	-142.1814	S	5	270	Gmo	Mu	45	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-salgla-carbig-vacvit-moss-dryint
WRST_T47_04_2005	7/10/2005	62.1131	-142.1782	S	12	220	Gmo	N	5	Sdeb	Boreal Alpine Ericaeous Dwarf Shrub	empnig-artarc1	kobmyo-arcuva-calpur-oxyvis-salgla-artfri
WRST_T47_05_2005	7/10/2005	62.1171	-142.1805	S	32	200	Gmo	N	10	Hgdgs	Boreal Subalpine Sagebrush Meadow	artfri-calpur-linper	ericae-artfri-carobt-calpur-potpen-agrop
WRST_T47_06_2005	7/10/2005	62.1178	-142.1764	S	7	60	Gmo	Mu	30	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-salgla-carbig-arcrub-salret-dryint
WRST_T47_07_2005	7/10/2005	62.1186	-142.1681	A	9	60	Ch	Ml	45	Sddf	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	equarv-dryint-tomnit-salret-carsci-salgla

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T48_01_2005	7/9/2005	62.2453	-141.7787	A	28	210	Ch	Mrs	10	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-salret-rhyrug-vaculi-fesalt-saxtri
WRST_T48_02_2005	7/9/2005	62.2452	-141.7784	A	28	110	Ch	Mrs	10	Sdet	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	castet-dryoct-vaculi-tomnit-stetom-salret
WRST_T48_03_2005	7/9/2005	62.2427	-141.7757	S	28	130	Ch	Mrs	10	Slobe	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-vaculi-arcuva-tomnit-dryoct-polyt
WRST_T48_04_2005	7/9/2005	62.2418	-141.7721	S	20	165	Ch	Mrs	15	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	arcuva-vaculi-fesalt-salgla-vacvit-salbeb
WRST_T50_01_2005	7/12/2005	62.4060	-141.7052	R	0	0	Wrug	W		W	Glacial River		Water
WRST_T50_02_2005	7/12/2005	62.4061	-141.7057	R	0	0	Fbrac	Ds	40	Bbg	Boreal Riverine Circumalkaline Barrens	epilat-salala	hylspl-epilat-picgla
WRST_T50_03_2005	7/12/2005	62.4059	-141.7086	R	0	0	Fboa	Ds	40	Stcaw	Boreal Riverine Tall Alder Shrub	alnten-calcan	alnten-salarb-merpan-salric-arttil-brach
WRST_T50_04_2005	7/12/2005	62.4053	-141.7103	R	0	0	Fboi	Ds	40	Fbop	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-alnten-picgla-rosaci-merpan-shecan
WRST_T50_05_2005	7/12/2005	62.4058	-141.7138	R	0	0	Fbric	N		Fnwws	Boreal Riverine White Spruce Forest	picgla-hedalp	shecan-dryint-drydru-dicra1-picgla-stere
WRST_T50_06_2005	7/12/2005	62.4073	-141.7144	L	0	0	Fbob	Mu	30	Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	plesch-hylspl-empnig-vacvit-picgla-pticri
WRST_T50_07_2005	7/12/2005	62.4079	-141.7092	L	0	0	Fbrb	Ds	40	Fnwws	Boreal Lowland White Spruce Forest	picgla-vaculi	shecan-cladi-picgla-dryint-drydru-dicra1
WRST_T50_08_2005	7/12/2005	62.4076	-141.7081	R	0	0	Fbric	N	30	Fmosp	Boreal Riverine Spruce-Poplar Forest	popbal-picgla-oxycam	picgla-shecan-hylspl-popbal-dryint-rosac
WRST_T52_01_2005	7/9/2005	62.4306	-141.3961	U	20	240	Ch	Ml	20	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	betpap-hylspl-picgla-alncri-vacvit-ledgro
WRST_T52_02_2005	7/9/2005	62.4291	-141.3946	U	32	275	Ch	Ml	30	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	hylspl-picgla-betpap-vacvit-alncri-equarv
WRST_T52_03_2005	7/9/2005	62.4284	-141.3963	L	8	255	Fs	Fh	30	Sfobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	picmar-equsyl-plesch-vaculi-hylspl-vacvi
WRST_T52_04_2005	7/9/2005	62.4273	-141.3987	L	0	0	Ell	Fh	30	Sfobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	picmar-erivag-leddec-rubcha-vacvit-vaculi
WRST_T52_05_2005	7/9/2005	62.4287	-141.3997	L	0	0	Of	N	5	Hgwsb	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	tricae-carade-scosco-betnan-eriang-junsty
WRST_T52_06_2005	7/9/2005	62.4288	-141.4004	P	0	0	Of	N	0	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	eriang-mentri-carbux-carlas-myrsib
WRST_T52_07_2005	7/9/2005	62.4289	-141.4007	P	0	0	Wldit	W		W	Lowland Lake		Water
WRST_T53_01_2005	7/12/2005	62.2653	-142.4851	A	5	210	Ch	Mrb		Bpv	Boreal Alpine Alkaline Barrens	dryoct-hiealp-sauvis	dryoct-lichc-pertu-saxopp-flacuc-oxyhuc
WRST_T53_02_2005	7/12/2005	62.2647	-142.4844	A	5	50	Ch	Mrb		Sdec	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	castet-dryoct-moss-silaca-lichc-salpol
WRST_T53_03_2005	7/12/2005	62.2629	-142.4839	A	17	150	Ch	Mrb		Bpv	Boreal Alpine Alkaline Barrens	dryoct-hiealp-sauvis	dryoct-lichc-flaniv-vulpi-ochro-thaver
WRST_T53_04_2005	7/12/2005	62.2620	-142.4830	A	6	220	Ch	N		Sdds	Boreal Alpine Alkaline Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-flaniv-carsci-silaca-lichc-thaver
WRST_T53_05_2005	7/12/2005	62.2625	-142.4799	A	25	80	Ch	Mrs	10	Sddt	Boreal Alpine Alkaline Dryas Dwarf Shrub	dryint-oxynig-arcrub	dryint-castet-flaniv-cetisl2-hedalp-salret
WRST_T53_06_2005	7/12/2005	62.2629	-142.4773	A	17	100	Ch	Mrs	8	Sdet	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	castet-dryint-arcrub-cetisl2-luparc-salret
WRST_T53_07_2005	7/12/2005	62.2619	-142.4749	A	2	150	Ch	Fh	10	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	salret-dryala-hedalp-fesalt-tomnit-carmem
WRST_T55_01_2005	7/13/2005	62.3876	-143.0215	A	0	0	Ch	N	20	Slott	Boreal Alpine Tussock Meadow	erivag-salpul-polbis	erivag-moss-betgla-dryoct-salpul-vaculi
WRST_T55_02_2005	7/13/2005	62.3886	-143.0211	A	22	358	Ch	Mu	30	Sdec	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	erivag-castet-dryoct-thurec-vaculi-dryala
WRST_T55_03_2005	7/13/2005	62.3903	-143.0170	A	50	130	Ct	Mrs	30	Sddt	Boreal Alpine Alkaline Dryas Dwarf Shrub	dryint-oxynig-arcrub	dryint-castet-lichc-arcrub-poagla-hedhed
WRST_T55_04_2005	7/13/2005	62.3911	-143.0148	S	30	65	Ch	Ml	20	Fnwws	Boreal Subalpine Spruce Woodland	picgla-vaculi	hylspl-geoliv-liche-castet-vacvit-alncri
WRST_T55_05_2005	7/13/2005	62.3916	-143.0084	U	9	75	Ch	N	30	Fnwws	Boreal Upland White Spruce Forest	picgla-rosaci	equarv-tomnit-hylspl-plesch-ledgro-picgla
WRST_T55_10_2005	7/13/2005	62.3945	-142.9921	L	3	190	Ell	N	10	Slott	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	sphag-betnan-erivag-picgla-tomnit-hylspl
WRST_T56_01_2005	7/12/2005	62.2407	-143.0843	A	0	333	Ch	Mrb	20	Hbbd	Boreal Alpine Barrens	racom-carmic1	raclan-aleoch-clasty-claarb-umbpro-psemin
WRST_T56_02_2005	7/12/2005	62.2313	-143.0932	A	11	190	Ch	N	35	Hgmt	Boreal Alpine Tussock Meadow	erivag-salpul-polbis	carsty-erivag-salix-salret-petfri-claarb

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T56_03_2005	7/12/2005	62.2290	-143.0960	A	6	355	Ch	Mi	25	Hgmswt	Boreal Alpine Sedge-Dwarf Willow Meadow	eriang-caraqu-salpul	carsty-eriang-caraqu-petfri-carex-tomnit
WRST_T56_04_2005	7/12/2005	62.2266	-143.0995	A	5	265	Cs	Ms	25	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	carsty-epiang-tomnit-aultur-cetisl2-erivag
WRST_T56_05_2005	7/12/2005	62.2226	-143.1101	A	0	0	Ch	Mrb	15	Hgmss	Boreal Alpine Sedge-Dwarf Willow Meadow	carmic1-salrot	raclan-carmic1-claarb-cetisl2-clasty-salix
WRST_T56_06_2005	7/12/2005	62.2222	-143.1098	A	0	0	Wlsim	W	0	W	Alpine Lake		eriang-water-moss-caraqu-carsty-erisch
WRST_T56_07_2005	7/12/2005	62.2201	-143.1145	A	212	4	Of	Ff	20	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	carsty-tomnit-claarb-clado-aultur-cetisl2
WRST_T56_08_2005	7/12/2005	62.2185	-143.1178	A	2	290	Of	Plll	25	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	caraqu-carmem-carsty-erisch-palsqu-claarb
WRST_T56_09_2005	7/12/2005	62.2079	-143.1190	A	6	250	Ch	N	20	Hgmt	Boreal Alpine Tussock Meadow	erivag-salpul-polbis	erivag-eriang-carsty-salix-sphag-clasty
WRST_T56_10_2005	7/12/2005	62.2059	-143.1150	A	11	312	Gmo	Mrs	5	Hbbd	Boreal Alpine Barrens	racom-carmic1	raclan-aleoch-clasty-claste-cetisl2-luzul
WRST_T58_01_2005	7/15/2005	62.4800	-143.5003	L	1	80	Of	Ms	20	Hgwsb	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	erivag-tricae-eriang-calli-erirus-cladi
WRST_T58_02_2005	7/15/2005	62.4800	-143.5058	L	333	333	Fs	Fh		Slobe	Boreal Lowland Low Birch-Willow Shrub	betnan-salpul-leddec	arcrub-sphag-betnan-vacvit-plesch-empnig
WRST_T58_03_2005	7/15/2005	62.4792	-143.5081	L	5	60	Gmo	Mg	40	Sfwbs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	vaculi-hylspl-empnig-arcrub-betnan-polstı
WRST_T58_04_2005	7/15/2005	62.4820	-143.5101	S	12	255	Gmo	Mg	40	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-vaculi-hylspl-vacvit-carbig-rhyrug
WRST_T58_05_2005	7/15/2005	62.4839	-143.5167	S	20	55	Cs	Mg	40	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-hylspl-leddec-plesch-vaculi-vacvit
WRST_T58_06_2005	7/15/2005	62.4799	-143.5143	L	2	90	Gmo	Fh	20	Hgmt	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	sphfus-erivag-betnan-arcalp-empnig-sphag
WRST_T58_07_2005	7/15/2005	62.4779	-143.5158	U	15	150	Gmo	Mg	3024	Fnows	Boreal Upland White Spruce Forest	picgla-rosaci	vaculi-picgla-betnan-empnig-hylspl-cladc
WRST_T60_01_2005	7/15/2005	62.6418	-143.9226	L	1	358	Gmo	N	30	Hgmt	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	sphfus-betnan-erivag-empnig-sphag-plesch
WRST_T60_02_2005	7/15/2005	62.6422	-143.9226	L	0	0	Of	N	0	Hgwfs	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	carros-utric-drepa-potpal-equflu
WRST_T60_03_2005	7/15/2005	62.6418	-143.9247	U	18	110	Esi	N		Fbob	Boreal Upland Birch Forest	bethum-ledgro	hylspl-ledgro-bethum-empnig-betgla-vacul
WRST_T60_04_2005	7/15/2005	62.6416	-143.9262	L	0	0	Esi	N	10	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	picmar-hylspl-moss-claarb-betnan-leddec
WRST_T60_05_2005	7/15/2005	62.6391	-143.9240	L	1	280	Of	Dt	20	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	sphag-eriang-rhyrug-potfru-drepa-erivag
WRST_T60_06_2005	7/15/2005	62.6387	-143.9245	L	2	283	Ob	N	25	Slotb	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	sphfus-sphag-leddec-betnan-empnig-erivag
WRST_T60_07_2005	7/15/2005	62.6375	-143.9255	L	5	10	Gmo	N	25	Fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	sphag-picmar-hylspl-empnig-salpul-tomni
WRST_T60_08_2005	7/15/2005	62.6381	-143.9271	L	0	0	Of	N	0	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	drepa-caraqu-potpal-carros-galtri1
WRST_T61_01_2005	7/15/2005	62.6930	-144.0021	R	0	0	Fbric	N	10	Bpv	Boreal Riverine Circumalkaline Barrens	epilat-salala	raccan-stere-epilat-pelti-polyt-alnten
WRST_T61_02_2005	7/15/2005	62.6938	-144.0093	L	0	0	Fbob	N	25	Fnwws	Boreal Lowland White Spruce Forest	picgla-vaculi	equarv-hylspl-empher-salgla-alnten-picgla
WRST_T61_03_2005	7/15/2005	62.6952	-144.0104	R	0	0	Fmoa	Ds	15	Stca	Boreal Riverine Tall Alder Shrub	alnten-calcan	alnten-calcan-equarv-rubarc1-arttil-vioepi
WRST_T61_04_2005	7/15/2005	62.6957	-144.0095	R	0	0	Fbrac	N	5	Fbop	Boreal Riverine Tall Alder Shrub	alnten-calcan	popbal-alnten-moss-stere-raccan-hedalp
WRST_T61_05_2005	7/15/2005	62.6942	-144.0124	R	0	0	Fboa	Ds	40	Slow	Boreal Riverine Loamy Willow Shrub	salpul-calcan	calcan-salpul-vaculi-tomnit-alnten-sphag
WRST_T61_06_2005	7/15/2005	62.6934	-144.0180	R	333	333	Fbric		50	Sloe	Boreal Riverine Loamy Willow Shrub	salpul-calcan	calcan-vaculi-carmed-potfru-salpul-myrgal
WRST_T62_01_2005	7/17/2005	62.4324	-144.8933	R	0	0	Fbrac	Ds	60	Bpv	Boreal Riverine Circumalkaline Barrens	epilat-salala	salala-caline-vaculi-potpal-agros-alnten
WRST_T62_02_2005	7/17/2005	62.4324	-144.8929	R	0	0	Fboa	N	20	Stoaw	Boreal Riverine Tall Alder Shrub	alnten-calcan	alnten-equarv-salarb-salala-salmon-salric
WRST_T62_03_2005	7/17/2005	62.4330	-144.8917	R	0	0	Fboi	N	15	Fbop	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-alnten-rubarc1-equarv-calcan-salmon
WRST_T62_04_2005	7/17/2005	62.4325	-144.8901	L	0	0	Fbob	Ml	30	Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-empnig-picgla-ledgro-salgla-vacvit
WRST_T62_05_2005	7/17/2005	62.4306	-144.8888	P	0	0	Ltnm	N	0	Hfwfh	Boreal Lacustrine Sedge Meadow	carutr-potpal	equflu-scosco-carutr-potgra-carcho-hipvul

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T62_06_2005	7/17/2005	62.4303	-144.8888	P	0	0	Ltnm	Mi	30	Hgwsl	Boreal Lacustrine Sedge Meadow	carutr-potpal	carutr-potpal-potdiv-caline-equflu-galiu
WRST_T63_01_2005	7/16/2005	62.3388	-144.8166	P	0	0	L	N	5	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	sphag-carsax-eriang-caraqu-carutr
WRST_T63_02_2005	7/16/2005	62.3387	-144.8196	P	2	270	L	N	5	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	sphag-carsax-eriang-potpal-potam-caline
WRST_T63_03_2005	7/16/2005	62.3381	-144.8169	P	0	0	L	N	10	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	sphag-eriang-caraqu-scosco-potpal-carsax
WRST_T63_04_2005	7/16/2005	62.3371	-144.8151	L	3	348	Ell	N	30	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salpul-rubcha	hylspl-picmar-moss-betnan-salgla-salpu
WRST_T63_05_2005	7/16/2005	62.3378	-144.8154	L	2	360	Ell	Mi	35	Slott	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	sphag-betnan-picmar-erivag-vaculi-moss
WRST_T63_06_2005	7/16/2005	62.3364	-144.8119	L	4	250	L	N	45	Slotb	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	betnan-erivag-vaculi-sphag-moss-picmar
WRST_T63_07_2005	7/16/2005	62.3358	-144.8138	L	0	0	Of	N	10	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	petfri-carros-eriang-caraqu-carutr-moss
WRST_T63_08_2005	7/16/2005	62.3360	-144.8092	L	4	330	Gmo	N	20	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	hylspl-picmar-vaculi-ledgro-salgla-petfri
WRST_T63_09_2005	7/16/2005	62.3352	-144.8048	L	0	0	Ob	N	20	Slotb	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	betnan-erivag-hylspl-moss-vaculi-leddec
WRST_T63_10_2005	7/16/2005	62.3335	-144.7996	L	0	0	Gmo	N	45	Slott	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	betnan-erivag-hylspl-ledgro-moss-vaculi
WRST_T63_11_2005	7/16/2005	62.3350	-144.7975	L	0	0	Ob	N		Slotb	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	caraqu-erivag-sphag-betnan-vaculi-leddec
WRST_T64_01_2005	7/17/2005	62.2981	-144.6169	S	2	280	Elu	Fn	30	Fnwws	Boreal Subalpine Spruce Woodland	picgla-vaculi	betgla-equpra-hylspl-plesch-vacvit-salpul
WRST_T64_02_2005	7/17/2005	62.2982	-144.6180	S	15	70	Elu	Mg	40	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	plesch-hylspl-betgla-salgla-carbig-leddec
WRST_T64_03_2005	7/17/2005	62.2974	-144.6136	A	2	270	Of	N	5	Hgwsb	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	tricae-carrot-eriang-aulpal-sphfus-erirus
WRST_T64_04_2005	7/17/2005	62.2949	-144.6185	S	23	220	Gmo	Mg	30	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-vaculi-salgla-plesch-hylspl-leddec
WRST_T64_05_2005	7/17/2005	62.2951	-144.6203	P	1	10	L	N	10	Hgwsl	Boreal Lacustrine Sedge Meadow	caraqu-potpal-salpul	caraqu-scosco-drepa-calli-eleaci-equarv
WRST_T64_06_2005	7/17/2005	62.2958	-144.6217	A	0	0	Wldim	W		W	Alpine Lake		caraqu-scosco-eleaci-equarv-isoet-junalp
WRST_T64_07_2005	7/17/2005	62.2970	-144.6227	P	0	0	Wlsim	W		Hafl	Boreal Lacustrine Pondlily	nuppol-spaang	nuppol-eriang-eleaci-spaang-carsax-elepal
WRST_T64_08_2005	7/17/2005	62.2964	-144.6303	L	0	0	Of	N		Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	eriang-erirus-scosco-carex-tricae-carrot
WRST_T65_01_2005	7/16/2005	62.2192	-144.4817	A	10	180	Gmo	N		Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-salarc-bryor-poten-thaver-pertu
WRST_T65_02_2005	7/16/2005	62.2189	-144.4793	A	20	110	Gmo			Sdet	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	dryoct-vaculi-arcalp-rholap-lichc-flaniv
WRST_T65_03_2005	7/16/2005	62.2177	-144.4782	A	0	0	L	N		Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	mnium-caraqu-calli-pohli-eriang-arclat
WRST_T65_04_2005	7/16/2005	62.2192	-144.4754	A	5	250	Ch	N		Sdds	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	salret-dryoct-salarc-carbig-lichc-dicra1
WRST_T65_05_2005	7/16/2005	62.2167	-144.4678	A	5	200	Gmo	Mrs		Sdds	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-salarc-rholap-lichc-cames-carbig
WRST_T65_06_2005	7/16/2005	62.2149	-144.4689	A	3	200	Of	Pmp	25	Hgmss	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	salret-carbig-bryum-rhyrug-hylspl-dryoct
WRST_T65_07_2005	7/16/2005	62.2114	-144.4715	A	8	200	Ch	N		Hgmss	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	salret-petfri-vaculi-fesalt-equarv-carex
WRST_T65_08_2005	7/16/2005	62.2115	-144.4725	A	8	190	Cs	Mg		Sdev	Boreal Alpine Ericaeous Dwarf Shrub	castet-pedcap	rhyrug-vaculi-bryum-equarv-tomnit-lichc
WRST_T65_09_2005	7/17/2005	62.2071	-144.4793	S	10	200	Ch	Mrs	20	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	vaculi-betnan-salgla-rhyrug-dryoct-salarc
WRST_T65_10_2005	7/17/2005	62.2041	-144.4786	S	8	205	Ch	N		Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-salgla-tomnit-vacvit-fesalt-rhyrug
WRST_T67_01_2005	7/16/2005	62.1270	-145.2993	L	0	0	Ob	Fh	30	Sfwbs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	caraqu-vaculi-salpul-betgla-chacal-tomnit
WRST_T67_02_2005	7/16/2005	62.1240	-145.2993	L	0	0	GLl	N	10	Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-corcan-picgla-linbor-vacvit-shecan
WRST_T67_03_2005	7/16/2005	62.1242	-145.2962	L	0	0	GLl	Fh	20	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	picmar-aulpal-ledgro-hylspl-tomnit-salmyr
WRST_T67_04_2005	7/16/2005	62.1231	-145.2926	L	0	0	Ell	Fh	20	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	ledgro-picmar-tomnit-aulpal-hylspl-vacvit

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T67_05_2005	7/16/2005	62.1229	-145.2889	U	7	250	Elu	N		Fboa	Boreal Upland Aspen Forest	poptre-picgla-rosaci	poptre-vacvit-empher-salbeb-ledgro-arcrub
WRST_T67_06_2005	7/16/2005	62.1240	-145.2861	L	0	0	Of	N	20	Slowg	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	salpul-caraqu-calli-eriang-potpal-carros
WRST_T67_07_2005	7/16/2005	62.1236	-145.2857	P	0	0	Of	N	0	Hgwfs	Boreal Lacustrine Sedge Meadow	caraqu-potpal-salpul	caraqu-carros-calli-utrmin-potpal-utrvul
WRST_T67_08_2005	7/16/2005	62.1231	-145.2852	P	0	0	Wlsit	W	0	Hgwfs	Boreal Lacustrine Sedge Meadow	carutr-potpal	elepal-calli-potfri-utrmin-utrvul-potalp
WRST_T67_09_2005	7/16/2005	62.1220	-145.2839	L	0	0	GLl	Fn	10	Fnobw	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	hylspl-vacvit-litter-ledgro-picmar-plesch
WRST_T68_01_2005	7/14/2005	61.8621	-145.0447	P	0	0	Wldim	W		Hafl	Boreal Lacustrine Pondlily	nuppol-spaang	nuppol-utrmin-utrvul-drerev-calli-caraqu
WRST_T68_02_2005	7/14/2005	61.8622	-145.0449	L	0	0	Of	N		Slocg	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	caraqu-calli-chacal-cardia-sphag-utrmin
WRST_T68_03_2005	7/14/2005	61.8622	-145.0420	L	0	0	Gfob	Fh		Fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	picmar-leddec-tomnit-hylspl-thurec-arcrub
WRST_T68_04_2005	7/14/2005	61.8548	-145.0342	U	28	130	Ch	N		Slosg	Boreal Upland Sagebrush Meadow	artfri-calpur-linper	artfri-agrop-oxytr-poten-potpen-rosaci
WRST_T68_05_2005	7/14/2005	61.8597	-145.0266	L	2	350	Fbob	Mpm	20	Fnobw	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	hylspl-picmar-picgla-vacvit-linbor-geoliv
WRST_T68_06_2005	7/14/2005	61.8613	-145.0184	U	17	220	Ch	N		Fboa	Boreal Upland Aspen Forest	poptre-picgla-rosaci	agrop-poagla-poptre-rosaci-arcuva-artfri
WRST_T69_01_2005	7/14/2005	61.9516	-144.7923	S	2	262	Gmo	Fc	10	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salpul-salric-salgla-carena-carros-carsty
WRST_T69_02_2005	7/14/2005	61.9517	-144.7928	A	0	0	Wlsim	W		W	Alpine Lake		sparg
WRST_T69_03_2005	7/14/2005	61.9480	-144.7958	S	0	0	Gmo	Fc	30	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salret-cladi-fesalt-salpul-claarb-stere
WRST_T69_04_2005	7/14/2005	61.9469	-144.7953	S	0	0	Gmo	N	5	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salric-salpul-junfil-carena-moss-salbeb
WRST_T69_05_2005	7/14/2005	61.9437	-144.7972	S	14	65	Gmo	N	10	Stcb	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-empnig-ledgro-salgla-vaculi-pelaph
WRST_T69_06_2005	7/14/2005	61.9435	-144.7941	S	0	0	Gmo	N	5	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salpul-stere-fesalt-salret-clado-betnan
WRST_T70_01_2005	7/14/2005	61.8005	-144.2724	A	0	0	Wldim	W		W	Alpine Lake		water
WRST_T70_02_2005	7/14/2005	61.8009	-144.2710	P	2	330	L	Mrb	30	Bpv	Boreal Lacustrine Barrens	carsax-eriang	cerpur-carsax-salpul-racom-salbar1-salgla
WRST_T70_03_2005	7/14/2005	61.8027	-144.2652	S	23	180	Elu	N	10	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-salsco-corcan-linbor-plesch-hylspl
WRST_T70_04_2005	7/14/2005	61.8024	-144.2768	S	1	90	Elu	N	10	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	stere-salbar2-arcuva-cetisl2-potfru-cladi
WRST_T70_05_2005	7/14/2005	61.7975	-144.2779	S	5	0	Elu	Fh	20	Stcb	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-corcan-hylspl-plesch-clasty-linbor
WRST_T70_06_2005	7/14/2005	61.7910	-144.2908	P	0	0	Of	N	10	Hgwst	Boreal Lacustrine Sedge Meadow	caraqu-potpal-salpul	caraqu-sphag-potpal-calli-drerev-salfus
WRST_T70_07_2005	7/14/2005	61.7909	-144.2906	A	0	0	Wldim	W		Hfwfh	Alpine Lake		mentri-carros-carlim-potam
WRST_T70_08_2005	7/14/2005	61.7912	-144.2917	S	2	90	L	Fn	30	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salpul-calcan-petfri-aulpal-sphag-salret
WRST_T71_01_2005	7/13/2005	62.6461	-143.7943	P	0	0	L	N	10	Hgwsl	Boreal Lacustrine Sedge Meadow	carutr-potpal	sphag-carutr-scosco-equarv-carsax
WRST_T71_02_2005	7/13/2005	62.6461	-143.7934	P	2	295	L	N	5	Hgmsgt	Boreal Lacustrine Sedge Meadow	carsax-eriang	equsyl-descae-equarv-carsax-carutr-arclat
WRST_T71_03_2005	7/13/2005	62.6492	-143.8109	P	0	0	Of	N	0	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	eriang-drepa-caraqu-potpal-carcan-sphsqu
WRST_T71_04_2005	7/13/2005	62.6495	-143.8115	L	0	0	Of	N		Hgwsb	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	scosco-camste1-carlim-carex-pohli-eriang
WRST_T73_01_2006	7/7/2006	61.9978	-141.1146	A	19	220	Ch	Mrs	10	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-arcuva-potfru-epiang-fesalt-merpan
WRST_T73_02_2006	7/7/2006	61.9965	-141.1162	S	9	163	Ch	Mu	15	fnwws	Boreal Subalpine Spruce Woodland	picgla-vaculi	betnan-salgla-picgla-vaculi-empnig-aulac
WRST_T73_03_2006	7/7/2006	61.9953	-141.1149	S	18	224	Ch	N	0	Fbop	Boreal Subalpine Poplar Forest	popbal-fesalt	popbal-fesalt-hedalp-dicra1-aulac-epiang
WRST_T73_04_2006	7/7/2006	61.9899	-141.1175	S	34	230	Ch	N	10	Fbop	Boreal Subalpine Poplar Forest	popbal-fesalt	popbal-epiang-rosaci-merpan-potfru-fesalt
WRST_T74_01_2006	7/8/2006	62.2888	-141.1693	P	0	0	Wlsi	W	0	W	Lowland Lake		arcful-myrspi-hipvul-potam-eleaci-utrvul

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T74_02_2006	7/8/2006	62.2889	-141.1692	P	0	51	L	N	10	Hgwst	Boreal Lacustrine Sedge Meadow	carutr-potpal	calcan-carutr-caraqu-potpal-geumac1-carrot
WRST_T74_03_2006	7/8/2006	62.2903	-141.1669	L	6	240	Ob	Mu	30	Sfwbs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	picmar-sphag-betnan-plesch-erivag-leddec
WRST_T74_04_2006	7/8/2006	62.2919	-141.1655	U	20	196	Ch	Mu	10	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	hylspl-vacvit-betpap-alncri-picgla-calcan
WRST_T74_05_2006	7/8/2006	62.2940	-141.1619	U	2	160	Ch	N	15	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	hylspl-vacvit-ledgro-betpap-picgla-alncri
WRST_T74_06_2006	7/8/2006	62.2954	-141.1544	U	28	262	Ch	N	20	Fbob	Boreal Upland Birch Forest	bethum-ledgro	ledgro-betpap-alncri-picgla-calcan-rosaci
WRST_T74_07_2006	7/8/2006	62.2904	-141.1539	L	28	335	Ch	N	30	Sfobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	sphag-picmar-hylspl-leddec-plesch-vacul
WRST_T74_08_2006	7/8/2006	62.2893	-141.1526	U	18	225	Ch	N	15	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	hylspl-ledgro-picgla-betpap-vacvit-rosaci
WRST_T75_01_2006	7/9/2006	62.5048	-141.7240	L	2	340	Ob	N	30	Sfwbs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	sphag-picmar-erivag-salpul-betnan-rubcha
WRST_T75_02_2006	7/9/2006	62.5042	-141.7227	L		338	Ell	N	35	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salpul-rubcha	picmar-moss-claran-ledgro-plesch-sphag
WRST_T75_03_2006	7/9/2006	62.5030	-141.7186	U	18	120	Gmo	N	10	Fbcb	Boreal Upland Birch Forest	bethum-ledgro	betpap-alncri-ledgro-vacvit-hylspl-geoliv
WRST_T75_04_2006	7/9/2006	62.5019	-141.7147	U	2	70	Gmo	N	15	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	betpap-alncri-equsyl-hylspl-picgla-picmar
WRST_T75_05_2006	7/9/2006	62.5001	-141.7101	P	0	0	L	N	5	Hgwsl	Boreal Lacustrine Sedge Meadow	carutr-potpal	carutr-sphagg-potpal-equflu-salpul-iriset
WRST_T75_06_2006	7/9/2006	62.5003	-141.7064	L	2	80	Ob	N	25	Fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	picmar-ledgro-betnan-sphag-plesch-rubcha
WRST_T76_01_2006	7/7/2006	62.4951	-142.6190	R	0	0	Wrug	W	0	w	Glacial River		water
WRST_T76_02_2006	7/7/2006	62.4952	-142.6192	R	0	0	Fbrac	N	10	Bbg	Boreal Riverine Circumalkaline Barrens	epilat-salala	hedmac-oxydef-oxyvis-carkra-agro01-aralyr
WRST_T76_03_2006	7/7/2006	62.4944	-142.6195	R	0	0	Fboa	N	20	Stca	Boreal Riverine Tall Alder Shrub	alnten-calcan	alnten-salala-equarv-popbal-arclat-arttil
WRST_T76_04_2006	7/7/2006	62.4947	-142.6302	L	0	0	Fbob	Ml	50	Fnows	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-equarv-vacvit-alnten-ledgro-picgla
WRST_T76_05_2006	7/7/2006	62.4980	-142.6337	L	0	0	Of	Mu	75	Stow	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	salpul-equarv-salbar1-salric-mnium-aulpal
WRST_T76_06_2006	7/7/2006	62.4974	-142.6273	L	0	0	Fbob	Ml	75	Fnwws	Boreal Lowland White Spruce Forest	picgla-vaculi	hylspl-empher-vacvit-ledgro-picgla-equarv
WRST_T76_07_2006	7/7/2006	62.4957	-142.6210	R	0	0	Fbraf	Ds	50	Stca	Boreal Riverine Tall Alder Shrub	alnten-calcan	alnten-rubarc1-salala-popbal-moelat-calcan
WRST_T76_08_2006	7/7/2006	62.4946	-142.6174	R	0	0	Fbrac	Ds	50	Slol	Boreal Riverine Low Silverberry Shrub	elacom-oxycam	elacom-fesric-salala-agro02-hedmac-calcan
WRST_T77_01_2006	7/7/2006	62.5073	-142.6570	A	8	10	Gmo	mrs	5	sdev	Boreal Alpine Ericaceous Dwarf Shrub	castet-pedcap	vaculi-castet-dryoct-rhyrug-luparc-flacuc
WRST_T77_02_2006	7/7/2006	62.5068	-142.6543	A	30	110	ch	fh	7	Sdet	Boreal Alpine Ericaceous Dwarf Shrub	empnig-artarc1	vaculi-betnan-dryoct-hylspl-leddec-arcalp
WRST_T77_03_2006	7/7/2006	62.5070	-142.6516	U	28	150	ch	fh	4	Stoaw	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-salgla-betnan-drepa-hylspl-salpul
WRST_T77_04_2006	7/7/2006	62.5051	-142.6461	U	21	100	ch	N	7	stca	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-linbor-rosaci-hylspl-epiang-lycann
WRST_T77_05_2006	7/7/2006	62.5050	-142.6414	U	11	130	ch	fh	7	fnwws	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-ledgro-hylspl-drepa-vacvit-calcan
WRST_T77_06_2006	7/7/2006	62.5029	-142.6331	L	0		L	999		slowg	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	salpul-tomnit-calcan-caraqu-hypnu-eriang
WRST_T78_01_2006	7/8/2006	62.4621	-143.2459	S	2	330	Gmo	fh	18	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	hylspl-salpul-empnig-carbig-aulpal-betnan
WRST_T78_02_2006	7/8/2006	62.4629	-143.2393	S	4	70	Gmo	fh	15	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salret-hylspl-leddec-salpul-carbig-vaculi
WRST_T78_03_2006	7/8/2006	62.4620	-143.2329	A	0		Ob	fh	20	Slowg	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	hylspl-salpul-salret-eriang-caraqu-aulpal
WRST_T78_04_2006	7/8/2006	62.4621	-143.2363	A	10	20	Gmo	fh	15	Hgwswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	hylspl-salret-cladi-empnig-carbig-betnan
WRST_T78_05_2006	7/8/2006	62.4623	-143.2356	A	0		Wlsim	W		W	Alpine Lake		water
WRST_T78_06_2006	7/8/2006	62.4621	-143.2317	A	0		Of	999		Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	carrot-eriang-carcho-caraqu-erirus-mnium
WRST_T78_07_2006	7/8/2006	62.4629	-143.2322	A	8	280	ch	fh	10	Hgmswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	hylspl-dryint-tomnit-cladi-salret-salpul

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T78_08_2006	7/8/2006	62.4631	-143.2342	A	0		L	N	5	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	eriang-aulpal-drerev-caraqu-pohli-salpul
WRST_T78_09_2006	7/8/2006	62.4648	-143.2253	A	5	10	Ch	n	20	Slott	Boreal Alpine Tussock Meadow	erivag-salpul-polbis	erivag-salpul-leddec-salret-betnan-empnig
WRST_T79_01_2006	7/9/2006	62.3440	-143.3180	A	25	240	ch	ds	40	sdet	Boreal Alpine Ericaceous Dwarf Shrub	castet-pedcap	castet-potfru-dryoct-vaculi-alncri-hylspl
WRST_T79_02_2006	7/9/2006	62.3437	-143.3176	A	22	140	ch	mu	20	sloe	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-potfru-vaculi-camar-tomnit-lichc
WRST_T79_03_2006	7/9/2006	62.3432	-143.3177	S	20	190	ch	mu	10	stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	vaculi-salgla-tomnit-salpul-potfru-hylspl
WRST_T79_04_2006	7/9/2006	62.3432	-143.3199	U	22	240	ch	mu	10	stca	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-thuid-hylspl-ribtri-arcrub-tomnit
WRST_T79_05_2006	7/9/2006	62.3427	-143.3202	S	12	170	ch	mu	15	slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-salgla-vaculi-rhyrug-tomnit-aulpal
WRST_T79_06_2006	7/9/2006	62.3404	-143.3221	S	10	210	ch	fh	7	sfwws	Boreal Subalpine Spruce Woodland	picgla-vaculi	betnan-rhyrug-salgla-vaculi-aulpal-picgla
WRST_T79_07_2006	7/9/2006	62.3399	-143.3243	S	10	230	ch	fh	20	Slobw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	vaculi-rhyrug-betgla-picgla-tomnit-dryint
WRST_T79_08_2006	7/9/2006	62.3397	-143.3259	A	9	230	ch	fh	20	hgmss	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	carbig-salret-tomnit-aulpal-dryint-cladi
WRST_T79_09_2006	7/9/2006	62.3399	-143.3298	S	8	230	ch	fh	30	Slobe	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betnan-vaculi-cladi-empnig-aulpal-rhyrug
WRST_T80_01_2006	7/8/2006	62.6348	-143.5547	A	28	240	Ch	Mg	50	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-vaculi-moss-liche-fesalt-arcalp
WRST_T80_02_2006	7/8/2006	62.6313	-143.5586	S	28	220	Ch	Mg	30	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-vacvit-vaculi-leddec-moss-salpul
WRST_T80_03_2006	7/8/2006	62.6312	-143.5627	U	25	210	Ch	N	20	Stoa	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-calcan-leddec-salpul-epiang-moss
WRST_T80_04_2006	7/8/2006	62.6318	-143.5660	U	20	230	Ch	Mg	50	Fnwws	Boreal Upland White Spruce Forest	picgla-rosaci	moss-alncri-equarv-plesch-picgla-salret
WRST_T80_05_2006	7/8/2006	62.6298	-143.5700	U	25	210	Ch	Mg	50	Fbcb	Boreal Upland Birch Forest	bethum-ledgro	betpap-rosaci-alncri-calcan-linbor-moss
WRST_T80_06_2006	7/8/2006	62.6279	-143.5680	U	15	210	Ch	Mg	50	Fmosb	Boreal Upland Spruce-Birch Forest	bethum-picgla-ribtri	hylspl-vacvit-ledgro-picgla-rosaci-alncri
WRST_T80_07_2006	7/8/2006	62.6280	-143.5808	U	15	250	Gmo	Mu	50	Fnwws	Boreal Upland White Spruce Forest	picgla-rosaci	moss-hylspl-ledgro-vacvit-picgla-vaculi
WRST_T80_08_2006	7/8/2006	62.6276	-143.5846	L	2	150	Ob	Fh	30	Slotb	Boreal Lowland Tussock-Shrub Bog	erivag-betnan	eribra-sphag-leddec-vacvit-vaculi-betgla
WRST_T81_01_2006	7/9/2006	62.4360	-143.9945	A	15	270	Gmo	Mrb	10	Sddl	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	liche-dryoct-alenig-aleoch-psepub-thamn
WRST_T81_02_2006	7/9/2006	62.4360	-143.9941	A	23	110	GFk	Fh	30	Sdee	Boreal Alpine Ericaceous Dwarf Shrub	empnig-artarc1	empher-dryoct-castet-fesalt-salret-dicra1
WRST_T81_03_2006	7/9/2006	62.4356	-143.9905	A	18	120	Cs	Mg	100	Hgmswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	moss-equarv-plesch-salret-carbig-anepar
WRST_T81_04_2006	7/9/2006	62.4350	-143.9897	A	1	10	Ch	N	10	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	caraqu-eriang-moss-drepa-salpul-aulpal
WRST_T81_05_2006	7/9/2006	62.4321	-143.9881	A	3	330	Cs	Mg	50	Hgwswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	carbig-moss-salret-plesch-hylspl-eriang
WRST_T81_06_2006	7/9/2006	62.4362	-143.9818	A	15	35	Cs	Mg	50	Hgwswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	equarv-salret-carbig-moss-plesch-petfri
WRST_T81_07_2006	7/9/2006	62.4387	-143.9831	A	25	50	GFk	Fh	30	Sdee	Boreal Alpine Ericaceous Dwarf Shrub	empnig-artarc1	empher-moss-dryala-dicra1-liche-fesalt
WRST_T81_08_2006	7/9/2006	62.4398	-143.9832	A	5	310	Gmo	Mrb	20	Hgdgh	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	desbre-carsax-equarv-stere-junbig-salpol
WRST_T81_09_2006	7/9/2006	62.4342	-144.0034	A	0	0	Of	N	10	Hgwst	Boreal Alpine Sedge Meadow	eriang-caraqu-salpul	caraqu-eriang-moss-erirus-sphag-drerev
WRST_T81_10_2006	7/9/2006	62.4325	-143.9960	A	8	190	Gmo	Mrb	20	Sddl	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-liche-clado-moss-aleoch-clamit
WRST_T81_11_2006	7/9/2006	62.4338	-143.9991	A	0	0	Wlsim	W	0	W	Alpine Lake		eriang-carmem-caraqu-carsax-scosco-rantri
WRST_T82_01_2006	7/10/2006	62.6310	-144.3384	P	0		Of	999		Hgwfs	Boreal Lacustrine Sedge Meadow	carsax-eriang	scosco-carros1-sphag-carcho-eriang-caraqu
WRST_T82_02_2006	7/10/2006	62.6300	-144.3371	U	0	0	Elu	N	10	Fbcb	Boreal Upland Birch Forest	bethum-ledgro	betpap-calcan-equsyl-picgla-drepa-rosaci
WRST_T82_03_2006	7/10/2006	62.6292	-144.3360	P	0	0	wlsim	W		W	Lowland Lake		mentri-nuppol-potpal-potam-sparg-utrint
WRST_T82_04_2006	7/10/2006	62.6290	-144.3341	L	0	0	Ob	mpm	30	Sfwbs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	sphag-betnan-erivag-picmar-leddec-arcalp

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T82_05_2006	7/10/2006	62.6282	-144.3334	L	3	30	Ob	fh	35	fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	hylspl-picmar-plesch-vacvit-ledgro-rosaci
WRST_T82_06_2006	7/10/2006	62.6278	-144.3399	L	0	0	Ell	fh	25	fnobs	Boreal Lowland Black Spruce Forest	picmar-salpul-rubcha	hylspl-ledgro-picmar-sphag-vaculi-betnan
WRST_T82_07_2006	7/10/2006	62.6294	-144.3501	U	18	350	Gmo	fh	5	Fbob	Boreal Upland Birch Forest	bethum-ledgro	betpap-drepa-vacvit-ledgro-thuid-equsyl
WRST_T83_01_2006	7/10/2006	62.2390	-145.0996	L	0	0	Of	N	20	Slowg	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	eriang-moss-salpul-drerev-calcan-potpal
WRST_T83_02_2006	7/10/2006	62.2404	-145.0997	P	0	0	Of	N	10	Hgwsl	Boreal Lacustrine Sedge Meadow	carsax-eriang	moss-carros1-scosco-drerev-trimar-mnium
WRST_T83_03_2006	7/10/2006	62.2420	-145.0998	U	5	180	Gmo	N	10	Fnows	Boreal Upland White Spruce Forest	picgla-rosaci	moss-hylspl-picgla-pelaph-vacvit-dicra1
WRST_T83_04_2006	7/10/2006	62.2448	-145.0974	L	3	350	Gmo	N	10	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	moss-hylspl-alncri-vaculi-empher-picma
WRST_T83_05_2006	7/10/2006	62.2425	-145.0949	U	3	250	Gmo	N	10	Fbca	Boreal Upland Aspen Forest	poptre-picgla-rosaci	poptre-linbor-vacvit-alncri-geoliv-moss
WRST_T83_06_2006	7/10/2006	62.2381	-145.0934	U	5	220	Gmo	N	10	Fbca	Boreal Upland Aspen Forest	poptre-picgla-rosaci	poptre-linbor-arcuva-empher-vacvit-epiang
WRST_T83_07_2006	7/10/2006	62.2357	-145.0927	L	1	180	Ell	Fh	50	Fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	moss-tomnit-arcrub-picmar-aulpal-salmy
WRST_T83_08_2006	7/10/2006	62.2347	-145.0944	P	0	0	Of	N	10	Hgwsl	Boreal Lacustrine Sedge Meadow	carutr-potpal	carutr-moss-scosco-caraqu-potgra-calli
WRST_T83_09_2006	7/10/2006	62.2342	-145.0957	P	0	0	Wlsit	W	0	W	Lowland Lake		calli-hipvul-potgra-carutr-potalp-spahyp
WRST_T83_10_2006	7/10/2006	62.2349	-145.0958	L	0	0	Ob	Fh	30	Fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	moss-hylspl-picmar-vacvit-empher-salmy
WRST_T85_01_2006	7/11/2006	62.1053	-144.8271	A	0	0	Gmy	mg	30	Slow	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	salpul-salret-carbig-carpod-bryum-castet
WRST_T85_02_2006	7/11/2006	62.1052	-144.8297	A	10	80	Gmy	mg	12	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-salarc-rhyrug-castet-luparc-dialap
WRST_T85_03_2006	7/11/2006	62.1050	-144.8315	A	2	280	Gmy	ff	30	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-lichc-dialap-salarc-castet-racom
WRST_T85_04_2006	7/11/2006	62.1045	-144.8337	A	4	230	Gmy	fh	30	Sdec	Boreal Alpine Ericaceous Dwarf Shrub	castet-pedcap	casste-salpol-empnig-bryum-castet-dodfr
WRST_T85_05_2006	7/11/2006	62.1042	-144.8346	A	2	290	Gmy	fh	15	Hgmswt	Boreal Alpine Sedge-Dwarf Willow Meadow	carbig-salret	dryoct-salret-carbig-salpul-hiealp-vaculi
WRST_T85_06_2006	7/11/2006	62.1039	-144.8400	A	4	270	Gmy	n	5	Sddt	Boreal Alpine Dryas Dwarf Shrub	dryoct-hiealp-sauvis	dryoct-lichc-dialap-rholap-castet-bryoc
WRST_T85_07_2006	7/11/2006	62.1033	-144.8531	A	0	0	Ch	n	5	Sdwt	Boreal Alpine Sedge-Dwarf Willow Meadow	salpol-artarc1	salpol-salret-fesalt-aulpal-castet-stere
WRST_T85_08_2006	7/11/2006	62.1041	-144.8584	S	0	0	Elu	n		Stcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salpul-calcan-aneric-tomnit-petfri-polacu
WRST_T86_01_2006	7/11/2006	61.7365	-144.7113	U	32	190	GLu	Ft	30	Slol	Boreal Upland Sagebrush Meadow	artfri-calpur-linper	artfri-elacom-agro1-calpur-agro2-epilat
WRST_T86_02_2006	7/11/2006	61.7368	-144.7081	U	35	165	GLu	Fs	50	Slosj	Boreal Upland Sagebrush Meadow	artfri-calpur-linper	junhor-rosaci-artfri-oxycam-liche-poagla
WRST_T86_03_2006	7/11/2006	61.7372	-144.7075	U	30	140	Ch	Mw	50	Slosg	Boreal Upland Sagebrush Meadow	artfri-calpur-linper	artfri-agro2-oxycam-rosaci-hedmac-liche
WRST_T86_04_2006	7/11/2006	61.7391	-144.7026	U	30	180	Ch	N	20	Fbca	Boreal Upland Aspen Forest	poptre-picgla-rosaci	poptre-rosaci-bropum2-moss-galbor-hedalp
WRST_T86_05_2006	7/11/2006			U	32	140	Ctb	Mw	50	Fboa	Boreal Upland Aspen Forest	poptre-picgla-rosaci	rosaci-poptre-bropum3-moss-carros2-galbor
WRST_T86_06_2006	7/11/2006			U	32	140	Ctb	Mw	50	Slosg	Boreal Upland Sagebrush Meadow	artfri-calpur-linper	artfri-agro2-rosaci-lapmyo-oxycam-hedalp
WRST_T86_07_2006	7/11/2006	61.7427	-144.6971	U	0	0	Elu	Ml	100	Fnwws	Boreal Upland White Spruce Forest	picgla-rosaci	moss-hylspl-linbor-geoliv-rosaci-arcrub
WRST_T86_08_2006	7/11/2006	61.7460	-144.7003	R	1	270	Fboi	Ds	150	Fmosp	Boreal Riverine Spruce-Poplar Forest	popbal-picgla-oxycam	picgla-alnten-moss-popbal-hylspl-rosac
WRST_T87_01_2006	7/12/2006	61.6698	-144.6574	U	32	110	Ch	N	20	Slosg	Boreal Upland Sagebrush Meadow	artfri-calpur-linper	artfri-moss-raclan-calpur-lichc-oxycam
WRST_T87_02_2006	7/12/2006	61.6695	-144.6555	R	0	0	Fboi	N	20	Fbop	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-corsto-vibedu-rosaci-alnten-equarv
WRST_T87_03_2006	7/12/2006	61.6676	-144.6493	R	0	0	Fboi	Ml	30	Fnows	Boreal Riverine White Spruce Forest	picgla-hedalp	moss-hylspl-picgla-sanunc-astalp1-fesrub
WRST_T87_04_2006	7/12/2006	61.6666	-144.6465	R	0	0	Fboi	N	20	Fbop	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-rosaci-equarv-alnten-arcrub-hedalp
WRST_T87_05_2006	7/12/2006	61.6684	-144.6461	R	0	0	Fboa	N	10	Slol	Boreal Riverine Low Silverberry Shrub	elacom-oxycam	hieodo-elacom-bropum3-moss-achbor-hedma

Appendix 2. Continued.

Plot ID	Date	LatDD83	LongDD83	Physiography	Slope	Aspect	Geomorphic Unit	Micro-topography	Micro-Relief	Veg Class 4	Ecotype	Floristic Class	Dominant Plants
WRST_T87_06_2006	7/12/2006	61.6690	-144.6430	R	0	0	Fboa	Ds	30	Fbcp	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-alnten-corsto-rosaci-astsib-equarv
WRST_T87_07_2006	7/12/2006	61.6658	-144.6357	R	0	0	Fboa	N	10	Stoa	Boreal Riverine Tall Alder Shrub	alnten-calcan	corsto-alnten-trieur3-calcan-salala-ribhud
WRST_T87_08_2006	7/12/2006	61.6662	-144.6385	R	0	0	Fbric	N	10	Hfds	Boreal Riverine Low Silverberry Shrub	elacom-oxycam	moss-racom-potmul-bropum3-polpul-achbo
WRST_T87_09_2006	7/12/2006	61.6659	-144.6449	R	0	0	Fboi	N	20	Fbop	Boreal Riverine Loamy Poplar Forest	popbal-alnten-equarv	popbal-equarv-rosaci-vibedu-corsto-hedalp
WRST_T87_10_2006	7/12/2006	61.6654	-144.6552	R	0	0	Fboi	N	20	Fnows	Boreal Riverine White Spruce Forest	picgla-hedalp	moss-hylspl-picgla-hedalp-linbor-tomni
WRST_T87_11_2006	7/12/2006	61.6622	-144.6575	R	0	0	Wlsir	W	0	Hgwfs	Boreal Lacustrine Sedge Meadow	carutr-potpal	carutr-calli-potpal-caraqu-calcan-cardia
WRST_T88_01_2006	7/11/2006	61.5150	-143.8107	S	24	209	Ch	D	30	Slow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	dryoct-potfru-salgla-moss-luparc-anemul1
WRST_T88_02_2006	7/11/2006	61.5145	-143.8116	S	23	216	Ch	D	30	Slcbw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	betgla-salgla-betnan-potfru-moss-fesalt
WRST_T88_03_2006	7/11/2006	61.5112	-143.8158	S	24	206	Ch	D	30	Stcw	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	salric-arttil-epiang-equarv-calcan-gereri
WRST_T88_04_2006	7/11/2006	61.5102	-143.8170	S	27	191	Ch	D	50	Stow	Boreal Subalpine Willow and Birch Shrub	betnan-salpul-fesalt	potfru-salgla-salbeb-fesalt-calcan-moss
WRST_T88_05_2006	7/11/2006	61.5090	-143.8197	U	17	235	Ch	D	30	Stoa	Boreal Upland Tall Alder Shrub	alncri-ribtri-calcan	alncri-calcan-equarv-empnig-sphag-ledgro
WRST_T88_06_2006	7/11/2006	61.5093	-143.8171	S	16	207	Ch	n	30	Fbcp	Boreal Subalpine Poplar Forest	popbal-fesalt	popbal-calcan-rosaci-corcan-herlan-merpan
WRST_T88_07_2006	7/11/2006	61.5082	-143.8179	S	15	250	Ch	Mrm	150	Hfmm	Boreal Subalpine Forb Meadow	artarc1-fesalt-valcap	equarv-calcan-herlan-delgla-epiang-gereri
WRST_T89_01_2006	7/12/2006	61.5080	-144.0637	L	0	0	Of	N	10	Hgwsl	Boreal Lowland Sedge-Shrub Fen	caraqu-potpal-salpul	potpal-caraqu-moss-salpul-cardia-astjun
WRST_T89_02_2006	7/12/2006	61.5074	-144.0629	L	5	310	Ell	F	50	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	hylspl-moss-picmar-empnig-arcrub-ledgro
WRST_T89_03_2006	7/12/2006	61.5072	-144.0650	L	0	0	Ell	N	50	Stow	Boreal Lowland Tall Willow Shrub	salsco-salbar1-rosaci	vacvit-salsco-rosaci-geoliv-salbeb-ledgro
WRST_T89_04_2006	7/12/2006	61.5073	-144.0659	P	0	0	Of	N	20	Hgwss	Boreal Lacustrine Sedge Meadow	caraqu-potpal-salpul	moss-caraqu-salpul-mentri-andpol-potpal
WRST_T89_05_2006	7/12/2006	61.5083	-144.0609	U	7	220	Elu	N	20	Fnows	Boreal Upland White Spruce Forest	picgla-rosaci	picgla-hylspl-salbeb-arcrub-empnig-picma
WRST_T89_06_2006	7/12/2006	61.5080	-144.0585	U	26	210	Elu	N	10	Fbopa	Boreal Upland Aspen Forest	poptre-picgla-rosaci	arcuva-salbeb-popbal-poptre-shecan-luparc
WRST_T89_07_2006	7/12/2006	61.5076	-144.0579	U	999		Elu	N	10	Stow	Boreal Upland Tall Willow Shrub	salbeb-shecan	salbeb-salarb-rosaci-equarv-salgla-cyppas
WRST_T90_01_2006	7/12/2006	61.4717	-143.9783	L	3	30	Ell	Fh	25	Fnobs	Boreal Lowland Black Spruce Forest	picmar-salgla-equsci	hylspl-ledgro-picmar-empnig-arcrub-vacvit
WRST_T90_02_2006	7/12/2006	61.4737	-143.9771	L	0	0	Ob	Mpm	30	Fnobs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	hylspl-ledgro-picmar-betnan-tomnit-rubcha
WRST_T90_03_2006	7/12/2006	61.4738	-143.9757	L	0	0	Of	N	40	Slocg	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	myrgal-aulpal-trialp-drepa-tomnit-aultur
WRST_T90_04_2006	7/12/2006	61.4735	-143.9751	L	0	0	Of	N	15	Hgwss	Boreal Lowland Sedge-Shrub Fen	caraqu-eriang-andpol	caraqu-scosco-aulpal-myrgal-potpal-cardia
WRST_T90_05_2006	7/12/2006	61.4731	-143.9701	U	3	210	Gmo	F	50	Fbca	Boreal Upland Aspen Forest	poptre-picgla-rosaci	poptre-salbeb-picgla-brach-vacvit-ledgro
WRST_T90_06_2006	7/12/2006	61.4724	-143.9657	U	4	210	Elu	F	30	Fmoas	Boreal Upland Aspen Forest	poptre-picgla-rosaci	poptre-picgla-salbeb-brach-vacvit-geoliv
WRST_T90_07_2006	7/12/2006	61.4716	-143.9650	L	0	0	Ob	Mpm	40	Sfwbs	Boreal Lowland Black Spruce Bog	picmar-salpul-rubcha	betnan-erivag-picmar-drepa-aulpal-vacvit
WRST_V07_01_2004	7/4/2004	59.8253	-139.8226	C	0		Esac	nd		Hfmu	Maritime Coastal Angelica Meadow	lupnoo-angluc	herlan(65)-angluc(10)-elymol(10)-calcan(5)-lupnut(20)-epiang(10)
WRST_V11_01_2004	7/3/2004	59.6964	-140.3453	C	0		Mbi	N	0	Hfmm	Maritime Coastal Angelica Meadow	lupnoo-angluc	elymol(20)-lupnoo(25)-herlan(10)-latmar(30)-frachi(5)-conchi(10)
WRST_V14_01_2004	7/5/2004	59.7943	-140.9489	L	0		GFoi	N		Stcaw	Maritime Lowland Tall Alder-Willow Shrub	alnsin-salbar1-athfil	alnsin(60)-salsit(10)-salsco(25)-equarv(30)-carsit(10)-rubspe(1)
WRST_V30_01_2004	7/19/2004	60.8730	-143.3379	A	nd		Gmo	Mrs		Sdev	Boreal Alpine Ericaceous Dwarf Shrub	empnig-artarc1	vaculi-salarc-empnig-artarc1-luparc-epiang

Appendix 3. Data file listing of environmental characteristics intensive ground reference plots in Wrangell-St. Elias National Park and Preserve, southcentral Alaska, 2004–2006.

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_G57_01_2005	Nsa	-16	Y	W			Y	A	20	26	L	O	8	33	1	5.2	630	Acidic
WRST_T02_01_2004	U	-75	n	M	a	a	n	a	5	5	B	B	0	100		4.3	150	Acidic
WRST_T02_02_2004	Np	50	y	A			u	na	0	0	w	W				6.4	50	Circumneutral
WRST_T02_03_2004	U	-100	n	M	a	a	n	a	10	10	K	K		100		3.4	150	Acidic
WRST_T02_05_2004	U	-150	n	M	a	a	n	p	1	1	K	K	5			4.8	50	Acidic
WRST_T02_06_2004	U	-150	n	M	a	a	n	a	1	1	K	K	0			4.5	140	Acidic
WRST_T02_07_2004	U	-150	n	M	a	a	n	p	3	3	K	K	0			3.7	140	Acidic
WRST_T02_08_2004	U	-150	n	M	a	a	n	p	2	2	R	R	0			4.3	70	Acidic
WRST_T02_09_2004	U	-150	n	M	a	a	n	p	1	1	K	K	0			4.1	80	Acidic
WRST_T02_10_2004	U	-150	n	M	a	a	n	p	2	2	K	K	0			4.3	100	Acidic
WRST_T03_01_2004	U	-150	n	M	a	25	n	a	7	7	G	G	0			4.2	60	Acidic
WRST_T03_02_2004	Nsa	-6	y	W	a	13	y	a	13	13	G	G	0			6.6	320	Circumneutral
WRST_T04_01_2004	U	-200	n	D	a	a	n	a	0	0	K	K	0	100		4.7	60	Acidic
WRST_T05_01_2004	Np	250	y	A	nd	nd	u	na	0		w	W				7.9	160	Alkaline
WRST_T05_02_2004	Np	30	y	A	0	0	y	a	0	0	L	L	0			7.9	160	Alkaline
WRST_T05_03_2004	U	-150	n	M	a	a	n	a	4	4	B	B	0	100		4.6	60	Acidic
WRST_T05_04_2004	U	-150	n	M	a	a	n	a	9	9	K	K	0			4.5	70	Acidic
WRST_T05_05_2004	U	-150	n	M	a	a	n	a	3	3	B	B	0			4.3	70	Acidic
WRST_T06_01_2004	Np	40	y	A	nd	nd	u	na	0		w	W				8.3	120	Alkaline
WRST_T06_02_2004	Nt	-23	y	M	a	a	y	a	0	0	B	B	0			8	190	Alkaline
WRST_T06_03_2004	Nt	-41	n	M	a	a	n	a	0	0	G	G	0			7.6	230	Alkaline
WRST_T06_04_2004	Nsa	-15	y	W	4	30	y	a	0	1	S	S	0			6.5	500	Circumneutral
WRST_T06_05_2004	Nsa	-3	y	W	0	7	y	a	2	3	L	L	0			7.1	330	Circumneutral
WRST_T06_06_2004	U	-71	n	M	64	a	n	a	0	0	S	S	0			4.8	180	Acidic
WRST_T06_07_2004	Nsa	-1	y	W	4	7	y	a	0	0	L	L	0			6.7	380	Circumneutral
WRST_T06_08_2004	Nsa	-10	y	W	14	24	y	a	2	3	S	S	0			6.2	140	Circumneutral
WRST_T06_09_2004	U	-32	n	M	a	a	n	a	2	2	S	S	0			5.4	60	Acidic
WRST_T06_10_2004	Ni	-100	n	M	5	a	n	a	4	4	S	S	0			5.1	50	Acidic
WRST_T07_01_2004	Ts	200	y	A	nd	nd	n	A	0		w	W				7.9	4E+04	Saline
WRST_T07_02_2004	Ti	-100	n	M	a	a	n	A	0	0	S	S	0			8.3	60	Brackish
WRST_T07_03_2004	Ti	-100	n	M	a	a	n	A	0	0	S	S	0			8.2	70	Brackish
WRST_T07_04_2004	U	-100	n	M	a	a	n	A	4	4	S	S	0			6.7	80	Circumneutral
WRST_T07_05_2004	Tr	4	y	W	17	0	y	A	0	0	L	L	0			7.3	990	Brackish
WRST_T07_06_2004	Tr	-15	y	W	15	nd	y		0	0	C	C	0			7.6	1E+03	Brackish
WRST_T07_07_2004	U	-55	n	M	a	a	n	na	0	0	S	S	0			6.5	90	Circumneutral
WRST_T07_08_2004	Ni	7	y	W	a	7	y	na	7	7	C	C	0			6.7	666	Brackish
WRST_T08_01_2004	Np	50	y	A	nd	nd			0		w	W				7.5	230	Alkaline
WRST_T08_02_2004	Nse	-100	n	M	a	a	n	A	0	0	G	G	0			7.6	180	Alkaline
WRST_T08_03_2004	U	-75	n	M	a	25	n	A	13	13	R	R	0			6	50	Circumneutral
WRST_T08_04_2004	Nse	-75	n	M	a	a	n	A	0	0	S	S	0			6.9	140	Circumneutral
WRST_T08_05_2004	Nse	-75	n	M	a	a	n	a	0	0	G	G	0	150		7.1	160	Circumneutral
WRST_T08_06_2004	Nsa	-19	y	M	a	a	y	A	0	0	G	G	0	150		7.8	280	Alkaline
WRST_T08_07_2004	U	-100	n	M	a	a	n	A	1	1	K	K	0			7	150	Circumneutral
WRST_T08_08_2004	Np	100	y	A	nd	nd	y		0		w	W				8	200	Alkaline
WRST_T08_09_2004	U	-100	n	M	a	a	n	a	4	4	R	R	0			6.8	130	Circumneutral
WRST_T08_10_2004	Np	100	y	A	nd	nd	y		0		w	W				7.8	260	Alkaline
WRST_T09_01_2004	U	-75	n	D	a	a	n	a	0	0	S	S	0			7.2	100	Circumneutral
WRST_T09_02_2004	U	-75	n	M	a	a	n	a	3	3	S	S	0			6.2	170	Circumneutral
WRST_T09_03_2004	Nsp	20	y	A	a	a	y	a	5	10	L	L	0			7.2	184	Brackish
WRST_T09_04_2004	Nse	-48	n	M	a	a	n	a	3	5	G	G	0			5.4	150	Acidic
WRST_T09_05_2004	Ti	-48	y	M	a	a	y	a	0	0	S	S	0			6.3	310	Circumneutral
WRST_T09_06_2004	U	-50	n	M	a	a	n	a	5	5	G	G	0			5.5	100	Acidic
WRST_T10_01_2004	Nsa	-30	y	W	P	P	y	NA	60	40	P	P	0	150		4.6	110	Acidic
WRST_T10_02_2004	U	-100	n	M	a	a	n	A	23	23	R	O	0	150		4.3	100	Acidic
WRST_T10_03_2004	U	-100	n	M	a	a	n	a	37	37	L	O	0	150		4.1	70	Acidic
WRST_T10_04_2004	Nse	-30	y	M	32	27	y	A	27	27	L	O	0	150		6	170	Circumneutral
WRST_T10_05_2004	Nsa	-15	y	W	a	36	y	a	36	36	L	O	0	150		6.4		Circumneutral
WRST_T10_06_2004	Np	100	y	A	nd	nd	y	a	0		w	W				6.3	270	Circumneutral
WRST_T11_01_2004	Ts	200	y	A	nd	nd	u	na	0		w	W				8	4E+04	Saline
WRST_T11_02_2004	Tr	-100	n	M	a	a	n	A	0	0	G	G	0	150		8.3	700	Brackish

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T11_03_2004	Ti	-75	n	D	a	a	n	a	0	0	S	S	0			7.8	150	Alkaline
WRST_T11_04_2004	Ti	-100	n	M	a	a	n	A	0	0	S	S	0			7.4	110	Alkaline
WRST_T11_05_2004	U	-150	n	M	a	a	n	A	1	2	S	S	0			5.4	100	Acidic
WRST_T11_06_2004	Ti	-150	n	M	a	a	n	A	0	0	S	S	0			6.4	120	Circumneutral
WRST_T12_01_2004	Np	40	y	A	nd	nd	u	na	0		w	W				8.3	90	Alkaline
WRST_T12_02_2004	U	-150	n	D	a	a	n	a	0	0	B	B	0			7.6	130	Alkaline
WRST_T12_03_2004	Ni	-150	n	M	a	a	n	a	1	1	B	B	0			6.4	120	Circumneutral
WRST_T12_04_2004	Ni	-250	n	D	a	a	n	a	1	1	B	B	0			7.6	110	Alkaline
WRST_T12_05_2004	Ni	-150	n	M	a	a	n	a	2	2	G	G	6			5.4	70	Acidic
WRST_T12_06_2004	Ni	-150	n	M	a	a	n	a	3	3	B	B	7			5	50	Acidic
WRST_T12_07_2004	Ni	-150	n	M	a	a	n	a	5	5	G	G	4			4.7	40	Acidic
WRST_T12_08_2004	Ni	-150	n	M	a	a	n	a	2	2	G	G	0		na	5.4	90	Acidic
WRST_T12_09_2004	Ni	-150	n	D	a	a	n	a	1	1	G	G	2			6.8	130	Circumneutral
WRST_T13_01_2004	U	-150	n	D	a	a	n	p	0	0	K	K	0			5.4	30	Acidic
WRST_T13_02_2004	U	-150	n	D	a	a	n	p	0	0	K	K	0			5.5	10	Acidic
WRST_T13_03_2004	U	-150	n	M	a	a	n	a	3	3	K	K	0			5.4	80	Acidic
WRST_T13_04_2004	U	-75	n	M	a	a	n	a	3	3	R	R	0			4.1	120	Acidic
WRST_T13_05_2004	U	-150	n	M	a	a	n	a	3	3	K	K	0			4.7	40	Acidic
WRST_T13_06_2004	U	-150	n	M	a	a	n	a	2	2	K	K	0			4.1	120	Acidic
WRST_T13_07_2004	U	-150	n	M	a	a	n	a	2	2	K	K	8			4.3	80	Acidic
WRST_T13_08_2004	U	-150	n	M	a	a	n	a	1	1	K	K	0			4.4	70	Acidic
WRST_T14_01_2004	Nsa	0	y	W	p	p	y	a	76	40	P	P	0			6.4	320	Circumneutral
WRST_T14_02_2004	Nsa	-1	y	W	a	a	y	a	22	32	L	O	0			7.1	320	Circumneutral
WRST_T14_03_2004	U	-100	n	M	a	18	n	a	12	12	B	B	0			4.3	80	Acidic
WRST_T14_04_2004	Nsa	-4	y	W	a	a	y	a	10	10	G	G	0			6.2	350	Circumneutral
WRST_T14_05_2004	U	-100	n	M	a	a	n	a	11	11	G	G	0			5.2	80	Acidic
WRST_T14_06_2004	U	-150	n	M	a	a	n	a	8	8	G	G	0			5.8	80	Circumneutral
WRST_T14_07_2004	Nsa	0	y	W	a	a	y	a	40	40	P	P	0			6.6	330	Circumneutral
WRST_T15_01_2004	nd	75	y	A	nd	nd			0		w	W				7.2	100	Circumneutral
WRST_T15_02_2004	Nse	-50	n	M	0	0	n	a	0	1	K	K	0			7.1	120	Circumneutral
WRST_T15_03_2004	U	-100	n	M	a	a	n	a	7	7	R	R	0			5.8	70	Circumneutral
WRST_T15_04_2004	U	-100	n	M	a	a	n	a	9	9	R	R	0			6	70	Circumneutral
WRST_T15_05_2004	U	-100	n	M	a	a	n	a	10	10	S	S	0			5.2	60	Acidic
WRST_T15_06_2004	U	-100	n	M	a	a	n	a	15	15	G	G	0			5.4	140	Acidic
WRST_T15_07_2004	U	-100	n	M	7	a	n	a	7	7	G	G	0			5.8	40	Circumneutral
WRST_T19_01_2004	U	-100	n	D	a	a	n	a	0	0	K	K	0	100		7.4	50	Alkaline
WRST_T19_02_2004	U	-100	n	M	a	a	n	a	4	4	K	K	0			6.2	90	Circumneutral
WRST_T19_03_2004	U	-100	n	M	a	a	n	a	5	5	R	R	0			5.5	40	Acidic
WRST_T19_04_2004	U	-100	n	M	a	a	n	a	14	14	G	G	0			5.5	200	Acidic
WRST_T19_05_2004	U	-75	n	D	a	a	n	A	0	0	K	K	0			7.3	60	Circumneutral
WRST_T19_06_2004	U	-200	n	D	a	a	n	a	2	2	K	K	0			7.1	70	Circumneutral
WRST_T19_07_2004	Nsa	-5	y	W	nd	nd	y	a	0	0	K	K	0			8.8	80	Alkaline
WRST_T20_01_2004	U	-100	n	M	a	a	n	a	4	4	L	L	0			6.7	130	Circumneutral
WRST_T20_02_2004	U	-100	n	M	a	a	n	a	2	2	L	L	0			7.3	130	Circumneutral
WRST_T20_03_2004	U	-100	n	M	a	a	n	a	7	10	L	L	0			7.5	30	Alkaline
WRST_T20_04_2004	U	-50	n	M	a	a	n	a	9	9	L	L	0	50		7.4	140	Alkaline
WRST_T20_05_2004	U	-100	n	D	a	a	n	a	2	2	R	R	0			7.6	150	Alkaline
WRST_T20_06_2004	U	-100	n	D	a	a	n	a	1	1	R	R	0			7.8	120	Alkaline
WRST_T20_10_2004	U	-150	n	D	a	a	n	a	0	0	K	K	0			8.6	90	Alkaline
WRST_T20_11_2004	U	-150	n	D	a	a	n	a	2	2	B	B	0			8	210	Alkaline
WRST_T20_12_2004	U	-150	n	D	a	a	n	a	3	3	R	R	0			8.1	200	Alkaline
WRST_T20_13_2004	U	-150	n	D	a	a	n	a	4	4	K	K	0			8	210	Alkaline
WRST_T20_14_2004	U	-150	n	D	a	a	n	a	4	4	R	R	0			7.9	240	Alkaline
WRST_T20_15_2004	U	-150	n	D	a	a	n	a	3	3	R	R	0			7.9	230	Alkaline
WRST_T20_16_2004	Np	300	y	A	nd	nd	u	na	0		W	W				8.7	350	Alkaline
WRST_T20_17_2004	U	-150	n	M	a	a	n	a	4	4	L	L	27			7.9	200	Alkaline
WRST_T22_01_2004	U	-42	n	M	a	a	n	A	6	6	R	R	0	42		5.4	180	Acidic
WRST_T22_02_2004	U	-75	n	M	a	60	n	A	6	6	L	L	0			5.7	130	Circumneutral
WRST_T22_03_2004	U	-75	n	M	a	a	n	a	9	9	L	L	0			5	50	Acidic
WRST_T22_04_2004	U	-75	n	M	a	a	n	a	4	4	L	L	0			5.8	90	Circumneutral
WRST_T22_05_2004	U	-100	n	M	a	a	n	a	15	15	L	L	0			5.4	90	Acidic
WRST_T22_06_2004	U	-100	n	M	23	45	y	a	2	5	L	L	0			5.8	70	Circumneutral
WRST_T23_01_2004	U	-60	n	M	a	a	n	a	0	0	S	S	0			8.2	50	Alkaline

Appendix 3. Continued.

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T23_02_2004	Nsa	-73	y	M	3	a	y	a	0	0	L	L	0			7.4	680	Alkaline
WRST_T23_03_2004	Nse	-70	n	M	9	a	y	a	1	6	S	S	0			7.6	600	Alkaline
WRST_T23_04_2004	U	-150	n	M	23	a	n	a	0	2	S	S	0			8.4	110	Alkaline
WRST_T23_05_2004	U	-100	n	M	a	a	n	a	14	25	L	O	0			7.1	220	Circumneutral
WRST_T23_06_2004	Nse	-100	y	M	23	a	y	a	0	1	S	S	0			8.1	140	Alkaline
WRST_T23_07_2004	U	-75	n	M	a	a	n	a	3	3	G	G	0			7.7	60	Alkaline
WRST_T23_08_2004	Ni	-75	n	D	a	a	n	a	1	1	B	B	0			7.4	50	Alkaline
WRST_T24_01_2004	Ni	-75	n	D	a	a	n	a	0	0	B	B	0			7.7	240	Alkaline
WRST_T24_02_2004	Nse	-100	n	D	a	a	n	a	1	1	B	B	0			8	140	Alkaline
WRST_T24_03_2004	Nse	-100	n	D	a	a	n	a	5	5	G	G	0			7.6	80	Alkaline
WRST_T24_04_2004	Ni	-100	n	M	a	a	n	a	3	3	G	G	0			7.3	150	Alkaline
WRST_T24_05_2004	Ni	-55	n	M	18	a	y	a	7	12	L	L	0			7	240	Circumneutral
WRST_T24_06_2004	Ni	-100	n	M	a	a	n	a	9	12	L	L	0			7.5	120	Alkaline
WRST_T24_07_2004	Ni	-100	n	D	a	a	n	a	2	2	G	G	0			7.8	80	Alkaline
WRST_T25_01_2004	Np	150	y	A	nd	nd	u	n/a	0		W	W				8.6	280	Alkaline
WRST_T25_02_2004	Nsp	2	y	W	P	P	y	a	150	40	P	P	0			5.7	90	Circumneutral
WRST_T25_03_2004	U	-40	n	M	a	a	y	p	26	26	L	O	>14	40		5.3	100	Acidic
WRST_T25_04_2004	U	-60	n	M	12	a	n	p	12	12	L	L	20			4.4	110	Acidic
WRST_T25_05_2004	Nsa	1	y	W	P	P	y	a	88	40	P	P				6.5	460	Circumneutral
WRST_T25_06_2004	U	-100	n	M	a	a	n	a	11	11	R	R	12			6.7	90	Circumneutral
WRST_T25_07_2004	U	-100	n	M	26	a	u	p	16	16	L	L	>27			5.6	180	Circumneutral
WRST_T25_08_2004	Nsp	7	y	W	P	P	y	a no p	90	40	P	P				6.4	350	Circumneutral
WRST_T25_09_2004	Nsa	-12	y	W	P	P	y	a	150	40	P	P				6	220	Circumneutral
WRST_T25_10_2004	Nsa	-11	y	W	P	P	y	a	150	40	P	P				6.2	280	Circumneutral
WRST_T26_01_2004	U	-150	n	D	a	a	n	p	0	0	K	K	0			6.9	430	Circumneutral
WRST_T26_02_2004	Ts	-150	n	M	a	a	n	p	3	3	R	R	0			5.5	340	Acidic
WRST_T26_03_2004	U	-150	n	D	a	a	n	p	0	0	K	K	0			5.1	150	Acidic
WRST_T26_04_2004	U	-150	n	M	a	a	n	p	4	4	R	R	0			5.3	110	Acidic
WRST_T26_05_2004	U	-150	n	M	a	a	n	p	7	7	R	R	0			4.8	140	Acidic
WRST_T26_06_2004	U	-150	n	D	a	a	n	a	3	3	K	K	0			6.4	160	Circumneutral
WRST_T26_07_2004	U	-150	n	M	a	a	n	a	4	4	K	K	3			5.4	30	Acidic
WRST_T26_08_2004	U	-150	n	M	a	a	n	a	1	1	L	L	21			5.4	30	Acidic
WRST_T26_10_2004	U	-150	n	M	a	a	n	a	3	3	L	L	0			4.5	20	Acidic
WRST_T26_11_2004	U	-150	n	D	a	a	n	p	4	4	K	K	0			5.1	30	Acidic
WRST_T26_12_2004	U	-100	n	M	a	a	n	a	9	9	L	L	75			5.2	20	Acidic
WRST_T26_13_2004	Nsa	-20	y	W	P	P	y	a	75	40	P	P	0			6	140	Circumneutral
WRST_T27_01_2004	Ni	-100	n	D	a	a	n	a	0	0	B	B	0			5.7	10	Circumneutral
WRST_T27_02_2004	Nse	-10	y	W	18	5	y	a	0	5	S	S	0			5.9	250	Circumneutral
WRST_T27_03_2004	Nsa	-7	y	W	16	a	y	a	9	9	G	G	0			6.5	160	Circumneutral
WRST_T27_04_2004	Nse	-75	n	M	a	a	n	a	0	0	B	B	0			4.7	80	Acidic
WRST_T27_05_2004	Ni	-100	n	M	a	a	n	a	0	0	B	B	0			5.4	10	Acidic
WRST_T27_06_2004	Ni	-75	n	D	a	a	n	a	0	0	B	B	0			5.2	10	Acidic
WRST_T27_07_2004	Ni	-75	n	D	a	a	n	a	0	0	B	B	0			5.2	10	Acidic
WRST_T27_08_2004	Ni	-75	n	D	a	a	n	a	0	0	B	B	0			5.3	80	Acidic
WRST_T27_09_2004	Np	50	y	A	nd	nd	y	a			W	W				6.3	120	Circumneutral
WRST_T27_10_2004	Nsa	-38	y	M	a	a	n	a	2	2	G	G	1			6.4	80	Circumneutral
WRST_T28_01_2004	U	-100	n	M	21	27	y	a	12	12	L	L	30			5	110	Acidic
WRST_T28_02_2004	Nsa	-105	n	M	11	a	y	p	6	6	L	L	32	105		5.5	100	Acidic
WRST_T28_03_2004	Nsa	-5	y	W	0	a	y	a	0	0	G	G	0			5.5	70	Acidic
WRST_T28_04_2004	U	-150	n	D	a	a	n	p	2	2	B	B	0			4.5	90	Acidic
WRST_T28_05_2004	U	-150	N	D			n	P	5	5	B	B	0	50		4.7	150	Acidic
WRST_T28_06_2004	Nsa	-20	y	W	p	p	y	p	20	25	B	O	0			4.6	240	Acidic
WRST_T28_07_2004	Nsp	2	y	W	P	P	y	a	105	40	P	P	0			5.3	60	Acidic
WRST_T28_08_2004	Np	50	y	A	nd	nd	u	nd	0		W	W				7.1	60	Circumneutral
WRST_T29_01_2004	U	-100	n	M	a	a		a	2	2	K	K	5.5			5.6	30	Circumneutral
WRST_T29_02_2004	U	-100	n	M	a	a	n	a	3	3	R	R	11			5.4	10	Acidic
WRST_T29_03_2004	U	-100	n	M	a	a	n	a	9	9	L	L	60			5.7	50	Circumneutral
WRST_T29_04_2004	U	-75	n	M			n	a	2	2	L	L	11			5.3	20	Acidic
WRST_T29_05_2004	U	-100	y	M	a	a	n	a	7	7	L	L	33			5.1	70	Acidic
WRST_T29_06_2004	U	-100	n	M	a	a	n	a	16	22	L	O	8			5.6	160	Circumneutral
WRST_T29_07_2004	U	-150	n	M	a	a	n	a	3	3	G	G	16			5.6	30	Circumneutral
WRST_T30_01_2004	U	-100	n	D	a	a	n	a	1	1	K	K	0			5.8	50	Circumneutral
WRST_T30_02_2004	U	-100	n	M	a	a	n	p	1	1	L	L	0			5	30	Acidic

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T30_03_2004	Np	100	y	A	nd	nd			0		W	W				6.4	10	Circumneutral
WRST_T30_04_2004	U	-100	n	M	a	a	n	a	1	1	K	K	0			5.2	10	Acidic
WRST_T30_05_2004	U	-50	n	M	a	a	n	a	3	4	L	L	0			5.2	20	Acidic
WRST_T30_06_2004	U	-75	n	M	a	a	n	a	12	12	L	L	0			5.6	50	Circumneutral
WRST_T30_07_2004	U	-100	n	M	a	a	n	a	4	4	L	L	0			5.1	20	Acidic
WRST_T30_08_2004	U	-58	n	M	a	a	n	a	10	12	L	L	0			5.1	50	Acidic
WRST_T31_01_2004	U	-100	n	M	a	a	n	a	5	5	K	K	0			3.8	110	Acidic
WRST_T31_02_2004	U	-150	n	D	a		n	a	2	2	K	K	0			4.1	80	Acidic
WRST_T31_03_2004	U	-100	n	M	a	a	n	a	19	19	L	L	0			3.7	70	Acidic
WRST_T31_04_2004	U	-75	n	M	a	a	n	a	3	3	K	K	0			3.9	80	Acidic
WRST_T31_05_2004	Np	300	y	A	nd	nd	n	a	0		W	W				6.2	30	Circumneutral
WRST_T31_06_2004	U	-75	n	M	a	a	n	a	5	5	L	L	0			4.7	40	Acidic
WRST_T31_07_2004	U	-100	n	M	a	a	n	a	15	15	L	L	0			5.1	30	Acidic
WRST_T31_08_2004	Ni	-7	y	W	p	p	n	a	80	40	P	P	0			4.9	50	Acidic
WRST_T32_01_2004	Nse	-75	n	D	a	a	n	a	0	0	B	B	0			6.9	80	Circumneutral
WRST_T32_02_2004	Ni	-75	n	D	a	a	n	a	1	1	G	G	0			7.6	40	Alkaline
WRST_T32_03_2004	Ni	-100	n	D	a	a	n	a	1	1	G	G	0			7.5	50	Alkaline
WRST_T32_04_2004	Ni	-100	n	D	a	a	n	a	2	2	B	B	0			7.3	60	Circumneutral
WRST_T32_05_2004	Ni	-100	n	D	a	a	n	a	4	4	B	B	0			6.3	120	Circumneutral
WRST_T32_06_2004	U	-100	n	D	a	a	n	a	0	0	R	R	0					no data
WRST_T32_07_2004	U	-150	n	M	a	a	n	a	12	12	L	L	22			6.4	110	Circumneutral
WRST_T32_08_2004	U	-100	n	M	a	a	n	a	8	8	L	L	38			5.9	150	Circumneutral
WRST_T32_09_2004	Nse	-75	nd	D	a	a	u	nd	0	0	B	B	0					no data
WRST_T34_01_2004	Ni	-6	y	W	p	p	y	a	80	40	P	P	0			6.7	740	Circumneutral
WRST_T34_02_2004	U	-100	n	M	23	a	u	p	5	7	L	L	0			5.1	610	Acidic
WRST_T34_03_2004	Nsa	-3	y	W	p	p	y	a	50	40	P	P	0	149		6.8	390	Circumneutral
WRST_T34_04_2004	U	-60	n	M	17	a	u	a	7	14	L	L	0	140		6.2	90	Circumneutral
WRST_T34_05_2004	U	-39	n	M	p	p	y	a	40	40	P	P	0	39		5.3	80	Acidic
WRST_T34_06_2004	Np	100	y	A	nd	nd	y	a	0		W	W				8.7	250	Alkaline
WRST_T34_07_2004	Nsa	0	y	W	p	p	y	a	40	40	P	P	0	39		6.9	920	Circumneutral
WRST_T35_01_2004	U	-100	n	M	a	a	n	a	7	7	R	R	0			6.4	90	Circumneutral
WRST_T35_02_2004	U	-100	n	M	a	a	n	a	5	5	L	L	75			5.4	90	Acidic
WRST_T35_03_2004	U	-100	n	M	a	a	n	a	4	4	L	L	49			4.2	100	Acidic
WRST_T35_04_2004	U	-100	n	M	a	30			10	10	L	L	20			6	100	Circumneutral
WRST_T35_05_2004	U	-100	n	M	a	a	n	a	17	17	L	L	80			5.6	90	Circumneutral
WRST_T35_06_2004	Nsa	-10	y	W	p	p	y	a	100	40	P	P	0			5.9	160	Circumneutral
WRST_T35_07_2004	Np	100	y	A	nd	nd			0		W	W						no data
WRST_T36_01_2004	U	-100	n	M	a	a	n	a	10	10	L	L	22			5.8	410	Circumneutral
WRST_T36_02_2004	U	-90	n	M	a	a	n	p	6	6	L	L	22			4.9	130	Acidic
WRST_T36_03_2004	U	-150	n	M	a	a	n	a	26	26	L	O	35			6.5	150	Circumneutral
WRST_T36_04_2004	U	-150	n	M	a	a	n	a	10	10	L	L	32			4.6	80	Acidic
WRST_T36_05_2004	Nsa	-29	y	W	a	15	y	a	18	18	L	L	0			6.7	160	Circumneutral
WRST_T36_06_2004	Nsa	-10	y	W	p	p	y	a	105	40	P	P	0			6.9	230	Circumneutral
WRST_T36_07_2004	Nsa	-3	y	W	a	20	y	a	19	19	L	L	0			6.5	440	Circumneutral
WRST_T36_08_2004	Np	100	y	A	nd	nd	u	na	0		W	W				7.3	260	Circumneutral
WRST_T37_01_2004	U	-100	n	M	a	a	n	a	12	12	L	L	21			6	20	Circumneutral
WRST_T37_02_2004	U	-100	n	M	a	a	n	a	30	30	R	O	0			5.8	50	Circumneutral
WRST_T37_03_2004	U	-100	n	M	a	a	n	a	10	10	L	L	0			5.4	40	Acidic
WRST_T37_04_2004	Nsa	-35	y	W	a	a	y	a	40	40	R	P	0			5	40	Acidic
WRST_T37_05_2004	Nsa	-75	n	M	a	a	y	a	30	30	R	O	0			4.6	50	Acidic
WRST_T37_06_2004	U	-150	n	D	a	a	n	a	8	8	K	K				4.8	60	Acidic
WRST_T37_07_2004	U	-150	nd	D	a	a	6[no p	999	2	2	K	K	0			4.8	60	Acidic
WRST_T38_01_2004	U	-100	n	D	a	a	n	A	0	0	R	R	0			6.6	240	Circumneutral
WRST_T38_02_2004	U	-100	n	M	a	a	n	p	2	2	K	K	0			6.3	180	Circumneutral
WRST_T38_03_2004	U	-100	n	M	a	a	n	p	2	2	K	K	0			5.7	40	Circumneutral
WRST_T38_04_2004	U	-150	n	M	a	a	n	p	3	3	L	L	23			4.9	110	Acidic
WRST_T38_05_2004	Nsa	-7	y	W	p	p	y	a	30	35	L	O	0			6.2	40	Circumneutral
WRST_T38_06_2004	U	-100	n	M	a	a	n	a	2	2	R	R	0			4.9	120	Acidic
WRST_T39_01_2004	U	-100	n	D	a	a	n	a	0	0	K	K	0			5.1	110	Acidic
WRST_T39_02_2004	U	-100	n	D	a	a	n	a	8	8	K	K	0			6.1	60	Circumneutral
WRST_T39_03_2004	U	-100	n	M	a	a	n	a	3	3	L	L	0			5.8	50	Circumneutral
WRST_T39_04_2004	U	-100	n	M	a	a	n	a	12	12	L	L	0			6	30	Circumneutral
WRST_T39_05_2004	U	-100	n	M	a	a	n	a	10	10	L	L	0			5.6	30	Circumneutral

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T39_06_2004	U	-100	n	M	a	a	n	y	5	6	L	L	0			6	40	Circumneutral
WRST_T40_01_2005	Np	100	N	A			N	U	0		W	W			999.9	6.9	370	Circumneutral
WRST_T40_02_2005	Nt	-80	N	D			N	A	0	0	G	G	0		0	7.6	70	Alkaline
WRST_T40_03_2005	U	-200	N	D			N	A	0	0	B	B	0		0	8	110	Alkaline
WRST_T40_04_2005	U	-150	N	D	999.9	999.9	N	A	2	2	B	B	6		0	8.1	180	Alkaline
WRST_T40_05_2005	U	-150	N	D	999.9	999.9	N	A	2	2	B	B	0		0	7.7	70	Alkaline
WRST_T40_06_2005	U	-150	N	M	999.9	999.9	N	A	10	10	L	L	21		0	5.4	180	Acidic
WRST_T40_07_2005	U	-150	N	M			N	A	5	5	L	L	12		0	6.6	140	Circumneutral
WRST_T40_08_2005	U	-150	N	M			N	P	25	25	L	O			0	4.9	80	Acidic
WRST_T40_09_2005	Nsa	-10	N	W			Y	P	13	17	L	L	27	41	0	6.5	30	Circumneutral
WRST_T41_01_2005	U	-150	N	D			N	U	0	0	B	B			999.9	7.4	180	Alkaline
WRST_T41_02_2005	U	-100	N	M			N	U	12	22	R	R			999.9	6.3	7	Circumneutral
WRST_T41_03_2005	U	-150	N	D			N	U			S	R			999.9	7.6	150	Alkaline
WRST_T41_04_2005	U	-20	Y	W			Y	U	20	20	G	G	0		999.9	6.9	200	Circumneutral
WRST_T41_05_2005	Nsa	-10	Y	W			Y	U	18	18	S	S	0	42	999.9	6	70	Circumneutral
WRST_T41_06_2005	Nsa	1	Y	W			Y	U	30	30	L	O		45	999.9	6.5	100	Circumneutral
WRST_T41_07_2005	U	-150	N	M			N	A	8	8	L	L			999.9	6.8	70	Circumneutral
WRST_T42_01_2005	U	-150	N	D			N	A	0	0	K	K	0	150	0	7.1	130	Circumneutral
WRST_T42_02_2005	U	-150	N	D			N	A	1	1	K	K	0	150	0	5.8	110	Circumneutral
WRST_T42_03_2005	U	-150	N	M			N	P	2	2	K	K	0		3	5.2	70	Acidic
WRST_T42_04_2005	U	-150	N	D			N	P	10	10	K	K	0	150	0	5.3	80	Acidic
WRST_T42_05_2005	U	-150	N	D			N	A	1	1	R	R	0		0	5.9	100	Circumneutral
WRST_T42_06_2005	U	-45	N	M			N	A	10	13	S	L	10	46	0	5.1	30	Acidic
WRST_T42_07_2005	Nse	-15	Y	M			Y	A	10	10	S	S	0	38	999.9	6.1	70	Circumneutral
WRST_T43_01_2005	U	-150	N	M			N	P	4	4	K	K			10	6.1	80	Circumneutral
WRST_T43_02_2005	Nsa	-35	N	M			Y	P	15	15	L	L		45	999.9	6.2	40	Circumneutral
WRST_T43_03_2005	U	-90	N	D			N	A	3	3	S	S		92	999.9	6	120	Circumneutral
WRST_T43_04_2005	Nsa	-10	N	M			Y	P	6	6	L	L		60	5	5.6	50	Circumneutral
WRST_T43_05_2005	U	-150	N	M			N	U	23	23	L	O			999.9	5.5	60	Acidic
WRST_T43_06_2005	Np	15	Y	A			Y	U	43	40	P	P		95	999.9	6.1	60	Circumneutral
WRST_T43_07_2005	Nsa	-21	Y	M			Y	A	17	17	S	S		47	999.9	5.7	50	Circumneutral
WRST_T43_08_2005		200	N	A			N	U	0		W	W			999.9	6.6	40	Circumneutral
WRST_T44_01_2005	U	-100	N	M			N	A	3	3	L	L	0	105	0	5.6	60	Circumneutral
WRST_T44_02_2005	Nsa	-8	Y	M			Y	P	3	3	L	L	30	105	5	5.6	60	Circumneutral
WRST_T44_03_2005	U	-150	N	M			N	A	2	2	R	R	2	150	0	5.7	10	Circumneutral
WRST_T44_04_2005	Nsa	-20	Y	M			Y	A	20	20	K	L		100	0	5.8	110	Circumneutral
WRST_T44_05_2005	Nsa	-12	Y	M			Y	A	18	18	S	S	0	100	0	5.8	40	Circumneutral
WRST_T45_01_2005	U	-150	N	D			N	P	0	0	K	K	0	150	1	6	30	Circumneutral
WRST_T45_02_2005	U	-150	N	M			N	A	1	1	K	K	0	150	0	6	10	Circumneutral
WRST_T45_03_2005		-150	N	M			N	A	1	1	R	R	0	150	0	5.6	10	Circumneutral
WRST_T45_04_2005	Nsa	-20	Y	M			N	A	10	10	R	R	4	100	0	6.4	180	Circumneutral
WRST_T45_05_2005	U	-150	N	D			N	A	1	1	K	K	3	150	0	5.5	30	Acidic
WRST_T45_06_2005	Nse	-150	N	D			N	A	0	0	B	B	0		0	6.4	30	Circumneutral
WRST_T45_07_2005	U	-150	N	D			N	U	0	0	K	K	0	150	0			no data
WRST_T45_08_2005	U	-150	N	D			N	A	1	1	K	K	2	150	0			no data
WRST_T46_01_2005	Nsa	-5	N	M			Y	U	13	28	L	O			999.9	5.8	140	Circumneutral
WRST_T46_02_2005	Nsa	-10	Y	W			Y	P	8	38	S	O			999.9	6.1	300	Circumneutral
WRST_T46_03_2005	U	-150	N	M			N	U	2	2	G	G			999.9	7.3	140	Circumneutral
WRST_T47_01_2005	Nsa	-55	Y	M			Y	P	8	10	L	L	4		0	6.4	90	Circumneutral
WRST_T47_02_2005	Nsa	-5	Y	W			Y	A	25	31	S	O		64	0	6.6	110	Circumneutral
WRST_T47_03_2005	Nsa	-40	Y	M	35	35	Y	A	4	4	L	L	10	74	0	6.3	80	Circumneutral
WRST_T47_04_2005	Np	-150	N	D			N	A	1	1	R	R	3		1	6.6	110	Circumneutral
WRST_T47_05_2005	U	-150	N	D			N	A	0	0	B	B	0		0	8.2	260	Alkaline
WRST_T47_06_2005	Nsa	-30	Y	M			Y	U	18	18	L	L	5		0			no data
WRST_T47_07_2005	U	-60	N	M			N	A	6	6	B	G	2		9	7.2	110	Circumneutral
WRST_T48_01_2005	U	-150	N	D			N	P	4	4	K	K			999.9	6.1	120	Circumneutral
WRST_T48_02_2005	U	-150	N	M			N	P	4	4	K	K		150	999.9	5.3	60	Acidic
WRST_T48_03_2005	U	-150	N	D			N	P	5	5	K	K			999.9	4.6	40	Acidic
WRST_T48_04_2005	U	-150	N	M			N	A	2	2	R	R			999.9	4.9	30	Acidic
WRST_T50_01_2005		100	Y	A			Y	U	0		W	W			999.9	6.9	170	Circumneutral
WRST_T50_02_2005	Nt	-40	N	M			N	A	0	0	B	B	0		0	7.4	120	Alkaline
WRST_T50_03_2005	Nt	-70	N	M			N	A	2	2	L	L	0		0	7.4	140	Alkaline
WRST_T50_04_2005	U	-150	N	M			N	A	3	8	L	L	0		0	6.1	70	Circumneutral

Appendix 3. Continued.

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T50_05_2005	U	-150	N	D			N	A	2	2	G	G	4		0	6.5	130	Circumneutral
WRST_T50_06_2005	U	-150	N	M			N	A	33	33	L	O	0		0	4.5	50	Acidic
WRST_T50_07_2005	U	-150	N	D			N	A	1	1	G	G	0		0	6.3	280	Circumneutral
WRST_T50_08_2005	U	-150	N	D			N	A	4	5	G	B	0		0	5.8	80	Circumneutral
WRST_T52_01_2005	U	-150	N	M			N	A	10	10	K	K	3		0	4.1	110	Acidic
WRST_T52_02_2005	U	-150	N	M			N	P	12	12	L	L	18		0	4.6	130	Acidic
WRST_T52_03_2005	Nsa	-19	Y	W	14		Y	P	10	10	L	L	0	39	0	4.8	430	Acidic
WRST_T52_04_2005	Nsa	-10	Y	W	23	23	Y	A	23	23	L	O	13	36	0	4.5	230	Acidic
WRST_T52_05_2005	Nse	3	Y	W			Y	A	100	40	P	P	0		0	5.2	40	Acidic
WRST_T52_06_2005	Nse	10	Y	A			N	a	100	40	P	P			999.9			no data
WRST_T52_07_2005	Np	200	Y	A			Y	U	0		W	W			999.9	5.7	50	Circumneutral
WRST_T53_01_2005	U	-150	N	D			N	U	1	1	R	R		150	999.9	8	200	Alkaline
WRST_T53_02_2005	U	-150	N	M			N	P	3	3	R	R		150	999.9	7.6	120	Alkaline
WRST_T53_03_2005	U	-150	N	D			N	U	1	1	R	R		150	999.9	7.7	100	Alkaline
WRST_T53_04_2005	U	-150	N	D			N	U	1	1	R	R		150	999.9	7.6	140	Alkaline
WRST_T53_05_2005	U	-150	N	D			N	P	2	2	K	K		150	999.9	7.7	130	Alkaline
WRST_T53_06_2005	U	-150	N	M			N	P	6	6	R	R		150	999.9	7.4	100	Alkaline
WRST_T53_07_2005	U	-150	N	M			N	U	4	4	L	L		150	999.9	6.9	110	Circumneutral
WRST_T55_01_2005	Nsa	-40	Y	M			Y	P	16	21	L	O	5	51	0.5	5.8	60	Circumneutral
WRST_T55_02_2005	U	-150	N	M			N	A	5	5	R	R	2	150	2	6.1	220	Circumneutral
WRST_T55_03_2005	U	-150	N	D			N	A	1	1	K	K	5		0	7.7	160	Alkaline
WRST_T55_04_2005	U	-150	N	D			N	A	1	1	R	R	13		0	7.2	100	Circumneutral
WRST_T55_05_2005	Nsa	-53	Y	M	10		Y	A	2	3	L	L	6		0	7	560	Circumneutral
WRST_T55_10_2005	Nsa	-23	Y	W	20		Y	P	6	6	L	O	51	55	0	5.2	130	Acidic
WRST_T56_01_2005	U	-69	N	D			N	A	0	0	K	K	0	70	0.1			no data
WRST_T56_02_2005	Nsa	-18	Y	M			Y	P	1.5	3	K	K	12	69	0.1	5.9	30	Circumneutral
WRST_T56_03_2005	Nsa	-30	Y	M	8	25	Y	P	2	5	L	L	34	69	7	6.6	160	Circumneutral
WRST_T56_04_2005	Nsa	-23	Y	W	20		Y	P	20	20	G	O	0	25	0.1	5.8	50	Circumneutral
WRST_T56_05_2005	Nsa	-25	Y	M			N	A	1.5	1.5	K	K	9		1	6.2	60	Circumneutral
WRST_T56_06_2005	Np	20	Y	A			N	U	0		W	W			999.9	6.5	40	Circumneutral
WRST_T56_07_2005	Nsa	-28	Y	W	10		Y	P	36	40	P	P	0	36	10	5.8	40	Circumneutral
WRST_T56_08_2005	Nsp	5	Y	W			Y	P	40		P	P		36	0	5.4	30	Acidic
WRST_T56_09_2005	Nsa	-30	Y	M	6		Y	A	15	15	L	L	8	64	0	6.1	50	Circumneutral
WRST_T56_10_2005	U	-150	N	M			N	A	8	8	K	K	1		0	5.8	30	Circumneutral
WRST_T58_01_2005	Nsa	-1	Y	W			Y	A	108	40	P	P	0	108	0	6.1	60	Circumneutral
WRST_T58_02_2005	Nsa	-13	Y	W	22		Y	P	13	13	L	L	7	61	2	5	140	Acidic
WRST_T58_03_2005	Nsa	-50	Y	M	10		Y	P	8	13	L	L	0	80	1	5.4	60	Acidic
WRST_T58_04_2005	U	-63	Y	M	25		N	P	9	9	L	L	8	65	0	4.1	40	Acidic
WRST_T58_05_2005	Nsa	-58	Y	M	14		Y	P	13	21	L	O	23	53	0	3.9	60	Acidic
WRST_T58_06_2005	Nsa	-20	Y	M	27		Y	A	27	34	L	O	5	49	0	5	130	Acidic
WRST_T58_07_2005	Nsa	-20	Y	M	33		Y	A	10	16	L	L	8	83	0	5.9	60	Circumneutral
WRST_T60_01_2005	Nsa	-15	Y	W		31	Y	P	30	32	L	O	20	54	0	5.7	50	Circumneutral
WRST_T60_02_2005	Nsp	20	Y	A			Y	A	40	40	P	P			0	5.6	30	Circumneutral
WRST_T60_03_2005		-150	N	M	60	60	N	A	11	11	S	S	0		0	5.8	10	Circumneutral
WRST_T60_04_2005	Nsa	-20	Y	W	8	8	Y	U	7	7	S	S	27	140	0	5.8	20	Circumneutral
WRST_T60_05_2005	Nsp	10	Y	W			Y	A	105	40	P	P		104	0	5.7	40	Circumneutral
WRST_T60_06_2005	Nsa	-40	n	M			Y	A	40	40	L	P		40	0	5.5	40	Acidic
WRST_T60_07_2005	Nsa	-40	Y	M	35	35	Y	P	25	27	L	O	5	97	0	6.2	50	Circumneutral
WRST_T60_08_2005	Nsp	10	Y	W			Y	U	40	40	P	P	0		0			no data
WRST_T61_01_2005	Te	-67	N	M			N	U			B	B	0		999.9	5.3	40	Acidic
WRST_T61_02_2005	U	-41	N	M			N	A	16	16	S	S	0	41	0			no data
WRST_T61_03_2005	U	-150	N	M			N	A	3	3	L	L			999.9	5.8	50	Circumneutral
WRST_T61_04_2005	Ti	-150	N	D			N	A	0	0	B	B	0		0	6.8	50	Circumneutral
WRST_T61_05_2005	Nse	-35	Y	M			Y	A	0	0	L	L	0		0	5.4	90	Acidic
WRST_T61_06_2005		-100	N	M			U	A	5	5	S	S	0		999.9	5.6	110	Circumneutral
WRST_T62_01_2005	Nse	-28	Y	M			N	A	0	0	G	G	0		0	7.6	280	Alkaline
WRST_T62_02_2005	U	-100	Y	M			Y	A	0	0	L	L	0		0			no data
WRST_T62_03_2005	U	-150	N	M			N	A	0	15	L	L	0		0			no data
WRST_T62_04_2005	U	-56	N	M			Y	A	28	30	L	O	15	57	0			no data
WRST_T62_05_2005	Np	10	Y	A			Y	A	38	38	O	O	0		0	6.8	130	Circumneutral
WRST_T62_06_2005	Nsa	-20	Y	W	17	18	Y	A	17	17	S	S	0	42	0	7.1	140	Circumneutral
WRST_T63_01_2005	Nsa	-3	Y	W		10	Y	p	8	19	L	L	19		999.9	5.6	60	Circumneutral
WRST_T63_02_2005	Nsa	-100	Y	M	8	13	Y	A	6	6	C	C	10		0	5.8	30	Circumneutral

Appendix 3. Continued.

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T63_03_2005	Nsp	-1	Y	W	10	12	Y	A	10	10	L	L	25	51	999.9	5.7	50	Circumneutral
WRST_T63_04_2005	Nsa	-33	Y	M	30	33	Y	A	12	12	L	L	18	34	0	5.8	60	Circumneutral
WRST_T63_05_2005	Nsa	-35	Y	M	10		Y	P	6	6	L	L	34	40	0	5.7	30	Circumneutral
WRST_T63_06_2005	Nsa	-50	Y	M	12	12	Y	A	11	11	C	C	0	88	0	6.2	70	Circumneutral
WRST_T63_07_2005	Nsp	-3	Y	W			Y	A	70	40	P	P	0		0	6	50	Circumneutral
WRST_T63_08_2005	Nsa	-50	Y	M		46	Y	A	5	5	L	L	35	73	0	6.4	40	Circumneutral
WRST_T63_09_2005	Nsa	-37	n	M			Y	A	38	40	P	P		38	0	5.7	60	Circumneutral
WRST_T63_10_2005	Nsa	-31	Y	M			Y	A	15	15	L	O	15	31	0	5.7	30	Circumneutral
WRST_T63_11_2005		-5	Y	W			Y	A	51	40	P	P		51	0	4	6	Acidic
WRST_T64_01_2005	U	-62	N	M			N	P	5	7	L	L	0	63	0	5.5	130	Acidic
WRST_T64_02_2005	Nsa	-23	Y	M	27		Y	A	8	17	L	L	15	74	1	6.5	70	Circumneutral
WRST_T64_03_2005	Nse	-1	Y	W			Y	A	46	40	P	P	0	46	0	5.9	70	Circumneutral
WRST_T64_04_2005	U	-150	N	M			N	A	10	14	G	G	7		0	4.6	30	Acidic
WRST_T64_05_2005	Nsa	-14	Y	W	20		Y	A	15	15	S	S	0	125	0	5.1	20	Acidic
WRST_T64_06_2005	Np	200	Y	A			Y	U	0		W	W			999.9	6.3	30	Circumneutral
WRST_T64_07_2005	Np	100	Y	A			Y	U	0		w	W			999.9	6.6	40	Circumneutral
WRST_T64_08_2005	Nsa	-2	Y	W			Y	P	52	40	P	P	0	52	0	5.8	70	Circumneutral
WRST_T65_01_2005	U	-150	N	D			N	U			R	R			999.9	5.7	30	Circumneutral
WRST_T65_02_2005	U	-150	N	M			N	U	1	1	R	R			999.9	5.6	20	Circumneutral
WRST_T65_03_2005	Nsa	0	Y	W			Y	U	10	10	S	S			999.9	6.2	180	Circumneutral
WRST_T65_04_2005	U	-150	N	M			N	U	3	3	S	L			999.9	5.6	40	Circumneutral
WRST_T65_05_2005	U	-150	N	M			N	U	5	5	R	R			999.9	6.2	50	Circumneutral
WRST_T65_06_2005	Nsa	-20	Y	M			Y	U	42	40	P	P		72	999.9	5.8	70	Circumneutral
WRST_T65_07_2005	U	-150	N	M			N	U	13	13	L	L			999.9	5.8	40	Circumneutral
WRST_T65_08_2005	Nse	-18	Y	W			Y	P	8	8	L	L		92	999.9	6	90	Circumneutral
WRST_T65_09_2005	U	-150	N	M			N	P	7	7	R	R			999.9	6.1	60	Circumneutral
WRST_T65_10_2005	U	-150	N	M			N	U	6	6	S	L			999.9	5.8	40	Circumneutral
WRST_T67_01_2005	Nsa	-2	Y	W			Y	A	86	40	P	P	0	86	0	6	160	Circumneutral
WRST_T67_02_2005	U	-150	N	M			N	A	6	6	L	L	28		0	5.2	40	Acidic
WRST_T67_03_2005	Nsa	-30	Y	W	18	36	Y	P	12	12	L	L	6	66	0	5.4	40	Acidic
WRST_T67_04_2005	U	-47	N	M	14		N	A	14	14	L	L	34	48	0	5.9	120	Circumneutral
WRST_T67_05_2005	U	-150	N	M			N	P	7	7	L	L	7		0	5.9	70	Circumneutral
WRST_T67_06_2005	Nse	2	Y	W			Y	A	56	40	P	P	0	56	0	6.4	240	Circumneutral
WRST_T67_07_2005	Nsp	12	Y	A			Y	A	53	40	P	P	0	53	0	6.9	230	Circumneutral
WRST_T67_08_2005	Np	50	Y	A			Y	U			W	W			0	7.7	220	Alkaline
WRST_T67_09_2005	U	-75	N	M			N	U	10	10	L	L	20	75	999.9	6.1	80	Circumneutral
WRST_T68_01_2005	Np	80	N	A			N	U	0		W	W			999.9	6.3	60	Circumneutral
WRST_T68_02_2005	Nsa	0	Y	W			Y	U	45	40	P	P			999.9	5.3	90	Acidic
WRST_T68_03_2005	Nsa	-50	Y	M			Y	U	32	32	L	O	7	40	999.9	6.3	70	Circumneutral
WRST_T68_04_2005	U	-200	N	D			N	A	0	1	G	G			999.9	7.1	230	Circumneutral
WRST_T68_05_2005	U	-150	N	M			N	U	10	10	S	S	12		999.9	6.3	70	Circumneutral
WRST_T68_06_2005	U	-200	N	D			N	U	8	8	G	G	0		999			no data
WRST_T69_01_2005	U	-150	N	M	5		N	A	0	0	L	L	0		50	6.2	10	Circumneutral
WRST_T69_02_2005	Np	35	Y	A			Y	U	0		W	W			999.9	6.1	10	Circumneutral
WRST_T69_03_2005	U	-150	N	M			N	P	0.5	0.5	L	L	4		0	5.6	10	Circumneutral
WRST_T69_04_2005	U	-150	N	M			N	A	0.5	0.5	L	L	20		0.1	5.6	20	Circumneutral
WRST_T69_05_2005	U	-150	N	M			N	A	6	6	L	L	20		0	4.7	60	Acidic
WRST_T69_06_2005	U	-150	N	M			N	A	4	4	L	L	50		0			no data
WRST_T70_01_2005	Np	150	Y	A			Y	U	0		w	W			999.9	7.6	10	Alkaline
WRST_T70_02_2005	Nsa	-45	Y	M			Y	A	0	0	G	G	0		50	5.8	20	Circumneutral
WRST_T70_03_2005	U	-150	N	M			N	A	9	12	L	L	44		0	3.7	50	Acidic
WRST_T70_04_2005	U	-150	N	M			N	P	2	2	L	L	46		0	5.2	10	Acidic
WRST_T70_05_2005	U	-150	N	M			N	P	10	10	L	L	40		0	3.8	30	Acidic
WRST_T70_06_2005	Nsp	1	Y	W			Y	A	80	40	P	P	0		0	5.1	60	Acidic
WRST_T70_07_2005	Np	30	Y	A			Y	U	0		W	W			0	5.5	30	Acidic
WRST_T70_08_2005	Nsa	-15	Y	W			Y	A	9	9	G	G	0		0	5.3	50	Acidic
WRST_T71_01_2005	Nsa	-5	Y	W			Y	A	5	5	L	L	35		0	5.1	70	Acidic
WRST_T71_02_2005	Nse	-85	N	M			N	A	2	2	L	L	95		0	5.1	40	Acidic
WRST_T71_03_2005	Nsp	5	Y	W			Y	A	60	40	P	P	0		0	6.1	230	Circumneutral
WRST_T71_04_2005	Nsp	3	Y	W			Y	A	110	40	P	P	0		0	5.9	110	Circumneutral
WRST_T73_01_2006	U	-200	n	M			n	a	6	6	L	L	0		0	6.4	160	Circumneutral
WRST_T73_02_2006	U	-42	n	M	999	999	n	A	13	14	R	R	0		0	6.2	90	Circumneutral
WRST_T73_03_2006	U	-200	n	M	999	999	n	a	4	4	S	S	0		0	6.4	50	Circumneutral

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T73_04_2006	U	-200	n	M	999	999	n	a	6	6	L	L	0		0	6.1	70	Circumneutral
WRST_T74_01_2006	Np	20	y	A	999	999	y	u	0		W	W	0		0	7.4	70	Alkaline
WRST_T74_02_2006	Nse	2	y	W	999	999	y	A	29	29	L	O	0	51	0	6.4	70	Circumneutral
WRST_T74_03_2006	Nsa	-18	y	W	999	999	y	A	25	25	P	P	0	25	0	6.6	40	Circumneutral
WRST_T74_04_2006	U	-200	n	M	999	999	n	0	16	16	R	R	0		0	4.1	80	Acidic
WRST_T74_05_2006	U	-13	y	W	999	999	y	0	16	16	R	R	0		0	6	40	Circumneutral
WRST_T74_06_2006	U	-200	n	M	999	999	n	0	18	18	R	R	0		0	4.1	40	Acidic
WRST_T74_07_2006	U	-37	y	M	999	999	y	a	32	32	R	O	0		0	5.2	80	Acidic
WRST_T74_08_2006	U	-200	n	M	999	999	n	a	13	13	R	R	0		0	4.6	70	Acidic
WRST_T75_01_2006	Nsa	-10	y	W	999	999	y	p	29	29	P	P	0	29	0	6	20	Circumneutral
WRST_T75_02_2006	Nsa	-28	y	W	a	a	y	a	11	11	L	L	22	33	0	5.7	40	Circumneutral
WRST_T75_03_2006	U	-200	n	M	a	a	n	a	4	4	L	L	28		0	5.4	90	Acidic
WRST_T75_04_2006	Nsa	-7	y	W	999	999	y	a	14	14	L	L	8	22	0	5.6	40	Circumneutral
WRST_T75_05_2006	Nse	0	y	W	999	999	y	a	29	29	L	O	0	52	0	5.6	50	Circumneutral
WRST_T75_06_2006	Nsa	-20	y	W	a	a	y	a	23	23	P	P	0	23	0	5.1	40	Acidic
WRST_T76_01_2006	Np	30	y	A	999	999	y		0		w	W				8.4	110	Alkaline
WRST_T76_02_2006	Nse	-40	n	D	999	999	n	a	0	0	G	G	0		0	8	320	Alkaline
WRST_T76_03_2006	Nsa	-7	n	W	999	999	y	a	2	2	L	L	0		0	7.7	570	Alkaline
WRST_T76_04_2006	U	-49	n	M	999	999	y	a	33	33	L	O	0		0	4.8	190	Acidic
WRST_T76_05_2006	Np	40	y	A	999	999	y	u	43	43	P	P	0		0	7.6	390	Alkaline
WRST_T76_06_2006	Nsa	-28	y	W	999	21	y	a	21	21	L	O	0	28	0	5.1	70	Acidic
WRST_T76_07_2006	U	-100	n	M	999	999	n	a	3	3	S	S	0		0	7.4	80	Alkaline
WRST_T76_08_2006	U	-44	n	M	999	999	n	a	0	0	G	G	0		0	8	80	Alkaline
WRST_T77_01_2006	u		n	M	999	999	n	a	2	2	K	K	0		0	6.7	70	Circumneutral
WRST_T77_02_2006	u		n	M	999	999	n	p	4	4	r	R	0		0	6.3	500	Circumneutral
WRST_T77_03_2006	u		n	M	999	999	n	p	7	7	l	L	0		0	5.7	80	Circumneutral
WRST_T77_04_2006	u		n	M	999	999	n	a	6	6	l	L	0		0	5.3	60	Acidic
WRST_T77_05_2006	u		n	M	999	999	n	n	16	16	l	L	0	43	0	5.1	80	Acidic
WRST_T77_06_2006	Nsa	-6	y	W			y	n	35	35	l	O	0	40	0	7.1	370	Circumneutral
WRST_T78_01_2006	nsa	-30	y	M	11	999	y	a	12	12	L	L	0	30	0	6.3	140	Circumneutral
WRST_T78_02_2006	Nsa	-17	y	W	999	999	y	a	6	6	S	S	999	19	0	6	60	Circumneutral
WRST_T78_03_2006	nsa	-15	y	W	999	999	y	a	23	23	P	P	999	23	0	6.3	30	Circumneutral
WRST_T78_04_2006	Nsa	-5	y	W	999	999	y	p	9	9	L	L	999	16	0	6.5	20	Circumneutral
WRST_T78_05_2006	Np		y	A	999	999	y	u	0		w	W	999		0	7	30	Circumneutral
WRST_T78_06_2006	Nsp	12	y	W			y	a	25	25	P	P	999	25	0	6.9	20	Circumneutral
WRST_T78_07_2006	nsa	-20	y	M	999	999	y	a	20	20	g	O	999	44	0	6.5	20	Circumneutral
WRST_T78_08_2006	Nsa	-17	y	W	999	999	y	0	3	3	g	G	999		0	7	220	Circumneutral
WRST_T78_09_2006	Nsa	-7	y	W	999	999	y	p	15	15	P	O	999	15	0	6.9	20	Circumneutral
WRST_T79_01_2006	u		n	M	999	999	n	u	0	0	r	R	0		0	8	200	Alkaline
WRST_T79_02_2006	u		n	M	999	999	n	0	4	4	l	L	0		0	6	90	Circumneutral
WRST_T79_03_2006	u	-150	n	M	999	999	n	u	5	5	l	L	0		0	6.1	90	Circumneutral
WRST_T79_04_2006	u		n	M	999	999	n	0	6	6	s	S	0		0	6.1	160	Circumneutral
WRST_T79_05_2006	u	-150	n	M	999	999	n	0	3	3	l	L	9		0	5.8	70	Circumneutral
WRST_T79_06_2006	Nsa	-6	y	W	999	999	y	a	24	24	l	O	0	23	0	5.9	40	Circumneutral
WRST_T79_07_2006	Nsa	-33	y	M	999	999	y	y	20	20	l	L	0	33	0	6.3	70	Circumneutral
WRST_T79_08_2006	Nsa	-22	y	M	999	999	y	p	28	28	l	O	0	30		6.7	40	Circumneutral
WRST_T79_09_2006	nsa	-33	y	M	999	999	y	p	15	15	L	L	0	31		6.3	30	Circumneutral
WRST_T80_01_2006	U		n	D	999	999	n	p	2	2	K	K	0		0.1	6.1	100	Circumneutral
WRST_T80_02_2006	U	-150	n	M	999	999	n	p	3	3	L	L	0		0.1	5.3	40	Acidic
WRST_T80_03_2006	U		n	M	999	999	n	p	3	3	K	K	0		0	4.5	80	Acidic
WRST_T80_04_2006	U		n	M	999	999	n	a	2	6	L	L	0		0	6.5	170	Circumneutral
WRST_T80_05_2006	U		n	M	999	999	n	a	4	4	L	L	28		0	4.8	70	Acidic
WRST_T80_06_2006	U		n	M	999	999	n		14	18	L	L	16		0			no data
WRST_T80_07_2006	U		n	M	999	999	n	p	7	9	K	K	15		0			Acidic
WRST_T80_08_2006	Nsa	-28	y	W	999	999	y	a	32	32	P	P	0	32	0			no data
WRST_T81_01_2006	U		n	D	999	999	n	a	0	0	B	B	0		0	5.9	10	Circumneutral
WRST_T81_02_2006	U		n	M	999	999	n	a	1	1	L	L	0		2	5.7	10	Circumneutral
WRST_T81_03_2006	Nsa	-28	y	M	999	999	y	p	4	10	L	L	0	42	0.1	5.4	40	Acidic
WRST_T81_04_2006	Nse	3	y	W	0	16	y	a	16	16	L	L	0	33	0	5.9	220	Circumneutral
WRST_T81_05_2006	Nsa	-10	y	W	999	8	y	a	2	7	L	L	0	32	1			no data
WRST_T81_06_2006	Nsa	-12	y	W	999	7	y	a	7	10	L	L	0	28	0.1	6.2	70	Circumneutral
WRST_T81_07_2006	U		n	M	999	999	n	a	4	4	L	L	0		3	5.6	20	Circumneutral
WRST_T81_08_2006	Nt	-60	n	M	999	999	y	a	0	0	K	K	0		0			no data

Appendix 3. Continued.

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T81_09_2006	Nse	1	y	W	999	999	y	a	29	29	P	P	0	29	0	4.9	120	Acidic
WRST_T81_10_2006	U		n	D	999	999	n	a	1	1	B	B	0		1	5.1	10	Acidic
WRST_T81_11_2006	Np	100	y	A	999	999	y	a	0	0	w	W	999		999	6.1	50	Circumneutral
WRST_T82_01_2006	Np	17	y	A	999	999	y	a	39	39	P	P	0	39	0	5.8	50	Circumneutral
WRST_T82_02_2006	u		n	M	999	999	n	a	14	14	l	L	106		0	5.3	90	Acidic
WRST_T82_03_2006	Np	120	y	A	999	999	y	u	0		w	W	0		0	7.1	60	Circumneutral
WRST_T82_04_2006	Nsa	-7	y	W	999	999	y	a	33	33	P	P	0	33	0	5.6	30	Circumneutral
WRST_T82_05_2006	Nsa	-28	y	W	999	999	y	p	32	32	P	P	0	32	0	4.6	30	Acidic
WRST_T82_06_2006	Nsa	-23	y	W	999	999	y	a	9	9	L	L	0	23	0	5.3	90	Acidic
WRST_T82_07_2006	u		n	M	999	999	n	p	12	24	s	S	0	43	1	5.2	80	Acidic
WRST_T83_01_2006	Nsa	-20	y	W	999	999	y	a	40	40	P	P	0		0	5.7	70	Circumneutral
WRST_T83_02_2006	Nse	-1	y	W	999	999	y	a	60	40	P	P	0		0	5.5	80	Acidic
WRST_T83_03_2006	U		n	M	999	999	n	a	4	4	L	L	22		0	6	60	Circumneutral
WRST_T83_04_2006	U		n	M	34	999	n	p	12	12	L	L	24		0	4.9	80	Acidic
WRST_T83_05_2006	U		n	M	999	999	n	a	4	4	R	R	14		0	6.6	60	Circumneutral
WRST_T83_06_2006	U		n	M	999	999	n	a	3	3	L	L	22		0	5.8	30	Circumneutral
WRST_T83_07_2006	Nsa	-18	y	W	999	999	y	p	23	23	L	O	19	42	0	6.6	330	Circumneutral
WRST_T83_08_2006	Nse	-5	y	W	999	999	y	a	60	40	P	P	999		0	6.2	130	Circumneutral
WRST_T83_09_2006	Np	60	y	A	999	999	y	a	0		W	W			999	6.6	60	Circumneutral
WRST_T83_10_2006	Nsa	-28	y	W	999	999	y	a	28		P	P	0	28	0	4.6	80	Acidic
WRST_T85_01_2006	nsa	-10	y	W	999	999	y	p	13	30	l	O	0	43	10	6.2	20	Circumneutral
WRST_T85_02_2006	nsa	-28	y	M	999	999	y	p	16	16	B	B	0	63	10	6.8	50	Circumneutral
WRST_T85_03_2006	u		n	M	999	999	n	p	10	10	B	B	0		40	5.8	20	Circumneutral
WRST_T85_04_2006	u		n	M	999	999	n	p	20	20	K	K	0	50	0	5.6	20	Circumneutral
WRST_T85_05_2006	nsa	-13	y	W	999	999	y	p	30	30	l	O	0	33	2	5.8	20	Circumneutral
WRST_T85_06_2006	u		n	D	999	999	n	a	2	2	B	B	0		0	6.1	40	Circumneutral
WRST_T85_07_2006	u		n	M	999	999	n	u	10	10	l	L	0	48	0	5.7	20	Circumneutral
WRST_T85_08_2006	u	-150	n	M	999	999	n	999	8	8	l	L	0	43	0	5.6	50	Circumneutral
WRST_T86_01_2006	U		n	D	999	999	n	a	0	0	G	G	0		0	8	360	Alkaline
WRST_T86_02_2006	U			D	999	999	n	a	0	0	G	G	0		0	8.3	100	Alkaline
WRST_T86_03_2006	U		n	D	999	999	n	a	0	0	L	L	0		0	8.1	180	Alkaline
WRST_T86_04_2006	U		n	D	999	999	n	a	2	2	L	L	14		0	8.3	110	Alkaline
WRST_T86_05_2006	U		n	D	999	999	n	a	0	0	L	L	0		0	8.1	580	Alkaline
WRST_T86_06_2006	U		n	D	999	999	n	a	0	0	L	L	0		0	8.1	580	Alkaline
WRST_T86_07_2006	U		n	M	999	999	n	p	4	7	L	L	36		0	5.8	80	Circumneutral
WRST_T86_08_2006	U	-150	n	M	999	999	n	a	5	7	S	S	0		0	6	30	Circumneutral
WRST_T87_01_2006	U		n	D	999	999	n	a	0	0	R	R	10		0	8	70	Alkaline
WRST_T87_02_2006	U	-150	n	M	999	999	n	a	3	8	S	L	0		0	7.2	90	Circumneutral
WRST_T87_03_2006	U		n	M	999	999	n	a	2	7	L	L	0		0	7.3	70	Circumneutral
WRST_T87_04_2006	U	-150	u	M	999	999	n	a	3	9	L	L	0		0	7.1	50	Circumneutral
WRST_T87_05_2006	U	-100	n	D	999	999	n	a	0	0	S	S	2		0	8.2	50	Alkaline
WRST_T87_06_2006	U	-150	u	M	23	999	n	a	1	3	L	L	0		0	7.1	100	Circumneutral
WRST_T87_07_2006	Nse	-75	n	M	999	999	n	a	2	3	S	S	0		0	8	250	Alkaline
WRST_T87_08_2006	U	-100	n	D	999	999	n	a	0	0	G	G	0			7.3	60	Circumneutral
WRST_T87_09_2006	U	-150	n	M	999	999	n	a	4	11	L	L	0		0	7.9	50	Alkaline
WRST_T87_10_2006	U		n	M	999	999	n	n	5	10	L	L	0		0	6.8	150	Circumneutral
WRST_T87_11_2006	Np	40	y	A	999	999	y	u	15	15	w	W	0		0	6.9	250	Circumneutral
WRST_T88_01_2006	U	-150	n	M	999	999	n	a	8	8	K	K	0		0	6.4	140	Circumneutral
WRST_T88_02_2006	U	-150	n	M	999	999	n	a	18	18	R	R	0		0	5.6	40	Circumneutral
WRST_T88_03_2006	U	-150	n	M	999	999	n	0	23	23	L	O	0		0	5.6	170	Circumneutral
WRST_T88_04_2006	U	-150	n	M	999	999	n	0	7	7	L	L	0		0	5.7	140	Circumneutral
WRST_T88_05_2006	U		n	M	a	a	y	a	23	23	O	O	0	57	0	4.8	120	Acidic
WRST_T88_06_2006	U		n	M	999	999	n	0	15	15	L	L	0		0	6.4	100	Circumneutral
WRST_T88_07_2006	U		n	M	999	999	n	0	10	10	R	R	0		0	4.9	50	Acidic
WRST_T89_01_2006	Nsp	0	y	W	999	999	y	a	57	40	P	P	0		0	6.8	330	Circumneutral
WRST_T89_02_2006	Nsa	-27	y	W	999	999	y	a	13	13	L	L	999	28	0	7	110	Circumneutral
WRST_T89_03_2006	U		n	M	999	999	n	a	12	37	L	O	0		0	5.4	110	Acidic
WRST_T89_04_2006	Nsa	-5	y	W	0	0	y	a	40	40	P	P	0		0	6.6	280	Circumneutral
WRST_T89_05_2006	U		n	M	999	999	n	a	11	11	L	L	0		0	6.8	50	Circumneutral
WRST_T89_06_2006	U		n	M	999	999		a	7	7	L	L	31		0	7.9	90	Alkaline
WRST_T89_07_2006	U		n	M	999	999	n	a	7	7	L	L	31		0	7	110	Circumneutral
WRST_T90_01_2006	Nsa		y	M	999	999	y	p	14	14	L	L	999	43	0	7.3	170	Circumneutral
WRST_T90_02_2006	Nsa	-15	y	W	999	999	y	a	40	40	P	P	0		0	6.3	170	Circumneutral

Appendix 3. Continued.

Plot ID	NWIWaterReg	WaterDepth	Saturated30cm	SoilMoisture	LowMottDep	LowMatrDep	HydricSoil	Cryoturb	SurfOrg	CumOrg40	DomMineral40	DomText40	LoessThick	ThawDepth	FrostBoil	SitepH	SiteEC	Site Chemistry
WRST_T90_03_2006	Nsa	-15	y	W	999	999	y	a	40	40	P	P	0		0	6.8	170	Circumneutral
WRST_T90_04_2006	Nsp	-2	y	W	999	999	y	a	40	40	P	P	0	55	0	6.3	110	Circumneutral
WRST_T90_05_2006	U		n	M	999	999	n	a	3	3	L	L	21		0	6.8	130	Circumneutral
WRST_T90_06_2006	U		n	M	999	999	n	a	6	6	L	L	41		0	5.4	80	Acidic
WRST_T90_07_2006	Nse	-5	y	W	999	999	y	a	36	36	L	P	0	69	0	7.4	250	Alkaline
WRST_V07_01_2004	nd		nd	M			u					S						no data
WRST_V11_01_2004	U	-100	n	M	a	a	n	A	0	0	S	S	0					no data
WRST_V14_01_2004	nd			M	nd	nd	u				G	G						no data
WRST_V30_01_2004	nd	0	nd	M	nd	nd	u				K	K						Circumneutral

Appendix 4. List of vascular plant species found in Wrangell-St. Elias National Park and Preserve, southcentral Alaska, 2004–2006.

Adoxaceae
- Adoxa moschatellina L.

Araliaceae
- Oplopanax horridus (Smith) Miquel

Aspidiaceae
- Dryopteris dilatata (Hoffm.) A.Gray ssp. Americana (Fisch.) Hult.
- Gymnocarpium dryopteris (L.) Newm.

Athyriaceae
- Athyrium filix-femina (L.) Roth
- Cystopteris fragilis (L.) Bernh.
- Cystopteris montana (Lam.) Bernh.
- Woodsia alpina (Bolton) S.F. Gray
- Woodsia glabella R. Br.

Betulaceae
- Alnus crispa (Ait.) Pursh
- Alnus sinuata (Regel) Rydb.
- Alnus tenuifolia Nutt.
- Betula glandulosa Michx.
- Betula hybrids
- Betula nana L.
- Betula occidentalis Hooker
- Betula papyrifera Marsh. var humilis (Reg.) Fern. & Raup

Boraginaceae
- Lappula myosotis Moench
- Lappula squarrosa (Retz.) Dumort
- Mertensia paniculata (Ait.) G. Don
- Myosotis alpestris F. W. Schmidt ssp. asiatica Vestergr.

Campanulaceae
- Campanula lasiocarpa Cham.
- Campanula latisepala Hult.
- Campanula rotundifolia L.
- Campanula uniflora L.
- Lomatogonium rotatum (l.) E. Fries

Caprifoliaceae
- Linnaea borealis L.
- Sambucus racemosa L
- Viburnum edule (Michx.) Raf.

Caryophyllaceae
- Cerastium beeringianum Cham. & Schlecht.
- Cerastium beeringianum Cham. & Schlecht. var. beeringianum
- Cerastium beeringianum Cham. & Schlecht. var. grandiflorum (Fenzl.) Hult.
- Honckenya peploides (L.) Ehrh.
- Melandrium apetalum (L.) Fenzl.
- Melandrium taimyrense Tolm.
- Minuartia arctica (Stev.) Aschers. & Graebn
- Minuartia dawsonensis (Britt.) Mattf.
- Minuartia macrocarpa (Pursh) Ostenf.
- Minuartia obtusiloba (Rydb.) House
- Minuartia rubella (Wahlenb.) Graebn.
- Moehringia lateriflora (L.) Fenzl
- Sagina saginoides (L.) Karst.
- Silene acaulis L.
- Silene menziesii Hook.
- Silene repens Patrin
- Stellaria alaskana Hult.
- Stellaria borealis Bigelow
- Stellaria calycantha (Ledeb.) Bong.
- Stellaria edwardsii R. Br.
- Stellaria laeta Richards.
- Stellaria longifolia Muhl. ex Willd.
- Stellaria longipes Goldie
- Stellaria monantha Hult.
- Stellaria sitchana Steud var. bongardiana (Fern.) Hult.
- Wilhelmsia physodes (Fisch.) McNeill

Compositae (Asteraceae)
- Achillea borealis Bong
- Achillea millefolium L.
- Antennaria friesiana (Trautv.) Ekman
- Antennaria isolepis Greene
- Antennaria monocephala DC.
- Antennaria pallida E. Nels.
- Antennaria pulcherrima (Hook.) Greene
- Arnica alpina (L.) Olin ssp. angustifolia (M. Vahl) Maguire
- Arnica cordifolia Hook.
- Arnica frigida C.A. Mey.
- Arnica latifolia Bong.
- Arnica lessingii Greene
- Arnica mollis Hook
- Artemisia alaskana Rydb.
- Artemisia arctica Less.
- Artemisia arctica Less. ssp. arctica
- Artemisia borealis Pall.
- Artemisia frigida Willd.
- Artemisia furcata Bieb.
- Artemisia tilesii Ledeb.
- Aster junciformis Rydb.
- Aster sibiricus L.
- Crepis elegans Hook.
- Crepis nana Richards.
- Crepis tectorum L.
- Erigeron acris L.
- Erigeron caespitosus Nutt.
- Erigeron humilis Graham
- Erigeron lonchophyllus Hook.
- Erigeron peregrinus (Pursh) Greene
- Erigeron purpuratus Greene
- Petasites frigidus (L.) Franchet
- Petasites hyperboreus Rydb.
- Petesites sagittatus (Banks) Gray

Prenanthes alata (Hook.) Dietr.
Saussurea angustifolia (Willd.) DC.
Saussurea viscida Hultén var. yukonensis (Porsild) Hultén
Senecio atropurpureus (Ledeb.) Fedtsch.
Senecio atropurpureus (Ledeb.) Fedtsch. ssp. frigidus (Richards.) Hult.
Senecio fuscatus (Jord. & Fourr.) Hayek
Senecio lugens Richardson
Senecio pauciflorus Pursh
Senecio pseudoarnica Less.
Senecio resedifolius Less.
Senecio triangularis Hook.
Solidago decumbens Greene var. oreophila (Rydb.) Fern.
Solidago lepida DC.
Solidago multiradiata Ait.
Solidago multiradiata Ait. var. multiradiata
Taraxacum alaskanum Rydb.
Taraxacum ceratophorum (Ledeb.) DC.
Taraxacum officinale Weber

Cornaceae

Cornus canadensis L.
Cornus stolonifera Michx.
Cornus suecica L.

Cruciferae (Brassicaceae)

Arabis divaricarpa Nels.
Arabis drummondii Gray
Arabis holboellii Hornem.
Arabis lyrata L. ssp. kamchatica (Fisch.) Hult.
Barbarea orthoceras Ledeb.
Braya glabella Richards. ssp. glabella
Braya humilis (C.A. Mey.) Robins.
Cardamine bellidifolia L.
Cardamine pratensis L. ssp. angustifolia (Hook.) O.E. Schultz
Draba borealis DC.
Draba cana Rydb. [=D. lanceolata Royle In: Hulten)
Draba exalata Ekman
Draba juvenilis Komarov
Draba lactea Adams
Draba longipes Raup
Draba macounii O.E. Schultz
Erysimum inconspicuum (S. Wats.) MacM.
Erysimum pallasii (Pursch) Fern.
Eutrema edwardsii R. Br.
Halimolobos mollis (Hook.) Rollins
Parrya nudicaulis (L.) Regel
Rorippa barbareaefolia (DC.) Kitigawa
Rorippa islandica (Oeder) Borbás ssp. fernaldiana (Butters & Abbe) Hultén
Subularia aquatica L.

Cryptogrammaceae

Cryptogramma crispa (L.) R. Br.

Cupressaceae

Juniperus communis L.
Juniperus horizontalis Moench.

Cyperaceae

Carex adelostoma Krecz.
Carex albo-nigra Mack.
Carex anthoxanthea Presl
Carex aquatilis Wahlenb. ssp. aquatilis
Carex atrofusca Schkuhr
Carex atrosquama Mackenzie
Carex aurea Nutt.
Carex bigelowii Torr.
Carex buxbaumii Wahlenb.
Carex canescens L.
Carex capillaris L.
Carex capitata Soland. In L.
Carex chordorrhiza Ehrh.
Carex concinna R. Br.
Carex diandra Schrank
Carex dioica gynocrates (Wormsk.) Hult.
Carex disperma Dew.
Carex eburnea Boott.
Carex filifolia Nutt.
Carex garberi Fern. ssp. bifaria (Fern.) Hult.
Carex glacialis Mack.
Carex holostoma Drej.
Carex interior Bailey
Carex kelloggii W. Boott
Carex krausei Boeck.
Carex lachenalii Schkuhr.
Carex lapponica Lang
Carex lasiocarpa Ehrl. ssp. americana (Fern.) Hult.
Carex leptalea Wahlenb.
Carex limosa L.
Carex livida (Wahlenb.) Willd.
Carex lyngbyaei Hornem.
Carex macrochaeta C.A. Mey.
Carex maritima Gunn.
Carex media R. Br.
Carex membranacea Hook.
Carex microchaeta Holm.
Carex misandra R. Br.
Carex nardina E. Fries
Carex nesophila Holm.
Carex nigricans C.A. Meyer
Carex obtusata Lilj.
Carex oederi Retz. ssp. viridula (Michx.) Hult.
Carex pauciflora Lightf.
Carex petricosa Dewey
Carex pluriflora Hult.
Carex podocarpa C. B. Clarke
Carex rossii Boott
Carex rostrata Stokes
Carex rotundata Wahlenb.
Carex rupestris All.

Carex saxatilis L.ssp. laxa (Trautv.) Kalela
Carex scirpoidea Michx.
Carex sitchensis Prescott
Carex spectabilis Dewey
Carex stylosa C. A. Mey
Carex supina Willd. ssp. spaniocarpa (Steud.) Hultén
Carex tenuiflora Wahlenb.
Carex utriculata F. Boott
Carex vaginata Tausch
Carex Williamsii Britt.
Eleocharis acicularis (L.) Roem. & Schult.
Eleocharis palustris (L.) Roem. & Schult.
Eleocharis quinqueflora (F. Hartmann) O. Schwarz
Eriophorum angustifolium Honck. ssp. subarcticum (V. Vassiljev) Hult.
Eriophorum brachyantherum Trautv. & Mey.
Eriophorum callitrix Cham.
Eriophorum russeolum Fries
Eriophorum scheuchzeri Hoppe
Eriophorum vaginatum L.
Kobresia myosuroides (Vill.) Fiori & Paol.
Kobresia simpliciuscula (Wahlenb.) Mack.
Trichophorum alpinum (L.) Pers.
Trichophorum caespitosum (L.) Hartm.

Diapensiaceae

Diapensia lapponica L.

Droseraceae

Drosera anglica Huds.
Drosera rotundifolia L.

Elaegnaceae

Elaeagnus commutata Bernh.
Shepherdia canadensis (L.) Nutt.

Empetraceae

E. nigrum L. ssp. hermaphroditum (Lange) Boecher
Empetrum nigrum L.

Equisetaceae

Equisetum arvense L.
Equisetum fluviatile L. ampl. Ehrh.
Equisetum palustre L.
Equisetum pratense L.
Equisetum scirpoides Michx.
Equisetum sylvaticum L.
Equisetum variegatum Schleich.

Ericaceae

Andromeda polifolia L.
Arctostaphylos alpina (L.) Spreng.
Arctostaphylos rubra (Rehd. & Wilson) Fern.
Arctostaphylos uva-ursi (L.) Sprengel
Cassiope stelleriana(Pall.) DC.
Cassiope tetragona (L.) D. Don
Chamaedaphne calyculata (L.) Moench
Ledum decumbens (Ait.) Lodd.
Ledum groenlandicum Oeder
Loiseleuria procumbens (L.) Desv.
Oxycoccus microcarpus Turcz. ex Rupr.
Phyllodoce aleutica (Spreng.) A. A. Heller
Rhododendron lapponicum (L.) Wahlenb.
Vaccinium alaskensis Howell
Vaccinium ovalifolium Sm.
Vaccinium uliginosum L.
Vaccinium vitis-idaea L.

Fumariaceae

Corydalis pauciflora (Steph.) Pers.

Gentianaceae

Gentiana glauca Pallas
Gentiana propinqua Richards. ssp. propinqua
Gentiana prostrata Haenke

Geraniaceae

Geranium erianthum DC.

Graminae (Poaceae)

Agropyron boreale (Turcz.) Drobov ssp. alaskanum (Scribn. & Merr.) Melderis
Agropyron pauciflorum (Schwein.) Hitchc.
Agropyron pauciflorum (Schwen.) Hitchc. ssp. novae-angliae (Scribn.) Melderis
Agropyron violaceum (Hornem.) Lange violaceum
Agropyron yukonense Scribn. & Merr.
Agrostis alaskana Hult.
Agrostis scabra Willd.
Alopecuris aequalis Sobol.
Alopecuris alpinus Sm. ssp. alpinus
Arctagrostis latifolia (R. Br.) Griseb.
Arctophila fulva (Trin.) Anderss.
Bromopsis pumpellianus Scribn. Var. arcticus (Shear) Pors.
Bromus pumpellianius Scribn. var.pumpellianus
Bromus pumpellianus SL
Calamagrostis canadensis (Michx.) Beauv.
Calamagrostis canadensis (Michx.) Beauv. ssp. Langsdorfffii (Link.) Hult.
Calamagrostis inexpansa Gray
Calamagrostis lapponica (Wahlenb.) Hartman. F.
Calamagrostis purpurascens R. Br. ssp. purpurascens
Deschampsia beringensis Hultén
Deschampsia brevifolia R. Br.
Deschampsia caespitosa (L.) P. Beauv.
Elymus arenarius L. ssp. mollis (Trin.) Hult.
Elymus trachycaulis SL
Festuca altaica Trin.
Festuca baffinensis Polunin
Festuca brachyphylla Schult.
Festuca lenensis Drobow
Festuca ovina L. ssp. alaskensis Holmen
Festuca richardsonii Hook.
Festuca rubra L.
Festuca sp.
Glyceria pulchella (Nash) Schum.
Hierchloe alpina (Sw.) Roem. & Schult.

Appendix 4. Continued.

Hierochloe odorata (L.) P. Beauv.
Hordeum brachyantherum Nevski
Hordeum jubatum L.
Phleum pratense L.
Poa alpigena (E. Fries) Lindm.
Poa alpina L.
Poa arctica R. Br.
Poa glauca M. Vahl.
Poa lanata Scribn. & Merr.
Poa palustris L.
Poa pratensis L.
Puccinellia interior Sorens.
Trisetum spicatum (L.) Richter ssp. spicatum

Haloragaceae

Hippuris montana Ledeb.
Hippuris vulgaris L.
Myriophyllum spicatum L.
Myriophyllum spicatum ssp. exalbescens (Fern.) Hult.

Iridaceae

Iris setosa Pall. ssp. setosa

Juncaceae

Juncus alpinoarticulatus Chaix in Vill ssp. americanus (Farwell) Hamet-Ahti
Juncus alpinus Villers
Juncus arcticus Willd.
Juncus biglumis L.
Juncus bufonius L.
Juncus castaneus Sm. ssp. castaneus
Juncus drummondii E. M
Juncus filiformis L.
Juncus triglumis L.
Luzula arctica Blytt.
Luzula arcuata (Wahlenb.) Sw.
Luzula arcuata (Wahlenb.) Sw. ssp. unalaschensis (Buchenau) Hult.
Luzula confusa Lindeb.
Luzula multiflora (Retz.) Lej.
Luzula parviflora (Ehrh.) Desv.
Luzula spicata (L.) DC.
Luzula tundricola Gorodk.
Luzula wahlenbergii Rupr. ssp. wahlenbergii

Juncaginaceae

Triglochin maritimum L.
Triglochin palustris L.

Leguminosae (Fabaceae)

Astragalus adsurgens Pall.
Astragalus alpinus L.
Astragalus americanus (Hook.) M.E. Jones
Astragalus bodinii Sheld.
Astragalus nutzotinensis Rousseau
Astragalus polaris Benth.
Astragalus umbellatus Bunge
Hedysarum alpinum L.
Hedysarum hedysaroides (L.) Schinz & Thell.
Hedysarum mackenzii Richards.
Lathyrus maritimus L. ssp. maritimus
Lupinus arcticus S. Wats.
Lupinus kuschei Eastw.
Lupinus nootkatensis Donn
Oxytropis borealis DC.
Oxytropis campestris (L.) DC.
Oxytropis campestris (L.) DC. ssp. varians (Rydb.) Cody
Oxytropis deflexa (Pall.) DC.
Oxytropis huddelsonii Pors.
Oxytropis maydelliana Trautv.
Oxytropis nigrescens (Pall.) Fisch.
Oxytropis scammaniana Hultén
Oxytropis viscida Nutt.

Lemnaceae

Lemna minor L.

Lentibulariaceae

Pinguicula villosa L.
Utricularia intermedia Hayne
Utricularia minor L.
Utricularia vulgaris L. ssp. macrorhiza (LeConte) Clauson

Liliaceae

Allium schoenoprasum L.
Fritillaria camschatcensis (L.) Ker-Gawl.
Streptopus amplexifolius (L.) DC.
Tofieldia coccinea Richards.
Tofieldia glutinosa (Michx.) Pers.
Tofieldia pusilla (Michx.) Pers.
Veratrum viride Ait. ssp. Eschscholtzii (Gray) Love & Love
Zygadenus elegans Pursh

Linaceae

Linum perenne L. ssp. lewisii

Lycopodiaceae

Lycopodium alpinum L.
Lycopodium annotinum L.
Lycopodium clavatum L.
Lycopodium complanatum L.
Lycopodium selago L.

Menyanthaceae

Fauria crista-galli (Menzies) Makino
Menyanthes trifoliata L.

Myricaeae

Myrica gale L.

Nymphaceae

Nuphar polysepalum Engelm.

Onagraceae

Circaea alpina L.
Epilobium anagallidifolium Lam.
Epilobium angustifolium L.
Epilobium ciliatum Raf.
Epilobium glandulosum Lehm.
Epilobium hornemannii Reichb. ssp. hornemannii

Epilobium latifolium L.
Epilobium palustre L.
Ophioglossaceae
Botrychium alaskense W.H.Wagner
Botrychium lunaria (L.) Sw.
Orchidaceae
Amerorchis rotundifolia (Banks) Hult.
Calypso bulbosa (L.) Rchb. F.
Corallorrhiza trifida Chatel.
Cypripedium passerinum Richards
Goodyera repens (L.) R. Br. var. ophioides Fern.
Listera borealis Morong
Listera caurina Piper
Listera cordata (L.) R. Br.
Lloydia serotina (L.) Rchb.
Platanthera dilatata Pursh
Platanthera hyperborea (L.) Lindl.
Platanthera obtusata (Pursh) Lindl.
Platanthera saccata (Greene) Hult.
Spiranthes romanzoffiana Cham.
Orobanchaceae
Boschniakia rossica (Cham & Schldl.) B. Fedtsch.
Papaveraceae
Papaver alaskanum Hultén
Papaver radicatum Rottb. ssp. radicatum
Papaver radicatum ssp. kluanensis (D. Löve) D. F. Murray
Pinaceae
Picea glauca (Moench) Voss
Picea mariana (Mill.) Britt., Sterns & Pogg
Picea sitchensis (Bong.) Carr.
Tsuga heterophylla (Raf.) Sarg.
Plantaginaceae
Plantago canescens Adams
Polemoniaceae
Phlox hoodii Richards.
Phlox sibirica L. ssp. richardsonii (Hook.) Hult
Polemonium acutiflorum Willd.
Polemonium boreale Adams
Polemonium pulcherrimum Hook.
Polygonaceae
Oxyria digyna (L.) Hill
Polygonum alaskanum (Small) Wight
Polygonum amphibium L.
Polygonum bistorta L. ssp. plumosum (Small) Hult.
Polygonum viviparum L.
Rumex arcticus Trautv.
Rumex beringensis Jurtzev & Petrovsky
Rumex maritimus L.
Portulacaceae
Claytonia bostockii Pors.
Claytonia sarmentosa C. Meyer
Montia fonata L. ssp. fontana
Potamogetonaceae
Potamogeton alpinus Balbis ssp. tenuifolius (Raf.) Hultén
Potamogeton friesii Rupr.
Potamogeton gramineus L.
Potamogeton perfoliatus L. ssp. richardsonii (Benn.) Hultén
Potamogeton zosterifolius Schum.
Primulaceae
Androsace chamaejasme Host ssp. lehmannia (Spreng.) Hult.
Androsace septentrionalis L.
Dodecatheon frigidum Cham. & Schlecht.
Trientalis europaea L.
Trientalis europaea L. ssp. arctica (Fisch.) Hult.
Pyrolaceae
Moneses uniflora (L.) Gray
Pyrola asarifolia Michx.
Pyrola chlorantha Sw.
Pyrola grandiflora Radius
Pyrola minor L.
Pyrola secunda L.
Ranunculaceae
Aconitum delphinifolium DC.
Actaea rubra (Ait.) Willd.
Anemone multifida Poir.
Anemone narcissiflora L.
Anemone parviflora Michx.
Anemone richardsonii Hook.
Caltha leptosepala DC.
Caltha palustris L.
Delphinium glaucum S. Wats.
Pulsatilla patens (L.) Mill ssp. Multifida (Pritz.) Zamels
Ranunculus bongardi Greene
Ranunculus confervoides (E. Fries) E. Fries
Ranunculus cooleyae Vasey & Rose
Ranunculus eschscholtzii Schlecht.
Ranunculus gmelini DC. ssp. gmelini
Ranunculus hyperboreus Rottb.
Ranunculus lapponicus L.
Ranunculus nivalis L
Ranunculus occidentalis Nutt.
Ranunculus pygmaeus Wahl.
Ranunculus reptans L.
Ranunculus sulphureus Soland. var. intercedens Hultén
Ranunculus trichophyllus Chaix
Ranunculus uncinatus D. Don ex G. Don
Thalictrum alpinum L.
Rosaceae
Amelanchier alnifolia (Nutt.) Nutt.
Aruncus sylvester Kostel.
Dryas drummondii Richards.
Dryas integrifolia Vahl.
Dryas octopetala L.
Dryas octopetala L. ssp. alaskensis (Pors.) Hult.
Fragaria chiloensis (L.) Duchesne

Appendix 4. Continued.

Geum macrophyllum Willd. ssp. macrophyllum
Geum rossii (R. Br.) Ser.
Luetkea pectinata (Pursh) Ktze.
Potentilla biflora Willd.
Potentilla diversifolia Lehm.
Potentilla egedii Wormsk. ssp. grandis (Torr. & Gray) Hult.
Potentilla fruticosa L.
Potentilla hookeriana Lehm.
Potentilla hyparctica Malte
Potentilla multifida L.
Potentilla nivea L.
Potentilla norvegica L.
Potentilla palustris (L.) Scop.
Potentilla pennsylvanica L.
Potentilla uniflora Ledeb.
Rosa acicularis Lindl.
Rubus arcticus L.
Rubus arcticus L. ssp. arcticus
Rubus chamaemorus L.
Rubus idaeus L.
Rubus pedatus Sm.
Rubus spectabilis Pursh
Sanguisorba officinalis L.
Sanguisorba stipulata Raf.
Sibbaldia procumbens L.
Sorbus scopulina Greene
Sorbus sitchensis Roem.
Spiraea beauverdiana Schneid.

Rubiaceae

Galium boreale L.
Galium brandegei Gray
Galium trifidum L. ssp. columbianum (Rydb.) Hult.
Galium trifidum L. ssp. trifidum
Galium triflorum Michx.

Salicaceae

Populus balsamifera L.
Populus balsamifera L. ssp. trichocarpa (Torr. & Gray) Brayshaw
Populus tremuloides Michx.
Salix alaxensis (Anderss.) Cov.
Salix arbusculoides Anderss.
Salix arctica Pall.
Salix barclayi Anderss.
Salix barrattiana Hook.
Salix bebbiana Sarg.
Salix brachycarpa Nutt. ssp. niphoclada (Rydb.) Argus
Salix commutata Bebb
Salix fuscescens Anderss.
Salix glauca L.
Salix hastata L.
Salix hookeriana Barratt
Salix lanata L. ssp. richardsonii (Hook.) Skvort.
Salix monticola Bebb
Salix myrtillifolia Anderss.
Salix novae-angliae Anderss.
Salix phlebophylla Anderss.
Salix planifolia Pursch. ssp.pulchra (Cham.) Argus
Salix polaris Wahlenb. ssp. pseudopolaris (Flod.) Hult.
Salix reticulata L.
Salix rotundifolia Trautv.
Salix scouleriana Barratt
Salix setchelliana Ball
Salix sitchensis Sanson

Santalaceae

Geocaulon lividum (Richards.) Fern.

Saxifragaceae

Chrysosplenium tetrandrum (Lund) T. Fries
Chrysosplenium wrightii Fr. And Sav.
Heuchera glabra Willd.
Leptarrhena pyrolifolia (D. Don) R. Br. ex Ser.
Parnassia kotzebuei Cham. & Schlecht.
Parnassia palustris L.
Ribes bracteosum Dougl.
Ribes hudsonianum Richards.
Ribes triste Pall.
Saxifraga adscendens L.
Saxifraga bronchialis L.
Saxifraga caespitosa L.
Saxifraga cernua L.
Saxifraga davurica Willd. ssp. grandipetala (Engler & Irmsch.) Hult.
Saxifraga flagellaris Willd.
Saxifraga foliolosa R. Br.
Saxifraga hieracifolia Waldst. & Kit.
Saxifraga hirculis L.
Saxifraga hyperborea R. Br.
Saxifraga lyallii Engler ssp. hultenii (Cald. & Sav.) Cald. & Sav.
Saxifraga nivalis L.
Saxifraga oppositifolia L.
Saxifraga punctata L.
Saxifraga punctata L. ssp. nelsoniana (D. Don) Hult.
Saxifraga reflexa Hook.
Saxifraga rivularis L.
Saxifraga serpyllifolia Pursh
Saxifraga tricuspidata Rottb.
Tellima grandiflora (Pursh) Dougl.
Tiarella trifoliata L.

Scrophulariaceae

Castilleja caudata (Pennell) Rebr.
Castilleja chrymactis Pennell
Castilleja elegans Malte
Castilleja hyperborea Pennell
Castilleja miniata Dougl.
Castilleja unalaschcensis (Cham. & Schlecht.) Malte
Pedicularis capitata Adams.
Pedicularis kanei Durand ssp. kanei

Appendix 4. Continued.

Pedicularis labradorica Wirsing
Pedicularis langsdorffii Fisch.
Pedicularis langsdorffii Fisch. ssp.arctica (R. Br.) Pennell
Pedicularis langsdorffii Fisch. ssp.langsdorffii
Pedicularis oederi M. Vahl
Pedicularis parviflora J.E. Sm. ssp. parviflora
Pedicularis sudetica Willd.
Pedicularis sudetica Willd. ssp. interior Hult.
Pedicularis verticillata L.
Rhinanthus minor L.
Synthyris borealis Pennell
Veronica wormskjoldii Roem & Schult.

Selaginellaceae
Selaginella selaginoides (L.) Link
Selaginella sibirica (Milde) Hieron.

Sparganiaceae
Sparganium angustifolium Michx.
Sparganium minimum (Hartm.) E. Fries

Umbelliferae (Apiaceae)
Angelica lucida L.
Bupleurum triradiatum Adams ssp. arcticum (Regel) Hult.
Cicuta mackenzieana Raup
Conioselinum chinense L. BSP.
Heracleum lanatum Michx.
Ligusticum scoticum L. ssp. hultenii (Fern.) Cald. & Tayl.
Osmorhiza purpurea (Coult. &Rose) Suksd.

Valerianaceae
Valeriana capitata Pall.
Valeriana sitchensis Bong.

Violaceae
Viola epipsila Ledeb. ssp. repens (Turcz.) Becker

Appendix 5. List of recorded nonvascular plant species in Wrangell-St. Elias National Park and Preserve, southcentral Alaska, 2004–2006.

Lichen

- Alectoria nigricans (Ach.) Nyl.
- Alectoria ochroleuca (Hoffm.) A. Massal.
- Alectoria sp.
- Arctoparmelia separata (Th. Fr.) Hale
- Arctoparmelia sp.
- Asahina sp.
- Asahinea chrysantha (Tuck.) Culb. & C. Culb.
- Bryocaulon divergens (Ach.) Kärnefelt
- Bryocaulon sp.
- Bryonora castanea (Hepp) Poelt
- Bryoria sp.
- Caloplaca jungermanniae (Vahl) Th. Fr.
- Caloplaca sp.
- Caloplaca tetraspora (Nyl.) H. Olivier
- Cetraria aculeata (Schreber) Fr.
- Cetraria islandica (L.) Ach.
- Cetraria islandica (L.) Ach. ssp. islandica
- Cetraria sp.
- Cetrariella delisei (Bory ex Schaerer) Kärnefelt & Thell
- Cladina arbuscula (Wallr.) Hale & Culb.
- Cladina mitis (Sandst.) Hustich
- Cladina rangiferina (L.) Nyl.
- Cladina sp.
- Cladina stellaris (Opiz) Brodo
- Cladina stygia (Fr.) Ahti
- Cladonia alaskana A. Evans
- Cladonia amaurocraea (Flörke) Schaerer
- Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel
- Cladonia coccifera (L.) Willd. s. lat.
- Cladonia cornuta (L.) Hoffm.
- Cladonia deformis (L.) Hoffm.
- Cladonia ecmocyna Leighton
- Cladonia gracilis (L.) Willd.
- Cladonia gracilis (L.) Willd. ssp. elongata (Jacq.) Vainio
- Cladonia pocillum (Ach.) Grognot
- Cladonia pyxidata (L.) Hoffm.
- Cladonia sp.
- Cladonia squamosa Hoffm.
- Cladonia symphycarpia (Ach.) Fr.
- Cladonia uncialis (L.) F. H. Wigg.
- Dactylina arctica (Richardson) Nyl.
- Dactylina ramulosa (Hook.) Tuck.
- Diploschistes muscorum (Scop.) R. Sant.
- Flavocetraria cucullata (Bellardi) Kärnefelt & Thell
- Flavocetraria nivalis (L.) Kärnefelt & Thell
- Hypogymnia enteromorpha (Ach.) Nyl.
- Hypogymnia sp.
- Hypogymnia subobscura (Vainio) Poelt
- Icmadophila ericetorum (L.) Zahlbr.
- Lecanora epibryon (Ach.) Ach.
- Lepraria sp.
- Lobaria linita (Ach.) Rabenh.
- Masonhalea richardsonii (Hook.)
- Melanelia commixta (Nyl.) Thell
- Nephroma arcticum (L.) Torss.
- Nephroma expallidum (Nyl.) Nyl.
- Nephroma sp.
- Ochrolechia frigida (Sw.) Lynge
- Ochrolechia sp.
- Ochrolechia upsaliensis (L.) A. Massal.
- Pannaria sp.
- Parmelia sp.
- Parmelia sulcata Taylor
- Peltigera aphthosa (L.) Willd.
- Peltigera canina (L.) Willd.
- Peltigera collina (Ach.) Schrader
- Peltigera didactyla (With.) J. R. Laundon
- Peltigera elisabethae Gyelnik
- Peltigera leucophlebia (Nyl.) Gyelnik
- Peltigera malacea (Ach.) Funck
- Peltigera membranacea (Ach.) Nyl.
- Peltigera neopolydactyla (Gyelnik) Gyelnik
- Peltigera polydactylon (Neck.) Hoffm.
- Peltigera rufescens (Weiss) Humb.
- Peltigera scabrosa Th. Fr.
- Peltigera sp.
- Peltigera venosa (L.) Hoffm.
- Pertusaria dactylina (Ach.) Nyl.
- Pertusaria geminipara (Th. Fr.) C. Knight ex Brodo
- Pertusaria sp.
- Pseudephebe minuscula (Nyl. ex Arnold) Brodo & D. Hawksw.
- Pseudephebe pubescens (L.) Choisy
- Psoroma hypnorum (Vahl) Gray
- Rhizocarpon geographicum (L.) DC.
- Rhizocarpon sp.
- Ricciocarpos natans (L.) Corda
- Rinodina turfacea (Wahlenb.) Körber
- Solorina crocea (L.) Ach.
- Solorina sp.
- Sphaerophorus globosus (Hudson) Vainio
- Sphaerophorus sp.
- Stereocaulon alpinum Laurer ex Funck
- Stereocaulon paschale (L.) Hoffm.
- Stereocaulon sp.
- Stereocaulon tomentosum Fr.
- Thamnolia sp.
- Thamnolia subuliformis (Ehrh.) Culb.
- Thamnolia vermicularis (Sw.) Ach. ex Schaerer
- Toninia sedifolia (Scop.) Timdal
- Trapeliopsis sp. Hertel & Gotth. Schneider
- Umbilicaria proboscidea (L.) Schrader
- Umbilicaria sp.
- Unknown arborial lichen
- Unknown crustose lichen
- Unknown foliose or fruticose lichen
- Unknown lichen
- Usnea sp.
- Vulpicida pinastri (Scop.) J.-E. Mattsson & M. J. Lai
- Vulpicida sp.
- Vulpicida tilesii (Ach.) J.-E. Mattsson & M. J. Lai
- Xanthoria elegans (Link) Th. Fr.

Xanthoria sp.

Moss

Abietinella abietina (Hedw.) Fleisch.
Andreaea rupestris Hedw.
Antitrichia curtipendula (Hedw.) Brid.
Aulacomnium acuminatum (Lindb. & Arnell) Kindb.
Aulacomnium palustre (Hedw.) Schwaegr.
Aulacomnium sp.
Aulacomnium turgidum (Wahlenb.) Schwaegr.
Bartramia ithyphylla Brid.
Blepharostoma trichophyllum (L.) Dum.
Brachythecium albicans(Hedw.) B.S.G.
Brachythecium coruscum Hag.
Brachythecium erythrorrhizon Schimp. in B.S.G.
Brachythecium reflexum (Starke in Web.et Mohr) Schimp.
Brachythecium rutabulum (Hedw.) Schimp. in B.S.G.
Brachythecium salebrosum (Web. et Mohr) B.S.G.
Brachythecium sp.
Brachythecium turgidum (Hartm.) Kindb.
Bryoerythrophyllum recurvirostrum (Hedw.) Chen
Bryum pseudotriquetrum (Hedw.) Gaertn. et al.
Bryum sp.
Calliergon giganteum (Schimp.) Kindb.
Calliergon sp.
Calliergon stramineum (Brid.) Kindb.
Campylium polygamum (B.S.G.) C.Jens.
Campylium sp.
Campylium stellatum (Hedw.) C.Jens.
Campylopus flexuosus (Hedw.) Brid.
Ceratodon purpureus (Hedw.) Brid.
Ceratodon sp.
Cinclidium arcticum B.S.G.
Cinclidium latifolium Lindb.
Cinclidium stygium Sw. in Schrad.
Climacium dendroides (Hedw.) Web. et Mohr.
Conocephalum sp.
Dicranella sp.
Dicranum acutifolium (Lindb. et H.Arnell) C.Jens.
Dicranum elongatum Schleich. ex Schwaegr.
Dicranum fragilifolium Lindb.
Dicranum groenlandicum Brid.
Dicranum laevidens Williams
Dicranum polysetum SW.
Dicranum scoparium Hedw.
Dicranum sp.
Dicranum spadiceum Zett.
Dicranum undulatum Brid.
Distichium capillaceum (Hedw.) B.S.G.
Distichium inclinatum (Hedw.) B.S.G.
Distichium sp.
Ditrichum flexicaule (Schwaegr.) Hampe
Ditrichum sp.
Drepanocladus brevifolius (Lindb.) Warnst.
Drepanocladus revolvens (Sw.) Warnst.
Drepanocladus sp.
Encalypta sp.
Entodon concinnus (De Not.) Par.
Eurhynchium pulchellum (Hedw.) Jenn.
Eurhynchium stokesii (Turn.) Schimp. in B.S.G.
Fissidens osmundioides Hedw.
Helodium blandowii (Web. & Mohr) Warnst.
Homalothecium sp.
Hylocomiastrum umbratum (Hedw.) Fleisch. in Broth.
Hylocomium splendens (Hedw.) B.S.G.
Hypnum bambergeri Schimp.
Hypnum holmenii Ando
Hypnum lindbergii Mitt.
Hypnum revolutum (Mitt.) Lindb.
Hypnum sp.
Hypnum vaucheri Lesq.
Limprichtia cossoni (Schimp.) Anderson et al.
Limprichtia revolvens (Sw.) Loeske
Loeskypnum badium (Hartm.) Paul
Marchantia polymorpha L
Marchantia sp.
Meesia triquetra (Richter) Aongstr.
Meesia uliginosa Hedw.
Mnium sp.
Myurella julacea (Schwaegr.) B.S.G.
Oncophorus virens (Hedw.) Brid.
Paludella squarrosa (Hedw.) Brid.
Philonotis fontana (Hedw.) Brid.
Plagiomnium insigne (Mitt.) T. Kop.
Plagiomnium medium (Bruch & Schimp. in B.S.G.) T. Kop.
Plagiomnium sp.
Plagiothecium undulatum (Hedw.) Schimp. in B.S.G.
Pleurozium schreberi (Brid.) Mitt.
Pogonatum urnigerum (Hedw.) P. Beauv.
Pohlia cruda (Hedw.) Lindb.
Pohlia nutans (Hedw.) Lindb.
Pohlia sp.
Pohlia wahlenbergii (Web. & Mohr) Andrews
Polytrichastrum alpinum (Hedw.) G.L.Sm.
Polytrichum jensenii Hag.
Polytrichum juniperinum Hedw.
Polytrichum piliferum Hedw.
Polytrichum sp.
Polytrichum strictum Brid.
Porella platyphylla (L.) Pfeiff.
Preissia quadrata (Scop.) Nees
Pseudoleskea baileyi Best & Grout in Grout
Ptilidium ciliare (L.) Hampe
Ptilidium pulcherrimum (G. Web.) Vain.
Ptilium crista-castrensis (Hedw.) De Not.
Racomitrium canescens (Hedw.) Brid.
Racomitrium elongatum Ehrh. ex Frisv.
Racomitrium ericoides (Web. ex Brid.) Brid.
Racomitrium lanuginosum (Hedw.) Brid.
Racomitrium panschii (C. Müll.) Kindb.
Racomitrium sp.
Rhizomnium glabrescens (Kindb.) T. Kop.
Rhizomnium nudum (Britt. & Williams) T. Kop.
Rhizomnium pseudopunctatum (Bruch & Schimp.) T. Kop.
Rhizomnium sp.
Rhytidiadelphus loreus (Hedw.) Warnst.
Rhytidiadelphus squarrosus (Hedw.) Warnst.
Rhytidiadelphus triquetrus (Hedw.) Warnst.
Rhytidiopsis robusta (Hook.) Broth.

Rhytidium rugosum (Hedw.) Kindb.
Sanionia uncinata (Hedw.) Loeske
Schistidium papillosum Culm.
Scorpidium scorpioides (Hedw.) Limpr.
Sphagnum angustifolium (Russ. ex Russ.) C.Jens
Sphagnum capillifolium (Ehrh.) Hedw.
Sphagnum fallax (Klinggr.) Klinggr.
Sphagnum fimbriatum Wils.
Sphagnum fuscum (Schimp.) Klinggr.
Sphagnum girgensohnii Russ.
Sphagnum jensnii H. Lindb.
Sphagnum lenense H.Lindb. ex Pohle
Sphagnum lindbergii Schimp. ex Lindb.
Sphagnum magellanicum Brid.
Sphagnum platyphyllum (Lindb. ex Braithw.) Sull. ex
Sphagnum rubellum Wils.
Sphagnum sp.
Sphagnum squarrosum Crome
Sphagnum subsecundum Nees ex Sturm
Sphagnum teres (Schimp.) Ångstr. in Hartm.
Sphagnum warnstorfii Russ.
Splachnum sp.
Syntrichia ruralis (Hedw.) Web. et Mohr
Tetraplodon mnioides (Hedw.) Bruch & Schimp. in B.S.G.
Thuidium recognitum (Hedw.) Lindb.
Thuidium sp.
Tomentypnum nitens (Hedw.) Loeske
Tortella fragilis (Hook. et Wils. in Drumm.) Limpr.
Tortella sp.
Tortella tortuosa (Hedw.) Limpr.
Unknown fungus
Unknown leafy liverwort
Unknown liverwort
Unknown moss
Warnstorfia cf. exannulata (Guemb. in B.S.G.) Loeske
Warnstorfia fluitans (Hedw.) Loeske
Warnstorfia sarmentosa (Wahlenb.) Hedenaes

Appendix 6. Notable species collected or recorded by ABR during 2004–2006 in Wrangell-St. Elias National Park and Preserve. # EOs = number of AKNHP element occurences. Data for number of EOs, new species, and species on the expected list are based on 2004 data provided by Mary Beth Cook, park botanist.

Taxon	*n*	AKNHP Rank	#EOs	New	On expected list?	Taxonomic Synonomy	Plot Number	Locality	Determiner
Agropyron yukonense Scribn. & Merr.	1	S2S3	1			Elymus calderi	WRST_T86_01_2006	Copper River bluffs	C. Parker
Alopecuris alpinus Sm. ssp. alpinus	3			Y			WRST_T30_07_2004	Bremner Mts	
							WRST_T36_01_2004	Mill Creek Ridge	
							WRST_T56_03_2005	Jaeger Mesa	
Arnica cordifolia Hook.	2			Y	Y		WRST_T02_06_2004	Esker Stream Ridge	D.Murray
							WRST_T02_07_2004	Esker Stream Ridge	
Artemisia furcata Bieb.	4			Y	Y		WRST_T41_01_2005	Rock Creek	D.Murray
							WRST_T55_03_2005	White Mtn.	D.Murray
							WRST_T73_01_2006	Horsfeld	C. Parker
							WRST_T79_01_2006	Goat valley	C. Parker
Astragalus americanus (Hook.) M.E. Jones	1			Y	Y		WRST_T67_09_2005	Copper Center Flats	
Astragalus polaris Benth.	1			Y			WRST_T80_01_2006	Suslota Hills	M. Duffy
Botrychium alaskense W.H.Wagner	2	S2S3	2				WRST_T48_03_2005	Sheep Creek	
							WRST_T48_04_2005	Sheep Creek	D.Murray
Carex adelostoma Krecz.	1	S1	6				WRST_T52_05_2005	Wellsley Hills	D.Murray
Carex holostoma Drej.	3	S2	2				WRST_T43_06_2005	Solo Flat	D.Murray
							WRST_T47_02_2005	Euchre Mtn	
							WRST_T64_08_2005	Sanford Morraine	D.Murray
Carex spectabilis Dewey	1			Y			WRST_T22_05_2004	Chititu Ridge	D.Murray
Claytonia bostockii Pors.	10	S3	21			Claytoniella bostockii	WRST_T22_01_2004	Chititu Ridge	
							WRST_T22_02_2004	Chititu Ridge	
							WRST_T47_07_2005	Euchre Mtn	
							WRST_T56_02_2005	Jaeger Mesa	
							WRST_T56_03_2005	Jaeger Mesa	
							WRST_T56_04_2005	Jaeger Mesa	
							WRST_T56_07_2005	Jaeger Mesa	
							WRST_T56_08_2005	Jaeger Mesa	
							WRST_T81_08_2006	Capital Mountain	C. Parker
							WRST_T81_06_2006	Capital Mountain	C. Parker
Cornus stolonifera Michx.	7			Y			WRST_T87_07_2006	Copper River Bluffs	
							WRST_T87_06_2006	Copper River Bluffs	
							WRST_T87_04_2006	Copper River Bluffs	
							WRST_T87_03_2006	Copper River Bluffs	
							WRST_T87_09_2006	Copper River Bluffs	
							WRST_T87_02_2006	Copper River Bluffs	
							WRST_T86_04_2006	Copper River Bluffs	C. Parker
Eleocharis quinqueflora (F. Hartmann) O. Schwarz	1			Y	Y		WRST_T35_06_2004	McCarthy Cr	D.Murray
Erysimum pallasii (Pursch) Fern.	2	S3S4	14				WRST_T80_03_2006	Suslota Hills	C. Parker
							WRST_T80_02_2006	Suslota Hills	C. Parker
Festuca lenensis Drobow	1	S3	9				WRST_T87_08_2006	Copper River Bluffs	M. Duffy

Appendix 6. Continued.

Taxon	*n*	AKNHP Rank	#EOs	New	On expected list?	Taxonomic Synonomy	Plot Number	Locality	Determiner
Juniperus horizontalis Moench.	9	S1S2	8				WRST_T20_05_2004	Upper Chitina	D.Murray
							WRST_T20_06_2004	Upper Chitina	
							WRST_T68_04_2005	Dadina R	D.Murray
							WRST_T87_01_2006	Copper River Bluffs	
							WRST_T87_08_2006	Copper River Bluffs	
							WRST_T86_04_2006	Copper River Bluffs	
							WRST_T86_03_2006	Copper River Bluffs	
							WRST_T86_02_2006	Copper River Bluffs	
							WRST_T86_05_2006	Copper River Bluffs	
Lupinus kuschei Eastw.	1	S2	7				WRST_T76_02_2006	Nabesna River	C. Parker
Oxytropis campestris (L.) DC. ssp. varians (Rydb.) Cody	3	S2S3	3				WRST_T68_04_2005	Dadina R	D.Murray
							WRST_T68_06_2005	Dadina R	
							WRST_T86_01_2006	Copper River bluffs	C. Parker
Oxytropis huddelsonii Pors.	8	S2S3	28				WRST_T42_01_2005	White Riv Mts	
							WRST_T42_02_2005	White Riv Mts	
							WRST_T53_01_2005	Cooper Pass	
							WRST_T53_04_2005	Cooper Pass	
							WRST_T65_02_2005	Sanford Bench	
							WRST_T85_06_2006	Mt. Drum	M. Duffy
							WRST_T85_03_2006	Mt. Drum	C. Parker
							WRST_T85_03_2006	Mt. Drum	C. Parker
Phlox hoodii Richards.	4	S1S2	4				WRST_T47_04_2005	Euchre Mtn	
							WRST_T47_05_2005	Euchre Mtn	
							WRST_T65_01_2005	Sanford Bench	
							WRST_T65_02_2005	Sanford Bench	
Puccinellia interior Sorens.	1			Y			WRST_T62_01_2005	Copper R. near Gakona	D. Murray
Rumex beringensis Jurtzev & Petrovsky	1	S3	17				WRST_T81_08_2006	Capital Mountain	C. Parker
Rumex maritimus L.	1			Y	Y		WRST_T67_09_2005	Copper Center Flats	
Salix hookeriana Barratt	5	S2	2				WRST_T06_03_2004	Grand Wash	D.Murray
							WRST_T06_04_2004	Grand Wash	
							WRST_T06_07_2004	Grand Wash	
							WRST_T06_08_2004	Grand Wash	D.Murray
							WRST_T14_04_2004	Yana	
Salix setchelliana Ball	2	S3	11				WRST_T76_08_2006	Nabesna River	M. Duffy
							WRST_T76_02_2006	Nabesna River	M. Duffy
Stellaria alaskana Hult.	6	S3	23				WRST_T42_01_2005	White River Mts	
							WRST_T45_01_2005	Klein Cr.	
							WRST_T45_02_2005	Klein Cr.	
							WRST_T45_03_2005	Klein Cr.	
							WRST_T45_06_2005	Klein Cr.	
							WRST_T45_08_2005	Klein Cr.	
Stellaria sitchana Steud var. bongardiana (Fern.) Hult.	1			Y	Y	Stellaria borealis Bigelow ssp. sitchana (Steud.) Piper	WRST_T07_04_2004	Grand Wash	D.Murray

Appendix 7. List of codes used for soil subgroup associations identified in Wrangell-St. Elias National Park and Preserve.

Soil Group	Soil Code	Soil Subgroup
Entisols		
	Efca	Aquic Cryofluvent
	Eoca	Aquic Cryorthents
	Epco	Oxyaquic Cryopsamments
	Eoco	Oxyaquic Cryorthents
	Eogo	Oxyaquic Gelorthents
	Eact	Typic Cryaquents Subgroup
	Epct	Typic Cryopsamments
	Eoct	Typic Cryorthent
	Eagt	Typic Geliaquents
	Eogt	Typic Gelorthents
Gelisols		
	Goad	Andic Aquorthels
	Gtla	Aquic Haploturbels
	Goap	Psammentic Aquorthels
	Gtar	Ruptic-histic Aquiturbels
	Ghfs	Sphagnic Fibristels
	Ghfe	Terric Fibristels
	Ghhe	Terric Hemistels
	Gtat	Typic Aquiturbels
	Goat	Typic Aquorthels
	Ghft	Typic Fibristels
	Golt	Typic Haplorthels
	Gtlt	Typic Haploturbels
	Ghht	Typic Hemistels
	Goht	Typic Historthels
	Gtht	Typic Histoturbels
	Gopt	Typic Psammorthels
	Gout	Typic Umbrorthels
Histosols		
	Hfce	Terric Cryofibrists
	Hhce	Terric Cryohemist
	Hfct	Typic Cryofibrists
	Hhct	Typic Cryohemist
Inceptisols		
	Iacrh	Aeric Humic Cryaquepts
	Icea	Aquic Eutrocryepts
	Iach	Histic Cryaquepts
	Iacu	Humic Cryaquepts
	Icdh	Humic dystrocryepts
	Igdh	Humic Dystrogelepts
	Iceh	Humic Eutrocryepts
	Igeh	Humic Eutrogelepts
	Icdo	Oxyaquic dystrocryepts
	Iceo	Oxyaquic Eutrocryepts
	Icds	Spodic dystrocryepts
	Iact	Typic cryaquepts
	Icdt	Typic dystrocryepts
	Igdt	Typic Dystrogelepts
	Icet	Typic Eutrocryepts
	Iget	Typic Eutrogelepts
	Iagt	Typic Gelaquepts
	Iceu	Ustic Eutrocryepts
Mollisols		
	Mclt	Typic Haplocryolls
	Mglt	Typic Haplogelolls
Spodosols		
	Sclt	Typic Haplocryods
	Scht	Typic Humicryods

Appendix 8. Description of GRS Landcover Classes (excerpted from Stumpf 2008).

VEGETATION/LAND COVER CLASSIFICATION

As the project progressed and training site information were summarized, reviewed, and processed in terms of confusion and fidelity AKRO, ABR, and GRS met on four different occasions from 2005–2007 to review in-progress mapping results and findings. Field observations as well as ABR field site data and information from other ground locations were reviewed relative to the mapping effort in an effort to identify errors and inconsistencies. One of the major results of this effort was the modification and refinement of the land cover vegetation classification system that would be used to categorically describe the different classes contained in the WRST Land Cover data set. Integral to any discussions was the nomenclature used to describe different land cover classes or types found on the ground and in the data set. The land cover vegetation classification system in place at the beginning of the project was the Viereck classification system as was used when GRS mapped Katmai National Park and Preserve (2003). It was "slightly-modified" to reflect some very minor modifications that could result in the misnaming or misclassification of a site into a potentially incorrect name/type (for example, the Sparse Vegetation class was modified so that sites with more than 30% vegetative cover, but no life form cover sufficient to categorize the site as a tree, tall or low shrub, dwarf shrub, or herbaceous type were not mistakenly labeled as Barren; in a similar vein, all alder shrub forms would be considered as Tall Shrub, regardless of actual height). Over the course of the project several modifications and enhancements were made to the vegetation/land cover classification system (rules), each designed to handle certain issues identified during the mapping project. These modifications concerned the development of 'new' vegetation types, as well as the modification of several cover component thresholds and mixtures. In most cases the modifications and enhancements to the classification system were made in an attempt to meet the intent of the Viereck Classification System when a type's cover components were slightly different than the requirements necessary to assign a particular class. Rather than follow a very strict interpretation of the Viereck Classification System rules and thresholds and assign classes that appeared inappropriate or inaccurate the rules were modified to better represent these 'different' types. It is important to note these deviations from what would be considered the traditional Viereck Classification System nomenclature so that the user of this land cover data set understands the differences and correctly interprets the mapped types. Modifications to the Viereck Classification System thresholds and nomenclature used during this mapping effort are discussed below.

MODIFIED TYPES AND DESIGNATIONS

HARDWOOD WOODLAND COVER DENSITY CLASS

The Woodland cover density designation for all deciduous hardwood types and Mixed Deciduous-Conifer types dominated by hardwoods was dropped from the classification. This change allowed the type name to be developed based on the cover of the predominant lifeform/species present in the type, rather than the very scattered hardwood component. As a result there are no Aspen:Woodland, Balsam Poplar: Woodland, Cottonwood:Woodland, Paper Birch:Woodland, or Mixed Deciduous: Woodland types in the WRST Land Cover data set. These types are now represented by type names based on the non-hardwood cover components present in each type. In addition, most of the Mixed Deciduous-conifer: Woodland types also were typed to different nonhardwood types, except those Mixed deciduous-conifer:Woodland types that had a sufficient amount of conifer cover to have been the basis for a conifer:Woodland designation without the hardwood composition. For example, a Mixed deciduous-conifer:Woodland type comprised of 10% hardwood cover and 5% conifer cover would have received a new type name based on the non-tree cover present in this type. However, a Mixed deciduous-conifer:Woodland type comprised of 10% conifer cover and 5% hardwood cover would remain a Mixed deciduous-conifer:Woodland type, as the 10% conifer cover would comprise a Conifer:Woodland type by itself.

TREE SHRUB CLASS

The Tree Shrub class involves training sites that were dominated by either Salix scouleriana and Alnus tenuifolia where these shrubs were found growing as very tall tree-like shrubs. These tall shrubs were often

at least 10–15 meters in height and the types classified using these very tall shrub sites were often somewhat confused and intermixed with other Deciduous Hardwood type pixels rather than Tall Shrub type pixels. The Tree Shrub class was developed so that these very tall treelike types may be differentiated from the more traditional tall shrubs that are closer to 1.5-4.5 meters in height. The same cover density levels for the Tall Shrub class were applied to the Tree Shrub classes.

MIXED SHRUB TYPE CLASS

The Mixed Shrub class indicates types in which neither the Tall Shrub cover or Low Shrub cover met the minimum 25% cover threshold to call the type either a Tall or Low shrub type, but the combination of the Tall and Low shrub cover is the dominant lifeform present and the sum of the shrub cover exceeds the minimum 25% shrub cover threshold. If the combined cover is of a dominant genus (*Salix* or *Alnus*) or alliance (*Salix*-*Betula*), then that floristic component is also carried forward in the type name. By definition, there should only be "Open" Mixed shrub types, since if there is enough combined Tall and Low shrub cover to exceed the 75% cover threshold for a Closed density class then either Tall or Low shrub cover should have been sufficient to result in either a Low shrub:Open or Tall shrub:Open class. However, a Sparse shrub density class designation was added to identify one particular situation; the Sparse designation indicates that the sum of the Tall and Low shrub cover are greater than the Dwarf shrub cover, but the sum is not greater than the 25% shrub cover threshold unless the Dwarf shrub cover is added to the Tall and Low shrub cover. Sparse therefore indicates that the Tall, Low, and Dwarf shrub cover sum to more than 25% cover and that the Tall and Low shrub are predominant relative to the Dwarf cover. A mixture of this nature in which the sum of the Tall, Low, and Dwarf shrub cover exceed the 25% minimum cover threshold and the Dwarf shrub cover is the predominant cover would be classified as a Dwarf Shrub type.

DWARF SHRUB CLASS

The definition of the Dwarf Shrub class was expanded to include situations when the dominant shrub component was comprised of dwarf shrubs and the sum of the dwarf shrub, tall shrub, and low shrub cover exceeded the minimum requirement of 25% shrub cover.

MOIST SEDGE SHRUB MEADOW TYPE CLASS

The Moist Sedge Shrub Meadow Designation was developed to represent certain combinations of shrubs (predominantly Dwarf shrub) and *Carex* species that occurred with regularity, but were not being named consistently. This designation indicates types in which the sum of the shrub cover (Tall, Low, and Dwarf) is at least 25% cover; the Dwarf shrub component is the dominant shrub cover component and is not more than 35% cover; and the *Carex* (graminoid) cover component is at least 10% cover.

HERBACEOUS TYPE CLASS

The Herbaceous cover thresholds were modified slightly from the typical Viereck minimum threshold of 25% herbaceous cover to include an additional requirement of a minimum total vegetation cover of at least 30%. In addition, Herbaceous cover did not include cover of lichens or moss, and types for each of these types of plant life were based solely on the cover of these life forms meeting their appropriate minimum levels of 25% cover.

AQUATIC FORB CLASS

The Aquatic Forb class was used to differentiate aquatic forb cover from other herbaceous cover. The dominant species in all of the Aquatic Forb types that were mapped was *Nuphar* sp.(pond lily), but this class also included plants such as, *Menyanthes* sp.(buckbean), and *Potamogeton* sp. (pondweed), and *Potentilla palustris* (marsh cinquefoil). The Aquatic Forb class was assigned when the cover of aquatic forbs was the dominant plant form. In this classification effort the aquatic forb component always comprised more than 50% cover.

WATER CLASS DEFINITION AND DESIGNATIONS

The Water class was assigned when the water cover component comprised at least 50% cover of a type. Additional designations were added to the Water class to differentiate combinations of water and vegetation cover. If vegetation, including aquatic cover, comprised at least 15% cover in addition to the minimum 50% water cover component the Sparse Vegetation designation was added to the Water class name. In cases when the cover of vegetation was between 30 and 50% cover, and the dominant life form of vegetation was aquatic forbs the Aquatic Forb designation was added to the Water class name.

UNKNOWN CLASSES

Six different unknown classes are represented in the WRST Land Cover Map. These six classes include a generic Unknown class assigned to all unclassified pixels, an Unknown ClSh class assigned to mapped clouds and their shadows, and four Unknown terrain shadow classes (Tsb, Tss, Tsv, and Tsu) assigned to pixels modeled to represent locations where the imagery was dominated by terrain shadow and the mapped results were though to be unreliable. The four variations of the Unknown terrain shadow classes all represent different estimates of what generic land cover type may exist in those particular locations, where Unknown Tsb represents areas of terrain shadow thought to be barren, Unknown Tss represents areas of terrain shadow thought to be snow or ice, Unknown Tsv represents areas of terrain shadow thought to be vegetation, and Unknown Tsu represents areas of terrain shadow that are of an unknown type.

CONIFER COVER STATUS/MORTALITY DESIGNATIONS

Due to the presence of significant amounts of dead White Spruce cover due to Spruce Bark Beetle kill, the status of the conifer cover is included in the conifer type name. This type name situation is already handled in Viereck as 'stunted' spruce types are distinguished from normal spruce types with separate type names. In this case "dead" and mixed dead-and-alive designations will be added to the classification system. If at least two-thirds of the tree cover of a conifer type is described as "dead," the adjective "Dead" is added to the name of the type. If the type is a mix of live and dead cover with neither live or dead comprising a dominant component (at least 66.67%), then the adjective "Cmplx" is added to the name of the type indicating it is a mixture of live and dead cover. If the dominant conifer cover is alive no change is made to the existing Viereck type name. For example, the White Spruce Dead:Open type indicates a type with between 25 and 59.9% tree cover dominated by White Spruce of which at least 66.67% of that cover is dead; the White Spruce Cmplx:Woodland type indicates a type with between 10 and 24.9% tree cover dominated by White Spruce of which at least 33.33% of that cover is alive and 33.33% of the cover is dead.

LICHEN DESIGNATION

The Lichen designation was appended to any land cover type that was estimated to contain at least 10% cover of lichens unless the type was a Lichen type.

SAGE BLUFF DESIGNATION

The Sage Bluff designation was appended to any class that originated in an area that was determined to be representative of a Sage Bluff. Based on the vegetation cover estimated for these areas during field data collection efforts, these areas could be Dwarf shrub, Sparse Vegetation, and Barren types. The assignment of this designation was a qualitative decision based on a comparison of the geophysical characteristics of the individual field sites relative areas commonly referred to as Sage Bluffs that were primarily located in the Copper, Sanford, and Chitina River drainages.

TUSSOCK DESIGNATIONS

The Tussock designation was appended to any land cover type that was estimated to contain at least 15% cover of Eriophorum vaginatum.

WET DESIGNATION

The Wet designation was appended to Barren classes when there was a water component of at least 5% cover in the type. The class was often used to describe what appeared to be Barren areas that were also found in areas that were associated with components of water in an attempt to differentiate Barren types in wet surroundings from other Barren types. Most common applications of this designation are in wet damp gravel beds that may include very shallow water, edges of glaciers with very wet damp gravel/soil and standing water, as well as areas of wet damp gravel till on the top surface of glaciers.

Appendix 9. Crosswalk of landcover class variables produced by GRS (Stumpf 2008).

Calc_Class	GrivClVal	Major_Class	Vegetation Structure
Lichen	Lichen	Herbaceous	Bryoid Herbaceous
Water	Water	Water	Water
Herbaceous	Herbaceous/Forb	Herbaceous	Forb Herbaceous
Aquatic Forb	Aquatic Forb	Herbaceous	Forb Herbaceous
Aspen:Closed	Closed Deciduous	Hardwood	Broadleaf Forest
Aspen:Open	Open Deciduous	Hardwood	Broadleaf Forest
Balsam Poplar:Closed	Closed Deciduous	Hardwood	Broadleaf Forest
Balsam Poplar:Open	Open Deciduous	Hardwood	Broadleaf Forest
Barren/NonVeg	Barren	Barren	Barren
Barren-Sage Bluff	Barren	Barren	Barren
Barren-Wet	Barren	Barren	Barren
Black Spruce Cmplx:Open	Open Conifer	Conifer	Needleleaf Forest
Black Spruce Cmplx:Wdlnd-Lichen	Wdlnd Conifer	Conifer	Needleleaf Forest
Black Spruce Stunted:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
Black Spruce:Closed	Closed Conifer	Conifer	Needleleaf Forest
Black Spruce:Open	Open Conifer	Conifer	Needleleaf Forest
Black Spruce:Open-Lichen	Open Conifer	Conifer	Needleleaf Forest
Black Spruce:Open-Tussock	Open Conifer	Conifer	Needleleaf Forest
Black Spruce:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
Black Spruce:Wdlnd-Tussock	Wdlnd Conifer	Conifer	Needleleaf Forest
Cottonwood:Closed	Closed Deciduous	Hardwood	Broadleaf Forest
Cottonwood:Open	Open Deciduous	Hardwood	Broadleaf Forest
Dwarf Shrub	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub:Cassiope	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub:Cassiope-Lichen	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub:Dryas	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub:Dryas-Lichen	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub:Ericaceous	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub-Lichen	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub-Sage Bluff	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Dwarf Shrub-Tussock	Dwarf Shrub	Dwarf Shrub	Dwarf Scrub
Elymus	Graminoid	Herbaceous	Graminoid Herbaceous
EriVag-Tussock	Graminoid	Herbaceous	Graminoid Herbaceous
Graminoid	Graminoid	Herbaceous	Graminoid Herbaceous
Graminoid-Lichen	Graminoid	Herbaceous	Graminoid Herbaceous
Graminoid-Tussock	Graminoid	Herbaceous	Graminoid Herbaceous
Low shrub:Closed:Alder	Closed Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Closed:Birch	Closed Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Closed:Ericaceous	Closed Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Closed:Mix	Closed Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Closed:Willow	Closed Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Closed:Willow-Birch Mix	Closed Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Alder	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Birch	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Birch-Lichen	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Birch-Tussock	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Ericaceous	Open Low or Mixed Shrub	Low Shrub	Low Scrub

Appendix 9. Continued.

Calc_Class	GrivClVal	Major_Class	Vegetation Structure
Low shrub:Open:Ericaceous-Tussock	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Mix	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Mix-Tussock	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Silverberry	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Willow	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Willow-Birch Mix	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Willow-Birch Mix-Lichen	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Willow-Birch Mix-Tussock	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Willow-Lichen	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Low shrub:Open:Willow-Tussock	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed deciduous:Closed	Closed Deciduous	Hardwood	Broadleaf Forest
Mixed deciduous:Open	Open Deciduous	Hardwood	Broadleaf Forest
Mixed deciduous-conifer:Closed	Closed Deciduous-conifer	ConHwd Mix	Mixed Forest
Mixed deciduous-conifer:Open	Open Deciduous-conifer	ConHwd Mix	Mixed Forest
Mixed deciduous-conifer:Open-Lichen	Open Deciduous-conifer	ConHwd Mix	Mixed Forest
Mixed deciduous-conifer:Wdlnd	Wdlnd Deciduous-conifer	ConHwd Mix	Mixed Forest
Mixed shrub:Open:Alder	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Open:Mix	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Open:Mix-Lichen	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Open:Mix-Tussock	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Open:Willow	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Open:Willow-Lichen	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Sparse:Alder	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Sparse:Mix	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Mixed shrub:Sparse:Mix-Lichen	Open Low or Mixed Shrub	Low Shrub	Low Scrub
Moist Sedge-Shrub Meadow	Graminoid	Herbaceous	Graminoid Herbaceous
Moist Sedge-Shrub Meadow-Lichen	Graminoid	Herbaceous	Graminoid Herbaceous
Moist Sedge-Shrub Meadow-Tussock	Graminoid	Herbaceous	Graminoid Herbaceous
Moss	Moss	Herbaceous	Bryoid Herbaceous
Paper Birch:Closed	Closed Deciduous	Hardwood	Broadleaf Forest
Paper Birch:Open	Open Deciduous	Hardwood	Broadleaf Forest
Sitka Spruce:Closed	Closed Conifer	Conifer	Needleleaf Forest
Sitka Spruce:Open	Open Conifer	Conifer	Needleleaf Forest
Sitka Spruce:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
Snow/Glacier	Snow/Ice	Barren	Snow/Glacier
Sparse Vegetation	Sparse Vegetation	Sparse	Sparse
Sparse Vegetation-Lichen	Sparse Vegetation	Sparse	Sparse
Sparse Vegetation-Sage Bluff	Sparse Vegetation	Sparse	Sparse
Spruce Mix Cmplx:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
Spruce Mix:Open	Open Conifer	Conifer	Needleleaf Forest
Spruce Mix:Open-Tussock	Open Conifer	Conifer	Needleleaf Forest
Spruce Mix:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
Spruce Mix:Wdlnd-Tussock	Wdlnd Conifer	Conifer	Needleleaf Forest
Tall shrub:Closed:Alder	Closed Tall Shrub	Tall Shrub	Tall Scrub
Tall shrub:Closed:Mix	Closed Tall Shrub	Tall Shrub	Tall Scrub

Appendix 9. Continued.

Calc_Class	GrivClVal	Major_Class	Vegetation Structure
Tall shrub:Open:Mix	Open Tall Shrub	Tall Shrub	Tall Scrub
Tall shrub:Open:Willow	Open Tall Shrub	Tall Shrub	Tall Scrub
Tree shrub:Closed:Alder	Closed Tall Shrub	Tall Shrub	Tall Scrub
Tree shrub:Closed:Willow	Closed Tall Shrub	Tall Shrub	Tall Scrub
Tree shrub:Open:Alder	Open Tall Shrub	Tall Shrub	Tall Scrub
Tree shrub:Open:Willow	Open Tall Shrub	Tall Shrub	Tall Scrub
Unknown	Undefined	Unknown	Unknown
Unknown ClSh	Undefined	Unknown	Unknown
Unknown TSb	Undefined	Unknown	Unknown
Unknown TSs	Undefined	Unknown	Unknown
Unknown TSu	Undefined	Unknown	Unknown
Unknown TSv	Undefined	Unknown	Unknown
Water-Aquatic Forb	Aquatic Forb	Herbaceous	Forb Herbaceous
Water-Sparse Vegetation	Sparse Vegetation	Sparse	Sparse
White Spruce Cmplx:Closed	Closed Conifer	Conifer	Needleleaf Forest
White Spruce Cmplx:Open	Open Conifer	Conifer	Needleleaf Forest
White Spruce Cmplx:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce Cmplx:Wdlnd-Lichen	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce Dead:Open	Open Conifer	Conifer	Needleleaf Forest
White Spruce Dead:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce Dead:Wdlnd-Lichen	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce Stunted:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce:Closed	Closed Conifer	Conifer	Needleleaf Forest
White Spruce:Open	Open Conifer	Conifer	Needleleaf Forest
White Spruce:Open-Lichen	Open Conifer	Conifer	Needleleaf Forest
White Spruce:Open-Tussock	Open Conifer	Conifer	Needleleaf Forest
White Spruce:Wdlnd	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce:Wdlnd-Lichen	Wdlnd Conifer	Conifer	Needleleaf Forest
White Spruce:Wdlnd-Tussock	Wdlnd Conifer	Conifer	Needleleaf Forest

Appendix 10. Cross-tabulation of 68 ecotypes that were derived from vegetation classes calculated from the spectral database.

Calc_Class	Maritime Lowland Sitka Spruce Forest	Maritime Riverine Cottonwood-Spruce Forest	Maritime Upland Sitka Spruce Forest	Boreal Riverine White Spruce Forest	Boreal Subalpine Spruce Woodland	Boreal Upland White Spruce Forest	Boreal Lowland White Spruce Forest	Boreal Lowland Black Spruce Forest	Boreal Lowland Black Spruce Bog	Boreal Riverine Spruce-Poplar Forest	Maritime Lowland Cottonwood-Spruce Forest	Boreal Upland Spruce-Birch Forest	Boreal Subalpine Poplar Forest	Boreal Riverine Loamy Poplar Forest	Boreal Riverine Gravelly Poplar Forest	Maritime Lowland Cottonwood Forest	Maritime Riverine Cottonwood Forest	Boreal Upland Birch Forest	Boreal Upland Aspen Forest	Maritime Upland Tall Alder Shrub	Boreal Upland Tall Alder Shrub	Boreal Riverine Tall Alder Shrub	Maritime Riverine Tall Alder-Willow Shrub	Maritime Glaciated Tall Alder-Willow Shrub	Maritime Lowland Tall Alder-Willow Shrub	Boreal Upland Tall Willow Shrub	Boreal Lowland Tall Willow Shrub	Boreal Riverine Loamy Willow Shrub	Boreal Riverine Sandy Willow Shrub	Boreal Glaciated Willow Shrub	Boreal Lowland Low Birch-Willow Shrub	Boreal Subalpine Willow and Birch Shrub	Maritime Lowland Forb-Willow Meadow	Boreal Riverine Low Silverberry Shrub	Boreal Alpine Ericaceous Dwarf Shrub	Maritime Alpine Cassiope Dwarf Shrub	Maritime Subalpine Low Blueberry Shrub	Boreal Alpine Dryas Dwarf Shrub	Boreal Riverine Dryas Dwarf Shrub	Boreal Glaciated Dryas Dwarf Shrub	Boreal Upland Sagebrush Meadow	Boreal Alpine Sedge-Dwarf Willow Meadow	Maritime Lowland Sedge-Blueberry Bog	Boreal Alpine Tussock Meadow	Boreal Lowland Tussock-Shrub Bog	Boreal Lowland Sedge-Shrub Fen	Maritime Coastal Angelica Meadow	Maritime Coastal Elymus Meadow	Boreal Subalpine Forb Meadow	Maritime Riverine Horsetail Meadow	Maritime Subalpine Lupine Meadow	Boreal Lacustrine Sedge Meadow	Boreal Alpine Sedge Meadow	Boreal Lacustrine Pondlily	Boreal Riverine Circumalkaline Barrens	Maritime Glaciated Barrens	Maritime Riverine Barrens	Boreal Lowland Barrens	Boreal Glaciated Barrens	Boreal Alpine Barrens	Maritime Alpine Barrens	Maritime Coastal Barrens	Alpine Lake	Glacial Lake	Glacial River	Lowland Lake	Nearshore Water	Snow/Glacier	Grand Total
Sitka Spruce:Closed	4	2	3																																																																		9
Sitka Spruce:Open	6	2	4																																																										2								14
Sitka Spruce:Wdlnd	3	2	3													1																																																					9
White Spruce Cmplx:Closed				8	9	6	4																												1																																		28
White Spruce Cmplx:Open				27	22	14	5																												2																																		70
White Spruce Cmplx:Wdlnd				26	20	11	6																																			12																											75
White Spruce Cmplx:Wdlnd-Lichen				3	5																														1							4																											13
White Spruce Dead:Open				3	3	4	2																												1							2																											15
White Spruce Dead:Wdlnd				15	11	7	4																												1							6																											44
White Spruce Dead:Wdlnd-Lichen				4	7	5	2																																			4																											22
White Spruce Stunted:Wdlnd				13	11	2	2																																			8																											36
White Spruce:Closed				30	12	24	6																												1																																		73
White Spruce:Open				31	25	23	3																																																														82
White Spruce:Open-Lichen				17	20	7	2																												1																																		47
White Spruce:Open-Tussock				11	18				3																										1																																		33
White Spruce:Wdlnd				31	23	12	6																																			12																			1								85
White Spruce:Wdlnd-Lichen				27	18	8	6																																			12																											71
White Spruce:Wdlnd-Tussock				20	16	1	5		2																																	12																											56
Black Spruce Cmplx:Open				5	5			4																																																													14
Black Spruce Cmplx:Wdlnd-Lichen				4	5			5																																																													14
Black Spruce Stunted:Wdlnd				12	6	1			7																																																												26
Black Spruce:Closed				15	8	1		8																																																													32
Black Spruce:Open				29	15	8		12																																		11																											75
Black Spruce:Open-Lichen				16	9	1		10																																																													36
Black Spruce:Open-Tussock				11	6				6																																																												23
Black Spruce:Wdlnd				25	15	2			12																																	9																											63
Black Spruce:Wdlnd-Tussock				18	8				8																																	7																											41
Spruce Mix Cmplx:Wdlnd				12	14	5			5																																																												36
Spruce Mix:Open				27	23	13	6																																																														69
Spruce Mix:Open-Tussock				15	10				10																																																												35
Spruce Mix:Wdlnd				24	20	8			6																										2																																		60
Spruce Mix:Wdlnd-Tussock				4	4				2																										1																																		11
Mixed deciduous-conifer:Closed		1	1		11					30	4	14				2																										13																											76
Mixed deciduous-conifer:Open		2	2		7					32	4	17	10			2																										16																			1								93
Mixed deciduous-conifer:Open-Lichen					6					14		6																														5																											31
Mixed deciduous-conifer:Wdlnd		2	2		11					30	4	12	13			2																										11																											87
Mixed deciduous:Closed													30	12	20			12																																																			74
Mixed deciduous:Open													37	10	18	5	1	12																																																			83
Cottonwood:Closed																6	2																																																				8
Cottonwood:Open													17	2	7	6	2		7																		2																																43
Balsam Poplar:Closed													33	10	19	5	2		12																																																		81
Balsam Poplar:Open													41	11	20			8	4																		1																																85
Paper Birch:Closed													29	12	20			12																																																			73
Paper Birch:Open													16	9	12			8																								1																											46
Aspen:Closed													34	10	20				12																																																		76
Aspen:Open													34	10	19				11																																																		74
Tree shrub:Closed:Alder																					16	23								2		9																																					50
Low shrub:Open:Alder																				2	2	1	2	2	4							2					2																																17
Tree shrub:Open:Alder																					6	8										5																																					19
Tall shrub:Closed:Alder																				1	24	31	2	2	4					15		12					1																																92
Tall shrub:Open:Alder																				2	24	31	2	5	4					16		12					2																																98
Mixed shrub:Open:Alder																				2	6	4	2	4	4					5		3					2																																32
Low shrub:Closed:Alder																					4	5								3		6																																					18
Mixed shrub:Sparse:Alder																					10	18								2		4																																					34
Tall shrub:Closed:Mix																				2	18	21	2	2	4		6	3	1	15		11																																					85
Tall shrub:Open:Mix																				2	18	32	2	4	3		6			17		12					1										1																						98
Mixed shrub:Open:Mix																							2	4				8	19	19	12	12	2			1	2					11					2																						94
Mixed shrub:Sparse:Mix																												9	18	17	12	12				1						8																		2									79
Mixed shrub:Open:Mix-Lichen																												1	13	11	8	12										11																											56
Tree shrub:Closed:Willow																										12	4	4	14	8		6																																					48
Tree shrub:Open:Willow																										13	3	6	7	4		1																																					34

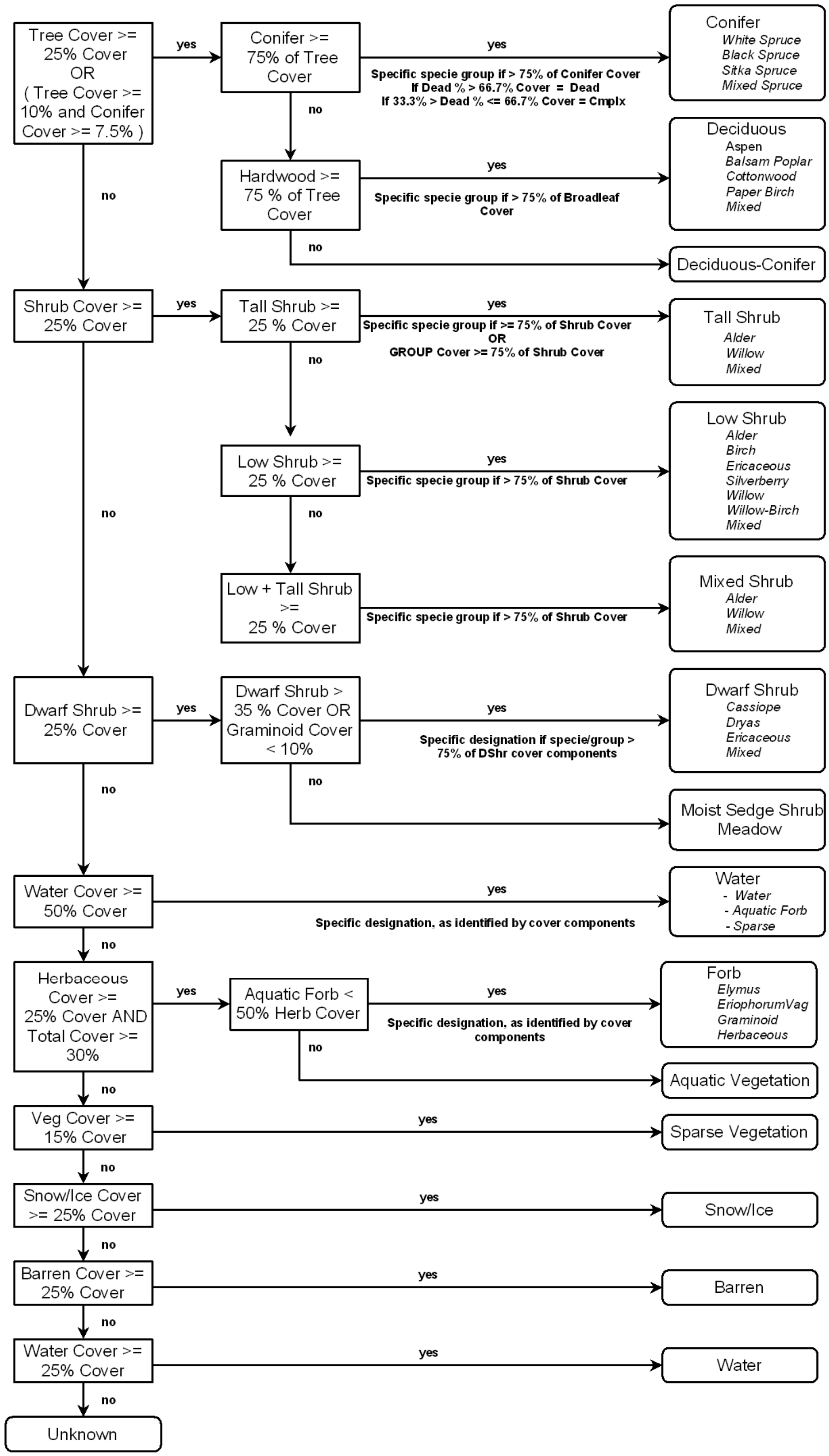
Appendix 10. Continued.

Calc_Class	Maritime Lowland Sitka Spruce Forest	Maritime Riverine Cottonwood-Spruce Forest	Maritime Upland Sitka Spruce Forest	Boreal Riverine White Spruce Forest	Boreal Subalpine Spruce Woodland	Boreal Upland White Spruce Forest	Boreal Lowland White Spruce Forest	Boreal Lowland Black Spruce Forest	Boreal Lowland Black Spruce Bog	Boreal Riverine Spruce-Poplar Forest	Maritime Lowland Cottonwood-Spruce Forest	Boreal Upland Spruce-Birch Forest	Boreal Subalpine Poplar Forest	Boreal Riverine Loamy Poplar Forest	Boreal Riverine Gravelly Poplar Forest	Maritime Lowland Cottonwood Forest	Maritime Riverine Cottonwood Forest	Boreal Upland Birch Forest	Boreal Upland Aspen Forest	Maritime Upland Tall Alder Shrub	Boreal Upland Tall Alder Shrub	Boreal Riverine Tall Alder Shrub	Maritime Riverine Tall Alder-Willow Shrub
Tall shrub:Closed:Willow																							
Tall shrub:Open:Willow																				2			2
Low shrub:Closed:Willow																							2
Low shrub:Open:Willow																							2
Mixed shrub:Open:Willow																							
Mixed shrub:Open:Willow-Lichen																							
Mixed shrub:Sparse:Mix-Lichen																							
Low shrub:Open:Willow-Birch Mix																							
Low shrub:Open:Willow-Birch Mix-Lichen																							
Low shrub:Open:Willow-Birch Mix-Tussock																							
Low shrub:Open:Willow-Lichen																							
Low shrub:Open:Willow-Tussock																							
Low shrub:Closed:Willow-Birch Mix																							
Low shrub:Open:Mix																							2
Low shrub:Closed:Birch																							
Low shrub:Closed:Ericaceous																							2
Low shrub:Closed:Mix																							
Low shrub:Open:Birch																							
Low shrub:Open:Birch-Lichen																							
Low shrub:Open:Birch-Tussock																							
Low shrub:Open:Ericaceous																							2
Mixed shrub:Open:Mix-Tussock																							
Low shrub:Open:Ericaceous-Tussock																							
Low shrub:Open:Mix-Tussock																							
Low shrub:Open:Silverberry																							
Dwarf Shrub																							
Dwarf Shrub:Dryas																							
Dwarf Shrub:Dryas-Lichen																							
Dwarf Shrub:Ericaceous																							
Dwarf Shrub:Cassiope																							
Dwarf Shrub:Cassiope-Lichen																							
Dwarf Shrub-Lichen																							
Dwarf Shrub-Tussock																							
Dwarf Shrub-Sage Bluff																							
Herbaceous																				1			
Elymus																							
Graminoid																							
Graminoid-Lichen																							
EriVag-Tussock																							
Graminoid-Tussock																							
Moist Sedge-Shrub Meadow																							
Moist Sedge-Shrub Meadow-Lichen																							
Moist Sedge-Shrub Meadow-Tussock																							
Sparse Vegetation																							
Sparse Vegetation-Lichen																							
Sparse Vegetation-Sage Bluff																							
Lichen																							
Moss																							
Unknown																				2			
Unknown ClSh																							
Unknown TSb	2					5																	
Unknown TSs																							
Unknown TSu	2																						
Unknown TSv			2		6	8																	
Aquatic Forb																							
Barren/NonVeg																							
Barren-Sage Bluff																							
Barren-Wet																							
Water																							
Water-Aquatic Forb																							
Water-Sparse Vegetation																							
Snow/Glacier																							
Grand Total	17	11	17	483	409	176	59	39	61	106	12	49	294	86	155	29	7	52	46	16	128	174	26

Calc_Class	Maritime Glaciated Tall Alder-Willow Shrub	Maritime Lowland Tall Alder-Willow Shrub	Boreal Upland Tall Willow Shrub	Boreal Lowland Tall Willow Shrub	Boreal Riverine Loamy Willow Shrub	Boreal Riverine Sandy Willow Shrub	Boreal Glaciated Willow Shrub	Boreal Lowland Low Birch-Willow Shrub	Boreal Subalpine Willow and Birch Shrub	Maritime Lowland Forb-Willow Meadow	Boreal Riverine Low Silverberry Shrub	Boreal Alpine Ericaceous Dwarf Shrub	Maritime Alpine Cassiope Dwarf Shrub	Maritime Subalpine Low Blueberry Shrub	Boreal Alpine Dryas Dwarf Shrub	Boreal Riverine Dryas Dwarf Shrub	Boreal Glaciated Dryas Dwarf Shrub	Boreal Upland Sagebrush Meadow	Boreal Alpine Sedge-Dwarf Willow Meadow	Maritime Lowland Sedge-Blueberry Bog	Boreal Alpine Tussock Meadow	Boreal Lowland Tussock-Shrub Bog	Boreal Lowland Sedge-Shrub Fen
Tall shrub:Closed:Willow			18	6	12	20	15		12					1									
Tall shrub:Open:Willow	2	3	22	6	14	9	13		2					1									
Low shrub:Closed:Willow	2		3		2	10	4	2	6	2				1					8				
Low shrub:Open:Willow	3				21	6	19	12	24	2				3									
Mixed shrub:Open:Willow			4		3	12	11	4	8										6				
Mixed shrub:Open:Willow-Lichen						1		3	2										2				
Mixed shrub:Sparse:Mix-Lichen					2	8	5	7	5										4				
Low shrub:Open:Willow-Birch Mix					25	6	20	12	24		1			1									
Low shrub:Open:Willow-Birch Mix-Lichen					2	14	3	10	11										9				
Low shrub:Open:Willow-Birch Mix-Tussock					6	8	3														17	8	
Low shrub:Open:Willow-Lichen					2	11	6	4	7										6				
Low shrub:Open:Willow-Tussock					2	12	7														13	8	
Low shrub:Closed:Willow-Birch Mix					9	11	4	8	8										9				
Low shrub:Open:Mix	2				26	6	20	12	24	2				3									
Low shrub:Closed:Birch					10	15	8	12	12										10				
Low shrub:Closed:Ericaceous	2																			2			
Low shrub:Closed:Mix					10	20	4	12	12										10				
Low shrub:Open:Birch					17	6	14	12	24		8												
Low shrub:Open:Birch-Lichen			2		4	12	10	6	8			7											
Low shrub:Open:Birch-Tussock					6	10	2														16	8	
Low shrub:Open:Ericaceous	2				2	8		7	7			5	1	2			4			2			
Mixed shrub:Open:Mix-Tussock					5	16	7														22	10	
Low shrub:Open:Ericaceous-Tussock					7	10	3														17	8	
Low shrub:Open:Mix-Tussock					9	19	6														21	15	
Low shrub:Open:Silverberry			4		2		4	2	7		8								4				
Dwarf Shrub								12	12				4		12	32	20						
Dwarf Shrub:Dryas								12					2		24	29	19						
Dwarf Shrub:Dryas-Lichen								2					2		10	10	12						
Dwarf Shrub:Ericaceous								2				8				3	2						
Dwarf Shrub:Cassiope								7				20				19	7						
Dwarf Shrub:Cassiope-Lichen								7				19				18	3						
Dwarf Shrub-Lichen								11							23	23	20						
Dwarf Shrub-Tussock																17	3				23	10	
Dwarf Shrub-Sage Bluff			2													7	6	5					
Herbaceous	5		10		30		20				2		2						12	1			1
Elymus																							
Graminoid	2		9													30	20		10	2			3
Graminoid-Lichen			6													10	3		9				
EriVag-Tussock																18	4				22	10	
Graminoid-Tussock																5	2				11	2	
Moist Sedge-Shrub Meadow	2					8				2			2	2		20	15		12				24
Moist Sedge-Shrub Meadow-Lichen						5			1							13	9		18				7
Moist Sedge-Shrub Meadow-Tussock					4						10						1				14	5	
Sparse Vegetation																							
Sparse Vegetation-Lichen																							
Sparse Vegetation-Sage Bluff			2													6	8	4					
Lichen								12															
Moss													2							2			7
Unknown		2	3					3	3														
Unknown ClSh																							
Unknown TSb									8					1									
Unknown TSs												4											
Unknown TSu									4					1									
Unknown TSv														1			7						
Aquatic Forb																							
Barren/NonVeg																							
Barren-Sage Bluff			2													8	5	4					
Barren-Wet			5																				2
Water																							
Water-Aquatic Forb																							
Water-Sparse Vegetation																							
Snow/Glacier																							
Grand Total	45	28	117	31	263	335	342	225	350	10	29	75	17	30	69	268	170	13	304	9	176	84	44

Calc_Class	Maritime Coastal Angelica Meadow	Maritime Coastal Elymus Meadow	Boreal Subalpine Forb Meadow	Maritime Riverine Horsetail Meadow	Maritime Subalpine Lupine Meadow	Boreal Lacustrine Sedge Meadow	Boreal Alpine Sedge Meadow	Boreal Lacustrine Pondlily	Boreal Riverine Circumalkaline Barrens	Maritime Glaciated Barrens	Maritime Riverine Barrens	Boreal Lowland Barrens	Boreal Glaciated Barrens	Boreal Alpine Barrens	Maritime Alpine Barrens	Maritime Coastal Barrens	Alpine Lake	Glacial Lake	Glacial River	Lowland Lake	Nearshore Water	Snow/Glacier	Grand Total
Tall shrub:Closed:Willow																							84
Tall shrub:Open:Willow	1																						77
Low shrub:Closed:Willow	2																						44
Low shrub:Open:Willow	2																						94
Mixed shrub:Open:Willow																							48
Mixed shrub:Open:Willow-Lichen																							8
Mixed shrub:Sparse:Mix-Lichen														3									34
Low shrub:Open:Willow-Birch Mix																							89
Low shrub:Open:Willow-Birch Mix-Lichen																							49
Low shrub:Open:Willow-Birch Mix-Tussock																							42
Low shrub:Open:Willow-Lichen																							36
Low shrub:Open:Willow-Tussock																							42
Low shrub:Closed:Willow-Birch Mix																							49
Low shrub:Open:Mix	2																						99
Low shrub:Closed:Birch																							67
Low shrub:Closed:Ericaceous	1																						7
Low shrub:Closed:Mix																							68
Low shrub:Open:Birch																							81
Low shrub:Open:Birch-Lichen																							49
Low shrub:Open:Birch-Tussock																							42
Low shrub:Open:Ericaceous	2																						44
Mixed shrub:Open:Mix-Tussock																							60
Low shrub:Open:Ericaceous-Tussock																							45
Low shrub:Open:Mix-Tussock																							70
Low shrub:Open:Silverberry																							31
Dwarf Shrub																							92
Dwarf Shrub:Dryas																							86
Dwarf Shrub:Dryas-Lichen																							36
Dwarf Shrub:Ericaceous																							15
Dwarf Shrub:Cassiope																							53
Dwarf Shrub:Cassiope-Lichen																							47
Dwarf Shrub-Lichen															1								78
Dwarf Shrub-Tussock																							53
Dwarf Shrub-Sage Bluff																							20
Herbaceous	2		12	2	2	1																	##
Elymus		2								4	1												7
Graminoid		2	10	2	2		4								2								98
Graminoid-Lichen			8																				36
EriVag-Tussock																							54
Graminoid-Tussock																							20
Moist Sedge-Shrub Meadow	1			2																			90
Moist Sedge-Shrub Meadow-Lichen																							53
Moist Sedge-Shrub Meadow-Tussock																							34
Sparse Vegetation									32	8	2	12	20	24	4	2							##
Sparse Vegetation-Lichen									3			3	6	7									19
Sparse Vegetation-Sage Bluff					1				2					6									29
Lichen									25				14	24									75
Moss					1				21	2	1		20	18		2							76
Unknown									9	6	1		10	12	2	2							55
Unknown ClSh														2									2
Unknown TSb									11	3		3	19	11	2								65
Unknown TSs									2			1	3	1									11
Unknown TSu					1				8	2		2	6	10									36
Unknown TSv									12					5									41
Aquatic Forb								8	1	1			2	14		1			15	1			43
Barren/NonVeg						1			32	8	2	11	20	24	4	2							##
Barren-Sage Bluff																							19
Barren-Wet			1						18	8	1	3	20	20	4	2							84
Water														3	1		25	22	29	14	2		96
Water-Aquatic Forb								9						7			11	4	13	2	1		47
Water-Sparse Vegetation								7			1			5	1		9	6	13	4	1		47
Snow/Glacier									18			5				2						52	77
Grand Total	16	4	31	9	7	2	4	24	194	42	9	40	140	198	25	13	45	32	70	21	4	52	6465

Appendix 11. Decision tree for classifying landcover types (Appendix C from Stumpf 2008).



NPS D-100, March 2008

National Park Service
U.S. Department of the Interior

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