



USER'S GUIDE FOR BRISTOL BAY LAND COVER MAPS



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Chapter 1

INTRODUCTION (MW)

PURPOSE

The purpose of this User's Guide is to explain how to use the land cover maps and field data generated by the Bristol Bay Land Cover Mapping Project. The complete data base for the Bristol Bay Land Cover Mapping Project consists of several field data and digital data products.

This chapter will identify and describe the data products, explain how and where to acquire copies of the data products, and how to use the land cover maps in conjunction with the vegetation descriptions and application information provided in this guide.

DATA PRODUCTS

The land cover information is available in digital and printed format. The various data products produced by the project are listed here with a description of what the product is and who might use it.

Digital Products

Raw Landsat Digital Tape Information consists of the original Landsat satellite data in its original four-band unaltered form. This product may be used when it is desirable to start with unaltered data to reference a different map base and to derive a new classification.

Registered Raw Landsat Digital Tape Information consists of the original Landsat satellite data after the data has been reviewed, errors corrected, and geographically referenced to a 50-meter U.S. Geological Survey Universal Transverse Mercator (USGS UTM) map base. It may be used to generate a new classification with the same base map reference.

Preliminary Classified Landsat Digital Tape Information consists of Landsat data which has been referenced to a 50-meter UTM USGS map base and has had the Landsat data grouped or classified into approximately 50 different cover types. It may be used to group the preliminary classes into different combinations for different map categories.

Final Smoothed Classified Landsat Digital Tape Information consists of the final land cover map data as presented in the printed 1:250,000-scale quad format. This data was derived from the Preliminary Classified Landsat Digital Tape Information product by grouping the 50 classes into 15 map categories and then mosaicing the classified Landsat data into complete USGS quad format. This product may be used for the assessment of land value for settlement, forestry, wetlands, etc. See Chapter 3 for some specific examples of data applications.

Registered Elevation, Slope & Aspect Digital Tape Information consists of topographic information in the form of elevation, slope and aspect for all quad areas covered by the land cover maps except for the Cold Bay, Port Moller and Stepovak Bay quads. No data was available for the three exceptions. These products would be used in conjunction with the final land cover map to further enhance one's ability to characterize an area for planning or management purposes.

Printed Data Products

Field Site Data Tabulations consists of a listing of all detailed vegetation information as grouped into 51 vegetation types. This data is identified by site and can be located on a map. It may be used to better understand the species composition of each vegetation class or mapped land cover category.

Field Site Location Maps consists of a set of 1:63,360 and 1:250,000 scale USGS map reproductions showing the field site locations which were visited by the field data collection team. This may be used to correlate field data with specific site locations.

Field Site Slides and Photos consists of color slides and prints taken at the field data sites. These may be used to obtain a pictorial representation of vegetation classes or map categories.

Field Site Data Tabulation Summaries (User's Guide) consists of a summary of the field data tabulation described above. This may be used to

obtain a general description of a vegetation cover type contained in a map category.

Field Site Vegetation Type Descriptions (User's Guide) consists of a narrative description of the vegetation types previously identified and described by the field site data tabulations. This product may be used to obtain a narrative description of a vegetation type without a tabulation of species present in the type.

Photo Interpreter Package consists of instructions on how to use a series of photos, slides, vegetation descriptions and field site locations, in preparation for doing photo interpretive work.

Film Transparencies of Land Cover Maps (1:250,000 scale quadrangle format) consists of color film reproductions of the final smoothed classified digital tape data. These are available in 1:250,000 and 1:63,360 scale USGS quad format. The 1:63,360 scale formats are available only upon user request.

Land Cover Maps consists of the final smoothed classified Landsat digital tape information reproduced on paper, either as color photographs from the film transparencies or as computer generated maps. These maps may be used to obtain land cover information or to do land use analyses.

User's Guide For Bristol Bay Land Cover Maps consists of this printed document which describes how to use the land cover maps, lists the products available and provides field data to be used in conjunction with the land cover map. This guide should be used by anyone using the land cover maps in order to better understand the map categories and the relationship of the vegetation types contained in the map categories.

Final Report For Bristol Bay Land Cover Mapping Project consists of the project documentation and technical description of the activities conducted during the project. This document would be useful to someone planning similar or other data collection work in the Bristol Bay Region.

Information about the above products is available from any of the following agencies in Anchorage: the Alaska Department of Natural Resources, the U.S. Fish and Wildlife Service, or the U.S. Geological Survey EROS Field Office.

USING THE MAP WITH THE GUIDE

The steps followed in the process of understanding the land cover information and subsequently being able to apply the information to a given data use are basically the same regardless of the data format used. The process of using the land cover information is described here in reference to using the printed map format. Before the process is described certain characteristics about the data should be understood.

Data Characteristics

The digital data base is in raster form. This means that individual units of ground area are represented as uniformly sized rectangular picture units called pixels. Each pixel represents a ground area approximately 50 to 50 meters square or six-tenths of an acre. Every pixel is described by four numerical values representing each of the four data elements, i.e. land cover, elevation, slope and aspect. The digital information is available in digital computer tape files corresponding to 1:250,000 scale USGS topographic quadrangle maps.

The hardcopy version of the digital data base consists of printed land cover maps corresponding to 1:250,000 or 1:63,360 scale USGS quadrangles and terrain information in the form of U.S.G.S. topographic quadrangle mylar overlays.

The land cover information is represented by 15 land cover map categories. The digital terrain information is expressed as elevation in one-meter intervals above mean high tide, as slope in one-degree intervals and aspect as numerical values ranging from 0 to 250. Each aspect numerical value represents an interval of 1.4 degrees on a 360-degree compass.

Land Cover Map Use Steps

The steps followed in understanding and applying the land cover data are:

1. Refer to Figure 1 and identify the quad map which covers the area of interest.
2. Obtain a copy of the land cover map desired from any of the agencies noted above. Copies are available for review at each agency.

3. Overlay the land cover map with a clear acetate copy of the USGS quad map corresponding to the scale of the land cover map you are using.
4. Locate the area of interest on the map overlay.
5. Turn to Figure 2 to determine the physiographic province in which the area of interest occurs.
6. Turn to Table 1. Study the map and identify the land cover categories of interest and locate them among those listed in the table. The table provides a cross reference between the land cover map categories and the vegetation types contained in each map category.
7. Review the map categories by following the map categories column on the left, the vegetation types column in the center and the appropriate physiographic province column on the right. This will tell you which vegetation types occur in each map category, and whether the types occur commonly, uncommonly, or rarely in the selected area.
8. Focusing on a particular map category, turn to the specific vegetation type descriptions in this guide which correspond to the types contained in each map category as identified in Table 1. An index to the vegetative type descriptions and photo representations can be found in the front of this guide.
9. Turn to the appropriate photo representation of the vegetation type you are reviewing.
10. Repeat steps 5 through 9 for each map category and vegetation type of interest.

As a follow up to the basic land cover information in Chapter 2, Chapter 3 provides preliminary interpretation of the land cover map categories with respect to other surface resources or land uses. Once the map categories and vegetation types in the area of interest are identified, they can be cross referenced in the tables presented in Chapter 3 to provide additional information about the area being studied. Tables similar to those in Chapter 3 can be generated for other resources and land uses not presented in this guide. Rather than present a comprehensive interpretation and application of the land cover data, only a few key applications are presented. Their purpose is to serve as models for future interpretive work.

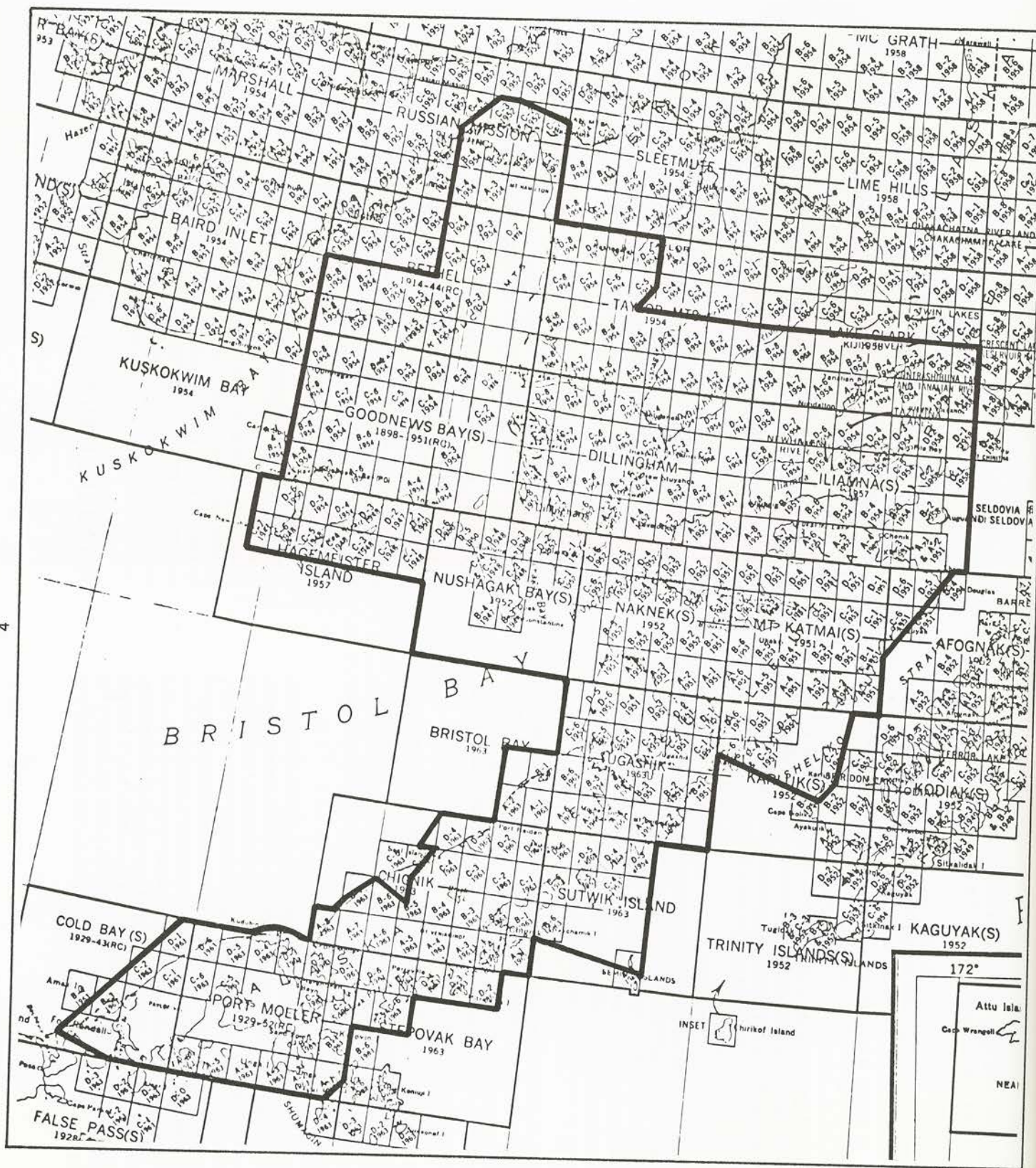
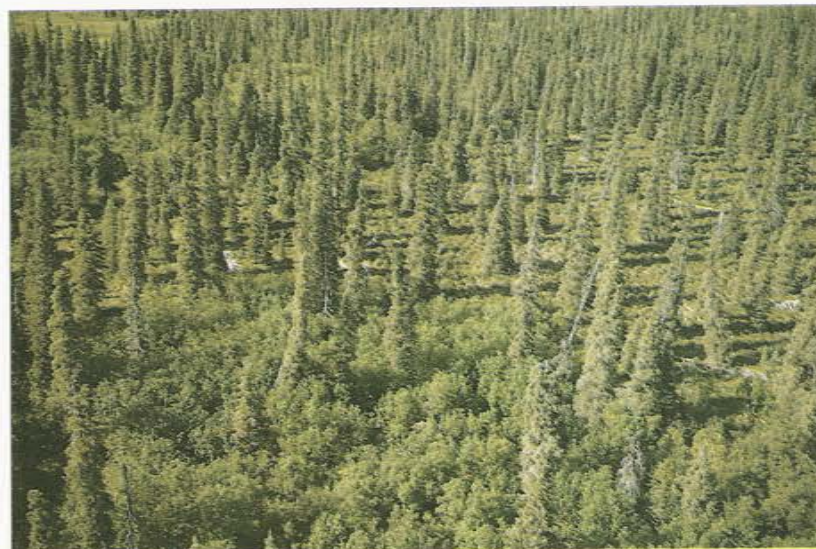


FIGURE 1
BRISTOL BAY LAND COVER MAP PROJECT AREA



A1 Closed White Spruce Forest



A2 Open White Spruce Forest



A3 Open Black Spruce Forest



A4 White Spruce Woodland

The general occurrence of vegetation communities within map categories found in these three subregions is substantially different. Conifer and Mixed Forests, frequently occurring communities in Area II are rare or absent in Areas I and III. In Areas I and II, the **Miscellaneous Deciduous** category occurs as birch and cottonwood forests and/or tall and low willow, frequently in riparian environments. However, in Area III the **Miscellaneous Deciduous** category occurs as cottonwood only in the Mother Goose Lake and Katmai Bay area. The **Miscellaneous Deciduous** category in Area III generally occurs as willow in tall, low or dwarf shrub growth form. Tall and low willow are the dominant deciduous species associated with riparian areas.

TABLE 1
LAND COVER MAP CATEGORIES AND VIERECK, et. al.
LEVEL IV ASSOCIATIONS

CATEGORY/DESCRIPTION	VIERECK, ET. AL. LEVEL IV	DISTRIBUTION						
		*Y-K	NU	BB	AL	AK	AH	KM
CONIFER Greater than 25% Conifer canopy. Not present on lower Alaska Peninsula.	Closed White Spruce Forest Open White Spruce Forest Open Black Spruce Forest		U		C		U	
			U		C	C	C	
MIXED FOREST Greater than 25% and less than 75% deciduous canopy. Greater than 10% and less than 75% conifer canopy. Not present on Alaska Peninsula.	Closed White Spruce-Balsam Poplar Forest Closed White Spruce-Birch-Balsam Poplar Forest Closed White Spruce-Birch Forest Open White Spruce-Balsam Poplar Forest Open White Spruce-Birch Forest White Spruce-Birch Woodland White Spruce Woodland				U		U	
			C		C	U		
			C		C	C		
			U				U	
		U	C		C	U	U	
			U					
			U		C	C	C	
MISCELLANEOUS DECIDUOUS (open alder, cottonwood, Kenai birch, willow) Greater than 25% deciduous canopy, frequently willow, generally in association with grass, ferns, and forbs. Frequently riparian. Less than 10% conifer canopy. On Alaska Peninsula, generally low or dwarf willow (1-5 ft.), however, in Mother Goose Lake and Katmai Bay areas, scattered balsam poplar stands are also included in this category.	Closed Birch Forest Closed Birch-Balsam Poplar Forest Open Birch Forest Open Balsam Poplar Forest Balsam Poplar Woodland Closed Willow Tall Shrub Open Willow Tall Shrub Closed Willow Low Shrub Open Willow Low Shrub Open Willow Low Shrub-Sedge or Grass Fen				U		U	
					U	U	U	
		C	C		U	U	U	
		C	U		C	C	C	
			U		U	U	U	
			U		U	U	U	
		U	U		U	U	C	
		U	U		U	U	U	
		U	U		U	U	U	
			U		C	C	U	
			U				U	

Open Low Shrub Ericaceous and **Graminoid** categories are common in Area II as low shrub and may represent seasonally wet bog areas. In Areas I and III these categories generally occur as ericaceous or graminoid dominated shrub tundra types. The **Graminoid Shrub Tundra** of Areas I and III is generally wetter than the **Ericaceous Shrub Tundra**.

Lichen and **Lichen Shrub Tundra**, commonly found in Areas I and II, are rare or absent in Area III.

CATEGORY/DESCRIPTION	VIERECK, ET. AL. LEVEL IV	DISTRIBUTION						
		*Y-K	NU	BB	AL	AK	AH	KM
CLOSED SHRUB/ GRAMINOID Greater than 75% shrub (typically alder) canopy, or fern, forb, and graminoid communities with greater than 95% cover. Frequently a mosaic of both shrub and graminoid/forb types.	Closed Alder Tall Shrub Closed Alder-Willow Tall Shrub Open Alder Tall Shrub Open Alder-Willow Tall Shrub Closed Alder-Willow Tall Shrub Closed Willow Low Shrub Mesic Herb Bluejoint Tall Grass Bluejoint Tall Grass-Herb Coastal Beach Rye Tall Grass Herb Fresh Sedge Marsh Halophytic Sedge Wet Meadow		C		C	C	C	U
			C	C	C	C	U	C
					C	C	C	U
		U	U		C	C	U	U
		U	U		U	U	U	
		U	U		U	U	U	
			U		U	U	U	
			U		U	C	U	C
			U		U	C	U	U
		U	U		U	U	U	
		U	U		C	U		U
		C	C		U	U	U	
OPEN LOW SHRUB ERICACEOUS/CONIFER WOODLAND/MESIC BOG ERICACEOUS SHRUB TUNDRA Less than 25% conifer canopy, less than 75% shrub canopy. Ericaceous shrub species are the dominant understory component. On AK Peninsula, this type is typically "hummocky heath" (ericaceous shrub tundra with 1'-4' micro-relief).	Black Spruce Woodland Open Alder-Willow Low Shrub Open Dwarf Birch-Willow Low Shrub Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog Ericaceous Shrub Sphagnum Bog Open Dwarf Birch-Low Shrub Open Willow Low Shrub Ericaceous Shrub Tundra Ericaceous Mat and Cushion Tundra Dryas-Lichen Mat and Cushion Tundra		C			U	U	C
			C	U			U	U
						U	U	
			C	C		U	C	C
		C	U		C	U	C	U
					U	U	U	
		U			C	C	U	U
		C	C		C	C	C	U
			U		U	U	C	C
			U		U	U	C	U

CATEGORY/DESCRIPTION	VIERECK, ET. AL. LEVEL IV	DISTRIBUTION						
		*Y-K	NU	BB	AL	AK	AH	KM
OPEN LOW SHRUB	Open Alder Low Shrub			C	U	U		
GRAMINOID MESIC BOG/	Sedge Tussock-Mixed Shrub Sphagnum Bog	U	C	U		U	C	
GRAMINOID SHRUB	Open Dwarf Birch-Ericaceous Shrub			C	C		U	C
TUNDRA	Sphagnum Bog						U	C
Less than 10% conifer, less than 75% shrub canopy.	Dwarf Birch-Ericaceous-Sedge Shrub Tundra	U	U	U			C	C
Greater than 20% graminoid and forb in understory. On Alaska Peninsula typically mesic to wet graminoid/	Subarctic Lowland Sedge Wet Meadow	C	C	C	U	U	C	U
graminoid shrub tundra.	Subarctic Lowland Sedge Bog Meadow	U	U	U				
LICHEN SHRUB TUNDRA	Ericaceous Shrub Tundra	C	C	C	C	C	C	U
Less than 60% lichen, less than 25% low shrub. Greater than 25% dwarf shrub.	Dwarf Birch-Ericaceous Sedge Shrub Tundra	U	U	U			C	C
	Ericaceous Mat and Cushion Tundra			U	U	C	C	
	Dryas-Lichen Mat and Cushion Tundra		U	U		U	C	U
LICHEN	Foliose and Fructicose Lichen	U	U			C	C	C
Greater than 60% lichen. Less than 25% low or tall shrubs. Not present on Alaska Peninsula.								
MARSH/VERY WET BOG	Wet Sedge-Herb Meadow Tundra			U	U			
Dominated by graminoids, forbs, and mosses with substantial areas of standing water.	Fresh Herb Marsh		U	C	U		U	
	Subarctic Lowland Herb Bog Meadow			C			U	
WET BOG/WET MEADOW	Subarctic Lowland Sedge-Wet Meadow	C	C	C	U	U	C	U
Saturated soil dominated by sedges, mosses, and water tolerant shrub species.	Subarctic Lowland Sedge-Bog Meadow			U	U	U		
	Subarctic Lowland Sedge-Moss Bog Meadow	C	C	C			C	U
	Sweetgale-Sphagnum Bog				U		C	U
	Wet Moss		U					U

CATEGORY/DESCRIPTION	VIERECK, ET. AL. LEVEL IV	DISTRIBUTION						
		*Y-K	NU	BB	AL	AK	AH	KM
BARREN								
SNOW/ICE/LIGHT BARREN								
DARK CLEAR WATER								
SHALLOW SEDIMENTED WATER								
MOUNTAIN SHADOW								

*See key to Table 1 for abbreviations.

KEY

Distribution Codes:

C — Common occurrence
U — Uncommon occurrence
Blank — Rare or absent

Province Codes:

Y-K — Yukon-Kuskokwim Lowlands
NU — Nushagak Lowlands
BB — Bristol Bay Lowlands
AL — Aleutian Range
AK — Alaska Range
AH — Ahklun Mountains
KM — Kuskokwim Mountains, Nushagak-Big River Hills

LAND COVER MAP CLASSIFICATION EVALUATION SUMMARY (JG)

The land cover map classification evaluation was conducted to determine the level of confidence associated with identification of map categories and to identify the types of errors or confusion found between map categories.

Conclusions:

- 1) The overall mapping accuracy of the Bristol Bay Land Cover Map categories can be expected to be on the order of 68% when considering the combined accuracy of 15 separate categories.
- 2) Overall map accuracy can be increased to 81% by grouping similar map categories as follows:

Conifer-Mixed Forest
 Miscellaneous Deciduous-Closed Shrub/Graminoid
 Open Low Shrub Ericaceous-Open Low Shrub Graminoid
 Lichen Shrub Tundra-Lichen
 Very Wet Bog/Meadow-Wet Bog/Meadow

- 3) Confusion may exist in some areas among Conifer Forest, Conifer Woodland, and Wet Bog Meadow.

For further information and explanation see Chapter 4—Landcover Map Classification Evaluation.

VEGETATION SUMMARY TABLES AND DESCRIPTIONS (LS)

The following vegetation summary tables and descriptions are the results of the grouping and analysis of approximately 400 of the 1,000 field sites visited. The legend in Table 2 applies to all the abbreviations found in the vegetation summary tables. Each vegetation type is coded with alphanumerics for quick reference, beginning with A1. Code E6 is absent because the vegetation type originally assigned that code was eliminated due to insufficient data to maintain it as a separate vegetation type. A quick reference index to the photos and descriptive narratives is located in the front of this guide.

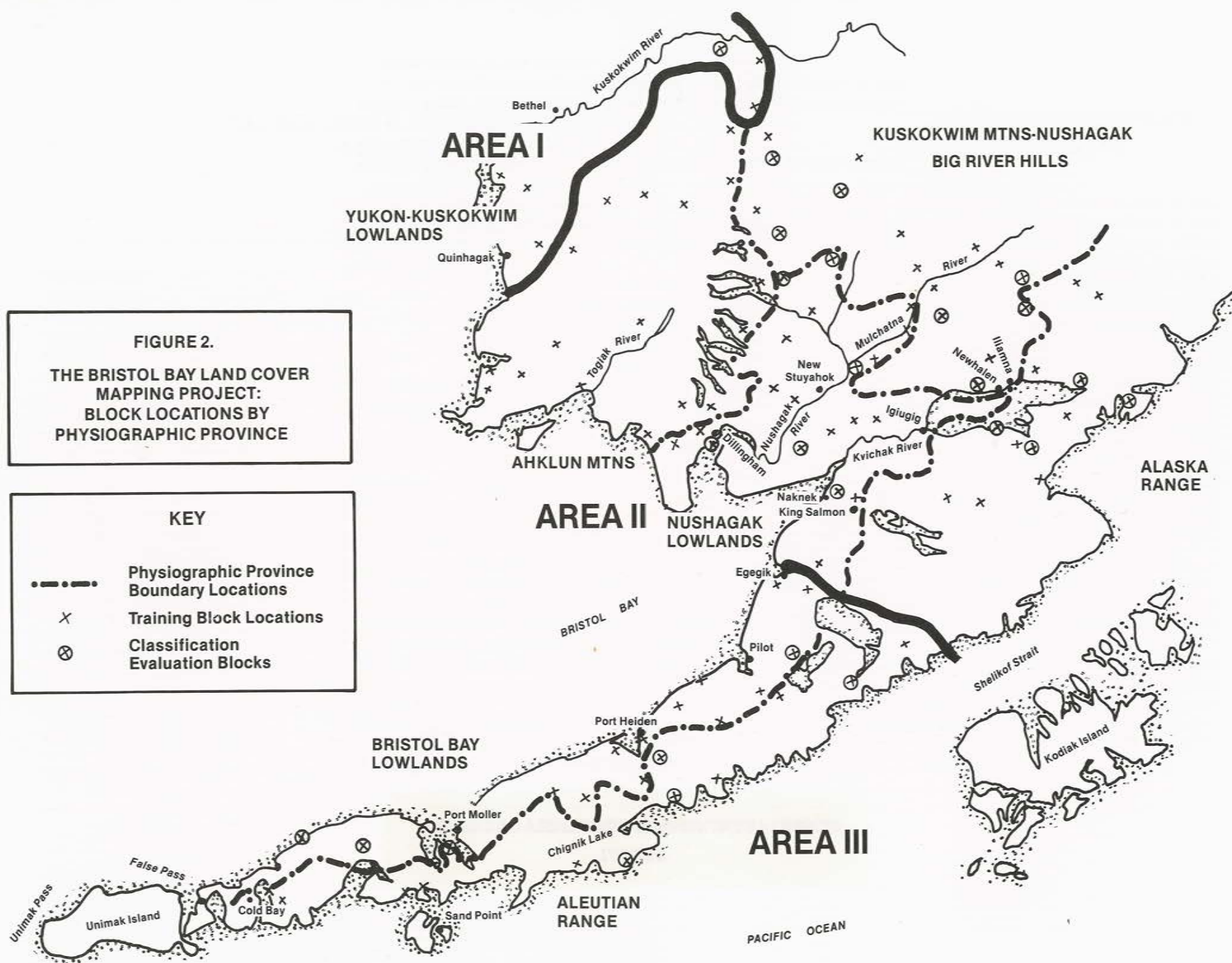


TABLE 2
LEGEND TO VEGETATION TYPE SUMMARY TABLES

Sites The number of sites with numerical cover data.

Cov. Rg The highest and lowest observed values of percent horizontal cover.

Av. Cov. The average cover of the species or Species Group based on the number of sites where it was possible to record cover data. This may be equal to or less than the total number of sampling sites. Sites which did not have detailed data recorded would be excluded. The sum of the average covers of species within a Species Group may not be equal to the Species Group average cover. This occurs where there were less sites with species cover data than with Species Group cover data.

Ht. Rg. The highest and lowest average heights in feet.

Av. Ht. The average maximum height in feet.

Sp. Group Freq. The frequency of occurrence of the Species Group as indicated by a Roman numeral where:

- I = 100-81%
- II = 80-61%
- III = 60-41%
- IV = 60-21%
- V = 20- 1%

Sp. Group Dom. The dominance of one Species Group in comparison to all Species Groups as indicated by an integer. Number I represents the most dominant Species Group.

Species Freq. The frequency of occurrence of the species as indicated by a Roman numeral.

Species Dom. The dominance of one species *within* its Species Group, i.e., the dominance of a lichen species cannot be compared to the dominance of a tree species.

CLOSED WHITE SPRUCE FOREST
4 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	4	90-65	78			I	1		
Total Conifer	4	90-65	75						
Picea glauca	4	90-65	75	55-40	48			I	1
Total Deciduous	2	11-5	4						
Betula kenaica	2	10-5	4					III	2
Populus balsamifera	1	1	1					IV	3
TOTAL TALL SHRUB	4	15-5	10			I	2		
Alnus sp.	2	5-3	2	6	6			III	2
Salix sp.	4	10-2	8	6	6			I	1
TOTAL ERICACEOUS SHRUB	1	25	25			III	3		
Empetrum nigrum	1	20	20						
Vaccinium uliginosum	1	5	5						
Vaccinium vitis-idaea	0								
TOTAL DWARF SHRUB	1	5	5			IV	5		
Betula nana	1	5	5						
TOTAL GRAMINOID	0					II			
Total Grass Cover	0								
TOTAL FORB	0					II			
Epilobium angustifolium	0								
TOTAL LICHEN COVER	1	80	80			IV	4		

**CLOSED WHITE SPRUCE
FOREST A1**

In Alaska, a closed forest has a tree canopy cover of 60% to 100% of the ground surface. In a Closed White Spruce Forest, at least $\frac{3}{4}$ of the total tree canopy cover is white spruce. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim River area, Closed White Spruce Forest has an average white spruce canopy cover of 75% of the ground surface. The average spruce tree height is 48 ft. (14.6 m.). The midstory of scattered alder and willow shrubs averages six feet (1.8 m.) in height. Crowberry, blueberry, dwarf birch, and lichens dominate the ground cover.

Closed White Spruce Forest is a common cover type only in the Alaska Range. It is an uncommon type in the Nushagak Lowlands and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This forest occurs on moderately-well to well drained flood plains, lowlands, and gentle lower slopes with south, west, or east aspects.

OPEN WHITE SPRUCE FOREST 10 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	10	55-25	39			I	1		
Total Conifer Trees	10	50-25	39						
Picea glauca	10	50-25	39	55-30	39			I	1
Total Deciduous Trees	2	5-1	1						
Populus balsamifera	1	1	1					V	2
TOTAL TALL SHRUB	7	60-5	29			I	2		
Alnus sp.	4	30-5	12	15-6	11			III	2
Salix sp.	6	30-5	19	15-6	8			I	1
TOTAL LOW SHRUB	4	30-15	24			IV	4		
Betula glandulosa	1	30	10					IV	1
Betula nana	1	20	7					IV	2
Salix sp.	1	15	5					IV	3
TOTAL ERICACEOUS SHRUB	3	20-17	28			IV	5		
TOTAL GRAMINOID	3	10	10			III	3		
Total Grass Cover	1	10	3						
Calamagrostis canadensis	1	10	10					I	1
TOTAL FORB	0					V			
TOTAL FERN COVER	0					V			
TOTAL BRYOPHYTE COVER	1	100	100			V	6		
TOTAL LICHEN COVER	1	20	20			V	7		

OPEN WHITE SPRUCE FOREST A2

In Alaska, an open forest has a tree canopy cover of 25% to 59% of the ground surface. In an Open White Spruce Forest, at least $\frac{3}{4}$ of the total tree canopy cover is white spruce. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim River area, Open White Spruce Forest has an average white spruce canopy cover of 39% of the ground surface. The average spruce tree height is 39 feet (12 m.). The midstory of alder and willow tall shrubs has an average cover of 29% and an average height of 10 feet (3 m.). Shrub birch, low willow, and bluejoint grass dominate the understory. Lichens and mosses comprise the ground cover.

Open White Spruce Forest is a common cover type in the Alaska Range, the Ahklun Mountains, and the Kuskokwim Mountains — Nushagak-Big River Hills. It is an uncommon type in the Nushagak Lowlands and is rare or absent elsewhere. This forest occurs on both poorly and well drained floodplains and gentle lower slopes with a south, west, or east aspect.

OPEN BLACK SPRUCE FOREST 4 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	4	55-40	46			I	1		
Total Conifer	4	55-40	46						
Picea glauca	1	5	1					IV	2
Picea mariana	4	50-40	45	30-20	24	I	1		
TOTAL ERICACEOUS SHRUB	4	40-10	19			I	3		
Empetrum nigrum	0							II	
Ldeum palustre	0							I	
Vaccinium uliginosum	0							I	
Vaccinium vitis-idaea	0							II	
TOTAL DWARF SHRUB	4	40-5	29			I	2		
Betula nana	4	30-5	19					I	1
Salix sp.	2	30-10	10					III	2
TOTAL BRYOPHYTE COVER	2	5	5			III	5		
TOTAL LICHEN COVER	3	10-5	7			I	4		

OPEN BLACK SPRUCE FOREST A3

In Alaska, an open forest has a tree canopy cover of 25% to 59% of the ground surface. In an Open Black Spruce Forest, at least ¾ of the total tree canopy cover is black spruce. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim River area, Open Black Spruce Forest has an average black spruce canopy cover of 45% of the ground surface. The average spruce tree height is 24 feet (7.3 m). Crowberry, Labrador tea, blueberry, cranberry, and dwarf willow dominate the ground cover.

Open Black Spruce Forest is an uncommon cover type in the Kuskokwim Mountains-Nushagak-Big River Hills. It occurs on poorly drained lowlands and very gentle north-facing slopes to at least 700 feet (244 m). This type often forms a mosaic with dwarf shrub bogs.

WHITE SPRUCE WOODLAND

18 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	18	25-10	18			I 2	
Total Conifer	18	25-10	18				
Picea glauca	18	25-10	18	40-5	23		I 1
TOTAL TALL SHRUB	8	50-5	19			III 6	
Alnus sp.	1	5	1	10-5	8		V 3
Betula glandulosa	0	0	0	5	5		V
Betula kenaica	2	20-10	4	10-4	6		IV 2
Salix sp.	6	50-5	14	10-4	5		I 1
TOTAL LOW SHRUB	12	90-5	33			II 5	
Betula glandulosa	1	15	1				V 4
Betula nana	8	40-3	15				II 1
Salix sp.	6	40-5	9				III 2
Spirea Beauverdiana	2	15-10	2				IV 3
TOTAL ERICACEOUS SHRUB	10	50-25	36			II 4	
Empetrum nigrum	6	30-10	16				II 1
Ledum palustre	2	20-10	5				IV 4
Vaccinium uliginosum	5	20-10	9				II 2
Vaccinium vitis-idaea	4	20-5	8				III 3
TOTAL DWARF SHRUB	3	10-1	5			V 8a	
Rubus chamaemorus	2	5-1	3				
Salix sp.	1	10	5				
TOTAL GRAMINOID	5	10-1	5			IV 7	
Total Grass Cover	5	10-1	5				
Calamagrostis canadensis	3	10-2	4				II 1
Festuca sp.	1	2	1				V 2
Total Sedge Cover	1	1	1				
Carex sp.	1	1	1				V 3
TOTAL HORSETAIL	1	3	3			V 9a	
Equisetum arvense	1	3	3				

WHITE SPRUCE

WOODLAND A4

In Alaska, a woodland has a tree canopy cover of 10% to 24% of the ground surface. In a White Spruce Woodland, at least ¾ of the total tree canopy cover is white spruce. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim River area, White Spruce Woodland has an average white spruce canopy cover of 18% of the ground surface. The average spruce tree height is 23 feet (7.0 m). The midstory is dominated by willow shrubs which provide an average cover of 14% and have an average height of 5 feet (1.5 m). The understory is dominated by dwarf birch which provides an average cover of 15% and an average height of 1.5 feet (0.5 m). Non-sphagnum mosses, lichens, crowberry, blueberry, and cranberry dominate the ground cover.

White Spruce Woodland is a common cover type in the Alaska Range, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is an uncommon type in the Nushagak Lowlands and is rare or absent elsewhere. This forest occurs on both poorly and moderately well-drained soils. It is found on floodplains, gentle and moderate slopes, and rounded summits to at least 2,000 feet (610 m).

TOTAL FORB	3	5	5		V	8b		
Artemisia sp.	0							
Cornus sp.	0							
Epilobium angustifolium	0							
Geranium erianthum	0							
Iris setosa	0							
Pyrola sp.	0							
Sanguisorba stipulata	0							
Trientalis europaea	0							
TOTAL FERN COVER	1	3	3		V	9b		
Dryopteris dilatata	1	3	3					
TOTAL BRYOPHYTE COVER	10	100-2	34		I	1		
Total Non-Sphagnidae	8	90-1	25				I	1
Dicranum sp.	0							
Hypnum sp.	3	40-3						
Polytrichum sp.	1	2						
Sphagnidae	3	20-1	3				IV	2
TOTAL LICHEN COVER	13	60-5	20		I	3		
Cetraria sp.	0						II	
Cladina sp.	0						II	
Cladonia sp.	1	10	10				II	2
Foliose	1	10	10				I	1
	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Sp.Groups	Freq. Dom. Species	

BLACK SPRUCE WOODLAND

11 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	11	25-10	18			I 4	
Total Conifer	11	25-10	18				
Picea mariana	11	25-10	18	30-1	16		I 1
TOTAL LOW SHRUB	7	40-5	16			II 5	
Betula glandulosa	1	10	1				V 2a
Betula nana	6	20-5	13				I 1
Salix sp.	1	10	1				V 2b
TOTAL ERICACEOUS SHRUB	9	50-10	27			I 3	
Chamaedaphne calyculata	1	10	2				IV 3
Empetrum nigrum	1	5	1				II 2
Ledum palustre	4	25-5	12				II 1
Vaccinium uliginosum	0						III
Vaccinium vitis-idaea	0						IV
TOTAL DWARF SHRUB	6	50-10	23			III 6	
Betula nana	2	35-30	22				IV 2
Rubus chamaemorus	1	10	3				III 1
Salix sp.	1	15	5				V 3
TOTAL GRAMINOID	5	10-5	8			III 7	
Total Sedge Cover	5	10-5	8				
Carex sp.	5	10-5	8				I 1
TOTAL HORSETAIL	1	1	1			V 8	
Equisetum sylvaticum	1	1	1				

BLACK SPRUCE

WOODLAND A5

In Alaska, a woodland has a tree canopy cover of 10% to 24% of the ground surface. In a Black Spruce Woodland, at least $\frac{3}{4}$ of the total tree canopy cover is black spruce. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim River area, Black Spruce Woodland has an average black spruce canopy cover of 18% of the ground surface. The average spruce tree height is 19 feet (5.8 m). The understory is dominated by dwarf birch low shrubs with an average cover of 13%. The ground cover is dominated by several types of plants in the following order of importance: sphagnum mosses, lichens, Labrador tea, non-sphagnum mosses, and dwarf birch.

Black Spruce Woodland is a common cover type in the Kuskokwim Mountains-Nushagak-Big River Hills and the Yukon-Kuskowkim Lowlands. It is an uncommon type in the Alaska Range and the Ahklun Mountains. It occurs on very poorly drained lowlands and gentle lower slopes to at least 900 feet (274 m) elevation. It is interspersed with bog

TOTAL LICHEN COVER	9	50-15	31			I	2	
Cetraria sp.	0							I
Cladonia sp.	0							I
Cladonia sp.	0							I
Foliose	0							I

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups	Species
					Freq. Dom.	Freq. Dom.

CLOSED BIRCH FOREST 1 Site Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups	Species
						Freq. Dom.	Freq. Dom.
TOTAL TREE	1	85	85	40	40	I	1
Total Conifer	1	15	15				
Picea glauca	1	15	15	40	40		
Total Deciduous	1	70	70				
Betula kenaica	1	70	70	20	20		
TOTAL TALL SHRUB	1	10	10			I	2
Alnus sp.	1	5	5				
Salix sp.	1	5	5				
TOTAL GRAMINOID	1	1	1			I	3a
Total Grass Cover	1	1	1				
TOTAL FORB	1	1	1			I	3b

CLOSED BIRCH FOREST B1

In Alaska, a closed forest has a tree canopy cover of 60% to 100% of the ground surface. In a Closed Birch Forest, at least $\frac{3}{4}$ of the total tree canopy cover is Kenai birch. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim area, Closed Birch Forest has an average Kenai birch canopy cover of 70% of the ground surface. The average birch tree height is 20 feet (6.1 m). There is insufficient data to describe the understory and ground cover.

Closed Birch Forest is an uncommon cover type in the Alaska Range and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. It occurs on well drained south, west, and east-facing gentle lower slopes.

CLOSED BIRCH-BALSAM POPLAR FOREST
3 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	3	75-60	70			I	1		
Total Conifer	2	5	3						
Picea glauca	2	5	3					III	3
Total Deciduous	3	70-60	67						
Betula kenaica	3	40-20	27					I	2
Populus balsamifera	3	50-20	40					I	1
TOTAL TALL SHRUB	2	80-40	60			I	2		
Alnus sp.	2	40-20	30					I	1
Salix sp.	2	40-20	30					II	2
TOTAL GRAMINOID	0					IV			
Total Grass Cover	0								
Calamagrostis canadensis	0								
TOTAL FORB	0					I			
TOTAL FERN COVER	0					I			

CLOSED BIRCH-BALSAM
POPLAR FOREST B2

In Alaska, a closed forest has a tree canopy cover of 60% to 100% of the ground surface. In a Closed Birch-Balsam Poplar Forest, at least $\frac{3}{4}$ of the total tree canopy cover is birch and poplar. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay area, Closed Birch-Balsam Poplar Forest has an average Kenai birch canopy cover of 27% and an average balsam poplar canopy cover of 40% of the ground surface. The mid-story of alder and willow tall shrubs has an average cover of 60%. There are insufficient data to describe the understory and ground cover.

Closed Birch-Balsam Poplar Forest is an uncommon cover type in the Alaska Range and the Ahklun Mountains and is rare or absent elsewhere. It occurs on moderately well drained floodplains and south-facing lower slopes.

OPEN BIRCH FOREST 4 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	4	50-30	41			I	2		
Total Conifer	2	5	3						
Picea glauca	2	5	3	30	30			III	2
Total Deciduous	4	50-30	39						
Betula kenaica	4	50-30	38	12-6	10			I	1
Populus balsamifera	1	5	1	30	30			IV	3
TOTAL TALL SHRUB	4	75-10	46			I	1		
Alnus sp.	3	75-20	31	10	10			II	1
Salix sp.	3	30-10	15	10	10			II	2
TOTAL LOW SHRUB	1	15	15			IV	5		
Betula glandulosa	1	15	15						
TOTAL GRAMINOID	2	30-20	25			II	3		
Total Grass Cover	2	30-20	25						
Calamagrostis canadensis	2	30-20	25					I	1
TOTAL FORB	1	20	20			III	4		
Cornus canadensis	0								
Epilobium angustifolium	0								
Viola sp.	0								
TOTAL FERN COVER	0					IV			

OPEN BIRCH FOREST B3

In Alaska, an open forest has a tree canopy cover of 25% to 59% of the ground surface. In an Open Birch Forest, at least ¾ of the total tree canopy is birch. The remaining tree canopy cover is provided by other tree species.

In the Bristol Bay-Lower Kuskokwim River area, Open Birch Forest has an average Kenai birch canopy cover of 38% and an average tree height of only 10 feet (3.1 m). Alder and willow tall shrubs have a combined average cover of 46% and an average height of 10 feet (3.1m). Therefore, they are also important components of the overstory. Bluejoint grass, forbs, and shrub birch dominate the understory.

Open Birch Forest is a common cover type in the Nushagak Lowlands and Yukon-Kuskokwim Lowlands. It is an uncommon type in the Ahklun Mountains and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This forest occurs on moderately well-drained lowlands and gentle lower slopes.

OPEN BALSAM POPLAR FOREST 13 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	13	50-25	43			I 2	
Total Conifer	1	5	1				
Picea glauca	1	5	1	40	40		V 2
Total Deciduous	13	50-25	39				
Populus balsamifera	13	50-25	39	60-15	38		I 1
TOTAL TALL SHRUB	11	80-35	52			I 1	
Alnus sp.	7	40-20	24	30-6	16		II 2
Salix sp.	9	60-10	32	30-12	18		I 1
TOTAL LOW SHRUB	1	40	40			V 6	
Salix sp.	1	40	40				
TOTAL ERICACEOUS SHRUB	2	10-5	8			V 7	
Ledum palustre	1	10	5				
Vaccinium vitis-idaea	1	5	3				
TOTAL DWARF SHRUB	2	10-3	7			V 8	
Betula nana	1	10	5				
Rubus arcticus	1	3	2				
TOTAL GRAMINOID	5	65-5	21			II 3	
Total Grass Cover	5	60-5	20				
Calamagrostis canadensis	5	60-5	20				I 1
Total Sedge Cover	1	5	1				
Carex sp.	1	5		1			V 2
TOTAL HORSETAIL	0					V	
TOTAL FORB	1	10	10			II 4	
Cardamine sp.	0						
Galium sp.	0						
Geranium erianthum	0						
Polemonium acutiflorum	0						
Viola sp.	0						
TOTAL FERN COVER	0					IV	

OPEN BALSAM POPLAR FOREST B4

In Alaska, an open forest has a tree canopy cover of 25% to 59% of the ground surface. In an Open Balsam Poplar Forest, at least ¾ of the total tree canopy cover is balsam poplar. The remaining tree canopy cover is provided by other tree species.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Balsam Poplar Forest has an average balsam poplar canopy cover of 39% of the ground surface. The average balsam poplar tree height is 38 feet (11.6 m). Willow and alder tall shrubs dominate the midstory with average covers of 32% and 24% and average heights of 18 feet (5.5 m) and 16 feet (4.9 m), respectively. Bluejoint grass dominates the understory. Feather moss dominates the ground cover.

Open Balsam Poplar Forest is a common cover type in the Alaska Range, the Aleutian Range, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is an uncommon type in the Nushagak Lowlands and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This forest generally occurs on well-drained floodplains but also occurs in small stands on south-facing lower slopes.

TOTAL BRYOPHYTE COVER	1	90	90	IV	5
Total Non-Sphagnidae	1	90	90		
Hypnum sp.	1	90			

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Sp.Groups	Freq. Dom. Species
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BALSAM POPLAR WOODLAND 5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups	Species
						Freq. Dom.	Freq. Dom.
TOTAL TREE	5	20-10	12			I	2
Total Deciduous	5	20-10	12				
Populus balsamifera	5	20-10	12	40	40		I 1
TOTAL TREE SHRUB	5	100-60	80			I	1
Alnus sp.	3	35-20	16	20	20		III 2
Salix sp.	5	100-35	64	20	20		I 1
TOTAL GRAMINOID	3	5	5			II	3
Total Grass Cover	3	5	5				
Calamagrostis canadensis	3	5	5				I 1
TOTAL FORB	0					V	
TOTAL FERN COVER	0					V	

BALSAM POPLAR WOODLAND B5

In Alaska, a woodland has a tree canopy cover of 10% to 24% of the ground surface. In a Balsam Poplar Woodland, at least ¾ of the total tree canopy cover is balsam poplar. The remaining tree canopy cover is provided by other tree species.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Balsam Poplar Woodland has an average balsam poplar canopy cover of 12% of the ground surface. The average balsam poplar tree height is 40 feet (12.2 m). Willow tall shrubs dominate the mid-story with an average cover of 64% and an average height of 20 feet (6.1 m). Bluejoint grass dominates the understory.

Balsam Poplar Woodland is an uncommon cover type in the Alaska Range, the Aleutian Range, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This type generally occurs on well-drained floodplains but also occurs on south-facing lower slopes.

CLOSED WHITE SPRUCE-BALSAM POPLAR FOREST
1 Site Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	1	80	80			1	1		
Total Conifer	1	50	50						
Picea glauca	1	50	50						
Total Deciduous	1	30	30						
Populus balsamifera	1	30	30	40	40				
TOTAL TALL SHRUB	1	30	30			1	2		
Alnus sp.	1	15	15	20	20				
Salix sp.	1	15	15	20	20				
TOTAL LOW SHRUB	0					1			
Rosal acicularis	0								
TOTAL GRAMINOID	0					1			
Total Grass Cover	0								

**CLOSED WHITE SPRUCE-
BALSAM POPLAR FOREST**
C1

In Alaska, a closed forest has a tree canopy cover of 60% to 100% of the ground surface. In a Closed White Spruce-Balsam Poplar Forest, each tree species has less than 3/4 of the total tree canopy cover.

In the Alaska Range-Bristol Bay-Lower Kuskokwim River area, Closed White Spruce-Balsam Poplar Forest has an average tree canopy cover of 50% white spruce and 30% balsam poplar. The average tree height is 40 feet (12.2 m). Alder and willow tall shrubs dominate the midstory with a combined average cover of 30% and an average height of 20 feet (6.1 m). There are insufficient data to describe the understory or ground cover.

Closed White Spruce-Balsam Poplar Forest is an uncommon cover type in the Alaska Range and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This forest occurs on well-drained floodplains of major rivers.

CLOSED WHITE SPRUCE-BIRCH-BALSAM POPLAR FOREST C2
5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	5	85-60	66			I	1		
Total Conifer	4	30-15	19						
Picea glauca	4	30-15	24	50-30	40			II	3
Total Deciduous	4	85-30	35						
Betula kenaica	4	30-25	29	30	30			II	2
Populus balsamifera	4	30-5	23	35-30	33			I	1
TOTAL TALL SHRUB	1	30	30			IV	3		
Alnus sp.	1	10	10	14	14				
Salix sp.	1	20	20	14	14				
TOTAL LOW SHRUB	1	35	35			IV	2		
Betula glandulosa	1	35	35						
TOTAL ERICACEOUS SHRUB	1	15	15			IV	4		
TOTAL GRAMINOID	2	10-5	8			IV	5		
Total Grass Cover	1	5	3						

**CLOSED WHITE SPRUCE-
BIRCH-BALSAM POPLAR
FOREST C2**

In Alaska, a closed forest has a tree canopy cover of 60% to 100% of the ground surface. In a Closed White Spruce-Birch-Balsam Poplar Forest, each tree species has less than ¼ of the total tree canopy cover.

In the Alaska Peninsula-Bristol Bay area, Closed White Spruce-Birch-Balsam Poplar Forest has average tree canopy covers of 29% Kenai birch, 24% white spruce and 23% balsam poplar. The average tree heights range from 30 feet (9.1 m) for birch to 40 feet (12.2 m) for white spruce. The midstory of alder and willow tall shrubs has an average cover of 30% and an average height of 14 feet (4.3 m). Shrub birch dominates the understory. There are insufficient data to describe the ground cover.

Closed White Spruce-Birch-Balsam Poplar Forest is a common cover type in the Alaska Range and the Nushagak Lowlands and an uncommon type in the Ahklun Mountains. It is rare or absent elsewhere. This forest occurs on moderately well-drained floodplains of major rivers and on gentle, low elevation, lower slopes.

CLOSED WHITE SPRUCE-BIRCH FOREST **8 Sites Visited**

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	8	90-60	71			I	1		
Total Conifer	8	30-15	22						
Picea glauca	8	30-15	22	50-40	45			I	1
Total Deciduous	8	70-35	49						
Betula kenaica	8	60-30	44	20	20			I	2
Populus balsamifera	3	40-1	5					IV	3
TOTAL TALL SHRUB	3	30-15	20			IV	5		
Alnus sp.	1	15	5	8	8			IV	2
Salix sp.	2	30-15	15					II	1
TOTAL LOW SHRUB	2	15-5	10			IV	6		
Betula nana	0								
Ledum palustre	0								
Rosa acicularis	1	5	5						
Spirea Beauverdiana	0								
Viburnum edule	1	10	10						
TOTAL ERICACEOUS SHRUB	1	5	5			V	10a		
Arctostaphylos alpina	0								
Empetrum nigrum	0								
Vaccinium uliginosum	0								
Vaccinium vitis-idaea	0								
TOTAL DWARF SHRUB	1	5	5			IV	8		
Rubus arcticus	1	5	5						
TOTAL GRAMINOID	3	40-5	25			II	2		
Total Grass Cover	3	40-5	25						
Calamagrostis canadensis	1	5	5					I	1
TOTAL HORSETAIL	2	10-5	8			IV	7		
Equisetum arvense	1	5	3					II	1
Equisetum sylvaticum	1	10	5					IV	2

CLOSED WHITE SPRUCE-BIRCH FOREST C3

In Alaska, a closed forest has a tree canopy cover of 60% to 100% of the ground surface. In a Closed White Spruce-Birch Forest, each of the tree species has less than ¼ of the total tree canopy cover.

In the Alaska Peninsula-Bristol Bay area, Closed White Spruce-Birch Forest has average tree canopy covers of 44% Kenai birch and 22% white spruce. The average tree heights range from 20 feet (6.1 m) for birch to 45 feet (13.7 m) for white spruce. Willow and alder tall shrubs provide a limited midstory canopy. Grasses and wildflowers dominate the understory. Mosses dominate the ground cover.

Closed White Spruce-Birch Forest is a common cover type in the Alaska Range, the Nushagak Lowlands, and the Ahklun Mountains. It is rare or absent elsewhere. This forest occurs on moderately to well-drained floodplains of major rivers and on gentle, low elevation, lower slopes.

TOTAL FORB	2	50-20	35		III	3
Artemisia sp.	0					
Delphinifolium sp.	0					
Epilobium angustifolium	0					
Galium sp.	0					
Geranium erianthum	0					
Trientalis europaea	0					
TOTAL FERN COVER	1	25	25		IV	9
Dryopteris dilatata	1	25	25			
TOTAL BRYOPHYTE COVER	2	30	30		IV	4
Total Non-Sphagnidae	1	5	5			
Dicranum sp.	0					
Hypnum sp.	0					
Rhacomitrium sp.	0					
TOTAL LICHEN COVER	1	5	5		V	10b
Cetraria sp.	0					
Cladina sp.	0					
Cladonia sp.	0					
Foliose	0					
	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Freq. Dom.
						Sp.Groups Species

OPEN WHITE SPRUCE-BALSAM POPLAR FOREST

2 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	2	50-40	45			I	1
Total Conifer	2	50-40	45				
Picea glauca	2	15-10	13	40	40		
Total Deciduous	2	35-30	33				
Populus balsamifera	2	35-30	33	50-30	40		
TOTAL TALL SHRUB	1	60	60			III	2
Alnus sp.	1	36	18	20	20		
Salix sp.	2	40-24	32	20-8	14		
TOTAL GRAMINOID	1	10	10			III	3
Total Grass Cover	1	10	10				

OPEN WHITE SPRUCE-BALSAM POPLAR FOREST

C4

In Alaska, an open forest has a tree canopy cover of 25% to 59% of the ground surface. In an Open White Spruce-Balsam Poplar Forest, each of the tree species has less than 3/4 of the total tree canopy cover.

In the Bristol Bay-Lower Kuskokwim River area, Open White-Spruce-Balsam Poplar Forest has average tree canopy covers of 33% balsam poplar and 13% white spruce. The average tree height is 40 feet (12.2 m). The midstory has an average cover of 32% willow and 18% alder. The average height is 14 feet (4.3 m) for willow and 20 feet (6.1 m) for alder. Grasses dominate the understory. There are insufficient data to describe the ground cover.

Open White Spruce-Balsam Poplar Forest is an uncommon cover type in the Nushagak Lowlands and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This forest occurs on well-drained floodplains of major rivers.

OPEN WHITE SPRUCE-BIRCH FOREST
11 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	11	55-30	46			I	1
Total Conifer	11	40-15	24				
Picea glauca	10	40-15	21	60-30	40		I 1
Picea mariana	1	30	3	25-12	19		V 3
Total Deciduous	11	40-10	22				
Betula kenaica	11	40-10	22	40-10	20		I 2
TOTAL TALL SHRUB	10	60-5	25			I	2
Alnus sp.	5	30-5	9	20-5	15		III 2
Salix sp.	10	40-5	19	20-4	9		I 1
TOTAL LOW SHRUB	3	45-1	19			IV	7
Betula nana	2	10-5	8				I 1
Spirea Beauverdiana	1	10	5				II 2
Vaccinium ovalifolium	1	25	13				IV 3
Viburnum edule	1	5	3				IV 4
TOTAL ERICACEOUS SHRUB	4	30-5	20			II	3
Arctostaphylos alpina	0						IV
Empetrum nigrum	0						IV
Ledum palustre	0						II
Vaccinium vitis-idaea	0						IV
TOTAL GRAMINOID	4	10-5	8			II	4
Total Grass Cover	4	10-5	8				
Calamagrostis canadensis	4	10-5	8				I 1
TOTAL HORSETAIL	2	10-5	8			V	10
Equisetum arvense	1	5	3				
Equisetum sylvaticum	1	10	5				
TOTAL FORB	2	70-20	45			III	6
Rubus pedatus	1	20	20				
TOTAL FERN COVER	1	10	10			IV	8
Athyrium felix-femina	1	10	10				

**OPEN WHITE SPRUCE-
BIRCH FOREST C5**

In Alaska, an open forest has a tree canopy cover of 25% to 59% of the ground surface. In an Open White Spruce-Birch Forest, each tree species has less than ¾ of the total tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open White Spruce-Birch Forest has average tree canopy covers of 22% Kenai birch and 21% white spruce. The average tree heights range from 20 feet (6.1 m) for birch to 40 feet (12.2 m) for spruce. The midstory has an average cover of 19% willow and 9% alder and an average height of 9 feet (2.8 m) for willow and 15 feet (4.6 m) for alder. Bluejoint grass and low shrubs dominate the understory. Ericaceous shrubs and non-sphagnum mosses dominate the ground cover.

Open White Spruce-Birch Forest is a common cover type in the Alaska Range and the Nushagak Lowlands. It is an uncommon type in the southern area of the Ahklun Mountains, the Kuskokwim Mountains-Nushagak-Big River Hills, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. This forest occurs on moderately well-drained slopes and rounded summits to at least 1,500 feet (457 m) and on floodplains.

OPEN WHITE SPRUCE-BIRCH FOREST (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL BRYOPHYTE COVER	3	90-10	60			III	5		
Total Non-Sphagnidae	3	90-10	53					I	1
Dicranum sp.	0								
Hypnum sp.	0								
Polytrichum sp.	0								
Sphagnidae	1	20	27					V	2
TOTAL LICHEN COVER	2	5	5			IV	9		
Cladonia sp.	0								
Foliose	0								

WHITE SPRUCE-BIRCH WOODLAND 3 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	3	20	20			I	1		
Total Conifer	3	10	10						
Picea glauca	3	10	10	50	50			I	1a
Total Deciduous	3	10	10						
Betula kenaica	3	10	10	40	40			I	1b
TOTAL TALL SHRUB	1	10	10			IV	5		
Salix sp.	1	10	10						
TOTAL LOW SHRUB	2	50-30	40			II	3a		
Betula glandulosa	1	20	20						
Rubus chamaemorus	0								
Salix sp.	1	10	10						
Spirea Beauverdiana	0								
TOTAL ERICACEOUS SHRUB	2	50	50			II	2		
Empetrum nigrum	0								
Vaccinium uliginosum	0								
Vaccinium vitis-idaea	0								
TOTAL GRAMINOID	1	1	1			IV	6		
Total Grass Cover	1	1	1						
Festuca sp.	1	1	1						
TOTAL HORSETAIL	0					V			
TOTAL BRYOPHYTE COVER	1	10	10			II	4		
Total Non-Sphagnidae	1	10	10						
Sphagnidae	0								
TOTAL LICHEN COVER	2	60-20	40			II	3b		
Cetraria sp.	0								
Cladonia sp.	0								
Cladonia sp.	0								
Foliose	0								

WHITE SPRUCE-BIRCH WOODLAND C6

In Alaska, a woodland has a tree canopy cover of 10% to 24% of the ground surface. In a White Spruce-Birch Woodland, each tree species has less than $\frac{3}{4}$ of the total tree canopy cover.

In the Bristol Bay-Lower Kuskokwim River area, White Spruce-Birch Woodland has an average Kenai birch canopy cover of 10% and white spruce canopy cover of 10%. The average tree height ranges from 40 feet (12.2 m) for birch to 50 feet (15.2 m) for spruce. Willow tall shrubs dominate the mid-story but generally have a limited canopy cover. Dwarf birch and willow low shrubs dominate the understory. Ericaceous shrubs and lichens dominate the ground cover.

White Spruce-Birch Woodland is an uncommon cover type in the Nushagak Lowlands. This type occurs on moderately well-drained floodplains and gentle lower slopes.

CLOSED WILLOW TALL SHRUB 8 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE CANOPY	1	3	1			V	7
Total Deciduous	1	3	1				
Populus balsamifera cover	1	3	3				
TOTAL TALL SHRUB	8	100-60	77			I	1
Alnus sp.	2	15-20	3	6	6		IV 2
Salix sp.	8	90-60	74	20-2	8		I 1
TOTAL DWARF SHRUB	0					V	
Betula nana	0						
Salix sp.	0						
TOTAL GRAMINOID	5	60-5	36			II	2
Total Grass Cover	5	60-5	36				
Calamagrostis canadensis	4	60-5	33				I 1
TOTAL HORSETAIL	2	10-5	8			IV	5
Equisetum arvense	2	10-5	8				I 1
TOTAL FORB	5	20-1	13			II	3
Aconitum delphinifolium	0						
Angelica sp.	0						
Epilobium angustifolium	0						
Geranium erianthum	0						
Heracleum lanatum	0						
Petasites hyperboreus	0						
Polemonium acutiflorum	0						
TOTAL FERN COVER	1	5	5			V	6
Thelypteris phegopteris	1	5	5				
TOTAL BRYOPHYTE COVER	2	80-70	75			IV	4
Total Non-Sphagnidae	1	80	80				

CLOSED WILLOW TALL SHRUB D1

In Alaska, Closed Willow Tall Shrub has 75% to 100% total tall shrub cover, primarily willow species, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Closed Willow Tall Shrub has average tall shrub covers of 74% willow and 3% alder. The average willow height is 8 feet (2.4 m). Bluejoint grass dominates the understory. Non-sphagnum mosses dominate the ground cover.

Closed Willow Tall Shrub is an uncommon cover type in the Alaska Range, the Aleutian Range, the Bristol Bay Lowlands, the Nushagak Lowlands, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. This type occurs on well-drained alluvial deposits and in riparian areas flooded by beaver activity. It is infrequent above 1,000 feet (305 m) elevation.

CLOSED ALDER TALL SHRUB
35 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	1	5	1			V	10		
Total Conifer	1	5	1						
TOTAL TALL SHRUB	35	100-60	78			I	1		
Alnus sp.	35	95-40	73					I	1
Betula glandulosa	1	30	1	5	5			V	3
Salix sp.	11	20-5	3	15-4	8			IV	2
Sambucus racemosa	1	5	1					V	4
TOTAL LOW SHRUB	4	30-5	14			V	7		
Spirea Beauverdiana	4	30-5	14					I	1
TOTAL ERICACEOUS SHRUB	5	25-5	15			V	6		
Empetrum nigrum	0								
Ledum palustre	0								
Vaccinium uliginosum	0								
Vaccinium vitis-idaea	1	10	10						
TOTAL DWARF SHRUB	2	10-5	8			V	8		
Betula nana	1	5	3						
Rubus chamaemorus	1	10	5						
TOTAL GRAMINOID	12	60-5	25			III	3		
Total Grass Cover	12	60-5	25						
Calamagrostis canadensis	12	60-5	25					I	1
TOTAL FORB	11	25-1	9			IV	4		
Epilobium angustifolium	1	5	2					II	1
Geranium erianthum	0							IV	
Heracleum lanatum	0							IV	
Sanguisorba stipulata	0							IV	
Trientalis europaea	1	5	3					III	2
Viola sp.	0							IV	
TOTAL FERN COVER	14	95-5	39			III	2		

**CLOSED ALDER
TALL SHRUB D2**

In Alaska, Closed Alder Tall Shrub has 75% to 100% tall shrub cover, primarily alder, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Closed Alder Tall Shrub has an average alder cover of 73% and a small percent cover of several other species. Ferns and blue-joint grass dominate the understory. Mosses dominate the ground cover.

Closed Alder Tall Shrub is a common cover type in the Alaska Range, the Aleutian Range, the Nushagak Lowlands, and the Ahklun Mountains. It is an uncommon type in the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. Closed Alder Tall Shrub generally occurs on moderately well-drained lower and middle slopes. It also occurs on floodplains and on the upper slopes of low elevation hills to at least 2,000 feet (610 m) elevation.

CLOSED ALDER TALL SHRUB (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL BRYOPHYTE COVER	4	40-5	24			V	5		
Total Non-Sphagnidae	1	5	5					II	1
Hypnum sp.	1	5							
Polytrichum sp.	0								
Sphagnidae	0							IV	
TOTAL LICHEN COVER	3	10-5	7			V	9		

CLOSED ALDER-WILLOW TALL SHRUB
10 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	5	20-1	4			III	2		
Total Deciduous	5	20-1	4						
Betula kenaica	2	10	4	5-10	8			IV	2
Populus balsamifera	4	10-1	4					II	1
TOTAL TALL SHRUB	10	90-60	76			I	1		
Alnus sp.	10	45-30	38	20-3	11			I	1
Salix sp.	10	50-30	35	20-3	12			I	2
TOTAL ERICACEOUS SHRUB	3	10-5	6			IV	5		
TOTAL DWARF SHRUB	1	5	5			V	8		
Rubus chamaemorus	1	5	5						
TOTAL GRAMINOID	1	60	60			IV	3		
Total Grass Cover	1	60	60						
Calamagrostis canadensis	1	60	60					I	1
Total Sedge Cover	0								
TOTAL HORSETAIL	1	20	20			V	6		
Equisetum arvense	0								
TOTAL FORB	2	25-10	18			IV	4		
Aconitum delphinifolium	1	5	5						
Trientalis europaea	1	5	5						
TOTAL FERN COVER	0					V			
TOTAL BRYOPHYTE COVER	1	5	5			V	7		
Total Non-Sphagnidae	1	5	5						

**CLOSED ALDER-
WILLOW TALL SHRUB D3**

In Alaska, Closed Alder-Willow Tall Shrub has 75% to 100% tall shrub cover, primarily alder and willow, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Closed Alder-Willow Tall Shrub has average tall shrub covers of 38% alder and 35% willow. These shrubs average 11 to 12 feet (3.4-3.7 m) in height. Bluejoint grass dominates the understory.

Closed Alder-Willow Tall Shrub is a common cover type in the Alaska Range, the Aleutian Range, the Bristol Bay Lowlands, the Nushagak Lowlands, and the Kuskokwim Mountains-Big River Hills. It is an uncommon type in the Ahklun Mountains and is rare or absent elsewhere. It occurs on moderately well- to well-drained floodplains, gentle to moderate slopes, and rounded summits to at least 1,200 feet (366 m) elevation.

OPEN WILLOW TALL SHRUB 12 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	1	20	2			V	10		
Total Deciduous	1	20	2						
Betula kenaica	1	20	2	7	7				
TOTAL TALL SHRUB	12	50-25	38			I	2		
Alnus sp.	1	5	1	5	5			V	2
Salix sp.	12	50-25	37	10-2	5			I	1
TOTAL LOW SHRUB	3	25-10	17			IV	7		
Betula glandulosa	2	10	17					II	1
Myrica gale	1	25	8					IV	2
Spirea Beauverdiana	1	5	2					IV	3
TOTAL ERICACEOUS SHRUB	3	50-10	25			IV	6		
Arctostaphylos alpina	0								
Empetrum nigrum	0								
Ledum palustre	0								
Vaccinium uliginosum	1	15	15						
Vaccinium vitis-idaea	0								
TOTAL DWARF SHRUB	5	25-8	15			III	5		
Betula nana	2	5	3					III	2
Rubus arcticus	3	15-3	7					II	1
Salix sp.	1	10	3					IV	3
TOTAL GRAMINOID	12	95-10	44			I	1		
Total Grass Cover	12	95-15	42						
Calamagrostis canadensis	9	95-10	42					I	1
Festuca sp.	0							I	
Total Sedge Cover	5	10-5	3						
Carex sp.	5	10-5	4					III	2
TOTAL HORSETAIL	2	5	5			V	8		
Equisetum fluviatile	1	5	5						

OPEN WILLOW TALL SHRUB D4

In Alaska, Open Willow Tall Shrub has 25% to 74% tall shrub cover, primarily willow, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Willow Tall Shrub has an average tall willow cover of 37% and average height of 5 feet (1.5 m). Bluejoint grass dominates the understory with an average cover of 42%. Mosses dominate the ground cover with an average cover of 68%.

Open Willow Tall Shrub is a common cover type in the Ahklun Mountains and the Kuskokwim Mountains-Nushagak-Big River Hills. It is an uncommon type in the Alaska Range, the Aleutian Range, the Bristol Bay Lowlands, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. Open Willow Tall Shrub generally occurs on poorly-drained soils adjacent to streams and in open depressions. It also occurs on moderately well-drained volcanic soils.

TOTAL FORB	8	60-5	19	II	3		
Achillea borealis	0					IV	
Aconitum delphinifolium	0					V	
Angelica sp.	0					V	
Artemisia arctica	0					IV	
Cornus canadensis	1	1	1			V	6
Epilobium angustifolium	1	5	5			IV	4
Galium sp.	0					V	
Geranium erianthum	1	10	5			IV	3
Heracleum lanatum	0					IV	
Iris setosa	1	5	3			V	5
Petasites hyperboreus	0					IV	
Polemonium acutiflorum	1	1	1			I	1
Potentilla fruticosa	0					V	
Potentilla palustris	2	20-1	11			IV	2
Pyrola sp.	0					IV	
Rumex sp.	0					V	
Sanguisorba stipulata	0					III	
Sedum rosea	0					V	
Solidago multiradiata	0					IV	
Thalictrum sp.	0					V	
Viola sp.	0					II	
TOTAL FERN COVER	0			V			
TOTAL BRYOPHYTE COVER	6	90-20	68	III	4		
Total Non-Sphagnidae	5	90-20	53			I	1
Dicranum sp.	0						
Hypnum sp.	1	90					
Polytrichum sp.	0						
Sphagnidae	2	80-10	15			IV	2
TOTAL LICHEN COVER	2	5-3	4	V	9		
Cladina sp.	0						
Cladonia sp.	0						
Foliose	1	3	3				

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom.	Freq. Dom.
					Sp.Groups	Species

OPEN ALDER TALL SHRUB

6 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TALL SHRUB	6	50-25	39			I	1		
Alnus sp.	6	50-25	38	9-2	6			I	1
Salix sp.	2	5	2					IV	2
TOTAL LOW SHRUB	1	30	30			V	3		
TOTAL DWARF SHRUB	1	35	35			V	2		
TOTAL GRAMINOID	0					V			
Total Grass Cover	0								
Calamagrostis canadensis	0								
Total Sedge Cover	0								
TOTAL FORB	0					III			
TOTAL FERN COVER	0					V			
TOTAL BRYOPHYTE COVER	0					V			

OPEN ALDER

TALL SHRUB D5

In Alaska, Open Alder Tall Shrub has 25% to 74% tall shrub cover, primarily alder, and less than 10% tree canopy cover. In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Alder Tall Shrub has an average tall alder cover of 38% and height of 6 feet (1.8 m). There is insufficient data to describe the understory and ground cover.

Open Alder Tall Shrub is generally interspersed with patches of Closed Alder Tall Shrub, Bluejoint Tall Grass-Herb, or Shrub Tundra.

Open Alder Tall Shrub is a common cover type in the Alaska Range, the Aleutian Range, and the Ahklun Mountains. It is an uncommon type in the Kuskokwim Mountains-Nushagak-Big River Hills and is rare or absent elsewhere. It generally occurs on moderately well- to well-drained slopes but is also found on flat plateaus and lowlands.

OPEN ALDER-WILLOW TALL SHRUB
5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	1	15	3			V	9
Total Conifer	1	5	1				
Picea glauca	1	5	5				
Total Deciduous	1	10	2				
Betula kenaica	1	10	10				
TOTAL TALL SHRUB	5	55-25	42			I	1
Alnus sp.	5	40-20	25	10-3	7		I 1
Salix sp.	5	25-5	17	6-3	5		I 2
TOTAL ERICACEOUS SHRUB	2	13-5	9			IV	5
Empetrum nigrum	1	5	5				
Rhododendron camtschaticum	1	3	3				
Vaccinium uliginosum	1	5	5				
TOTAL DWARF SHRUB	1	20	20			V	7
Betula nana	1	10	10				
Salix sp.	1	10	10				
TOTAL GRAMINOID	2	50-10	30			III	2
Total Grass Cover	1	50	25				
Calamagrostis canadensis	1	50	50				I 1
Total Sedge Cover	0						
TOTAL FORB	2	20-5	13			IV	4
Artemisia sp.	0						
Galium sp.	0						
Heracleum lanatum	0						
Petasites hyperboreus	0						
Sanguisorba stipulata	0						
Sedum rosea	0						
Viola sp.	0						
TOTAL FERN COVER	2	90-5	48			IV	3
Dryopteris dilatata	0						
Thelypteris phegopteris	0						

OPEN ALDER-WILLOW
TALL SHRUB D6

In Alaska, Open Alder-Willow Tall Shrub has 25% to 74% tall shrub cover, primarily alder and willow, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Alder-Willow Tall Shrub has average tall shrub covers of 25% alder and 17% willow. The average height is 7 feet (2.1 m) for alder and 5 feet (1.5 m) for willow. Bluejoint grass dominates the understory with an average cover of 50%.

Open Alder-Willow Tall Shrub is a common cover type in the Alaska Range and the Aleutian Range. It is an uncommon type in the Nushagak Lowlands, the Ahklun Mountains, the Kuskokwim Mountains-Nushagak-Big River Hills, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. This type occurs on moderately well-drained floodplains, gentle slopes, and hilltops to at least 1,000 feet (305 m) elevation.

OPEN ALDER-WILLOW TALL SHRUB (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL BRYOPHYTE COVER	2	5	5			IV	6		
TOTAL LICHEN COVER	1	5	5			V	8		
Cetraria sp.	0								
Cladina sp.	0								

CLOSED WILLOW LOW SHRUB 5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	5	90-75	81			I	1		
Potentilla egedii	1	20	4					V	2
Salix sp.	5	90-60	76					I	1
Spirea Beauverdiana	1	5	1					V	3b
TOTAL ERICACEOUS SHRUB	3	15-5	10			III	5		
Empetrum nigrum	3	10-5	7					I	1
Vaccinium vitis-idaea	2	5	3					II	2

CLOSED WILLOW LOW SHRUB E1

In Alaska, Closed Willow Low Shrub has 75% to 100% low shrub cover, primarily willow, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Closed Willow Low Shrub has an average low willow cover of 76%. Bluejoint grass and wildflowers dominate the small openings between the willow shrubs. Moses dominate the ground cover with an average cover of 45%.

TOTAL DWARF SHRUB	2	18-5	12	IV	6		
Rubus arcticus	2	5-3	4				
Salix sp.	1	15	8				
TOTAL GRAMINOID	5	20-5	11	I	3		
Total Grass Cover	3	10-5	6				
Calamagrostis canadensis	3	10-5	4			III	1
Phleum sp.	1	5	1			V	3
Total Sedge Cover	2	20-5	5				
Carex sp.	2	20-5	5			IV	2
TOTAL HORSETAIL	1	5	5	V	7		
Equisetum arvense	1	5	5				
TOTAL FORB	4	30-10	20	II	2		
Achillea borealis	1	3	3			I	3
Aconitum sp.	0					III	
Angelica sp.	0					III	
Castilleja sp.	0					IV	
Epilobium angustifolium	0					III	
Galium sp.	0					IV	
Geranium erianthum	1	5	5			II	2
Heracleum lanatum	0					IV	
Ligusticum scoticum	0					IV	
Petasites hyperboreus	0					II	
Pyrola sp.	1	3	3			I	4
Sanguisorba stipulata	1	5	5			II	1
Sedum rosea	1	2	2			IV	6
Solidago multiradiata	0					III	
Viola sp.	1	5	5			IV	5
TOTAL FERN COVER	1	10	10	V	8		
TOTAL BRYOPHYTE COVER	4	60-10	45	II	4		
Total Non-Sphagnidae	4	60-10	45			I	1
Hypnum sp.	3	60-10					
Polytrichum sp.	0						
TOTAL LICHEN COVER	1	5	5	V	9		

Closed Willow Low Shrub is an uncommon cover type in all provinces of the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area. It occurs on the well-drained gravelly soils of floodplains, on poorly-drained organic soils adjacent to streams and in open depressions, and infrequently on moderately well-drained gentle slopes to at least 2,000 feet (610 m).

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Sp.Groups	Dom.	Freq. Species	Dom.
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CLOSED ALDER-WILLOW LOW SHRUB 5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	5	100-85	88			I	1		
Alnus sp.	5	60-15	36					I	2
Betula nana	1	10	2					V	3
Salix sp.	5	70-15	50					I	1
TOTAL ERICACEOUS SHRUB	1	40	40			V	5		
Arctostaphylos alpina	0								
Empetrum nigrum	0								
Vaccinium vitis-idaea	0								
TOTAL GRAMINOID	0					I			
Total Grass Cover	0								
Calamagrostis canadensis	0							I	
Total Sedge Cover	0								
TOTAL HORSETAIL	0					V			
TOTAL FORB	2	20-5	13			I	2		
Achillea borealis	0								
Cornus canadensis	0								
Epilobium angustifolium	0								
Geranium erianthum	0								
Heracleum lanatum	0								
Pyrola sp.	0								
Sanguisorba stipulata	0								
Trientalis europaea	0								
TOTAL FERN COVER	1	5	5			II	3		
Athyrium filix-femina	0								
Gymnocarpium dryopteris	1	5	5						
TOTAL BRYOPHYTE COVER	1	80	80			V	4		
Total Non-Sphagnidae	1	80	80						

CLOSED ALDER-WILLOW LOW SHRUB E2

In Alaska, Closed Alder-Willow Low Shrub has 75% to 100% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Closed Alder-Willow Low Shrub has average low shrub covers of 50% willow and 36% alder. Wildflowers and ferns have low percent covers. Mosses and ericaceous shrubs dominate the ground cover.

Closed Alder-Willow Low Shrub is an uncommon cover type in the Alaska Range, the Aleutian Range, the Nushagak Lowlands, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. This type occurs on poorly to moderately well-drained soils adjacent to rivers and streams and on gentle slopes to at least 2,200 feet (671 m).

OPEN WILLOW LOW SHRUB
17 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	17	70-30	56			I	1		
Betula nana	1	5	1					V	2
Salix sp.	8	55-30	55	4-1	3			I	1
TOTAL ERICACEOUS SHRUB	6	55-20	41			IV	6		
Empetrum nigrum	1	50	25					I	1
Ledum palustre	1	25	13					IV	2
Vaccinium uliginosum	0							III	
Vaccinium vitis-idaea	0							III	
TOTAL DWARF SHRUB	6	50-8	19			I	3		
Betula nana	3	25-5	7					III	2
Rubus arcticus	4	10-3	2					II	1
Salix sp.	2	10	3					IV	3
Spirea Beauverdiana	1	5	1					V	4
TOTAL GRAMINOID	8	20-2	12			I	4		
Total Grass Cover	8	20-1	11						
Calamagrostis canadensis	6	20-1	9					I	1
Festuca sp.	2	5	1					V	3
Total Sedge Cover	2	10-1	1						
Carex sp.	2	10-1	2					IV	2
TOTAL HORSETAIL	5	10-1	5			IV	8		
Equisetum arvense	2	5-1	3						
TOTAL FORB	10	50-5	21			I	2		
Achillea borealis	1	10	5					III	2a
Aconitum delphinifolium	0							IV	
Aconitum sp.	0							IV	
Angelica sp.	0							IV	
Artemisia sp.	0							V	
Cardamine sp.	0							V	
Castilleja sp.	0							V	
Cornus canadensis	0							V	

**OPEN WILLOW
LOW SHRUB E3**

In Alaska, Open Willow Low Shrub has 25% to 74% low shrub cover, primarily willow, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Willow Low Shrub has an average low willow cover of 55%. Grasses, sedges and wildflowers dominate the small openings between the willow shrubs. Ericaceous shrubs, dwarf shrubs, and non-sphagnum mosses dominate the ground cover.

Open Willow Low Shrub is a common cover type in the Aleutian Range and the Bristol Bay Lowlands. It is an uncommon type in the Alaska Range, the Ahklun Mountains, the Kuskokwim Mountains-Nushagak-Big River Hills, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. This type occurs on moderately well-drained lowlands, gentle slopes and hilltops to at least 1,700 feet (518 m).

OPEN WILLOW LOW SHRUB (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
Epilobium angustifolium	1	10	5					III	2b
Gentiana sp.	0							V	
Geranium erianthum	1	10	5					III	2c
Heracleum lanatum	0							III	
Iris setosa	0							V	
Lupinus nootkatensis	1	10	5					IV	3a
Petasites hyperboreus	0							IV	
Polemonium acutiflorum	0							IV	
Rubus pedatus	0							V	
Rumex sp.	0							V	
Sanguisorba stipulata	1	10	5					II	1
Saxifraga punctata	0							V	
Sedum rosea	0							V	
Solidago multiradiata	0							IV	
Trientalis europaea	0							V	
Valeriana capitata	1	10	5					IV	3b
Veratrum viride	0							V	
Viola sp.	0							IV	
TOTAL FERN COVER	1	3	3			V	9		
Athyrium felix-femina	1	3	3						
TOTAL BRYOPHYTE COVER	7	90-10	28			III	5		
Total Non-Sphagnidae	7	90-10	26					I	1
Hypnum sp.	2	90-10							
Polytrichum sp.	0								
Sphagnidae	1	10	1					V	2
TOTAL LICHEN COVER	4	30-3	13			IV	7		
Cetraria sp.	1	3	3						
Cladina sp.	0								
Peltigera sp.	0								

OPEN WILLOW LOW SHRUB-SEDGE OR GRASS FEN
2 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	2	60	60			I	2		
Salix sp.	2	60	60						
TOTAL DWARF SHRUB	1	5	5			III	5a		
Betula nana	1	5	5						
TOTAL GRAMINOID	2	70-60	65			I	1		
Total Grass Cover	1	60	30						
Calamagrostis canadensis	1	60	30						
Total Sedge Cover	1	70	35						
Carex sp.	1	70	35						
TOTAL HORSETAIL	1	5	5			III	5b		
Equisetum fluviatile	1	5	5						
TOTAL FORB	2	50-20	35			I	3		
Potentilla palustris	2	50-20	35						
TOTAL BRYOPHYTE COVER	1	40	40			III	4		
Total Non-Sphagnidae	1	10	10						
Sphagnidae	1	30	30						

**OPEN WILLOW LOW SHRUB-
SEDGE OR GRASS FEN E4**

In Alaska, Open Willow Low Shrub-Sedge or Grass Fen has 25% to 74% low shrub cover, primarily willow, less than 25% tall shrub cover, less than 10% tree canopy cover, and a high percent of sedge and grass.

In the Bristol Bay area, Open Willow Low Shrub-Sedge or Grass Fen has an average low willow cover of 60%. The understory has an average grass and sedge cover of 65% and marsh five-finger cover of 35%. Mosses dominate the ground cover.

Open Willow Low Shrub-Sedge or Grass Fen is an uncommon cover type in the Ahklun Mountains and the Nushagak Lowlands. It is rare or absent elsewhere. This type occurs on very poorly-drained organic soils and in lowlands, open depressions and on the shores of lakes and streams.

OPEN ALDER LOW SHRUB
1 Site Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	1	50	50			1		1	
Alnus sp.	1	50	50	4-3	4				
TOTAL GRAMINOID	0					1			
Total Grass Cover	0								
Total Sedge Cover	0								
TOTAL FORB	0					1			

OPEN ALDER
LOW SHRUB E5

In Alaska, Open Alder Low Shrub has 25% to 74% low shrub cover, primarily alder, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Range-Bristol Bay area, Open Alder Low Shrub has an average low alder cover of 50%. There are insufficient data to describe the understory or ground cover.

Open Alder Low Shrub is a common type on lower slopes in the Bristol Bay Lowlands province. It is an uncommon type in the Alaska Range and the Aleutian Range provinces where it occurs on lowlands, adjacent to rivers, and on lower and middle slopes.

OPEN DWARF BIRCH-WILLOW LOW SHRUB
1 Site Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	1	30	30			1	2		
Betula nana	1	20	20						
Salix sp.	1	10	10						
TOTAL ERICACEOUS SHRUB	1	60	60			1	1		
Empetrum nigrum	1	20	20						
Ledum palustre	1	20	20						
Vaccinium vitis-idaea	1	20	20						
TOTAL GRAMINOID	1	6	6			1	4		
Total Grass Cover	1	3	3						
Total Sedge Cover	1	3	3						
TOTAL LICHEN COVER	1	10	10			1	3		

**OPEN DWARF BIRCH-
WILLOW LOW SHRUB E7**

In Alaska, Open Dwarf Birch-Willow Low Shrub has 25% to 74% low shrub cover, primarily dwarf birch and willow, less than 25% tall shrub cover, and less than 10% tree canopy.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, there are insufficient data to further describe this vegetation type.

Open Dwarf Birch-Willow Low Shrub is an uncommon cover type in the following provinces: Alaska Range, Nushagak Lowlands, Ahklun Mountains, and Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. It occurs on poorly-drained lowlands.

OPEN DWARF BIRCH LOW SHRUB 5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TREE	4	5	4			II	5		
Total Conifer	4	5	4						
Picea glauca	4	5	5	20-1	14			I	1
TOTAL LOW SHRUB	5	50-20	35			I	3		
Betula nana	5	50-20	35					I	1
TOTAL ERICACEOUS SHRUB	5	50-25	37			I	2		
Empetrum nigrum	2	15-10	8					II	2
Ledum palustre	3	25-20	23					I	1
Vaccinium uliginosum	1	20	7					IV	3
TOTAL GRAMINOID	2	5-1	1			IV	6		
Total Sedge Cover	1	1	1						
Carex sp.	1	1	1						
TOTAL FORB	1	5	1			V	7		
TOTAL BRYOPHYTE COVER	4	31-10	18			II	4		
Total Non-Sphagnidae	4	30-10	23					I	1
Dicranum sp.	0								
Polytrichum sp.	0								
Sphagnidae	1	1	1					IV	2
TOTAL LICHEN COVER	5	60-25	43			I	1		
Cladina sp.	0								
Cladonia sp.	0								
Peltigera sp.	0								
Stereocaulon sp.	0								

OPEN DWARF BIRCH LOW SHRUB E8

In Alaska, Open Dwarf Birch Low Shrub has 25% to 74% low shrub cover, primarily dwarf birch, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Dwarf Birch Low Shrub has an average dwarf low shrub cover of 33% and Labrador tea low shrub cover of 23%. Lichens and mosses dominate the ground cover.

Open Dwarf Birch Low Shrub is an uncommon cover type in the Alaska Range, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. This type occurs on level ground to at least 1,400 feet (427 m) elevation.

OPEN DWARF BIRCH-ERICACEOUS SHRUB-SPHAGNUM BOG
15 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL LOW SHRUB	1	5	1			V	8
Myrica gale	1	5	5				
TOTAL ERICACEOUS SHRUB	13	70-3	20			I	4
Andromeda polifolia	0						V
Empetrum nigrum	5	20-1	4				II 3
Ledum palustre	11	20-1	7				I 1
Oxycoccus-microcarpus	0						V
Vaccinium uliginosum	5	20-1	5				II 2
Vaccinium vitis-idaea	5	10-5	2				III 4
TOTAL DWARF SHRUB	15	40-10	20			I	3
Betula nana	12	15-10	10				I 1
Rubus arcticus	3	10-2	1				V 4
Rubus chamaemorus	8	10-3	4				III 3
Salix sp.	3	20-5	6				III 2
Spirea Beauverdiana	1	5	1				V 5
TOTAL GRAMINOID	14	50-10	21			I	2
Total Grass Cover	7	10-1	3				
Calamagrostis canadensis	7	10-1	4				III 2
Total Sedge Cover	10	50-10	15				
Carex sp.	4	10-2	3				III 3
Eriophorum sp.	4	50-3	11				II 1
TOTAL HORSETAIL	3	10-1	1			V	7
Equisetum fluviatile	2	15	6				I 1
Equisetum sylvaticum	0						IV
TOTAL FORB	8	20-1	4			III	5
Achillea borealis	0						V
Aconitum delphinifolium	0						V
Angelica sp.	0						V
Artemisia sp.	0						V
Campanula lasiocarpa	0						V
Epilobium angustifolium	0						V

OPEN DWARF BIRCH-ERICACEOUS SHRUB-SPHAGNUM BOG E9

In Alaska, Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog has 25% to 74% ericaceous and dwarf shrub cover, at least 10% dwarf birch cover, at least 10% sphagnum moss cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog has an average ericaceous shrub cover of 20% and dwarf shrub cover of 20%. Sedges are the dominant herbaceous plant with an average cover of 15%. Sphagnum moss is the dominant ground cover with an average cover of 49%.

Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog is a common cover type in the Bristol Bay Lowlands, the Nushagak Lowlands, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is an uncommon type in the Alaska Range and is rare or absent elsewhere. This type of bog occurs primarily on poorly-drained lowlands and flat terraces to at least 1,200 feet (366 m) elevation. It also occurs on moderately well-drained hillsides with up to 15% slope.

Small pools of shallow water and 1-2 feet (0.3-0.6 m) tall peat mounds are often interspersed with the bog areas. The better drained mounds support a denser cover of low shrubs, dwarf shrubs, lichens, and wildflowers than the wetter bog areas surrounding the mounds.

OPEN DWARF BIRCH-ERICACEOUS SHRUB-SPHAGNUM BOG (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
Polemonium acutiflorum	0							V	
Potentilla fruticosa	0							V	
Potentilla palustris	8	10-1	5					I	1
Sanguisorba stipulata	0							V	
TOTAL BRYOPHYTE COVER	15	100-20	67			I	1		
Total Non-Sphagnidae	11	90-5	19					II	2
Dicranum sp.	2	10-5							
Hypnum sp.	5	20-5							
Polytrichum sp.	3	20-5							
Sphagnidae	15	100-10	49					I	1
TOTAL LICHEN COVER	7	20-1	4			II	6		
Cetraria sp.	1	1	1					I	1
Cladina sp.	0							III	
Cladonia sp.	0							II	
Foliose	0							II	
Imadophila sp.	0							IV	
Stereocaulon sp.	0							V	

ERICACEOUS SHRUB-SPHAGNUM BOG
16 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL LOW SHRUB	5	20-1	2			IV 6	
Alnus sp.	1	15	3				V 3
Myrica gale	2	5	2				IV 2
Spirea Beauverdiana	3	5-1	2				III 1
TOTAL ERICACEOUS SHRUB	15	60-5	21			I 3	
Andromeda polifolia	2	3-2	1				V 5
Chamaedaphne calyculata	1	3	1				V 6
Empetrum nigrum	10	20-1	5				II 3
Ledum palustre	11	15-5	5				II 2
Oxycoccus-microcarpus	1	1	1				V 7
Vaccinium uliginosum	10	40-3	8				II 1
Vaccinium vitis-idaea	8	5-1	2				III 4
TOTAL DWARF SHRUB	15	40-5	10			I 5	
Betula nana	14	15-3	5				I 1
Rubus chamaemorus	5	25-3	3				IV 2
Salix sp.	5	15-5	2				IV 3
TOTAL GRAMINOID	16	40-5	13			I 4	
Total Grass Cover	2	10-3	1				
Arctophila fulva	1	10	1				V 3
Calamagrostis canadensis	1	3	1				V 4
Total Sedge Cover	16	20-5	12				
Carex sp.	6	15-5	5				III 2
Eriophorum sp.	7	30-5	6				II 1
TOTAL HORSETAIL	1	1	1			V 8	
TOTAL FORB	2	15-10	2			V 7	
Menyanthes trifoliata	1	5	5				
Petasites hyperboreus	0						
Platanthera sp.	0						
Potentilla palustris	1	10	10				
Trientalis europaea	0						
Valeriana capitata	0						

**ERICACEOUS SHRUB-
SPHAGNUM BOG E10**

In Alaska, Ericaceous Shrub-Sphagnum Bog has 25% to 74% ericaceous and dwarf shrub cover, less than 10% dwarf birch cover, at least 10% sphagnum moss cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Ericaceous Shrub-Sphagnum Bog has an average ericaceous shrub cover of 21% and dwarf shrub cover of 10%. Combined sedge and grass cover averages 13%. Sphagnum moss and "reindeer" lichens dominate the ground cover with 55% and 23% covers, respectively.

Ericaceous Shrub-Sphagnum Bog is a common cover type in the Aleutian Range, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is an uncommon type in the Alaska Range, the Nushagak Lowlands, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. It occurs on poorly-drained level ground to at least 1,000 feet (305 m) elevation.

Small pools of shallow water and 1-3 feet (0.3-1 m) tall peat mounds are often interspersed with the bog areas. The better-drained mounds support a denser cover of low shrubs, dwarf shrubs, lichens, and wildflowers than the wetter bog areas surrounding the mounds.

ERICACEOUS SHRUB-SPHAGNUM BOG (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL BRYOPHYTE COVER	16	100-30	63			I	1		
Total Non-Sphagnidae	9	40-3	9					III	2
Dicranum sp.	4	40-3							
Hypnum sp.	5	50-3							
Polytrichum sp.	4	5-2							
Rhacomitrium sp.	1	5							
Sphagnidae	16	100-15	55					I	1
TOTAL LICHEN COVER	14	60-15	22			I	2		
Alectoria nigrescens	0							V	
Alectoria ochreoluca	0							V	
Cetraria sp.	0	5	2					II	1
Cladina sp.	3	60-5	23					III	2
Cladonia sp.	0							IV	
Foliose	1	5	2					V	3
Imadophila sp.	0							III	
Stereocaulon sp.	0							V	

SWEETGALE-SPHAGNUM BOG
9 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL LOW SHRUB	9	30-10	19			I 3	
Myrica gale	9	30-10	17				I 1
Potentilla fruticosa	2	10-5	2				IV 3
Spirea Beauverdiana	1	5	1				V 3
TOTAL ERICACEOUS SHRUB	4	20-1	4			III 5	
Andromeda polifolia	0						I
Empetrum nigrum	0						II
Ledum palustre	2	1	1				III 1
Vaccinium vitis-idaea	0						IV
TOTAL DWARF SHRUB	9	30-5	10			I 4	
Betula nana	9	20-5	7				I 1
Rubus arcticus	2	1	1				IV 4
Rubus chamaemorus	3	5-1	1				IV 3
Salix sp.	3	10-1	2				IV 2
TOTAL GRAMINOID	9	50-5	24			I 2	
Total Grass Cover	1	50	6				
Calamagrostis canadensis	1	50	17				V 3
Total Sedge Cover	8	45-5	17				
Carex sp.	1	20	7				II 2
Eriophorum sp.	1	45	15				II 1
Scirpus caespitosum	0						IV
TOTAL HORSETAIL	4	5-1	1			III 6	
Equisetum arvense	1	1	1				IV 2
Equisetum fluviatile	3	5-1	2				II 1
TOTAL FORB	2	15-5	2			IV 7	
Iris setosa	0						
Polemonium acutiflorum	0						
Potentilla palustris	1	15	15				

**SWEETGALE-SPHAGNUM
BOG E11**

In Alaska, Sweetgale-Sphagnum Bog has 25% to 74% combined low shrub, dwarf shrub, and ericaceous shrub cover. This bog type has at least 10% sphagnum moss cover, at least 10% sweetgale shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Sweetgale-Sphagnum Bog has an average sweetgale shrub cover of 17%, dwarf shrub cover of 10%, and ericaceous shrub cover of 4%. Combined sedge and grass cover averages 24%. Sphagnum moss cover dominates the ground cover with 59% cover.

Sweetgale-Sphagnum Bog is a common cover type in the Ahklun Mountains and an uncommon type in the Aleutian Range and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. It occurs on very poorly drained open depressions, level ground, or gentle slopes to at least 1,000 feet (305 m) elevation. Sweetgale bog is generally associated with areas of standing water.

SWEETGALE-SPHAGNUM BOG (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL BRYOPHYTE COVER	9	100-30	82			I	1		
Total Non-Sphagnidae	6	55-15	23					II	2
Hypnum sp.	4	80-5							
Rhacomitrium sp.	1	10							
Sphagnidae	9	100-10	59					I	1
TOTAL LICHEN COVER	2	5-1	1			V	8		
Cladina sp.	0								
Cladonia sp.	0								

ERICACEOUS SHRUB TUNDRA 62 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL TREE	3	10-1	1			V 8	
Total Conifer	3	10-1	1				
Picea glauca	3	10-1	4	8-6	7		I 1
TOTAL TALL SHRUB	1	15	1			V 9	
Alnus sp.	1	5	5	6	6		
Betula kenaica	1	5	5	6	6		
Salix sp.	1	5	5	6	6		
TOTAL LOW SHRUB	11	20-3	2			V 7	
Alnus sp.	3	10-5	2				IV 2
Salix sp.	7	20-3	8				II 1
TOTAL ERICACEOUS SHRUB	62	90-15	45			I 1	
Andromeda polifolia	0						V
Arctostaphylos alpina	19	15-1	3				II 3
Diapensia lapponica	2	10-2	1				V 7
Empetrum nigrum	27	65-5	14				I 1
Ledum palustre	32	50-1	6				II 2
Loiseluria procumbens	16	20-2	3				IV 6
Phyllodoce aleutica	0						V
Rhododendron camtschaticum	0						V
Vaccinium uliginosum	13	50-1	3				III 4
Vaccinium vitis-idaea	13	10-1	1				III 5
TOTAL DWARF SHRUB	45	30-3	8			II 3	
Betula nana	30	20-1	4				II 1
Rubus arcticus	6	15-1	1				V 3
Rubus chamaemorus	2	2	1				V 5
Salix sp.	27	30-3	7				III 2
Spirea Beauverdiana	6	5-1	1				V 4
TOTAL GRAMINOID	48	15-1	5			II 5	
Total Grass Cover	28	10-1	2				
Calamagrostis canadensis	2	5-1	1				V 5
Elymus arenarius	2	10-5	1				V 3

ERICACEOUS SHRUB TUNDRA F1

In Alaska, Ericaceous Shrub Tundra has 25% to 75% cover of erect to decumbent shrubs less than 8 inches (20 cm) high. It has less than 25% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Ericaceous Shrub Tundra is dominated by ericaceous shrubs and lichens with average covers of 45% and 28%, respectively.

Ericaceous Shrub Tundra is a common cover type in the Alaska Range, the Aleutian Range, the Bristol Bay Lowlands, the Nushagak Lowlands, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is an uncommon type in the Kuskokwim Mountains-Nushagak-Big River Hills. Ericaceous Shrub Tundra generally occurs on well-drained silty sand, sandy gravel, or rocky mineral soils but is also found on moderately well- to poorly-drained organic soils. Ericaceous Shrub Tundra is extensive on level terraces, coastal lowlands, gentle to moderate slopes, and rounded summits to at least 2,000 feet (610 m) elevation. It also occurs in small patches on peat mounds within bogs and on barren sand dunes and volcanic soil.

A microtopography consisting of regularly spaced 1-4 feet (0.3-1.2 m) tall hummocks frequently exists. The taller hummocks support a denser cover of wildflowers and low and dwarf willow shrubs.

ERICACEOUS SHRUB TUNDRA (continued)

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
Festuca sp.	9	10-1	1					IV	2
Poa sp.	3	5-3	1					V	4
Total Sedge Cover	33	15-1	3						
Carex sp.	33	30-1	4					II	1
TOTAL FORB	26	30-1	4			III	6		
Achillea borealis	1	5	1					IV	3
Anemone narcissiflora	0							V	
Angelica sp.	2	5-1	1					IV	2
Antennaria sp.	0							V	
Arnica sp.	0							V	
Artemisia globularia	0							IV	
Astragalus sp.	0							V	
Campanula lasiocarpa	0							V	
Cornus suecica	1	5	1					V	6
Dryas octopetala	3	5-1	2					IV	1
Epilobium angustifolium	0							IV	
Gentiana algida	0							V	
Geranium erianthum	0							IV	
Lagotis glauca	0							V	
Lathyrus maritima	1	20	3					V	5
Lupinus nootkatensis	1	3	1					IV	4
Pedicularis sp.	0							IV	
Petasites hyperboreus	1	2	1					V	7a
Pyrola sp.	1	1	1					V	8
Rumex sp.	0							V	
Sanguisorba stipulata	0							IV	
Saxifraga serpyllifolia	1	1	1					V	9
Sedum rosea	0							V	
Senecio pseudoarnica	0							V	
Silene acaulis	0							V	
Solidago multiradiata	0							V	
Trientalis europaea	0							V	
Viola sp.	1	2	1					V	7b

TOTAL BRYOPHYTE COVER	39	50-1	7	II	4		
Total Non-Sphagnidae	28	50-1	10			I	1
Dicranum sp.	12	10-2					
Hypnum sp.	12	50-3					
Polytrichum sp.	1	3					
Racomitrium sp.	9	10-3					
Sphagnidae	4	5-3	1			V	2
TOTAL LICHEN COVER	52	80-1	28	I	2		
Total Light Lichens	46	70-1	24				
Alectoria ochreolucra	0					V	
Cetraria sp.	2	5-1	1			II	1
Cladina sp.	0					I	
Cladonia sp.	0					III	
Foliose	0					IV	
Stereocaulon sp.	0					II	
Thamnolia sp.	0					IV	
Total Dark Lichens	28	30-1	5				
Alectoria nigrescens	3	20-2	3			IV	3
Cetraria sp.	10	20-1	4			III	2
Crustose	0					V	
Foliose	2	2	1			V	4

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom.	Freq. Dom.
					Sp.Groups	Species

DWARF BIRCH-ERICACEOUS-SEDGE SHRUB TUNDRA 31 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL TALL SHRUB	4	10-5	1			V	8		
Alnus sp.	1	10	3	5-3	4			IV	2
Salix sp.	3	5	4	4	4			II	1
TOTAL LOW SHRUB	6	20-1	2			V	7		
Betula nana	1	5	1					V	2
Salix sp.	6	15-1	8					I	1
TOTAL ERICACEOUS SHRUB	31	70-10	42			I	1		
Arctostaphylos alpina	7	10-1	1					IV	5
Empetrum nigrum	14	40-3	10					I	2
Ledum palustre	26	30-5	11					I	1
Vaccinium uliginosum	8	25-5	3					III	4
Vaccinium vitis-idaea	14	30-2	4					I	3
TOTAL DWARF SHRUB	29	50-10	22			I	3		
Betula nana	29	40-10	17					I	1
Rubus arcticus	4	10-3	1					V	3
Rubus chamaemorus	3	5-3	1					V	5
Salix sp.	15	30-1	4					III	2
Spirea Beauverdiana	4	5-3	1					V	4
TOTAL GRAMINOID	29	25-1	9			I	4		
Total Grass Cover	13	20-3	3						
Calamagrostis canadensis	4	20-3	1					IV	2
Festuca sp.	3	5-3	1					V	3
Poa sp.	2	3-2	1					V	4
Total Sedge Cover	28	15-1	6						
Carex sp.	28	15-1	7					I	1
TOTAL HORSETAIL	1	3	1			V	9		

DWARF BIRCH-ERICACEOUS-SEDGE SHRUB TUNDRA F2

In Alaska, Dwarf Birch-Ericaceous-Sedge Shrub Tundra has between 25% and 75% cover of erect to decumbent shrubs less than 8 inches (20 cm) high. It has less than 25% low shrub cover, less than 25% tree canopy cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Dwarf Birch-Ericaceous-Sedge Shrub Tundra is dominated by ericaceous shrubs, lichens, and dwarf shrubs with average covers of 42%, 26% and 22%, respectively.

Dwarf Birch-Ericaceous Shrub-Sedge Tundra is a common cover type in the Ahklun Mountains and Kuskokwim Mountains-Nushagak-Big River Hills. It is an uncommon type in the Bristol Bay Lowlands, Nushagak Lowlands, and Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. This shrub tundra type is extensive on level terraces, gentle slopes, and rounded summits to at least 2,000 feet (610 m) elevation. It also occurs in small patches on peat mounds within bogs.

A microtopography consisting of regularly spaced 1-4 feet (0.2-1.2 m) high hummocks frequently exists. The taller hummocks support a denser cover of wildflowers and low and dwarf willow shrubs.

TOTAL FORB	12	15-1	1	IV	6		
Arnica sp.	0					V	
Artemisia sp.	0					V	
Campanula lasiocarpa	2	3-2	1			IV	1
Cerastium sp.	0					V	
Cornus canadensis	0					V	
Epilobium angustifolium	0					IV	
Loiseluria procumbens	2	15-10	4			V	3
Lupinus nootkatensis	1	5	1			V	5
Pedicularis sp.	2	3-1	1			IV	2
Petasites hyperboreus	2	1	1			V	4
Polemonium acutiflorum	0					V	
Rumex sp.	0					V	
Seum rosea	0					V	
TOTAL BRYOPHYTE COVER	21	85-1	11	II	5		
Total Non-Sphagnidae	21	80-1	16			I	1
Dicranum sp.	3	3-2					
Hypnum sp.	8	60-3					
Polytrichum sp.	6	5-3					
Rhacomitrium sp.	2	5					
Sphagnidae	3	5-3	1			V	2
TOTAL LICHEN COVER	31	65-1	26	I	2		
Total Light Licens	27	60-1	21				
Alectoria ochrelucre	0					V	
Cetraria sp.	0					II	
Cladina sp.	0					I	
Cladonia sp.	0					III	
Foliose	0					V	
Peltigera sp.	0					IV	
Stereocaulon sp.	0					III	
Thamnolia sp.	0					V	
Total Dark Lichens	16	20-1	3				
Alectoria nigrescens	1	10	1			V	3
Cetraria sp.	4	20-5	5			IV	1
Peltigera sp.	2	1	1			V	2

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Sp.Groups	Dom. Species	Freq. Dom. Species
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ERICACEOUS MAT AND CUSHION TUNDRA 12 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL ERICACEOUS SHRUB	12	70-20	41			I 1	
Arctostaphylos alpina	2	10-5	3				II 3
Cassiope sp.	2	20-10	6				V 4
Empetrum nigrum	5	20-5	11				I 1
Ledum palustre	2	5-3	2				V 6
Loiseluria procumbens	2	5	2				V 5
Rhododendron camtschaticum	1	5	1				V 7
Vaccinium uliginosum	2	15-3	4				II 2
Vaccinium vitis-idaea	1	3	1				V 8
TOTAL DWARF SHRUB	4	20-5	4			IV 4	
Betula nana	2	10-5	4				III 2
Salix sp.	4	15-5	9				I 1
TOTAL GRAMINOID	3	20-10	4			IV 5	
Total Grass Cover	3	15-5	3				
Festuca sp.	2	15-5	7				II 1
Poa sp.	1	5	2				IV 3
Total Sedge Cover	2	10-5	1				
Carex sp.	2	10-5	5				II 2
TOTAL FORB	5	40-20	11			III 3	
Achillea borealis	0						V
Aconitum delphinifolium	0						V
Arnica sp.	0						V
Artemisia sp.	0						III
Dryas sp.	4	15-10	13				II 2
Gentiana sp.	1	1	1				IV 4
Geranium erianthum	0						V
Leguminosae	1	5	1				V 5
Pedicularis sp.	2	2	1				III 3
Sanguisorba stipulata	0						IV
Saxifraga punctata	0						IV
Sedum rosea	2	3-2	1				I 1
Viola sp.	0						V

ERICACEOUS MAT AND CUSHION TUNDRA G1

In Alaska, Ericaceous Mat and Cushion Tundra is dominated by mat and cushion plants less than 8 inches (20 cm) high due to the environmental stress of wind and prolonged snow cover. It has less than 25% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Range-Bristol Bay area, Ericaceous Mat and Cushion Tundra is dominated by ericaceous shrubs, lichens, and wildflowers with average covers of 41%, 23%, and 11%, respectively. Total plant cover rarely exceeds 90% and may be as low as 25%.

Ericaceous Mat and Cushion Tundra is a common cover type in the Alaska Range and the Ahklun Mountains and an uncommon type in the Aleutian Range and the Bristol Bay Lowlands. It is rare or absent elsewhere. Ericaceous Mat and Cushion Tundra generally occurs on moderate to steep upper slopes and high elevation ridges and mountaintops where the rocky mineral soil is well drained. It rarely occurs on well-drained alluvial deposits.

TOTAL BRYOPHYTE COVER	4	10-3	2		IV	6		
Dicranum sp.	1	10						
Hypnum sp.	0							
Rhacomitrium sp.	0							
Total Non-Sphagnidae	4	10-3	7				I	1
TOTAL LICHEN COVER	11	40-5	23		I	2		
Alectoria nigrescens	0						IV	
Alectoria ochroleuca	0						IV	
Cetraria sp.	1	3	3				I	2
Cladonia sp.	1	10	10				I	1
Cladonia sp.	0						III	
Foliose	0						II	
Thamnolia sp.	0						IV	

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Sp.Groups	Freq. Dom. Species
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DRYAS-LICHEN MAT AND CUSHION TUNDRA 5 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL ERICACEOUS SHRUB	5	21-5	13			I 3	
Arctostaphylos alpina	2	5	2				IV 3a
Diapensia lapponica	3	10-2	3				III 1
Empetrum nigrum	2	5	2				IV 3b
Ledum palustre	3	3-1	2				III 2
Loiseluria procumbens	1	5	1				V 4
Vaccinium uliginosum	2	5	2				IV 3c
Vaccinium vitis-idaea	1	3	1				V 5
TOTAL DWARF SHRUB	4	15-2	6			II 5	
Betula nana	1	5	1				IV 2
Salix sp.	4	10-2	5				I 1
TOTAL GRAMINOID	4	15-5	7			II 4	
Total Grass Cover	3	10-3	4				
Festuca sp.	0						IV
Hierochloa sp.	1	3	1				IV 2
Poa sp.	0						IV
Total Sedge Cover	4	5-2	3				
Carex sp.	4	5-2	4				I 1
TOTAL FORB	5	25-10	17			I 2	
Artemisia sp.	1	3	2				IV 2a
Campanula lasiocarpa	1	3	2				IV 2b
Dryas sp.	1	10	5				III 1
Gentiana sp.	0						V
Lagotis glauca	0						V
Leguminosae	1	2	1				V 3
Polygonum sp.	0						V
Saxifraga punctata	0						IV
Silene acaulis	0						V
TOTAL BRYOPHYTE COVER	3	10-3	4			III 6	
Total Non-Sphagnidae	3	10-3	6				I 1
Dicranum sp.	0						
Hypnum sp.	1	5					
Rhacomitrium sp.	0						

DRYAS-LICHEN MAT AND CUSHION TUNDRA G2

In Alaska, Dryas-Lichen Mat and Cushion Tundra is dominated by mat and cushion plants less than 8 inches (20 cm) high due to the environmental stress of wind and prolonged snow cover. It has less than 60% lichen cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Dryas-Lichen Mat and Cushion Tundra is dominated by lichens, wildflowers and dwarf ericaceous shrubs, with average covers of 20%, 17%, and 13%, respectively. Total plant cover rarely exceeds 90% and may be as low as 25%.

Dryas-Lichen Mat and Cushion Tundra is a common cover type in the Ahklun Mountains and an uncommon type in the Nushagak Lowlands, the Alaska Range, the Bristol Bay Lowlands, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. Dryas-Lichen Mat and Cushion Tundra generally occurs on high elevation upper slopes and mountaintops where the rocky mineral soil is well-drained. In the Nushagak Lowlands it occurs on lower elevation hilltops with scattered tall deciduous shrubs.

TOTAL LICHEN COVER	5	25-3	20	I	1	
Total Light Lichens	4	25-3	12			
Cetraria sp.	0					II
Cladina sp.	0					II
Cladonia sp.	0					IV
Foliose	0					II
Thamnolia sp.	0					II
Total Dark Lichens	3	20-10	8			
Alectoria nigrescens	0					II
Cetraria sp.	0					II

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Sp.Groups	Freq. Dom. Species
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BLUEJOINT TALL GRASS

12 Sites Visited

BLUEJOINT

TALL GRASS H1

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	5	20-5	5			III	4		
Salix sp.	3	20-10	9					III	1
Spirea Beauverdiana	2	5	2					IV	2
TOTAL ERICACEOUS SHRUB	1	20	2			V	7		
Vaccinium uliginosum	1	20	20						
TOTAL DWARF SHRUB	4	15-1	2			IV	5		
Rubus arcticus	4	15-1	7					I	1
TOTAL GRAMINOID	12	100-30	83			I	1		
Total Grass Cover	12	100-30	78						
Calamagrostis canadensis	12	100-30	78					I	1
Total Sedge Cover	6	15-1	5						
Carex sp.	5	15-5	4					III	2
Eriophorum sp.	1	5	1					V	3
TOTAL HORSETAIL	2	35-3	3			V	6		
Equisetum arvense	2	35-3	19						
TOTAL FORB	10	20-5	11			I	2		
Achillea borealis	1	2	1					IV	3a
Aconitum delphinifolium	0							V	
Angelica sp.	0							IV	
Artemisia sp.	0							V	
Caltha palustris	0							V	
Cerastium Beeringianum	1	1	1					V	7
Epilobium angustifolium	1	5	3					III	1
Geranium erianthum	1	10	5				V	4	
Heracleum lanatum	1	5	3					IV	2a
Lupinus nootkatensis	0							V	
Petasites hyperboreus	0							V	
Polemonium acutiflorum	1	2	1					IV	3b
Potentilla palustris	1	5	3					IV	2b
Pyrola sp.	0							V	
Rumex sp.	1	5	3					IV	2c

In Alaska, Bluejoint Tall Grass is dominated by bluejoint grass. It has less than 25% forb cover, less than 25% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay area, Bluejoint Tall Grass has an average bluejoint cover of 78%.

Bluejoint Tall Grass is a common cover type in the Aleutian Range and the Ahklun Mountains. It is an uncommon type in the Alaska Range, the Bristol Bay Lowlands, and the Nushagak Lowlands. It is most extensive on well-drained subalpine slopes, where it is often intermixed with tall shrub stands. It also occurs on poorly-drained alluvial deposits adjacent to meandering streams and on moderately well-drained coastal lowlands.

Sanguisorba stipulata	1	2	1			V	6
Sedum rosea	0					V	
Solidago lepida	0					V	
Trientalis europaea	0					IV	
Veratrum viride	1	3	2			V	5
Viola sp.	0					V	
TOTAL FERN COVER	2	10-5	1		V	8	
Thelypteris phegopteris	1	10	10				
TOTAL BRYOPHYTE COVER	5	50-3	7		III	3	
Total Non-Sphagnidae	5	50-3	17			I	1
Hypnum sp.	1	50					
Ptilidium ciliare	0						
Ptilidium crista cortreus	0						

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq.	Dom.	Freq.	Dom.
					Sp.Groups		Species	

BLUEJOINT TALL GRASS-HERB
2 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL DWARF SHRUB	1	5	3			III	6		
Rubus arcticus	1	5	5						
TOTAL GRAMINOID	2	40-30	35			I	1		
Total Grass Cover	2	40-30	35						
Calamagrostis canadensis	2	40-30	35						
TOTAL HORSETAIL	1	30	15			III	4		
Equisetum arvense	1	30	30						
TOTAL FORB	2	30	30			I	2		
Achillea borealis	0								
Epilobium angustifolium	1	3	3						
Galium sp.	0								
Geranium erianthum	0								
Heracleum lanatum	1	20	20						
Polemonium acutiflorum	0								
Sanguisorba stipulata	1	2	2						
Trientalis europaea	0								
Urtica gracilis	1	5	5						
TOTAL FERN COVER	1	10	5			III	5		
Athyrium filix-femina	1	10	10						
TOTAL BRYOPHYTE COVER	1	40	20			III	3		
Total Non-Sphagnidae	1	40	40						
Hypnum sp.	1	40							

**BLUEJOINT TALL GRASS-
HERB H2**

In Alaska, Bluejoint Tall Grass-Herb is dominated by bluejoint grass and wild-flowers. It has less than 25% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Bluejoint Tall Grass-Herb has an average bluejoint cover of 35% and an average wild-flower cover of 30%.

Bluejoint Tall Grass-Herb is a common cover type in the Alaska Range and the Aleutian Range. It is an uncommon type in the Bristol Bay Lowlands, the Nushagak-Lowlands, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. It occurs on well-drained subalpine slopes and on moderately well-drained or poorly-drained coastal lowlands.

COASTAL BEACH RYE TALL GRASS-HERB
6 Sites Visited

COASTAL BEACH RYE
TALL GRASS-HERB H3

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	1	5	1			IV	5		
Agnus sp.	0								
Myrica gale	1	5	5						
TOTAL ERICACEOUS SHRUB	4	60-4	34			I	2		
Empetrum nigrum	4	50-10	33					I	1
Vaccinium uliginosum	2	30-10	10					IV	2
TOTAL DWARF SHRUB	3	15	9			II	4		
Salix sp.	3	15	15					I	1
TOTAL GRAMINOID	5	70-5	39			I	1		
Total Grass Cover	4	70-40	38						
Calamagrostis canadensis	1	20	5					IV	3
Elymus arenarius	4	70-20	51					I	1
Total Sedge Cover	2	5-1	1						
Carex sp.	2	5-1	2					II	2

In Alaska, Coastal Beach Rye Tall Grass-Herb is dominated by beach rye, wildflowers and heaths. It has less than 25% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Coastal Beach Rye Tall Grass-Herb has an average beach rye cover of 51%, an average dwarf ericaceous shrub cover of 34%, and an average wildflower cover of 25%.

Coastal Beach Rye Tall Grass-Herb is an uncommon cover type in the Alaska Range, the Aleutian Range, the Bristol Bay Lowlands, the Nushagak Lowlands, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. It occurs on

WET SEDGE-HERB MEADOW TUNDRA

2 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL GRAMINOID	2	40	40			1	2		
Total Sedge Cover	2	40	40						
Carex sp.	2	20	20						
Eriophorum sp.	2	20	20						
TOTAL FORB	2	60-30	45			1	1		
Cicuta mackenzieana	1	2	1						
Menyanthes trifoliata	1	50	25						
Potentilla palustris	2	30-10	20						
TOTAL BRYOPHYTE COVER	2	20-5	13			1	3		
Total Non-Sphagnidae	1	20	10						
Sphagnidae	1	5	3						

WET SEDGE-HERB MEADOW TUNDRA I1

In Alaska, Wet Sedge-Herb Meadow Tundra is dominated by sedges and wildflowers. It has less than 10% sphagnum moss cover, less than 25% shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay area, Wet Sedge-Herb Meadow Tundra has an average sedge cover of 40% and an average wildflower cover of 45%. Marsh fivefinger and buckbean are the dominant wildflowers.

Wet Sedge-Herb Meadow Tundra is an uncommon cover type in the Aleutian Range and the Bristol Bay Lowlands and rare to absent elsewhere. It occurs on very poorly-drained organic soils in open depressions. Standing water is generally present in pools.

FRESH SEDGE MARSH **4 Sites Visited**

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL GRAMINOID	4	90-60	75			I	1		
Total Sedge Cover	4	90-60	75						
Carex sp.	3	90-60	75					I	1
TOTAL HORSETAIL	3	10-5	6			II	2		
Equisetum fluviatile	3	10-5	8					I	1
TOTAL FORB	2	70-10	20			II	3		
Hippuris vulgaris	1	10	5					III	3
Menyanthes trifoliata	1	5	3					III	4
Potentilla palustris	2	30-5	18					I	1
Polygonum sp.	1	30	15					III	2
TOTAL BRYOPHYTE COVER	1	5	1			IV	4		
Sphagnidae	1	5	5						

FRESH SEDGE **MARSH J1**

In Alaska, Fresh Sedge Marsh is dominated by sedges. It has very low or no sphagnum moss cover and no shrub or tree cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, the average sedge cover is 75%, and the average wildflower cover is 20%.

Fresh Sedge Marsh is a common cover type in the Bristol Bay Lowlands. It is an uncommon type in the Aleutian Range, the Nushagak Lowlands, the Ahklun Mountains, the Kuskokwim Mountains-Nushagak-Big river Hills, and the Yukon-Kuskokwim Lowlands. It occurs on very poorly-drained soils in open depressions. Standing water is always present and generally exceeds 6 inches (15 cm) in depth.

SUBARCTIC LOWLAND SEDGE WET MEADOW **9 Sites Visited**

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL LOW SHRUB	1	10	1			V	7
Salix sp.	1	10	10				
TOTAL ERICACEOUS SHRUB	2	5-1	1			IV	6
Andromeda polifolia	1	1	1				
Empetrum nigrum	0						
Oxycoccus-microcarpus	0						
TOTAL DWARF SHRUB	3	10-5	2			IV	4
Betula nana	2	3-2	2				II 3
Rubus arcticus	3	5-2	2				II 2
Salix sp.	2	5-3	3				II 1
TOTAL GRAMINOID	9	80-25	62			I	1
Total Grass Cover	4	20-3	4				
Calamagrostis canadensis	1	1	1				V 4
Total Sedge Cover	9	80-25	58				
Carex sp.	7	80-5	37				II 1
Eriophorum sp.	5	80-25	21				III 2
Luzula sp.	1	5	1				V 3
TOTAL HORSETAIL	3	5-3	1			IV	5
Equisetum fluviatile	2	5	5				
TOTAL FORB	7	35-5	12			II	3
Caltha palustris	1	2	1				V 5
Circuta mackenzieana	1 3	1					IV 3
Cornus suecica	0						V
Menyanthes trifoliata	1	3	1				V 4
Parnassia sp.	0						V
Pedicularis sp.	1	1	1				V 6
Platanthera sp.	0						V
Polemonium acutiflorum	0						IV
Potentilla palustris	4	10-2	8				I 1
Rumex sp.	2	3-2	1				IV 2

SUBARCTIC LOWLAND SEDGE WET MEADOW K1

In Alaska, Subarctic Lowland Wet Meadow is dominated by sedges. It has less than 5% sphagnum moss cover, less than 15% shrub cover and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, the average sedge cover is 58%, the average wildflower cover is 12%, and the average moss cover, primarily non-sphagnum mosses, is 17%.

Subarctic Lowland Sedge Wet Meadow is a common cover type in the Bristol Bay Lowlands, the Nushagak Lowlands, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is uncommon in the Alaska Range, the Aleutian Range, and the Kuskokwim Mountains-Nushagak-Big River Hills. It occurs on very poorly-drained organic soils along streams and in open depressions. Standing water is generally present but rarely exceeds 6 inches (15 cm) in depth.

Trientalis europaea	0					V		
Valeriana capitata	0					V		
Viola epipsila	0					IV		
TOTAL BRYOPHYTE COVER	7	43-5	17		II	2		
Total Non-Sphagnidae	7	40-3	20				I	1
Dicranum sp.	1	5						
Hepaticae	3	70-5						
Polytrichum sp.	1	3						
Sphagnidae	3	5-3	2				III	2
	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Sp.Groups	Freq. Dom. Species	

HALOPHYTIC SEDGE WET MEADOW 3 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL LOW SHRUB	2	10-5	5			II	3		
Betula nana	1	10	5						
Salix sp.	1	5	3						
TOTAL GRAMINOID	3	90-35	63			I	1		
Total Grass Cover	2	10-5	5						
Calamagrostis canadensis	1	10	3					IV	3
Total Sedge Cover	3	80-30	58						
Carex lyngbyaei	1	65	22					IV	2
Eriophorum sp.	2	80-30	37					II	1
TOTAL FORB	2	10	7			II	2		
Caltha palustris	0								
Cicuta mackenziana	0								
Pedicularis sp.	0								
Petasites hyperboreus	0								
Polemonium acutiflorum	0								
Potentilla egedii	0								
Potentilla palustris	0								
Rumex sp.	0								
TOTAL BRYOPHYTE COVER	1	5	2			IV	4		
Sphagnidae	1	5	5						

HALOPHYTIC SEDGE WET MEADOW K2

In Alaska, Halophytic Sedge Wet Meadow is dominated by sedges that are tolerant of periodic flooding by brackish water. It has less than 25% shrub cover and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Halophytic Sedge Wet Meadow has an average sedge cover of 58%.

Halophytic Sedge Wet Meadow is a common cover type in the Bristol Bay Lowlands, the Nushagak Lowlands, and the Yukon-Kuskokwim Lowlands. It is an uncommon type in the Alaska Range, the Aleutian Range, and the Ahklun Mountains. It is absent elsewhere. It occurs in very poorly-drained soils adjacent to the lower stretches of coastal streams and rivers. The depth of brackish water varies with the height of the diurnal tide.

SUBARCTIC LOWLAND SEDGE-MOSS BOG MEADOW **19 Sites Visited**

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL ERICACEOUS SHRUB	7	13-1	2			IV 5	
<i>Andromeda polifolia</i>	2	5-1	2				II 1
<i>Empetrum nigrum</i>	0						IV
<i>Ledum palustre</i>	1	5	2				III 2a
<i>Oxycoccus-microcarpus</i>	0						V
<i>Vaccinium uliginosum</i>	1	5	2				III 2b
<i>Vaccinium vitis-idaea</i>	1	3	2				V 3
TOTAL DWARF SHRUB	11	10-1	4			III 3	
<i>Betula nana</i>	7	5-3	3				II 1
<i>Rubus arcticus</i>	1	5	1				V 3
<i>Salix</i> sp.	5	10-1	3				III 2
TOTAL GRAMINOID	19	60-20	30			I 2	
Total Grass Cover	2	10-5	1				
Total Sedge Cover	19	60-10	29				
<i>Carex</i> sp.	8	30-5	12				II 2
<i>Eriophorum</i> sp.	9	30-10	16				I 1
<i>Scirpus caespitosum</i>	0						V
TOTAL HORSETAIL	2	30-3	2			V 6b	
<i>Equisetum fluviatile</i>	2	30-3	17				
TOTAL FORB	9	20-1	4			III 4	
<i>Drosera rotundifolia</i>	0						V
<i>Gentiana</i> sp.	0						V
<i>Parnassia</i> sp.	1						V
<i>Pedicularis</i> sp.	1	1	1				V 2
<i>Polemonium acutiflorum</i>	0						V
<i>Potentilla palustris</i>	6	20-5	9				II 1
<i>Rumex</i> sp.	0						V
<i>Valeriana capitata</i>	0						V

SUBARCTIC LOWLAND SEDGE-MOSS BOG MEADOW L2

In Alaska, Subarctic Lowland Sedge-Moss Bog Meadow is dominated by sedges and sphagnum moss. It has less than 15% shrub cover and less than 10% tree canopy cover.

In the Bristol Bay-Lower Kuskokwim River area, Subarctic Lowland Sedge-Moss Bog Meadow has an average sphagnum moss cover of 60% and an average sedge cover of 29%.

Subarctic Lowland Sedge-Moss Bog Meadow is a common cover type in the Bristol Bay Lowlands, the Nushagak Lowlands, the Ahklun Mountains, and the Yukon-Kuskokwim Lowlands. It is an uncommon type in the Kuskokwim Mountains-Nushagak-Big River Hills and rare or absent elsewhere. It occurs on very poorly-drained organic soils on level ground or in open depressions. Standing water is frequently present in pools. Barren soil may comprise up to 60% of the total ground area.

TOTAL BRYOPHYTE COVER	19	100-30	71		I	1		
Total Non-Sphagnidae	7	90-5	15				IV	2
Hypnum sp.	1	85						
Sphagnidae	17	100-5	60				I	1
TOTAL LICHEN COVER	2	30-3	2		V	6a		
Cetraria sp.	0							
Cladina sp.	0							
Imadophila sp.	0							

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq.	Dom.	Freq.	Dom.
					Sp.Groups		Species	

SEDGE TUSsock-MIXED SHRUB-SPHAGNUM BOG 18 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL ERICACEOUS SHRUB	17	50-5	22			I	3		
Andromeda polifolia	2	2	1					V	5
Arctostaphylos alpina	1	1	1					V	6
Empetrum nigrum	5	15-5	3					IV	4
Ledum palustre	13	25-5	11					I	1
Vaccinium uliginosum	9	20-3	7					II	2
Vaccinium vitis-idaea	6	20-2	4					III	3
TOTAL DWARF SHRUB	15	40-5	15			I	5		
Betula sp.	14	20-3	11					I	1
Myrica gale	2	5-1	1					V	4
Rubus chamaemorus	8	10-1	3					III	2
Salix sp.	4	20-1	6					IV	3
Spirea Beauverdiana	1	5	1					V	5
TOTAL GRAMINOID	18	75-15	35			I	2		
Total Grass Cover	1	5	1						
Total Sedge Cover	18	75-15	35						
Carex sp.	2	20-10	2					V	2
Eriophorum sp.	16	75-15	2					I	1
TOTAL FORB	1	15	1			V	6		
Menyanthes trifoliata	0								
Potentilla palustris	1	15	15						
TOTAL BRYOPHYTE COVER	18	100-10	40			I	1		
Total Non-Sphagnidae	9	30-5	5					III	2
Dicranum sp.	0								
Hypnum sp.	0								
Polytrichum sp.	3	5							
Rhacomitrium sp.	1	5							
Sphagnidae	18	100-10	35					I	1

SEDGE TUSsock-MIXED SHRUB-SPHAGNUM BOG L3

In Alaska, Sedge Tussock-Mixed Shrub-Sphagnum Bog is dominated by sphagnum moss, sedge tussocks, dwarf shrubs, and heaths. It has less than 25% low shrub cover, less than 25% tall shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Sedge Tussock-Mixed Shrub-Sphagnum Bog has average covers of 35% sphagnum moss, 35% sedge, and 22% ericaceous shrubs.

Sedge Tussock-Mixed Shrub-Sphagnum Bog is a common cover type in the Nushagak Lowlands and the Ahklun Mountains. It is an uncommon type in the Alaska Range, the Bristol Bay Lowlands, and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. It occurs in very poorly-drained organic soils on level plateaus or mounds and in riparian lowlands. Sedge tussocks are 4 to 12 inches (10-30.5 cm) in height. Standing water may occur in very small pools.

TOTAL LICHEN COVER	15	60-1	17		I	4		
Cetraria sp.	0						II	
Cladina sp.	0						IV	
Cladonia sp.	2	1	1				I	1
Icmadothphila sp.	0						V	
Stereocaulon sp.	0						III	

Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq.	Dom.	Freq.	Dom.
					Sp.Groups		Species	

MESIC HERB 5 Sites Visited

MESIC HERB M1

In Alaska, Mesic Herb is dominated by wildflowers and grass. It has less than 25% shrub and less than 10% tree canopy cover.

In the Alaska Range-Bristol Bay-Lower Kuskokwim River area, Mesic Herb has an average wildflower cover of 54% and an average grass cover of 25%. Non-sphagnum moss dominates the ground cover with an average cover of 40%.

Mesic Herb is an uncommon cover type in the Aleutian Range, the Bristol Bay Lowlands, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. It occurs on moderately well-drained slopes and level ground to at least 1,750 feet (533 m) elevation.

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups Freq. Dom.	Species Freq. Dom.
TOTAL LOW SHRUB							
Salix sp.	1	20	4			V 6	
	1	20	20				
TOTAL ERICACEOUS SHRUB							
Cassiope sp.	2	20-10	6			IV 5	
Empetrum nigrum	1	5	3				
Rhododendron camtschaticum	2	10-5	8				
Vaccinium ovalifolium	1	5	3				
	1	5	3				
TOTAL DWARF SHRUB							
Rubus arcticus	4	20-1	8			II 4	
Salix reticulata	3	10-1	5				I 1
	1	5	1				IV 2
TOTAL GRAMINOID							
Total Grass Cover	5	41-15	29			I 2	
Calamagrostis canadensis	4	41-15	25				
Festuca sp.	2	10-1	3				III 2
Poa sp.	1	40	10				IV 3
Total Sedge Cover	2	40-30	18				III 1
Carex sp.	1	5	1				IV 4
	1	5	1				
TOTAL HORSETAIL							
Equisetum arvense	1	5	1			V 7a	
	1	5	5				
TOTAL FORB							
Achillea borealis	5	65-45	54			I 1	
Aconitum delphinifolium	0						III
Artemisia sp.	0						IV
Cornus canadensis	0						III
Epilobium angustifolium	0						IV
Geranium erianthum	0						III
Geum rossii	0						III
Heracleum lanatum	0						IV
Polemonium acutiflorum	0						III
Pyrola sp.	0						IV
Rumex sp.	0						IV

Sanguisorba stipulata	0					II		
Saxifraga sp.	0					IV		
Sedum rosea	0					IV		
Thalictrum sparsiflorum	0					IV		
Trientalis europaea	0					II		
Viola sp.	0					II		
TOTAL FERN COVER	1	5	1		V	7b		
Thelypteris phegopteris	1	5	5					
TOTAL BRYOPHYTE COVER	4	90-5	32		II	3		
Total Non-Sphagnidae	4	90-5	40				I	1
Dicranum sp.	0							
Polytrichum sp.	0							

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Sp.Groups	Dom.	Freq. Species	Dom.
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FRESH HERB MARSH 8 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL GRAMINOID	6	50-10	16			II	2		
Total Sedge Cover	6	50-10	16						
Carex sp.	4	20-5	13					I	1
Eriophorum sp.	1	5	1					IV	2
TOTAL HORSETAIL	4	60-5	17			III	3		
Equisetum fluviatile	4	60-5	34					I	1
TOTAL FORB	7	60-20	32			I	1		
Caltha palustris	1	1	1					IV	5
Cicuta mackenziana	1	2	1					V	6a
Hippuris vulgaris	2	5	2					III	3
Menyanthes trifoliata	5	22-15	21					I	1
Nuphar polysepalum	1	5	1					III	4
Potentilla palustris	3	15-10	8					III	2
Rumex sp.	1	2	1					V	6b
TOTAL BRYOPHYTE COVER	2	10-5	2			IV	4		
Sphagnidae	2	10-5	8						

FRESH HERB MARSH N1

In Alaska, Fresh Herb Marsh is dominated by water tolerant wildflowers. It has less than 10% sphagnum moss cover, less than 25% shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay area, Fresh Herb Marsh has an average wildflower cover of 32% and an average sedge cover of 16%. Buckbean and marsh fivefinger are the most important wildflowers.

Fresh Herb Marsh is a common cover type only in the Bristol Bay Lowlands. It is an uncommon type in the Aleutian Range, the Nushagak Lowlands, and the Ahklun Mountains. It is rare or absent elsewhere. It occurs on very poorly-drained organic soils in open depressions at low elevations. Standing water is present and generally exceeds 6 inches (15 cm) in depth.

SUBARCTIC LOWLAND HERB BOG MEADOW
4 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL DWARF SHRUB	3	15-3	7			II	3		
Betula nana	1	5	2					IV	3
Myrica gale	1	10	3					IV	2
Salix sp.	2	10-3	4					II	1
TOTAL GRAMINOID	2	31-5	9			III	5		
Total Sedge Cover	2	31-5	9						
Carex sp.	2	5-1	3						
Eriophorum sp.	1	30	15						
TOTAL HORSETAIL	2	60-20	20			III	4		
Equisetum fluviatile	2	60-20	40						
TOTAL FORB	4	65-10	45			I	1		
Cicuta mackenzieana	1	3	1					IV	5
Menyanthes trifoliata	3	50-3	20					II	2
Pedicularis sp.	2	2	1					III	4
Polemonium acutiflorum	2	3	2					III	3
Potentilla palustris	4	50-5	20					I	1
Rumex sp.	1	2	1					IV	6a
Valeriana capitata	1	2	1					IV	6b
TOTAL BRYOPHYTE COVER	4	100-10	39			I	2		
Total Non-Sphagnidae	1	15	5					IV	2
Sphagnidae	3	100-10	35					I	1

SUBARCTIC LOWLAND
HERB BOG MEADOW N2

In Alaska, Subarctic Lowland Herb Bog Meadow is dominated by water tolerant wildflowers and sphagnum moss. It has less than 10% shrub cover and less than 10% tree canopy cover.

In the Bristol Bay area, Subarctic Lowland Herb Bog Meadow has an average wildflower cover of 45% and an average sphagnum moss cover of 35%. Buckbean and marsh fivefinger are the dominant wildflowers.

Subarctic Lowland Herb Bog Meadow is a common cover type in the Bristol Bay Lowlands and an uncommon type in the Ahklun Mountains. It is rare or absent elsewhere. It occurs on very poorly-drained organic soils on level ground or in open depressions. Standing water is frequently present in large pools.

WET MOSS 1 Site Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL ERICACEOUS SHRUB	1	5	5			I	2a		
Andromeda polifolia	1	5	5						
TOTAL DWARF SHRUB	1	5	5			I	2b		
Salix sp.	1	5	5						
TOTAL BRYOPHYTE COVER	1	100	100			I	1		
Sphagnidae	1	100	100						

WET MOSS O1

In Alaska, Wet Moss is dominated by sphagnum moss. It has less than 25% herbaceous cover, less than 25% shrub cover, and less than 10% tree canopy cover.

In the Bristol Bay-Lower Kuskokwim River area, Wet Moss has an average sphagnum moss cover of 100%.

Wet Moss is an uncommon cover type in the Nushagak Lowlands and the Kuskokwim Mountains-Nushagak-Big River Hills. It is rare or absent elsewhere. It occurs on very poorly-drained organic soil on level ground.

FOLIOSE AND FRUTICOSE LICHEN 12 Sites Visited

	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Sp.Groups		Species	
						Freq.	Dom.	Freq.	Dom.
TOTAL ERICACEOUS SHRUB	12	20-5	15			I	2		
Arctostaphylos alpina	3	5-3	2					IV	3
Cassiope sp.	1	1	1					V	4a
Diapensia lapponica	1	1	1					V	4b
Empetrum nigrum	6	20-1	9					II	1
Ledum palustre	4	10-1	2					III	2
TOTAL DWARF SHRUB	3	5	1			IV	4		
Betula nana	1	2	1					IV	2
Salix sp.	3	5-3	4					I	1

FOLIOSE AND FRUTICOSE LICHEN P1

In Alaska, Foliose and Fruticose Lichen is dominated by lichens. It has less than 15% herbaceous cover, less than 25% shrub cover, and less than 10% tree canopy cover.

In the Alaska Peninsula-Bristol Bay-Lower Kuskokwim River area, Foliose and Fruticose Lichen has an average lichen cover of 67% and an average ericaceous shrub cover of 15%.

TOTAL GRAMINOID	6	13-2	3	III	3		
Total Grass Cover	1	1	1				
Hierochloe sp.	1	1	1			V	2
Total Sedge Cover	5	10-1	3				
Carex sp.	6	10-1	6			I	1
TOTAL FORB	2	8-1	2	V	5		
Anemone narcissiflora	0						
Antennaria sp.	0						
Campanula lasiocarpa	0						
Dryas octopetala	0						
Pedicularis sp.	0						
Petasites hyperboreus	1	1	1				
Sedum rosea	0						
TOTAL BRYOPHYTE COVER	1	8	1	V	6		
Total Non-Sphagnidae	1	5	5				
Dicranum sp.	1	2					
Rhacomitrium sp.	1	3					
Sphagnidae	1	3	3				
TOTAL LICHEN COVER	12	81-40	67	I	1		
Total Light Lichens	8	80-50	44				
Cetraria sp.	1	3	1			II	2
Cladina sp.	1	65	33			I	1
Stereocaulon sp.	0					IV	
Thamnolia sp.	1	2	1			IV	4
Total Dark Lichens	3	10-1	2				
Cetraria sp.	2	10-1	4			IV	3
	Sites	Cov.Rg.	Av.Cov.	Ht.Rg.	Av.Ht.	Freq. Dom. Sp.Groups	Freq. Dom. Species

Foliose and Fruticose Lichen is a common cover type in the Alaska Range, the Ahklun Mountains, and the Kuskokwim Mountains-Nushagak-Big River Hills. It is an uncommon type in the Nushagak Lowlands and the Yukon-Kuskokwim Lowlands. It is rare or absent elsewhere. It occurs on moderately well-drained soils on lowlands, gentle slopes, and mountaintops. Barren soil may comprise up to 40% of the total ground area.

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K2, L3.

Alaska Department of Natural Resources—all others.



A1 Closed White Spruce Forest



A2 Open White Spruce Forest



A3 Open Black Spruce Forest



A4 White Spruce Woodland

This page done already



A5 Black Spruce Woodland



B1 Closed Birch Forest



B2 Closed Birch - Balsam Poplar Forest



B3 Open Birch Forest



B4 Open Balsam Poplar Forest



B5 Balsam Poplar Woodland



C1 Closed White Spruce - Balsam Poplar Forest



C2 Closed White Spruce - Birch - Balsam Poplar Forest



C3 Closed White Spruce - Birch Forest



C4 Open White Spruce - Balsam Poplar Forest



C5 Open White Spruce - Birch Forest



C6 White Spruce - Birch Woodland



D1 Closed Willow Tall Shrub



D2 Closed Alder Tall Shrub



D3 Closed Alder - Willow Tall Shrub



D4 Open Willow Tall Shrub



D1 Closed Willow Tall Shrub



D2 Closed Alder Tall Shrub



D3 Closed Alder - Willow Tall Shrub



D4 Open Willow Tall Shrub



D5 Open Alder Tall Shrub



D6 Open Alder - Willow Tall Shrub



E1 Closed Willow Low Shrub



E2 Closed Alder - Willow Low Shrub



E3 Open Willow Low Shrub



E4 Open Willow Low Shrub - Sedge or Grass Fen



E5 Open Alder Low Shrub



E7 Open Dwarf Birch - Willow Low Shrub



E8 Open Dwarf Birch Low Shrub



E9 Open Dwarf Birch - Ericaceous Shrub - Sphagnum Bog



E10 Ericaceous Shrub - Sphagnum Bog



E11 Sweetgale - Sphagnum Bog



F1 Ericaceous Shrub Tundra



F2 Dwarf Birch - Ericaceous - Sedge Shrub Tundra



G1 Ericaceous Mat and Cushion Tundra



G2 Dryas - Lichen Mat and Cushion Tundra



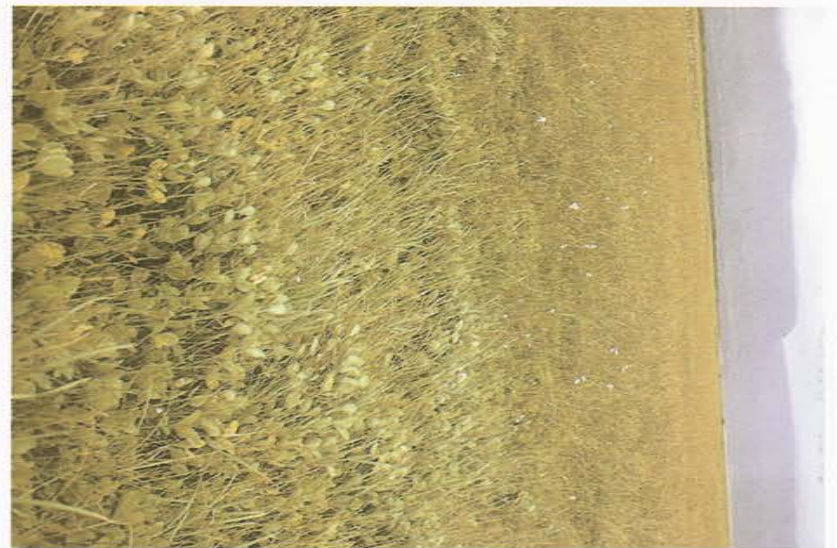
H1 Bluejoint Tall Grass



H2 Bluejoint Tall Grass - Herb



H3 Coastal Beach Rye Tall Grass - Herb



I1 Wet Sedge - Herb Meadow Tundra



J1 Fresh Sedge Marsh



K1 Subarctic Lowland Sedge Wet Meadow



K2 Halophytic Sedge Wet Meadow



L1 Subarctic Lowland Sedge Bog Meadow



L2 Subarctic Lowland Sedge-Moss Bog Meadow



L3 Sedge Tussock-Mixed Shrub-Sphagnum Bog



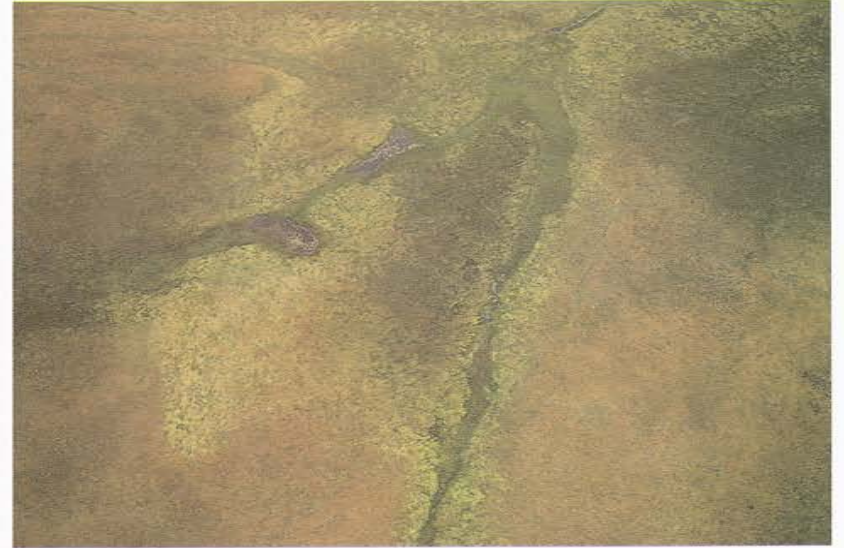
M1 Mesic Herbs



N1 Fresh Herb Marsh



N2 Subarctic Lowland Herb Bog Meadow



O1 Wet Moss



P1 Foliose and Fruticose Lichen

Chapter 3

APPLICATIONS OF LAND COVER DATA

INTRODUCTION (LS)

Understanding existing land cover is an important element in land use planning. Potential forestry and agriculture areas can be identified based on existing vegetation. Fire management strategies also require a knowledge of the existing vegetation. The value of areas as food or cover for wildlife is better understood if the existing vegetation is mapped and described to the species or generic level.

The detailed vegetation descriptions and the land cover map developed in this study provide information to better understand the vegetation of the Bristol Bay-Alaska Peninsula-Lower Kuskokwim River area. With the data provided by this mapping effort, further interpretive analysis can be done on other resource values present. The following are examples of some applications of the Bristol Bay Land Cover Mapping Project data. These examples emphasize the use of land cover data; however, in all cases the land cover data is best used along with other resource information such as soils surveys, wildlife distribution data or topographic data.

MULTISTAGE RESOURCE INVENTORY (JG)

The immensity of the Bristol Bay Area as well as time and money constraints prevented the acquisition of detailed vegetation information for the entire study area. While adequate for regional applications, the information presented by the Land Cover Maps may not provide the detail necessary for more site specific resource evaluation. For those who require more specific land cover information, the Landsat derived land cover maps should be used to allocate resources for more detailed photo interpretive or field inventory efforts. Such a multiple step approach to resource evaluation is called multistage inventory.

Multistage inventory maximizes the information gained while minimizing the costs of information acquisition. In such an inventory process,

generally the less expensive sampling techniques are used to determine areas where more detailed and costly information gathering might be most useful. A typical multistage inventory design would employ Landsat derived vegetation information for regional community level categories. Areas of interest can then be selected from throughout the general interpretation. Finally, where necessary, field studies can be conducted to gather site-specific information.

Multistage sampling is most effective where the categories of interest in the inventory are clearly defined so that a logical relationship between stages of the inventory can be maintained. In addition, the field data produced by the initial mapping effort should be compatible with a more intensive inventory.

A compilation of the field data for Bristol Bay vegetation communities has been prepared. This field data contains ground and low aerial oblique 35mm slide illustrations of the ground plots visited by field crews during the field data collection portion of the land cover project. This field data, when used in conjunction with the vegetation community and land cover map category summaries and photographs of Chapter 2 should provide an understanding of the diversity of vegetation types within the Bristol Bay Area.

Training block areas and associated ground plots are located on 1:63,360 scale USGS topographic quads and, where available, on 1:60,000 color infrared (CIR) photographs. This information is available on request from the Department of Natural Resources Division of Research and Development. Such information should familiarize a user of the Bristol Bay Land Cover Maps with the general geographic distribution of vegetation types within the Bristol Bay Region and provide sufficient material to train future photo interpreters.

WETLAND INTERPRETATION OF MAPPING CATEGORIES (LS, JG)

It is possible to map the general occurrence of wetlands if the land cover mapping categories are used in conjunction with USGS topographic maps, the wetland designations of the Viereck et. al. Level IV vegetation types, the mapping categories as shown in Table 1, the regional distribution of Viereck et. al. Level IV types also shown in Table 1, and detailed soils survey maps when available. Only exploratory soils maps are available for most of Bristol Bay at this time.

There are many definitions of wetlands. The 1979 Alaska Coastal Zone Management Act defined freshwater wetlands as those environments characterized by rooted vegetation which is partially submerged either continuously or periodically by surface fresh water. This definition excludes freshwater aquatic habitats dominated by floating unrooted plants but includes areas characterized by soils which are at least periodically saturated, such as where the roots are partially submerged.

Saltwater wetlands are those coastal areas along sheltered shorelines characterized by halophytic hydrophytes and macroalgae extending from extreme low tide to an area above extreme high tide which is influenced by sea spray or tidally induced water table changes.

The U.S. Fish and Wildlife Service is mapping wetlands as defined by the *Classification of Wetlands and Deepwater Habitats* (U.S. Fish and Wildlife Service, 1979). Their definition characterized wetlands as lands where the water table is at or near the surface or where the land is covered by shallow water. Wetlands must have one or more of the following attributes: (1) hydrophytic plants are dominant at least periodically as in the case of marshes, swamps, or bogs; (2) the substrate is primarily undrained hydric soils; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at least periodically as in the case of seaweed-covered portions of rocky shores, gravel beaches or rocky shores without vegetation.

Table 3 provides a preliminary interpretation of the wetland character of each mapping category based on the wetland character of the Viereck et. al. Level IV vegetation types within each mapping category. Since many vegetation types grow in a variety of hydrologic and soil conditions, it is necessary to consider these conditions in any determination of whether or not a particular vegetation type is a wetland. USGS topographic maps and U.S. Soil Conservation Service soil maps are the best sources of such information short of on-site reconnaissance.

Tables 2 and 3 provide guidelines for mapping wetlands using the land cover mapping categories, the regional distribution of the Level IV vegetation types, and topographical conditions. In all determinations of wetlands based on the mapping categories the user should also consider the satellite image date and the likelihood of dense vegetation obscuring surface water or saturated soil.

TABLE 3
WETLAND INTERPRETATION OF MAPPING CATEGORIES

CATEGORY	VIERECK et. al. LEVEL IV TYPE	*APPLICABLE WETLAND DEFINITION	
		ACMP	USFWS
CONIFER Generally not wetland except where black spruce forest occurs on flat, poorly drained soils, or active flood plain	Closed White Spruce Forest Open White Spruce Forest Open Black Spruce Forest	X	X
MIXED FOREST Not wetland except where balsam poplar occurs on active floodplain.	Closed White Spruce-Balsam Poplar Forest Closed White Spruce-Birch-Balsam Poplar Forest Closed White Spruce-Birch-Forest Open White Spruce-Balsam Poplar Forest Open White Spruce-Birch Forest White Spruce-Birch Woodland White Spruce Woodland		X X
MISCELLANEOUS DECIDUOUS Wetland where balsam poplar or willow occur on active floodplain; where beavers have flooded riparian areas; or on poorly drained soils. Generally not a wetland on slopes.	Closed Birch Forest Closed Birch-Balsam Poplar Forest Open Birch Forest Open Balsam Poplar Forest Balsam Poplar Woodland Closed Willow Tall Shrub Open Willow Tall Shrub Closed Willow Low Shrub Open Willow Low Shrub Open Willow Low Shrub-Sedge or Grass Fen	X X	X X
CLOSED SHRUB GRAMINOID Wetland if on active floodplain or poorly drained soils. Generally not a wetland on slopes.	Closed Alder Tall Shrub Closed Alder-Willow Tall Shrub Open Alder Tall Shrub Open Alder-Willow Tall Shrub Closed Alder-Willow Low Shrub Closed Willow Low Shrub Mesic Herbs Bluejoint Tall Grass Bluejoint Tall Grass-Herb Coastal Beach Rye Tall Grass-Herb Fresh Sedge Marsh Halophytic Sedge Wet Meadow	 X X	X X X
OPEN LOW SHRUB ERICACEOUS/CONIFER WOODLAND/MESIC BOG/ ERICACEOUS SHRUB TUNDRA Wetland if on an active floodplain or poorly drained soils. Generally not wetland on slopes.	Black Spruce Woodland Open Dwarf Birch-Willow Low Shrub Open Dwarf Birch-Ericaceous Shrub- Sphagnum Bog Open Dwarf Birch-Low Shrub Open Willow Low Shrub Ericaceous Shrub Tundra Ericaceous Mat and Cushion Tundra Dryas-Lichen Mat and Cushion Tundra	X X X X	X X X X

CATEGORY	VIERECK et. al. LEVEL IV TYPE	*APPLICABLE WETLAND DEFINITION	
		ACMP	USFWS
OPEN LOW SHRUB GRAMINOID/MESIC BOG/ GRAMINOID SHRUB TUNDRA Wetland if on active flood- plain or poorly drained soils. Generally not wetland on slopes.	Open Alder Low Shrub Sedge Tussock-Mixed Shrub Sphagnum Bog Open Dwarf Birch-Ericaceous Sphagnum Bog Dwarf Birch-Ericaceous-Sedge Shrub Tundra Subarctic Lowland Sedge Wet Meadow Subarctic Lowland Sedge Bog Meadow	 X X X X X	X X X X X X
LICHEN SHRUB TUNDRA Generally not wetland.	Ericaceous Shrub Tundra Dwarf Birch-Ericaceous Sedge Shrub Tundra Ericaceous Mat and Cushion Tundra Dryas-Lichen Mat and Cushion Tundra		
LICHEN Generally not wetland.	Foliose and Fructicose Lichen		
BARREN Generally not wetland except where it represents tidal flats.			
MARSH/VERY WET BOG Generally a wetland.	Wet Sedge-Herb Meadow Tundra Fresh Herb Marsh Subarctic Lowland Herb Bog Meadow	X X X	X X X
WET BOG/WET MEADOW Generally a wetland.	Subarctic Lowland Sedge-Wet Meadow Subarctic Lowland Sedge-Bog Meadow Subarctic Lowland Sedge-Moss Bog Meadow Sweetgale Sphagnum Bog Wet Moss	X X X X X	X X X X X

*An "X" means the vegetation type is defined as a wetland for the definition and column in which the are found.

ACMP = Alaska Coastal Management Program definition of a wetland.

USFWS = U.S. Fish & Wildlife Service definition of a wetland.

PRELIMINARY ASSESSMENT OF HABITAT VALUES (LS)

The Bristol Bay Land Cover map may be useful in the assessment of the values of specific areas for wildlife. Terrestrial wildlife species depend on identifiable vegetation communities for food, reproduction requirements, thermal cover, and, for some species, concealment from predators. Herbivores are directly tied to those vegetation communities that provide sufficient quantities of their preferred forage species. Carnivores are indirectly associated with the vegetation communities in which their prey are present and easily hunted.

The descriptions of the mapped land cover categories and the Level IV vegetation communities included within the Bristol Bay area provide information on the average covers of the dominant plant species. If there is information describing the habitat requirements of an animal in terms of vegetation, then it would be possible to determine the intrinsic habitat value of each vegetation community or mapped category for that animal. Where cover and food requirements vary with the seasons, it is necessary to determine the seasonal habitat values of each vegetation community or mapped category. Where seasonal habitat values are assigned, it is necessary to consider the proximity and size of areas that would be capable of providing all seasonal requirements in order to determine the suitability of an area to support an animal year round.

When the habitat requirements of an animal are poorly understood, the land cover map can be correlated with population distribution and density data to investigate habitat-wildlife requirements. The study method will vary with the quality and type of existing population data and the possibility of collecting additional population data. In general, habitat requirements may be better understood by statistically analyzing the significance of correlations between the seasonal distribution and density of an animal population and the distribution and composition of vegetation communities and topographical features. Population data of use in this approach includes: mapped and dated radio collared-animal locations; mapped seasonal and annual home ranges, preferably with animal density estimates; and geographically referenced population survey results. It would be best to work closely with the biologists who collected the population data during the interpretation of their results and the formulation of correlations between populations and vegetation.

PRELIMINARY ASSESSMENT OF SETTLEMENT POTENTIAL (Karen McGuiness, MW)

Vegetation or land cover information, when mapped, can be used to assist in the identification of lands potentially suitable for various types of human settlement. The ability to reliably identify and rate lands for settlement based on vegetation or land cover information is directly related to the detail and accuracy of the cover information and to the analyst's ability to correlate the cover information with known soil/vegetation associations and characteristics.

Using the Bristol Bay Land Cover Maps and the vegetation type information provided in this guide, the physical capability of land for settlement can be rated for settlement activities on a simple high, medium, low or unsuitable scale. For example, "Community Expansion-Residential" settlement for land identified by the "Conifer" map category, Closed White Spruce Forest type, would be considered high for residential development when based on land cover. This is because the characteristics of the land, i.e., land form, exposure, soils, water content, etc., where this category and type are found, are generally highly favorable for residential development. Similar determinations can be made for each vegetation type and map category.

Thus, general areas suitable for specified settlement activities can be identified and selected for more site-specific investigation. The land cover data should be used in conjunction with other data which indicates the physical capability of the land to support settlement such as soils information or slope data.

Table 4 provides a preliminary assessment of the map categories for three general settlement activities based on ratings assigned to the individual vegetation types associated with each map category.



TABLE 4
PRELIMINARY ASSESSMENT OF SETTLEMENT POTENTIAL

CATEGORY	VIERECK et. al. LEVEL IV	SETTLEMENT TYPE		
		*1	2	3
CONIFER	Closed White Spruce Forest	H	H	H
	Open White Spruce Forest	H	H	H
	Open Black Spruce Forest	U	L	L
MIXED FOREST	Closed White Spruce-Balsam Poplar Forest	H	H	H
	Closed White Spruce-Birch-Balsam Poplar Forest	H	H	H
	Closed White Spruce-Birch Forest	M	M	M
	Open White Spruce-Balsam Poplar Forest	M	M	M
	Open White Spruce-Birch Forest	M	M	M
	White Spruce-Birch Woodland	M	M	M
	White Spruce Woodland	M	M	M
MISCELLANEOUS DECIDUOUS	Closed Birch Forest	H	H	H
	Closed Birch-Balsam Poplar Forest	H	H	H
	Open Birch Forest	M	M	M
	Open Balsam Poplar Forest	M	M	M
	Balsam Poplar Woodland	L	L	L
	Closed Willow Tall Shrub	M	M	M
	Open Willow Tall Shrub	L	L	L
	Closed Willow Low Shrub	L	L	L
	Open Willow Low Shrub	L	L	L
	Open Willow Low Shrub-Sedge or Grass Fen	U	U	U
CLOSED SHRUB/ GRAMINOID	Closed Alder Tall Shrub	M	H	H
	Closed Alder-Willow Tall Shrub	L	M	H
	Open Alder Tall Shrub	L	M	M
	Open Alder-Willow Tall Shrub	L	M	M
	Closed Alder-Willow Low Shrub	L	M	M
	Closed Willow Low Shrub	L	M	M
	Mesic Herbs	H	H	H
	Bluejoint Tall Grass	H	H	H
	Bluejoint Tall Grass-Herb	H	H	H
	Coastal Beach Rye Tall Grass-Herb	U	L	U
	Fresh Sedge Marsh	U	U	U
	Halophytic Sedge Wet Meadow	U	U	U
OPEN LOW SHRUB ERICACEOUS/CONIFER WOODLAND MESIC BOG ERICACEOUS SHRUB TUNDRA	Black Spruce Woodland	L	M	M
	Open Dwarf Birch-Willow Low Shrub	L	M	M
	Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog	U	L	L
	Ericaceous Shrub-Sphagnum Bog	U	L	L
	Open Dwarf Birch-Low Shrub	L	L	M
	Ericaceous Shrub Tundra	L	L	L
	Ericaceous Mat and Cushion Tundra	L	L	L
	Dryas-Lichen Mat and Cushion Tundra	L	L	L

CATEGORY	VIERECK et. al. LEVEL IV	SETTLEMENT TYPE		
		*1	2	3
OPEN LOW SHRUB GRAMINOID/MESIC BOG/GRAMINOID SHRUB	Open Alder Low Shrub	L	L	L
	Sedge Tussock-Mixed Shrub-Sphagnum Bog	U	U	U
	Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog	L	L	L
	Dwarf Birch-Ericaceous-Sedge Shrub Tundra	U	U	U
	Subarctic Lowland Sedge Wet Meadow	U	U	U
	Subarctic Lowland Sedge Bog Meadow	U	U	U
LICHEN SHRUB TUNDRA	Ericaceous Shrub Tundra	L	L	L
	Dwarf Birch-Ericaceous Sedge Shrub Tundra	L	L	L
	Ericaceous Mat and Cushion Tundra	L	L	L
	Dryas-Lichen Mat and Cushion Tundra	L	L	L
LICHEN	Foliose and Fruticose Lichen	L	M	M
BARREN		U	L	L
MARSH/VERY WET BOG	Wet Sedge-Herb Meadow Tundra	U	U	U
	Fresh Herb Marsh	U	U	U
	Subarctic Lowland Herb Bog Meadow	U	U	U
WET BOG/WET MEADOW	Subarctic Lowland Sedge-Wet Meadow	U	U	U
	Subarctic Lowland Sedge-Bog Meadow	U	U	U
	Subarctic Lowland Sedge-Moss Bog Meadow	U	U	U
	Sweetgale Sphagnum Bog	U	U	U
	Wet Moss	U	U	U

*See key to Table 4 for type (1, 2, 3) definitions.

KEY

- 1 = Community Expansion - Residential
- 2 = Community Expansion - Commercial/Industrial
- 3 = Small Lot Remote - Seasonal Recreational
- H = Good Potential
- M = Potential Average to Poor
- L = Poor Potential
- U = Unsuitable for normal development

PRELIMINARY ASSESSMENT OF TRANSMISSION LINE AND TRANSPORTATION CORRIDOR POTENTIAL (Dick Mylius, MW)

Similar to the assessment of land cover for settlement, land capability for other uses can be evaluated using the land cover maps and additional information, i.e. vegetation type descriptions, slope, aspect, elevation, etc. Cover types can be useful in determining the land's capability for construction of electrical transmission lines, pipelines, roads or trails.

Table 5 presents a preliminary assessment of vegetation types as an indicator of the capability of the land for construction of transmission lines and roads. The ratings developed and the criteria used here are patterned after a similar modeling effort conducted for the Bristol Bay Cooperative Study.

The criteria used in rating land cover for transmission line and road capability differ significantly. In the case of transmission line locations, the needs for suitable access and construction are different from those needed for locating roads. For example, electric transmission lines do not need continuous stable soil types, indicated by certain vegetation types, rather they may be constructed on lands with interspersed lakes, bogs or marshes. Interference with overhead lines is less likely to occur in low lying vegetation types. Construction might be less expensive where a minimal amount of clearing is required to present a clear path. Therefore, vegetation types which indicate minimal overhead obstructions (shrubs) would be rated higher than vegetation types (forests) which tend to obstruct the path of transmission lines. Areas of continuous bogs, which present difficult or insurmountable construction problem areas, would be rated lower.

In the case of road construction, the criteria which indicated good road locations are different from those for transmission lines. For example, overhead obstructions are not as important as having a continuous stable base on which to construct the road. Therefore vegetation types which indicate dry stable soils (Closed White Spruce-Balsam Poplar Forest) would be rated higher than a type indicating unstable soil conditions (Sweetgale-Sphagnum Bog).

Table 5 rates vegetation types as to their capability for supporting the construction of transmission lines and roads. A further refinement should be made on these ratings by applying topographic information in the form of other data such as elevation, slope and soils.

PRELIMINARY ASSESSMENT OF FORESTRY AND AGRICULTURE POTENTIAL (MW, Joseph Wehrman)

Another more direct assessment which can be applied to the Bristol Bay Land Cover Maps is to assess the value of the vegetation as a resource in itself or as an indicator of potential productivity of agricultural crops. Examples of vegetation resource assessment would be to identify forest or range lands and to assess them for commercial harvest or local use potential.

In the case of forest assessment several types of evaluation can be done, such as forest utilization for large scale commercial timber harvest (lumber or pulp), local commercial harvest (lumber and firewood), and personal use (houselogs or firewood). Table 6 presents a preliminary assessment of vegetation types for local use houselog or firewood harvest. The criteria used to make this assessment are similar to previous models in that soil/vegetation characteristics, as indicators of productivity potential, are used to rate the vegetation types as well as direct assessment of the vegetation itself, i.e. Is it forested or not? What species are present and the quality of the stands?

Assessment of agriculture potential can generally be done based on land cover types, but it requires a more cautious analysis. A more cautious analysis is recommended because agriculture potential is more directly related to soil type rather than the vegetation present in uncultivated lands. Also, potential productivity of various soils will vary depending on the type of crop to be cultivated. Generally, agriculture potential can be linked with forest locations and rated on the presence of certain plant species and the health and vigor of the forest.

Further refinements can be made on the ratings in Table 6 by incorporating other data attributes in the assessments, i.e. elevation, slope, aspect, soils, hydrology, etc. Table 6 presents a simple high, medium, low or unsuitable rating based on the concepts briefly described above. The land cover data could also be rated to assess grazing potential, particularly for reindeer.

TABLE 5
PRELIMINARY ASSESSMENT OF TRANSMISSION LINE AND
TRANSPORTATION CORRIDOR POTENTIAL

CATEGORY	VIERECK et. al. LEVEL IV	TRANS- MISSION LINES	ROADS
CONIFER	Closed White Spruce Forest	L	H
	Open White Spruce Forest	M	H
	Open Black Spruce Forest	M	L
MIXED FOREST	Closed White Spruce-Balsam Poplar Forest	L	H
	Closed White Spruce-Birch-Balsam Poplar Forest	L	H
	Closed White Spruce-Birch Forest	L	H
	Open White Spruce-Balsam Poplar Forest	M	M
	Open White Spruce-Birch Forest	M	H
	White Spruce-Birch Woodland	M	H
	White Spruce Woodland	M	H
MISCELLANEOUS DECIDUOUS	Closed Birch Forest	L	H
	Closed Birch-Balsam Poplar Forest	L	H
	Open Birch Forest	M	H
	Open Balsam Poplar Forest	M	L
	Balsam Poplar Woodland	H	L
	Closed Willow Tall Shrub	H	L
	Open Willow Tall Shrub	H	L
	Closed Willow Low Shrub	H	L
	Open Willow Low Shrub	H	L
	Open Willow Low Shrub-Sedge or Grass Fen	H	U
CLOSED SHRUB/ GRAMINOID	Closed Alder Tall Shrub	H	M
	Closed Alder-Willow Tall Shrub	H	M
	Open Alder Tall Shrub	H	M
	Open Alder-Willow Tall Shrub	H	L
	Closed Alder-Willow Low Shrub	H	L
	Closed Willow Low Shrub	H	L
	Mesic Herbs	H	H
	Bluejoint Tall Grass	H	H
	Bluejoint Tall Grass-Herb	H	H
	Coastal Beach Rye Tall Grass-Herb	M	U
	Fresh Sedge Marsh	L	U
	Halophytic Sedge Wet Meadow	L	U
	Black Spruce Woodland	L	VL
	Open Dwarf Birch-Willow Low Shrub	H	VL
OPEN LOW SHRUB ERICACEOUS/CONIFER WOODLAND MESIC BOG ERICACEOUS SHRUB TUNDRA	Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog	L	VL
	Ericaceous Shrub-Sphagnum Bog	VL	VL
	Open Dwarf Birch-Low Shrub	M	L
	Open Willow Low Shrub	L	L
	Ericaceous Shrub Tundra	H	L
	Ericaceous Mat and Cushion Tundra	M	M
	Dryas-Lichen Mat and Cushion Tundra	M	H

CATEGORY	VIERECK et. al. LEVEL IV	TRANS- MISSION LINES	ROADS
OPEN LOW SHRUB GRAMINOID/MESIC BOG/ GRAMINOID SHRUB TUNDRA	Open Alder Low Shrub	L	L
	Sedge Tussock-Mixed Shrub-Sphagnum Bog	U	U
	Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog	VL	VL
	Dwarf Birch-Ericaceous-Sedge Shrub Tundra	L	VL
	Subarctic Lowland Sedge Wet Meadow	U	U
LICHEN SHRUB TUNDRA	Subarctic Lowland Sedge Bog Meadow	U	U
	Ericaceous Shrub Tundra	L	L
	Dwarf Birch-Ericaceous Sedge Shrub Tundra	L	L
	Ericaceous Mat and Cushion Tundra	M	M
LICHEN	Dryas-Lichen Mat and Cushion Tundra	H	H
BARREN	Foliose and Fruticose Lichen	H	H
MARSH/VERY WET BOG	Wet Sedge-Herb Meadow Tundra	U	U
	Fresh Herb Marsh	U	U
	Subarctic Lowland Herb Bog Meadow	U	U
WET BOG/WET MEADOW	Subarctic Lowland Sedge-Wet Meadow	U	U
	Subarctic Lowland Sedge-Bog Meadow	U	U
	Subarctic Lowland Sedge-Moss Bog Meadow	U	U
	Sweetgale Sphagnum Bog	U	U
	Wet Moss	U	U

* See key to Table 5.

KEY

Ratings

H = High potential with no or minimal construction constraints
M = Medium potential with minor construction constraints
L = Low potential with moderate construction constraints
VL = Very low potential with severe construction constraints
U = Unsatisfactory, unacceptable or impossible route

TABLE 6
PRELIMINARY ASSESSMENT OF FOREST AND
AGRICULTURE POTENTIAL

CATEGORY	VIREECK et. al. LEVEL IV	*FOR-ESTRY	AGRI-CULTURE
CONIFER	Closed White Spruce Forest	H	L
	Open White Spruce Forest	H	M
	Open Black Spruce Forest	L	L
MIXED FOREST	Closed White Spruce-Balsam Poplar Forest	H	H
	Closed White Spruce-Birch-Balsam Poplar Forest	H	H
	Closed White Spruce-Birch Forest	H	H
	Open White Spruce-Balsam Poplar Forest	H	H
	Open White Spruce-Birch Forest	H	H
	White Spruce-Birch Woodland	M	M
	White Spruce Woodland	M	M
MISCELLANEOUS DECIDUOUS	Closed Birch Forest	H	H
	Closed Birch-Balsam Poplar Forest	H	H
	Open Birch Forest	H	H
	Open Balsam Poplar Forest	M	M
	Balsam Poplar Woodland	L	L
	Closed Willow Tall Shrub	L	L
	Open Willow Tall Shrub	U	L
	Closed Willow Low Shrub	U	L
	Open Willow Low Shrub	U	L
	Open Willow Low Shrub-Sedge or Grass Fen	U	L
CLOSED SHRUB/ GRAMINOID	Closed Alder Tall Shrub	U	L
	Closed Alder-Willow Tall Shrub	U	L
	Open Alder Tall Shrub	U	U
	Open Alder-Willow Tall Shrub	U	U
	Closed Alder-Willow Low Shrub	U	U
	Closed Willow Low Shrub	U	U
	Mesic Herbs	U	L
	Bluejoint Tall Grass	U	U
	Bluejoint Tall Grass-Herb	U	U
	Coastal Beach Rye Tall Grass-Herb	U	U
	Fresh Sedge Marsh	U	U
	Halophytic Sedge Wet Meadow	U	U
OPEN LOW SHRUB ERICACEOUS/CONIFER WOODLAND MESIC BOG ERICACEOUS SHRUB TUNDRA	Black Spruce Woodland	U	L
	Open Dwarf Birch-Willow Low Shrub	U	U
	Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog	U	U
	Ericaceous Shrub-Sphagnum Bog	U	U
	Open Dwarf Birch-Low Shrub	U	U
	Open Willow Low Shrub	U	U
	Ericaceous Shrub Tundra	U	U
	Ericaceous Mat and Cushion Tundra	U	U
	Dryas-Lichen Mat and Cushion Tundra	U	U

CATEGORY	VIREECK et. al. LEVEL IV	*FOR-ESTRY	AGRI-CULTURE
OPEN LOW SHRUB GRAMINOID/MESIC BOG/GRAMINOID SHRUB	Open Alder Low Shrub	U	U
	Sedge Tussock-Mixed Shrub-Sphagnum Bog	U	U
	Open Dwarf Birch-Ericaceous Shrub-Sphagnum Bog	U	U
	Dwarf Birch-Ericaceous-Sedge Shrub Tundra	U	U
	Subarctic Lowland Sedge Wet Meadow	U	U
	Subarctic Lowland Sedge Bog Meadow	U	U
LICHEN SHRUB TUNDRA	Ericaceous Shrub Tundra	U	U
	Dwarf Birch-Ericaceous Sedge Shrub Tundra	U	U
	Ericaceous Mat and Cushion Tundra	U	U
	Dryas-Lichen Mat and Cushion Tundra	U	U
LICHEN	Foliose and Fructicose Lichen	U	U
BARREN			
MARSH/VERY WET BOG	Wet Sedge-Herb Meadow Tundra	U	U
	Fresh Herb Marsh	U	U
	Subarctic Lowland Herb Bog Meadow	U	U
WET BOG/WET MEADOW	Subarctic Lowland Sedge-Wet Meadow	U	U
	Subarctic Lowland Sedge-Bog Meadow	U	U
	Subarctic Lowland Sedge-Moss Bog Meadow	U	U
	Sweetgale Sphagnum Bog	U	U
	Wet Moss	U	U

*See key to Table 6.

KEY Forestry

For local use houselogs and fuelwood (primarily)

H = High potential
M = Moderate potential
L = Low potential
U = Unsuitable

Agriculture

For small scale local development.
Same rating scale as forestry.

PLANNING, MANAGEMENT AND REGULATORY DECISION-MAKING (MW)

Use of land cover information to assess the potential for various land uses or to determine natural resource values are important. However, it should be recognized that the ultimate use to which the land cover information or assessments of that information can be put is to make planning, management or regulatory decisions. This section briefly explains the process for using the land cover information for decision making. The use of land cover is emphasized in this discussion; however, other data, such as soils, geology, elevation, etc. should be used in conjunction with land cover to make permanent land use decisions.

Regardless of the type of decision being made, the process involves the same basic steps. Step one involves defining the decision to be made, i.e. identify type of decision (planning, management or regulatory), level of decision, and identify the issue, activity, or problem requiring the decision. Step two is to obtain information about the decision to be made, i.e. applicable laws, location, and resources affected. The third step is to develop alternatives or options which the decision might take, i.e. permit an activity to occur unrestricted, permit the activity to occur with restrictions or not to permit the activity to occur at all. Step four, evaluate the alternatives for future impacts, i.e. will the particular decision alternative result in improvement to the existing community, resources present, or legal responsibilities? Step five, select an alternative. Step six, implement the decision. Step seven, evaluate the results after the decision has been implemented.

The Bristol Bay Land Cover Maps can be used throughout the decision making process. In step one a review of the land cover map in the general area in which the decision is to be made will help define the problem by giving an overview of the location and environment in which the decision will have effect. In step two the land cover map provides specific information about the character of the area in the form of vegetation, water content, and soil relationships. Refer to Chapter 1 of this guide for more complete instructions on how to review and interpret the land cover maps. Also, refer to Chapter 3 where the preliminary assessment models are presented to get a general understanding of some of the land use and resource values present.

In step three the information gathered in step two can be used to define decision alternatives. A particular decision may require a new or different assessment of the land cover than those presented in this guide. In step four, return to the map and review the impacts of the alternatives

selected based on the information presented by the map about the area and its surroundings.

Steps five and six do not necessarily involve the use of the land cover map directly. It is important to remember, however, that the level of decision making to which the Bristol Bay Land Cover Map information can be reliably applied is limited by the level of the detail presented by the map, the seriousness of the decision being made and the time available to make the decision. Generally, the land cover map information alone is able to support decisions by; (1) identifying areas where decisions can be made to clearly approve an activity because no negative factors are present; (2) identify areas where decisions can be made that require stipulations, limitations or prohibition of activities, and; (3) identify areas where decisions will require more specific information.

Step seven can utilize the land cover maps to evaluate the effects of the decision, after it has been made and implemented, by providing information about the original state of the area effected. Refinements on alternatives or additional support for a decision can be had by applying topographic information or by obtaining other attribute data to be used in conjunction with the land cover maps.

Chapter 4

METHODOLOGY

PROJECT DESIGN (MW)

The Bristol Bay Land Cover Mapping Project was designed to map vegetation and land cover characteristics over approximately 40 million acres in a period of 12 months. Several criteria were used to guide the final project design.

At the time the project was first considered, the Bristol Bay region had very little vegetation or land cover information available. The region also lacked any extensive recent aerial photography or detailed photo interpreted information. Data users needed reliable and accurate information about land cover types and their location. In addition, the size of the area required data gathering efforts to be efficient as well as effective, because there would be no time to verify results in the field a second time. The actual design also had to consider the cost effectiveness of the data collection and analysis and production of final products. These factors led to the selection of classifying summer Landsat data as the method to map land cover.

Past experiences with classified Landsat pointed out several things which had to be dealt with. These considerations centered on user orientation and understanding of the Landsat classified map information. It was recognized that the final classified data must be easily accessible to the public and agency people; that it must be available in printed as well as automated format; that it must be clearly understandable to a wide range of users with varying needs and map skills; it must provide new information about land cover type identification and location; and finally, that the project data collection and data products must be cost effective to the project participants and data users.

The data access and format concerns were met by making data available in photographic prints and computer tape files at public agencies. Two things were done to make the data understandable to the various data users. A project working group, made up of the key data users, was organized at the beginning of the project to educate users throughout the entire mapping process. Second this "User's Guide" was planned

for the end of the project. Its purpose, as stated earlier, is to offer explanations on how to use the land cover data and to provide further description and information about the actual mapped information.

New information was obtained by collecting vegetation descriptions in the field and using that information to interpret region-wide Landsat data. The Landsat data was registered to a 50-meter USGS Universal Transverse Mercator (UTM) quadrangle map base to provide reliable data location. Thus, all key project considerations were met.

The Landsat classification process chosen was a combination of supervised and unsupervised techniques. (See the project final report for more technical details on the overall process.) Approximately 1,000 field sites throughout the region were visited using a three-person crew and a small four-passenger helicopter. This field data provided new information in the form of on site photos, slides and vegetation descriptions to be used in the classification of the Landsat data. This User's Guide includes summaries of the new field information and thus links it with the classified Landsat land cover maps.

The combination of field site data collection, Landsat imagery and the User's Guide provides a data base which addresses more than just a reconnaissance level mapping effort. It provides a common data base consisting of land cover and topographic data with a half acre spatial resolution. This is accompanied with specific field data of vegetation composition and characteristics describing the map categories.

The real value of this particular data base, as it was designed, can only be realized if it is used at its full potential. To be used at its fullest potential the general land cover map must be used in conjunction with the User's Guide which contains summaries of site-specific information. These two products in combination allow an analyst, manager, or planner to make decisions at a general or regional level, and also to identify areas of concern for more detailed photointerpretive or field site inves-

tigation. Consequently, these more costly activities can be better allocated to specific sites should developers, resource managers or other interests require additional information.

The remainder of this chapter is devoted to detailing the more specific activities involved with the field data gathering and analysis and the Landsat classification and analysis.

FIELD VEGETATION DATA COLLECTION AND ANALYSIS

Field reconnaissance of the vegetation communities of the Lower Kuskokwim River-Bristol Bay-Alaska Peninsula study area was conducted during the summer of 1981. The primary objectives of the survey were to facilitate the interpretation of existing Landsat data and develop more detailed plant community descriptions. These plant community descriptions could then be correlated to the final mapped land cover categories to describe the map categories.

Field Preparation

The *Revision of the Preliminary Classification System for the Vegetation of Alaska* (Viereck, Dyrness and Batten 1981) was selected as the basis for plant community type names. As was noted earlier in Chapter 2, this vegetation classification scheme describes the vegetation communities found in Alaska in five levels of detail, Level I being the most general and Level V being species specific. Level IV of the above classification scheme, hereafter referred to as "Viereck et. al. Level IV," was used because; (1) the hierarchical structure allowed the Viereck et. al. Level IV detailed descriptions of plant communities to be combined to define the more general mapped vegetation categories; (2) it had been adopted by the U.S. Fish and Wildlife Service for the evaluation of wildlife habitat in Alaska (Konkel et. al. 1980), and; (3) it complied with a general effort by state and federal agencies within Alaska toward the use of a single vegetation classification system.

Potential users of the land cover map were contacted before and during the field surveys. The goals and methods were explained to them and their opinions about useful mapping categories were discussed.

Sites for field visitation and initial Landsat interpretation were subjectively selected in order to most efficiently sample all types of vegetation throughout the 40-million-acre study area. Blocks of 36 square miles were delineated on the false color Landsat image to ensure that all apparent vegetation communities on each Landsat scene and within each physiographic province were surveyed.

Sampling sites were selected within each block to represent each relatively homogeneous vegetation community. The subjective selection of sites was based on the interpretation of the aerial photographs and Landsat images, the results of the clustering analysis and topographic features. The field sites were delineated on the maps, photographs, and Landsat images.

A field information packet was developed for each block which included a U.S. Geological Survey 1:63,360 scale topographical map; a 1:60,000 scale color infrared aerial photograph, where available; and an enlarged false color Landsat image. In most cases the results of the initial clustering analysis of the Landsat data was also included.

A vegetation description sampling method was selected to meet several criteria. The sampling method chosen had to use the same locations selected for the Landsat interpretation portion of the program; it had to be flexible enough to utilize both ground and aerial site descriptions; and it had to be feasible to complete the sampling with only 10-15 minutes per sampling site.

The vegetation sampling method chosen was centralized replicate sampling using releve' analysis (Mueller-Dombois and Ellenberg 1974). This sampling method consists of walking or flying over the sampling area and recording the vegetation species present. Visual estimates of cover and height are subjectively determined for the dominant vegetation species. The aim of this method is to group individual species into vegetation types based primarily on presence while considering abundance. The vegetation communities can then be correlated with the Landsat map categories.

Field Reconnaissance

The study area was surveyed by helicopter from June 13-28 and August 3-30 in 1981. The field team consisted of one botanist and one or two remote sensing specialists. A total of 102 blocks and approximately 1,000 field sites were visited.

Each sampling area was located by the remote sensing specialist using definitive topographical features and the color-texture patterns apparent on the aerial photograph, the Landsat image and the ground. The pilot would slowly circle low over the sampling area while the botanist assessed general composition of the delineated area and selected a small representative site for the detailed 'releve' description. A complete 'releve' description was obtained at one or more sites for each vegetation type. The complete description included a species list, ocular estimates of the percent cover of each species group (e.g., ericaceous shrubs, ferns, etc.), and of most genera and species, maximum heights of tall shrubs and trees, soil type and drainage, landform, slope, aspect and elevation.

Time and budget constraints did not allow a complete 'releve' description at each sampling site. However, the botanist recorded as much information as possible at each site in the time allotted. Descriptions from a low aerial position were often required for vegetation types in which it was difficult to land, e.g. closed and open forests, and tall shrubs, closed low shrubs, and marshes.

Site descriptions recorded from the air accurately portrayed the cover of trees, tall shrubs, low shrubs that were not obscured by an overstory of taller plants, and prominent forbs such as cows parsnip (*Heracleum lanatum*), marsh five finger (*Potentilla palustris*) and buckbean (*Menyanthes trifoliata*). The covers of the less prominent and less dominant species were not accurately described. Generally, the cover of each species group was estimated and the presence of observable species indicated.

Each sampling site was further documented with 35mm photographs taken as either close-up ground photos and/or low oblique aerial shots.

Field Data Analysis

Site data was translated into Viereck et. al. Level IV vegetation types. Sufficient guidelines were not available to allow a routine assignment of a type name to each site description. Therefore, preliminary rules were developed to distinguish between the Viereck et. al. Level IV types which occur in the study area. Each site was then assigned a type name, based on these rules, and entered into the data table of the appropriate vegetation type. Fifty-one Viereck et. al. Level IV types were described and documented according to the characteristics shown in Table 7.

TABLE 7

LAND COVER AND VEGETATION EVALUATION CRITERIA

Sampling Site	Total Forb Cover
Total Tree Canopy	Forb Species Cover
Total Conifer Canopy	Total Fern Cover
Conifer Species Cover	Fern Species Cover
Conifer Species Height	Total Bryophyte Cover
Total Deciduous Tree Canopy	Bryophyte Species Cover
Deciduous Tree Species Cover	Total Lichen Cover
Deciduous Tree Species Height	Total Light Color Lichen Cover
Total Tall Shrub Canopy	Light Color Lichen Species Cover
Tall Shrub Species Cover	Total Dark Color Lichen Cover
Tall Shrub Species Height	Dark Color Lichen Species Cover
Total Low Shrub Canopy	Open Water Cover
Low Shrub Species Cover	Barren Rock or Soil Cover
Total Ericaceous Shrub Cover	Soil Type
Ericaceous Species Cover	Soil Drainage
Total Dwarf Shrub Cover	Landform
Dwarf Shrub Species Cover	Elevation (ft.)
Total Graminoid Cover	Aspect
Total Grass Cover	Slope (degrees)
Grass Species Cover	Comments
Total Sedge Cover	
Sedge Species Cover	
Total Horsetail Cover	
Horsetail Species Cover	

After all field data had been entered into the appropriate vegetation type table, the field data were summarized and entered into a summary data table for each vegetation type according to the following rules:

1. **Sample Sites** The total number of well-described sampling sites.
2. **Sites** The total number of sites with numerical cover data for a species or Species Group.

3. **Cover Range** The highest and lowest percent horizontal cover values observed.
4. **Average Cover** The average cover of species and Species Groups using the sites at which it was possible to estimate cover values. The average cover of Species Groups was determined as follows:
 - a. For forest, tall shrub, closed low shrub and open low willow shrub aerially described vegetation types, the percent cover was totaled and then divided by the number of sites with numerical cover data for that Species Group. Because of the visibility of trees, their total cover was divided by the total number of sampled sites.
 - b. For the remaining ground surveyed vegetation types, for which more complete descriptions were always obtained, the total percent cover of a Species Group in all sites was divided by the total number of sampled sites.

The average cover of a species was determined by dividing the sum of the percent cover values at all sites by the total number of sampled sites at which the species *could have been observed*. The sum of the average covers of species within a Species Group may not be equal to the total average cover of the Species Group. These differences would occur where there were less sites with species cover data than with Species Group cover data.

5. **Height Range** The highest and lowest maximum heights observed for each species of trees and tall shrubs expressed in feet.
6. **Average Height** The average maximum height of each tree and tall shrub species expressed in feet.
7. **Frequency of Species Group and Species** The frequency of occurrence of a Species Group was determined by dividing the total number of sites in which the Species Group was present by the total number of sampled sites and then multiplying the result by 100 to obtain a percent.

The frequency of occurrence of a species was determined by dividing the total number of sites with the species occurring by the total number of sites in which any species of that Species

Group was observed. Each site included in the "number" of Species Group sites used had to have data on the presence of any species to be included. The result was then multiplied by 100. This method accounted for the variability in species depending on survey conditions.

The numerical frequency values were converted into the following classes:

Frequency Class I	=	100-81%
Frequency Class II	=	80-61%
Frequency Class III	=	60-41%
Frequency Class IV	=	40-21%
Frequency Class V	=	21- 1%

Frequency values were only determined for species with at least three sites of data.

8. **Dominance of Species Groups and Species** The data provides a reliable estimate of the dominance of individual species within a Species Group and of one Species Group in comparison to the other Species Groups. However, the variety of detail in the site descriptions did not allow a determination of the dominance of species within the total plant community because of the bias toward the observation of the more prominent or dominant species.

Dominance was determined by the following method:

- a. Species within a Species Group were ranked by their frequency class (I being the most important) and then according to their average cover values. The most commonly occurring species with the highest average cover was given a dominance rank of 1.
- b. Species Groups were also ranked first by their frequency classes and then according to their average cover values.

Narrative Description

A narrative description of each Viereck et. al. Level IV vegetation type was written using the summarized field data, the photographic documentation, and field notes on the distribution of the vegetation types. These descriptions identified the dominant species within each struc-

tural layer, i.e., overstory, midstory, understory, and ground cover; the relationship of the vegetation type to landform, soil, drainage, and slope; and the frequency of occurrence of each type within each of seven biophysiographic provinces. See Figure 2.

DIGITAL DATA BASE COMPILATION AND ANALYSIS (JG)

The Bristol Bay Data Base consists of land cover and terrain information for the Bristol Bay Study Area as shown in Figure 1. This land cover and terrain information consists of four data elements; land cover type, elevation, slope and aspect. The source of land cover information was computer-aided analysis of Landsat digital data. The terrain information in the form of elevation data were obtained from the National Cartographic Information Center (NCIC) Digital Elevation Modeling (DEM) tapes; slope and aspect values were calculated from raw DEM elevation data.

Data Acquisition

All available Landsat imagery for the Bristol Bay Study Area was evaluated. Twelve scenes were selected to provide the best cloud free coverage during the months of maximum green plant development (July-August). DEM terrain data was acquired for all quad areas within the study except for Cold Bay, Port Moller and Stepovak Bay quads for which no DEM data was available. Six scenes of winter Landsat data were also acquired in regions within the study area where significant conifer cover existed. See Table 8 for a complete listing of the acquired data.

Data Analysis

Significant digital data band striping and bad data lines within the new Landsat data were corrected prior to registration. All Landsat and DEM data were geometrically registered to be compatible in coverage and orientation with 1:250,000 USGS quadrangle maps within the study area. One Exception is the Cold Bay Quadrangle which is produced in *polyconic* projection by the USGS and therefore does not correspond in orientation to the Bristol Bay Land Cover Map. At this time it is not possible to produce a land cover map in polyconic projection.

The Landsat data were geometrically registered by selecting control points on the raw Landsat data and on 1:63,360 USGS quadrangle maps.

Generally, two control points per 1:63,360 map were selected. Where 1:63,360 coverage was unavailable, 1:250,000 maps were used. This only occurred in the Cold Bay and Port Moller quadrangle. A positional accuracy of 1 pixel is expected for the Landsat derived land cover information. See the Land Cover Map Classification Assessment section for a discussion of classification accuracy for the Landsat derived land cover map.

Digital terrain information is derived from the elevation data as found on the 1:250,000 USGS topographic maps. Caution should be exercised in site specific application of this data as no quantitative evaluation of geometric accuracy or elevation accuracy is available.

TABLE 8
BRISTOL BAY LAND COVER PROJECT
LANDSAT SCENE IDENTIFICATION

*Ref #	Scene	Path/Row	I.D.	Date
1	Naknek	78 19	1772-20592	9/03/74
2	Iliamna	78 18	1772-20585	9/03/74
3	Seal	80 20	30127-21095	7/10/78
4	Chignik	78 21	2192-20581	8/02/75
5	Taylor	81 17	30146-21143	7/29/78
6	Wood Tik	80 18	2950-20441	8/29/77
7	Pavlof	80 21	21688-21044	9/16/79
8	Lake Clark	77 18	1735-20543	7/28/74
9	Katmai	77 19	2533-20450	7/08/76
10	Ugashik	78 20	2534-20511	7/09/76
11	Nushagak	79 19	2949-203855	8/28/77
12	Togiak - a	82 19	30147-212111	7/30/78
	Togiak - b	81 19	30146-21152	7/29/78
	Togiak - c	82 18	30147-21204	7/30/78
	Togiak - d	81 18	30146-21150	7/29/78

*Each Landsat scene has been given a reference number. These reference numbers are used in Figure 3 to show the relationship of the Landsat scenes as they are mosaiced in the land cover map quads.

Training blocks of 6 × 6 miles were selected from each Landsat scene to be representative of the diversity of land cover within that scene. Field sites within training blocks were visited by field crews. See the preceding section on Field Vegetation Data Collection and Analysis for a complete discussion of field data collection procedures.

Both supervised and unsupervised analysis methods were employed within the training block areas. Supervised analysis was conducted by evaluating specific field sites within the Landsat data. Unsupervised analysis was conducted by allowing the computer to statistically group the Landsat data based on the reflectance values recorded by the satellite. Interpretation of the supervised and unsupervised analysis was done using the available field data, high altitude color infrared photography and color 35mm 1:2,000 scale transects photographs. Use of the field information and photographs aided the further interpretation and statistical grouping of the Landsat data into the maximum likelihood Landsat classification or land cover map categories. The transect photos were taken by a helicopter, with a 35mm camera mounted on its side, while flying line transects over portions of the training blocks.

The classified summer Landsat data was further evaluated by incorporating winter Landsat and terrain information in the land cover analysis. The winter data was used to facilitate discrimination between wetlands and conifer categories. Terrain information was used to identify water and wetland classes on slopes. Water classes on slopes were renamed mountain shadow. Since terrain information was not available for the Cold Bay, Port Moller and Stepovak Bay areas, these corrections could not be applied to the cover maps for those quad areas.

Once land cover categories had been assigned, images for each quad area were digitally mosaiced to obtain full quad area coverage. See Figure 3. Each mosaiced quad area was smoothed using a 3 × 3 pixel mask wherein the computer reassigned the class identity of the majority class occurrence within the 3 × 3 window to the central pixel of that group. Therefore, the final minimum mapping unit of the land cover map is generally a 3 × 3 or 9 pixel area equal to about 5 acres.

The final smoothed classified quad area image files were used to produce a film transparency image of the quad area. An internegative produced from this transparency was used to generate color photographic copies of the land cover maps.

LAND COVER MAP CLASSIFICATION EVALUATION (JG)

The final land cover map data generated for the Bristol Bay Land Cover Mapping Project was evaluated to assess the reliability of the mapping category assignments. An estimate of confusion between mapping categories was also generated to provide an indication of the potential confusion among categories.

Classification evaluation was performed within block areas previously used in the initial classification analysis phase of the mapping effort. As these sites were selected to represent the variety of cover types and conditions within the study area, it is expected that classification accuracy within the sample blocks should reflect the overall classification accuracy of the entire scene. For an indepth treatment of accuracy assessment methodology the reader is referred to "Remote Sensing: The Quantitative Approach" edited by Philip H. Swain and Shirley M. Davis.

Sample Selection for Classification Evaluation

Block areas for accuracy assessment were chosen from the previously identified 36-square-mile training blocks according to the following criteria:

1. Adequate representation of the diversity of mapping categories.
2. Availability of high altitude 1:60,000 scale color infrared photo coverage.
3. Availability of 1:2,000 scale transect photography.

From those block areas chosen for accuracy assessment, a stratified random sample of pixels was selected for each mapping category. The location of these sample pixels were recorded on Versatec grey scale maps printed at 1:63,360 scale. These sample points were then transferred to USGS topoquads to facilitate the location of sample points on the available 1:60,360 scale color infrared and 1:2,000 scale color transect photography. Sample pixels were delineated with a buffer area of about 3 × 3 pixels. Sample pixels with buffers that could not be reliably located within a homogenous type, such as those pixels occurring at borders, were discarded. To accommodate such selection, over-sampling was performed to ensure an adequate sample. In addition to

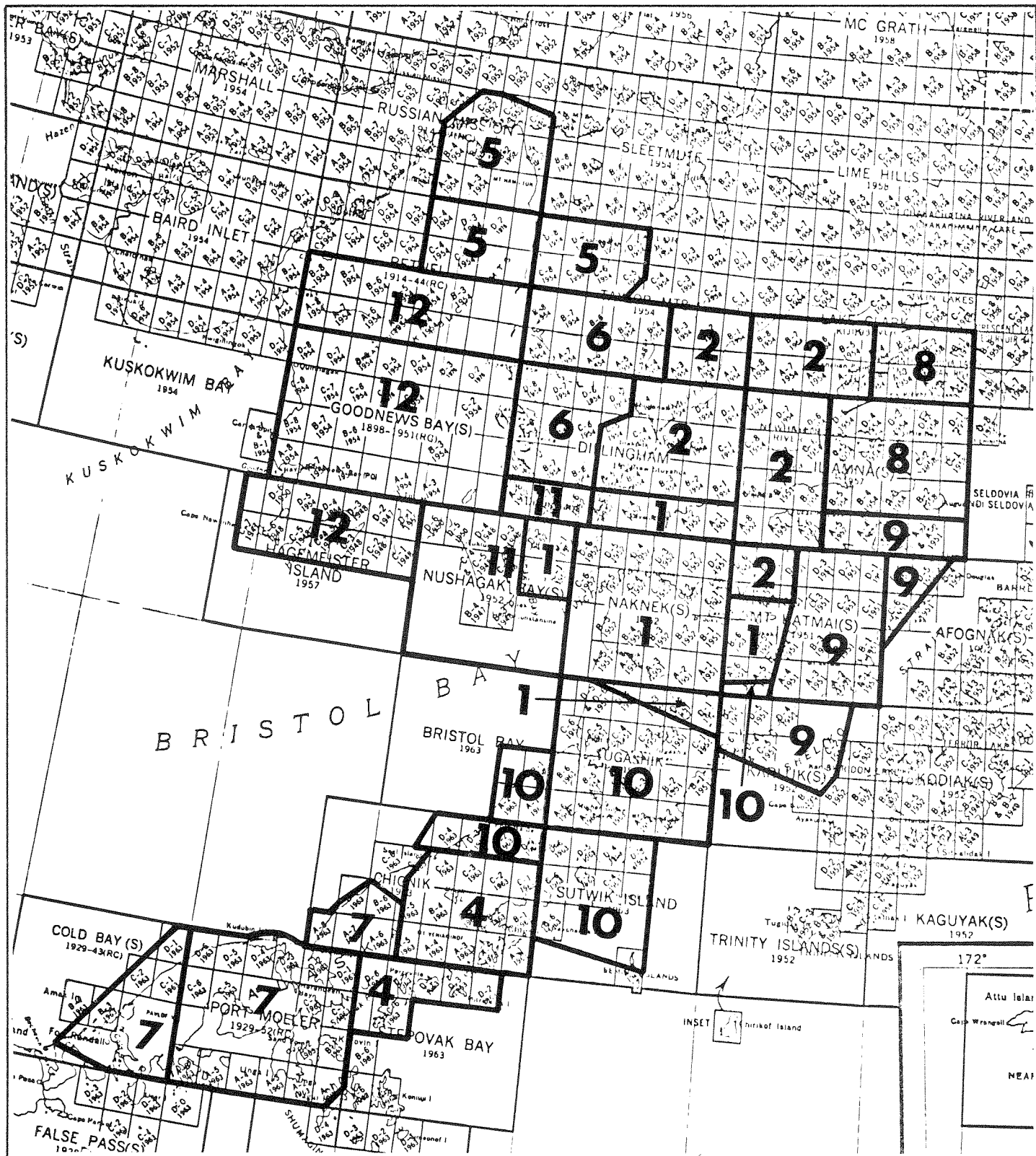


FIGURE 3
LANDSAT SCENE MOSAIC OF LAND COVER MAPS

these randomly selected pixels, sample pixels for which class identity could be verified by ground observations were included in the analysis.

Photointerpreters were trained before analysis with 35mm slides of ground samples to illustrate mapping categories. A limited number of ground observations for which photo coverage was available, and that were not included in the accuracy assessment sample, were provided to familiarize the photointerpreters with the identification of mapping categories. Photointerpreters were required to assign a mapping category for each sample area. However, alternate calls were allowed for samples where the photointerpreter felt another category might apply as well. Landsat alternate calls were based on pixel locations that were verified by referring to the final photo located sample pixel. These alternate calls can be expected to be more reliably located than the primary calls, as random pixel location was difficult to transfer exactly from the classified data to the air photos.

Three photointerpreters were used to provide independent interpretations of pixel identity from the 1:60,000 CIR and 1:2,000 transect photographs. Primary and alternate calls were recorded and the consistency of interpretation between photointerpreters was determined. A comparison of the Landsat classification with the photointerpreted classification was then performed and evaluated in light of between interpreter consistency. A comparison of Landsat and photointerpreter determined identities of sample sites was also performed for sites where ground data was available.

Results

Table 9 illustrates the results of a pairwise comparison between each photointerpreter's land cover interpretation. Table 10 shows the results of a pairwise comparison of sample identity determined by each photointerpreter and by the classified Landsat data. Table 11 represents the agreement between each photo interpretation, the Landsat classification and the sample identity as determined from the ground verified field data. Finally, Table 12 describes the agreement for generalized class categories between known ground verified sample pixels, the various photointerpretations and the Landsat classification.

Discussion

The percentage agreement among photointerpreters is 25 to 50 percent. The Landsat agreement with photointerpreted class identities (25-51%)

is similar to the agreement among photointerpreters. This suggests that the Landsat derived class identities should be at least as accurate as these photointerpreted class identities.

The identification of ground verified sample pixels is better for the Landsat classified pixels (60-68%) than for the photointerpreted pixel identities (32-57%). The Landsat alternate calls are more accurate due to the more reliable pixel location. The variety of accuracies achieved by the photointerpreters and the substantial change in agreement of interpreter A between primary and alternate calls is indicative of the variability among interpretations. These results emphasize the need for both substantial local training of photointerpreters and clear definition of what vegetation communities each land cover mapping category represents.

Substantial improvement in accuracy is noted for both photointerpreters and the Landsat classified pixels as a result of grouping the following similar map categories:

Coniferous Forest-Mixed Forest
Miscellaneous Deciduous-Closed Shrub/Graminoid
Open Low Shrub Ericaceous-Open Low Shrub/Graminoid
Lichen Shrub Tundra-Lichen
Very Wet Bog - Wet Bog/Wet Meadow

TABLE 9
RESULTS OF INTERPRETATION COMPARISON
AMONG PHOTOINTERPRETERS

TREATMENT	PERCENT AGREEMENT	SAMPLE SIZE
AB11	.42	217
AB22	.39	217
AB21	.40	217
AB12	.46	217
BC11	.43	207
BC22	.25	207
BC21	.25	207
BC12	.38	207
AC11	.50	196
AC22	.48	196
AC21	.51	196
AC12	.49	196

TABLE 10
RESULTS OF INTERPRETATION COMPARISON
BETWEEN INTERPRETERS AND LANDSAT

TREATMENT	PERCENT AGREEMENT	SAMPLE SIZE
BL11	.38	180
BL22	.35	180
BL21	.34	180
BL12	.40	180
AL11	.27	172
AL22	.31	172
AL21	.27	172
AL12	.28	172
CL11	.47	178
CL22	.48	178
CL21	.40	178
CL12	.49	178

TABLE 11
RESULTS OF INTERPRETATION COMPARISON
BETWEEN LANDSAT, INTERPRETERS AND GROUND INFORMATION

TREATMENT	PERCENT AGREEMENT	SAMPLE SIZE
AG12	.32	60
AG22	.45	60
BG12	.40	60
BG22	.40	60
CG12	.57	58
CG22	.55	58
LG12	.60	62
LG22	.68	62

TABLE 12
RESULTS OF GROUPED GROUND CATEGORIES
COMPARED TO PHOTOINTERPRETERS AND LANDSAT

TREATMENT	PERCENT AGREEMENT	SAMPLE SIZE
AGG22	.60	60
BGG12	.66	60
CGG12	.75	58
LGG22	.81	62

TREATMENT KEY TO TABLES 9-12

CALL	IDENTIFIER
A = photointerpretation 1	1 = Primary call for identifier
B = photointerpretation 2	in ordered pair
C = photointerpretation 3	2 = Alternate call for identifier
L = Landsat	in ordered pair
GG = Grouped Ground	



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APPENDIX A

GLOSSARY

Alluvial Deposits Soil deposits left as a result of river or stream action.

Brackish Somewhat salty.

Bryophyte A moss or liverwort.

Conifer Any of an order (coniferales) of mostly evergreen trees and shrubs including forms (such as spruce) with true cones.

Cover The characteristic to obscure soil or vegetation by overlaying or overlapping as perceived from a vertical overhead position.

Crustose Having a thin thallus adhering closely to the substratum of rock, bark, or soil.

Crustose Lichen A lichen growth form with Thalli growing in intimate contact with the substrate and lacking a lower cortex and rhizomes.

Decumbant Lying down, but tending to rise at the end.

DEM Digital Elevation Model; digital elevation data developed by the National Cartographic Information Center.

Diurnal Having a daily cycle, e.g. tides.

Dwarf Shrub A deciduous woody plant less than 8 inches (20 cm) tall.

Ericaceous Shrub A deciduous woody plant in the Ericaceae family, e.g. cranberry, blueberry, crowberry, Labrador tea, etc.

Fen An area characterized by slowly moving water and, generally, sedges and grasses. Low shrubs are often present but sphagnum moss is absent or of low cover.

Foliose Having characteristics similar to separate leaflike structures.

Foliose Lichen A leaflike lichen growth form.

Forb A flowering herbaceous plant.

Fruticose More or less shrublike.

Fruticose Lichen A shrubby or hairlike lichen growth form.

Graminoid An herbaceous plant with linear leaves. A sedge or grass.

Ground Cover Any plant less than 8 inches tall.

Halophytic Tolerant of salty soil or water.

Herbaceous Leaflike in texture or color, pertaining to an herb.

Hummocks A rounded knoll or hillock usually of a micro-landform character found in association with tundra types.

Hydrophytic Plant A plant growing in water or in soil too waterlogged for most plants to survive.

Landsat Satellite derived images.

Low Shrub A deciduous woody plant that is between 8 inches (20 cm) and 5 feet (1.5 m) tall.

Mesic Characterized by relating to or requiring a moderate amount of moisture.

Microtopography Small scale landform or topographic relief formed within large-scale landform such as mountains, hills or valleys.

Midstory The tall shrub canopy under a tree canopy.

Mosaic A composite of several parts—photos, vegetation species, satellite images.

Overstory Extending over lower levels of vegetation.

Physiographic Provinces An area of similar botanical and physical site characteristics.

Pixel Single data or picture element of a digital satellite image.

Riparian Associated with rivers or streams.

Species A particular kind of plant—red rose, maple tree, etc.

Species Group An association of similar plants, e.g. conifer trees, deciduous trees, tall shrubs, low shrubs, ericaceous shrubs, dwarf shrubs, graminoids, horsetails, ferns, forbs, bryophytes, or lichens.

Tall Shrub A deciduous woody plant at least 5 feet (1.5 m) tall with multiple stems.

Transects Straight-line routes flown over vegetation to take photographs of ground cover.

Tussocks A compact tuft of grass, moss, or sedge, usually found in marsh areas.

Understory The vegetation layer under a tall shrub or tree canopy which is comprised of low shrubs and tall ericaceous plants.

USGS U.S. Geological Survey.

UTM Universal Transverse Mercator, type of map projection.

APPENDIX B

INDEX OF COMMON PLANT NAMES

LATIN NAME	COMMON NAME	LATIN NAME	COMMON NAME
<i>Achillea borealis</i>	Yarrow	<i>Dicranum</i> sp.	Crane's-bill moss
<i>Aconitum delphinifolium</i>	Monkshood	<i>Drosera rotundifolia</i>	Round-leaved sundew
<i>Aconitum</i> sp.	Crowfoot, Monkshood	<i>Dryas octopetala</i>	White mountain avens
<i>Alectoria</i> sp.	Lichen	<i>Dryas</i> sp.	Mountain avens
<i>Alectoria nigrescens</i>	Lichen	<i>Dryopteris dilatata</i>	Spreading wood-fern
<i>Alectoria ochreolucra</i>	Lichen	<i>Elymus arenarius</i>	Lyme grass, beach rye grass
<i>Alnus</i> sp.	Alder	<i>Empetrum nigrum</i>	Crowberry, mossberry, blackberry, curlewberry
<i>Andromeda polifolia</i>	Bog rosemary	<i>Epilobium angustifolium</i>	Fireweed, willow herb
<i>Anemone narcissiflora</i>	Narcissus—flowered anemone	<i>Equisetum arvense</i>	Common horsetail
<i>Angelica lucida</i>	Seacoast angelica	<i>Equisetum fluviatile</i>	Swamp horsetail
<i>Angelica</i> sp.	Angelica	<i>Equisetum sylvaticum</i>	Wood horsetail, bottle brush
<i>Antennaria</i> sp.	Pussytoe	<i>Eriophorum</i> sp.	Cotton grass
<i>Arctophila fulva</i>	Pendant grass	<i>Festuca</i> sp.	Fescue grass
<i>Arctostaphylos alpina</i>	Alpine bearberry	<i>Galium</i> sp.	Bed straw
<i>Arnica</i> sp.	Arnica	<i>Gentiana algida</i>	Whitish gentian
<i>Artemisia arctica</i>	Arctic wormwood	<i>Gentiana</i> sp.	Gentian
<i>Artemisia globularia</i>	Purple wormwood	<i>Geranium erianthum</i>	Cranesbill, wild geranium
<i>Artemisia</i> sp.	Wormwood	<i>Geum rossii</i>	Ross avens
<i>Astragalus</i> sp.	Milk vetch	<i>Gymnocarpium dryopteris</i>	Fern
<i>Athyrium felix-femina</i>	Lady fern	<i>Hepatica</i>	Liverwort family and scale
<i>Betula glandulosa</i>	Resin birch	<i>Heracleum lanatum</i>	Cow parsnip
<i>Betula Kenaica</i>	Kenai birch	<i>Hierochloa</i> sp.	Holy grass
<i>Betula nana</i>	Dwarf arctic birch	<i>Hippuris vulgaris</i>	Common mare's tail
<i>Calamagrostis canadensis</i>	Bluejoint grass	<i>Honckenya peploides</i>	Seabeach sandwort
<i>Caltha palustris</i>	Marsh marigold	<i>Hypnum</i> sp.	Feather moss, plume moss
<i>Campanula lasiocarpa</i>	Mountain harebell, bluebell	<i>Icmadothphila</i> sp.	Lichen
<i>Cardamine</i>	Bitter cress	<i>Iris setosa</i>	Wild flag, wild iris
<i>Carex lyngbyaei</i>	Lyngbyaei sedge	<i>Lagotis glauca</i>	Lagotis, weasel snout
<i>Carex</i> sp.	Sedge	<i>Lathyrus maritima</i>	Beach pea
<i>Cassiope</i> sp.	Cassiope, mountain heather	<i>Ledum palustre</i>	Labrador tea
<i>Castilleja</i> sp.	Indian paintbrush, figwort	<i>Leguminosae</i>	Pea family
<i>Cerastium Beeringianum</i>	Beering chickweed	<i>Ligusticum scoticum</i>	Beach lovage
<i>Cerastium</i> sp.	Chickweed	<i>Linnaea borealis</i>	Twinflower
<i>Cetraria</i> sp.	Iceland moss (lichen)	<i>Loiseluria procumbens</i>	Alpine azalea
<i>Chamaedaphne calyculata</i>	Leatherleaf	<i>Lupinus nootkatensis</i>	Nootka lupine
<i>Chrysanthemum arcticum</i>	Arctic daisy	<i>Luzula</i> sp.	Wood rush
<i>Cicuta mackenziana</i>	MacKenzie water hemlock	<i>Menyanthes trifoliata</i>	Buckbean
<i>Cladina</i> sp.	Reindeer moss (lichen)	<i>Myrica gale</i>	Sweetgale
<i>Cladonia</i> sp.	Lichen	<i>Non-sphagnidae</i>	Non-sphagnum moss
<i>Conioselinum chinense</i>	Hemlock parsley	<i>Nuphar polysepalum</i>	Yellow pond lily
<i>Cornus canadensis</i>	Bunchberry, Canadian dwarf	<i>Oplopanax horridum</i>	Devil's club
<i>Cornus</i> sp.	Dogwood	<i>Oxycoccus microcarpus</i>	Bog cranberry
<i>Cornus suecica</i>	Swedish dwarf dogwood	<i>Oxytropis</i> sp.	Oxytrope
<i>Delphinifolium</i> sp.	Larkspur	<i>Parnassia</i> sp.	Grass of Parnassus
<i>Diapensia lapponica</i>	Lapland diapensia	<i>Pedicularis</i> sp.	Lousewort

LATIN NAME

Peltigera sp.
Petasites hyperboreus
Pheleum sp.
Phylodoce aleutica

Picea glauca
Picea mariana
Platanthera sp.
Poa sp.
Polemonium acutiflorum

Polytrichum sp.
Populus balsamifera
Potentilla egedii
Potentilla fruticosa
Potentilla palustris

Polygonum sp.
Ptilidium ciliare
Ptilidium crista cortreus
Pyrola sp.
Ranunculus pallasii

Ranunculus sp.
Rhacomitrium sp.
Rhianthus minor
Rhododendron camschaticum
Rosa acicularis

Rubus arcticus
Rubus chamaemorus
Rubus pedatus
Rumex sp.
Salix reticulata

COMMON NAME

Dog lichen
Sweet coltsfoot
Timothy grass
Aleutian mountain heath, heather

White spruce
Black spruce
Bog orchid
Bluegrass
Jacob's ladder

Haircap moss, bird wheat
Balsam poplar, tacamahac, cottonwood
Pacific silverweed
Bush cinquefoil, tundra rose
Marsh fivefinger

Buckwheat
Liverwort
Liverwort
Wintergreen
Pallas buttercup

Buttercup, crowfoot
Moss
Yellow rattle
Kamchatka rhododendron
Prickly rose

Nagoon berry
Cloudberry
Five-leaved bramble
Sorrel, dock
Creeping willow, netleaf will

LATIN NAME

Salix sp.
Sambucus racemosa
Sanguisorba stipulata
Saxifraga punctata
Saxifraga serpyllifolia

Saxifraga sp.
Scirpus sp.
Scirpus caespitosum
Sedum rosea
Senecio pseudoarnica

Silene acaulis
Solidago lepidia
Solidago multiradiata
Sphagnidae
Spirea Beauverdiana

Thalictrum sparsiflorum
Thalictrum sp.
Thamnolia sp.
Thelypteris phegopteris
Trientalis europaea

Triglochin sp.
Urtica gracilis
Vaccinium ovalifolium
Vaccinium uliginosum
Vaccinium vitis-idaea

Viburnum edule
Valeriana capitata
Veratrum viride
Viola epipsila
Viola sp.

COMMON NAME

Willow
European red elder, red berried elder
Burnet
Heart-leaved saxifrage, brook saxifrage
Thyme-leaved saxifrage

Saxifrage
Bulrush
Tufted clubrush
Roseroot, King's crown
Groundsel, ragwort, seabeach senecio

Moss campion, cushion pink
Goldenrod
Northern goldenrod
Sphagnum moss, peat moss, swamp moss
Alaska spirea, beauverd spirea

Few-flowered meadow rue
Meadow rue
Lichen
Beech fern
Starflower

Arrow grass
Slender nettle
Early blueberry
Bog blueberry
Lingonberry, mountain cranberry

High-bush cranberry
Mountain heliotrope
White hellebore
Marsh violet
Violet