Map of Forested Habitats in Anchorage's Parks and Greenbelts

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Introduction

Parks and greenbelts within the Municipality of Anchorage (MOA) are inhabited by numerous wildlife such as moose *(Alces alces)*, bears *(Ursus americanus*), geese *(Branta canadensis*), lynx *(Felis lynx*), small mammals, wood frogs *(Rana sylvatica*) and songbirds. Because wildlife are an integral part of the Anchorage landscape they present both unique wildlife viewing opportunities and management challenges. For example, moose/human interactions have increased in the last few years. A task force was formed and is proposing recommendations for addressing the burgeoning goose population, and a spruce bark beetle *(Dendrotconus rufipennis*) infestation has slowly been encroaching upon white spruce *(Picea glauca)* in the Municipality.

Knowledge of vegetation in habitats used by wildlife in the Anchorage Bowl is important for both park planning and wildlife management. To address this issue I mapped vegetation in two parks and two greenbelts in Anchorage using aerial photo interpretation, field sampling and a geographic information system (GIS). The mapped areas were Kincaid Park in West Anchorage, Russian Jack Springs Park in East Anchorage, the Chester Creek Greenbelt and the Tony Knowles Coastal Trail (Figure 1).

Dr. Roman Dial and I developed this project as a master's thesis at Alaska Pacific University. The Alaska Natural Heritage Program helped develop the thesis into a project of use to other agencies in the community and has provided staff support for a grant funded by the Alaska Division of Forestry.

Literature Review

The natural vegetation of Kincaid Park, Russian Jack Park, the Chester Creek Greenbelt and the Coastal Trail has never before been described or mapped (Jerry Tande, Alaska Natural Heritage Program; Dave Gardner, Division of Parks and Recreation, personal communications).

Stone (1950) developed a key to natural vegetation for black and white aerial photographic interpretation using United States Air Force photographs of the Anchorage area. Air photo interpretation and field sampling were used to define and delineate seven types of natural vegetation. The keys were also field tested for interpretation of vegetation in other areas of the state for use in planning for fire control, mining, and timber uses, as well as classification of land for settlement. Although Stone determined the features of natural vegetation in Anchorage, he did not actually map where the vegetation was found.

Hogan and Tande (1983) studied wetland vegetation and its use by birds. They looked at wetlands designated as preservation, conservation, development or special study areas by the Anchorage Wetlands Management Plan. Steer (1999) also mapped wetlands within the Chester Creek watershed and classified them using Viereck's classification scheme.

Werner and Holsten (1997) studied the dispersal distance of the spruce bark beetle (*Dendrotconus rufipennis*). Knowledge of where stands of white spruce are in parks and the dispersal behavior of the spruce bark beetle will help in managing the white spruce in the Anchorage Bowl.

Russian Jack Park was acquired in two parcels in 1943 and 1948 through funding from the Bureau of Land Management (MOA, 1983). Chester Creek Greenbelt was acquired through a number of funding sources and in a number of parcels from the 1970's through 1981 (MOA, 1983). Kincaid Park, like Russian Jack, was acquired in two lots. The first in 1972 and the second in 1979 (MOA, 1983). The Coastal Trail consists of some

purchased property, but is mostly easements from adjoining landowners, primarily from the Anchorage International Airport (Dave Gardner, Division of Parks and Recreation, personal communication).

Methods

Aerial photo interpretation was used to draw polygons representing different vegetation cover types. A total of 213 polygons were delineated and labeled. These included ballparks, other cultivated grassy areas and native vegetation. Field sampling of randomly selected terrestrial polygons was conducted in the summer of 1997 on 119 polygons. Polygons were digitized and attributes assigned in a geographic information system (GIS) using the Alaska Pacific University GIS lab. These included the polygons originally counted delineated and labeled, as well as man-made structures such as parking lots, trails, roads and buildings, and water bodies such as ponds and lakes. A total of 482 polygons were digitized. Map classes were described from the data and statistical analysis using the SYN-TAX software package was run to corroborate the map class divisions. Each task is covered in more detail below.

Air photo interpretation

True-color aerial photographs, photographed in August 1995 at the 1 inch to 1000 feet scale, and obtained from AEROMAP, Anchorage were used to delineate vegetation polygons (Table 1).

Table 1. List of Anchorage 1" - 1000' aerial photographs filmed and produced by AEROMAP and used for mapping of Anchorage's forested parks and greenbelts project

1-1	2-1	3-2	4-11*	5-13	6-12*	7-18	8-16*	9-17	10-18	11-26
1-2*	2-2*	3-3*	4-12	5-14*	6-13	7-19*	8-17	9-18*	10-19*	11-27*
1-3	2-3*	3-4		5-15				9-19	10-20	11-28
1-5*	2-4*	3-5								
1-6	2-5	3-6*								
	2-6*	3-7								
		3-8*								
		3-9								

* Aerial photographs on which 9" X 9" acetate overlays were placed and polygons delineated. The other photographs listed were used to create a stereo view with the stereoscope.

Using a stereoscope, each different vegetation unit was outlined on acetate overlays placed over the aerial photographs. Polygons were delineated by looking at the texture of the trees and other vegetation as well as the differences in color between adjoining areas. In some cases a road, trail, building or other human structure was the dividing line between two polygons.

When all polygons were delineated I determined which looked similar and coded them with a letter. For example, one type of vegetation was coded A, another type of vegetation was coded B, and so on. Each polygon on each aerial photograph was given a code. After all polygons were coded, I assigned a number as well as a code to each polygon. For example polygons coded A were numbered A1 through A17, and polygons labeled Y were numbered Y1 though Y5, etc. I then counted how many polygons there were for each code. Later, when digitizing the polygons, I realized that some polygons had not been assigned codes and/or numbers and that some man-made structures had not been delineated. Thus after digitizing the number of polygons was greater than the number used for selecting plots to sample. These new polygons were assigned codes after digitizing in GIS.

Man-made structures such as roads, parking lots, houses, etc., and water bodies such as Goose Lake and Little Campbell Lake were also digitized and included in the list of polygons. All man-made structures were coded MMS, and all water bodies were coded WATER. In addition areas bare of vegetation were labeled with SAND or MUD and 32 polygons were labeled as unknown since they had not been identified originally and were not used in sampling. I then counted how many polygons there were for each code (Table 2). Map class names were assigned to each code after analysis.

Table 2. List of codes and numbers of polygons for each code

Code	Number of polygons delineated	Number of polygons digitized	Total area (acres) for each digitized code	Code (cont.)	Number of polygons delineated (cont.)	Number of polygons digitized (cont.)	Total area (acres) for each digitized code (cont.)
A	17	27	390 98	AA	2	5	15 37
B	11	18	246.50	BB	2	3	17.22
C	14	19	404.00	DD	4	6	44.38
D	14	20	258.556	EE	4	5	29.51
E	1	1	4.27	FF	2	2	13.97
G	1	1	6.72	GG	13	18	21.87
H	3	3	29.74	HH	2	2	3.41
I	2	2	14.20	II	1	1	3.33
J	2	2	re-coded X	JJ	1	1	5.02
K	16	55	205.60	KK	2	4	12.02
L	3	6	37.57	LL	6	10	85.69
M	7	15	121.98	NN	1	1	11.09
N	1	2	5.26	OO	1	2	3.67
O	3	2	14.79	PP	1	3	3.22
P	3	5	85.46	QQ	1	1	2.23
Q	2	2	7.79	RR	2	4	17.22

R	9	16	112.18	SS	3	4	13.23
S	2	2	27.22	TT	4	6	17.98
T	1	1	5.34	VV	4	2	5.02
U	2	3	52.17	WW	2	2	15.54
V	1	2	12.05	XX	3	4	44.91
X	21	43	589.82	YY	1	1	2.13
Y	5	5	40.65	ZZ	3	4	9.89
Z	18	32	207.03	SAND	not labeled	2	17.20
MMS	not labeled	49	209.39	UNK	not labeled	32	148.24
MUD	not labeled	2	6.10	WATER	not labeled	16	120.65
Total number of delineated polygons = 219 Total number of digitized polygons = 482							

A maximum of five polygons from each code were sampled. Twelve codes (A, B, C, D, K, M, R, X, Y, Z, GG, and LL) had more than five polygons with the same code. A random number table was used to select the five polygons sampled for these twelve codes. In the cases in which there were fewer than five polygons for a code, all the polygons were sampled. Consequently, a total of 119 out of the 213 total polygons were sampled. Figure 2 shows the distribution of the total number of coded polygons by study area, and Figure 3 shows the distribution of sampled polygons among the study area.

Figure 2. Total Number of Coded Polygons by Study Area

Figure 3. Number of Sampled Polygons by Study Area

Forty eight aerial photo codes were delineated in the aerial photo interpretation phase of the project (Table 2). Through reexamination of the aerial photos, polygons labeled as Code J were determined to be the same as Code X and were subsequently renamed "X." Code K included mostly cultivated grass and was not sampled properly, so was deleted from analysis. Codes HH and VV were determined to be too small for analysis. Therefore, a total of forty five aerial photo codes were used in the final product.

Vegetation sampling

One 10 x 10 meter plot within each of the 119 polygons was sampled between June 16 and September 5, 1997. In addition, about ten polygons were revisited in late summer 1998 to record tree cover data that was missed the previous summer. Data was collected for the overstory, middle story and understory within each selected polygon. Within the

10 x 10 meter plot, three 1 x 1 meter plots were set up, and cover and abundance of all species within them were recorded. Tree height, diameter at breast height and cover abundance was recorded for five trees and tall shrubs of each species within the 10 x 10 meter plot.

Each polygon was located with the aid of a map, a chain meter and a compass. In some instances the distance to a polygon was paced out instead of using a chain meter. When I arrived at each polygon, I walked through as much of the polygon as possible, noting the vegetation within the polygon. I then selected an area that was representative of the polygon. Using a chain meter, compass and stakes, I set up a 10 x 10 meter plot. I walked the perimeter of the plot writing down the species names for all the trees, shrubs and herbaceous plants seen within the 10 x 10 meter plot. Three representative sites were selected within the 10 x 10 meter plot in which a 1 x 1 meter apparatus was placed. Percent cover for each species within each 1 x 1 meter sample area was estimated using a cover-abundance table with nine divisions (Table 3).

Table 3. Cover-abundance table used for estimating cover of vegetation	
Cover-Abundance Code	**Description of cover**
1	One or a few individuals
2	Occasional and less than 5% *
3	Abundant and with very low cover or less abundant but with higher cover; in any case less than 5% **
4	Very abundant and less than 5% ***
5	Cover 5-11%
6	Cover 12-24%
7	Cover 25-49%
8	Cover 50-74%
9	Cover 75-100%
* where 5-10 individuals cover up to 5% of the 1 x 1 meter plot ** in between codes 2 and 4 *** where there are many individuals as in *Vaccinium oxycoccus*	

Each layer height was measured using a meter stick for smaller vegetation, and a clinometer for tall trees. This information was recorded on a data sheet similar to one used by the U.S. Fish and Wildlife Service, Region 7 [Steve Talbot, personal communication (Appendix A)].

The height of each species was measured and then recorded in one of the stratum listed in Table 4. Some of the stratum data was recorded incorrectly, therefore only the cover data was used in statistical analysis.

Table 4. Stratum table used when measuring vegetation	
Stratum	
I	0 - 4 cm
II	5 - 24 cm
III	25-49 cm
IV	50 cm - 99 cm
V	1 m - 1.99 m
VI	2 m - 4.99 m
VII	5 m - 9.99 m
VIII	10 m - 19.99 m
IX	20 m- 29.99 m
X	30 m +

The dbh and height class for five trees from each species within a 10 x 10 meter plot were then measured. This entailed estimating the height class using a meter stick or using a clinometer and a 30 meter tape to ascertain the angle for later conversion to height class.

The largest and smallest trees for each species were chosen and three intermediate trees for that species were also selected for measurement.

Shrubs were counted and measured in the 10 x 10 meter plot if they were taller than 1.22 meters (4 feet) in height (approximate breast height). Percent cover was estimated for all trees and shrubs within each 10 x 10 meter plot. Dead trees and snags of each species in the 10 x 10 meter plot were counted but not measured. In cases where most of the trees in the plot were dead, they were counted and measured.

Plant identification was conducted in the evenings after field sampling and in September and October 1997, after the field season was completed. The Elmendorf Air Force Base and UAA herbaria were used, and Rob Lipkin of the Alaska Natural Heritage Program aided with identification of some species.

Vegetation Description and Statistical Analysis

Vegetation description was accomplished in two manners. Map classes were defined by determining the cover abundance of the dominant species in each aerial photo code. In addition SYN-TAX statistical software program was used to confirm the map class definitions. Data were entered into a MS-Excel spreadsheet for use in the SYN-TAX analysis. Although five plots were sampled for most aerial photo codes, due to the column limitations of MS-Excel (Microsoft, 1994), only four of the sampled five plots were used in the final description and analysis. A random numbers table was used to determine which plots to eliminate for each code. A total of 99 plots were used for description and analysis of the vegetation. Figure 4 shows the distribution of analyzed polygons by study area.

Map classes were named by deciding which were the dominant species in each aerial photo code. For each aerial photo code, the polygons sampled were listed with each

species found in that polygon. The cover was listed next to each species. For example, the polygons A1, A6, A11 and A16 were sampled for aerial photo code "A." The four sampled polygons were listed on a piece of paper and the names and cover for each species was listed next to each code. After all species were listed, I looked for the species with the highest cover in the four polygons. I then named the map class after that species or combination of species. In this example, aerial photo code "A" was named map class *"Betula papyrifera-Populus tremuloides."*

In some instances it was evident that the same species was dominant in more than one aerial photo code. In this case, the aerial photo codes were combined to form one map class. For example, alders had both the highest cover and in most instances the same cover percentage in the polygons sampled in codes "G," "M," "P," and "R." Therefore these four aerial photo codes were assigned the map class *"Alnus."*

Confirmation of the map classes was done using SYN-TAX. Cover data from 99 plots was entered into a matrix in MS-Excel (Microsoft, 1994). Data from the three 1 x 1 samples was entered into the spreadsheet. The end product was a matrix with 115 columns (species) and 297 rows (samples). The matrix was then transposed within the statistical package SYN-TAX to fit its matrix convention of objects (samples) as columns and variables (species) as rows. This matrix was the basis for creating all other matrices discussed below.

The SYN-TAX statistical package limits the number of objects to 150. Therefore the matrix had to be reduced. A matrix was created of tree data collected within the 10 x10 meter plots. In addition, matrices were created for shrub and herb data within the 1 x 1 samples to be analyzed for within plot variation. This analysis will be discussed in the final thesis, but is not part of this report.

For this report, vegetation data from the 1 x 1 meter samples was averaged for each species and plot, and combined into one matrix which then represented each 10 x 10 plot. Since averaging cover abundance codes is meaningless, the cover abundance code was

converted to the midpoints of the percentage each cover class represented. For example, cover class 5 represented a percentage range from 5% to 12%. The midpoint is 8.5%. Thus the cover class was converted to 8.5% (Table 5).

Table 5. Conversion of cover abundance code to midpoint	
Cover abundance code	**Midpoint**
1	0.5
2	1
3	2
4	4
5	8.5
6	18.5
7	37.5
8	62.5
9	87.5

The three 1 x 1 samples within each plot were averaged for each species to represent the cover for the species in the 10 x 10 meter plot. For example, cover abundance for *Gymnocarpium dryopteris* in each 1 x 1 meter sample might be 5, 6, and 8. These values were converted to the midpoints 8.5%, 18.5% and 62.5% and the average of 29.83% was assigned to *Gymnocarpium dryopteris* for that plot. A matrix that represented the 10 x 10 meter plot was then created of the averaged midpoint plot data. Since tree and larger shrub data were collected within the 10 x 10 meter plots, a matrix of this data was also created and converted to midpoints. The information from the tree and larger shrub matrix was combined with the other vegetation matrix. This produced a matrix of midpoint data for 105 species and 99 plots (Table 6).

Since using midpoint data will create bias in statistical analysis by giving more weight to larger numbers, the percentages computed from the averages were then converted back to cover classes for analysis in SYN-TAX (Table 7).

Table 7. Conversion from midpoint percent cover back to cover class

Percent cover from midpoint data matrix	Cover class
<0.5	1
0.6-1.5	2
1.6-3.5	3
3.6- 4.9	4
5-12.9	5
13-25.9	6
26-50.9	7
51-75.9	8
76-100	9

This new matrix representing the 10 x 10 plot cover abundance classes was used to interpret map classes using the software package SYN-TAX (Podani, 1994).

Podani (1994) writes that the results of non-hierarchical clustering are not acceptable by themselves, therefore a two step approach was used confirm map classes. First, ordination was used to separate dissimilar objects from each other, and then non-hierarchical clustering was used to group like plots together. Ordination analyzes data on a species abundance basis only (Gauch, 1982). Ordination is used to arrange species and samples (plots) in space in such a manner that similar elements are close to each other, and dissimilar elements are further from each other.

Podani (Personal communication, 1998) suggests using ordination to determine how many clusters to use for non-hierarchical clustering. He looks at the bar graph (named a scree graph in SYN-TAX) that is generated from ordination to determine how many clusters to specify in non-hierarchical clustering.

Two ordination methods are used in SYN-TAX to analyze data. One is *principal components analysis* (PCA), which is similar to ANOVA, and looks for the maximum direction of variance. The other ordination analysis method is *correspondence analysis*

(COA). Principal component analysis, using correlation as the algorithm was used for analyzing the data for this project.

Non-hierarchical clustering arranges objects into clusters without showing a between-cluster relationship and is useful in vegetation ecology for creating maps (Podani, 1994). Therefore, non-hierarchical clustering is the primary statistic used for analyzing the data. Within SYN-TAX there are six partitioning methods: k-means clustering, global optimization, multiple partitioning, quick-clustering, fuzzy clustering and ordinal clustering. The data collected in this project was ordinal data, therefore ordinal clustering was used applying the Goodman-Kruskal algorithm [Y_{jk} = (a-b)/(a+b), "where *a* is the number of pairs of variables ordered for objects *j* and *k* identically, and *b* is the number of pairs of variables that are reversely ordered in *j* and *k*"] (Podani 1998).

Ordination was run on the cover-abundance matrix of 105 species and 99 plots representing the 10 x 10 meter plots. The bar graph, biplot and "scattergram for objects" was printed and examined to look for groupings into clusters. This information was used to determine how many clusters to specify in the subsequent non-hierarchical clustering. Usually one or two plots were clustered into groups. The data matrix was saved and then the plots that fell into the prior cluster were eliminated from the matrix and a new iteration of ordination and non-hierarchical clustering was run. This was done until no further clustering was useful. For example, the first analysis of all species shows a break in the bar graph after the first bar. Two clusters are evident (Figure 5).

Figure 5. Bar graph of all species ordination

One cluster has 33 plots in it, the other 66. A data matrix was labeled and saved for each cluster (ie.1st split 33 plots, 1st split 66 plots) and new ordination and non-hierarchical clustering statistics were run for each group. The same process was followed until no further clustering was evident. This was done for the 33 plot group and the 66 plot group. After map classes were confirmed, the aerial photo code was assigned a map class

name and it was entered into the GIS attribute table in the feature labeled "MAP_CLASS."

GIS

Digitizing of the aerial photos commenced in late summer 1998. In all, 17 aerial photos were digitized as separate coverages in ARC/INFO (ESRI, Inc. 1997). The coverages were named for distinct features or parks in the photo. For example, aerial photo 11-27 covers Russian Jack Park. Originally the coverage was given the name "rjtic," then "rjdg," then "rjbuild," "rjlabel," and so forth as digitizing, building, transforming and other activities progressed. The final coverage was named "rjstate," indicating the coverage had been transformed to state plane coordinates. Table 8 gives the aerial photo number, the corresponding final coverage name, and a brief description of the area.

Table 8. List of aerial photos with GIS coverage name and full name of area photographed

Aerial photo number	Coverage name	Full name of area
Anchorage 1-2	kpcstate	Kincaid Park
Anchorage 1-5	ald5state	alder area within Kincaid Park
Anchorage 2-2	sdnstate	sand dune area within Kincaid Park
Anchorage 2-3	rds	roads within Kincaid Park
Anchorage 2-4	lclstate	Little Campbell Lake area
Anchorage 2-6	grv7state	gravel/sand pits near airport
Anchorage 3-3	jod6state	Jodhpur Rd. entrance to Kincaid Park
Anchorage 3-6	iastate	International Airport area
Anchorage 3-8	ptw9state	Point Woronzof area
Anchorage 4-11	eq8state	Earthquake Park area
Anchorage 5-14	trnstate	Turnagain area
Anchorage 6-12	wcl10state	Westchester Lagoon area
Anchorage 7-19	vmnstate	Valley of the Moon Park
Anchorage 8-16	sewstate	area east and west of Seward Highway
Anchorage 9-18	stkstate	Sitka Street Park area
Anchorage 10-19	glstate	Goose Lake area (MOA property only)
Anchorage 11-27	rjstate	Russian Jack Park

Each coverage was edited for extraneous labels, arcs and nodes, and then built in ARC/INFO (ESRI, Inc. 1997). After all coverages were acceptable they were transformed to the state plane coordinate system using tic coordinates obtained from the Department of Community Planning at the Municipality of Anchorage (Appendix B).

Fifteen of the coverages were then joined to each other using the "union" command in ARC/INFO (ESRI, Inc. 1997), and in some cases using the "edgematch" function to adjust them to the adjacent coverage. The coverages "ald5state" and "rds" were duplicates and were not used in the final product. The coverages were merged to form one big coverage named "PARKSGOOD." The original labels assigned by ARC/INFO for each coverage were deleted and new labels were attached to each polygon. An attribute table was created in ArcView and joined to the coverage "PARKSGOOD" (Table 9).

Table 9. List of GIS attributes

ITEM NAME	DESCRIPTION
STUDY-AREA	name of study area KP (Kincaid), CT (Coastal Trail), CC (Chester Creek), RJ (Russian Jack)
AERIAL_PHOTO_ CODE	original letter code assigned to delineated polygons
AERIAL_PHOTO_ CODE_2	number assigned to each polygon for a particular aerial photo-code
AERIAL_CLASS	original classification from aerial photo interpretation
MAP_CLASS	classification based on dominant* species in a 10x 10 plot
TREE_DBH	dbh for dominant* tree species
TREE_DBH_SD	standard deviation of dbh for dominant* tree species
TREE_DBH_2**	dbh for co-dominant* tree species
TREE_DBH_SD_2**	standard deviation of dbh for co-dominant* tree species
OWNERSHIP	legal status of land (owned by Municipality of Anchorage = MOA, private = PVT, Anchorage International Airport = AIA)
AREA_ACRES	Area in acres calculated from area in feet created by ARC/INFO
AREA_HA	Area in hectares calculated from AREA_ACRES
DEAD-TREES	lists the species of dead trees, if present, in the sampled plot

* dominant = highest cover in a polygon
** used when two species have same or similar cover

The "STUDY-AREA" is the park or greenbelt in which the polygon is present. In the attribute table each area is given a code. Thus Russian Jack Park is RJ, Chester Creek Greenbelt is CC, the Coastal Trail is CT, and Kincaid Park is KP. Polygons near the end of the west runway of Anchorage International Airport are included in the study. Therefore for coding purposes, polygons north and west of the fence separating Kincaid Park from International Airport property are coded as Coastal Trail, all those South and east of Airport property are coded as Kincaid Park.

The "AERIAL_PHOTO_CODE" is the original letter code (A, B, ...X, Z, etc.) assigned to each polygon delineated on aerial photos. "AERIAL_PHOTO_CODE_2" is the original number assigned to each polygon within each code (M1, SS3, etc.). The "AERIAL_CLASS" is the vegetation assigned to each polygon during aerial photo interpretation. "MAP_CLASS" is the vegetation with the greatest cover in a sampled polygon. "TREE_DBH" and "TREE_DBH_SD" are the diameter at breast height for the tree(s) or shrub(s) with the greatest cover in a map class in the sampled plot, and the standard deviation of the dbh for the tree or shrub species in the plot. "TREE_DBH_2" and "TREE_DBH_SD_2" are used when tree or shrub species are co-dominant. "OWNERSHIP" describes the legal status of the polygon if known. Property owned by the Municipality is listed as "MOA," property owned by Anchorage International Airport is listed as "AIA," and property that is neither is listed as private "PVT." "AREA_ACRES" lists the area of each polygon in acres. This is calculated from the area in feet generated by ARC/INFO using the conversion, 43560 square feet equals 1 acre. "AREA_HA" lists the are of each polygon in hectares, and is calculated from "AREA_ACRES" using the conversion, 1 hectare equals 2.471 acres. "DEAD_TREES" lists the species of dead trees in a sampled 10 x 10 plot, if any.

Results

GIS

An ARC/INFO coverage is included with this report. Forty map classes (Table 10) were defined and are named after the dominant cover species. All information from sampled plots is included in the attribute table for the appropriate polygon.

Table 10. List of map classes in the study area

Map class	Park/Greenbelt	Plot #
Picea glauca/Alnus tenuifolia	Russian Jack Park	RR1
	Russian Jack Park	RR2
Picea mariana	Chester Creek Greenbelt	EE1
	Chester Creek Greenbelt	EE2
	Chester Creek Greenbelt	EE4
Picea mariana-Betula papyrifera	Chester Creek Greenbelt	BB1
	Chester Creek Greenbelt	BB2
	Russian Jack Park	PP1

Picea mariana/Myrica gale	Chester Creek Greenbelt	AA1 AA2
Picea mariana/Ledum decumbens-Myrica gale	Chester Creek Greenbelt	NN1
Picea mariana/Ledum	Chester Creek Greenbelt Chester Creek Greenbelt	FF1 FF2
Picea mariana/Betula nana	Russian Jack Park Russian Jack Park	SS1 SS3
Picea mariana/Betula nana-Myrica gale	Chester Creek Greenbelt Chester Creek Greenbelt Chester Creek Greenbelt Chester Creek Greenbelt	DD1 DD2 DD3 DD4
Picea mariana/Calamagrostis canadensis	Chester Creek Greenbelt	II1
Picea mariana/Equisetum	Chester Creek Greenbelt Chester Creek Greenbelt Chester Creek Greenbelt Chester Creek Greenbelt	GG3 GG5 GG8 GG12
Betula papyrifera-Picea glauca	Coastal Trail Coastal Trail Russian Jack Park Russian Jack Park	LL1 LL2 LL5 LL6
Betula papyrifera-Picea glauca/Alnus species	Chester Creek Greenbelt Chester Creek Greenbelt Chester Creek Greenbelt Chester Creek Greenbelt	Y1 Y2 Y3 Y5

Table 10. (Continued)

Map class	**Park/Greenbelt**	**Plot #**
Betula papyrifera-Picea glauca/Calamagrostis canadensis	Kincaid Park Kincaid Park Kincaid Park Chester Creek Greenbelt	C3 C7 C8 C12
Betula papyrifera (mature)	Coastal Trail Coastal Trail	S1 S2
Betula papyrifera	Chester Creek Greenbelt Coastal Trail Chester Creek Greenbelt Chester Creek Greenbelt	Z1 Z6 Z15 Z16
Betula papyrifera (young)	Coastal Trail Russian Jack Park Russian Jack Park	X4 X15 X19
Betula papyrifera-Populus balsamifera/Viburnum edule/Calamagrostis canadensis	Kincaid Park Kincaid Park	TT1 TT4
Betula papyrifera/Populus tremuloides	Kincaid Park Kincaid Park Kincaid Park Coastal Trail	A1 A6 A11 A16
Betula papyrifera/Alnus species/Calamagrostis canadensis	Kincaid Park Kincaid Park	ZZ1 ZZ3
Betula papyrifera (young)/Alnus sinuata/Calamagrostis canadensis	Russian Jack Park	OO1
Betula papyrifera (mature)/Calamagrostis canadensis	Kincaid Park Kincaid Park Kincaid Park Kincaid Park	B1 B2 B6 B7
Betula papyrifera/Equisetum arvense	Coastal Trail Coastal Trail	U1 U2
Populus balsamifera-Betula papyrifera/Calamgrostis canadensis	Kincaid Park Coastal Trail Coastal Trail Coastal Trail	D1 D11 D12 D13
Populus balsamifera/Alnus species	Kincaid Park Kincaid Park	WW1 WW2
Populus balsamifera/Lathyrus maritimus	Kincaid Park Kincaid Park Kincaid Park	XX1 XX2 XX3
Populus balsamifera/Calamagrostis canadensis	Kincaid Park Kincaid Park	O1 O2
Populus balsamifera/Calamagrostis canadensis and other grasses	Kincaid Park Kincaid Park	I1 I2

Populus balsamifera/Equisetum arvense	Kincaid Park	YY1
Alnus	Coastal Trail	M1
	Coastal Trail	M3
	Coastal Trail	M6
	Coastal Trail	M7
	Coastal Trail	R3
	Coastal Trail	R7
	Coastal Trail	R8
	Coastal Trail	R9
	Kincaid Park	G1
	Kincaid Park	P2
	Kincaid Park	P3
Alnus sinuata/Grasses	Coastal Trail	N1
Salix scouleriana/Calamagrostis canadensis	Chester Creek Greenbelt	JJ1
Echinopanax horridum-Viburnum edule-Salix scouleriana	Coastal Trail	T1
Betula nana/Grasses/other shrubs	Chester Creek Greenbelt	KK2
Betula nana/Calamagrostis canadensis/Mosses	Kincaid Park	E1
Grasses and Populus species	Kincaid Park	H1
	Kincaid Park	H2
	Kincaid Park	H3
Trifolium species	Coastal Trail	L1
	Coastal Trail	L2
Grasses/Shrubs	Russian Jack Park	QQ1
Grasses/Trifolium species	Chester Creek Greenbelt	V2

Users can click on a polygon and find the map class assigned to the polygon for each code. In addition, the size of each polygon in acres or hectares, and in most instances whether the property is owned by the Municipality, Anchorage International Airport or is private, is listed. Maps of each parkland are also available showing the map classes in each parkland.

Statistical analysis

Ordination using principal components analysis was run on the data matrix representing each 10 x 10 meter plot described above. Podani (1998) states that a break between bars in a scree graph indicates where the useful data is and what is “noise” or unimportant.

The bar graph in Figure 5 is the first ordination run on all the species and plots in the study area. There is a large difference between the first bar and the second and subsequent bars. This indicates one strong group or cluster. Non-hierarchical analysis was run using the Goodman-Kruskal algorithm with two clusters specified. The result was a cluster with 33 plots, and a cluster with 66 plots. Subsequent ordination and non-hierarchical clustering was run on each subset to confirm map classes assigned more

subjectively. Flow charts of the SYN-TAX analysis show the plot clusters (Figures 6 and 7).

Figure 6. Flow chart of SYN-Tax analysis for 33-plot group.

		1 plot	M7	Alnus
	5 plots			
			L1	Trifolium species
		4 plots	L2	Trifolium species
			N1	Alnus sinuata/Grasses
			V2	Grasses/Trifolium species
33 plots				
			DD2	Picea mariana/Betula nana-Myrica gale
			DD3	Picea mariana/Betula nana-Myrica gale
		6 plots	EE1	Picea mariana
			EE2	Picea mariana
			EE4	Picea mariana
			JJ1	Salix scouleriana/Calamagrostis canadensis
	28 plots		QQ1	Grasses/Shrubs
			RR2	Picea glauca/Alnus tenuifolia
		5 plots	Y5	Betula papyrifera-Picea glauca
			Z15	Betula papyrifera
			Z16	Betula papyrifera
			AA1	Picea mariana/Myrica gale
			AA2	Picea mariana/Myrica gale
			BB2	Betula papyrifera-Picea mariana
			DD4	Picea mariana/Betula nana-Myrica gale
			E1	Betula nana/Calamagrostis canadensis/Mosses
		17 plots	FF1	Picea mariana/Ledum
			FF2	Picea mariana/Ledum
			GG5	Picea mariana/Equisetum
			GG8	Picea mariana/Equisetum
			GG12	Picea mariana/Equisetum
			II1	Picea mariana/Calamagrostis canadensis
			KK2	Betula nana/Grasses/other shrubs
			NN1	Picea mariana/Ledum decumbens-Myrica gale
			Q1	Betula papyrifera (young)-Picea mariana
			R8	Alnus
			SS1	Picea mariana/Betula nana
			SS3	Picea mariana/Betula nana

Figure 7. Flow chart of SYN-TAX analysis for 66 plot group

		C12	Betula papyrifera-Picea glauce/Calamagrostis canadensis
	3 plot	D12	Populus balsamifera-Betula papyrifera/Calamagrostis canadensis
		I1	Populus balsamifera/Calamagrostis canadensis and other grasses
		H2	Grasses and Populus species
	10 plots	H3	Grasses and Populus species
	7 plots	I2	Populus balsamifera/Calamagrostis canadensis and other grasses
		XX1	Populus species/Lathyrus maritimus
		XX2	Populus species/Lathyrus maritimus
		XX3	Populus species/Lathyrus maritimus
		YY1	Populus balsamifera/Equisetum arvense
		B2	Betula papyrifera (mature)/Calamagrostis canadensis
		B6	Betula papyrifera (mature)/Calamagrostis canadensis
		D13	Populus balsamifera-Betula papyrifera/Calamagrostis canadensis
		DD1	Picea mariana/Betula nana-Myrica gale
		M1	Alnus
66 plots		O1	Populus balsamifera/Calamagrostis canadensis
		O2	Populus balsamifera/Calamagrostis canadensis
		P2	Alnus
	13 plots	P3	Alnus
		R9	Alnus
		WW1	Populus balsamifera-Alnus species
		ZZ1	Betula papyrifera/Alnus species/Calamagrostis canadensis
		ZZ3	Betula papyrifera/Alnus species/Calamagrostis canadensis
		A16	Betula papyrifera-Populus tremuloides
	56 plots	BB1	Betula papyrifera-Picea mariana
		G1	Alnus
		GG3	Picea mariana/Equisetum
		H1	Grasses and Populus species
		M3	Alnus
	16 plots	OO1	Betula papyrifera (young)/Alnus sinuata/Calamagrostis canadensis
		PP1	Betula papyrifera-Picea mariana
		Q2	Betula papyrifera (young)-Picea mariana
		R7	Alnus
		U1	Betula papyrifera/Equisetum arvense
		U2	Betula papyrifera/Equisetum arvense
		X4	Betula papyrifera (young)
		Y3	Betula papyrifera-Picea glauca/Alnus species
		Z1	Betula papyrifera
		Z6	Betula papyrifera
	27 plots (next page)		

Figure 7. (Continued)

66 plots

56 plots

27 plots

A1	Betula papyrifera-Populus tremuloides
A6	Betula papyrifera-Populus tremuloides
A11	Betula papyrifera-Populus tremuloides
B1	Betula papyrifera (mature)/Calamagrostis canadensis
B7	Betula papyrifera (mature)/Calamagrostis canadensis
C3	Betula papyrifera-Picea glauce/Calamagrostis canadensis
C7	Betula papyrifera-Picea glauce/Calamagrostis canadensis
C8	Betula papyrifera-Picea glauce/Calamagrostis canadensis
D1	Populus balsamifera-Betula papyrifera/Calamagrostis canadensis
D11	Populus balsamifera-Betula papyrifera/Calamagrostis canadensis
LL1	Betula papyrifera-Picea glauca
LL2	Betula papyrifera-Picea glauca
LL5	Betula papyrifera-Picea glauca
LL6	Betula papyrifera-Picea glauca
M6	Alnus
R3	Alnus
RR1	Picea glauce/Alnus tenuifolia
S1	Betula papyrifera (mature)
S2	Betula papyrifera (mature)
T1	Echinopanax horridum-Viburnum edule-Salix scouleriana
TT1	Betula papyrifera-Populus balsamifera/Viburnum edule/Calamagrostis canadensis
TT4	Betula papyrifera-Populus balsamifera/Viburnum edule/Calamagrostis canadensis
WW2	Populus balsamifera-Alnus species
X15	Betula papyrifera (young)
X19	Betula papyrifera (young)
Y1	Betula papyrifera-Picea glauca/Alnus species
Y2	Betula papyrifera-Picea glauca/Alnus species

Map classes described

Species names follow Viereck and Little (1972) for trees and shrubs, and HultÈn (1968) for herbaceous plants.

Picea glauca/Alnus tenuifolia

Code "RR" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Picea glauca (White spruce, 9% and 38%) and *Alnus tenuifolia* (Thinleaf alder, 9% and 38%) are the dominant species. Both *Picea glauca* and *Alnus tenuifolia* have an average dbh of 9 cm. White spruce is between 2 and 10 meters tall and thinleaf alder is between 5 and 10 meters tall. *Betula papyrifera* (Paper birch, 9%) also has 100% constancy in the map class and *Picea mariana* (Black spruce, 19%) is present in 50% of the map class. *Betula papyrifera* is between 5 and 20 meters tall and has an average dbh of 19.5 cm, and *Picea mariana* is between 2 and 10 meters tall and has an average dbh of 8 cm.

Shrub species present are *Viburnum edule* (Highbush cranberry), *Spiraea beauverdiana* (Beauverd spirea), *Ribes triste* (American red currant), *Rubus arcticus* (Nagoonberry), *Linnaea borealis* (Twin flower), *Rubus spectabilis* (Salmonberry) and *Vaccinium uliginosum* (Bog blueberry). Herbaceous species present are *Cornus canadensis* (Bunchberry or Dwarf dogwood), *Trientalis europaea* (Starflower), *Gymnocarpium dryopteris* (Oak fern), *Dryopteris dilatata* (Shield fern) and *Equisetum silvaticum* (horsetail). Mosses are also present.

Picea mariana

Code "EE" was assigned to this class in aerial photo interpretation. Three polygons were sampled.

Picea mariana (38%), with an average dbh of 6.5 cm and between 1 and 10 meters tall, is constant in 67% of the map class. *Picea glauca* (19%), with an average dbh of 8 cm and between 2 and 5 meters tall, is present in 33% of the map class. No tree species are present in 33% of the map class. *Myrica gale* (Sweetgale, 36%) is the dominant species where trees are absent.

Other shrubs in the map class are *Potentilla fruticosa* (Shrubby cinquefoil), *Salix scouleriana* (Scouler willow), *Salix novae-anglia* e(Tall blueberry willow), *Ledum groenlandicum* (Labrador tea), *Betula nana* (Dwarf Arctic birch), *Rubus spectabilis* (Salmonberry), *Vaccinium uliginosum*, and *Vaccinium oxycoccus* (Bog cranberry). Herbaceous species present are *Potentilla palustris* (Marsh fivefinger), *Calamagrostis canadensis,* (Canadian bluejoint grass), unidentified grasses, *Equisetum arvense* (Horsetail), *Equisetum fluviatile* and *Carex* (Sedge). Mosses are also present.

Picea mariana- Betula papyrifera

Codes "BB" and "PP" were assigned to this feature in aerial photo interpretation. Three polygons were sampled.

Picea mariana (9% to 63%), with an average dbh of 7 cm and between 5 and 20 meters tall, is constant in 100% of the class. *Picea glauca* (<1% to 38%) and *Betula papyrifera* (38%) are present in 67% of the map class. *Picea glauca* with an average dbh of 8.5 cm is between 5 and 10 meters tall. *Betula papyrifera,* with an average dbh of 12 cm is between 5 and 20 meters tall. *Salix bebbiana* (1% and 3%),with an average dbh of 7 cm and between 5 and 20 meters tall, is also present in 67% of the map class.

Other shrubs present are *Salix scouleriana*, *Vaccinium uliginosum*, *Ledum groenlandicum, Rosa acicularis, Rubus arcticus* and *Vaccinium vitis-idaea*. Herbaceous species present are *Cornus canadensis*, *Pyrola minor*, *Epilobium angustofolium, Trientalis europaea*, *Taraxacum* species, *Calamagrostis canadensis,* unidentified grasses, *Equisetum arvense* and *Equisetum silvaticum*. Mosses are also present.

When determining the map class for these codes, it was evident that the two polygons coded BB were different. Upon reexamination of the aerial photos, it is apparent that they should have been coded differently. One should have been coded with the PP code, and the other BB polygon should have been coded with one of the *Picea mariana* map classes, probably with aerial photo code II.

Picea mariana/Myrica gale

Code "AA" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Picea mariana (38%), with an average dbh of 8 cm and between 0.5 and 5 meters tall, and *Myrica gale* (32% and 38%) are the dominant species. Other species conspicuous in 100% of the map class are *Betula nana* (Dwarf birch, 19% and 22%), *Calamagrostis canadensis* (13% and 38%) and *Ledum groenlandicum* (6% and 25%).

Shrubs present are *Salix barclayi* (Barclay willow), *Salix scouleriana*, *Potentilla fruticosa*, *Ledum decumbens* (Narrow-leaf Labrador tea), *Vaccinium uliginosum*, *Vaccinium vitis-idaea* (Lingonberry or Lowbush cranberry), *Empetrum nigrum* (Crowberry), *Arctostaphylos rubra* (Bearberry), *Andromeda polifolia* (Bog rosemary) and *Vaccinium oxycoccus* (Bog cranberry). Herbaceous species present are *Rubus chamaemorus* (Cloudberry) and *Equisetum arvense*.

Picea mariana/Ledum decumbens-Myrica gale

Code "NN" was assigned to this class in aerial photo interpretation. One polygon was sampled.

Picea mariana (19%), with an average dbh of 4 cm and between 1 and 5 meters tall, is the dominant tree species. *Ledum decumbens* (31%) and *Myrica gale* (21%) are the dominant shrub species. *Empetrum nigrum* (17%) is also conspicuous in this map class.

Other shrubs present are *Salix* species, *Ledum groenlandicum, Betula nana*, *Vaccinium uliginosum* and *Vaccinium vitis-idaea*. Herbaceous species present are *Rubus chamaemorus, Drosera rotundifolia* (Sundew), unidentified grasses, *Equisetum fluviatile* and *Equisetum arvense*.

Picea mariana/Ledum

Code "FF" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Picea mariana (38%), *Ledum decumbens* (9% to 12%), and *Ledum groenlandicum* (7% to 15%) are the dominant species. *Picea mariana* has an average dbh of 3.5 cm and is between 25 cm and 2 meters tall. *Alnus tenuifolia* (<1%) is found in 50% of the map class, with an average dbh of 2 cm and is between 2 and 5 meters tall.

Other shrubs present are *Salix planifolia* (Diamondleaf willow), *Salix scouleriana, Alnus tenuifolia*, *Potentilla fruticosa, Betula nana*, *Vaccinium uliginosum*, *Arctostaphylos rubra*, *Empetrum nigrum*, *Andromeda polifolia*, *Vaccinium vitis-idaea* and *Vaccinium oxycoccus*. Other plants present are *Rubus chamaemorus*, *Calamagrostis canadensis*, unidentified grasses, *Equisetum palustre,* unidentified *Carex* and mosses.

Picea mariana/Betula nana

Code "SS" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Picea mariana (38% and 63%), with an average dbh of 5.5 cm and between 1 and 10 meters tall, and *Betula nana* (24% and 30%) are the dominant tree and shrub species. *Ledum groenlandicum* (18% and 40%) is also an important component of the map class.

Other shrub species present are *Salix bebbiana* (Bebb willow), *Salix* species, *Myrica gale, Spiraea beauverdiana*, *Ledum decumbens*, *Vaccinium uliginosum, Vaccinium vitis-idaea*, *Arctostaphylos rubra*, *Empetrum nigrum* and *Andromeda polifolia*. Herbaceous species present are *Rubus chamaemorus*, *Cornus canadensis*, *Geocaulon lividum* (Pumpkin berry), *Iris setosa* (Wild iris), *Equisetum silvaticum* and *Equisetum arvense*. Mosses are also present.

Picea mariana/Betula nana-Myrica gale

Code "DD" was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Picea mariana (9% to 63%), *Betula nana* (3% to 25%) and *Myrica gale* (3% to 62%) are constant in 75% of the class. *Picea mariana* has an average dbh of 5.5 cm and is between 1 and 10 meters tall. *Calamagrostis canadensis* (15% to 88%) is constant in 75% of the class.

Other shrubs present are *Salix* species, *Potentilla fruticosa*, *Ledum groenlandicum, Ledum decumbens*, *Betula nana*, *Vaccinium uliginosum*, *Rubus spectabilis, Vaccinium vitis-idaea, Empetrum nigrum*, *Andromeda polifolia* and *Vaccinium oxycoccus*. Herbaceous species present are *Potentilla palustris*, *Thalictrum sparsiflorum* (Few-flowered meadow rue), *Parnassia palustris* (Grass of Parnassus), *Rorippa islandica* (Yellow cress), *Swertia perennis* (Gentian), *Rubus chamaemorus*, *Calamagrostis canadensis*, *Carex* species, and four horsetail species: *Equisetum arvense*, *E. fluviatile*, *E. palustre* and *E. pratense*. Mosses are also present.

One polygon sampled does not have the same species as the other three sampled. Upon reexamination of the aerial photos, it is apparent that this polygon was misinterpreted in the original delineation.

Picea mariana/Calamagrostis canadensis

Code “II” was assigned to this class in aerial photo interpretation. One polygon was sampled.

Picea mariana (38%), with an average dbh of 14 cm and between 5 and 20 meters tall, is the dominant tree species. *Calamagrostis canadensis* (12%) is the dominant herbaceous species. Mosses (21%) are also an important component in the map class.

Shrubs present are *Ledum groenlandicum, Rosa acicularis* and *Vaccinium vitis-idaea*. Herbaceous species present are *Cornus canadensis*, *Equisetum arvense* and *Pyrola minor* (Wintergreen).

Picea mariana/Equisetum

Code “GG” was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Picea mariana (38% to 63%), with an average dbh of 7.5 cm and between 1 and 10 meters tall, is the dominant tree species. Either *Equisetum arvense* (Horsetail, 13% to 71%) or *Equisetum silvaticum* (31%) are the dominant understory species. *Alnus tenuifolia* (1%), with an average dbh of 5 cm, is present in 25% of the map class.

Shrub species present are *Salix novae-angliae*, *Salix* species, *Alnus* species, *Spiraea beauverdiana*, *Rosa acicularis*, *Rubus idaeus* (American red raspberry), *Betula glandulosa* (Resin birch), *Vaccinium uliginosum*, *Vaccinium vitis-idaea* and *Empetrum nigrum*. Herbaceous plants are *Adoxa moschatellina* (Moschatel), *Sanguisorba stipulata* (Sitka burnet), *Rubus chamaemorus*, *Cornus canadensis*, *Trientalis europaea*, *Epilobium angustofolium*, *Taraxacum* species (Dandelion), and *Calamagrostis canadensis*. Mosses are also present.

Betula papyrifera-Picea glauca

Code “LL” was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Betula papyrifera (38% to 63%) has 100% constancy in the map class. *Picea glauca* (38% to 63%) is found in 75% of the map class. *Betula papyrifera,* with an average of 16.5 cm, is between 5 and 30 meters tall, and *Picea glauca,* with an average dbh of 21 cm, is between 2 and 30 meters tall. *Calamagrostis canadensis* (3% to 32%) and *Gymnocarpium dryopteris* (6% to 79%) are found in 75% of the map class. *Viburnum edule* (19% to 63%) is found in 50% of the map class. *Sorbus scopulina* (Greene Mountain ash, 6%) is also found in this map class.

Other shrubs present are *Menziesia ferruginea* (Rusty menziesia), *Echinopanax horridum* (Devil’s club), *Betula glandulosa, Rosa acicularis* (Prickly rose), *Ribes triste* (American red currant), and *Linnaea borealis* (Twin flower). Herbaceous species present are *Actaea rubra* (Baneberry), *Moehringia lateriflora* (Grove sandwort), *Cornus canadensis*, *Epilobium angustofolium* (Fireweed), *Galium trifolium* (Sweet-scented bedstraw), *Trientalis europaea*, *Pyrola asarifolia*, *Lycopodium annotinum* (Club moss), unidentified grasses, *Dryopteris dilatata*, *Equisetum arvense* and *Equisetum pratense*. Mosses are also present.

Betula papyrifera-Picea glauca/Alnus species

Code “Y” was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Betula papyrifera (19% and 37%) and *Picea glauca* (1% to 19%) are constant in 75% of the map class. *Betula papyrifera,* with an average dbh of 19.5 cm, is between 2 and 30 meters tall, and *Picea glauca,* with an average dbh of 20.5 cm, is between 2 to 30 meters tall. *Alnus sinuata* (Sitka alder, 63%) and *Sambucus callicarpa* (Red elderberry, 1% and 12%) are found in 50% of the map class. *Alnus sinuata,* with an average dbh of 7.5 cm is between 2 and 10 meters tall, and *Sambucus callicarpa,* with an average dbh of 3.5 cm, is

2 to 5 meters tall. *Picea mariana* (19%) and *Alnus* species (1%) are found in 25% of the map class. *Picea mariana*, with an average dbh of 14 cm, is between 5 and 30 meters tall, and *Alnus* species with an average dbh of 7 cm is between 2 and 5 meters tall.

Other shrub species present are *Viburnum edule, Echinopanax horridum*, *Rosa acicularis, Rubus ideaus*, *Ledum groenlandicum*, *Linnaea borealis* and *Vaccinium vitis-idaea*. Herbaceous species present are *Streptopus amplexifolius* (Twisted Stalk or Wild Cucumber), *Epilobium angustofolium*, *Geocaulon lividum*, *Cornus canadensis*, *Lycopodium annotinum, Lycopodium complanatum* (Creeping jenny), *Calamagrostis canadensis*, unidentified grasses, *Gymnocarpium dryopteris*, *Dryopteris dilatata*, *Athyrium felix-femina* (Lady fern), *Equisetum arvense* and *Equisetum silvaticum*.

Betula papyrifera-Picea glauca/Calamagrostis canadensis

Code "C" was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Betula papyrifera (19% to 38%) is the dominant deciduous tree in 75% of the map class. *Populus balsamifera* (Cottonwood, 19%) is the dominant deciduous tree in 25% of the map class. Living (1% to 19%) and dead (9%) *Picea glauca* are present in 100% of the map class. *Betula papyrifera*, with an average dbh of 22.5 cm, is between 5 and 30 meters tall, and *Populus balsamifera,* with an average dbh of 11 cm, is between 20 and 30 meters tall. Living *Picea glauca,* with an average dbh of 15 cm, is between 2 to 20 meters tall, and dead *Picea glauca*, with an average dbh of 42.5 cm, is between 20 and 30 meters tall. *Calamagrostis canadensis* (15% to 44%) has 100% constancy in the map class. *Populus tremuloides* (Quaking aspen, 19%), with an average dbh of 11 cm and between 2 and 10 meters tall, is present in 25% of the map class. *Gymnocarpium dryopteris*(6% to 48%) is found in 75% of the map class.

Shrub species present are *Viburnum edule, Echinopanax horridum*, *Menziesia ferruginea*, *Rosa acicularis, Vaccinium vitis-idaea* and *Linnaea borealis*. Herbaceous species present

are *Actaea rubra*, *Moehringia lateriflora*, *Sanguisorba stipulata*, *Cornus canadensis, Trientalis europaea*, *Epilobium angustofolium, Geocaulon lividum*, *Pyrola secunda* (Sidebells pyrola), *Lycopodium annotinum*, *Lycopodium complanatum*, *Dryopteris dilatata* and *Equisetum arvense*. Mosses are also present.

Betula papyrifera (young)-Picea mariana

Code "Q" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Betula papyrifera (9% to 38%) and *Calamagrostis canadensis* (15% to 71%) have 100% constancy in the map class. Trees and shrubs present in 50% of the map class are *Picea mariana* (63%), *Picea glauca* (1%), *Salix bebbiana* (19%) and *Salix lanata* ssp. *richardsonii* (Richardson willow, <1%). *Betula papyrifera*, with an average dbh of 10.5 cm is between 5 and 30 meters tall. *Picea mariana*, with an average dbh of 7 cm is between 2 and 10 meters tall, and *Picea glauca*, with an average dbh of 3 cm is between 2 and 5 meters tall. *Salix bebbiana*, with an average dbh of 2 cm is 1 to 2 meters tall, and *Salix lanata*, with an average dbh of 10 cm, is between 5 and 10 meters tall.

Other shrubs present are *Alnus sinuata, Spiraea beauverdiana*, *Ledum groenlandicum, Linnaea borealis* and *Vaccinium vitis-idaea*. Herbaceous species present are *Cornus canadensis*, *Rubus chamaemorus, Geocaulon lividum, Rhianthus minor* (Rattlebox), *Moehringia lateriflora*, *Achillea borealis* (Common Yarrow), *Trientalis europaea*, *Gymnocarpium dryopteris, Calamagrostis canadensis*, *Equisetum arvense* and *Equisetum silvaticum*. Mosses are also present.

Two polygons were sampled for this map class. When determining the map class for this code, it was evident from the vegetation present that the two polygons were different. Upon reexamination of the aerial photos, it is apparent that they should have been coded differently.

Betula papyrifera (mature)

Code "S" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Betula papyrifera (19% and 63%), with an average dbh of 31.5 cm and between 5 and 20 meters tall, is the dominant species in the map class. *Calamagrostis canadensis* (6% and 50%), *Sambucus callicarpa* (13% and 19%) and *Dryopteris dilatata* (6%) have 100% constancy in the map class. *Alnus sinuata* (88%) is present in 50% of the map class. *Alnus sinuata,* with an average dbh of 12 cm is between 2 and 10 meters tall, and *Sambucus callicarpa* was measured in one plot with an average dbh of 2 cm and is between 2 and 5 meters tall.

Other shrub species present are *Viburnum edule*, *Echinopanax horridum* and *Ribes glandulosum* (Skunk currant). Other herbaceous species present are *Actaea rubra*, *Galium triflorum, Trientalis europaea, Gymnocarpium dryopteris* and *Equisetum arvense*.

Betula papyrifera

Code "Z" was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Betula papyrifera (38%) is the dominant tree species in 75% of the map class and *Picea mariana* (19%) is the dominant tree species in 25% of the map class. *Populus balsamifera* (9% and 38%) is found in 50% of the map class. *Betula papyrifera*, with an average dbh of 20.5 cm, is between 2 and 20 meters tall, and *Picea mariana,* with an average dbh of 15 cm, is between 1 and 10 meters tall. *Populus balsamifera,* with an average dbh of 17.5 cm, is between 10 and 30 meters tall. *Picea glauca* (9%) with an average dbh of 29.5 cm and between 10 and 20 meters tall, is found in 25% of the map class. *Alnus* species (29%) and *Alnus tenuifolia* (21%) are found in 50% of the map

class. *Alnus* species, with an average dbh of 2 cm, is between 1 and 5 meters tall, and *Alnus tenuifolia,* with an average dbh of 7 cm, is between 5 and 10 meters tall.

Other shrub species present are *Salix bebbiana*, *Salix barclayi*, *Viburnum edule, Ledum groenlandicum*, *Vaccinium uliginosum, Rosa acicularia*, *Linnaea borealis*, *Vaccinium vitis-idaea* and *Empetrum nigrum*. Herbaceous species present are *Adoxa moschatellina* (Moschatel), *Sanguisorba stipulata* (Sitka burnet), *Cornus canadensis*, *Epilobium angustofolium*, *Mertensia paniculata* (Bluebells), *Geocaulon lividum*, *Trientalis europaea*, *Viola* species (Violet), *Lycopodium annotinum*, *Lycopodium complanatum*, *Taraxacum* species, *Calamagrostis canadensis*, unidentified grasses and *Equisetum arvense*. Mosses are also present.

One polygon sampled does not have the same dominant tree/shrub species as the other three sampled. When reexamining the aerial photos again, it is evident this was misinterpreted in the original delineation. This polygon should have been coded with one of the *Picea mariana* map classes, probably aerial photo code GG.

Betula papyrifera (young)

Code "X" was assigned to this class in aerial photo interpretation. Three polygons were sampled.

Betula papyrifera (38%) is the dominant tree species in 67% of the map class. In areas where *Betula papyrifera* is the dominant tree species, average dbh for paper birch is 17 cm and the trees are between 10 and 30 meters tall. *Populus balsamifera* (38%), with an average dbh of 26 cm and between 10 and 30 meters tall, is the dominant tree species in 33% of the map class. *Betula papyrifera* (<1%), with an average dbh of 6 cm and between 10 and 20 meters tall, has a minor presence in the stands dominated by *Populus balsamifera*.

Shrub species present are *Alnus sinuata*, *Salix bebbiana*, *Viburnum edule*, *Echinopanax horridum*, *Rosa acicularis* and *Ribes triste*. Herbaceous species present are *Mertensia paniculata*, *Cornus canadensis*, *Galium triflorum*, *Streptopus amplexifolius, Trientalis europaea*, *Epilobium angustofolium, Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Dryopteris dilatata, Equisetum arvense* and *Equisetum pratense*.

Since other randomly selected polygons were on private property, only three polygons were sampled in this map class. One polygon does not have the same overstory as the other two, but when reexamining the aerial photos, all three polygons still look similar.

Betula papyrifera-Populus balsamifera/Viburnum edule/ Calamagrostis canadensis

Code "TT" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

Betula papyrifera (38% and 63%) and *Populus balsamifera* (38%) are the dominant tree species in this map class. *Betula papyrifera*, with an average dbh of 26 cm is between 5 and 30 meters tall, and *Populus balsamifera* (38%), with an average dbh of 39.5 cm, is between 10 and 30 meters tall. *Viburnum edule* (38% and 71%) is the dominant shrub species. *Calamagrostis canadensis* (32% and 48%) is the dominant understory species. *Echinopanax horridum* (29%) is also an important component of this map class. Unidentified *Alnus* (1%), with an average dbh of 5 cm, and unidentified *Salix* (9%), with an average dbh of 20 cm, are also present.

Other shrub species present are *Rosa acicularis*, *Salix* species and *Ribes triste*. Herbaceous species present are *Actaea rubra*, *Mertensia paniculata*, *Moehringia lateriflora*, *Smilacina racemosa* (False Solomon's seal), *Epilobium angustofolium, Galium triflorum*, *Trientalis europaea*, *Gymnocarpium dryopteris, Dryopteris dilatata* and *Equisetum arvense*,

Betula papyrifera-Populus tremuloides

Code “A” was assigned to this class in aerial photo interpretation. Four polygons were sampled.

Betula papyrifera (9% to 63%) and *Populus tremuloides* (1% to 63%) are constant in 75% of the map class. *Salix bebbiana* (<1%), with an average dbh of 13 cm and between 10 and 20 meters tall, and dead *Populus tremuloides* (9%), with an average dbh of 8 cm and between 5 and 10 meters tall, are found in 25% of the map class. *Betula papyrifera*, with an average dbh of 20.5 cm, is between 10 and 20 meters tall, and living *Populus tremuloides*, with an average dbh of 13.5 cm, is between 5 and 20 meters tall. *Alnus sinuata* (62% to 71%), with an average dbh of 5.5 cm and between 5 and 20 meters tall, is found in 50% of the map class.

Other shrubs present are *Sambucus callicarpa, Viburnum edule* and *Echinopanax horridum*. Herbaceous species present are *Heracleum lanatum* (Cow parsnip), *Actaea rubra*, *Trientalis europaea*, *Galium triflorum*, *Streptopus amplexifolius*, *Moehringia lateriflora*, *Galium triflorum, Epilobium angustofolium, Lycopodium annotinum*, *Calamagrostis canadensis,* unidentified grasses, *Gymnocarpium dryopteris* and *Equisetum arvense*.

One polygon sampled does not have the same dominant tree or shrub species as the other three sampled. Upon reexamination the aerial photos, it is evident that one polygon was misinterpreted in the original delineation. This polygon should have been coded with the *Alnus* map class.

Betula papyrifera/Alnus species/Calamagrostis canadensis

Code "ZZ" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

The polygons sampled for this map class are not similar. *Betula papyrifera* (63%) and *Alnus tenuifolia* (30%) are dominant species in 50% of the map class. *Betula papyrifera,* with an average dbh of 29 cm, is between 5 and 10 meters tall, and *Alnus tenuifolia*, with an average dbh of 11 cm, is between 2 and 5 meters tall. *Alnus sinuata* (33%), with an average dbh of 7 cm and between 2 and 5 meters tall, is the dominant species in 50% of the map class. *Calamagrostis canadensis* (21% to 58%) has 100% constancy throughout the map class.

Other shrubs present are *Sambucus callicarpa, Viburnum edule*, *Echinopanax horridum*, *Rubus idaeus*, *Ribes glandulosum* and *Ribes triste*. Herbaceous species are *Actaea rubra*, *Urtica lyallii* (Stinging nettle), *Heracleum lanatum*, *Streptopus amplexifolius*, *Galium triflorum*, *Galium boreale* (Bedstraw), *Moehringia lateriflora, Dryopteris dilatata* and *Equisetum arvense*.

Only two polygons were sampled for this map class. When determining the map class for this code, it was evident that the two polygons were different. Upon reexamination of the aerial photos, it is apparent that they should have been coded differently.

Betula papyrifera (young)/Alnus sinuata/Calamagrostis canadensis

Code "OO" was assigned to this class in aerial photo interpretation. One polygon was sampled.

Betula papyrifera (88%), *Alnus sinuata* (19%) and *Calamagrostis canadensis* (36%) are the dominant species. *Betula papyrifera*, with an average dbh of 2 cm, is between 2 and 5 meters tall, and *Alnus sinuata,* with an average dbh of 1 cm, is between 1 and 2 meters tall. Other tree species present in the map class are *Populus balsamifera* (9%) and *Picea*

mariana (<1%). *Populus balsamifera,* with an average dbh of 3 cm, is between 1 and 5 meters tall, and *Picea mariana,* with and average dbh of 4 cm, is between 2 and 5 meters tall. *Rubus idaeus* (16%) and *Equisetum arvense* (16%) are also conspicuous in the map class. Other species present are *Ledum groenlandicum, Achillea borealis*, *Pyrola asarifolia*, *Taraxacum* species and *Equisetum silvaticum*.

Betula papyrifera (mature)/Calamagrostis canadensis

Code "B" was assigned to this feature in aerial photo interpretation. Four polygons were sampled.

Two of the polygons sampled are dissimilar from the other two polygons. The lack of paper birch recorded in the plot data is a result of where the plots were set up since paper birch trees were noted as present in all the polygons sampled. Also all four polygons look similar in the aerial photos and in the field.

Two polygons in which no trees were recorded on the data form, are dominated by *Calamagrostis canadensis* (71%). *Ribes triste* (<1% and 25%) occurs in both of the polygons dominated by *Calamagrostis canadensis*.

Other shrubs present in the polygons dominated by *Calamagrostis canadensis* are *Sambucus callicarpa, Viburnum edule, Rubus idaeus* and *Rosa acicularis*. Other herbaceous species present are *Heracleum lanatum, Epilobium angustofolium*, *Mertensia paniculata*, *Cornus canadensis*, *Galium trifolium*, *Trientalis europaea*, *Moehringia lateriflora*, *Dryopteris dilatata, Gymnocarpium dryopteris, Equisetum arvense* and *Equisetum silvaticum*.

The other polygons are dominated by *Betula papyrifera* (19% to 38%), with an average dbh of 35 cm and between 10 and 30 meters tall. *Echinopanax horridum* (25% to 29%), *Calamagrostis canadensis* (6% to 79%) and *Ribes triste* (12% to 27%) occur in both polygons dominated by *Betula papyrifera*.

Other shrub species present are *Viburnum edule*, *Salix scouleriana* and *Rosa acicularis*. Other herbaceous species present are *Heracleum lanatum, Cornus canadensis*, *Epilobium angustofolium*, *Galium triflorum, Trientalis europaea*, *Pyrola asarifolia*, *Moehringia lateriflora, Lycopodium annotinum, Dryopteris dilatata, Gymnocarpium dryopteris* and *Equisetum arvense*.

Betula papyrifera/Equisetum arvense

Code "U" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

This species-poor map class is found in Earthquake Park along the Coastal Trail. *Betula papyrifera* (9% and 63%) and *Equisetum arvense* (54% and 79%) are the dominant species. *Betula papyrifera*, with an average dbh of 14 cm, is between 10 and 20 meters tall. Species present in 50% of the map class are *Populus balsamifera* (9%), *Populus tremuloides* (1%), *Picea mariana* (1%), and unidentified *Alnus* species (79%). *Populus balsamifera*, with an average dbh of 9 cm, is between 5 and 20 meters tall, and *Populus tremuloides*, with an average dbh of 12 cm, is between 10 and 20 meters tall. *Picea mariana* was too small to measure dbh and is between 1 and 5 meters tall. *Salix bebbiana* (<1% and 9%) has 100% constancy in the map class, with an average dbh of 10 cm and between 10 and 20 meters tall. *Alnus* species, with an average dbh of 7 cm, is between 5 and 10 meters tall. *Calamagrostis canadensis* and mosses are the only understory species and are constant in 100% of the map class.

Populus balsamifera-Betula papyrifera/Calamagrostis canadensis

Code "D" was assigned to this feature in aerial photo interpretation. Four polygons were sampled.

Two of the polygons sampled are dissimilar from the other two. Half of this map class is dominated by *Populus balsamifera* (9% to 38%) and the other half is dominated by *Betula papyrifera* (9% to 38%). *Calamagrostis canadensis* (6% to 71%) has 100% constancy in the map class.

Two polygons are dominated by *Populus balsamifera* (9% and 38%) and *Calamagrostis canadensis* (6% and 71%). *Sambucus callicarpa* (1% to 63%) and *Heracleum lanatum* (21% to 88%) have 100% constancy in these polygons. *Alnus sinuata* (63%) is found in 50% of these polygons. *Populus balsamifera,* with an average dbh of 11.5 cm, is

between 2 and 20 meters tall, and *Sambucus callicarpa,* with an average dbh of 4.5 cm, is between 1 and 10 meters tall. *Alnus sinuata*, with an average dbh of 5 cm, is between 2 and 10 meters tall. Other trees and shrubs found in 50% of these polygons are *Populus tremuloides* (9%), *Salix bebbiana* (9%), *Viburnum edule* (8%), unidentified *Alnus* species (1%), *Sorbus scopulina* (<1%), unidentified *Salix* species (<1%) and *Rubus ideaus* (22%). *Populus tremuloides,* with an average dbh of 11 cm, is between 5 and 20 meters tall, and *Salix bebbiana,* with an average dbh of 9 cm, is between 5 and 10 meters tall. *Viburnum edule*, with an average dbh of 1 cm, is between 5 and 10 meters tall, and unidentified *Alnus* species, with an average dbh of 3 cm, is between 5 and 10 meters tall. *Sorbus scopulina,* with an average dbh of 4 cm, is between 5 and 10 meters tall.

Herbaceous species present in these plots are *Heracleum lanatum*, *Actaea rubra*, *Sorbus scopulina*, *Galium triflorum*, *Epilobium angustofolium*, *Trientalis europaea, Calamagrostis canadensis*, unidentified grasses, *Athyrium felix-femina*, *Dryopteris dilatata* and *Equisetum arvense*.

The other two plots are dominated by *Betula papyrifera* (9% and 38%), *Echinopanax horridum* (21% and 50%) and *Calamagrostis canadensis* (13% and 56%). *Betula papyrifera*, with an average dbh of 34 cm, is between 10 and 20 meters tall. Other trees and shrubs found in 50% of these polygons are *Picea glauca* (19%), *Sambucus callicarpa* (63%), *Alnus* species (63%), *Rosa acicularis* (18%), *Viburnum edule* (15%) and unidentified *Salix* species (<1%). *Picea glauca*, with an average dbh of 20 cm, is between 5 and 10 meters tall, and *Sambucus callicarpa*, with an average dbh of 4.5 cm, is between 2 and 5 meters tall. *Alnus* species, with an average dbh of 6.5 cm, is between 2 and 10 meters tall, and *Viburnum edule* has an average dbh of 1 cm.

Herbaceous species present in these plots are *Cornus canadensis*, *Epilobium angustofolium*, *Streptopus amplexifolius*, *Galium triflorum*, *Trientalis europaea*, *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Dryopteris dilatata*, *Athyrium felix-femina* and *Equisetum arvense*.

Upon reexamination of the aerial photos, two of the four polygons sampled were found to be different than the other two and should have been coded differently.

Populus balsamifera-Alnus species

Code "WW" was assigned to this feature in aerial photo interpretation. Two polygons were sampled.

Populus balsamifera (38%), *Alnus* species, *Calamagrostis canadensis* (3% to 12%) and *Echinopanax horridum* (42% to 50%) have 100% constancy in the map class. Trees and shrubs found in 50% of the map class are *Betula papyrifera* (9%), *Alnus sinuata* (21%), *Alnus tenuifolia* (29%) and *Sambucus callicarpa* (63%). *Populus balsamifera,* with an average dbh of 32 cm, is between 5 and 30 meters tall, and *Betula papyrifera* (9%), with an average dbh of 7 cm, is between 5 and 10 meters tall. *Alnus sinuata*, with an average dbh of 8 cm, is between 5 and 10 meters tall, and *Alnus tenuifolia,* with an average dbh of 5 cm, is between 5 and 10 meters tall. *Sambucus callicarpa*, with an average dbh of 3 cm, is between 2 and 5 meters tall.

Herbaceous species present are *Urtica lyallii*, *Heracleum lanatum*, *Smilacina racemosa*, *Galium triflorum*, *Epilobium angustofolium*, *Trientalis europaea*, *Taraxacum* species, *Calamagrostis canadensis*, *Gymnocarpium dryopteris, Dryopteris dilatata, Equisetum arvense* and *Equisetum silvaticum*. Mosses are also present.

Populus balsamifera/Lathyrus maritimus

Code "XX" was assigned to this feature in aerial photo interpretation. Three polygons were sampled.

This map class is found along the bluff facing Turnagain Arm. *Populus balsamifera* (19% and 63%) and *Lathyrus maritimus* (Beach pea, 13% and 33%) are constant in 100% of the map class. *Populus balsamifera,* with an average dbh of 9 cm, is between 2 and 20 meters tall. Other vegetation with 100% constancy in the map class are *Rosa acicularis*

(15% to 36%) and unidentified grasses (6% to 48%). *Populus tremuloides* (38%) and *Alnus sinuata* (<1%) are found in 33% of the map class. *Populus tremuloides,* with an average dbh of 10 cm, is between 2 and 10 meters tall, and *Alnus sinuata,* with an average dbh of 3 cm, is between 2 and 5 meters tall. This is one of two map classes in which *Juniperus communis* (Common mountain juniper, 6%) is found, and the only map class in which *Cornus stolonifera* (American dogwood, 6%) is found.

Other shrubs present are *Viburnum edule*, *Rubus idaeas*, *Vaccinium ovalifolium* (Early blueberry) and *Ribes triste*. Herbaceous species present are *Achillea borealis*, *Smilacina racemosa*, *Galium triflorum*, *Solidago multirada* (Northern goldenrod), *Solidago* species (Goldenrod), *Dodecatheon pulchellum* (Shooting Star), *Moehringia lateriflora*, *Epilobium angustofolium*, *Calamagrostis canadensis,* unidentified grasses and *Equisetum arvense*. Mosses are also present.

Populus balsamifera/Calamagrostis canadensis

Code "O" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

This map class is surrounded by map classes dominated by *Calamagrostis canadensis* and large diameter *Betula papyrifera*. *Populus balsamifera* (19% and 38%) and *Calamagrostis canadensis* (79% and 88%) are the dominant species. *Populus balsamifera,* with an average dbh of 39.5 cm, is between 10 and 30 meters tall. Dead *Betula papyrifera* is present with an average dbh of 39 cm and is between 10 and 20 meters tall. *Heracleum lanatum* (21% and 31%), *Galium trifolium* (3% and 24%), and *Equisetum arvense* (3% and 18%) have 100% constancy in the map class.

Shrubs present are *Viburnum edule*, *Ribes triste*, *Rosa acicularis* and *Arctostaphylos rubra*. Herbaceous species present are *Mertensia paniculata*, *Moehringa lateriflora*, *Trientalis europaea, Epilobium angustofolium*, *Calamagrostis canadensis, Gymnocarpium dryopteris* and *Dryopteris dilatata*.

Populus balsamifera/Calamagrostis canadensis and other grasses

Code "I" was assigned to this class in aerial photo interpretation. Two polygons were sampled.

This map class is a found on a steep bluff facing Turnagain arm. Live *Populus balsamifera* (88%), with an average dbh of 4 cm, and dead *Populus balsamifera* (38%) are found in 100% of the map class. Both living and dead *Populus balsamifera* are between 2 and 5 meters tall. *Calamagrostis canadensis* (27% and 88%) has 100% constancy in the map class. Other grasses (live, 12%; dead, 88%) are also an important component of the map class.

Rubus idaeus is the only shrub present in the map class. Herbaceous species present are *Smilacina racemosa*, *Lathyrus maritimus*, *Solidago lepida* (Elegant goldenrod), *Achillea borealis*, *Moehringia lateriflora*, *Linaria vulgaris* (Butter-and-eggs), *Calamagrostis canadensis*, unidentified dead grasses and *Equisetum arvense*.

Populus balsamifera/Equisetum arvense

Code "YY" was assigned to this feature in aerial photo interpretation. One polygon was sampled.

This map class is found near the sanddunes in Kincaid Park. *Populus balsamifera* (88%), and *Equisetum arvense* (12%) are the dominant species. *Populus balsamifera* has an average dbh of 5 cm and is between 1 and 10 meters tall. Other vegetation found in this map class is *Smilacina racemosa, Lathyrus maritimus* and mosses.

Alnus

Codes "G," "M," "P" and "R" were assigned to this class in aerial photo interpretation. Eleven polygons were sampled. (G1, M1, M3, M6, M7, P2, P3, R3, R7, R8, R9)

This map class is a closed canopy shrub class. *Alnus sinuata* (38% to 88%) is the dominant alder in nine polygons sampled. *Alnus crispa* (American green alder, 88%) is the dominant alder in one polygon sampled. *Alnus sinuata*, with an average dbh of 6.5 cm, is between 2 and 10 meters tall. *Alnus crispa,* with an average dbh of 9 cm, is between 5 and 10 meters tall. One polygon sampled is different than the others in this map class. *Picea mariana* (63%) is the dominant species in this polygon. *Picea mariana,* with an average dbh of 10 cm, is between 1 and 10 meters tall.

Other shrub species present are *Sambucus callicarpa, Viburnum edule, Salix* species, *Echinopanax horridum, Rubus ideaus* and *Linnaea borealis*. Herbaceous species present are *Heracleum lanatum*, *Artemesia tilesii*, *Streptopus amplexifolius*, *Trientalis europaea*, *Galium triflorum, Parnassia palustris*, *Moehringia lateriflora, Geocaulon lividum, Achillea borealis*, *Rubus chamaemorus, Stellaria calycantha* (Chickweed), *Calamagrostis canadensis,* unidentified grasses, *Dryopteris dilatata*, *Gymnocarpium dryopteris*, *Athyrium felix-femina, Equisetum arvense, Equisetum silvaticum* and *Equisetum fluviatile*. Mosses, unidentified rushes and unidentified sedges are also present.

One polygon sampled does not have the same dominant tree/shrub species as the others sampled. Upon reexamination of the aerial photos, it is evident this was misinterpreted in the original delineation. This polygon should have been coded as a *Picea mariana*/*Equisetum arvense* map class, probably with aerial photo code GG.

Alnus sinuata/Grasses

Code "N" was assigned to this class in aerial photo interpretation. One polygon was sampled.

The *Alnus sinuata*/Grasses map class is an open shrub community. It is dominated by *Alnus sinuata* (54%) and unidentified grasses (79%). *Alnus sinuata* is between 1 and 2

meters tall. Other species present are *Dodecatheon pulchellum*, *Rhianthus minor, Taraxacum* species, *Achillea borealis*, *Solidago multirada* and *Trifolium* species (Clover).

Salix scouleriana/Calamagrostis canadensis

Code "JJ" was assigned to this feature in aerial photo interpretation. One polygon was sampled.

Salix scouleriana (71%) and *Calamagrostis canadensis* (71%) are the dominant species. *Picea glauca* (<1%) and dead *Picea mariana* (1%) are also found in the map class. *Picea glauca*, with an average dbh of 8 cm, is between 5 and 10 meters tall, and dead *Picea mariana*, with an average dbh of 4 cm, is between 2 and 5 meters tall. *Potentilla fruticosa* (15%) and unidentified grasses (12%) are also conspicuous in the map class. Other vegetation present is *Myrica gale*, *Betula nana*, *Potentilla palustris*, *Rubus* species and mosses.

Echinopanax horridum-Viburnum edule-Salix scouleriana

Code "T" was assigned to this feature in aerial photo interpretation. One polygon was sampled.

Echinopanax horridum (71%), *Viburnum edule* (58%) and *Salix scouleriana* (53%) are the dominant species. *Calamagrostis canadensis* (27%) is also conspicuous in the map class. Other species present are *Ribes triste, Angelica lucida* (Wild celery), *Epilobium angustofolium* and *Trientalis europaea*.

Betula nana/Grasses/other shrubs

Code "KK" was assigned to this feature in aerial photo interpretation. One polygon was sampled.

The map class is dominated by *Betula nana* (25%), *Calamagrostis canadensis* (12%), unidentified grasses (19%), as well as the shrubs, *Ledum decumbens* (18%) and *Empetrum nigrum* (9%). Other shrubs present are *Spiraea beauverdiana, Vaccinium uliginosum*, *Andromeda polifolia*, *Vaccinium oxycoccus* and *Vaccinium vitis-idaea*. Other plants present are *Trientalis europaea*, *Rubus chamaemorus* and mosses.

Betula nana/Calamagrostis canadensis/Mosses

Code "E" was assigned to this feature in aerial photo interpretation. One polygon was sampled.

The map class is dominated by *Betula nana* (19%), *Calamagrostis canadensis* (79%) and mosses (79%). Other shrubs present are *Ledum decumbens*, *Spiraea beauverdiana*, *Vaccinium vitis-idaea*, *Vaccinium oxycoccus* and *Linnaea borealis*. Herbaceous species are present, but are not in abundance. They are *Cornus canadensis*, *Galium trifidum* (Bedstraw), *Trientalis europaea* and *Equisetum silvaticum*.

Grasses and Populus species

Code "H" was assigned to this class in aerial photo interpretation. Three polygons were sampled.

This map class is found along the bluffs facing Turnagain Arm. The area has a very steep 70∞-80∞ slope. *Calamagrostis canadensis* (12% to 54%) and unidentified grasses (29% to 54%) are constant in 100% of the map class. *Populus balsamifera* (38%) is constant in 67% and *Populus tremuloides* (38%) is found in 33% of the map class. *Populus balsamifera*, with an average dbh of 13.5 cm, is between 2 and 10 meters tall, and *Populus tremuloides,* with an average dbh of 11 cm, is between 2 and 10 meters tall. This is one of two map classes in the study area in which *Juniperus communis* (3%) is present.

Other shrubs present are *Viburnum edule*, *Rosa acicularis*, *Ribes triste*, and *Rubus idaeas*. Herbaceous species present are *Lathyrus maritimus*, *Solidago multirada*, *Artemesia tilesii* (Common wormwood), *Achillea borealis*, *Smilacina racemosa*, *Galium triflorum*, *Moehringia lateriflora*, *Epilobium angustofolium, Taraxacum* species, *Linaria vulgaris*, *Calamagrostis canadensis*, unidentified grasses and *Equisetum arvense*.

Trifolium species

Code "L" was assigned to this feature in aerial photo interpretation. Two polygons were sampled.

This map class is found on disturbed sites with a sandy soil. There are no trees or shrubs in this class. The class is species-poor and is found in proximity to stands of *Alnus sinuata*. *Trifolium* species (62% to 79%) is the dominant vegetation. Other vegetation present is *Hordeum jubatum* (Squirreltail grass), unidentified grasses, *Achillea borealis*, *Artemesia tilesii*, *Heracleum lanatum*, *Taraxacum* species and *Equisetum arvense*.

Grasses/Shrubs

Code "QQ" was assigned to this class in aerial photo interpretation. One polygon was sampled.

This map class is located in the northern part of Russian Jack Park and shows signs of a past fire. All *Picea mariana* (9%) trees in the class have evidence of fire damage and are dead.

Calamagrostis canadensis (42%) and unidentified grasses (71%) are the dominant vegetation in the map class. *Rosa acicularis* (22%) and *Ledum groenlandicum* (13%) are the dominant shrub species. Mosses (21%) are also an important component of the map class. Other shrub species present are *Potentilla fruticosa* and *Vaccinium uliginosum*. Herbaceous species present are *Epilobium angustofolium*, *Geocaulon lividum*, *Galium trifidum*, *Cornus canadensis*, *Rubus arcticus, Taraxacum* species and *Equisetum arvense*.

Grasses/Trifolium species

Code "V" was assigned to this class in aerial photo interpretation. One polygon was sampled.

The Grasses/*Trifolium* species map class is dominated by unidentified grasses (79%) and *Trifolium* species (62%). *Achillea borealis* (46%) is also conspicuous in the map class. Other species present are *Rhianthus minor*, *Linaria vulgaris* (Butter and eggs) and *Taraxacum* species.

Parklands described

The results indicate the four parks differed structurally and vegetatively. Mean dbh differs among tree species, shrub species, and parks (Table11). Map classes also differ among parks (Table 12).

Table 11. Mean dbh (in cm) for tree and shrub species by park

	Chester Creek (CC)	**Coastal Trail (CT)**	**Russian Jack (RJ)**	**Kincaid (KP)**
Picea glauca (white spruce)	16.93	25.11	7.60	20.11/35.49*
Picea mariana (black spruce)	6.72/3.70*	9.02	4.95	none measured
Alnus species (alder)	1.67	6.34/9.34*	none present	4.93
Alnus crispa (American green alder)	none present	none present	none present	9.36
Alnus sinuata (Sitka alder)	7.29	6.57	none measured	6.23
Alnus tenuifolia (thinleaf alder)	4.83	none measured	8.01	2.10
Betula papyrifera (paper birch)	15.33	17.49	13.68	29.21/19.01*
Populus balsamifera (cottonwood)	23.33	13.88	none measured	24.67
Populus tremuloides (quaking aspen)	10.73	12.49	none present	15.39/7.99*
Salix species (willow)	2.07	9.31	none measured	16.35
Salix barclayi (Barclay willow)	5.44	none measured	none present	none present
Salix bebbiana (Bebb willow)	3.74	10.64	5.90	none present
Salix lanata ssp richardsonii (Richardson willow)	none present	10.19	none present	none present
Salix scouleriana (Scouler willow)	4.67	9.75	none measured	none measured
Sambucus callicarpa (red elderberry)	6.46	2.70	none present	3.12
Sorbus scopulina (Greene	none present	4.19	none measured	none present

Mountain ash)				
Viburnum edule (highbush cranberry)	none measured	9.75	none measured	none measured
* the first number is the mean dbh for living trees; the second number is mean dbh for dead trees				

TABLE 12

The following are descriptions of the vegetation in each park.

Chester Creek Greenbelt

Thirty polygons were sampled along the Chester Creek Greenbelt. The majority of them are in Sitka Street Park and Goose Lake. The rest are spread out along the Greenbelt from UAA Drive to the west end of Westchester Lagoon, and included areas just north of West High School.

Picea mariana is the dominant tree species in Sitka Street Park and parts of Goose Lake (Figure 8). *Betula papyrifera* is also found to be the dominant tree in areas around Goose Lake, and near Westchester Lagoon. Mean dbh for living black spruce is 7 cm, and for dead black spruce it is 4 cm. Mean dbh for paper birch is 15 cm. A co-dominant combination of *Betula papyrifera-Picea glauca* is found in two polygons just north of West High School. Mean dbh for white spruce is 17 cm.

Shrubs important in map classes dominated by *Picea mariana* are *Myrica gale, Betula nana*, *Potentilla fruticosa*, *Ledum groenlandicum*, and *Ledum decumbens*. *Equisetum arvense* and *Calamagrostis canadensis* are the dominant herbaceous species in *Picea mariana* map classes.

Vegetation important in map classes dominated by *Betula papyrifera* is *Viburnum edule*, *Echinopanax horridum*, *Rosa acicularis*, *Cornus canadensis*, and *Calamagrostis canadensis*. Alder is the dominant shrub in map classes with co-dominant *Betula papyrifera* and *Picea glauca*. *Populus balsamifera* and *Populus tremuloides* are also found in *Betula papyrifera* map classes. Mean dbh for cottonwood is 23 cm, and for quaking aspen mean dbh is 11 cm.

FIGURE 8

Coastal Trail

Twenty-six polygons were sampled along the Coastal Trail from Westchester Lagoon in the north to the fence between Anchorage International Airport and Kincaid Park in the south. The Coastal Trail includes Earthquake Park, which is unique with undulating soil, and *Populus tremuloides* and *Alnus sinuata* patches.

Betula papyrifera is the dominant tree species along the Coastal Trail (Figure 9). *Populus balsamifera* is also present near the Point Woronzof parking lot and Anchorage Wastewater treatment plant. *Populus tremuloides* is present in Earthquake Park in association with *Betula papyrifera*. Mean dbh is similar for both paper birch and cottonwood, 15 cm and 14 cm, respectively. Mean dbh for quaking aspen is 11 cm.

Alder is also common along the Coastal Trail, especially between the wastewater treatment plant and the fence dividing Kincaid Park and airport property. Mean dbh for alders ranges from 2 cm to 7 cm. Clover is the dominant vegetation in disturbed areas southwest of Clitheroe Center and north of the fence. It is also adjacent to areas dominated by *Alnus*. Map classes unique to the Coastal Trail are *"Echinopanax horridum-Viburnum edule-Salix scouleriana," "Trifolium* species," *"Alnus sinuata*/Grasses," and *"Betula papyrifera/Equisetum arvense."*

Picea glauca is co-dominant with *Betula papyrifera* in one map class along the Coastal Trail. Mean dbh for *Picea glauca* is 21 cm. *Gymnocarpium dryopteris* and *Equisetum arvense* are important understory species in this map class. *Picea mariana*, with a mean dbh of 7 cm, is found in the *Alnus* and the *Betula papyrifera* (young)-*Picea mariana* map classes.

FIGURE 9

Kincaid Park

Thirty-two polygons were sampled in Kincaid Park, which included all areas south of the International Airport fence to Turnagain Arm, and east to Jodhpur Road and the park boundary.

Betula papyrifera and *Populus balsamifera* are the two dominant tree species (Figure 10). *Picea glauca* is also found in co-dominance with *Betula papyrifera*. Mean dbh for paper birch is 24 cm, and for cottonwood mean dbh is 26 cm. Most white spruce at Kincaid is dead or dying. Mean dbh for living white spruce is 18 cm, and for dead white spruce mean dbh is 32 cm.

Populus tremuloides and *Populus balsamifera* are found in map classes located along the bluffs facing Turnagain Arm. *Echinopanax horridum* is the dominant shrub species and *Calamagrostis canadensis*, unidentified grasses or *Lathyrus maritimus* are the dominant herbaceous vegetation in these map classes. *Cornus stolonifera* and *Juniperus communis* are unique to these bluffs.

The *Alnus* map class is also found at Kincaid Park. *Echinopanax horridum*, *Calamagrostis canadensis* and *Equisetum arvense* are the conspicuous shrub and herbaceous species in the Alnus map class. Mean dbh for all *Alnus* species ranges from 2 cm to 9 cm. Map classes dominated by *Calamagrostis canadensis* or large diameter (24 cm) *Betula papyrifera* and *Calamagrostis canadensis* are also a large part of the landscape of Kincaid Park. In addition, map classes dominated by or including a high cover of unidentified grasses are present along the bluffs at Kincaid Park.

Shrubs important in the *Betula papyrifera* map classes are *Viburnum edule, Alnus* species, *Ribes triste* and *Menziesia ferruginea*. Herbaceous species important in the paper birch map classes are *Calamagrostis canadensis* and *Gymnocarpium dryopteris*.

Shrubs important in the *Populus balsamifera* dominated map classes are *Sambucus callicarpa, Echinopanax horridum, Viburnum edule* and *Alnus* species. Herbaceous vegetation is *Calamagrostis canadensis*, *Gymnocarpium dryopteris* and *Cornus canadensis*.

FIGURE 10

Russian Jack Park

Eleven polygons were sampled in Russian Jack Park. This park includes upland areas in the south and eastern part of the park, and wetland areas in the northwestern and southwestern areas of the park.

Dominant tree species are *Picea mariana* in the low-lying areas and *Betula papyrifera* in the uplands (Figure 11). Mean dbh for black spruce is 7 cm, and for paper birch mean dbh is 14 cm. *Picea glauca* is co-dominant with *Betula papyrifera* in one map class and is found with *Alnus tenuifolia* as the dominant shrub species in another map class. Mean dbh for *Picea glauca* is 8 cm.

Shrubs conspicuous in *Picea mariana* map classes are *Myrica gale, Potentilla fruticosa, Ledum groenlandicum*, *Betula nana* and *Ledum decumbens*. *Calamagrostis canadensis*, mosses, and *Equisetum* are also important in black spruce map classes at Russian Jack Park.

Shrubs associated with the *Betula papyrifera* map classes are *Alnus sinuata*, *Rosa acicularis*, *Viburnum edule* and *Ribes triste*. *Calamagrostis canadensis* and *Gymnocarpium dryopteris* are important herbaceous species in the *Betula papyrifera* map classes.

Viburnum edule, Calamagrostis canadensis and *Cornus canadensis* are important shrub and herbaceous species in the *Betula papyrifera-Picea glauca* map class, and *Equisetum silvaticum* and *Equisetum arvense* are the important understory species in the *Picea glauca/Alnus tenuifolia* map class.

At Russian Jack there are areas where *Calamagrostis canadensis* and *Betula papyrifera* are both the dominant vegetation for trees and herbs. In these areas paper birch has a mean dbh of 11 cm.

FIGURE 11

General observations

Picea glauca

Map classes with *Picea glauca* as the dominant or co-dominant tree species are found in all parklands in the study area. The size of the trees as measured by diameter at breast height indicates that larger trees are found at Kincaid Park and the Coastal Trail (Table 11). *Picea glauca* is found in all four areas studied, but dead trees are found only at Kincaid Park. Average dbh for dead white spruce is similar to average dbh for living trees along the Coastal Trail. The average dbh for these trees indicates that older trees are being infected by the spruce bark beetle.

Picea mariana

Map classes dominated by *Picea mariana* are found mainly in the Chester Creek Greenbelt (Table 12). Two sampled polygons along the Coastal Trail include black spruce areas. Four sampled polygons in Russian Jack Park are dominated by black spruce, whereas 17 sampled polygons in the Chester Creek Greenbelt have map classes dominated by black spruce. This map class is absent in Kincaid Park.

Betula papyrifera

Map classes dominated by *Betula papyrifera* are found in all parklands studied, but co-dominant trees and/or shrubs and herbaceous layers are different in the four areas studied (Tables 12). Areas with *Betula papyrifera* and *Populus* are found at Kincaid Park and the Coastal Trail. The *Betula papyrifera-Alnus* map classes are found at Russian Jack Park and Kincaid Park. Map classes with co-dominant *Betula papyrifera-Picea glauca* are found in all areas studied. Although *Betula papyrifera* is found in all four areas studied, there is a difference in the size of the trees among the parklands. Birch is large (measured in dbh) at Kincaid Park, and smaller in Russian Jack and Chester Creek (Table 11). Mean dbh for *Betula papyrifera* is smallest at Russian Jack Park (14 cm), and

largest at Kincaid Park (29 cm). Mean dbh is intermediate on the Coastal Trail (17 cm) and the Chester Creek Greenbelt (15 cm).

Populus balsamifera

Areas dominated by *Populus balsamifera* are almost exclusively found at Kincaid Park. Mean dbh is 25 cm at Kincaid Park. Polygons with a co-dominant *Populus balsamifera-Betula papyrifera* map class are found along the Coastal Trail where mean dbh is 14 cm. *Populus balsamifera* is found along the Chester Creek Greenbelt, but not as the dominant tree species in a map class. Mean dbh is 23 cm along the Chester Creek Greenbelt. There are no map classes in which cottonwood was measured at Russian Jack Park.

Populus tremuloides

Populus tremuloides is found co-dominant with *Betula papyrifera* on the Coastal Trail and at Kincaid Park, and in one plot as a minor species on the Chester Creek Greenbelt. Mean dbh for quaking aspen is 15 cm at Kincaid Park, 12 cm on the Coastal Trail and 11 cm on the Chester Creek Greenbelt. Quaking aspen was recorded at Kincaid Park with a mean dbh of 8 cm.

Alnus

Alder is found in all areas studied, but is the dominant species only along the Coastal Trail and in Kincaid Park. There are no map classes dominated by alder at Russian Jack Park or along the Chester Creek Greenbelt (Table 12). *Alnus sinuata* is found in all areas but Russian Jack Park. *Alnus tenuifolia* is found in all areas but the Coastal Trail. All species of alder are found at Kincaid Park, and all but *Alnus crispa* is found on the Chester Creek Greenbelt.

Salix

Willows are found in all four areas, but the species and dbh for each species differ in each area (Tables 11 and 12). *Salix bebbiana* is found at Russian Jack, Chester Creek and the Coastal Trail, but not at Kincaid. Mean dbh for Bebb willow is 5 cm at Russian Jack and

the Chester Creek Greenbelt, and 10 cm on the Coastal Trail. *Salix barclayi* is only found along the Chester Creek Greenbelt, with a mean dbh of 11 cm. *Salix scouleriana* is found only on the two greenbelts. Scouler willow had a mean dbh of 5 cm along the Chester Creek Greenbelt, and 10 cm on the Coastal Trail.

Comments

Since collecting data in the Summer of 1997, two plots that were used to collect data have been altered. D12 along the Coastal Trail was bisected to reroute a trail that was eroding into Turnagain Arm. In addition, parts of R5 west of the Sewage Treatment plant and along Northern Lights Boulevard were cleared and cut down. In addition, some polygons not sampled, but delineated on the aerial photos and digitized in GIS were converted from natural areas to soccer fields on the north side of Russian Jack Park. All the information collected was used to analyze the vegetation in these areas, but the GIS map will indicate that the areas have been altered since being sampled.

Chester Creek Greenbelt may not be adequately represented in this study. Most of the plots sampled for Greenbelt are in Sitka Street Park and around Goose Lake area where *Betula papyrifera* and *Picea mariana* are the dominant tree species. The few plots sampled along the creek itself are between Lake Otis Parkway and the New Seward Highway, and near Westchester Lagoon. Thus areas between the New Seward Highway and Westchester Lagoon were not sampled. This may be why *Populus balsamifera* is found in only one map class along the Chester Creek Greenbelt.

There are some unique areas within the parklands. A black spruce burn area is located in the northern half of Russian Jack Park. The bluffs facing Turnagain Arm in Kincaid Park are different than any other areas sampled. They are dominated by small *Populus balsamifera* and *Populus tremuloides* trees. This is also the only area in which *Cornus stolonifera* and *Juniperus communis* was recorded. Areas affected by the 1964 earthquake are dominated by *Betula papyrifera-Populus tremuloides* or *Betula*

papyrifera/Equisetum arvense and the undulating ground surface is found no where else in this study.

Further analysis and discussion will be included in a master's thesis on this project. Please contact the author for status on the thesis.

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