NATURAL REVEGETATION OF DISTURBANCES IN THE PEACE RIVER COALFIELD

by

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ABSTRACT

A total of 248 species of bryophytes and tracheophytes are found colonizing recently disturbed sites in the Peace River Coalfield. The families with the greatest number of species are the Poaceae (33), Asteraceae (32), Rosaceae (16), Brassicaceae (13), Salicaceae (13), Cyperaceae (11), Ranunculaceae (11), Fabaceae (10) and Caryophyllaceae (8).

Using both R-type factor analysis and the Braun-Blanquet Table Sorting Method, six species groups distributed along gradients of elevation and moisture are described. The *Festuca brachyphylla, Poa alpina, Arnica latifolia, Epilobium alpinum, Populus balsamifera* and *Rosa acicularis* species groups define thirteen pioneer community types.

The pioneer communities are described for each of the biogeoclimatic zones in the area. Alpine Tundra and Engelmann Spruce - Subalpine Fir (ESSF) Parkland pioneer communities are the Festuca, Festuca/Poa and Poa. The Poa/Arnica, Poa/Epilobium and Poa/Arnica/Epilobium communities are found in the transition area between the ESSF Parkland and the Forested subzone of the ESSF zone. The Arnica and Arnica/Epilobium communities occur within the

ESSF Forested subzone with the Epilobium and Epilobium/ Populus communities in the ESSF and Boreal White and Black Spruce (BWBS) zone transition. Boreal (BWBS) pioneer communities are the Populus, Populus/Rosa and Rosa.

The pioneer plant communities are basically distributed along elevational and moisture gradients. In some cases, edaphic factors such as the soil compaction or pH of a site are also important.

The environmental factors significantly correlated with the total vascular plant cover on a site (used as a measure of revegetation success) are basically age, elevation, compaction, texture and site moisture. Some differences occur between sites in the forested zones (BWBS and ESSF) and the alpine zone.

Interpretations of the results of this study are also presented.

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INTRODUCTION

Increased energy demands will accelerate the development of British Columbia's gas, oil and coal resources. Such development inevitably results in a variety of disturbances. Present legislation requires that these disturbances be reclaimed. In general, reclamation can be considered as the process of returning the disturbed land to a productive land use.

Revegetation, or establishing vegetation on disturbed land, is often an important stage in reclamation. Revegetation can either be assisted or unassisted. Assisted revegetation involves one or more deliberate steps by man to encourage the reestablishment of vegetation, whereas unassisted revegetation results from the natural reinvasion of plants onto surfaces that have been disturbed by either natural or man-made causes (Peterson & Peterson, 1977). Successful assisted revegetation of a disturbed area requires a definition of the environmental factors which could limit the growth on a site (Murray, 1977) and, using these parameters, the proper selection of revegetation species.

The advantages of using native species for revegetation have been presented by numerous authors (Johnson & Van Cleve, 1976; and Bell & Meidinger, 1977,

inter alia). Many individuals have stressed the merits of understanding natural ecosystem succession, including the biogeochemical cycles involved (Curry, 1977; and Mains, 1977, *inter alia*).

The following study was conducted in order to gain more knowledge of the initial colonization of disturbances in the Peace River Coalfield (Northeast Coal Block) in British Columbia. The objectives were: to identify the native species invading disturbed sites in the Peace River Coalfield; to describe and classify pioneer community types on these sites; and to assess the environmental factors limiting revegetation within the area.

Errington (1975) examined the natural revegetation of abandoned roads and mine sites, as well as the environmental factors limiting revegetation on such sites, in southern and coastal British Columbia, but studies applicable to north-eastern British Columbia are relatively few. Natural revegetation of mine sites has been studied in areas physiographically and climatically similar to north-eastern British Columbia in western and northern Alberta by Root (1973), Selner (1973), and Syncrude Canada Ltd. (1975). In British Columbia, Utah Mines Ltd. (1976) conducted a survey of natural species colonizing disturbances on their licences near Williston Lake, but no attempt was made to define pioneer communities.

In addition to studies on the natural revegetation

of man-made disturbances, investigations of the natural colonization of newly formed parent materials such as gravel bars and recessional moraines have provided useful information on pioneer plant communities. A few who have studied the colonization of glacial moraines or gravel bars in British Columbia and adjacent areas include Heusser (1956), Crocker & Dickson (1957), Tisdale, *et al.* (1966), Viereck (1966, 1970), Given & Soper (1975) and Fyles (1976).

Although these studies provide background information on the plant species found on early successional sites and the processes involved in soil formation on such sites, information more specific to the Peace River Coalfield is necessary to deal with present and future revegetation problems.

DESCRIPTION OF STUDY AREA

Location and Physiography

The Peace River Coalfield (Northeast Coal Block) is located on the eastern slope of the Rocky Mountains and runs in a northwest to southeast band within the Rocky Mountain Foothills Physiographic Region (Holland, 1964). Although some coal is found north of Williston Lake (BCMMPR, 1977), the coalfield primarily extends from Williston Lake in the north (56°N latitude) to the Alberta border in the south (54°N latitude) (see Figure 1).

The elevation within this region ranges from about 600 meters in some valley bottoms, to 2100 meters (Figure 2). The area is drained by numerous tributaries of the Peace River.

Geology and Soils

A typical sequence of bedrock stratigraphy for the Peace River Coalfield is shown in Table 1. The strata are heavily folded into synclines and anticlines with axes trending northwest (BCMMPR, 1977). Several large thrust faults are found together with numerous smaller faults.

A thick sequence of Cretaceous rocks occurs in the Foothills Region. These are the most common rocks

FIGURE 1: LOCATION OF STUDY SITES

I. Carbon Creek/McAllister Creek Area

II. Cinnabar Peak Area

III. Bullmoose Mountain/Mount Chamberlain

IV. Mount Spieker

V. Mount Reesor

VI. Babcock Mountain

VII. Duke Mountain

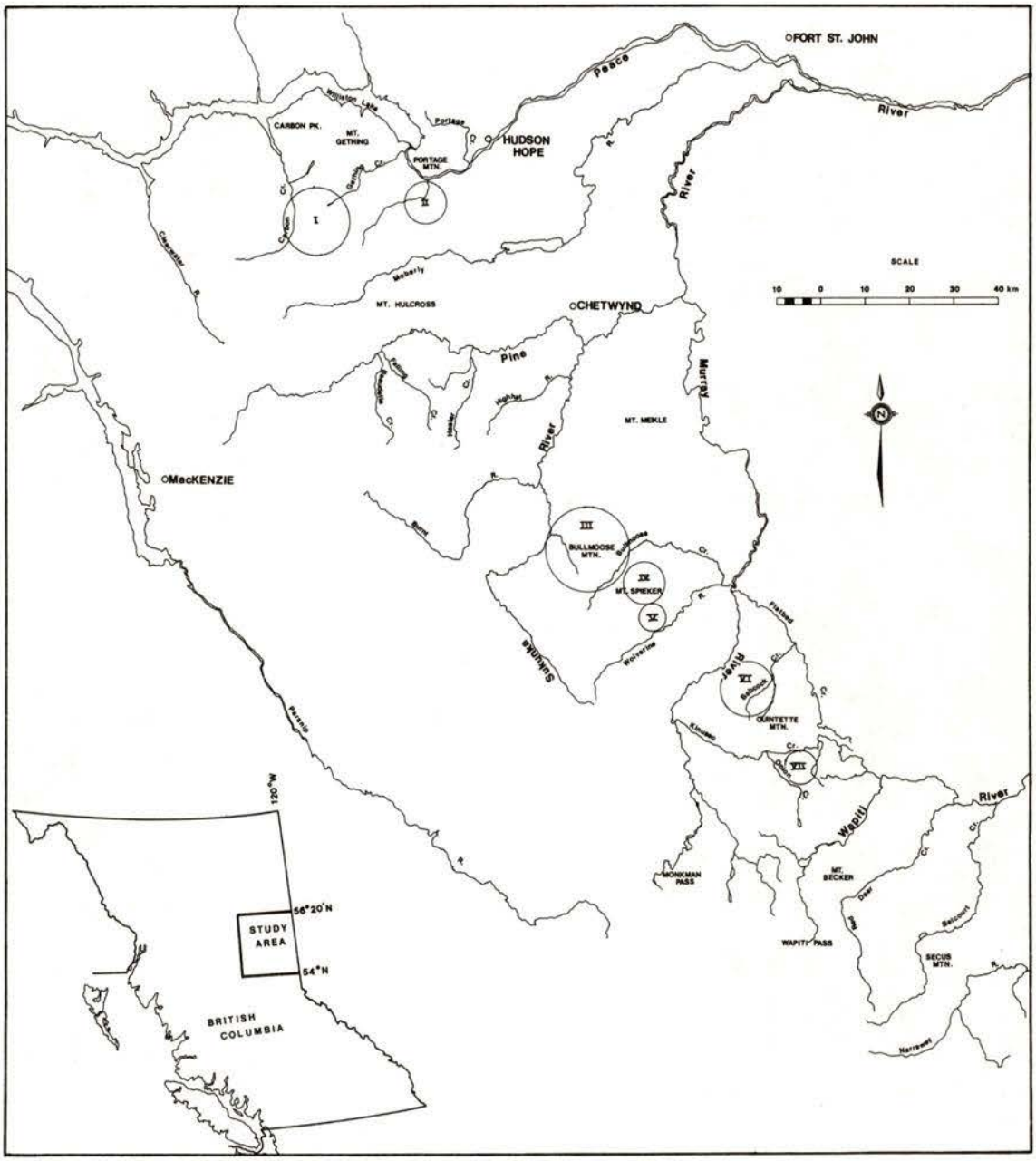

FORT ST. JOHN
Peace River
HUDSON HOPE
CARBON PK.
MT. GETHING
Wolverton Lake
Portage Cr.
PORTAGE MTN.
Carbon Cr.
Cameron Cr.
I
II
Halfway R.
MT. HULCROSS
CHETWYND
Pine River
Murray River
SCALE
10 0 10 20 30 40 km
MT. MERKLE
MacKENZIE
III
BULLMOOSE MTN.
IV
MT. SPIEKER
V
Sukunka River
Parsnip R.
VI
QUINTETTE MTN.
VII
Wapiti River
MONKMAN PASS
MT. BECKER
WAPITI PASS
SECUS MTN.
Kiskatinaw R.
120°W
56°20'N
54°N
STUDY AREA
BRITISH COLUMBIA

FIGURE 2: QUINTETTE MOUNTAIN

Quintette Mountain is located within the Rocky Mountain Foothills Physiographic Region

TABLE 1

BEDROCK STRATIGRAPHY IN THE FOOTHILLS REGION OF THE PEACE RIVER COALFIELD[1]

Era	Period or Epoch	Formation or Group (thickness in meters)	Lithology
Mesozoic	Upper Cretaceous	Dunvegan (90-365)	Marine and non-marine sandstone and shale.
	Lower Cretaceous	Ft. St. John Group (325-1500)	Mostly marine shale and sandstone; some coal and conglomerate.
		Bullhead Group (45-825)	Non-marine sandstone, shale, and coal above; and mostly marine sandstone and shale below; some conglomerate.
	Jurassic	Fernie Group (330±)	Marine shales; some sandstone.
	Triassic	Spray River Group (250-1025)	Marine, lithological units of dark siltstones, dolostones, and limestones; with minor amounts of sandstone, silty shale, and phosphatic pebble conglomerate.
Paleozoic	Permian	Fantasque and Prophet, or Belcourt, or Mowitch Formations (50±)	Either chert and siliceous mudstones with cherty limestone, or cherty sandstone with conglomeritic limestone, or sandstone, respectively.
	Permian to Cambrian	3600±	Mostly marine limestones; some shale, siltstone, conglomerate, sandstone, and quartzite.

[1]From: McLearn and Kindle (1950), Stott (1960 and 1961), and Gibson (1975).

outcropping in the area. Coal seams varying in thickness from one to ten or more meters are found in conjunction with the Lower Cretaceous sandstones, shales and conglomerates.

Almost all of British Columbia, including the northeast, was glaciated a number of times during the Pleistocene Epoch. Morainal tills, derived primarily from cordilleran ice sheets, are a dominant parent material in this area of the Rocky Mountain Foothills Region. Colluvial, fluvial and lacustrine materials are also common in the landscape.

The soils in the area have been classified as members of three main soil orders (Vold, 1977). The Luvisolic Order is dominant in the Rocky Mountain Foothills below 1220 meters on both morainal and lacustrine material. Most of these soils have a Brunisolic Gray Luvisol development. The Brunisolic Order is dominant on colluvial deposits and some high elevation tills, with primarily an Eluviated Eutric or Dystric Brunisol development. Podzolic soils, with Orthic Humo-Ferric Podzols being the dominant subgroup, are restricted to high elevation areas (>1370 meters) in the Rocky Mountain Foothills.

Soils of the Regolsolic, Gleysolic and Organic Orders are also found in the Foothills, but they are not as common as the previous three orders. Regosolic soils are fairly common in the high elevation alpine areas, but all three of these soils can be found at any elevation.

Climate

According to the Köppen climatic classification system (Strahler, 1975), the climate for most of the Foothills Region would be classed as Dfc, with the alpine areas being classed as ET (Krajina, 1965). The Dfc climate type is a cold, snowy forest climate, moist all year, with cool, short summers. The ET climate type is a cold, tundra climate, with the mean temperature of the warmest month less than 10°C, but above 0°C.

The nearest base meteorological station to the study area is located at Dawson Creek, approximately 100 kilometers to the east. The Dawson Creek station is located at approximately 660 meters and is still classed as Dfc according to Köppen. Climatic data for this station are summarized in Table 2 and Figure 3 (Walter & Lieth, 1967).

Ecological Zonation

Natural ecosystems or biogeocoenoses occurring within the study sites are distributed among three biogeoclimatic zones (Krajina, 1965 and 1978). The Boreal White and Black Spruce (BWBS) Zone occurs in the valley bottoms in the Rocky Mountain Foothills to an elevation of approximately 1050 meters. The Engelmann Spruce - Subalpine Fir (ESSF) Zone is located roughly between 1050 meters and 1600 meters elevation. The Alpine Tundra (AT) Zone occurs above approximately 1600 meters elevation.

TABLE 2

SUMMARY OF CLIMATOLOGICAL CHARACTERISTICS FOR

DAWSON CREEK, BRITISH COLUMBIA[1]

Month / Climatic Parameter	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily temperature (°C)	-18	-13	-7	2	9	13	15	14	10	4	-6	-14	1
Mean daily maximum temperature (°C)	-12	-6	-1	8	16	20	22	21	16	10	-1	-8	7
Mean daily minimum temperature (°C)	-24	-19	-13	-4	2	7	8	7	4	-1	-11	-19	-5
Extreme maximum temperature (°C)	11.1	15.6	13.9	21.7	30.0	31.7	32.2	32.2	28.3	26.7	17.8	11.1	32.2
Extreme minimum temperature (°C)	-48.3	-47.2	-42.8	-38.3	-11.7	-2.2	-1.1	-1.7	-10.0	-25.0	-41.7	-44.4	-48.3
Mean rainfall (mm)	Trace	1.3	0.5	5.1	37.1	57.2	48.0	37.3	39.1	19.8	7.1	0.5	253.0
Mean snowfall (mm)	29.7	30.2	24.4	9.1	5.3	Trace	0.0	Trace	1.3	15.2	24.9	26.9	167.0
Mean total precipitation (mm)	31.8	31.5	27.4	14.2	42.4	57.2	48.0	37.3	40.4	35.1	32.0	27.4	424.7

[1]Data from Environment Canada (1975a, 1975b).

FIGURE 3: CLIMOGRAPH FOR DAWSON CREEK, B.C.

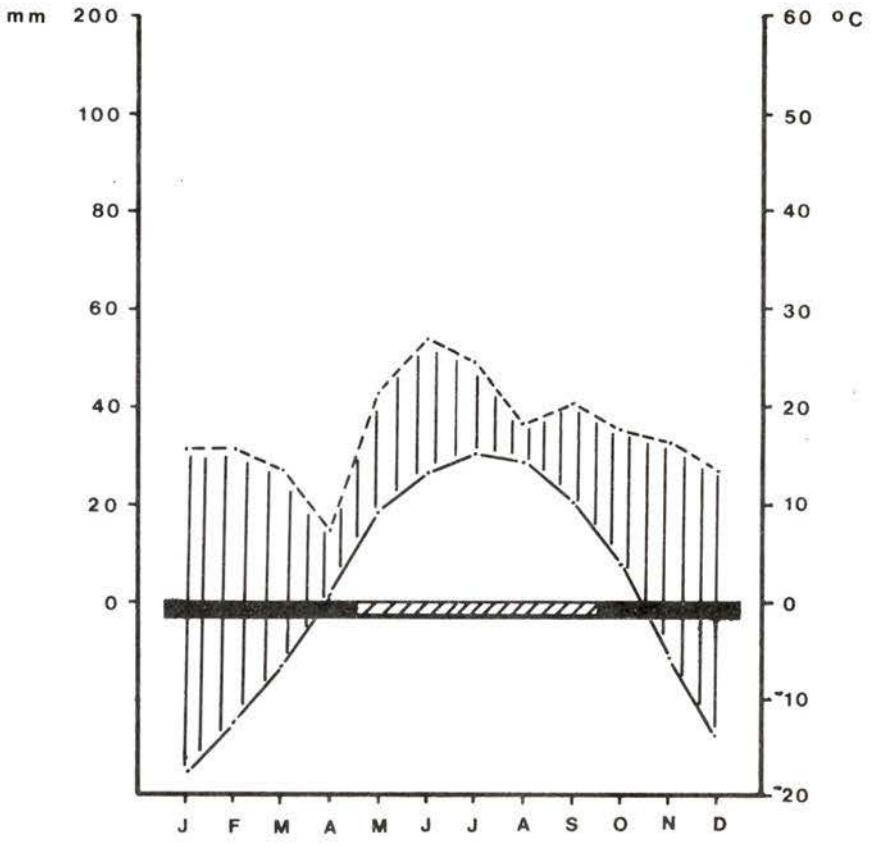
mean monthly temperature (°C)

mean monthly precipitation (mm)

months with mean daily minimum temperature below 0°C

months with absolute minimum temperature below 0°C

DAWSON CREEK (660m.)



At the higher elevations of the Engelmann Spruce Subalpine Fir Zone, transitional to the AT Zone, there is an area where stunted Engelmann spruce and/or subalpine fir patches are found in a mosaic with alpine vegetation. This area is referred to as the Parkland Subzone of the ESSF Zone (Annas, 1979) and is distinguished from the Forested Subzone by the patchy distribution and often krummholz form of the trees.

Although the biogeoclimatic classification scheme has been used in this study, it is useful to place the study sites within other existing classification systems.

Following a biophysical approach, Harcombe (1978) classified the areas around all the study sites, except the Cinnabar Peak Area, as part of the Subboreal Forest Region. The BWBS, ESSF and AT biogeoclimatic zones near the study sites are considered as the Subboreal white spruce - alpine fir zone: common paper birch subzone, the Subalpine Engelmann spruce - alpine fir zone, and the Alpine tundra zone, respectively. The Cinnabar Peak Area is classed as part of the Boreal white spruce zone of the Boreal Forest Region.

According to Rowe (1972), the BWBS Zone within the area of the study sites, is classed as the Upper Foothills Forest Section of the Boreal Forest Region. The ESSF Zone is classed within the East Slope Rockies Forest Section of the Subalpine Forest Region.

Development of Resources

Some forestry development has occurred in the area, with the logging primarily restricted to the valley bottoms. The main disturbances are associated with logging access roads and skidder trails.

Development of the natural gas resource has resulted in the construction of numerous seismic trails, two major gas pipelines, and a number of roads and drillsites.

Development of the coal resource has been limited to several small mines near the Peace and Pine Rivers. Since the last of these mines closed in 1964, there has been no active mining in the Peace River Coalfield. With the development of the Japanese export market for coking coal from western Canadian coalfields in the late 1960's, however, renewed interest has occurred in the Peace River Coalfield resulting in intensive exploration activity from 1969 to the present. As a result of the exploration activity, the coal resource has been estimated at 7.7 billion tonnes of metallurgical coal (BCMMPR, 1977). Disturbances associated with exploration include access roads, drillsites, adits and trenches.

METHODS

Field Sampling

Field sampling was carried out during the summers of 1977 and 1978 while the author was employed by the Reclamation Section of the British Columbia Ministry of Energy, Mines and Petroleum Resources. Sampling was concentrated in the Bullmoose Mountain/Mount Chamberlain area due to its wide range of coal exploration-related disturbances (i.e. drillsites, roads, trenches and adit sites), and the relative ease of access. Sample sites were also located in the Carbon Creek/McAllister Creek area, the Cinnabar Peak area, Mount Spieker, Mount Reesor, Babcock Mountain and Duke Mountain (Figure 1).

One hundred and forty-six sites were sampled on a broad range of disturbed areas that had been left to revegetate naturally. Plots were subjectively located on these sites in sections where there was uniformity in species composition, community physiognomy, parent material, and adjacent vegetation, as well as consistency in such physical factors as slope and aspect.

Sample plot size varied from 25 to 40 square meters, depending on the site dimensions. These plot sizes are within the limits of the estimates given in Mueller-

Dombois & Ellenberg (1974) for a similar vegetation regime. For each plot, in addition to an estimate of the total vascular plant cover, a list of all bryophytes and tracheophytes along with the Braun-Blanquet combined estimate of cover and abundance (Mueller-Dombois & Ellenberg, 1974) were collected. Additional information collected included: the date of the observation, plot location, year of site abandonment, and physical environmental parameters such as slope, aspect, elevation, moisture regime, micro-relief, exposure type and magnitude, and position on slope. In addition, features of the soil such as texture, color, pH, drainage, compaction, degree of erosion and origin of surficial material were noted, as were features of the adjacent undisturbed vegetation community including slope, aspect, dominant plants in each stratum, and the biogeoclimatic zone.

At all sites sampled during 1978, a soil sample was collected which was analyzed by the British Columbia Ministry of Agriculture, Soils Lab, Kelowna, for nitrate, phosphorus, potassium, magnesium and calcium levels, percent organic matter, and electrical conductivity.

Nomenclature for most vascular plants followed Taylor & MacBryde (1977) with the exception of *Carex*, which followed Hermann (1970) and MacKenzie (1940), and *Epilobium*, which followed Hitchcock & Cronquist (1973). The mosses and liverworts followed Lawton (1971) and Schofield (1960)

respectively. Voucher specimens are filed in either the University of Victoria Herbarium (UVIC), or the Herbarium of the British Columbia Provincial Museum, Victoria (V.). See Appendix A for a listing of the taxonomic references used in this study.

Data Analysis and Synthesis

Factor Analysis

R-type factor analysis can be used in vegetation science to ordinate species in a k-dimensional space with the aim of identifying groups of species which tend to occur together, and to indirectly determine the "k" environmental factors which underlie the observed distribution of species (Dagnelie, 1973). Factor analysis was used in this study as a first step in the determination of species associations.

All species with five or more occurrences in the 146 plots were included in the factor analytic procedure utilizing a program written in FORTRAN by Adolf Češka, Češka Geobotanical Research Co., Victoria, B.C. The decision to eliminate rare species from the data matrix in order to better facilitate the graphic representation of the data, resulted in a reduction in the number of species used to 134 from a possible 248. The program calculated point correlation coefficients (Goodall, 1973) based on the presence or absence of a species in a plot, for all pairs of species. The factor scores were determined from the correlation matrix using the centroid method (Cattell, 1965).

The unrotated scores for the first two factors were then used to plot the species in two-dimensional space.

A communality value, which is a measure of the variance of a species accounted for by the common factors extracted (Cattell, 1965), was calculated for each species using the first two factor scores.

Braun-Blanquet Table Sorting Method

The primary method used to distinguish species groups and pioneer community types was the presentation of the data in a synthesis table using the table sorting method of Braun-Blanquet, as outlined in Mueller-Dombois & Ellenberg (1974). This is a method of floristic classification which is based on the presence or absence of a species in the sample plots. The data is presented in a species/sample plot matrix which is sorted using a "two-parameter method" (Češka, 1978) to classify both the species and the sample plots (relevés) into species/relevé blocks. The community types are distinguished on the basis of the presence or absence of various species/relevé blocks in the final table. This method has been computerized by Češka & Roemer (1971) and an updated version of the program (Češka, 1978) was used in this study.

When utilizing the Češka-Roemer Program for Identifying Species-Relevé Groups (CERO), a number of different inside and outside percentages are available for

group (species/relevé block) formation (Češka & Roemer, 1971; and Češka, 1978). The ecologist must decide which species groups to use, based on his knowledge of the ecological amplitudes of the species within each group, by taking into consideration the mean floristic similarity (Češka, 1966; and Češka, 1968) of the relevés within the group.

In this study, the species groups determined by the factor analysis approach were used to aid in the selection of species groups by the Braun-Blanquet method. Even so, the ultimate decision on the composition of a species group was based on the "strength" of a group as determined by the concentration of positive entries within the group, knowledge of the ecological amplitude of the species involved, and the mean similarity of the relevés within both a species/relevé block and a defined community-type.

Correlation Analysis

The total vascular plant cover in a plot was used as a measure of the "revegetation success" on a particular site in order to determine the relationship between the degree of revegetation on these young sites and various environmental variables. The relationship was determined by calculating correlation coefficients between each of the environmental variables measured and the total vascular plant cover on a site, expressed as percent cover.

Product-moment correlation coefficients (Zar, 1974)

were calculated to determine the relationship between total cover and the continuous variables of age, elevation, site slope, adjacent site slope, site exposure, adjacent site exposure, soil pH, soil nitrates, soil phosphorus, soil potassium, soil calcium, soil magnesium, soil organic matter, soil salt level, percent soil erosion, compaction, and texture of coarse fragments. Table 3 presents an explanation of the variables and their units of measurement.

Spearman rank correlation coefficients (Zar, 1974) were calculated to determine the relationship between total cover and the ordinal variables of wind exposure magnitude, heat index, site moisture regime, compaction magnitude, erosion intensity index, erosion magnitude, texture index, and soil color. See Table 4 for an explanation of the coding used for the ordinal variables.

To determine if there was any differentiation between factors affecting revegetation above and below the treeline, the data set was divided into two subsets; sites located within the Alpine Tundra Zone, and sites within the forested zones (ESSF and BWBS Zones). The previously described analysis was performed on each subset.

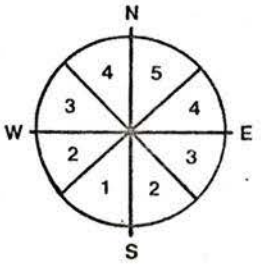
TABLE 3

EXPLANATION OF CONTINUOUS VARIABLES MEASURED

Variable	Units of Measurement	Explanation
Age	Years	Years since site was abandoned.
Elevation	Meters	Elevation above sea level.
Site slope	Degrees	Slope of road or drill site sampled.
Adjacent site slope	Degrees	Slope of natural site adjacent to the disturbance
Site exposure	Degrees	Exposure of road or drill site measured as $\lvert 180° - (\text{exposure } °\text{true}) \rvert$
Adjacent site exposure	Degrees	Exposure of natural site adjacent to the disturbance; measured as above.
pH		Soil reaction using Hellige-Truog Soil Reaction Kit.
Nitrates	Pounds/acre	Measured using colorimetric method utilizing phenoldisulfonic acid.
Phosphorus	Pounds/acre	Measured using Bray P-1 colorimetric method.
Potassium	Pounds/acre	Measured using atomic absorption spectrophotometer.
Calcium	Pounds/acre	Measured using atomic absorption spectrophotometer.
Magnesium	Pounds/acre	Measured using atomic absorption spectrophotometer.
Salts	Mmhos/ centimeter	Electrical conductance.
Organic matter content	Percent	Measured using modified Wakely Black Method.
Percent erosion	Percent	Visual estimate of percent of plot eroded.
Compaction	Kilogrammes/ centimeter^2	Estimated using pocket penetrometer (Soil Test Inc., Chicago).
Texture of coarse fragments	Percent	Volume of coarse fragments (>2 mm) in soil profile.

TABLE 4

EXPLANATION OF CODING OF ORDINAL VARIABLES

Variable	Explanation
Wind exposure magnitude	0 - wind exposure not important 1 - strong wind exposure 2 - very strong wind exposure 3 - extreme wind exposure
Heat index	Exposure of site determines "heat index" as follows: 
Site moisture regime	1 - very xeric 2 - xeric 3 - subxeric 4 - submesic 5 - mesic 6 - subhygric 7 - hygric 8 - subhydric 9 - hydric
Compaction magnitude	0 - material on site less compacted than adjacent natural site 1 - material on site compacted about the same as adjacent site 2 - moderately compacted relative to adjacent site 3 - highly compacted relative to adjacent site
Erosion magnitude	0 - no visible erosion 1 - sheet erosion 2 - rill erosion 3 - gully erosion
Texture index	1 - sand, loamy-sand 2 - sandy-loam 3 - loam, silt-loam 4 - silt, sandy-clay-loam, clay-loam, silty-clay-loam 5 - sandy-clay, clay, silty-clay, heavy clay 6 - organic
Soil color	Value plus chroma using 10YR Munsell Color Chart

RESULTS AND DISCUSSION

Invading Species

A total of 248 species were found invading disturbed sites in the Peace River Coalfield (Northeast Coal Block). A list of species is found in Appendix B.

Of the 248 species, there are 2 hepatics, 6 mosses, and 240 tracheophytes. Of the 240 vascular plants, 225 are perennial, with only 8 annuals and 7 biennials. There are 46 vascular plant families represented, with the following families having the greatest number of species: Poaceae (33), Asteraceae (32), Rosaceae (16), Brassicaceae (13), Salicaceae (13), Cyperaceae (11), Ranunculaceae (11), Fabaceae (10) and Caryophyllaceae (8).

Species Groups

The Braun-Blanquet Table Sorting Method was the main method used to select species groups, but R-type factor analysis was used to aid in the selection process.

From the factor analysis approach, the first two factor scores and the corresponding communality value for each species included in the factor analysis are shown in Table 5. Although ten factors were extracted in the analysis, the first two factors accounted for more of the

TABLE 5

FACTOR SCORES AND COMMUNALITY VALUE FROM FACTOR ANALYSIS[1,2]

Species	Factor 1	Factor 2	Communality
1. *Epilobium angustifolium*	0.512	-0.067	0.267
2. *Equisetum arvense*	0.376	0.033	0.142
3. *Epilobium alpinum*	0.348	-0.454	0.327
4. *Trisetum spicatum*	-0.443	0.046	0.198
5. *Senecio triangularis*	0.371	-0.425	0.318
6. *Poa alpina*	-0.610	0.110	0.384
7. *Artemisia arctica*	-0.533	-0.088	0.292
8. *Poa arctica*	-0.596	0.029	0.356
9. *Carex mertensii*	0.489	-0.246	0.300
10. *Mertensia paniculata*	0.108	0.348	0.133
11. *Arnica latifolia*	0.193	-0.512	0.299
12. *Luzula parviflora*	0.381	-0.267	0.216
13. *Lupinus nootkatensis*	0.187	-0.543	0.330
14. *Alnus viridis*	0.518	0.330	0.377
15. *Sanguisorba canadensis*	0.210	-0.267	0.115
16. *Luzula piperi*	-0.144	-0.360	0.150
17. *Phleum alpinum*	-0.031	-0.393	0.155
18. *Aconitum delphinifolium*	-0.199	-0.125	0.055
19. *Arnica cordifolia*	0.343	0.352	0.242
20. *Festuca brachyphylla*	-0.528	0.155	0.303
21. *Vahlodea atropurpurea*	0.142	-0.519	0.290
22. *Calamagrostis canadensis*	0.333	0.077	0.167
23. *Phleum pratense*	0.098	-0.180	0.042
24. *Trifolium hybridum*	0.268	-0.065	0.076
25. *Abies lasiocarpa*	0.287	-0.141	0.102
26. *Festuca rubra*	0.046	-0.227	0.054
27. *Stellaria longipes*	-0.610	0.245	0.432
28. *Valeriana sitchensis*	0.343	-0.454	0.324
29. *Vaccinium membranaceum*	0.252	-0.279	0.141
30. *Luzula spicata*	-0.581	0.174	0.368
31. *Erigeron peregrinus*	0.095	-0.268	0.081
32. *Taraxacum officinale*	0.434	0.293	0.274
33. *Cerastium berringianum*	-0.633	0.293	0.487
34. *Minuartia rubella*	-0.619	0.323	0.487
35. *Petasites palmatus*	0.461	0.300	0.303
36. *Cornus canadensis*	0.304	0.124	0.108

[1] Species in order of decreasing constancy.

[2] Point correlation coefficients in Appendix C.

TABLE 5, Continued[1,2]

Species	Factor 1	Factor 2	Communality
37. *Carex praticola*	0.423	0.080	0.185
38. *Populus balsamifera*	0.401	0.371	0.298
39. *Elymus innovatus*	0.073	0.445	0.203
40. *Carex rossii*	0.266	-0.127	0.087
41. *Anaphalis margaritacea*	0.367	0.143	0.155
42. *Agrostis scabra*	0.257	0.220	0.114
43. *Cinna latifolia*	0.430	0.225	0.236
44. *Thalictrum occidentale*	0.314	0.170	0.127
45. *Bistorta vivipara*	-0.494	0.141	0.264
46. *Galium triflorum*	0.417	0.331	0.283
47. *Rubus idaeus*	0.458	0.366	0.344
48. *Salix arctica*	-0.325	0.037	0.107
49. *Rosa acicularis*	0.337	0.509	0.373
50. *Heracleum sphondylium*	0.315	-0.138	0.118
51. *Cardamine pensylvanica*	-0.157	0.122	0.040
52. *Polytrichum juniperinum*	0.134	-0.207	0.058
53. *Salix discolor*	0.317	0.210	0.145
54. *Salix barclayi*	0.170	-0.217	0.076
55. *Aster conspicuus*	0.318	0.458	0.311
56. *Lathyrus ochroleucus*	0.375	0.510	0.401
57. *Achillea millefolium*	-0.138	0.387	0.169
58. *Spiraea betulifolia*	0.313	0.391	0.251
59. *Osmorhiza depauperata*	0.346	0.315	0.219
60. *Equisetum sylvaticum*	0.220	-0.121	0.063
61. *Ribes lacustre*	0.438	0.205	0.234
62. *Potentilla diversifolia*	-0.472	0.217	0.270
63. *Saxifraga ferruginea*	-0.244	-0.176	0.090
64. *Juncus drummondii*	0.136	-0.435	0.208
65. *Veratrum viride*	0.290	-0.370	0.221
66. *Juncus mertensianus*	0.203	-0.377	0.182
67. *Castilleja miniata*	0.226	0.226	0.102
68. *Carex microptera*	0.308	-0.174	0.125
69. *Equisetum scirpoides*	0.030	0.124	0.016
70. *Pedicularis bracteosa*	0.212	-0.222	0.094
71. *Silene acaulis*	-0.422	0.199	0.218
72. *Festuca baffinensis*	-0.399	0.178	0.191
73. *Hieracium gracile*	0.054	-0.252	0.066
74. *Rubus pubescens*	0.322	0.340	0.219
75. *Rubus pedatus*	0.246	-0.090	0.069

[1]Species in order of decreasing constancy.

[2]Point correlation coefficients in Appendix C.

TABLE 5; Continued[1,2]

Species		Factor 1	Factor 2	Communality
76.	*Hieracium albiflorum*	0.300	0.328	0.198
77.	*Astragalus alpinus*	-0.275	0.280	0.154
78.	*Agrostis borealis*	-0.259	0.053	0.070
79.	*Ranunculus occidentalis*	0.068	-0.372	0.143
80.	*Picea glauca x engelmannii*	0.371	0.165	0.165
81.	*Pinus contorta*	0.217	0.162	0.073
82.	*Frageria virginiana*	0.121	0.355	0.141
83.	*Stellaria calycantha*	0.295	0.105	0.098
84.	*Picea glauca*	0.335	0.333	0.223
85.	*Festuca altaica*	-0.284	0.048	0.083
86.	*Oxyria digyna*	-0.276	0.118	0.090
87.	*Carex phaeocephala*	-0.224	0.059	0.054
88.	*Veronica wormskjoldii*	0.051	0.353	0.127
89.	*Geranium bicknellii*	0.213	0.305	0.138
90.	*Salix scouleriana*	0.305	0.181	0.126
91.	*Aster subspicatus*	0.247	0.221	0.110
92.	*Carex macrochaeta*	-0.104	-0.282	0.090
93.	*Orthilia secunda*	0.159	-0.080	0.032
94.	*Carex podocarpa*	-0.340	0.132	0.133
95.	*Rubus parviflorus*	0.248	0.345	0.181
96.	*Ranunculus uncialis*	0.288	-0.128	0.099
97.	*Gymnocarpium dryopteris*	0.348	0.156	0.145
98.	*Aquilegia formosa*	0.332	0.249	0.172
99.	*Vicia americana*	0.282	0.423	0.258
100.	*Mitella pentandra*	0.312	-0.054	0.100
101.	*Carex brunnescens*	0.074	-0.214	0.051
102.	*Androsace septentrionalis*	-0.261	0.283	0.148
103.	*Solidago multiradiata*	-0.336	0.250	0.175
104.	*Myosotis asiatica*	-0.299	0.158	0.114
105.	*Draba borealis*	-0.192	0.154	0.061
106.	*Poa pratensis*	0.188	0.131	0.053
107.	*Picea engelmannii*	0.063	-0.171	0.033
108.	*Rumex acetosa*	-0.224	-0.058	0.054
109.	*Calamagrostis lapponica*	0.055	-0.261	0.071
110.	*Luzula arcuata*	-0.234	-0.089	0.063
111.	*Polemonium caeruleum*	-0.295	0.072	0.092
112.	*Parnassia fimbriata*	0.274	-0.102	0.085
113.	*Draba aurea*	-0.322	0.235	0.158
114.	*Campanula lasiocarpa*	-0.333	0.151	0.134

[1]Species in order of decreasing constancy.

[2]Point correlation coefficients in Appendix C.

TABLE 5, Continued[1,2]

Species	Factor 1	Factor 2	Communality
115. *Draba incerta*	-0.321	0.224	0.153
116. *Gentianella amarella*	0.166	0.247	0.089
117. *Populus tremuloides*	0.179	0.257	0.098
118. *Viburnum edule*	0.178	0.234	0.087
119. *Streptopus amplexifolius*	0.214	-0.065	0.050
120. *Elymus glaucus*	0.209	-0.132	0.061
121. *Geum macrophyllum*	0.252	0.130	0.080
122. *Poa interior*	0.087	0.085	0.015
123. *Agoseris aurantiaca*	0.139	-0.065	0.024
124. *Arnica alpina*	-0.235	0.092	0.064
125. *Oxytropis sericea*	-0.310	0.157	0.121
126. *Antennaria umbrinella*	-0.133	-0.067	0.022
127. *Salix sitchensis*	0.199	0.041	0.041
128. *Galium boreale*	0.140	0.225	0.070
129. *Senecio lugens*	-0.278	0.152	0.100
130. *Epilobium glandulosum*	0.209	0.189	0.079
131. *Alopecurus aequalis*	0.182	0.258	0.100
132. *Bromus richardsonii*	0.254	0.210	0.109
133. *Poa palustris*	0.176	0.241	0.089
134. *Sibbaldia procumbens*	-0.088	-0.205	0.050

[1]Species in order of decreasing constancy.

[2]Point correlation coefficients in Appendix C.

covariation than any other pair of factors (Table 6); factors 1 and 2 combined explain 16.1 percent of the variance. For this reason, these two factors were chosen for graphic representation of the data (Figure 4).

A comparison of the species with the highest and lowest factor scores for each factor can give some indication of the environmental parameter(s) associated with the "sociological" factor extracted (Goodall, 1954). In this case, it seems that factor 1 and factor 2 are associated with an elevational gradient and a moisture gradient, respectively. Those species with the highest factor scores for factor 1 are found at the lowest elevations, and those species with the highest factor scores for factor 2 are found on the driest sites. Since these two factors only accounted for 16.1 percent of the variance, there are obviously many more factors influencing the distribution of the species in this study.

Although the factor analysis was not very successful in determining particular environmental gradients associated with the interspecies correlation, evidence of some species/environment relationships could be detected. Species with the highest communality values have the greatest amount of their correlation with other species explained by the extraction of the two common factors. These species are also the furthest away from the origin when these parameters are graphed, as those species near the

TABLE 6

PERCENT VARIANCE EXPLAINED BY

EXTRACTED FACTORS

Factor Number	Percent Variance Explained	Cumulative Percent Variance Explained
1	9.6	9.6
2	6.5	16.1
3	4.7	20.8
4	3.5	24.3
5	2.5	26.8
6	3.1	29.9
7	2.5	32.4
8	2.3	34.7
9	2.3	37.0
10	1.9	38.9

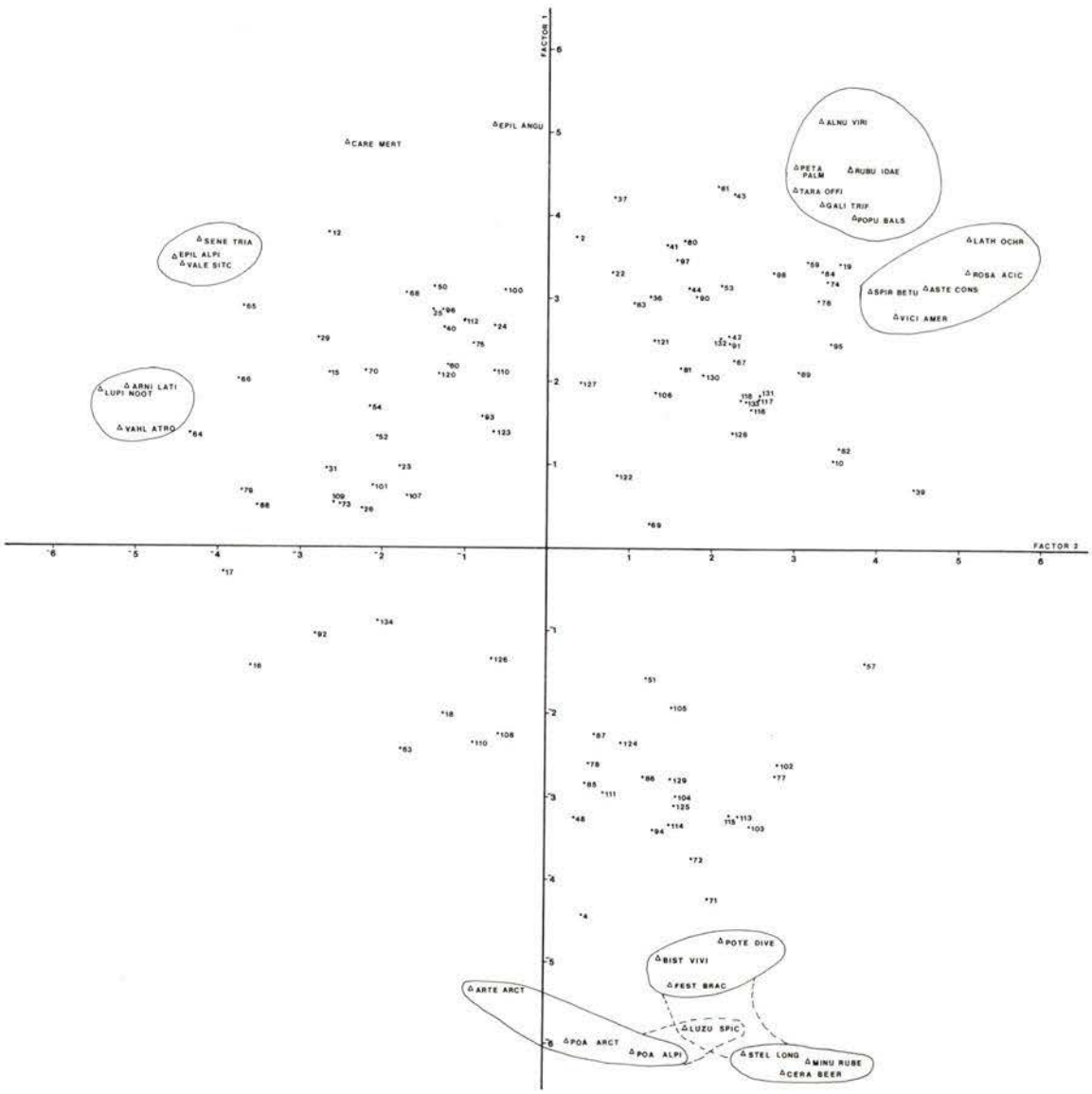
FIGURE 4

SPECIES POSITION IN FACTOR SPACE USING

FIRST TWO FACTORS

See Table 5 for individual species values and numbers. Abbreviated species names are indicated for those species with a communality value ≥ 0.250. Full species names are presented below.

ALNI VIRI	*Alnus viridis*	MINU RUBE	*Minuartia rubella*
ARNI LATI	*Arnica latifolia*	PETA PALM	*Petasites palmatus*
ARTE ARCT	*Artemisia arctica*	POA ALPI	*Poa alpina*
ASTE CONS	*Aster conspicuus*	POA ARCT	*Poa arctica*
BIST VIVI	*Bistorta vivipara*	POPU BALS	*Populus balsamifera*
CARE MERT	*Carex mertensii*	POTE DIVE	*Potentilla diversifolia*
CERA BEER	*Cerastium beeringianum*	ROSA ACIC	*Rosa acicularis*
EPIL ALPI	*Epilobium alpinum*	RUBU IDAE	*Rubus idaeus*
EPIL ANGU	*E. angustifolium*	SENE TRIA	*Senecio triangularis*
FEST BRAC	*Festuca brachyphylla*	SPIR BETU	*Spiraea betulifolia*
GALI TRIF	*Galium triflorum*	STEL LONG	*Stellaria longipes*
LATH OCHR	*Lathyrus ochroleucus*	TARA OFFI	*Taraxacum officinale*
LUPI NOOT	*Lupinus nootkatensis*	VAHL ATRO	*Vahlodea atropurpurea*
LUZU SPIC	*Luzula spicata*	VALE SITC	*Valeriana sitchensis*
		VICI AMER	*Vicia americana*


FACTOR 1
FACTOR 2
ALNU VIRI
PETA PALM
RUBU IDAE
TARA OFFI
GALI TRIF
POPU BALS
LATH OCHR
ROSA ACIC
SPIR BETU
ASTE CONS
VICI AMER
SENE TRIA
EPIL ALPI
VALE SITC
ARNI LATI
LUPI NOOT
VAHL ATRO
EPIL ANGU
CARE MERT
POTE DIVE
BIST VIVI
FEST BRAC
ARTE ARCT
LUZU SPIC
POA ARCT
POA ALPI
STEL LONG
MINU RUBE
CERA BEER

origin are associated primarily with specific factors, rather than with the common factors extracted (Greig-Smith, 1964). Those species which show a similar response to the two factors will be close together in two-dimensional factor space. Therefore, when the species were graphed using the two factor scores (Figure 4), species with the highest communality values were noted, and these species were used to select species groups. The species groups formed with each successive lowering of a critical communality value were graphed and recorded. Final species groups were chosen at a point where the member species in a group were relatively close together in the two-dimensional factor space and yet still showed similar ecological distributions. The final groups were formed when a critical communality value of 0.250 was chosen.

The final species groups from this method are shown in Table 7. Although the low-elevation and mid-elevation groups were relatively distinct, the high-elevation groups were fairly "loose." Due to the nature of the data and the fact that this method produces an ordination, not a classification, the drawing of boundaries around species groups is very subjective. Nonetheless, the groups selected by this method were useful in selecting sociological species groups during the table-sorting procedure.

The final sociological species groups selected by table-sorting the data using the Češka-Roemer Program are

TABLE 7

SPECIES GROUPS FROM

FACTOR ANALYSIS METHOD

High-elevation groups:

Stellaria longipes
Minuartia rubella
Cerastium beeringianum

Luzula spicata

Festuca brachyphylla
Bistorta vivipara
Potentilla diversifolia
Poa alpina
Poa arctica
Artemisia arctica

Mid-elevation groups:

Arnica latifolia
Lupinus nootkatensis
Vahlodea atropurpurea
Epilobium alpinum
Senecio triangularis
Valeriana sitchensis

Low-elevation groups:

Rosa acicularis
Aster conspicuus
Lathyrus ochroleucus
Spiraea betulifolia
Vicia americana
Alnus viridis
Taraxacum officinale
Petasites palmatus
Populus balsamifera
Galium triflorum
Rubus idaeus

shown in Table 8. These species groups are primarily distributed along an elevational gradient with a moisture gradient of secondary importance.

Knowledge of the spatial relationships between these groups can prove useful in applying the results of this study to the selection and propagation of native species for use in operational reclamation. Information concerning the distribution of these species groups within the ecological zones in the area (Biogeoclimatic Zones *sensu* Krajina, 1965 and 1978) can prove useful when attempting to apply the results of this study to other areas.

The *Festuca brachyphylla* and the *Poa alpina* species groups were found at the highest elevations. The *Festuca brachyphylla* group was found on disturbed sites from 1550 to 1930 meters elevation within the Parkland Subzone of the Engelmann Spruce - Subalpine Fir (ESSF) Zone and the Alpine Tundra (AT) Zone. The *Poa alpina* group occurred throughout the same range of elevations, but it was found in the upper levels of the Forested Subzone of the ESSF Zone as well as in the previously mentioned zones.

The *Arnica latifolia* species group was found throughout most of the Forested Subzone of the ESSF Zone at elevations above 1310 meters. It was also found extending into the lower regions of the Parkland Subzone. This species group was generally associated with sites having a lower than average pH (i.e., 4.5 - 6.0).

TABLE 8

SOCIOLOGICAL SPECIES GROUPS FROM

TABLE-SORTING

Festuca brachyphylla group:

Festuca brachyphylla
Stellaria longipes
Luzula spicata
Cerastium beeringianum
Minuartia rubella

Poa alpina group:

Poa alpina
Artemisia arctica
Poa arctica

Arnica latifolia group:

Arnica latifolia
Lupinus nootkatensis
Vahlodea atropurpurea

Epilobium alpinum group:

Epilobium alpinum
Senecio triangularis
Carex mertensii
Luzula parviflora

Populus balsamifera group:

Populus balsamifera
Anaphalis margaritacea
Rubus idaeus

Rosa acicularis group:

Rosa acicularis
Aster conspicuus
Lathyrus ochroleucus
Spiraea betulifolia

The *Epilobium alpinum* species group occurred at elevations as high as the *Arnica latifolia* group, but it extended to much lower elevations (i.e., 1020 meters) to an area which could be called the Subalpine/Boreal transition zone. It was found primarily on moister sites than the *Arnica latifolia* group.

The *Populus balsamifera* species group was found primarily on drier sites from the lower elevations of the ESSF Zone (1350 meters) down to the Boreal White and Black Spruce (BWBS) Zone, with a minimum elevation of 900 meters.

The *Rosa acicularis* species group was found at the lowest elevations (630 - 1000 meters) in the valley bottoms within the BWBS Zone.

None of the species groups determined in this study were related successionally because all of the sites sampled were very young (i.e., 2 to 9 years since disturbance). All of the sites were still in the process of being invaded by "pioneer" plants and competitive exclusion had not yet played a factor in community development.

Most of the sites sampled had relatively sparse vegetation cover due to the early seral stage, and therefore competition for available nutrients and light was fairly low. Therefore, these species groups are probably not the result of complementary species competing for limited nutrients and light, but are more a function of the physiological adaptation to survive on the different types

of disturbed sites. As well, differences in the dispersal of propagules from the different species in the surrounding vegetation plays a role in the composition of the species groups. As mentioned previously, the main environmental factors influencing the distribution of the species groups appear to be elevation and moisture.

Community Types

The six sociological species groups were used to differentiate thirteen pioneer community types within the Peace River Coalfield. The differential portion of the vegetation table is shown in Table 9, with the full table in Appendix F. Table 10 is a summary table showing the constancies within each community type for all species with five or more occurrences in the 146 sample plots. A summary of some of the important environmental parameters within each community type is given in Table 11.

In all three tables, the community types are arranged in basically an elevational gradient, as demonstrated by the biogeoclimatic zonation categories on the tables. The Festuca community is found at the highest elevations and the Rosa community at the lowest. The average age of the community types is 6.5 years, there being no significant difference between ages of any of the types (Appendix D).

TABLE 9

DIFFERENTIAL PORTION OF VEGETATION TABLE

Symbol	Associated Braun-Blanquet Cover - Abundance Value
5	5 - 75-100 percent cover
4	4 - 50-75 percent cover
3	3 - 25-50 percent cover
2	2 - 5-25 percent cover
1	1 - numerous or scattered - less than 5% cover
+	+ - few, with small cover
-	r - solitary, with small cover

Biogeoclimatic Zonation:

ESSF - Engelmann Spruce - Subalpine Fir Zone

ESSF(p) Parkland Subzone

ESSF(f) Forested Subzone

BWBS - Boreal White and Black Spruce Zone

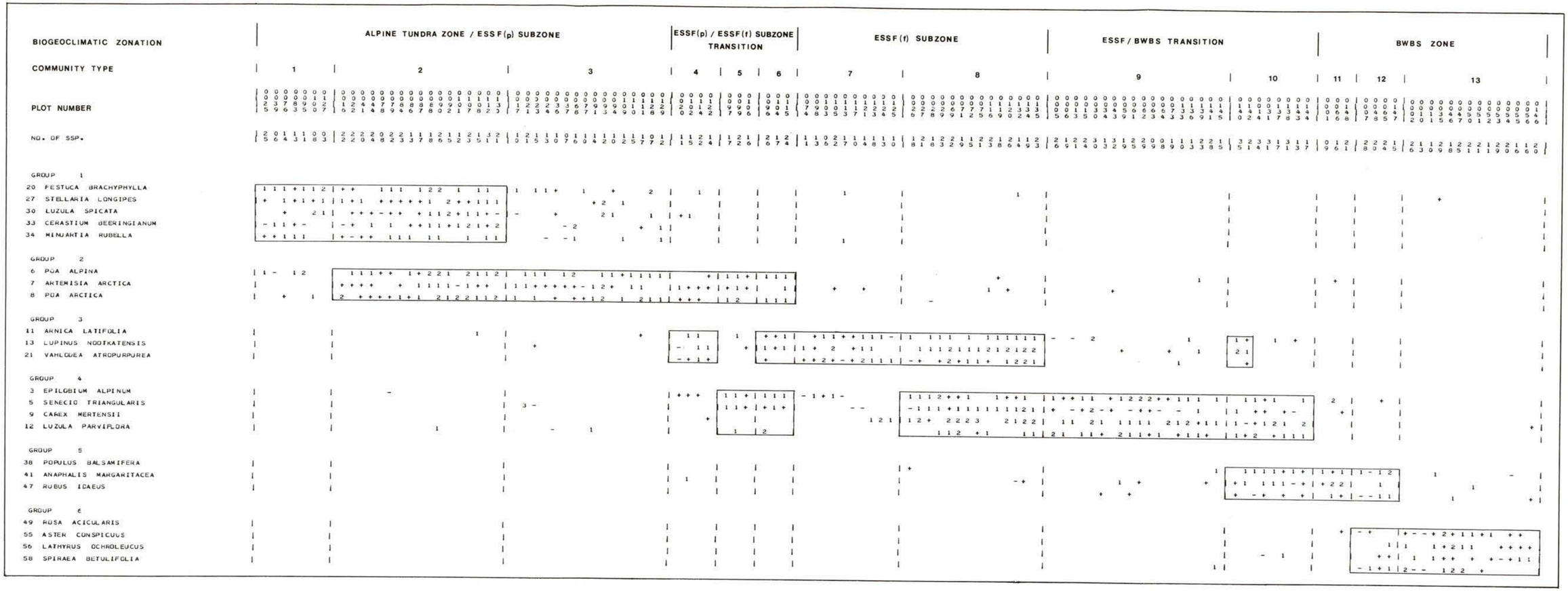

BIOGEOCLIMATIC ZONATION
ALPINE TUNDRA ZONE / ESSF(p) SUBZONE
ESSF(p) / ESSF(f) SUBZONE TRANSITION
ESSF(f) SUBZONE
ESSF / BWBS TRANSITION
BWBS ZONE
COMMUNITY TYPE
1
2
3
4
5
6
7
8
9
10
11
12
13
PLOT NUMBER
NO. OF SSP.
GROUP 1
20 FESTUCA BRACHYPHYLLA
27 STELLARIA LONGIPES
30 LUZULA SPICATA
33 CERASTIUM BEERINGIANUM
34 MINUARTIA RUBELLA
GROUP 2
6 POA ALPINA
7 ARTEMISIA ARCTICA
8 POA ARCTICA
GROUP 3
11 ARNICA LATIFOLIA
13 LUPINUS NOOTKATENSIS
21 VAHLODEA ATROPURPUREA
GROUP 4
3 EPILOBIUM ALPINUM
5 SENECIO TRIANGULARIS
9 CAREX MERTENSII
12 LUZULA PARVIFLORA
GROUP 5
38 POPULUS BALSAMIFERA
41 ANAPHALIS MARGARITACEA
47 RUBUS IDAEUS
GROUP 6
49 ROSA ACICULARIS
55 ASTER CONSPICUUS
56 LATHYRUS OCHROLEUCUS
58 SPIRAEA BETULIFOLIA

TABLE 10

SUMMARY TABLE OF SPECIES CONSTANCIES[1]

WITHIN EACH COMMUNITY TYPE

Constancy Class	Constancy (Percent)
I	0 - 20
II	20.1 - 40
III	40.1 - 60
IV	60.1 - 80
V	80.1 - 100

Note: For community types with less than five plots, the number of occurrences within the type is printed, rather than the constancy class.

Community Types:

1. Festuca Community Type
2. Festuca/Poa Community Type
3. Poa Community Type
4. Poa/Arnica Community Type
5. Poa/Epilobium Community Type
6. Poa/Arnica/Epilobium Community Type
7. Arnica Community Type
8. Arnica/Epilobium Community Type
9. Epilobium Community Type
10. Epilobium/Populus Community Type
11. Populus Community Type
12. Populus/Rosa Community Type
13. Rosa Community Type
14. Single transitional plot
15. Single transitional plot
16. Excluded plots

[1]Only species with five or more occurrences in the 146 plots are shown.

PIONEER COMMUNITIES SUMMARY TABLE REWRITING MODE

TYPE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1-ST REL.	0025	0016	0017	0020	0097	0096	0074	0026	0005	0140	0001	0007	0002	0032	0042	0003
NO.REL.	7	17	16	4	3	3	10	14	18	8	3	4	14	1	1	23
SPEC./REL.X10	114	195	125	155	183	223	134	200	201	248	153	217	196	250	210	95
SIMIL.	35	42	28	38	38	51	37	47	32	42	30	45	33	100	100	13
GROUP 1																
20 FESTUCA BRACHYPHYLLA	V	IV	III	1			I	I					I			I
27 STELLARIA LONGIPES	V	V	1													I
30 LUZULA SPICATA	III	V	II	2												
33 CERASTIUM BEERINGIANUM	IV	V	II													I
34 MINUARTIA RUBELLA	IV	IV	II				I									I
GROUP 2																
6 POA ALPINA	III	V	IV	1	3	3		I	I		1					I
7 ARTEMISIA ARCTICA		IV	V	4	3	1	I	I	I						1	I
8 POA ARCTICA	II	V	IV	3	2	3		I							1	I
GROUP 3																
11 ARNICA LATIFOLIA		I	I	2	1	3	V	IV	II	III						I
13 LUPINUS NOOTKATENSIS			I	3	1	3	III	V	I	II						I
21 VAHLODEA ATROPURPUREA				4		1	V	V	I	I						I
GROUP 4																
3 EPILOBIUM ALPINUM		I		3	3	3	III	IV	V	IV	1	1		1	1	I
5 SENECIO TRIANGULARIS			I		3	3	I	V	IV	IV	1					
9 CAREX MERTENSII				1			II	IV	IV	V			I	1		I
12 LUZULA PARVIFLORA		I	I		1	1		III	IV	V				1		I
GROUP 5																
38 POPULUS BALSAMIFERA								I	I	V	3	4	I	1	1	I
41 ANAPHALIS MARGARITACEA				1				I	I	V	3	1	I		1	I
47 RUBUS IDAEUS									I	IV	2	4	I	1		I
GROUP 6																
49 ROSA ACICULARIS											1	2	V			I
55 ASTER CONSPICUUS												1	IV	1		I
56 LATHYRUS OCHROLEUCUS										II		2	IV			
58 SPIRAEA BETULIFOLIA									I			4	III	1		
ACCOMP.SPEC.																
1 EPILOBIUM ANGUSTIFOLIUM	II	II	III	3	2	2	IV	V	IV	V	3	3	V	1	1	III
2 EQUISETUM ARVENSE	I	III	II		1	3	II	V	IV	IV		3	IV	1	1	II
4 TRISETUM SPICATUM	III	IV	III	2	1	1	I	II	II	II					1	I
10 MERTENSIA PANICULATA	I	III	II					I	III	II	1	2	II			II
14 ALNUS VIRIDIS							II	I	II	V	1	4	II	1		I
15 SANGUISORBA CANADENSIS	I	I	I	1	2	2	1	IV	II	II						I
16 LUZULA PIPERI	I	II	I	3	1	2	V	III								II
17 PHLEUM ALPINUM		I	II	1	2	3	I	III	II	II						I
18 ACONITUM DELPHINIFOLIUM		III	II		1	1	I	III	II	II						I
19 ARNICA CORDIFOLIA	I	I	I			1	I		III	II	2	3	III			I
22 CALAMAGROSTIS CANADENSIS		I	II				I	II	II	III	1	1	II			I
23 PHLEUM PRATENSE		I	I	1		1	II	I	II				II			II
24 TRIFOLIUM HYBRIDUM							I	II	II		1	1	III			II
25 ABIES LASIOCARPA		I		1			II	I	III	V				1		I
26 FESTUCA RUBRA		I		1			I	I	II		1		I			III
28 VALERIANA SITCHENSIS			I	1	1	1	II	IV	II	II						I
29 VACCINIUM MEMBRANACEUM				2		1	III	II	II	II				1		I
31 ERIGERON PEREGRINUS		I	I		2	3	I	III	II	II						I
32 TARAXACUM OFFICINALE				2				II	II	IV	1	2	III	1		
35 PETASITES PALMATUS								I	II	I	1	3	III	1		I
36 CORNUS CANADENSIS	II						I	I	II	III	1	2	II			I
37 CAREX PRATICOLA					1		I	I	III	II	1	3	I	1		I
39 ELYMUS INNOVATUS	I	I							I	I		2	III			II
40 CAREX ROSSII				1		1	I	II	II	II			II		1	I
42 AGROSTIS SCABRA				1				II	I	II		1	III		1	I
43 CINNA LATIFOLIA									II	III	1	2	II			I
44 THALICTRUM OCCIDENTALE			I			1		II	I	II		1	II		1	I
45 BISTORTA VIVIPARA		III	I	1		1	I									I
46 GALIUM TRIFLORUM									II	II	2	2	II			I
48 SALIX ARCTICA		III	I	1	1			I							1	I
50 HERACLEUM SPHONDYLIUM								II	II	II			I		1	I

SUMMARY TABLE CONTINUED

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
51	CARDAMINE PENSYLVANICA	II	I	I			1		I	I			1	I			I
52	POLYTRICHUM JUNIPERINUM				2			II		II			1				II
53	SALIX DISCOLOR							I	I	I	II	2	1	II	1	1	I
54	SALIX BARCLAYI		I			1	1	I	III	I	I		1				
57	ACHILLEA MILLEFOLIUM	III	II	I						I				II			I
59	OSMORHIZA DEPAUPERATA								I	I	I	2	2	II	1		
60	EQUISETUM SYLVATICUM							I	II	II	I		1				I
61	RIBES LACUSTRE									II	III		3	I	1		
62	POTENTILLA DIVERSIFOLIA		III	I													I
63	SAXIFRAGA FERRUGINEA	I	I	II		1		II									I
64	JUNCUS DRUMMONDII					2	1	I	III	I							I
65	VERATRUM VIRIDE						1		III	II	I						
66	JUNCUS MERTENSIANUS					1	1	I	II	I	I						I
67	CASTILLEJA MINIATA	I							I	I	II			I		1	I
68	CAREX MICROPTERA							I	I	II	II						I
69	EQUISETUM SCIRPOIDES	I	I	I				I	I	I	I				1		
70	PEDICULARIS BRACTEOSA			I		1	1	I	II	I	I						
71	SILENE ACAULIS	I	II	II													
72	FESTUCA BAFFINENSIS		II	II													I
73	HIERACIUM GRACILE				2	1		II	II			I					
74	RUBUS PUBESCENS									I		1	3	II			I
75	RUBUS PEDATUS							I		II	I		1	I			I
76	HIERACIUM ALBIFLORUM							I		I	III	1	1	I			
77	ASTRAGALUS ALPINUS	I	II	I				I			I						
78	AGROSTIS MERTENSII	II	I	I				I	I								I
79	RANUNCULUS OCCIDENTALIS		I			2	1	I	II								
80	PICEA GLAUCA X ENGELMANNII									I	IV	1			1		
81	PINUS CONTORTA							I		I	II		2	I			I
82	FRAGERIA VIRGINIANA	I	I									1		III			
83	STELLARIA CALYCANTHA					1	1			I	I			II			I
84	PICEA GLAUCA										I		3	II			I
85	FESTUCA ALTAICA		I	I	2		1										I
86	OXYRIA DIGYNA		II	I		1			I								
87	CAREX PHAEOCEPHALA	II	I	I	1		2										I
88	VERONICA WORMSKJOLDII				1	1	3	I	II								
89	GERANIUM BICKNELLII									I		1	1	II			I
90	SALIX SCOULERIANA									1	II		2	I			I
91	ASTER SUBSPICATUS								I	I		1		II			
92	CAREX MACROCHAETA			I	1	2		I	I								I
93	ORTHILIA SECUNDA				1			I	I	I			1		1		I
94	CAREX PODOCARPA		II	I		1											
95	RUBUS PARVIFLORUS									I		1	1	II			I
96	RANUNCULUS UNCINATUS								I	II	I						
97	GYMNOCARPIUM DRYOPTERIS								1	1	II		1	I	1		
98	AQUILEGIA FORMOSA									I	II		1	I			
99	VICIA AMERICANA										I		1	II			
100	MITELLA PENTANDRA								1	II	I			I			
101	CAREX BRUNNESCENS			I			1		I	I	I						
102	ANDROSACE SEPTENTRIONALIS	II	II											I			
103	SOLIDAGO MULTIRADIATA	I	II	I													I
104	MYOSOTIS ASIATICA		II	I						I							
105	DRABA BOREALIS	I	I	I						I							
106	POA PRATENSIS			I						I				I	1		
107	PICEA ENGELMANNII				1		1	I		I	I						I
108	RUMEX ACETOSA		I	I		1				I							
109	CALAMAGROSTIS LAPPONICA	I			1		1	I	I								I
110	LUZULA ARCUATA	I	I	I		1											I
111	POLEMONIUM CAERULEUM	I	I	II													
112	PARNASSIA FIMBRIATA								I	II	I						
113	DRABA AUREA	II	I	I													
114	CAMPANULA LASIOCARPA	I	II														I
115	DRABA INCERTA		II	I													
116	GENTIANELLA AMARELLA	I	I							I	II			I			
117	POPULUS TREMULOIDES													II			
118	VIBURNUM EDULE											1		II			
119	STREPTOPUS AMPLEXIFOLIUS							I		I				I			
120	ELYMUS GLAUCUS								I	I							
121	GEUM MACROPHYLLUM									I	II			I			
122	POA INTERIOR									I				I		1	I
123	AGOSERIS AURANTIACA					1				I	I					1	
124	ARNICA ALPINA		I	I													I
125	OXYTROPIS SERICEA		I	I													I
126	ANTENNARIA UMBRINELLA		I	I				I	I								I
127	SALIX SITCHENSIS								I	I	II						
128	GALIUM BOREALE									I				II			I
129	SENECIO LUGENS		I	I													
130	EPILOBIUM GLANDULOSUM								I				1	I			I
131	ALOPECURUS AEQUALIS							I					1	I			I
132	BROMUS RICHARDSONII									I	I			II			
133	POA PALUSTRIS										II			I			I
134	SIBBALDIA PROCUMBENS		I		1	1	1	I									

TABLE 11

SUMMARY OF DISTRIBUTIONS OF SPECIES GROUPS
IN COMMUNITY TYPES WITH SOME
IMPORTANT ASSOCIATED VARIABLES

Note: Values for environmental parameters are shown as mean ± standard error.

Biogeoclimatic Zonation:

ESSF - Engelmann Spruce - Subalpine Fir Zone

BWBS - Boreal White and Black Spruce Zone

Biogeoclimatic Zonation	Alpine Tundra Zone/ Parkland Subzone of ESSF Zone			ESSF Parkland and Forested Subzone Transition			Forested Subzone of ESSF Zone		ESSF/BWBS Transition		BWBS Zone		
Community Type / Species Group	Festuca	Festuca/ Poa	Poa	Poa/ Arnica	Poa/ Epilobium	Poa/Arnica /Epilobium	Arnica	Arnica/ Epilobium	Epilobium	Epilobium/ Populus	Populus	Populus/ Rosa	Rosa
Festuca brachyphylla													
Poa alpina													
Arnica latifolia													
Epilobium alpinum													
Populus balsamifera													
Rosa acicularis													
Elevation (m)	1707 ± 73	1673 ± 17	1658 ± 21	1617 ± 45	1613 ± 12	1638 ± 42	1518 ± 39	1475 ± 25	1269 ± 27	1230 ± 33	972 ± 49	946 ± 22	828 ± 41
Moisture regime	Submesic-mesic	Submesic-mesic	Submesic-subhygric	Submesic-mesic	Subhygric	Subhygric	Submesic-mesic	Subhygric	Mesic-subhygric	Submesic-mesic	Submesic-mesic	Submesic-mesic	Submesic-mesic
Cover (%)	12.2 ± 1.9	29.5 ± 4.4	37.6 ± 7.6	25.0 ± 8.6	46.7±20.3	71.7 ± 1.7	28.2 ± 5.3	62.5 ± 6.0	60.6 ± 7.0	42.7 ± 9.0	61.7±14.2	53.7±14.3	49.8 ± 6.8
Age (yrs)	6.3 ± 0.8	5.8 ± 0.5	7.0 ± 0.3	6.2 ± 1.4	8.7 ± 0.3	8.0 ± 0.6	6.9 ± 0.6	6.6 ± 0.2	6.1 ± 0.4	6.5 ± 0.3	6.7 ± 1.2	7.2 ± 1.0	5.5 ± 0.3
Number of Species	9.0 ± 1.7	19.5 ± 1.4	12.6 ± 0.9	15.5 ± 2.3	18.3 ± 1.9	22.3 ± 2.7	13.4 ± 1.5	20.0 ± 0.9	19.5 ± 1.7	24.9 ± 3.1	15.3 ± 3.5	21.7 ± 2.8	19.6 ± 1.6
Mean Similarity (%)	35	42	28	38	38	51	37	47	32	42	30	45	33
pH	6.4 ± 0.6	6.4 ± 0.2	6.2 ± 0.3	5.0 ± 0.3	6.5 ± 0.5	5.7 ± 0.2	5.3 ± 0.3	5.7 ± 0.2	6.1 ± 0.3	7.2 ± 0.3	8.0 ± 0.0	7.6 ± 0.5	7.1 ± 0.3

Based on the biogeoclimatic zones in the area, the thirteen community types are grouped in five divisions.

Alpine Tundra/
Parkland Communities

Three community types are differentiated by the presence or absence of two species groups in this division. All sites are located in the Alpine Tundra Zone or Parkland Subzone of the Engelmann Spruce - Subalpine Fir Zone.

1) Festuca Community Type
(Figure 5)

The Festuca community type is differentiated by the presence of the *Festuca brachyphylla* species group. This community is found on relatively dry (submesic to mesic), high elevation sites (1,550 - 1,935 meters) which have been abandoned for an average of 6.3 years (range of 3 to 8 years). These sites are all on abandoned roads and drillsites, and are therefore moderately to highly compacted. They are characterized by both a low vegetation cover, with a range of 5 to 18 percent, and a low number of species (from 3 to 14).

Although Plot 25 met the floristic requirements to be included in this community type, it did not fit ecologically with the other sites in this type. It has a greater number of species (25) and considerably more vegetation cover (60 percent) than the other plots and it was located at a lower elevation on a site within a

FIGURE 5: FESTUCA COMMUNITY

Dominant grasses on this site are *Festuca brachyphylla*, *Poa alpina*, *Agrostis mertensii* and *Trisetum spicatum*.

dry subalpine meadow vegetation type. Therefore, this plot was not included in the characterization of this community.

The sites included in this community are all highly exposed to wind, and the invading species are low growing perennials that often form clumps or loose mats. In addition to the species in the *Festuca brachyphylla* group, *Poa alpina*, *Trisetum spicatum* and *Achillea millefolium* are often found on these sites. The other 35 species found in this community type can be considered as rare due to their low constancy and cover.

2) Festuca/Poa Community Type (Figure 6)

The Festuca/Poa community type is differentiated by the presence of both the *Festuca brachyphylla* and the *Poa alpina* species groups. This community is found at somewhat lower elevations than the Festuca community. Although the mean elevation is only slightly lower, the range in elevations is much less (1555 to 1775 meters), with the maximum elevation 160 meters lower than that in the previous community. The sites are still relatively dry (submesic-mesic), with the average age (5.8 years) being about the same as the Festuca community. The age of the sites ranges from 3 to 9 years. The sites are not as compacted, and this, in conjunction with elevation, seems to be the reason

FIGURE 6: FESTUCA/POA COMMUNITY

Dominant species on this site are *Mertensia paniculata*, *Equisetum arvense*, *Poa alpina* and *Cerastium arvense*.

Note the Parkland Subzone of the ESSF Zone grading into the Alpine Tundra Zone.

for the higher vegetation cover, which ranges from 5 to 65 percent, and the greater number of species (range of 8 to 31).

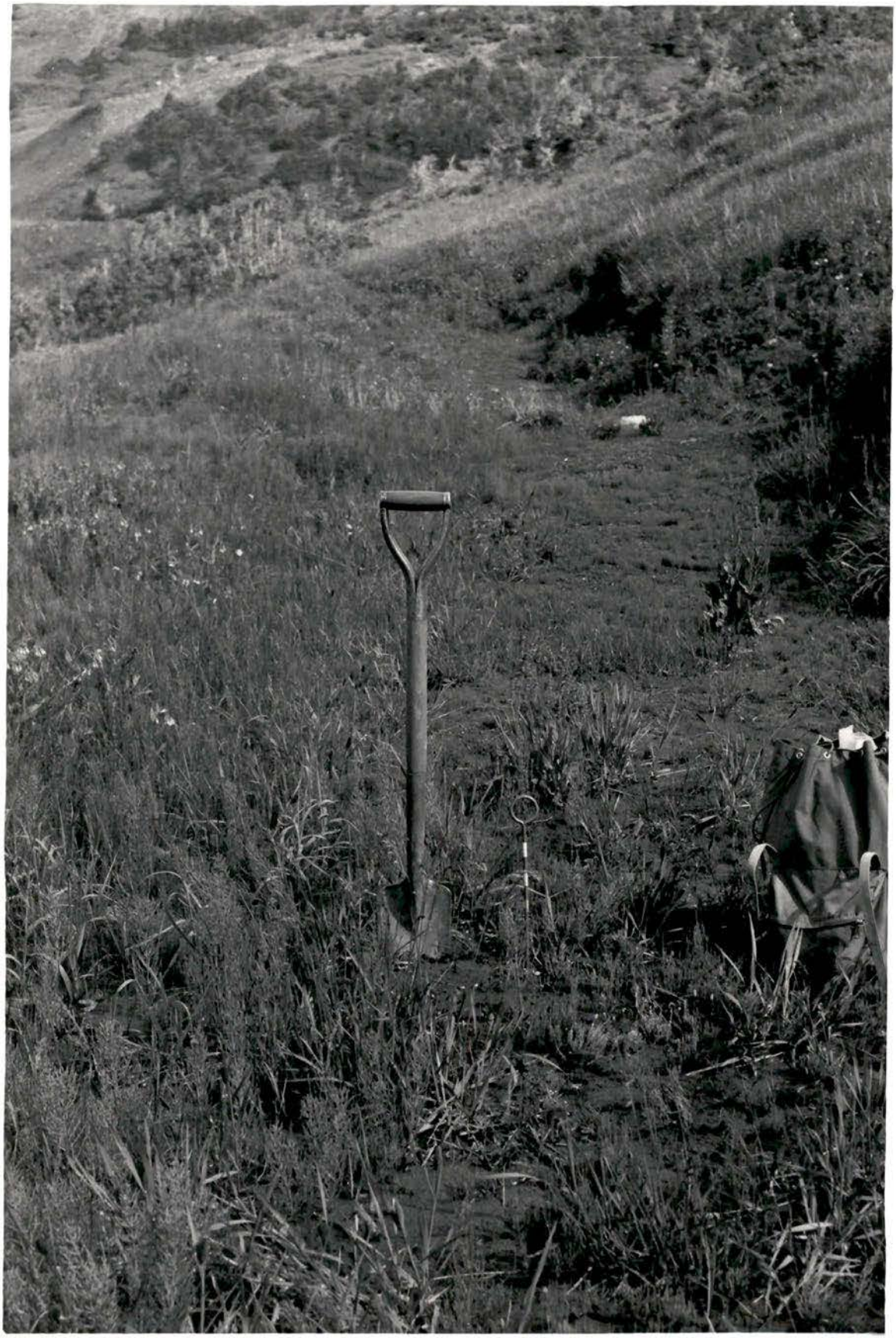
Other species commonly found on these sites, in addition to the members of the two species groups, are *Trisetum spicatum, Equisetum arvense, Mertensia paniculata, Aconitum delphinifolium, Bistorta vivipara, Potentilla diversifolia* and *Salix arctica. Silene acaulis, Festuca baffinensis* and *Oxyria digyna* are found on approximately one-third of the sites included in this community type, with the other 69 species found invading these sites considered as rare.

3) Poa Community Type (Figure 7)

The Poa community type is differentiated by the presence of only the *Poa alpina* species group. The sites range from 1540 to 1850 meters; almost the entire range of elevations characterizing the Festuca and the Festuca/Poa community types. The moisture regime of these sites ranges from submesic to subhygric, i.e. including moister sites than the other two communities and covering a much wider range of moisture conditions. This seems to be the reason for the higher mean vegetation cover, at 37.6 percent, and a wide variation in cover on these sites, with plots showing a range from 5 to 90 percent. The average age of sites in this type

FIGURE 7: POA COMMUNITY

Dominant species on this site are *Equisetum arvense*, *Phleum alpinum*, *Poa arctica*, *Poa alpina* and *Mertensia paniculata*.



is 7 years, with a range of 5 to 9 years. The number of species ranges from 7 to 21.

Although all the species in the *Poa alpina* group have high constancies in this community type, there are very few other common species. Those species occurring with the greatest constancy include *Festuca brachyphylla*, *Epilobium angustifolium*, *Trisetum spicatum* and *Aconitum delphinifolium*. Another species which is important, not because of its constancy, but due to its relatively high cover when it is present, is *Saxifraga ferruginea*. The other 63 species found on sites included in this community type are relatively rare due to their low constancy.

The only "wet" sites sampled above treeline are included in this community type. Very few exploration roads are constructed through "wet alpine" sites, for obvious practical reasons. As a result, it was not possible to sample many replicates. Nevertheless, no group of species was found which would separate the few moister sites sampled from the other sites in the alpine. Their inclusion in this type is due to their floristic similarity with the other sites in this type.

Parkland/Forested Subzone
Subalpine Communities

The three community types within this division are found in the transition area between the Parkland Subzone

and the Forested Subzone of the Engelmann Spruce - Subalpine Fir Zone. The three community types are differentiated by the occurrence or non-occurrence of the *Poa alpina*, *Arnica latifolia* and *Epilobium alpinum* species groups. Due to the small number of plots within each community type, the community designations should be considered tentative.

4) Poa/Arnica Community Type (Figure 8)

The presence of the *Poa alpina* and the *Arnica latifolia* species groups differentiates this community type. The elevation of the sites within this community type range from 1500 to 1720 meters, with an average of 1617 meters. The moisture regime varies from submesic to mesic, making this the driest of the three communities in this division. Vegetation cover is the lowest of the three types, ranging from 10 to 40 percent, with an average of 25 percent. The age of the sites ranges from 2 to 8 years, although the average is 6.2 years. Species number in a plot varies from 11 to 22. This community, with a mean pH of 5.0, has the lowest pH of any of the communities sampled.

In addition to most of the species within the *Poa alpina* and the *Arnica latifolia* species groups, *Epilobium alpinum*, *Epilobium angustifolium* and *Luzula piperi* have a high constancy within this community type. Other fairly common species, that is, with at least 50 percent

FIGURE 8: POA/ARNICA COMMUNITY

Dominant species on this abandoned drillsite are *Agrostis scabra*, *Epilobium angustifolium* and *Phleum alpinum*.

constancy, are *Luzula spicata, Trisetum spicatum, Festuca altaica, Hieracium gracile, Vaccinium membranaceum* and *Polytrichum juniperinum*. The other 24 species invading these sites are less common.

5) Poa/Epilobium Community Type (Figure 9)

The Poa/Epilobium community type is found on subhygric sites, and is differentiated by the presence of the *Poa alpina* and *Epilobium alpinum* species groups. The community has about the same mean elevation as the previous community (1613 meters), but the range is more restricted (1595-1635 meters). The sites are eight and nine years of age, and the pH, with an average of 6.5, is considerably higher than that of the Poa/Arnica community. The average cover is 46.7 percent but the cover ranges from 10 to 80 percent. One plot has a much lower cover than the other two; probably a result of the greater compaction of that site. The number of species per plot varies from 16 to 22.

Although all the species in the *Poa alpina* species group are represented in almost every site within this community type, only *Epilobium alpinum* and *Senecio triangularis* have a high constancy for the *Epilobium alpinum* species group. Other species with a high constancy within this type are *Epilobium angustifolium, Sanguisorba canadensis, Phleum alpinum, Erigeron peregrinus, Juncus*

FIGURE 9: POA/EPILOBIUM COMMUNITY

Dominant species on this highly compacted road are *Agrostis variabilis*, *Carex macrochaeta*, *Juncus drummondii*, *Saxifraga ferruginea* and *Sibbaldia procumbens*.

drummondii, Ranunculus occidentalis, Carex macrochaeta and *Caltha leptosepala*. Twenty-five other species were uncommon on these sites.

6) Poa/Arnica/Epilobium
Community Type (Figure 10)

The presence of all three of the *Poa alpina, Arnica latifolia* and *Epilobium angustifolium* species groups differentiates this community type. The three sites sampled range in elevation from 1580 to 1720 meters, with an average of 1638 meters. The sites are of about the same age (i.e. a range of 7 to 9 years) as those in the previous type, and they also have a subhygric moisture regime. The sites have a higher mean vegetation cover (71.7) than the previous community type and a more restricted range (70 to 75 percent). The higher cover is probably primarily due to the very low compaction of the sites. The number of species ranges from 17 to 26.

The mean pH, of 5.7, is intermediate to that found on sites in the other two community types. It may be that pH is an important factor in the distribution of species in the *Arnica latifolia* and the *Epilobium alpinum* species groups. Although the pH ranges overlap, species in the *Arnica latifolia* group are generally found on sites with a lower pH than those on which species in the *Epilobium alpinum* group are found. In this community

FIGURE 10: POA/ARNICA/EPILOBIUM COMMUNITY

Dominant species on this site are *Luzula parviflora*, *Equisetum arvense*, *Phleum alpinum* and *Sanguisorba canadensis*.

type, both species groups are found and the mean pH is intermediate to that found when only one of the groups is present in a community type.

The species composition within this community type is quite different from the previous type. Those species found on all sites are *Poa alpina, Poa arctica, Arnica latifolia, Senecio triangularis, Equisetum arvense, Phleum alpinum, Erigeron peregrinus* and *Vernonica wormskjoldii*. Some other common species are *Epilobium angustifolium, Sanguisorba canadensis, Luzula piperi* and *Carex phaeocephala*. A total of 29 other species were rare on the sites within this community type.

Forested Subzone
Subalpine Communities

Within the Forested Subzone of the Engelmann Spruce - Subalpine Fir Zone, two pioneer community types were distinguished on the basis of the presence or absence of the *Arnica latifolia* and *Epilobium alpinum* species groups.

7) Arnica Community Type
(Figure 11)

This community type is differentiated by the presence of the *Arnica latifolia* species group. It occurs on submesic to mesic sites, at elevations from 1375 to 1625 meters, that average 6.9 years since abandonment. The sites ranged from 6 to 9 years with the exception of one 2 year old site. The pH on these sites is quite low,

FIGURE 11: ARNICA COMMUNITY

Dominant species on this site are *Carex mertensii, Agrostis mertensii, Calamagrostis lapponica, Luzula piperi, Carex praticola* and *Arnica latifolia.*

with an average of 5.3. All sites have fairly low vegetation cover, with an average of 28.2 percent, and a range from 5 to 50 percent. The number of species per plot varies from 6 to 22 with a mean of 13.4.

In addition to the species of the *Arnica latifolia* group, a number of other species have fairly high constancies. These include *Luzula piperi, Epilobium angustifolium, Epilobium alpinum, Vaccinium membranaceum, Alnus viridis* and *Abies lasiocarpa* seedlings. Fifty other species were found on the sites in this community type, but with low constancies.

8) Arnica/Epilobium Community Type (Figure 12)

The presence of both the *Arnica latifolia* and the *Epilobium alpinum* species groups differentiates this community type. It occurs on sites of the same elevation as the Arnica community type, but the sites are moister; being mostly subhygric. Ages range from 5 to 8, with a mean of 6.6 years. The average pH, at 5.7, is a little higher than the previous community. With an average vegetation cover of 62.5 percent and a range from 20 to 95 percent, the effect of added moisture can be seen when this is compared to the Arnica community type. On the average, there is a greater number of species on these sites (mean of 20.0; range of 14 to 26).

A large number of species occur with fairly

FIGURE 12: ARNICA/EPILOBIUM COMMUNITY

Dominant species on this abandoned road are *Equisetum arvense, Carex mertensii, Phleum alpinum, Lupinus nootkatensis, Epilobium angustifolium, Luzula piperi, Senecio triangularis* and *Epilobium alpinum.*

high constancy in this community type. As well as the species in the two species groups, *Epilobium angustifolium*, *Equisetum arvense*, *Sanguisorba canadensis* and *Valeriana sitchensis* occur in most of the plots. Species which occur in greater than one-third of the plots include *Luzula piperi*, *Phleum alpinum*, *Aconitum delphinifolium*, *Erigeron peregrinus*, *Salix barclayi*, *Juncus drummondii*, *Veratrum viride* and *Juncus mertensianus*. In addition to the 19 species mentioned, another 58 species were found with lower constancies.

Subalpine/Boreal
Transition Communities

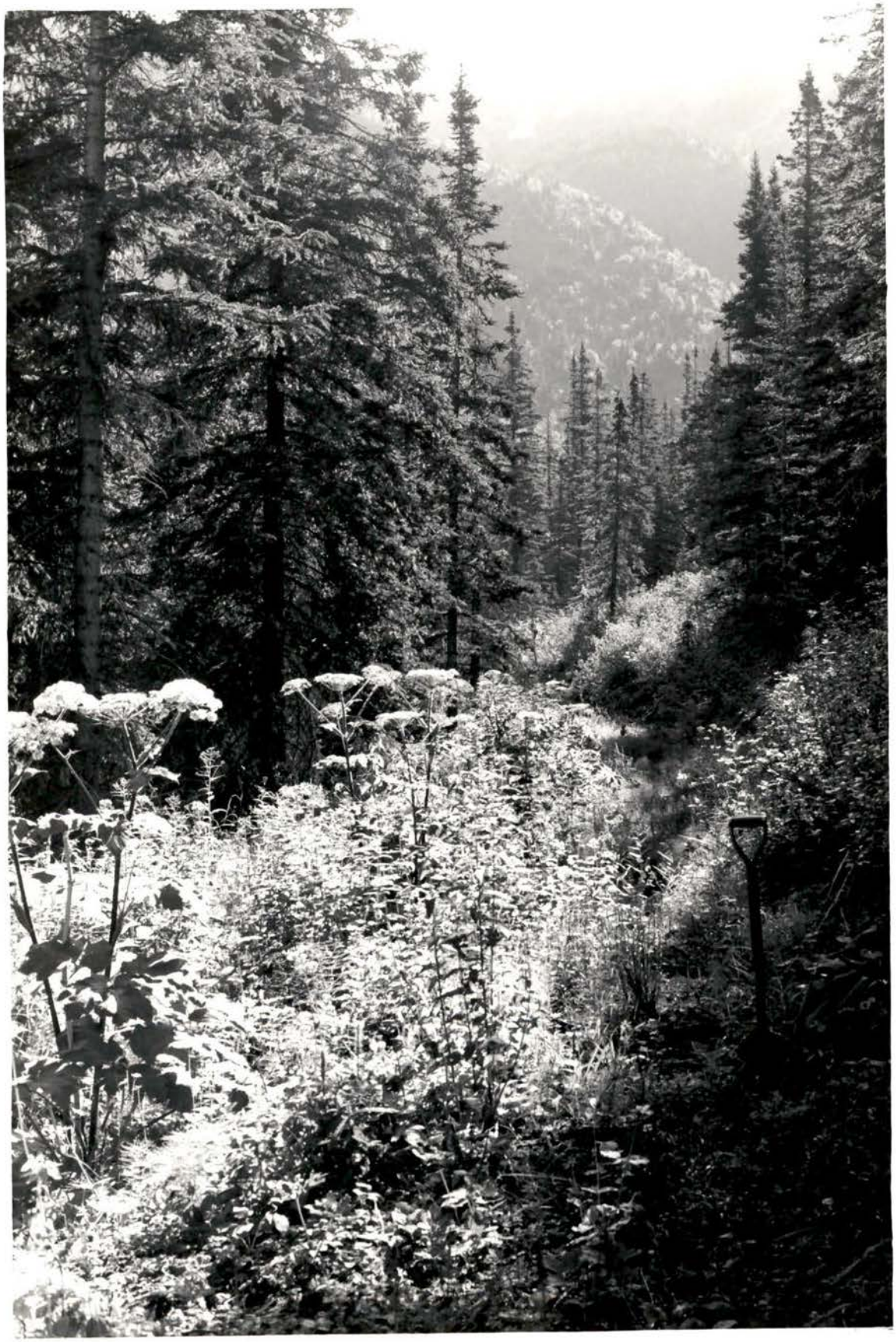
The two community types within this division are differentiated by the *Epilobium alpinum* and the *Populus balsamifera* species groups. These two communities are found from about 1025 to 1390 meters elevation within the lower regions of the Engelmann Spruce - Subalpine Fir Zone and within the transition area between the Engelmann Spruce - Subalpine Fir Zone and the Boreal White and Black Spruce Zone.

9) Epilobium Community Type
(Figure 13)

The Epilobium community type is differentiated by the presence of only the *Epilobium alpinum* species group. This community occurs on mesic to subhygric sites, varying from 3 to 9 years since abandonment (mean

FIGURE 13: EPILOBIUM COMMUNITY

Dominant species on this site are *Equisetum arvense, Senecio triangularis, Heracleum sphondylium, Valeriana sitchensis, Arnica latifolia, Mertensia paniculata, Carex mertensii* and *Marchantia polymorpha.*



of 6.1), within the range of elevations given above. The mean pH is 6.1. Although the cover on these sites varies from 4 to 100 percent, most of the sites range from 50 to 95 percent. The number of species per plot ranges from 8 to 32 with a mean of 19.5.

The species with the highest constancies include *Epilobium angustifolium, Equisetum arvense, Mertensia paniculata, Arnica cordifolia, Abies lasiocarpa* and *Carex praticola* in addition to those species in the *Epilobium alpinum* species group. Some species with lower constancies, but still occurring in more than one-third of the plots are *Alnus viridis, Sanguisorba canadensis, Calamagrostis canadensis, Valeriana sitchensis, Petasites palmatus* and *Heracleum sphondylium*. Another 95 species with lower constancies were found on the sites in this community type, clearly the most species rich pioneer community sampled.

10) Epilobium/Populus Community Type (Figure 14)

The presence of the *Populus balsamifera* species group, as well as the *Epilobium alpinum* species group differentiates this community type. It is found on submesic to mesic sites, the sites being generally drier than those on which the Epilobium community is found. This community is of about the same age as the Epilobium community (i.e. mean of 6.5 years and range

FIGURE 14: EPILOBIUM/POPULUS COMMUNITY

Dominant species on this disturbed area are *Carex mertensii, Cinna latifolia, Epilobium angustifolium, Agrostis scabra, Equisetum sylvaticum, E. arvense* and *Luzula parviflora.*

from 5 to 7 years) and is found throughout the same elevational range. The cover ranges from 20 to 90 percent, but most of the sites have between 20 and 50 percent cover. The number of species per plot ranges from 13 to 35, and the mean of 24.9 is higher than any other community type.

This community type could be split into two on the basis of the *Arnica latifolia* species group on two of the sites. Although further sampling may identify these two "subtypes" as distinct, no environmental factors were found to distinguish one subtype from the other. Also, leaving the plots together as one type did not affect the mean similarity of the plots within the type.

An average pH of 7.2 is considerably higher than the mean pH of 6.1 for the sites in the Epilobium community type. In all cases, the presence of the *Populus balsamifera* group is associated with a higher pH.

Species with a high constancy, in addition to the species in the *Populus balsamifera* and *Epilobium alpinum* species groups include *Abies lasiocarpa, Epilobium angustifolium, Alnus viridis, Equisetum arvense, Taraxacum officinale* and *Picea glauca* x *engelmannii*. Other species with a fairly high constancy include *Calamagrostis canadensis, Cornus canadensis, Cinna latifolia, Ribes lacustre, Hieracium albiflorum* and *Arnica latifolia*. Another 61

species were relatively rare in their occurrence in this community type.

Boreal Communities

Three pioneer community types differentiated by the *Populus balsamifera* and *Rosa acicularis* species groups are found in the Boreal White and Black Spruce Biogeoclimatic Zone. As two of them, the Populus community type and the Populus/Rosa community type, are based on a relatively low number of samples, they should be considered as tentative. More samples would result in a better differentiation of pioneer communities in the Boreal White and Black Spruce Zone.

11) Populus Community Type (Figure 15)

The Populus community type is differentiated by the presence of only the *Populus balsamifera* species group. This community is found at elevations ranging from 900 to 1070 meters on submesic to mesic sites. All the sites had a pH of 8.0. The average vegetation cover was 61.7 percent, but considering that one of the sites had been seeded with an agronomic mixture, the average cover of only natural invading species is approximately 35 percent. The range in cover of native species is 5 to 50 percent. The number of species per plot varies from 9 to 21, and the age ranges from 5 to 9 years.

FIGURE 15: POPULUS COMMUNITY

Dominants on this site are *Anaphalis margaritacea* and *Epilobium alpinum*. Note the gully erosion.

The most common species found on the sites in this community type, in addition to those in the *Populus balsamifera* species group, are *Epilobium angustifolium, Arnica cordifolia, Galium triflorum, Salix discolor* and *Osmorhiza depauperata*. Another 27 species were occasionally found.

12) Populus/Rosa Community Type (Figure 16)

Both the *Populus balsamifera* and *Rosa acicularis* species groups differentiate this community type. It is also found on submesic to mesic sites from 900 to 1000 meters elevation. The pH is again fairly high, with an average of 7.6 (range from 7.0 to 8.0). The vegetation cover on these sites ranges from 15 to 80 percent (mean of 53.7 percent) and the number of species varies from 15 to 28 per plot. The ages range from 5 to 9 years. The only environmental factor measured which tends to differentiate between this community type and the Populus community is the exposure of the site; the sites in this community type being more exposed to incoming solar radiation.

The most common species in this community type are *Populus balsamifera, Rubus idaeus, Spiraea betulifolia, Epilobium angustifolium, Equisetum arvense, Alnus viridis, Arnica cordifolia, Petasites palmatus, Carex praticola, Ribes lacustre, Rubus pubescens* and *Picea glauca*.

FIGURE 16: POPULUS/ROSA COMMUNITY

Dominant species on this abandoned road are *Elymus innovatus*, *Spiraea betulifolia*, *Agrostis scabra* and *Alopecurus aequalis*.

13) Rosa Community Type
(Figure 17)

This community type is differentiated by the *Rosa acicularis* species group. It is found on drier (subxeric-mesic) and lower elevation (630 - 950 meters) sites than the previous two communities. Most of the sites have a fairly high pH, with the average being 7.1. The ages range from 5 to 9 years, but the mean is only 5.5 years. Although this community is younger than the other two boreal communities, the difference is not statistically significant. The average vegetation cover is 49.8 percent, but considering that two sites had been seeded with an agronomic mixture, the average cover of naturally invading species is closer to 44 percent. The cover of native species ranges from 5 to 85 percent.

In addition to the species in the *Rosa acicularis* group, the species with the highest constancy in this community type are *Epilobium angustifolium, Equisetum arvense, Arnica cordifolia, Taraxacum officinale, Petasites palmatus, Elymus innovatus, Agrostis scabra* and *Fragaria virginiana*. A number of fairly common species, with a constancy greater than 33 percent, include *Alnus viridis, Cinna latifolia, Galium triflorum, Aster subspicatus, Vicia americana* and *Populus tremuloides*. Another 74 species with lower constancies were found in this community type.

FIGURE 17: ROSA COMMUNITY

Dominant species are *Agrostis exarata, Solidago canadensis, Equisetum arvense, Epilobium angustifolium* and *Aster conspicuus.*

Excluded Plots

A number of plots were not used to differentiate pioneer community types in the differentiated table. These were generally plots with a very low species diversity or plots of a transitional nature.

Two plots were pooled to the end of the synthesis table due to their transitional nature (Appendix F). The summary table (Table 10) shows plots 32 and 42 as community type 14 and 15, respectively.

Plot 32 is differentiated by the presence of the *Epilobium alpinum, Populus balsamifera* and *Rosa acicularis* species groups. The plot was located in the transition area between the Engelmann Spruce - Subalpine Fir Zone and the Boreal White and Black Spruce Zone on a seepage site with a south-west exposure. This resulted in a unique species combination, which was only sampled once in this study.

Plot 42 is differentiated by the *Poa alpina* and the *Populus balsamifera* species groups. The site was located within a dry, steeply sloping subalpine meadow area which resulted in a number of high elevation species being present in addition to a number of dry site indicators. Again, this community was only sampled once in this study.

Twenty-three of the sites sampled did not fit into any of the community types. In general, they are characterized by having a low number of species. This is often due to the youth of the sites, but it is also a

function of strong compaction, high exposure to insolation or wind, or coarse textured parent material. Given more time to develop, most of these sites would probably fit into one of the described communities, as it is not felt that the site conditions are so severe as to prevent growth.

Three of the sites in the "excluded plots" section had been seeded with an agronomic mixture, and it seems that the high cover of agronomic species is slowing down invasion of the site by native species. Although seeded sites were avoided in most of the areas sampled, the widespread seeding of sites in the Boreal White and Black Spruce Zone necessitated sampling some seeded sites in order to survey the native species invasion of them.

Environmental Factors Associated With Community Distribution

From the description of the pioneer plant communities, it is evident that the communities are basically distributed along elevational and moisture gradients. In some cases, edaphic factors such as the soil compaction or pH of a site are also important. Other factors such as the slope or aspect of a site, and the texture or color of the parent material were not strongly associated with the distribution of the different pioneer communities.

There are two possible reasons why factors such as slope and aspect and characteristics of the parent material

were not important in the distribution of the pioneer communities in this study. Either the species colonizing the recently disturbed sites are not related to these factors, or not enough sites were sampled to show the association with these factors.

During the field sampling, an attempt was made to sample as wide a range of sites as possible. Therefore, it is likely that elevation and moisture are the main factors influencing community development, with compaction and pH playing a less important role, and other factors such as slope and aspect unimportant. In some cases, though, the number of samples may have been important.

Succession and Community Development

The pioneer plant communities described in this study can be considered as the initial stages of primary succession. The type of succession on these sites is considered to be primary because in all the sites sampled, the previous vegetation cover was totally removed until all that remained was the relatively unweathered parent material.

The pioneer communities described are not related temporally to one another. Each community represents an initial stage of succession on a particular site type. In most cases, all that has occurred is an invasion of the site by the disseminules of various plant species and the subsequent growth and reproduction of these plants. Once a

plant is established on a site, it often increases by vegetative reproduction.

The autogenic processes apparent in seral community development are not prominent at this stage. On some sites, a litter layer has started to develop and slight changes in soil structure have occurred as a result of the rooting of various plants.

Competition for light, space and nutrients is not very "intense" on most of the sites due to the generally low vegetation cover. Successive replacement of species on a site due to interspecific competition has not yet occurred. There have not been significant changes in site conditions to allow different species a competitive advantage.

This study provides information on the initial stages of succession in the study area. A knowledge of the successional stages (seres) leading to the climax plant communities in an area, can be useful in attempts to accelerate the rehabilitation of disturbed sites. Information on the structural and compositional changes in the vegetation and soils is a necessary prerequisite to the successful manipulation of successional processes.

Environmental Factors Affecting Natural Revegetation

An understanding of the environmental factors influencing the revegetation of disturbed sites is important when applied to operational reclamation procedures. The

factors found to be significantly correlated with the total vascular plant cover on a site (used as a measure of revegetation success) are discussed below.

Summary statistics for both the continuous and ordinal environmental variables measured are shown in Tables 12 and 13, respectively. The maximum and minimum values recorded for the continuous variables give some idea of the range of sites sampled. As can be seen, cover varied from 0 to 100 percent on sites ranging in age from 1 to 9 years. Almost the entire possible range for the variables of slope, exposure, compaction, and texture of coarse fragments were sampled. The elevation of the sites sampled ranged from 632 to 1935 meters. Although the erosion on sites varied from 0 to 35 percent, the mean value was quite low (2.6 percent). All of the macronutrients sampled covered a good range of possible values from low to high except the nitrate concentration, which was very low at all sites. The variables of pH, soil compaction, and organic matter content cover a wide range of possible values. All the measured values for electrical conductivity (salts) were quite low.

All of the ordinal variables covered the full range of possible values with the exception of the erosion intensity index. Since most sites had no rill or gully erosion, there were many zeros for this measure. The maximum obtained value was 99.

TABLE 12

SUMMARY STATISTICS FOR CONTINUOUS VARIABLES MEASURED AT ALL SITES

Variable	Sample Size	Mean	Standard Deviation	Min.	Max.	Coefficient of Variation %
Cover (%)	141	41.1	27.55	0	100	67.09
Age (years)	141	6.1	1.78	1	9	29.03
Elevation (meters)	141	1423.2	290.87	632	1935	20.44
Site slope (degrees)	141	7.4	6.87	0	39	93.11
Adjacent site slope (degrees)	141	12.6	9.23	0	38	73.20
Site exposure (degrees)	141	88.0	55.00	0	180	62.52
Adjacent site exposure (degrees)	141	92.0	53.01	0	180	57.63
pH	141	6.3	1.22	4.5	8.0	19.32
Nitrates (pounds/acre)	103	2.0	1.34	1	9	65.84
Phosphorus (pounds/acre)	103	36.3	43.74	2	258	120.45
Potassium (pounds/acre)	103	53.5	43.16	25	335	80.65
Calcium (pounds/acre)	103	2881.4	2532.99	500	10,000	87.91
Magnesium (pounds/acre)	103	346.7	255.78	25	1,000	73.77
Salts (mmhos/ centimeter)	103	0.12	0.069	0.06	0.32	58.67
Organic matter (%)	103	4.9	5.09	0.5	30.0	103.10
Erosion (%)	103	2.6	5.64	0	35	215.86
Compaction (kilograms/ centimeter^2)	103	1.9	1.11	0.1	4.5	57.87
Texture of coarse fragments (%)	141	31.1	18.89	0	95	60.68

TABLE 13

SUMMARY STATISTICS FOR ORDINAL VARIABLES

MEASURED AT ALL SITES

Variable	Sample Size	Mean	Standard Deviation
Wind exposure magnitude	141	0.6	0.87
Heat index	141	2.9	1.30
Site moisture regime	141	4.8	1.12
Compaction magnitude	141	1.8	0.76
Erosion intensity index	141	5.7	15.06
Erosion magnitude	141	0.8	0.89
Texture index	141	2.8	0.84
Soil color	141	7.6	1.95

The correlation coefficients for the relationship between total vascular plant cover and the continuous and ordinal environmental variables are given in Tables 14 and 15. These are the correlation coefficients for the maximum number of sites sampled for each variable. Significant positive correlations, at the 99 percent level of significance occur with the variables of age, site moisture, and texture. Negative correlations are significant with the variables of elevation, texture of coarse fragments, wind exposure, and compaction as measured by two methods.

Due to the major macroclimatic difference between the forested zones (BWBS and ESSF Zones) and the alpine zone (AT Zone), the data were divided into these two categories to determine if the environmental factors influencing natural revegetation would be the same.

Forested Zones

The summary statistics for the continuous and ordinal variables measured from sites in the forested zones are shown in Tables 16 and 17 respectively. The range of values measured for each variable was very close to the ranges found when all the sites sampled were included in the analysis. The main differences occurred with elevation, which now ranged from 632 to 1745 meters, and site slope, which had a maximum of 24 degrees. The mean values were very similar, except for elevation and wind exposure, which were both lower in the forested zones.

TABLE 14

CORRELATION COEFFICIENTS FOR TOTAL COVER VERSUS CONTINUOUS ENVIRONMENTAL VARIABLES MEASURED AT ALL SITES

Variable	Product-Moment Correlation Coefficient	Degrees of Freedom	Significance
Age	0.331	139	*
Elevation	-0.247	139	*
Site slope	0.072	139	N.S.
Adjacent site slope	0.076	139	N.S.
Site exposure	-0.005	139	N.S.
Adjacent site exposure	0.035	139	N.S.
pH	0.145	139	N.S.
Nitrates	-0.050	101	N.S.
Phosphorus	-0.120	101	N.S.
Potassium	0.075	101	N.S.
Calcium	0.095	101	N.S.
Magnesium	0.187	101	N.S.
Salts	0.091	101	N.S.
Organic matter	0.207	101	N.S.
Erosion	-0.041	101	N.S.
Compaction	-0.299	101	*
Texture of coarse fragments	-0.261	139	*

* correlation significant at $p < 0.01$

N.S. not significant

TABLE 15

CORRELATION COEFFICIENTS FOR TOTAL COVER VERSUS ORDINAL ENVIRONMENTAL VARIABLES MEASURED AT ALL SITES

Variable	Sample Size	Spearman Rank Correlation Coefficient	Significance
Wind exposure magnitude	141	-0.304	*
Heat index	141	-0.002	N.S.
Site moisture regime	141	0.574	*
Compaction magnitude	141	-0.331	*
Erosion intensity index	141	-0.003	N.S.
Erosion magnitude	141	-0.096	N.S.
Texture index	141	0.379	*
Soil color	141	-0.147	N.S.

* correlation significant at $p < 0.01$

N.S. not significant

TABLE 16

SUMMARY STATISTICS FOR CONTINUOUS VARIABLES
MEASURED AT SITES IN FORESTED ZONES

Variable	Sample Size	Mean	Standard Deviation	Min.	Max.	Coefficient of Variation %
Cover (%)	102	45.0	27.63	0	100	61.39
Age (years)	102	6.3	1.68	2	9	26.81
Elevation (meters)	102	1328.1	281.85	632	1745	21.22
Site slope (degrees)	102	6.8	5.15	0	24	75.56
Adjacent site slope (degrees)	102	11.6	8.54	0	37	73.91
Site exposure (degrees)	102	87.6	55.43	0	180	63.27
Adjacent site exposure (degrees)	102	88.5	55.10	0	180	62.24
pH	102	6.1	1.18	4.5	8.0	19.17
Nitrates (pounds/acre)	78	1.7	0.95	1	6	54.82
Phosphorus (pounds/acre)	78	42.2	47.84	2.0	258.0	113.39
Potassium (pounds/acre)	78	53.0	47.20	25.0	335.0	89.08
Calcium (pounds/acre)	78	2482.2	2245.19	500.0	10,000	90.45
Magnesium (pounds/acre)	78	290.3	213.79	25.0	1,000	73.65
Salts (mmhos/ centimeter)	78	0.11	0.070	0.06	0.32	62.12
Organic matter (%)	78	4.2	3.99	0.5	30.0	94.73
Erosion (%)	78	2.7	5.98	0	35	225.24
Compaction (kilograms/ centimeter^2)	78	2.0	1.10	0.1	4.5	54.65
Texture of coarse fragments (%)	102	31.2	19.62	0	95	62.83

TABLE 17

SUMMARY STATISTICS FOR ORDINAL VARIABLES
MEASURED AT SITES IN FOREST ZONES

Variable	Sample Size	Mean	Standard Deviation
Wind exposure magnitude	102	0.2	0.52
Heat index	102	3.0	1.27
Site moisture regime	102	4.9	1.05
Compaction magnitude	102	1.8	0.75
Erosion intensity index	102	5.0	13.95
Erosion magnitude	102	0.8	0.92
Texture index	102	2.9	0.89
Soil color	102	7.9	1.85

The correlation coefficients for total cover versus the various environmental variables are shown in Tables 18 and 19. Highly significant positive correlations occur with the variables of age, magnesium concentration, site moisture and texture, and negative correlations are found with the variables of compaction, compaction magnitude and texture of coarse fragments.

Alpine Zone

The statistics for the continuous and ordinal variables measured from sites sampled in the alpine zone are summarized in Tables 20 and 21. The mean cover was much lower in the alpine zone. Of the nutrients sampled, the mean phosphorus concentration was much lower in the alpine, whereas the calcium and magnesium mean concentrations were higher than in the forested zones. The range of values was less for potassium, although the mean was approximately the same. The mean values for nitrates concentration and organic matter content were slightly higher in the alpine. Of course, the mean value for the wind exposure was much higher in the alpine zone. The other variables showed similar trends to those observed in the forested zones.

The correlation coefficients shown in Tables 22 and 23 are for the relationship between total cover and the environmental variables measured in the alpine zone. Only the variables of age and site moisture showed significant positive correlations, and the erosion intensity index was

TABLE 18

CORRELATION COEFFICIENTS FOR TOTAL COVER VERSUS CONTINUOUS ENVIRONMENTAL VARIABLES MEASURED AT SITES IN FORESTED ZONES

Variable	Product-Moment Correlation Coefficient	Degrees of Freedom	Significance
Age	0.283	100	*
Elevation	-0.147	100	N.S.
Site slope	0.026	100	N.S.
Adjacent site slope	0.048	100	N.S.
Site exposure	0.008	100	N.S.
Adjacent site exposure	0.098	100	N.S.
pH	0.201	100	N.S.
Nitrates	-0.124	76	N.S.
Phosphorus	-0.223	76	N.S.
Potassium	0.096	76	N.S.
Calcium	0.156	76	N.S.
Magnesium	0.299	76	*
Salts	0.126	76	N.S.
Organic matter	0.212	76	N.S.
Erosion	0.011	76	N.S.
Compaction	-0.325	76	*
Texture of coarse fragments	-0.299	100	*

* correlation significant at $p < 0.01$

N.S. not significant

TABLE 19

CORRELATION COEFFICIENTS FOR TOTAL COVER VERSUS ORDINAL ENVIRONMENTAL VARIABLES MEASURED AT SITES IN THE FORESTED ZONES

Variable	Sample Size	Spearman Rank Correlation Coefficient	Significance
Wind exposure magnitude	102	-0.167	N.S.
Heat index	102	0.008	N.S.
Site moisture regime	102	0.602	*
Compaction magnitude	102	-0.326	*
Erosion intensity index	102	0.191	N.S.
Erosion magnitude	102	0.023	N.S.
Texture index	102	0.412	*
Soil color	102	-0.241	N.S.

* correlation significant at $p < 0.01$

N.S. not significant

TABLE 20

SUMMARY STATISTICS FOR CONTINUOUS VARIABLES MEASURED AT SITES IN THE ALPINE ZONE

Variable	Sample Size	Mean	Standard Deviation	Min.	Max.	Coefficient of Variation %
Cover (%)	39	30.8	24.87	3	80	80.75
Age (years)	39	5.8	2.00	1	9	34.54
Elevation (meters)	39	1672.0	112.81	1480	1935	6.75
Site slope (degrees)	39	8.9	10.02	0	39	112.99
Adjacent site slope (degrees)	39	15.3	10.44	3	38	68.10
Site exposure (degrees)	39	88.9	54.70	8	180	61.52
Adjacent site exposure (degrees)	39	101.0	46.57	10	180	46.11
pH	39	6.7	1.24	4.5	8.0	18.59
Nitrates (pounds/acre)	25	3.0	1.87	1	9	62.36
Phosphorus (pounds/acre)	25	18.0	17.99	2	68	100.19
Potassium (pounds/acre)	25	55.2	27.67	25	112	50.16
Calcium (pounds/acre)	25	4127.2	2993.45	500	9728	72.53
Magnesium (pounds/acre)	25	522.8	297.94	25	1000	56.99
Salts (mmhos/ centimeter)	25	0.13	0.063	0.06	0.26	48.46
Organic matter (%)	25	7.2	7.21	1.5	29.0	100.14
Erosion (%)	25	2.5	4.52	0	15	182.24
Compaction (kilograms/ centimeter^2)	25	1.6	1.10	0.2	4.2	68.27
Texture of coarse fragments (%)	39	30.9	17.09	5	80	55.30

TABLE 21

SUMMARY STATISTICS FOR ORDINAL VARIABLES MEASURED AT SITES IN THE ALPINE ZONE

Variable	Sample Size	Mean	Standard Deviation
Wind exposure magnitude	39	1.5	0.82
Heat index	39	2.9	1.38
Site moisture regime	39	4.3	1.18
Compaction magnitude	39	1.8	0.78
Erosion intensity index	39	7.6	17.70
Erosion magnitude	39	0.9	0.83
Texture index	39	2.7	0.69
Soil color	39	6.9	2.04

TABLE 22

CORRELATION COEFFICIENTS FOR TOTAL COVER VERSUS CONTINUOUS ENVIRONMENTAL VARIABLES MEASURED AT SITES IN THE ALPINE ZONE

Variable	Product-Moment Correlation Coefficient	Degrees of Freedom	Significance
Age	0.391	37	*
Elevation	-0.222	37	N.S.
Site slope	0.250	37	N.S.
Adjacent site slope	0.311	37	N.S.
Site exposure	0.013	37	N.S.
Adjacent site exposure	-0.065	37	N.S.
pH	0.204	37	N.S.
Nitrates	0.325	23	N.S.
Phosphorus	0.215	23	N.S.
Potassium	0.001	23	N.S.
Calcium	0.176	23	N.S.
Magnesium	0.296	23	N.S.
Salts	0.072	23	N.S.
Organic matter	0.430	23	N.S.
Erosion	-0.302	23	N.S.
Compaction	-0.396	23	N.S.
Texture of coarse fragments	-0.173	37	N.S.

* correlation significant at $p < 0.01$

N.S. not significant

TABLE 23

CORRELATION COEFFICIENTS FOR TOTAL COVER VERSUS ORDINAL ENVIRONMENTAL VARIABLES MEASURED AT SITES IN THE ALPINE ZONE

Variable	Sample Size	Spearman Rank Correlation Coefficient	Significance
Wind exposure magnitude	39	-0.277	N.S.
Heat index	39	-0.048	N.S.
Site moisture regime	39	0.418	*
Compaction magnitude	39	-0.389	N.S.
Erosion intensity index	39	-0.420	*
Erosion magnitude	39	-0.391	N.S.
Texture index	39	0.238	N.S.
Soil color	39	-0.145	N.S.

* correlation significant at $p < 0.01$

N.S. not significant

the only variable displaying a significant negative correlation.

Table 24 provides a summary of the significant correlations found between total cover on a site and the measured environmental variables. Age of a site was found to be positively correlated with total cover in all three analyses. This result was expected and has been confirmed. Increasing elevation results in decreasing cover when all sites are considered, but when the data set is divided into the two zones, the relationship is not significant. Therefore, elevation is not as important a factor within a zone as it is between the two zones.

Magnesium was the only macronutrient measured which showed a significant relationship with cover. This occurred only in the forested zones, in that increasing magnesium concentrations correlated with increasing cover. The reason that none of the other nutrients showed a relationship with cover may have been due to the very low nitrate concentrations in the soils, in conjunction with the principle of limiting factors. That is, the other nutrients were not allowed to "express" themselves because of the very low nitrate levels limiting the growth.

Increasing compaction of a site was correlated with decreasing cover both when all sites were considered and when only sites in the forested zones were analyzed. There was also a fairly strong negative correlation between

TABLE 24

SUMMARY TABLE OF SIGNIFICANT CORRELATIONS*

Variable	All Sites	Forested Zones	Alpine Zone
Age	+	+	+
Elevation	-		
Magnesium		+	
Compaction	-	-	
Compaction magnitude	-	-	
Texture of coarse fragments	-	-	
Texture index	+	+	
Wind exposure magnitude	-		
Site moisture regime	+	+	+
Erosion intensity index			-

*Only variables with at least one significant correlation are summarized in this table.

+ Significant positive correlation ($p < 0.01$)

- Significant negative correlation ($p < 0.01$)

compaction and total cover for the alpine zone, but it was only significant at the 95 percent level. Consequently, it was not included in the summary table. Highly compacted soils primarily influence plant establishment by inhibiting root penetration. Compaction also results in decreased pore space for a particular soil, and this decreases the porosity of the soil to air and water, which could also affect growth.

Both the texture of the coarse fragments (> 2 mm) and the fine fragments were significantly correlated with cover. As the volume of coarse fragments in a soil increased, the cover decreased. Sites with fine textured soils had higher cover than sites with coarse textured soils. Therefore, in both cases, the coarse textured soils were correlated with lower cover. Coarse textured soils have a relatively low water holding capacity and do not have the capability to absorb nutrients as well as finer textured soils. Thus, they tend to show reduced potential for plant growth compared to finer soils.

Magnitude of wind exposure was only significant when all the sites were considered. It was thought that this factor would be important within the alpine zone even if elevation was not important, but apparently it is not. When all the sites are pooled together, this variable could be considered as just another measure of elevation.

Site moisture regime was consistently and

significantly correlated with the total cover on a site. Moisture regime is a composite index which takes into account a number of site factors such as the position on slope, drainage characteristics, texture and depth of the parent material, and the slope and exposure. Increasing moisture is highly correlated with increasing cover in all cases. This would indicate that moisture is limiting the rate of revegetation on some sites in the Peace River Coalfield.

Although three different measurements of erosion on a site were used in this study, only the erosion intensity index showed any significant correlation. As erosion increased in the alpine zone, as measured by the index, the cover decreased. This resulted basically from the direct removal of "habitable" ground. It is very difficult for young plants to become established in rills and gullies once these have formed, due to the continuous erosion which occurs in such topography. The lack of any relationship between erosion and cover in the forested regions was probably because very few sites had a large amount of erosion. Most of the roads sampled had erosion bars installed, even though they had not been seeded.

All the other variables measured did not show a significant correlation with the cover on a site. In some cases, this could have been the result of only a narrow range of possible values being sampled due to the

geographical area of the study and the nature of the sites, but in other cases, there may not be a simple relationship between the variables and total cover.

Practical Interpretations

The results of this study can be used in a number of ways to improve the revegetation of disturbances in northeastern British Columbia and other similar areas. Information is available which could improve both the quality of seed available and the preparation of seedbed for operational revegetation.

Presently in British Columbia, agronomic species are used almost exclusively in the revegetation of disturbances, primarily due to their commercial availability. The advantages to using native species in reclamation have been advocated by numerous individuals, including Johnson & Van Cleve (1976), and Bell & Meidinger (1977). The advantages are primarily that native species have a wider genetic variability, their phenology is better adapted to a specific area and they have a role in the natural succession in an area. In addition, native species can be selected which show adaptations for the range of various site factors, such as elevation, moisture, nutrients, pH, and heavy metal concentration.

A first step in the selection of native species for reclamation is the identification of those species which

most readily invade disturbed sites in a given area. This helps to identify those native species which are best adapted to take advantage of the environmental conditions prevalent on disturbed areas. The species invading disturbed sites in the Peace River Coalfield have been identified and classified into species groups and pioneer community types by this study.

The species groups and the pioneer community types are primarily distributed along elevation and moisture gradients. These pioneer community types define a number of "site-types" to which certain native species are adapted. In selecting native species for revegetation in the Peace River Coalfield, the species with the highest constancy within each of the pioneer community types could be used for reclamation of each site-type. These species can be selected from Table 10, or from the Community Types section of this thesis. A summary of the environmental characteristics associated with each community type or site-type are shown in Table 11.

Nitrogen-fixing species can be very important in the initial stages of succession, especially on such nutrient-poor parent materials. The nitrogen-fixing species invading disturbed sites in the Peace River Coalfield are listed in Table 25.

Practical considerations such as the most efficient method of propagation, and the cost of the propagation

TABLE 25

NITROGEN-FIXING NATIVE SPECIES
COLONIZING DISTURBED SITES IN THE
PEACE RIVER COALFIELD

Alnus viridis

Arctostaphylos uva-ursi

Astragalus americanus

Dryas integrifolia

Hedysarum alpinum

Lathyrus ochroleucus

Lupinus nootkatensis

Oxytropis deflexa

Oxytropis podocarpa

Oxytropis sericea

program versus the commercial demand, would have to be weighed for each potential species by the persons involved in producing the seed. Further research into the autecology of any promising species should be undertaken so that information on rooting depth, biomass production, reproductive capability, optimum germination conditions and competitive ability can be determined for each species. This information could be very useful in determining the role of the different species in the natural successional sequence.

Factors other than the cost and the successional role should be taken into account when selecting native species for revegetation. Depending on the reclamation goals, these may include the erosion control, browse production, or aesthetic enhancement provided by a species or combination of species. Again, more autecological information is required on the species identified by this study to adequately assess these factors.

Improvement of the seedbed for germination and seedling growth can be obtained by a number of methods. Methods of preparing the site prior to seeding and various seeding/fertilizing procedures are fairly well established (BCMMPR, 1978), but the importance of a few variables has been reaffirmed by this study.

The significance of environmental factors such as elevation, moisture and texture (Table 24) in influencing

the rate of revegetation can be lessened by the proper selection of revegetation species. The significance of other factors such as compaction or erosion in limiting plant growth on a site are better alleviated by site preparation techniques. The impact of compaction can be removed by "ripping" any compacted roads or drillsites when leaving an area. Erosion can be minimized by the proper installation of erosion bars and the selection of a suitable species mix.

The low level of nutrients on most sites possibly suggests a need for site fertilization. Although some native species can survive on nutrient poor sites, revegetation rates would probably be improved by fertilization. Fertilizers may be useful in speeding up the ground cover, but if they adversely affect the return of a site to a stable, self-perpetuating system, e.g., by destroying the mycorhizal fungi (Curry, 1977), then it may be unwise to use them. More knowledge of the biogeochemical processes involved in natural plant succession and of the influence of fertilizers on native reestablishment are a necessary prerequisite to the proper use of native species in reclamation.

Revegetation using agronomic species would also likely be improved by fertilization. Errington (1979) showed that fertilization using the standard N-P-K mixture improved growth in almost all cases. This study has shown

that increased Mg levels are associated with higher vegetation cover in the forested zones (Table 24). Therefore, fertilization with a dolomitic limestone could improve revegetation on some sites.

By observing native reestablishment on disturbed areas and the environmental features associated with the most successfully revegetated sites, selection of native species and site preparation methods for man-assisted reclamation may be vastly improved. In this way, it should be possible to establish stable, self-perpetuating ecosystems on the disturbed sites in the Peace River Coalfield at the least long-term cost.

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APPENDICES

APPENDIX A

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APPENDIX B

SPECIES FOUND ON DISTURBED SITES IN THE PEACE RIVER COALFIELD

Lophoziaceae

Lophozia lycopodioides (Wallr.) Cogn.

Marchantiaceae

Marchantia polymorpha L.

Polytrichidae

Polytrichum commune Hedw.

P. juniperinum Hedw.

P. piliferum Hedw.

Bryaceae

Bryum caespiticium Hedw.

Mniaceae

Plagiomnium insigne (Mitt.) Koponen

Entodonaceae

Pleurozium schreberi (Brid.) Mitt.

Equisetaceae

Equisetum arvense L.

E. palustre L.

E. pratense L.

E. scirpoides Michx.

E. sylvaticum L.

Aspleniaceae

Dryopteris assimilis S. Walker

Gymnocarpium dryopteris (L.) Newm.

Pinaceae

Abies lasiocarpa (Hook.) Nutt.

Picea engelmannii Parry

P. glauca (Moench) Voss

P. glauca x *P. engelmannii*

Pinus contorta Doug.

Juncaceae

Juncus drummondii E. Mey.

J. mertensianus Bong.

Luzula arcuata (Wahleng.) Sw. subsp. *unalaschkensis* (Buchenau) Hult.

L. parviflora (Ehrh.) Desv.

L. piperi (Cov.) M. E. Jones

L. spicata (L.) DC.

Cyperaceae

Carex albonigra Mack.

C. atrosquama Mack.

C. brunnescens (Pers.) Poir.

C. macrochaeta C. A. Mey.

C. media R. Br.

C. mertensii Prescott

C. microptera Mack.

C. phaeocephala Piper

C. podocarpa R. Br.

C. praticola Rydlb.

C. rossii Boott

Poaceae

Agropyron sibiricum (Willd.) Beauv. (sn. *A. desertosum* (Fischer ex. Link) Schult.)

A. violaceum (Hornem.) Lange

Agrostis exarata Trin.

A. mertensii Trin.

A. scabra Willd.

A. variabilis Rydb.

Alopecurus aequalis Sobol. subsp. *aequalis*

Bromus inermis Leyss. subsp. *pumpellianus* (Scribn.) Wagnon

B. richardsonii Link

Calamagrostis canadensis (Michx.) Beauv.

C. lapponica (Wahlenb.) Hartm.

Cinna latifolia (Triv.) Griseb.

Elymus glaucus Buckl.

E. innovatus Beal var. *innovatus*

Festuca altaica Trin.

F. baffinensis Polunin

F. brachyphylla Schult.

F. rubra L.

Hierochloe alpina (Sw.) Roem. & Schult. subsp. *alpina*

Lolium multiflorum Lam.

Phleum alpinum L. var. *commutatum* (Gaudin) Griseb.

P. pratense L.

Poa alpina L.

P. arctica R. Br.

P. glauca M. Vahl.

P. interior Rydb.

P. leptocoma Trin.

P. palustris L.

P. pratensis L.

P. reflexa Vasey & Scribn.

Sphenopholis obtusata (Michx.) Scribn. var. *major* (Torr.) Erdman

Trisetum spicatum (L.) Richter

Vahlodea atropurpurea (Wahlenb.) E. Fries

Liliaceae

Maianthemum canadense Desf.

Smilacina racemosa (L.) Desf.

S. stellata (L.) Desf.

Streptopus amplexifolius (L.) DC.

Veratrum viride (Ait.) subsp. *eschscholtzii* (Gray) Love & Love.

Orchidaceae

Platanthera hyperborea (L.) Lindl. (sn. *Habenaria hyperborea* (L.) R. Br.)

Salicaceae

Populus balsamifera L.

P. tremuloides Michx.

Salix alaxensis (Anderss.) Cov.

S. arbusculoides Anderss.

S. arctica Pall.

S. barclayi Anderss.

S. discolor Muhl.

S. glauca L.

S. lasiandra Benth.

S. polaris Wahlenb.

S. reticulata L.

S. scouleriana Barratt

S. sitchensis Sanson

Betulaceae

Alnus viridis (Chaix.) DC. (sn. *A. crispa* (Ait.) Pursh)

Betula glandulosa Michx.

Urticaceae

Urtica dioica L.

Polygonaceae

Bistorta vivipara (L.) S. F. Gray (sn. *Polygonum viviparum* L.)

Koenigia islandica L.

Oxyria digyna (L.) Hill

Rumex acetosa L.

Chenopodiaceae

Chenopodium capitatum (L.) Aschers.

Caryophyllaceae

Cerastium arvense L.

C. beeringianum Cham. & Schlecht.

Minuartia rossii (R. Br.) Graebner

M. rubella (Wahlenb.) Hiern

Moehringia lateriflora (L.) Fenzl

Silene acaulis (L.) Jacq.

S. involucrata (Cham. & Schlecht.) Bocquet subsp. *involucrata* (sn. *Melandrium affine* J. Vahl)

Stellaria calycantha (Ledeb.) Bong.

S. longipes Goldie

Ranunculaceae

Aconitum delphinifolium DC.

Anenome parviflora Michx.

Aquilegia formosa Fisch. subsp. *formosa*

Caltha leptosepala DC

Delphinium brachycentrum Ledeb.

D. glaucum S. Wats.

Ranunculus eschscholtzii Schlecht.

R. nivalis L.

R. occidentalis Nutt.

R. uncinatus D. Don

Thalictrum occidentale Gray

Papaveraceae

Papaver kluanense D. Love

Fumariaceae

Corydalis aurea Willd. subsp. *aurea*

C. sempervirens (L.) Pers.

Brassicaceae

Arabis divaricarpa Nels. var. *divaricarpa*

A. drummondii Gray

A. holboellii Hornem.

Cardamine bellidifolia L. subsp. *bellidifolia*

C. pensylvanica Muhl.

Draba aurea Vahl.

D. borealis DC.

D. crassifolia Graham

D. incerta Payson

D. lonchocarpa Rydb.

D. nivalis Liljebl.

D. oligosperma Hook.

D. stenoloba Ledeb.

Crassulaceae

Sedum lanceolatum Torr.

Saxifragaceae

Chrysosplenium tetrandrum (Lund) T. Fries

Mitella nuda L.

M. pentandra Hook.

Saxifraga adscendens L. subsp. *oregonensis* (Ruf.) Bacigalupi

S. caespitosa L.

S. ferruginea Graham

S. lyallii Engler

S. tricuspidata Rottb.

Tiarella trifoliata L.

Parnassiaceae

Parnassia fimbriata Konig

Grossulariaceae

Ribes glandulosum Grauer

Ribes lacustre (Pers.) Poir.

Rosaceae

Amelanchier alnifolia (Nutt.) Nutt.

Dryas integrifolia M. Vahl

Frageria virginiana Duchesne

Geum macrophyllum Willd. var. *macrophyllum*

Potentilla diversifolia Lehm.

P. nivea L.

P. villosa Pall.

Rosa acicularis Lindl.

Rubus idaeus L. subsp. *melanolasius* (Dieck) Focke

R. parviflorus Nutt. subsp. *parviflorus*

R. pedatus Sm.

R. pubescens Raf.

Sanguisorba canadensis L. supsp. *latifolia* (Hook.) Calder & Taylor (sn. *S. sitchensis* C. A. Mey.)

Sibbaldia procumbens L.

Sorbus scopulina Greene

Spiraea betulifolia (Ledeb.) Bong.

Fabaceae

Astragalus alpinus L. subsp. *alpinus*

A. americanus (Hook.) M. E. Jones

Hedysarum alpinum L. subsp. *americanum* (Michx.) Fedtsch.

Lathyrus ochroleucus Hook.

Lupinus nootkatensis Donn

Oxytropis deflexa (Pall.) DC.

O. podocarpa Gray

O. sericea Nutt.

Trifolium hybridum L.

Vicia americana Muhl.

Geraniaceae

Geranium bicknellii Britt.

G. richardsonii Fisch. & Trautv.

Violaceae

Viola orbiculata Geyer

Elaeagnaceae

Shepherdia canadensis (L.) Nutt.

Onagraceae

Epilobium alpinum L.

E. angustifolium L.

E. glandulosum Lehm.

E. latifolium L.

Araliaceae

Aralia nudicaulis L.

Apiaceae

Heracleum sphondylium L. subsp. *montanum* (Gaudin) Brig. (sn. *Heracleum lanatum* Michx.)

Osmorhiza depauperata Phillippi

Cornaceae

Cornus canadensis L.

Pyrolaceae

Orthilia secunda (L.) House (sn. *Pyrola secunda* L.)

Pyrola asarifolia (Michx.)

Ericaceae

Arctostaphylos uva-ursi (L.) Spreng.

Rhododendron albiflorum Hook.

Vaccinium membranaceum Doug.

V. myrtillus L.

V. uliginosum L.

V. vitis-idaea L.

Primulaceae

Androsace septentrionalis L.

Gentianaceae

Gentianella amarella (L.) Borner subsp. *acuta* (Michx.) Gillett

Apocynaceae

Apocynum androsaemifolium L.

Polemoniaceae

Polemonium caeruleum L. (sn. *P. acutiflorum* Willd.)

Boraginaceae

Hackelia micrantha (Eastw.) Gentry

Mertensia paniculata (Ait.) D. Don

Myosotis asiatica (Vestergr.) Schischk. & Serg. (sn. *M. alpestris* F. W. Schmidt subsp. *asiatica* Vestergr.)

Lamiaceae

Dracocephalum parviflorum Nutt.

Scrophulariaceae

Castilleja miniata Dougl.

C. sulphurea Rydb.

Pedicularis bracteosa Benth.

Rhinanthus minor L.

Vernonica americana Schwein.

V. serpyllifolia L.

V. wormskjoldii Roem. & Schult. var. *wormskjoldii*

Plantaginaceae

Plantago major L.

Rubiaceae

Galium boreale L.

G. triflorum Michx.

Caprifoliaceae

Linnaea borealis L.

Lonicera involucrata (Richards.) Banks

Sambucus racemosa L.

Viburnum edule (Michx.) Raf.

Valerianaceae

Valeriana sitchensis Bong.

Campanulaceae

Campanula lasiocarpa Cham. subsp. *lasiocarpa*

Asteraceae

Achillea millefolium L.

Agoseris aurantiaca (Hook.) Greene var. *aurantiaca*

Anaphalis margaritacea (L.) Benth. & Hook.f.

Antennaria microphylla Rydb. (sn. *A. rosea* Greene)

A. neglecta Greene

A. umbrinella Rydb.

Arnica alpina (L.) Olin

A. cordifolia Hook.

A. latifolia Bong.

Artemisia arctica Less. subsp. *arctica*

A. michauxiana Bess.

Aster conspicuus Lindl.

A. foliaceous Lindl.

A. sibiricus L.

A. subspicatus Nees

Chamomilla suaveolens (Pursh) Rydb. (sn. *Matricaria matricarioides* (Less.) Porter)

Crepis nana Richards.

Erigeron acris L.

E. compositus Pursh

E. humilis Graham

E. peregrinus (Pursh) Greene

E. philadelphicus L.

Hieracium albiflorum Hook.

H. canadense Michx.

H. gracile Hook.

Petasites palmatus (Ait.) Gray

Senecio lugens Richards.

S. pauperculus Michx.

S. triangularis Hook.

Solidago canadensis L.

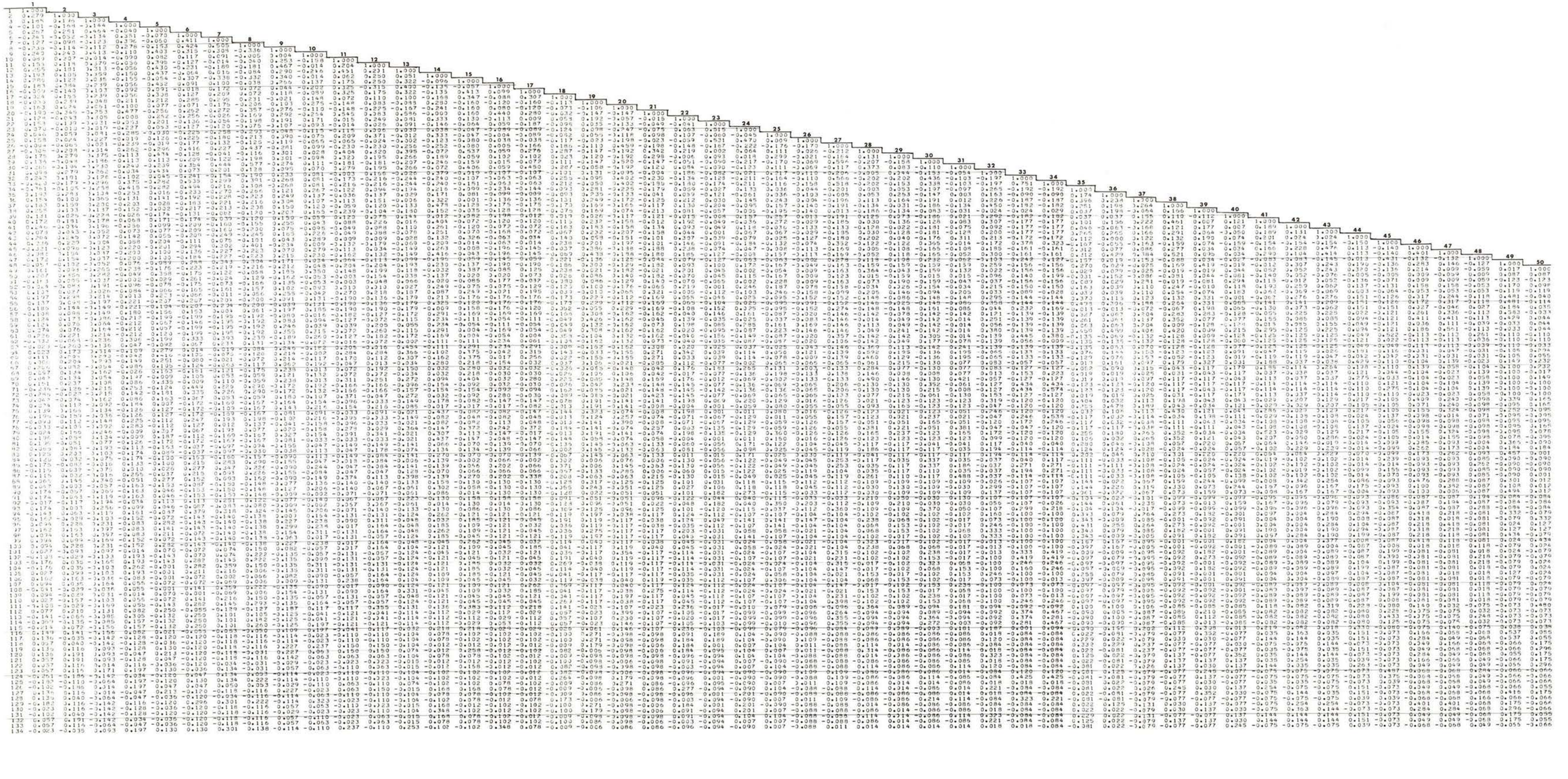
S. multiradiata Ait.

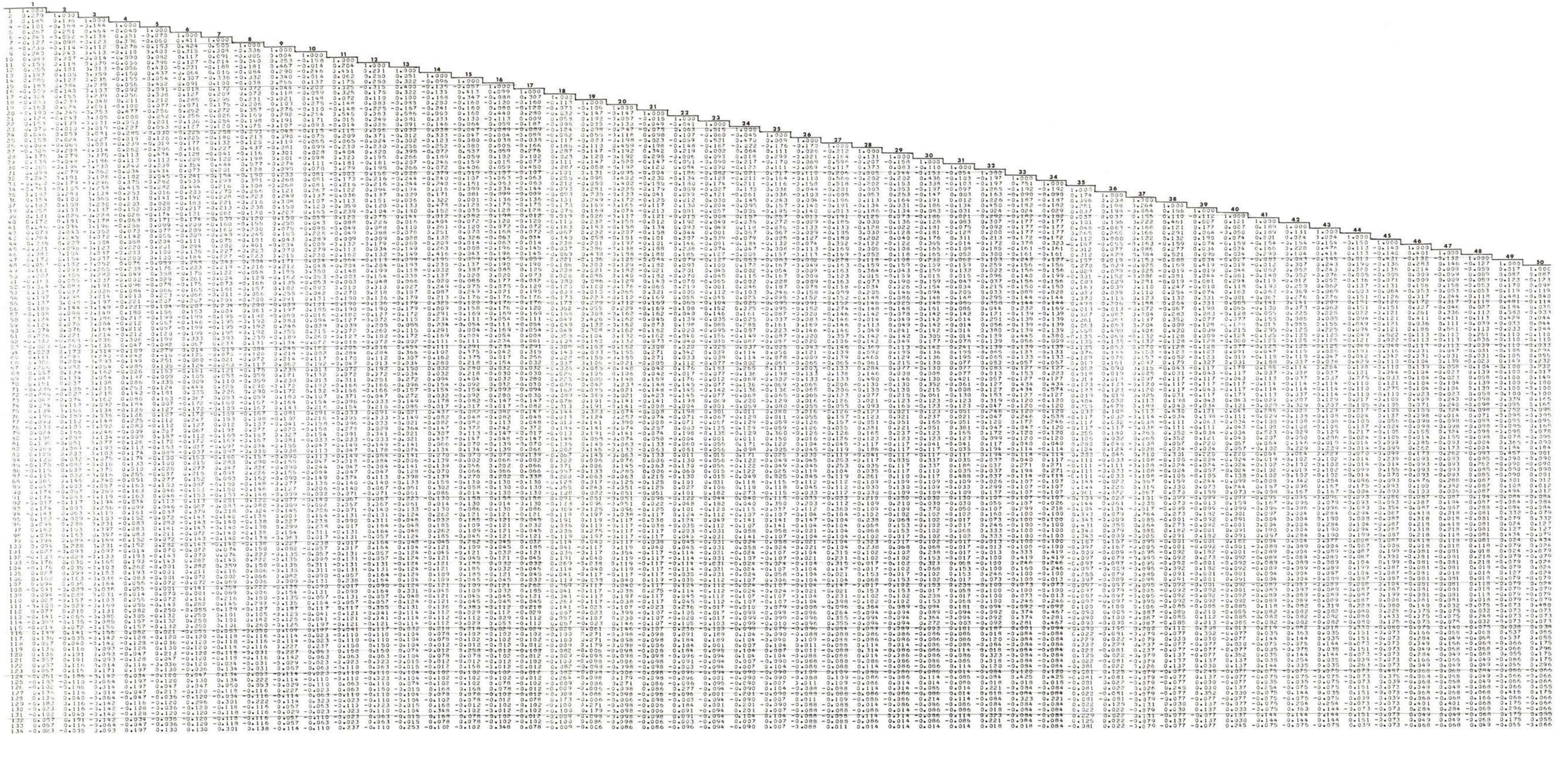
Taraxacum officinale Web.

APPENDIX C

INTERSPECIES CORRELATIONS

Point correlation coefficients for all species pairs.
See Table 5 for species names associated with numbers.





APPENDIX D

ANALYSIS OF VARIANCE COMPARISON FOR AGES OF COMMUNITY TYPES

H_o: there is no difference in the ages of the different community types

$\alpha = 0.01$

Analysis of Variance Summary Table

Source of Variation	df	SS	MS	F	P
Among groups	12	55.41	4.617	1.947	0.036
Within groups	108	256.09	2.371		
Total	120	311.50			

APPENDIX E

CORRELATION MATRIX FOR ENVIRONMENTAL VARIABLES[1]

Abbreviations for Environmental Variables:

COVER	- Cover
AGE	- Age
ELEV	- Elevation
SITE SLOPE	- Site slope
ADJ ST SLP	- Adjacent site slope
SITE EXP	- Site exposure
ADJ ST EXP	- Adjacent site exposure
pH	- pH
N	- Nitrates
P	- Phosphorus
K	- Potassium
Ca	- Calcium
Mg	- Magnesium
ORG MATTER	- Organic matter content
SALTS	- Salts
% EROSHN	- Percent erosion
COMPACTION	- Compaction
CRS FRAG	- Texture of coarse fragments
WND MAG	- Wind exposure magnitude
HEAT	- Heat index
SITE MOIST	- Site moisture regime
COMP MAG	- Compaction magnitude
ERSHN INDX	- Erosion intensity index
ERSHN MAG	- Erosion magnitude
SOIL COLOR	- Soil color

---

[1] See Table 3 and 4 for an explanation of each variable.

NUMBER OF OBSERVATIONS FOR EACH CORRELATION[1]

	Cover	Age	Elevation	Site Slope	Adjacent Site Slope	Site Exposure	Adjacent Site Exposure	pH	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Organic Matter	Salts	Percent Erosion	Compaction	Coarse Fragments	Wind Magnitude	Heat Index	Site Moisture Regime	Compaction Magnitude	Erosion Index	Erosion Magnitude	Texture	Soil Color
Cover	141																									
Age	141	141																								
Elevation	141	141	141																							
Site Slope	141	141	141	141																						
Adj.St.Slp.	141	141	141	141	141																					
Site Exp.	141	141	141	141	141	141																				
Adj.St.Exp.	141	141	141	141	141	141	141																			
pH	141	141	141	141	141	141	141	141																		
N	103	103	103	103	103	103	103	103	103																	
P	103	103	103	103	103	103	103	103	103	103																
K	103	103	103	103	103	103	103	103	103	103	103															
Ca	103	103	103	103	103	103	103	103	103	103	103	103														
Mg	103	103	103	103	103	103	103	103	103	103	103	103	103													
Org.Matter	103	103	103	103	103	103	103	103	103	103	103	103	103	103												
Salts	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103											
% Ershn.	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103										
Compaction	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103									
Crs.Frag.	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141								
Wnd.Mag.	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141							
Heat	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141						
Site Moist.	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141	141					
Comp.Mag.	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141	141	141				
Ershn.Indx.	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141	141	141	141			
Ershn.Mag.	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141	141	141	141	141		
Texture	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141	141	141	141	141	141	
Soil Color	141	141	141	141	141	141	141	141	103	103	103	103	103	103	103	103	103	141	141	141	141	141	141	141	141	141

[1]Unshaded area represents product-moment correlation coefficients and the shaded area represents Spearman rank correlation coefficients.

For n = 141, df = 139 and critical value for $r_{0.01(2),139} = 0.1656$.

For n = 103, df = 101 and critical value for $r_{0.01(2),101} = 0.2548$

The critical values can be used for both correlation coefficients due to the large sample size (Zar, 1974).

	Cover	Age	Elevation	Site Slope	Adjacent Site Slope	Site Exposure	Adjacent Site Exposure	pH	N	P	K	Ca	Mg	Organic Matter	Salts	% Ershn.	Compaction	Crs.Frag.	Wnd.Mag.	Heat	Site Moist.	Comp.Mag.	Ershn.Indx.	Ershn.Mag.	Texture	Soil Color
Cover	1.0000																									
Age	0.3308	1.0000																								
Elevation	-0.2472	0.0640	1.0000																							
Site Slope	0.0723	0.2018	0.0564	1.0000																						
Adj.St.Slp.	0.0758	0.0043	0.1273	0.4305	1.0000																					
Site Exp.	-0.0054	0.0790	-0.0093	-0.0330	-0.0042	1.0000																				
Adj.St.Exp.	0.0349	0.0689	0.0814	-0.0731	0.1034	0.6636	1.0000																			
pH	0.1454	-0.0920	-0.2094	0.1113	0.3664	0.0072	0.1220	1.0000																		
N	-0.0497	-0.3548	0.0256	0.0915	0.0815	-0.0123	-0.0656	0.1973	1.0000																	
P	-0.1202	0.0021	-0.0733	-0.0106	-0.0939	-0.0069	-0.1011	-0.3976	-0.1865	1.0000																
K	0.0755	-0.0074	-0.1870	0.2557	0.2385	-0.0907	-0.0404	0.1734	-0.1303	0.3570	1.0000															
Ca	0.0948	-0.2536	-0.1119	0.1751	0.3850	0.0049	0.1069	0.7461	0.3697	-0.3856	0.1501	1.0000														
Mg	0.1874	-0.2315	0.9050	0.2779	0.4485	0.0418	0.2092	0.6182	0.3316	-0.4065	0.1908	0.7860	1.0000													
Org.Matter	0.2070	-0.1892	0.2564	0.1780	0.2761	0.0486	0.1506	0.1394	0.3831	-0.1815	-0.0303	0.5198	0.5802	1.0000												
Salts	0.0912	-0.2404	-0.4266	0.0534	0.2880	-0.0042	0.0407	0.7874	0.3058	-0.2787	0.2073	0.8183	0.4955	0.1767	1.0000											
% Ershn.	-0.0405	-0.1575	-0.0042	0.1607	0.0366	0.1575	0.2071	-0.0038	-0.0226	-0.0292	0.0408	0.0550	0.1052	-0.0037	0.0070	1.0000										
Compaction	-0.2992	-0.3395	-0.3231	-0.2197	-0.2039	-0.0783	-0.1517	0.0375	0.0114	0.3073	0.0627	0.0156	-0.2276	-0.2805	0.2260	0.0713	1.0000									
Crs.Frag.	-0.2610	-0.1002	-0.1203	0.0635	0.0756	-0.0072	0.0227	0.0970	-0.1596	0.2269	0.2919	-0.0300	0.0112	-0.1319	0.0954	-0.0893	0.1957	1.0000								
Wnd.Mag.	-0.3039	-0.0848	0.6852	0.0222	-0.0210	0.0437	0.0765	-0.0137	0.3267	-0.1902	-0.0252	0.0835	0.1855	0.2631	-0.0310	0.0268	-0.1622	-0.0467	1.0000							
Heat	-0.0021	0.0402	-0.0596	-0.1410	-0.0148	0.9162	0.6275	-0.0315	-0.0691	0.1275	-0.0579	-0.0118	0.0257	0.0900	-0.0361	0.0946	-0.0659	-0.0420	0.0125	1.0000						
Site Moist.	0.5744	0.1766	-0.0654	-0.1602	-0.1414	0.1086	0.1288	-0.1158	-0.2429	-0.0979	-0.1236	-0.0151	0.0537	0.2545	0.0199	0.2288	-0.1990	-0.3930	-0.2554	0.1269	1.0000					
Comp.Mag.	-0.3306	-0.3663	-0.2496	-0.1810	-0.0303	0.0247	-0.0753	0.0778	0.1323	0.1589	0.0812	0.0067	-0.1026	-0.2253	0.0999	-0.0288	0.6886	0.3774	-0.0966	-0.0077	-0.2849	1.0000				
Ershn.Indx.	-0.0026	-0.1004	0.0868	0.2831	0.0312	0.0033	0.1125	-0.0016	0.0791	-0.2037	-0.0337	0.1042	0.1251	0.1236	0.0554	0.9660	0.0117	-0.1452	0.0323	0.0100	0.1623	-0.0209	1.0000			
Ershn.Mag.	-0.0958	0.0579	0.1568	0.3567	0.0624	0.0078	0.1145	0.0069	-0.0673	-0.1602	-0.0069	0.0969	0.1235	0.0742	-0.0244	0.7944	0.0010	0.0357	0.0101	-0.0285	0.0476	-0.0148	0.8020	1.0000		
Texture	0.3787	0.0943	-0.0970	0.0453	-0.0964	-0.0511	-0.0004	0.1074	0.0752	-0.4129	-0.1604	0.1863	0.0945	0.2058	0.1419	0.2146	-0.1608	-0.4330	-0.0664	-0.0274	0.3466	-0.2120	0.1615	0.1078	1.0000	
Soil Color	-0.1467	0.1177	-0.1274	-0.0235	-0.3105	-0.1152	-0.1845	-0.3067	-0.1015	0.2377	-0.1037	-0.4900	-0.5463	-0.7021	-0.3284	-0.1230	0.0814	-0.0305	-0.1249	-0.0634	-0.0422	-0.0664	-0.1554	-0.0728	-0.1109	1.0000

APPENDIX F

COMPLETE VEGETATION TABLE

Community Types:

1. Festuca Community Type
2. Festuca/Poa Community Type
3. Poa Community Type
4. Poa/Arnica Community Type
5. Poa/Epilobium Community Type
6. Poa/Arnica/Epilobium Community Type
7. Arnica Community Type
8. Arnica/Epilobium Community Type
9. Epilobium Community Type
10. Epilobium/Populus Community Type
11. Populus Community Type
12. Populus/Rosa Community Type
13. Rosa Community Type
14. single transitional plot
15. single transitional plot
16. excluded plots

VITA

Surname: MEIDINGER Given Names: DELLIS VERN

Place of Birth: CALGARY, ALBERTA Date of Birth: SEPTEMBER 13,1953

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Publications:

Meidinger, D. V. 1979. Natural revegetation of disturbances in the Peace River Coalfield. *In:* Reclamation of Lands Disturbed by Mining. Proceedings of the Third Annual British Columbia Mine Reclamation Symposium, Vernon, B.C. March 7-9, 1979. B.C. Ministry of Energy, Mines and Petroleum Resources Paper 1979-4; pp. 273-308.

Bell, M. A. M. and D. V. Meidinger. 1977. Native species in reclamation of disturbed lands. *In:* Reclamation of Lands Disturbed by Mining. Proceedings of the British Columbia Mine Reclamation Symposium, Vernon, B.C., March 16-18, 1977. pp. 143-158.

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Title of Thesis/Dissertation

NATURAL REVEGETATION OF DISTURBANCES IN THE

PEACE RIVER COALFIELD

Author [redacted]
Signature

Dellis Vern Meidinger
Name

April 1, 1981
Date

PIONEER COMMUNITIES — REWRITING MODE

	1							2																		3											
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	
	2	3	7	8	9	0	2	1	2	4	4	7	7	8	8	8	8	9	9	0	0	0	1	3	1	2	2	2	3	3	6	7	9	9	9	0	1
	5	9	6	3	5	0	7	6	2	1	4	8	9	4	6	7	8	0	2	1	7	8	2	0	7	1	3	4	6	7	8	7	1	3	4	9	0
NO. OF SSP.	2	0	1	1	1	0	0	2	2	2	2	0	2	2	1	1	1	2	1	1	2	1	3	2	1	2	1	1	1	0	1	1	1	1	1	1
	5	6	4	3	1	8	3	2	2	0	4	8	2	3	3	7	8	6	5	2	3	5	1	1	0	1	5	3	0	7	6	0	4	2	0	2	5
GROUP 1																																				
20 FESTUCA BRACHYPHYLLA	1	1	1	+	1	1	2	+	+			1	1	1		1	2	2		1		1	1		1		1	1	+			1			+	
27 STELLARIA LONGIPES	+		1	+	1	+	1	1	+	1		+	+	+	+	+	1		2	+	+	1	1	1									+	2		1	
30 LUZULA SPICATA			+			2	1		+	+	+	-	+	+		+	1	1	2	+	1	1	+	-	-			+						2	1	
33 CERASTIUM BEERINGIANUM	-	1	1	+	-			-	+		1		1		+	+	1	1	+	1	2	1	+	2						-	2				
34 MINUARTIA RUBELLA	+	+	1	1	1			+	-	+	+		1	1	1		1	1			1		1	1			-		-	1				1	
GROUP 2																																				
6 POA ALPINA	1	-		1	2				1	1	1	+	+		1	+	2	2	1		2	1	1	2		1	1	1		1	2			1	1	+	1
7 ARTEMISIA ARCTICA								+	+	+	+			+		1	1	1	1	-	1	+	+		1	1	+	+	+	+	+	+	-	1	2	+	1
8 POA ARCTICA			+			1		2		+	+	+	+	1	+	1		2	1	2	2	1	1	2	1		1		+		+	+	1	2		1	
GROUP 3																																				
11 ARNICA LATIFOLIA																						1														
13 LUPINUS NOOTKATENSIS																											+									
21 VAHLODEA ATROPURPUREA																																				
GROUP 4																																				
3 EPILOBIUM ALPINUM												-																								
5 SENECIO TRIANGULARIS																									3	-										
9 CAREX MERTENSII																																				
12 LUZULA PARVIFLORA																			1																	

GROUP 5																																					
38 POPULUS BALSAMIFERA																																					
41 ANAPHALIS MARGARITACEA																																					
47 RUBUS IDAEUS																																					
GROUP 6																																					
49 ROSA ACICULARIS																																					
55 ASTER CONSPICUUS																																					
56 LATHYRUS OCHROLEUCUS																																					
58 SPIRAEA BETULIFOLIA																																					
ACCOMP.SPEC.																																					
1 EPILOBIUM ANGUSTIFOLIUM	2				1							-		+			+	1	1						1	1	1					+	2	2	1		3
2 EQUISETUM ARVENSE	+									2	+			+	1			1					1	1		2									+	+	2
4 TRISETUM SPICATUM	+		+	1	-			2	-	+		+	1			1	1	2		1	1		+	1	+		-	-		1	+	1					+
10 MERTENSIA PANICULATA	1								+	1	+			+					+		+		1	1		1								2			2
14 ALNUS VIRIDIS																																					
15 SANGUISORBA CANADENSIS	-															+							+			+							+				+
16 LUZULA PIPERI			+						-					+							1	+					1					+					
17 PHLEUM ALPINUM										+	1											+						+	+			1					
18 ACONITUM DELPHINIFOLIUM								-		+					+	1	1	+		-	1			+		+					+			1		-	1
19 ARNICA CORDIFOLIA	+								-		+																-										
22 CALAMAGROSTIS CANADENSIS																	1												+					1	1		
23 PHLEUM PRATENSE																		1		+						+	1										
24 TRIFOLIUM HYBRIDUM																																					
25 ABIES LASIOCARPA																							-														
26 FESTUCA RUBRA											+									+																	
28 VALERIANA SITCHENSIS																										+											
29 VACCINIUM MEMBRANACEUM																																					
31 ERIGERON PEREGRINUS											-			-												+							+				
32 TARAXACUM OFFICINALE																																					
35 PETASITES PALMATUS																																					

No.	Species																																						
39	ELYMUS INNOVATUS	1							1						1				1																			
40	CAREX ROSSII																																						
42	AGROSTIS SCABRA																																						
43	CINNA LATIFOLIA																																						
44	THALICTRUM OCCIDENTALE																										2											+	
45	BISTORTA VIVIPARA								1		-			+		+	1	1	1	+				+	1	+						1							
46	GALIUM TRIFLORUM																																						
48	SALIX ARCTICA								+			-				+	+	1		+				1		-	1								1				
50	HERACLEUM SPHONDYLIUM																																						
51	CARDAMINE PENSYLVANICA				-	+						-		-									1					+	-								+		
52	POLYTRICHUM JUNIPERINUM																																						
53	SALIX DISCOLOR																																						
54	SALIX BARCLAYI																							1															
57	ACHILLEA MILLEFOLIUM	+			-		+							+			1							+	1													1	
59	OSMORHIZA DEPAUPERATA																																						
60	EQUISETUM SYLVATICUM																																						
61	RIBES LACUSTRE																																						
62	POTENTILLA DIVERSIFOLIA								-	-	+						1	2				+		+	+							1						+	
63	SAXIFRAGA FERRUGINEA					+														+		+				1				1			1	1		2			
64	JUNCUS DRUMMONDII																																						
65	VERATRUM VIRIDE																																						
66	JUNCUS MERTENSIANUS																																						
67	CASTILLEJA MINIATA	+																																					
68	CAREX MICROPTERA																																						
69	EQUISETUM SCIRPOIDES	1								+						1								+			1												
70	PEDICULARIS BRACTEOSA																										-												
71	SILENE ACAULIS		-							1		+								+		1		1	1			+	-										
72	FESTUCA BAFFINENSIS										+	-			+	1				1					1				1		-	2							
73	HIERACIUM GRACILE																																						
74	RUBUS PUBESCENS																																						
75	RUBUS PEDATUS																																						
76	HIERACIUM ALBIFLORUM																																						
77	ASTRAGALUS ALPINUS	1									+	+			+				1					+					+										

78	AGROSTIS MERTENSII			1	1								1	+					1										+				2						
79	RANUNCULUS OCCIDENTALIS																					–																	
80	PICEA GLAUCA X ENGELMANNII																																						
81	PINUS CONTORTA																																						
82	FRAGERIA VIRGINIANA	1										–																											
83	STELLARIA CALYCANTHA																																						
84	PICEA GLAUCA																																						
85	FESTUCA ALTAICA									+	+													+											+					
86	OXYRIA DIGYNA									+		1			+							1	+	1			+												
87	CAREX PHAEOCEPHALA			+	–														1					+					+										
88	VERONICA WORMSKJOLDII																																						
89	GERANIUM BICKNELLII																																						
90	SALIX SCOULERIANA																																						
91	ASTER SUBSPICATUS																																						
92	CAREX MACROCHAETA																										–						2						
93	ORTHILIA SECUNDA																																						
94	CAREX PODOCARPA										+						+	1						1	1									+					
95	RUBUS PARVIFLORUS																																						
96	RANUNCULUS UNCINATUS																																						
97	GYMNOCARPIUM DRYOPTERIS																																						
98	AQUILEGIA FORMOSA																																						
99	VICIA AMERICANA																																						
100	MITELLA PENTANDRA																																						
101	CAREX BRUNNESCENS																									+				–			1						
102	ANDROSACE SEPTENTRIONALIS			+	+				1					1	–				1																				
103	SOLIDAGO MULTIRADIATA	+							+			–							+						+							–							
104	MYOSOTIS ASIATICA									–	+						–					1		1			+												
105	DRABA BOREALIS	–								–					+												–											+	
106	POA PRATENSIS																										+						2						
107	PICEA ENGELMANNII																																						
108	RUMEX ACETOSA										–							+												+				+					
109	CALAMAGROSTIS LAPPONICA						1																																
110	LUZULA ARCUATA						1										1		1															+		1			

112	PARNASSIA FIMBRIATA																						
113	DRABA AUREA	-		+	-			-			+								-				
114	CAMPANULA LASIOCARPA		-					-		+	+	1											
115	DRABA INCERTA					-			+							+	+					+	
116	GENTIANELLA AMARELLA	+							-														
117	POPULUS TREMULOIDES																						
118	VIBURNUM EDULE																						
119	STREPTOPUS AMPLEXIFOLIUS																						
120	ELYMUS GLAUCUS																						
121	GEUM MACROPHYLLUM																						
122	POA INTERIOR																						
123	AGOSERIS AURANTIACA																						
124	ARNICA ALPINA				+																1		
125	OXYTROPIS SERICEA				+			-			2										+		
126	ANTENNARIA UMBRINELLA												+					-					
127	SALIX SITCHENSIS																						
128	GALIUM BOREALE																						
129	SENECIO LUGENS						-							1		-							-
130	EPILOBIUM GLANDULOSUM																						
131	ALOPECURUS AEQUALIS																						
132	BROMUS RICHARDSONII																						
133	POA PALUSTRIS																						
134	SIBBALDIA PROCUMBENS														1								
135	MAIANTHEMUM ~~DILATATUM~~ CANADENSE																						
136	CHAMOMILLA SUAVEOLENS																						
137	SAXIFRAGA TRICUSPIDATA				+			-	+		+												
138	HEDYSARUM ALPINUM				+																+		
139	MARCHANTIA POLYMORPHA																						
140	AGROSTIS VARIABILIS																						
141	ARALIA NUDICAULIS																						
142	POA REFLEXA																						
143	ASTER FOLIACEOUS																						
144	POTENTILLA VILLOSA				-			-												-			
145	SALIX RETICULATA				+		-																

146	SALIX POLARIS		- -	-
147	SALIX GLAUCA	1 1		
148	ARCTOSTAPHYLOS UVA-URSI	+		
149	BROMUS INERMIS	1		2
150	CAREX ATROSQUAMA		+	
151	SAMBUCUS RACEMOSA			
152	CERASTIUM ARVENSE		1	
153	RHINANTHUS MINOR			
154	SEDUM LANCEOLATUM	-		
155	ERIGERON ACRIS			
156	AGROPYRON VIOLACEUM		1	
157	SOLIDAGO CANADENSIS			
158	CAREX MEDIA			
159	OXYTROPIS PODOCARPA		- -	+
160	DRABA NIVALIS		- +	-
161	CAREX ALBONIGRA		+ 1 +	
162	CREPIS NANA		+	
163	CALTHA LEPTOSEPALA			
164	SALIX ALAXENSIS			+
165	VACCINIUM MYRTILLUS			
166	CORYDALIS AUREA			
167	PYROLA ASARIFOLIA			
168	VERONICA SERPYLLIFOLIA			
169	SHEPHERDIA CANADENSIS			
170	RIBES GLANDULOSUM			
171	RHODODENDRON ALBIFLORUM			
172	DELPHINIUM GLAUCUM			- 1
173	POA GLAUCA			
174	TIARELLA TRIFOLIATA			
175	ANTENNARIA MICROPHYLLA			
176	CASTILLEJA SULPHUREA			
177	ARABIS DRUMMONDII			
178	AGROSTIS EXARATA			

179	DRABA OLIGOSPERMA		-	
180	SILENE INVOLUCRATA		+ +	
181	HIEROCHLOE ALPINA	1		-
182	POLYTRICHUM COMMUNE			
183	DRABA CRASSIFOLIA		+ -	
184	CHRYSOSPLENIUM TETRANDRUM			
185	PLAGIOMNIUM INSIGNE			
186	DRYAS INTEGRIFOLIA		+	
187	VACCINIUM ULIGINOSUM			
188	BETULA GLANDULOSA			
189	VACCINIUM VITIS-IDAEA			
190	CORYDALIS SEMPERVIRENS			
191	SORBUS SCOPULINA			
192	POLYTRICHUM PILIFERUM			
193	ANENOME PARVIFLORA			-
194	DRABA STENOLOBA		+	
195	EQUISETUM PRATENSE		+	
196	ANTENNARIA NEGLECTA			
197	SAXIFRAGA LYALLII			
198	DRYOPTERIS ASSIMILIS			
199	LOPHOZIA LYCOPODIOIDES			
200	LONICERA INVOLUCRATA			
201	VIOLA ORBICULATA			
202	SENECIO PAUPERCULUS			
203	SALIX LASIANDRA			
204	MITELLA NUDA			
205	SMILACINA RACEMOSA			
206	ARTEMISIA MICHAUXIANA			
207	AMELANCHIER ALNIFOLIA			
208	HIERACIUM CANADENSE			
209	ARABIS DIVARICARPA			
210	PAPAVER KLUANENSE	+		
211	AGROPYRON SIBIRISOCUM			
212	DELPHINIUM BRACHYCENTRUM			

214	GERANIUM RICHARDSONII						
215	HACKELIA MICRANTHA						
216	LINNAEA BOREALIS						
217	URTICA DIOICA						
218	VERONICA AMERICANA						
219	DRACOCEPHALUM PARVIFLORUM						
220	APOCYNUM ANDROSAEMIFOLIUM						
221	SMILACINA STELLATA						
222	OXYTROPIS DEFLEXA						
223	CHENOPODIUM CAPITATUM						
224	ARABIS HOLBOELLII						
225	ERIGERON PHILADELPHICUS						
226	PLANTAGO MAJOR						
227	SPENOPHOLIS OBTUSATA						
228	BRYUM CAESPITICIUM						
229	PLEUROZIUM SCHREBERI						
230	PLATANTHERA HYPERBOREA						
231	ASTER SIBIRICUS						
232	MOEHRINGIA LATERIFLORA						
233	POTENTILLA NIVEA			+			
234	DRABA LONCHOCARPA		+				
235	EQUISETUM PALUSTRE						
236	POA LEPTOCOMA						
237	SAXIFRAGA CAESPITOSA				1		
238	CARDAMINE BELLIDIFOLIA				+		
239	RANUNCULUS NIVALIS				+		
240	EPILOBIUM LATIFOLIUM						1
241	ERIGERON COMPOSITUS					+	
242	ERIGERON HUMILIS					-	
243	MINUARTIA ROSSII					+	
244	RANUNCULUS ESCHSCHOLTZII						
245	SAXIFRAGA ADSCENDENS					+	
246	KOENIGIA ISLANDICA					2	

248 SALIX ARBUSCULOIDES

PIONEER COMMUNITIES — REWRITING MODE

	4	5	6	7	8
	000 | 0001 | 001 | 011 | 0010111111 | 0000000000111
	122 | 2012 | 990 | 901 | 7900111222222 | 2222677791123
	189 | 0242 | 796 | 645 | 4835371345 | 6789912569024
NO. OF SSP.	101 | 1121 | 121 | 212 | 1102111111111 | 1212211212121
	772 | 1524 | 726 | 674 | 1362704830 | 8183295136864
GROUP 1					
20 FESTUCA BRACHYPHYLLA	2 | 1 | | | 1 | 1
27 STELLARIA LONGIPES	| | | | |
30 LUZULA SPICATA	1 | +1 | | | |
33 CERASTIUM BEERINGIANUM	+1 | | | | |
34 MINUARTIA RUBELLA	1 | | | | 1 |
GROUP 2					
6 POA ALPINA	111 | +| 111+ | 111 | | +
7 ARTEMISIA ARCTICA	1 | 1+++ | +1+ | 1 | ++ | 1+
8 POA ARCTICA	211 | +++ | 12 | 111 | | -
GROUP 3					
11 ARNICA LATIFOLIA	+ | 11 | 1 | +++1 | +1++1111- | 1 111 1 1111
13 LUPINUS NOOTKATENSIS	| -11 | +| 1+1 | 1+2+11 | 1111211121212 1
21 VAHLODEA ATROPURPUREA	| -+1+ | | + | ++2+-+2111 | -+ +2+11+ 12
GROUP 4					
3 EPILOBIUM ALPINUM	| +++ | 111+ | 111 | -1+1- | 1112++1 1++
5 SENECIO TRIANGULARIS	| | 111+ | +1+ | --- | -1111+1111111
9 CAREX MERTENSII	| +| | | 121 | 12+ 2223 21
12 LUZULA PARVIFLORA	| | 1 | 2 | | 112 +1

GROUP 5						
38	POPULUS BALSAMIFERA						+
41	ANAPHALIS MARGARITACEA		1				-
47	RUBUS IDAEUS						
GROUP 6						
49	ROSA ACICULARIS						
55	ASTER CONSPICUUS						
56	LATHYRUS OCHROLEUCUS						
58	SPIRAEA BETULIFOLIA						
ACCOMP.SPEC.						
1	EPILOBIUM ANGUSTIFOLIUM		2 1 2	+ 1	1 3	+ - 1 1 1 1 +	+ 1 1 + 1 1 1 1 2 1 2
2	EQUISETUM ARVENSE	3		2	2 4 2	2 3 1	+ 2 4 4 1 3 3 3 1 2
4	TRISETUM SPICATUM	+ +	1 +	+	1	1 1	+ + +
10	MERTENSIA PANICULATA	2					
14	ALNUS VIRIDIS					2 - 1 -	
15	SANGUISORBA CANADENSIS		+	1 1	2 1	1	+ - 1 2 1 + 2 1
16	LUZULA PIPERI		+ 2 1	+	1 1	+ 2 1 2 + 1 1 1 +	1 1 + + 1 2
17	PHLEUM ALPINUM	1	2	2 2	2 2 1	1 1	2 1 1 1 1 1 1
18	ACONITUM DELPHINIFOLIUM	+		1	+	+	- - + + +
19	ARNICA CORDIFOLIA				1	1	
22	CALAMAGROSTIS CANADENSIS	1				1	1 1 1 2
23	PHLEUM PRATENSE		+		+	1 + +	1 1
24	TRIFOLIUM HYBRIDUM					- -	- + -
25	ABIES LASIOCARPA		-			- + - -	- +
26	FESTUCA RUBRA		+			2 +	+ 1
28	VALERIANA SITCHENSIS		-	2	+	- 1 -	+ + 1 2 1 1 1 1
29	VACCINIUM MEMBRANACEUM		+ +		+	- + - + - -	- 1
31	ERIGERON PEREGRINUS	1		+ 1	+ + 1	+	+ 1 1 1 - 1
32	TARAXACUM OFFICINALE		- -				+ + -
35	PETASITES PALMATUS						

37	CAREX PRATICOLA			1		1	1
39	ELYMUS INNOVATUS						
40	CAREX ROSSII		–		+	1 1	+ 1 1 1
42	AGROSTIS SCABRA		2				2
43	CINNA LATIFOLIA						
44	THALICTRUM OCCIDENTALE				+		+ + 1
45	BISTORTA VIVIPARA		+		+	–	
46	GALIUM TRIFLORUM						
48	SALIX ARCTICA		+	1			+
50	HERACLEUM SPHONDYLIUM						– + +
51	CARDAMINE PENSYLVANICA				–		–
52	POLYTRICHUM JUNIPERINUM		1 1			1 1 1	
53	SALIX DISCOLOR					+	+
54	SALIX BARCLAYI			+	+	– –	+ 1 1 1 +
57	ACHILLEA MILLEFOLIUM						
59	OSMORHIZA DEPAUPERATA						– –
60	EQUISETUM SYLVATICUM					1	2 2
61	RIBES LACUSTRE						
62	POTENTILLA DIVERSIFOLIA	+					
63	SAXIFRAGA FERRUGINEA			1		+ + –	
64	JUNCUS DRUMMONDII			1 1	1	1 1	+ 1 1 + 1 1
65	VERATRUM VIRIDE				–		– + 1 1 + +
66	JUNCUS MERTENSIANUS			1	1	1	1 1 1 2 1
67	CASTILLEJA MINIATA						
68	CAREX MICROPTERA					1	1 +
69	EQUISETUM SCIRPOIDES					1	+
70	PEDICULARIS BRACTEOSA			1	+	+	1 1
71	SILENE ACAULIS	+ 1					
72	FESTUCA BAFFINENSIS	+					
73	HIERACIUM GRACILE		+ +	+		– + –	+ + 1
74	RUBUS PUBESCENS						
75	RUBUS PEDATUS					–	
76	HIERACIUM ALBIFLORUM					+	

78	AGROSTIS MERTENSII					2	1
79	RANUNCULUS OCCIDENTALIS			+ −	+	+	+ + + 1 +
80	PICEA GLAUCA X ENGELMANNII						
81	PINUS CONTORTA					+ +	
82	FRAGERIA VIRGINIANA						
83	STELLARIA CALYCANTHA			1	1		
84	PICEA GLAUCA						
85	FESTUCA ALTAICA	+	− 1		1		
86	OXYRIA DIGYNA			1			−
87	CAREX PHAEOCEPHALA		+		1 1		
88	VERONICA WORMSKJOLDII		+	1	1 + +	+	− 1 −
89	GERANIUM BICKNELLII						
90	SALIX SCOULERIANA						
91	ASTER SUBSPICATUS						2
92	CAREX MACROCHAETA		1	1 1		+	1
93	ORTHILIA SECUNDA		+			−	−
94	CAREX PODOCARPA	1		+			
95	RUBUS PARVIFLORUS						
96	RANUNCULUS UNCINATUS						
97	GYMNOCARPIUM DRYOPTERIS						
98	AQUILEGIA FORMOSA						
99	VICIA AMERICANA						
100	MITELLA PENTANDRA						−
101	CAREX BRUNNESCENS				+		2
102	ANDROSACE SEPTENTRIONALIS						
103	SOLIDAGO MULTIRADIATA						
104	MYOSOTIS ASIATICA						
105	DRABA BOREALIS	+					
106	POA PRATENSIS						
107	PICEA ENGELMANNII		+		+	−	
108	RUMEX ACETOSA	1		2			
109	CALAMAGROSTIS LAPPONICA		1		1	1	1 2
110	LUZULA ARCUATA			+			

112	PARNASSIA FIMBRIATA						+
113	DRABA AUREA						
114	CAMPANULA LASIOCARPA						
115	DRABA INCERTA	–					
116	GENTIANELLA AMARELLA						
117	POPULUS TREMULOIDES						
118	VIBURNUM EDULE						
119	STREPTOPUS AMPLEXIFOLIUS					+	
120	ELYMUS GLAUCUS						+ 1
121	GEUM MACROPHYLLUM						
122	POA INTERIOR						
123	AGOSERIS AURANTIACA			+			
124	ARNICA ALPINA						
125	OXYTROPIS SERICEA						
126	ANTENNARIA UMBRINELLA					1	–
127	SALIX SITCHENSIS						+ +
128	GALIUM BOREALE						
129	SENECIO LUGENS	–					
130	EPILOBIUM GLANDULOSUM						1
131	ALOPECURUS AEQUALIS					+	
132	BROMUS RICHARDSONII						
133	POA PALUSTRIS						
134	SIBBALDIA PROCUMBENS		+	1	1	1	
135	MAIANTHEMUM ~~DILATATUM~~ CANADENSE						
136	CHAMOMILLA SUAVEOLENS						
137	SAXIFRAGA TRICUSPIDATA						
138	HEDYSARUM ALPINUM						
139	MARCHANTIA POLYMORPHA						
140	AGROSTIS VARIABILIS		+	1		–	
141	ARALIA NUDICAULIS						
142	POA REFLEXA						+
143	ASTER FOLIACEOUS						
144	POTENTILLA VILLOSA						

146	SALIX POLARIS						
147	SALIX GLAUCA						
148	ARCTOSTAPHYLOS UVA-URSI						
149	BROMUS INERMIS						
150	CAREX ATROSQUAMA						1 1
151	SAMBUCUS RACEMOSA						
152	CERASTIUM ARVENSE	+					
153	RHINANTHUS MINOR						
154	SEDUM LANCEOLATUM				+		
155	ERIGERON ACRIS						
156	AGROPYRON VIOLACEUM						
157	SOLIDAGO CANADENSIS						
158	CAREX MEDIA						
159	OXYTROPIS PODOCARPA						
160	DRABA NIVALIS						
161	CAREX ALBONIGRA						
162	CREPIS NANA	-					
163	CALTHA LEPTOSEPALA			1 +	-		
164	SALIX ALAXENSIS						
165	VACCINIUM MYRTILLUS						
166	CORYDALIS AUREA						
167	PYROLA ASARIFOLIA						+
168	VERONICA SERPYLLIFOLIA						
169	SHEPHERDIA CANADENSIS						
170	RIBES GLANDULOSUM						
171	RHODODENDRON ALBIFLORUM						
172	DELPHINIUM GLAUCUM						
173	POA GLAUCA						-
174	TIARELLA TRIFOLIATA						
175	ANTENNARIA MICROPHYLLA						
176	CASTILLEJA SULPHUREA						
177	ARABIS DRUMMONDII						
178	AGROSTIS EXARATA						

180	SILENE INVOLUCRATA						
181	HIEROCHLOE ALPINA						
182	POLYTRICHUM COMMUNE			1	+		
183	DRABA CRASSIFOLIA						
184	CHRYSOSPLENIUM TETRANDRUM						
185	PLAGIOMNIUM INSIGNE						
186	DRYAS INTEGRIFOLIA						
187	VACCINIUM ULIGINOSUM						
188	BETULA GLANDULOSA						
189	VACCINIUM VITIS-IDAEA						
190	CORYDALIS SEMPERVIRENS						
191	SORBUS SCOPULINA						
192	POLYTRICHUM PILIFERUM	1					
193	ANENOME PARVIFLORA						
194	DRABA STENOLOBA						
195	EQUISETUM PRATENSE						
196	ANTENNARIA NEGLECTA					-	
197	SAXIFRAGA LYALLII						1
198	DRYOPTERIS ASSIMILIS						
199	LOPHOZIA LYCOPODIOIDES						
200	LONICERA INVOLUCRATA						
201	VIOLA OREICULATA						
202	SENECIO PAUPERCULUS						
203	SALIX LASIANDRA						
204	MITELLA NUDA						
205	SMILACINA RACEMOSA						
206	ARTEMISIA MICHAUXIANA						
207	AMELANCHIER ALNIFOLIA						
208	HIERACIUM CANADENSE						
209	ARABIS DIVARICARPA						
210	PAPAVER KLUANENSE						
211	AGROPYRON SIBIRISOCUM						
212	DELPHINIUM BRACHYCENTRUM						

214	GERANIUM RICHARDSONII					
215	HACKELIA MICRANTHA					
216	LINNAEA BOREALIS					
217	URTICA DIOICA					
218	VERONICA AMERICANA					
219	DRACOCEPHALUM PARVIFLORUM					
220	APOCYNUM ANDROSAEMIFOLIUM					
221	SMILACINA STELLATA					
222	OXYTROPIS DEFLEXA					
223	CHENOPODIUM CAPITATUM					
224	ARABIS HOLBOELLII					
225	ERIGERON PHILADELPHICUS					
226	PLANTAGO MAJOR					
227	SPENOPHOLIS OBTUSATA					
228	BRYUM CAESPITICIUM					
229	PLEUROZIUM SCHREBERI					
230	PLATANTHERA HYPERBOREA					+
231	ASTER SIBIRICUS					
232	MOEHRINGIA LATERIFLORA					
233	POTENTILLA NIVEA					
234	DRABA LONCHOCARPA					
235	EQUISETUM PALUSTRE		3			
236	POA LEPTOCOMA				+	
237	SAXIFRAGA CAESPITOSA					
238	CARDAMINE BELLIDIFOLIA					
239	RANUNCULUS NIVALIS					
240	EPILOBIUM LATIFOLIUM					
241	ERIGERON COMPOSITUS					
242	ERIGERON HUMILIS					
243	MINUARTIA ROSSII					
244	RANUNCULUS ESCHSCHOLTZII			1		
245	SAXIFRAGA ADSCENDENS					
246	KOENIGIA ISLANDICA					

248 SALIX ARBUSCULOIDES

PIONEER COMMUNITIES — REWRITING MODE

		9																						10								11			12			
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	1	1	1	0	0	1	1	1	1	0	0	0	1	
		3	3	0	0	1	1	3	3	4	5	6	6	6	6	7	3	3	3	4	4	4	4	4	1	3	3	3	4	4	4	0	5	4	0	4	6	4
		4	5	5	6	3	5	0	4	3	9	1	2	3	4	3	3	6	9	1	5	0	2	4	1	7	8	3	4	1	6	8	7	8	5	7		
NO. OF SSP.		1	2	2	1	2	2	3	1	3	1	2	2	0	0	1	1	1	2	2	1	3	2	3	3	1	3	1	1	0	1	2	2	2	2	1		
		9	3	6	9	1	4	0	3	2	9	5	9	9	8	9	0	3	3	8	5	5	1	4	1	7	1	3	7	9	6	1	8	0	4	5		
GROUP 1																																						
20 FESTUCA BRACHYPHYLLA																																						
27 STELLARIA LONGIPES																																						
30 LUZULA SPICATA																																						
33 CERASTIUM BEERINGIANUM																																						
34 MINUARTIA RUBELLA																																						
GROUP 2																																						
6 POA ALPINA																	1														+				1			
7 ARTEMISIA ARCTICA									+																													
8 POA ARCTICA																																						
GROUP 3																																						
11 ARNICA LATIFOLIA	1	1	–	–	2											1						1	+			1		+										
13 LUPINUS NOOTKATENSIS	2	2						+				+			1							2	1															
21 VAHLODEA ATROPURPUREA	2	1												1									+															
GROUP 4																																						
3 EPILOBIUM ALPINUM	1		1	+	+	1	1		+	1	2	2	2	+	+	1	1	1		1			1	1	+	1		1		2				+				
5 SENECIO TRIANGULARIS	2	1	+		–	+	2	–	+		–	+	+	+	–		–		1			1		+	+		+	–			+							
9 CAREX MERTENSII	2	2		1	1		2	1		1	1	1	1		2	1	2	+	1	1		1	–	+	1	2	1		2									
12 LUZULA PARVIFLORA	1	1	2	1		1	1	+		2	1	1	+	1		+	1	1	+			1	+	2		+	1	1	1									

GROUP 5																																			
38 POPULUS BALSAMIFERA																				1		1	1	1	1	+	1	+	1	+	1	1	-	1	2
41 ANAPHALIS MARGARITACEA	+									1		+							+		+	1		1	1	1	-	+	+	2	2			1	
47 RUBUS IDAEUS								+			+										+		-	+		+		+		1	+	-	-	1	1
GROUP 6																																			
49 ROSA ACICULARIS																															+	-	+		
55 ASTER CONSPICUUS																																			1
56 LATHYRUS OCHROLEUCUS																								-		1								+	+
58 SPIRAEA BETULIFOLIA																				1												-	1	+	1
ACCOMP.SPEC.																																			
1 EPILOBIUM ANGUSTIFOLIUM	1	2	1	1	2		1	1	2	1	1	1		+			1	2	1	2	2	+	+	1	1	2	+	1	-	1	2	1		+	2
2 EQUISETUM ARVENSE	1	3	2	3	5	3	3		2		1	3					1	4	1	2	2		2		1	3		1				1		2	+
4 TRISETUM SPICATUM		+							+							1		+	+		+	1													
10 MERTENSIA PANICULATA	+		+		1	1	2		2		2	2						1					+	+		+				1		+		1	
14 ALNUS VIRIDIS	1	1		1						-							2	1	3	1	2	+		1	+	+	-	1			1	3	+	2	+
15 SANGUISORBA CANADENSIS		1			1	1	+		1						1			2	1		2		+			+									
16 LUZULA PIPERI																																			
17 PHLEUM ALPINUM		1					+		-							1		1			1				1										
18 ACONITUM DELPHINIFOLIUM		-	+						1			+						-			+		-												
19 ARNICA CORDIFOLIA			-	-				-		1	1	1	+					1				+		1		1				+	1	+	+	+	
22 CALAMAGROSTIS CANADENSIS	1		1	2		-					1				2			1	1		1			1		1	1				+		+		
23 PHLEUM PRATENSE			1			+		2		-				+	+																				
24 TRIFOLIUM HYBRIDUM			1	2		1		1	-	-					-														4				-		
25 ABIES LASIOCARPA				-							+	-	-	1		-	1		+		1	1	-	+	+		1	-							
26 FESTUCA RUBRA			2	2		2		2						-	1														3						
28 VALERIANA SITCHENSIS	+		+			1	2					1			1				1		1		-												
29 VACCINIUM MEMBRANACEUM		-								+	+	-			-		1				1			1		1									
31 ERIGERON PEREGRINUS	+								1			+				-			+		1			+											
32 TARAXACUM OFFICINALE				1						+								+	+				+	+	+	+		+			+	+			+
35 PETASITES PALMATUS		+	+	+		1	1				1	1								1				1						1		1		1	1

36	CORNUS CANADENSIS							+			+	1				+		+				1		-	1		1					1			1	1
37	CAREX PRATICOLA			1	+						2	2		+		1				+	2	+			+						1		+		2	2
39	ELYMUS INNOVATUS									1																	1							1	1	
40	CAREX ROSSII								+		1	1	1											+		1										
42	AGROSTIS SCABRA	1	1														1						+						1					+		
43	CINNA LATIFOLIA					2	-	1											1		2	+	+	1					2			1	1		2	
44	THALICTRUM OCCIDENTALE						+			1										+		+			-		+						-			
45	BISTORTA VIVIPARA																																			
46	GALIUM TRIFLORUM					+	-						1						1		1			-				-			+	1	+	-		
48	SALIX ARCTICA																																			
50	HERACLEUM SPHONDYLIUM	1		-		1	+	1		1									1			1		-												
51	CARDAMINE PENSYLVANICA			-																														-		
52	POLYTRICHUM JUNIPERINUM										3	2	1	+							1														2	
53	SALIX DISCOLOR				-											+						+	+							+		+		-		
54	SALIX BARCLAYI		1										-					-								+									+	
57	ACHILLEA MILLEFOLIUM									+																										
59	OSMORHIZA DEPAUPERATA												+												-						+	1	-	-		
60	EQUISETUM SYLVATICUM	1		2	1									-		2													1				+			
61	RIBES LACUSTRE							1			+	+	1											-	+	-	+						+		+	-
62	POTENTILLA DIVERSIFOLIA																																			
63	SAXIFRAGA FERRUGINEA																																			
64	JUNCUS DRUMMONDII															1																				
65	VERATRUM VIRIDE			-			-					1				+						1														
66	JUNCUS MERTENSIANUS															2								-												
67	CASTILLEJA MINIATA		+							1												+			+		1									
68	CAREX MICROPTERA					1	1				2									+		1		+												
69	EQUISETUM SCIRPOIDES							1												+			+													
70	PEDICULARIS BRACTEOSA	+	1					+												1		1														
71	SILENE ACAULIS																																			
72	FESTUCA BAFFINENSIS																																			
73	HIERACIUM GRACILE		+																												+					
74	RUBUS PUBESCENS			+			+																									1	-	-		+
75	RUBUS PEDATUS			-				+				2						+						+											+	
76	HIERACIUM ALBIFLORUM								+														1		+		1	+				1	-			

78	AGROSTIS MERTENSII					
79	RANUNCULUS OCCIDENTALIS					
80	PICEA GLAUCA X ENGELMANNII		+ − +	+ 1 + + 1	+	
81	PINUS CONTORTA		+	+ −		− +
82	FRAGERIA VIRGINIANA				+	
83	STELLARIA CALYCANTHA		+ 1	−		
84	PICEA GLAUCA			+		+ − +
85	FESTUCA ALTAICA					
86	OXYRIA DIGYNA					
87	CAREX PHAEOCEPHALA					
88	VERONICA WORMSKJOLDII					
89	GERANIUM BICKNELLII		−		+	+
90	SALIX SCOULERIANA		− +	+ −		1 +
91	ASTER SUBSPICATUS		+		1	
92	CAREX MACROCHAETA					
93	ORTHILIA SECUNDA		1 +			1
94	CAREX PODOCARPA					
95	RUBUS PARVIFLORUS		−		1	−
96	RANUNCULUS UNCINATUS	+	+ 1 + 1 2	+		
97	GYMNOCARPIUM DRYOPTERIS	−	−	− +		+
98	AQUILEGIA FORMOSA		+ + +	− 1		−
99	VICIA AMERICANA			1		−
100	MITELLA PENTANDRA		+ + 1 1	−		
101	CAREX BRUNNESCENS		1	+		
102	ANDROSACE SEPTENTRIONALIS					
103	SOLIDAGO MULTIRADIATA					
104	MYOSOTIS ASIATICA		+			
105	DRABA BOREALIS		−			
106	POA PRATENSIS		+ +			
107	PICEA ENGELMANNII		+	+		
108	RUMEX ACETOSA		+			
109	CALAMAGROSTIS LAPPONICA					
110	LUZULA ARCUATA					

112	PARNASSIA FIMBRIATA				+	+											+	+		+														
113	DRABA AUREA																																	
114	CAMPANULA LASIOCARPA																																	
115	DRABA INCERTA																																	
116	GENTIANELLA AMARELLA																	+		1					1									
117	POPULUS TREMULOIDES																																	
118	VIBURNUM EDULE																													+				
119	STREPTOPUS AMPLEXIFOLIUS	+				1				+																								
120	ELYMUS GLAUCUS	+		1														+																
121	GEUM MACROPHYLLUM			2																		+		−										
122	POA INTERIOR			+																														
123	AGOSERIS AURANTIACA							+										+				−												
124	ARNICA ALPINA																																	
125	OXYTROPIS SERICEA																																	
126	ANTENNARIA UMBRINELLA																																	
127	SALIX SITCHENSIS																	1							+	+								
128	GALIUM BOREALE							−																										
129	SENECIO LUGENS																																	
130	EPILOBIUM GLANDULOSUM																															−		
131	ALOPECURUS AEQUALIS																															+		
132	BROMUS RICHARDSONII																	+		+														
133	POA PALUSTRIS																				+				+									
134	SIBBALDIA PROCUMBENS																																	
135	MAIANTHEMUM ~~DILATATUM~~ CANADENSE																																	
136	CHAMOMILLA SUAVEOLENS																															−		
137	SAXIFRAGA TRICUSPIDATA																																	
138	HEDYSARUM ALPINUM							1																										
139	MARCHANTIA POLYMORPHA					2				1	1																							
140	AGROSTIS VARIABILIS																																	
141	ARALIA NUDICAULIS																																	
142	POA REFLEXA	+																													+			
143	ASTER FOLIACEOUS				+												1								1									
144	POTENTILLA VILLOSA																																	

146	SALIX POLARIS					
147	SALIX GLAUCA			+		
148	ARCTOSTAPHYLOS UVA-URSI					
149	BROMUS INERMIS		+			
150	CAREX ATROSQUAMA					
151	SAMBUCUS RACEMOSA		− −	−		
152	CERASTIUM ARVENSE		1			
153	RHINANTHUS MINOR		+ 1			
154	SEDUM LANCEOLATUM		+			
155	ERIGERON ACRIS				−	
156	AGROPYRON VIOLACEUM					
157	SOLIDAGO CANADENSIS				1	
158	CAREX MEDIA		1 1	+		
159	OXYTROPIS PODOCARPA					
160	DRABA NIVALIS					
161	CAREX ALBONIGRA					
162	CREPIS NANA					
163	CALTHA LEPTOSEPALA					
164	SALIX ALAXENSIS				−	
165	VACCINIUM MYRTILLUS				+	
166	CORYDALIS AUREA					
167	PYROLA ASARIFOLIA					
168	VERONICA SERPYLLIFOLIA		+ −			
169	SHEPHERDIA CANADENSIS					−
170	RIBES GLANDULOSUM		1	−		
171	RHODODENDRON ALBIFLORUM	−				
172	DELPHINIUM GLAUCUM					
173	POA GLAUCA		1			
174	TIARELLA TRIFOLIATA		1			
175	ANTENNARIA MICROPHYLLA			+		
176	CASTILLEJA SULPHUREA		1			
177	ARABIS DRUMMONDII		−			
178	AGROSTIS EXARATA		2			

180	SILENE INVOLUCRATA					
181	HIEROCHLOE ALPINA					
182	POLYTRICHUM COMMUNE					
183	DRABA CRASSIFOLIA					
184	CHRYSOSPLENIUM TETRANDRUM	1				
185	PLAGIOMNIUM INSIGNE	+				
186	DRYAS INTEGRIFOLIA					
187	VACCINIUM ULIGINOSUM					
188	BETULA GLANDULOSA					
189	VACCINIUM VITIS-IDAEA					
190	CORYDALIS SEMPERVIRENS					
191	SORBUS SCOPULINA					
192	POLYTRICHUM PILIFERUM					
193	ANENOME PARVIFLORA					
194	DRABA STENOLOBA					
195	EQUISETUM PRATENSE					
196	ANTENNARIA NEGLECTA					
197	SAXIFRAGA LYALLII					
198	DRYOPTERIS ASSIMILIS		-			
199	LOPHOZIA LYCOPODIOIDES		-			
200	LONICERA INVOLUCRATA			-		
201	VIOLA ORBICULATA			+		
202	SENECIO PAUPERCULUS			-		
203	SALIX LASIANDRA					
204	MITELLA NUDA					
205	SMILACINA RACEMOSA					
206	ARTEMISIA MICHAUXIANA					
207	AMELANCHIER ALNIFOLIA					
208	HIERACIUM CANADENSE					
209	ARABIS DIVARICARPA					
210	PAPAVER KLUANENSE					
211	AGROPYRON SIBIRISOCUM					
212	DELPHINIUM BRACHYCENTRUM					

214	GERANIUM RICHARDSONII	2				
215	HACKELIA MICRANTHA	-				
216	LINNAEA BOREALIS					
217	URTICA DIOICA					
218	VERONICA AMERICANA					
219	DRACOCEPHALUM PARVIFLORUM					
220	APOCYNUM ANDROSAEMIFOLIUM					
221	SMILACINA STELLATA					
222	OXYTROPIS DEFLEXA					
223	CHENOPODIUM CAPITATUM					
224	ARABIS HOLBOELLII					
225	ERIGERON PHILADELPHICUS					
226	PLANTAGO MAJOR					
227	SPENOPHOLIS OBTUSATA					
228	BRYUM CAESPITICIUM					
229	PLEUROZIUM SCHREBERI		1			
230	PLATANTHERA HYPERBOREA					
231	ASTER SIBIRICUS					
232	MOEHRINGIA LATERIFLORA					
233	POTENTILLA NIVEA					
234	DRABA LONCHOCARPA					
235	EQUISETUM PALUSTRE					
236	POA LEPTOCOMA					
237	SAXIFRAGA CAESPITOSA					
238	CARDAMINE BELLIDIFOLIA					
239	RANUNCULUS NIVALIS					
240	EPILOBIUM LATIFOLIUM					
241	ERIGERON COMPOSITUS					
242	ERIGERON HUMILIS					
243	MINUARTIA ROSSII					
244	RANUNCULUS ESCHSCHOLTZII					
245	SAXIFRAGA ADSCENDENS					
246	KOENIGIA ISLANDICA					

248 SALIX ARBUSCULOIDES

PIONEER COMMUNITIES　　　　REWRITING MODE

	13														14	15
	0002	0010	0011	0035	0046	0047	0050	0051	0052	0053	0054	0055	0056	0146	0032	0042
NO. OF SSP.	26	13	10	29	18	25	21	21	11	29	20	16	16	20	25	21
248 SALIX ARBUSCULOIDES																
GROUP 1																
20 FESTUCA BRACHYPHYLLA				+												
27 STELLARIA LONGIPES																
30 LUZULA SPICATA																
33 CERASTIUM BEERINGIANUM																
34 MINUARTIA RUBELLA																
GROUP 2																
6 POA ALPINA																
7 ARTEMISIA ARCTICA																+
8 POA ARCTICA																1
GROUP 3																
11 ARNICA LATIFOLIA																
13 LUPINUS NOOTKATENSIS																
21 VAHLODEA ATROPURPUREA																
GROUP 4																
3 EPILOBIUM ALPINUM															+	1
5 SENECIO TRIANGULARIS																
9 CAREX MERTENSII														+	2	
12 LUZULA PARVIFLORA															1	

	16																				
	0003	0008	0009	0018	0019	0033	0038	0040	0045	0049	0057	0058	0060	0067	0070	0080	0081	0082	0085	0089	0118
NO. OF SSP.	10	07	15	15	12	14	08	08	03	17	15	10	04	11	06	07	16	13	07	06	07
248 SALIX ARBUSCULOIDES	+																				
GROUP 1																					
20 FESTUCA BRACHYPHYLLA							1													1	
27 STELLARIA LONGIPES				1	–																
30 LUZULA SPICATA																					
33 CERASTIUM BEERINGIANUM																			+		
34 MINUARTIA RUBELLA																			1		
GROUP 2																					
6 POA ALPINA				+														1			
7 ARTEMISIA ARCTICA								–													
8 POA ARCTICA																+				1	
GROUP 3																					
11 ARNICA LATIFOLIA																					
13 LUPINUS NOOTKATENSIS						–															
21 VAHLODEA ATROPURPUREA					–																1
GROUP 4																					
3 EPILOBIUM ALPINUM												1						+			
5 SENECIO TRIANGULARIS																					
9 CAREX MERTENSII															2						
12 LUZULA PARVIFLORA						+															

GROUP 5																																					
38 POPULUS BALSAMIFERA				1								-			1	+						+															
41 ANAPHALIS MARGARITACEA								1								1											-										
47 RUBUS IDAEUS						1								+	+											+											
GROUP 6																																					
49 ROSA ACICULARIS	+	-	-	+	2	+	1	1	+	1		+	+																				1				
55 ASTER CONSPICUUS	1			1	+	2	1	1			+	+	+	+	2		1									+											
56 LATHYRUS OCHROLEUCUS		1		1	+	+		+		+	-	+	1	1																							
58 SPIRAEA BETULIFOLIA	2	-	-		1	2	2		+						-																						
ACCOMP.SPEC.																																					
1 EPILOBIUM ANGUSTIFOLIUM	1	+		1	1	2	1	1	-	1		+	+	2	+	2	1	+	+		1	1	1				+					1	2	1		-	
2 EQUISETUM ARVENSE	2	1	+			+			1	+	1	1	4	2	2	+		+				1				2		1			1	2	2	4			
4 TRISETUM SPICATUM																1						1	1													1	
10 MERTENSIA PANICULATA	1			+								+		1			1							-		+						+	2				
14 ALNUS VIRIDIS				2	1	1		3		+					1				+			+				-											
15 SANGUISORBA CANADENSIS																																	1	2			
16 LUZULA PIPERI																					+		1				1				+						1
17 PHLEUM ALPINUM																														1				1	-		+
18 ACONITUM DELPHINIFOLIUM																																		+	-		
19 ARNICA CORDIFOLIA	1		-		1	1	-	-						+							1					-											
22 CALAMAGROSTIS CANADENSIS	2			-				1														1	-			+											
23 PHLEUM PRATENSE	1	2	1				+		-									2	2						2		+				+	+					
24 TRIFOLIUM HYBRIDUM		2	1				-		-	+	-							2	2						3	-	+	-						-			
25 ABIES LASIOCARPA															+				-								1		+								
26 FESTUCA RUBRA		2	2															2	2					2	3		+			2		+		+			1
28 VALERIANA SITCHENSIS																																		+			
29 VACCINIUM MEMBRANACEUM															1				-		1								+								
31 ERIGERON PEREGRINUS																														-							
32 TARAXACUM OFFICINALE	1			-						+	+	+	+		+																						
35 PETASITES PALMATUS		-	-					1		+	1	+	+	2	1		+																				
36 CORNUS CANADENSIS						1						-		1						+	-									+							

37	CAREX PRATICOLA				1										2	1													1	1								
39	ELYMUS INNOVATUS				+	1	2	2	1	1			+					+			1		1	1							1			2				
40	CAREX ROSSII				+						1	+					1											1	+									1
42	AGROSTIS SCABRA	1					+	1	1	+	1	+					+					+	1				+											
43	CINNA LATIFOLIA						1	-					+	+	1				+								1	1										
44	THALICTRUM OCCIDENTALE	1			+				+								+	-																1				
45	BISTORTA VIVIPARA																				+				+						-						+	
46	GALIUM TRIFLORUM	1					-		1			-			1												1											
48	SALIX ARCTICA																-				1										+				-			
50	HERACLEUM SPHONDYLIUM	-															+																1	1				
51	CARDAMINE PENSYLVANICA							-				+																						-	-			
52	POLYTRICHUM JUNIPERINUM																											2	1	1								1
53	SALIX DISCOLOR	+									-	-				1	1	+																				
54	SALIX BARCLAYI																																					
57	ACHILLEA MILLEFOLIUM				+		-				1	2																						1				
59	OSMORHIZA DEPAUPERATA	+		-		-	-									+																						
60	EQUISETUM SYLVATICUM																		1	+							3											
61	RIBES LACUSTRE														+	1																						
62	POTENTILLA DIVERSIFOLIA																							+							+							
63	SAXIFRAGA FERRUGINEA																																					3
64	JUNCUS DRUMMONDII																															1						
65	VERATRUM VIRIDE																																					
66	JUNCUS MERTENSIANUS																												1			2						
67	CASTILLEJA MINIATA				2	+											1			-														+				
68	CAREX MICROPTERA																											1	2									
69	EQUISETUM SCIRPOIDES															1																						
70	PEDICULARIS BRACTEOSA																																					
71	SILENE ACAULIS																																					
72	FESTUCA BAFFINENSIS																																			+		
73	HIERACIUM GRACILE																																					
74	RUBUS PUBESCENS	1									1	+						-																				
75	RUBUS PEDATUS														1							-																
76	HIERACIUM ALBIFLORUM				-	+																																

78	AGROSTIS MERTENSII																							+													
79	RANUNCULUS OCCIDENTALIS																																				
80	PICEA GLAUCA X ENGELMANNII															+																					
81	PINUS CONTORTA				−	−																						+									
82	FRAGERIA VIRGINIANA		−			+			+		+	1	+																								
83	STELLARIA CALYCANTHA	−					−				+																+										
84	PICEA GLAUCA		−		+	1					+																	+									
85	FESTUCA ALTAICA																				1																
86	OXYRIA DIGYNA																																				
87	CAREX PHAEOCEPHALA																						+														
88	VERONICA WORMSKJOLDII																																				
89	GERANIUM BICKNELLII	−					+	+										−									−										
90	SALIX SCOULERIANA				1															−																	
91	ASTER SUBSPICATUS		+		+			1		−	+																										
92	CAREX MACROCHAETA																																		+		
93	ORTHILIA SECUNDA															1												+									
94	CAREX PODOCARPA																																				
95	RUBUS PARVIFLORUS				2				2						2			−																			
96	RANUNCULUS UNCINATUS																																				
97	GYMNOCARPIUM DRYOPTERIS														1	−																					
98	AQUILEGIA FORMOSA										+																										
99	VICIA AMERICANA							1	+		+	−		1																							
100	MITELLA PENTANDRA						−																														
101	CAREX BRUNNESCENS																																				
102	ANDROSACE SEPTENTRIONALIS										+																										
103	SOLIDAGO MULTIRADIATA																				−																
104	MYOSOTIS ASIATICA																																				
105	DRABA BOREALIS																																				
106	POA PRATENSIS										1		+			+																					
107	PICEA ENGELMANNII																						−							−							
108	RUMEX ACETOSA																																				
109	CALAMAGROSTIS LAPPONICA																																				
110	LUZULA ARCUATA																																				+

112	PARNASSIA FIMBRIATA																							
113	DRABA AUREA																							
114	CAMPANULA LASIOCARPA															+								
115	DRABA INCERTA																							
116	GENTIANELLA AMARELLA				1																			
117	POPULUS TREMULOIDES	+				2		1	1	+														
118	VIBURNUM EDULE	+	–	–					1															
119	STREPTOPUS AMPLEXIFOLIUS													+										
120	ELYMUS GLAUCUS																							
121	GEUM MACROPHYLLUM										–	+												
122	POA INTERIOR											2			+		1	+						
123	AGOSERIS AURANTIACA														1									
124	ARNICA ALPINA															–			–			+		
125	OXYTROPIS SERICEA																							+
126	ANTENNARIA UMBRINELLA															–								
127	SALIX SITCHENSIS																							
128	GALIUM BOREALE					+		+			+												2	
129	SENECIO LUGENS																							
130	EPILOBIUM GLANDULOSUM						+							+						+				
131	ALOPECURUS AEQUALIS						+				–									+				
132	BROMUS RICHARDSONII										+	2	+											
133	POA PALUSTRIS											2	+										1	
134	SIBBALDIA PROCUMBENS																							
135	MAIANTHEMUM ~~DILATATUM~~ CANADENSE	+					+	–	+															
136	CHAMOMILLA SUAVEOLENS	–						+		+														
137	SAXIFRAGA TRICUSPIDATA																							
138	HEDYSARUM ALPINUM															+								
139	MARCHANTIA POLYMORPHA																				1			
140	AGROSTIS VARIABILIS																					+		
141	ARALIA NUDICAULIS	+						+	1															
142	POA REFLEXA																							
143	ASTER FOLIACEOUS																							
144	POTENTILLA VILLOSA																							

78	AGROSTIS MERTENSII																			+					
79	RANUNCULUS OCCIDENTALIS																								
80	PICEA GLAUCA X ENGELMANNII														+										
81	PINUS CONTORTA			–	–																	+			
82	FRAGERIA VIRGINIANA		–		+			+		+	1	+													
83	STELLARIA CALYCANTHA	–				–				+											+				
84	PICEA GLAUCA		–	+	1					+												+			
85	FESTUCA ALTAICA																	1							
86	OXYRIA DIGYNA																								
87	CAREX PHAEOCEPHALA																		+						
88	VERONICA WORMSKJOLDII																								
89	GERANIUM BICKNELLII	–				+	+									–					–				
90	SALIX SCOULERIANA			1													–								
91	ASTER SUBSPICATUS		+	+			1		–	+															
92	CAREX MACROCHAETA																							+	
93	ORTHILIA SECUNDA														1							+			
94	CAREX PODOCARPA																								
95	RUBUS PARVIFLORUS			2				2						2		–									
96	RANUNCULUS UNCINATUS																								
97	GYMNOCARPIUM DRYOPTERIS													1	–										
98	AQUILEGIA FORMOSA									+															
99	VICIA AMERICANA						1	+		+	–		1												
100	MITELLA PENTANDRA					–																			
101	CAREX BRUNNESCENS																								
102	ANDROSACE SEPTENTRIONALIS									+															
103	SOLIDAGO MULTIRADIATA																	–							
104	MYOSOTIS ASIATICA																								
105	DRABA BOREALIS																								
106	POA PRATENSIS									1		+			+										
107	PICEA ENGELMANNII																		–				–		
108	RUMEX ACETOSA																								
109	CALAMAGROSTIS LAPPONICA																								
110	LUZULA ARCUATA																								+

112	PARNASSIA FIMBRIATA																							
113	DRABA AUREA																							
114	CAMPANULA LASIOCARPA															+								
115	DRABA INCERTA																							
116	GENTIANELLA AMARELLA				1																			
117	POPULUS TREMULOIDES	+				2		1	1	+														
118	VIBURNUM EDULE	+	-	-					1															
119	STREPTOPUS AMPLEXIFOLIUS													+										
120	ELYMUS GLAUCUS																							
121	GEUM MACROPHYLLUM										-	+												
122	POA INTERIOR											2			+		1	+						
123	AGOSERIS AURANTIACA														1									
124	ARNICA ALPINA															-			-			+		
125	OXYTROPIS SERICEA																							+
126	ANTENNARIA UMBRINELLA															-								
127	SALIX SITCHENSIS																							
128	GALIUM BOREALE					+		+			+												2	
129	SENECIO LUGENS																							
130	EPILOBIUM GLANDULOSUM						+							+						+				
131	ALOPECURUS AEQUALIS						+				-									+				
132	BROMUS RICHARDSONII										+	2	+											
133	POA PALUSTRIS											2	+										1	
134	SIBBALDIA PROCUMBENS																							
135	MAIANTHEMUM ~~DILATATUM~~ CANADENSE	+					+	-	+															
136	CHAMOMILLA SUAVEOLENS	-						+		+														
137	SAXIFRAGA TRICUSPIDATA																							
138	HEDYSARUM ALPINUM															+								
139	MARCHANTIA POLYMORPHA																				1			
140	AGROSTIS VARIABILIS																					+		
141	ARALIA NUDICAULIS	+						+	1															
142	POA REFLEXA																							
143	ASTER FOLIACEOUS																							
144	POTENTILLA VILLOSA																							

146	SALIX POLARIS														
147	SALIX GLAUCA														
148	ARCTOSTAPHYLOS UVA-URSI			-									+		
149	BROMUS INERMIS														
150	CAREX ATROSQUAMA														
151	SAMBUCUS RACEMOSA														
152	CERASTIUM ARVENSE														
153	RHINANTHUS MINOR										+				
154	SEDUM LANCEOLATUM														
155	ERIGERON ACRIS				+	+									
156	AGROPYRON VIOLACEUM						1		+						
157	SOLIDAGO CANADENSIS							1	1						
158	CAREX MEDIA														
159	OXYTROPIS PODOCARPA														
160	DRABA NIVALIS														
161	CAREX ALBONIGRA														
162	CREPIS NANA														-
163	CALTHA LEPTOSEPALA														
164	SALIX ALAXENSIS														
165	VACCINIUM MYRTILLUS														
166	CORYDALIS AUREA	+												+	
167	PYROLA ASARIFOLIA	-													
168	VERONICA SERPYLLIFOLIA														
169	SHEPHERDIA CANADENSIS			2											
170	RIBES GLANDULOSUM														
171	RHODODENDRON ALBIFLORUM											+			
172	DELPHINIUM GLAUCUM														
173	POA GLAUCA														
174	TIARELLA TRIFOLIATA									1					
175	ANTENNARIA MICROPHYLLA		1												
176	CASTILLEJA SULPHUREA										1				
177	ARABIS DRUMMONDII										1				
178	AGROSTIS EXARATA							2							

180	SILENE INVOLUCRATA					
181	HIEROCHLOE ALPINA					
182	POLYTRICHUM COMMUNE					
183	DRABA CRASSIFOLIA					
184	CHRYSOSPLENIUM TETRANDRUM					
185	PLAGIOMNIUM INSIGNE					
186	DRYAS INTEGRIFOLIA					
187	VACCINIUM ULIGINOSUM			+		
188	BETULA GLANDULOSA			1		
189	VACCINIUM VITIS-IDAEA			-		
190	CORYDALIS SEMPERVIRENS				1	
191	SORBUS SCOPULINA				+	
192	POLYTRICHUM PILIFERUM					
193	ANENOME PARVIFLORA					
194	DRABA STENOLOBA					
195	EQUISETUM PRATENSE					
196	ANTENNARIA NEGLECTA					
197	SAXIFRAGA LYALLII					
198	DRYOPTERIS ASSIMILIS					
199	LOPHOZIA LYCOPODIOIDES					
200	LONICERA INVOLUCRATA					
201	VIOLA ORBICULATA					
202	SENECIO PAUPERCULUS					
203	SALIX LASIANDRA		+			
204	MITELLA NUDA		+			
205	SMILACINA RACEMOSA	1				
206	ARTEMISIA MICHAUXIANA	+				
207	AMELANCHIER ALNIFOLIA	-				
208	HIERACIUM CANADENSE	+				
209	ARABIS DIVARICARPA	-				
210	PAPAVER KLUANENSE					
211	AGROPYRON SIBIRISCCUM					1
212	DELPHINIUM BRACHYCENTRUM					+

214	GERANIUM RICHARDSONII								
215	HACKELIA MICRANTHA								
216	LINNAEA BOREALIS	1							
217	URTICA DIOICA	-							
218	VERONICA AMERICANA						-		
219	DRACOCEPHALUM PARVIFLORUM		1						
220	APOCYNUM ANDROSAEMIFOLIUM		2						
221	SMILACINA STELLATA			+					
222	OXYTROPIS DEFLEXA				1				
223	CHENOPODIUM CAPITATUM				+				
224	ARABIS HOLBOELLII				+				
225	ERIGERON PHILADELPHICUS					1			
226	PLANTAGO MAJOR					+			
227	SPENOPHOLIS OBTUSATA					1			
228	BRYUM CAESPITICIUM							3	
229	PLEUROZIUM SCHREBERI								
230	PLATANTHERA HYPERBOREA								
231	ASTER SIBIRICUS								1
232	MOEHRINGIA LATERIFLORA								1
233	POTENTILLA NIVEA								
234	DRABA LONCHOCARPA								
235	EQUISETUM PALUSTRE								
236	POA LEPTOCOMA								
237	SAXIFRAGA CAESPITOSA								
238	CARDAMINE BELLIDIFOLIA								
239	RANUNCULUS NIVALIS								
240	EPILOBIUM LATIFOLIUM								
241	ERIGERON COMPOSITUS								
242	ERIGERON HUMILIS								
243	MINUARTIA ROSSII								
244	RANUNCULUS ESCHSCHOLTZII								
245	SAXIFRAGA ADSCENDENS								
246	KOENIGIA ISLANDICA								

247 ASTRAGALUS AMERICANUS

248 SALIX ARBUSCULOIDES

PIONEER COMMUNITIES

REWRITING MODE

	0 0
	1 1
	2 3
	6 1
	0 0
NO. OF SSP.	5 8
GROUP 1	
20 FESTUCA BRACHYPHYLLA	
27 STELLARIA LONGIPES	
30 LUZULA SPICATA	
33 CERASTIUM BEERINGIANUM	
34 MINUARTIA RUBELLA	
GROUP 2	
6 POA ALPINA	
7 ARTEMISIA ARCTICA	
8 POA ARCTICA	
GROUP 3	
11 ARNICA LATIFOLIA	+
13 LUPINUS NOOTKATENSIS	+
21 VAHLODEA ATROPURPUREA	
GROUP 4	
3 EPILOBIUM ALPINUM	
5 SENECIO TRIANGULARIS	
9 CAREX MERTENSII	
12 LUZULA PARVIFLORA	+ +

GROUP 5

38	POPULUS BALSAMIFERA		
41	ANAPHALIS MARGARITACEA		
47	RUBUS IDAEUS		

GROUP 6

49	ROSA ACICULARIS		
55	ASTER CONSPICUUS		
56	LATHYRUS OCHROLEUCUS		
58	SPIRAEA BETULIFOLIA		

ACCOMP. SPEC.

1	EPILOBIUM ANGUSTIFOLIUM	1	
2	EQUISETUM ARVENSE		
4	TRISETUM SPICATUM	1	
10	MERTENSIA PANICULATA		
14	ALNUS VIRIDIS		
15	SANGUISORBA CANADENSIS		
16	LUZULA PIPERI		
17	PHLEUM ALPINUM		
18	ACONITUM DELPHINIFOLIUM		
19	ARNICA CORDIFOLIA		
22	CALAMAGROSTIS CANADENSIS		
23	PHLEUM PRATENSE	+	
24	TRIFOLIUM HYBRIDUM		
25	ABIES LASIOCARPA		
26	FESTUCA RUBRA	1	
28	VALERIANA SITCHENSIS		
29	VACCINIUM MEMBRANACEUM	+	
31	ERIGERON PEREGRINUS		
32	TARAXACUM OFFICINALE		
35	PETASITES PALMATUS		

37	CAREX PRATICOLA		
39	ELYMUS INNOVATUS		
40	CAREX ROSSII		
42	AGROSTIS SCABRA	2	
43	CINNA LATIFOLIA		
44	THALICTRUM OCCIDENTALE		
45	BISTORTA VIVIPARA		
46	GALIUM TRIFLORUM		
48	SALIX ARCTICA		
50	HERACLEUM SPHONDYLIUM		
51	CARDAMINE PENSYLVANICA		
52	POLYTRICHUM JUNIPERINUM	+	
53	SALIX DISCOLOR		
54	SALIX BARCLAYI		
57	ACHILLEA MILLEFOLIUM		
59	OSMORHIZA DEPAUPERATA		
60	EQUISETUM SYLVATICUM		
61	RIBES LACUSTRE		
62	POTENTILLA DIVERSIFOLIA		
63	SAXIFRAGA FERRUGINEA		
64	JUNCUS DRUMMONDII		
65	VERATRUM VIRIDE		
66	JUNCUS MERTENSIANUS		
67	CASTILLEJA MINIATA		
68	CAREX MICROPTERA		
69	EQUISETUM SCIRPOIDES		
70	PEDICULARIS BRACTEOSA		
71	SILENE ACAULIS		
72	FESTUCA BAFFINENSIS		
73	HIERACIUM GRACILE		
74	RUBUS PUBESCENS		
75	RUBUS PEDATUS	1	
76	HIERACIUM ALBIFLORUM		

78	AGROSTIS MERTENSII	
79	RANUNCULUS OCCIDENTALIS	
80	PICEA GLAUCA X ENGELMANNII	
81	PINUS CONTORTA	
82	FRAGERIA VIRGINIANA	
83	STELLARIA CALYCANTHA	
84	PICEA GLAUCA	
85	FESTUCA ALTAICA	
86	OXYRIA DIGYNA	
87	CAREX PHAEOCEPHALA	
88	VERONICA WORMSKJOLDII	
89	GERANIUM BICKNELLII	
90	SALIX SCOULERIANA	
91	ASTER SUBSPICATUS	
92	CAREX MACROCHAETA	
93	ORTHILIA SECUNDA	
94	CAREX PODOCARPA	
95	RUBUS PARVIFLORUS	
96	RANUNCULUS UNCINATUS	
97	GYMNOCARPIUM DRYOPTERIS	
98	AQUILEGIA FORMOSA	
99	VICIA AMERICANA	
100	MITELLA PENTANDRA	
101	CAREX BRUNNESCENS	
102	ANDROSACE SEPTENTRIONALIS	
103	SOLIDAGO MULTIRADIATA	
104	MYOSOTIS ASIATICA	
105	DRABA BOREALIS	
106	POA PRATENSIS	
107	PICEA ENGELMANNII	
108	RUMEX ACETOSA	
109	CALAMAGROSTIS LAPPONICA	1
110	LUZULA ARCUATA	
111	POLEMONIUM CAERULEUM	

112 PARNASSIA FIMBRIATA

113 DRABA AUREA

114 CAMPANULA LASIOCARPA

115 DRABA INCERTA

116 GENTIANELLA AMARELLA

117 POPULUS TREMULOIDES

118 VIBURNUM EDULE

119 STREPTOPUS AMPLEXIFOLIUS

120 ELYMUS GLAUCUS

121 GEUM MACROPHYLLUM

122 POA INTERIOR

123 AGOSERIS AURANTIACA

124 ARNICA ALPINA

125 OXYTROPIS SERICEA

126 ANTENNARIA UMBRINELLA

127 SALIX SITCHENSIS

128 GALIUM BOREALE

129 SENECIO LUGENS

130 EPILOBIUM GLANDULOSUM

131 ALOPECURUS AEQUALIS

132 BROMUS RICHARDSONII

133 POA PALUSTRIS

134 SIBBALDIA PROCUMBENS

135 MAIANTHEMUM ~~SILVATICUM~~ CANADENSE

136 CHAMOMILLA SUAVEOLENS

137 SAXIFRAGA TRICUSPIDATA

138 HEDYSARUM ALPINUM

139 MARCHANTIA POLYMORPHA

140 AGROSTIS VARIABILIS

141 ARALIA NUDICAULIS

142 POA REFLEXA

143 ASTER FOLIACEOUS

144 POTENTILLA VILLOSA

146	SALIX POLARIS	
147	SALIX GLAUCA	
148	ARCTOSTAPHYLOS UVA-URSI	
149	BROMUS INERMIS	
150	CAREX ATROSQUAMA	
151	SAMBUCUS RACEMOSA	
152	CERASTIUM ARVENSE	
153	RHINANTHUS MINOR	
154	SEDUM LANCEOLATUM	
155	ERIGERON ACRIS	
156	AGROPYRON VIOLACEUM	
157	SOLIDAGO CANADENSIS	
158	CAREX MEDIA	
159	OXYTROPIS PODOCARPA	
160	DRABA NIVALIS	
161	CAREX ALBONIGRA	
162	CREPIS NANA	
163	CALTHA LEPTOSEPALA	
164	SALIX ALAXENSIS	
165	VACCINIUM MYRTILLUS	
166	CORYDALIS AUREA	
167	PYROLA ASARIFOLIA	
168	VERONICA SERPYLLIFOLIA	
169	SHEPHERDIA CANADENSIS	
170	RIBES GLANDULOSUM	
171	RHODODENDRON ALBIFLORUM	
172	DELPHINIUM GLAUCUM	
173	POA GLAUCA	
174	TIARELLA TRIFOLIATA	
175	ANTENNARIA MICROPHYLLA	
176	CASTILLEJA SULPHUREA	
177	ARABIS DRUMMONDII	
178	AGROSTIS EXARATA	

180	SILENE INVOLUCRATA
181	HIEROCHLOE ALPINA
182	POLYTRICHUM COMMUNE
183	DRABA CRASSIFOLIA
184	CHRYSOSPLENIUM TETRANDRUM
185	PLAGIOMNIUM INSIGNE
186	DRYAS INTEGRIFOLIA
187	VACCINIUM ULIGINOSUM
188	BETULA GLANDULOSA
189	VACCINIUM VITIS-IDAEA
190	CORYDALIS SEMPERVIRENS
191	SORBUS SCOPULINA
192	POLYTRICHUM PILIFERUM
193	ANENOME PARVIFLORA
194	DRABA STENOLOBA
195	EQUISETUM PRATENSE
196	ANTENNARIA NEGLECTA
197	SAXIFRAGA LYALLII
198	DRYOPTERIS ASSIMILIS
199	LOPHOZIA LYCOPODIOIDES
200	LONICERA INVOLUCRATA
201	VIOLA ORBICULATA
202	SENECIO PAUPERCULUS
203	SALIX LASIANDRA
204	MITELLA NUDA
205	SMILACINA RACEMOSA
206	ARTEMISIA MICHAUXIANA
207	AMELANCHIER ALNIFOLIA
208	HIERACIUM CANADENSE
209	ARABIS DIVARICARPA
210	PAPAVER KLUANENSE
211	AGROPYRON SIBIRISOCUM
212	DELPHINIUM BRACHYCENTRUM

214	GERANIUM RICHARDSONII	
215	HACKELIA MICRANTHA	
216	LINNAEA BOREALIS	
217	URTICA DIOICA	
218	VERONICA AMERICANA	
219	DRACOCEPHALUM PARVIFLORUM	
220	APOCYNUM ANDROSAEMIFOLIUM	
221	SMILACINA STELLATA	
222	OXYTROPIS DEFLEXA	
223	CHENOPODIUM CAPITATUM	
224	ARABIS HOLBOELLII	
225	ERIGERON PHILADELPHICUS	
226	PLANTAGO MAJOR	
227	SPENOPHOLIS OBTUSATA	
228	BRYUM CAESPITICIUM	
229	PLEUROZIUM SCHREBERI	
230	PLATANTHERA HYPERBOREA	
231	ASTER SIBIRICUS	
232	MOEHRINGIA LATERIFLORA	
233	POTENTILLA NIVEA	
234	DRABA LONCHOCARPA	
235	EQUISETUM PALUSTRE	
236	POA LEPTOCOMA	
237	SAXIFRAGA CAESPITOSA	
238	CARDAMINE BELLIDIFOLIA	
239	RANUNCULUS NIVALIS	
240	EPILOBIUM LATIFOLIUM	
241	ERIGERON COMPOSITUS	
242	ERIGERON HUMILIS	
243	MINUARTIA ROSSII	
244	RANUNCULUS ESCHSCHOLTZII	
245	SAXIFRAGA ADSCENDENS	
246	KOENIGIA ISLANDICA	

PIONEER COMMUNITIES

RELEVE VERSION

NO. OF SPECIES : 248

NO. OF RELEVES : 146

INDEX 1-12 : 201021010001

PERCENTAGE SELECTION : K1 = 0, M1 = 0

LIMIT 1-3 : 70 3 1

MAX.NO. OF GROUPS CONSIDERED FOR ORDINATION (KKMAX) : 20

KMEZ : 1

RELEVE TYPES WITH LESS THAN THIS NO. OF RELEVES CONSIDERED TRANSITIONAL

COVER VALUE SCALE USED : 1 2 3 4 5 - +

FORMAT : (I4,2X,A4,1X,A4,T21,50I1,/,T21,50I1,/,T21,46I1)

SUFFICIENT DIMENSION OF -DATA ARRAYS AND JMAX-VALUE: 2446