FL

AVALANCHE SLOPE VEGETATION,

VERMILION PASS BURN

Final Report

Kate M. Winterbottom

October 1973
University of Calgary,
Calgary, Alberta

TABLE OF CONTENTS

AVALANCHE SLOPE VEGETATION, VERMILION PASS BURN

INTRODUCTION

Previous surveys of the vegetation of Vermilion Pass have provided information on both pre-fire and post-fire plant communities (Olthof, 1971, Dube, 1972, Willard and Harris 1972). For the majority of the burn, the dominant tree, shrub and herb species were mapped to show the spatial distribution of the recolonizing vegetation. With the exception of (Olthof, 1971), these previous surveys did not study the avalanche chutes covering a large area of the southwest facing slope as this required a separate detailed investigation. Olthof only examined the lowest avalanche slopes in part of the area and made no attempt to map the vegetation, thus the present study was undertaken to provide data on the plant species existing on all the avalanche slopes within the burn and to examine the possible presence of vegetation zonation. Unburnt avalanche chutes at Marble Canyon, adjacent to the area were also studied using similar techniques to provide a comparison with the corresponding slopes within the burn.

METHODS - Design of data collection

Slope Sampling Procedure

The stratified random sampling procedure used in this study involves the creation of a stratified numbered grid over the study area and the choice of sample points by random numbers. Statistically this technique

leads to improved generalizations about a whole population based on the sampled data (Freund 1967).

The base map showing the locations and extent of the avalanche chutes in the burn, used in the study, was compiled in 1972 (Harris 1972). The sampling grid was based on a subdivision of the existing survey grid, completed last year. For each slope the 300 meter grid was divided into a 50 meter grid with numbered intersections. Each chute was then arbitrarily divided into elevation zones based on the 300 meter pins. Zones 1, 2, 3, etc., correspond to increases of 300 meters. Any point on the grid which fell outside the avalanche area, e.g., unburnt pockets or forested areas, were excluded and not numbered. The shape of the slopes varied greatly and within each zone the possible sample points showed a range from 10-108. Plot locations per zone were allocated using random numbers based on a sample size of 10 percent, i.e., one between 0-9, 10-19 and so on. Once assigned on the grid, these points were marked in the field and in doing so, the chute outlines were revised, as winter activity had produced morphological changes since the original mapping in 1972.

One slope was sampled using the above technique as a pilot project. It was found that a random distribution of data points is not ideal for the purposes of vegetation mapping because some areas on the slope are excluded. This problem was overcome by assigning extra sampling points within these areas and thus this slightly modified sampling procedure was applied to the remaining slopes.

Plot sampling procedure:

Based on work by Dube and Willard (1972), the plot sampling procedure was as follows: -

(1) A circle radius 5 meters was described using a measuring tape and divided into quarters using surveyors tape. Within each quarter data on diameter at breast height, height, approximate age and number of each tree species was collected. Data collection on the shrub species was limited to height and number of individuals per species. It was found that subdivision of the plots in this way made collection of data more accurate.

(2) A smaller circle radius 2 meters was described within the larger one using the same focal point and quarter subdivisions. Within each subdivision, numbers of individuals of each species, and percentage cover of each species were noted. From these sample plots the vegetation data was used in the compilation of a series of maps showing the spatial distribution of the dominant tree, shrub and herb vegetation for the avalanche areas. The data on trees and shrubs was converted into density figures per 5 meter flat (78.5 aq. meters) while the herb vegetation was analysed as percentage cover per 2 meter flat (12.5 sq. meters). In compiling the maps then dominant shrub by number was used while dominant and co-dominant herb was based on highest percentage cover.

RESULTS:

Broad shrub and herb zones did exist on the avalanche zones in both burn and non burnt areas.

(1) Shrub vegetation

a. Burned Avalanches

For the purposes of mapping the shrub vegetation was not subdivided into high and low shrub layers, since counting the numbers of individuals of low shrub species such as Linnaea borealis, Arctostaphalos uva-ursi and Vaccinium scoparium was often impossible. These above mentioned

species were counted as herb species and assessed on the basis of percentage cover. Excluding these three species on the 11 unburnt slopes studied, 19 shrub species were present, of which, Rosa acicularis, Salix sp. Amelanchier alnifolia, Juniperus communis, Lornicera involucrata, Potentilla fruticosa and Betula glanduosa, occurred in sufficient numbers to qualify as dominant species (Table 1, Appendix A).

Map 1 shows the distribution of shrub vegetation on the avalanche chutes on the south-west facing slope of the burn and from it certain conclusions can be drawn. The lower 300 to 400 meters of the slopes tend to have a more complex shrub pattern as this zone corresponds to the debris area. After each active avalanche period new debris is added and the vegetation constantly disturbed. A lack of clear ground for colonization aide in the production of a mosaic of different vegetation associations. Species adapted to such conditions and thus dominating the zone were Lornicera involucrata, Juniperus communis, Ribes sp., Betula glanduosa, Shepherdia canadensis and Menziesia glabella.

Above this debris area a broad Rosa-Spiraea zone occurred, within which, other species were locally dominant, e.g., Rosa-Amelancier, Rosa - Potentilla and Salix-Amelanchier. Above 900 meters the Rosa-Spiraea zone gave way to a Salix-Juniperus-Shepherdia-Potentilla area extending to rock face. In the case of slopes L, M, N and O, Rosa-Spiraea extended to rock face.

Of the 11 unburnt slopes only three were over 300 meters wide, i.e., B, D, F and this had an appreciable effect on the vegetation. These three slopes had a well defined zone where shrubs dominated the vegetation. The other slopes all showed an increase in the numbers of shrubs per plot with increasing elevation but no well defined dominant shrub area. A

possible explanation for this, is that the narrowness of these slopes tended to channel the snow avalanches, thus producing greater snow force and thus decreasing the chances of shrub survival in large concentrations.

b. Unburnt avalanche slopes

On these slopes a well defined shrub zone existed at 600 meters dominated by Alnus sinuata and Salix sp. This zone extended for 600 meters to rockface punctuated by meadow areas of grasses and herbs. Average shrub height here was 6-9 feet compared to 1-2 feet in the burn.

(2) Herb Vegetation

a. Burn

The dominant species present was Agropyron albicans which was common everywhere on the slopes. Again the lower 300 meters of the slopes showed varied associations of Epilobium augustifolium, Thalictrum occidentale, Solidago sp, Fragaria, and Arctostaphylos uva-ursi as co-dominants. These species formed distinct zones which were often slope specific and could not be traced across the whole avalanche slope complex. Above 700 meters Agropyron albicans gave way to a zone dominated by Arctostaphylos, Allium cernuum and Zygadenus elegans. This rocky area with steep slopes and poor soils reflected the capacity of certain species to adapt to a poor environment.

The narrow slopes showed stronger dominance, i.e., fewer competing herbs and a much simpler zonation pattern which is again possibly due to concentrated snow activity.

b. Unburned slopes

A well defined lower meadow zone and upper shrub zone exists although within the meadow area no single dominant species emerges. The meadow area exhibits a rich flora with numerous grass species including

Bromus carinatus, Agropyron albicans, Agropyron subsecundum, Agrostis alba, and Calamogrostis rubescens with Heracleum lanatum, Solidago, Senecio sp. and Hackelia floribunda. With elevation the herb areas in the shrub zone show an increase in species such as Gaillardia aristata, Allium cernuum and Zygadens elegans which is comparable to the burned avalanche slopes.

(3) Tree Vegetation

a. Burn

Map 3 shows the distribution of the different tree species. Pinus contorta has a wide distribution over the majority of the slopes especially at lower and higher altitudes. This widespread distribution indicates the part played by this species in the primary fire successional stage. Aspen is common at all altitudes on the narrow slopes and forms a broad media zone on the wider slopes. Aspen is also a fire successional species invading open areas and becoming well established. The occurrence of large numbers of spruce seedlings at lower altitudes on slope F is due to the presence of an unburnt pocket of spruce providing a seed source. Abies lasiocarpa seedlings occur adjacent to unburnt pockets and at high altitudes on the slopes. Pinus albicaulis occurred mainly at higher altitudes although a few isolated individuals were located at 300 meters reflecting the possible effects of snow avalanching carrying seed from higher up the slope.

(b) Non Burn

The lower meadow zone reflects the occassional invasion of seedlings from the surrounding mature Abies lasiocarpa-Picea englemanii forest. Populus tremuloides saplings dominated the zone, the seed source being both mature trees on the slope and in the forest. Above 600 meters

Populus balsamifera, Populus tremuloides are widespread forming dense clumps across the slope. This zone can be described as a ladder pattern with Salix and Alnus forming the uprights bordering the forest edge, Populus balsamifera and Populus tremuloides creating the cross pieces and the meadow vegetation forms the spaces. This pattern persists to rock face.

Interslope Variability

Table 1 (Appendix A) designed to indicate the total number of plant species present on both burnt and non-burnt slopes, numbers of species per slope and per elevation zone, and relative abundance per slope per zone. The following abbreviation has been used: -

R = Rare	1 - 24%	Occurrence in plots sampled per zone
M = Moderate	25 - 49%	" " " " "
F = Frequent	50 - 74%	" " " " "
C = Common	75 -100%	" " " " "

In the burn, total species per slope varied from 7-74, while the unburnt slopes had 69 and 66 respectively. The three widest slopes (B,D,& F) had totals of 37, 49, and 74 with an average of 53 species, while the narrow slopes had an average of 28 species per slope. In general the unburnt slopes showed greater species numbers but fewer dominants as competition was strong. These slopes had little or no bare ground and a stratified herb layer. The burnt avalanche slopes showed a strong dominence in certain species, e.g., Agropyron albicans, and also much bare ground.

Small slopes, Zones 2 and 3, showed greatest floristic variety in shrub and especially herb species. In the burn, 63% of slopes showed an increase in shrub species up to zone 3 while only 54% of the slopes showed the same trend in the herb species. The two unburnt slopes showed an increase in both shrub and herb species up to zone 4. As a general rule this

seems to show the effect of the debris area and the preponderence of available colonization sites in zones 2 and 3. Above zone 3 bare rock and poor soil development inhibits all but the hardy species and plant diversity decreases.

Limitations of the study

The sampling technique used proved effective in collecting data but certain limitations exist because estimation of percentage cover by eye leads to inaccuracies. Also the effect of seasonality is such that in spring, Arnica is in flower and appears to be dominant over Epilobium, while in the fall the reverse is true. This phenomenon is also true for many other species present in the burn and can also create inaccuracies in data collection.

Conclusions and recommendations for further study

Maps have now been completed of the vegetation of the avalanche chute complex of the southwest-facing slope of the burn. The investigations presented here indicate that a distinct vegetation zonation does exist on the avalanche slopes although complications exist in the lower debris zone. This pattern is shown most clearly by the shrub vegetation and most poorly by the tree cover. A comparison between avalanche and non-avalanche slope zonation will be presented in a forthcoming report. Preliminary investigations indicate the need for remapping the vegetation of the burn every two to three years since dynamic changes appear to be taking place reflecting the competition between Arnica and Epilobium and between certain shrub species.

VEGETATION MAPPING OF THE VERMILION PASS BURN

Kate M. Winterbottom, 1973.

Introduction

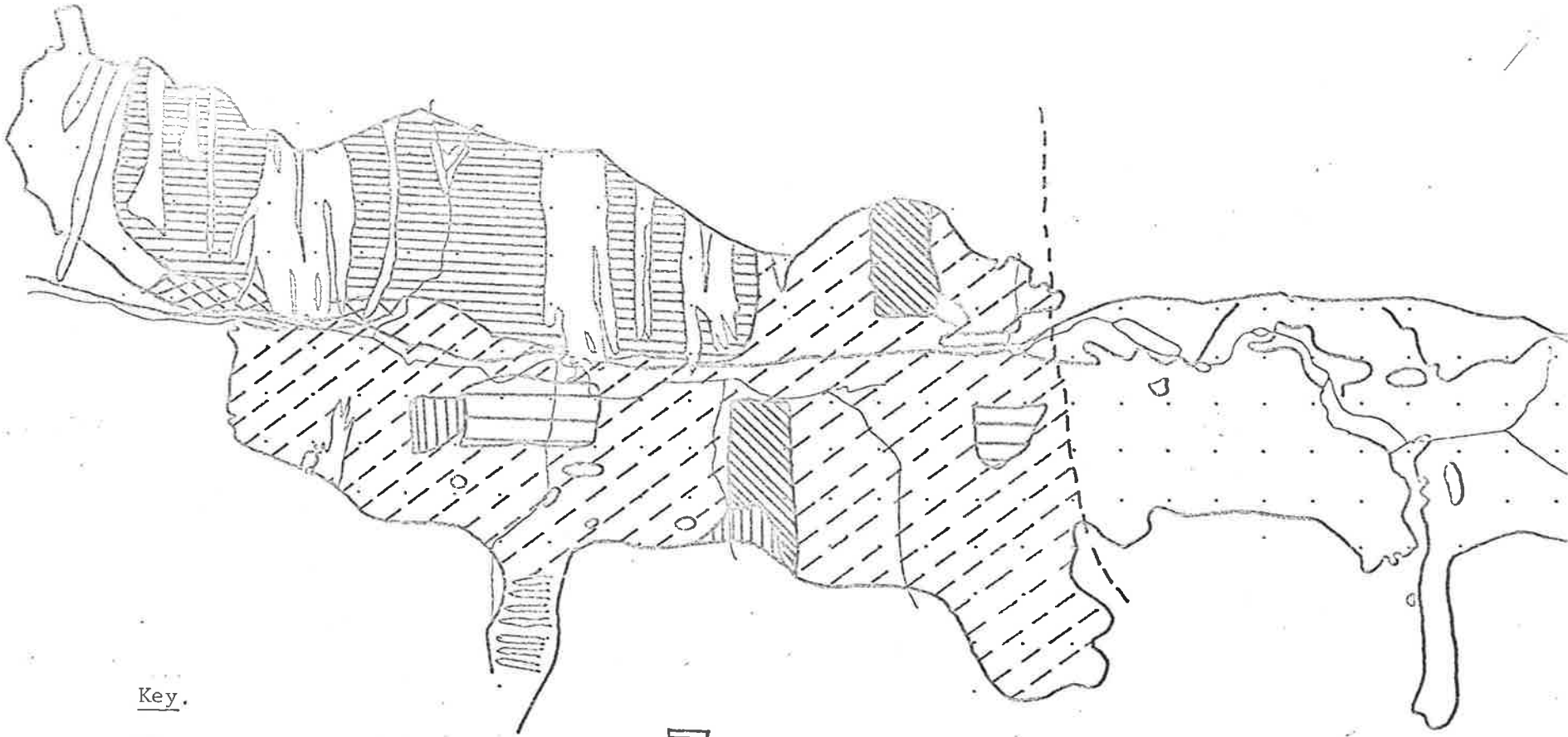
After fire the vegetation of an area experiences certain dynamic vegetation changes as part of the process of succession. The vegetation pattern present at any one time period will reflect the competition for dominance between the various species present in the area and often the invasion of new species.

The maps of Willard and Harris (1972), show the vegetation pattern of the Vermilion Pass burn present in 1972. In using these maps in a survey of the avalanche areas in 1973, it became obvious that changes in species dominance had taken place. This study was undertaken to re-map the area of the burn between the Continental Divide and Marble Canyon thus providing data on the differences in vegetation in the period between 1972 and 1973. From the data collected a comparison between the avalanche vegetation and that of the adjacent slopes will also be possible.

Methods - Design of Data Collection

To sample the vegetation of the burn, transects were set vertically upslope along the existing survey grid, using the 300 meter pins as plot points. The initial choice of the location of the transects was arbitrarily based on the position of the avalanche slopes on the south-facing slope and east of fording the river on the north-facing slope.

MAP I. SHRUB ASSOCIATION, 1973



Key.

Menziesia glabella.

Menzi[illegible]-Sambucus melanocarpa.

Menzi[illegible]um groenlandicum.

Menzi[illegible]ccinium scoparium.

Menzi[illegible]Ribes sp- Rubus.

Rosa- Spiraea.

Limit of study area.

0 1600
METRES

KMW

At each pin upslope on the transect the plot sampling procedure was as follows: -

(1) A 5 meter circle was described using a measuring tape and divided into quarters marked with surveyors tape. In each quarter, data was collected on height and numbers of individuals of the various tree and shrub species present.

(2) A 2 meter circle was described within the larger one using the same focal point and subdivisions. Within each quarter, data on the percentage cover of the different herb species was collected.

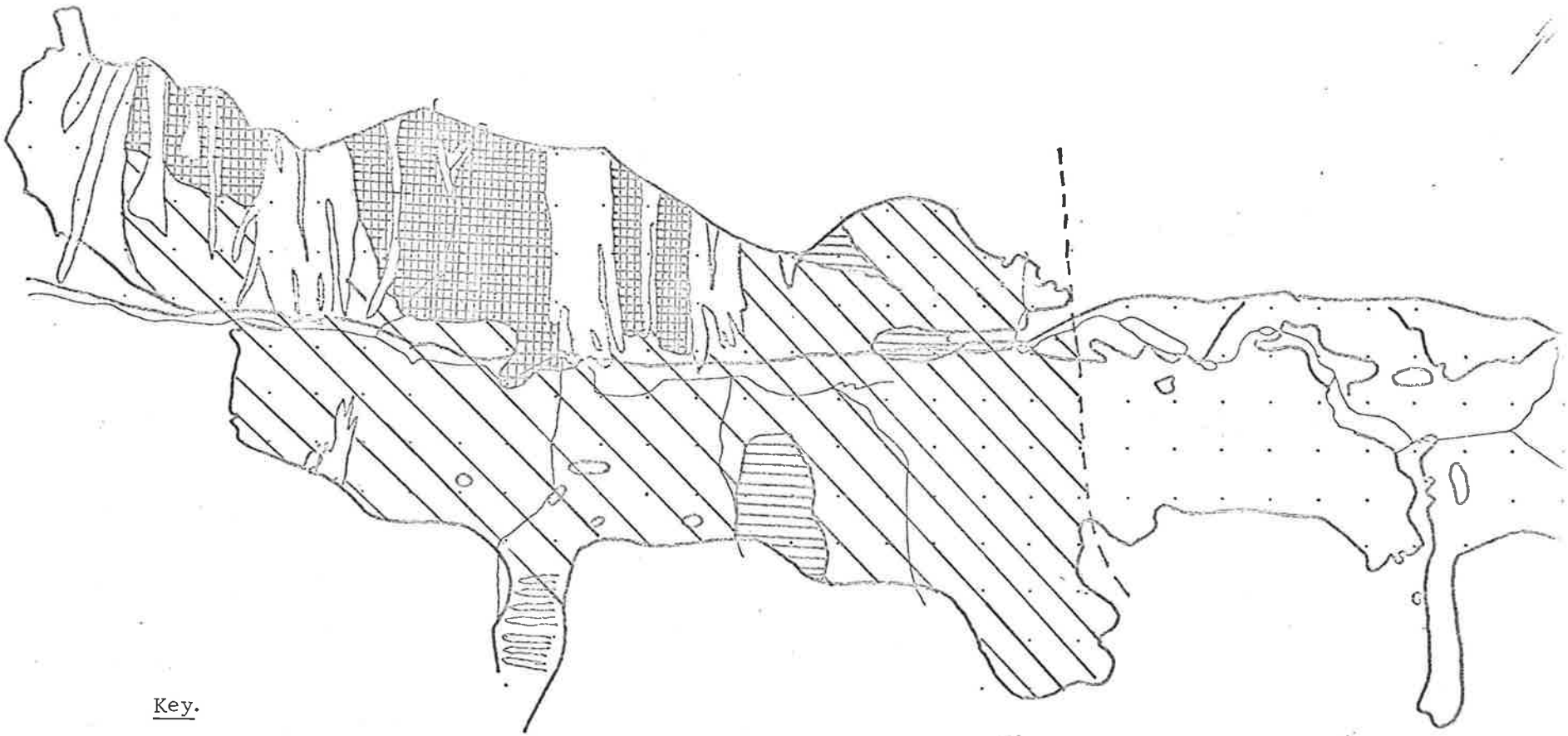
It was found by subdividing the plots in this manner that collection of data was facilitated as estimation of percentage cover and numbers of individuals over a large area is often difficult. For each plot the selection of dominant and co-dominant shrub was based on the two highest numbers of individuals per species. The dominant and co-dominant herb species were selected on the basis of the two highest percentage covers per plot. This data was plotted on overlay paper and the results were compared to the vegetation maps of 1972 (Willard and Harris). The maps of the vegetation as it appears in 1973 and the changes in the period 1972-1973 are included in the appendix.

Results

(1) Shrubs

On the north-facing slope of the valley Menziesia glabella is the dominant shrub species (map 1). This shrub is rarely a sole dominant as it generally occurs in association with other shrub species such as Ledum groenlandicum and Sambucus melanocarpa. A Menziesia-Sambucus association occurs in the area around pins 11 and 12 SEC and within this

MAP 2. HERB ASSOCIATION 1973



Key.

Arnica cordifolia.

Epilobium augustifolium.

Grasses.

Limit of study area.

0 1600

METRES

KM

area Sambucus become locally dominant. In the vicinity of pins 7 and 6 SEA-C, Menziesia occurs in association with Vaccinium scoparium forming a well defined two layered shrub strata. Pins 10 SE-C and 1 and 2 SE-C show an association of Menziesia and Ledum groenlandicum and again within this area Ledum groenlandicum becomes locally dominant.

On the south-facing slope, the avalanche areas are a disturbing influence on the vegetation, the whole complex being dominated by a Rosa-Spiraea association. At the eastern edge of the avalanche area, Menziesa replaces the Rosa-Spiraea association with Vaccinium scoparium, Shepherdia canadensis, Rubus strigosus and Ribes sp.

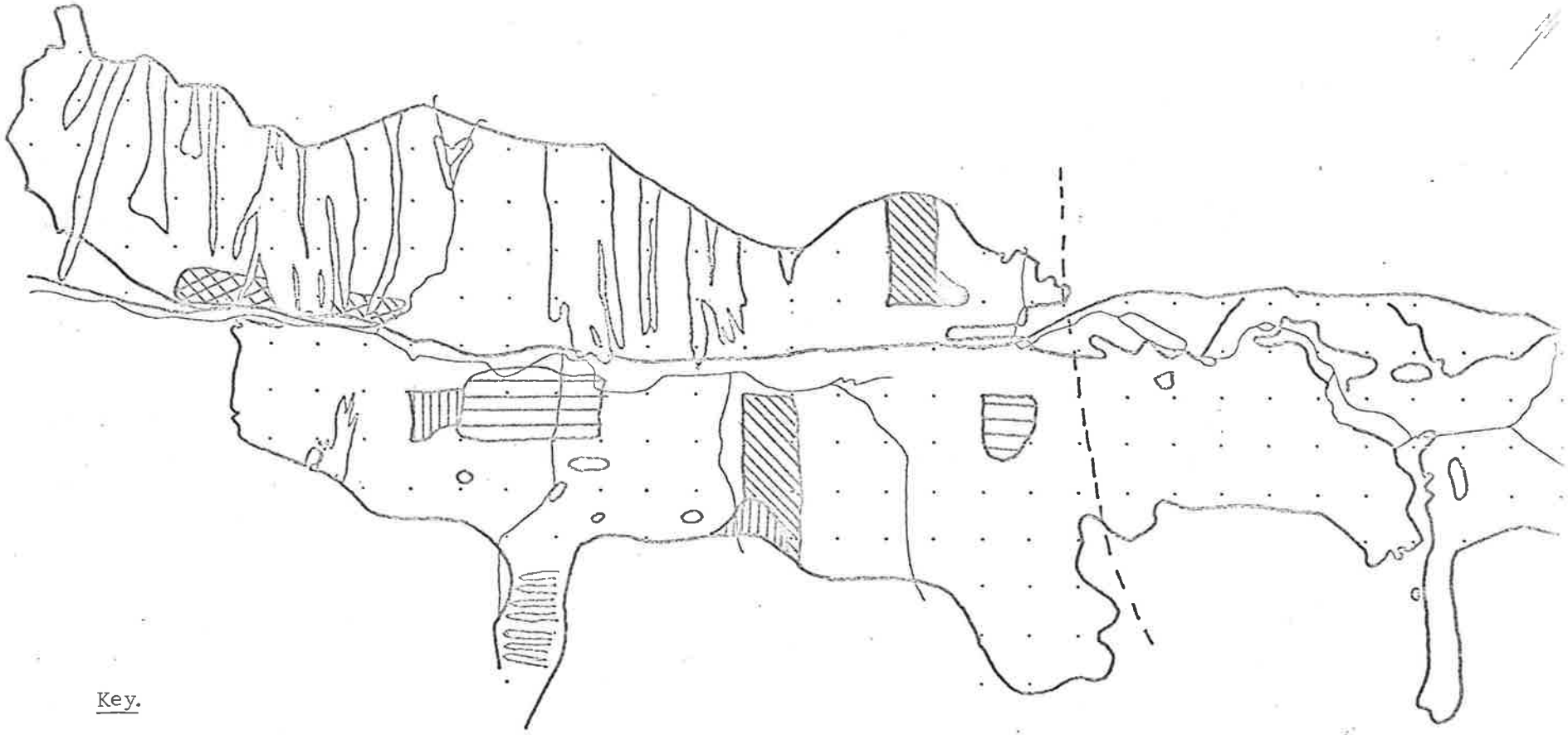
(2) Herbs

The herb associations found in 1973 are shown on Map 2. Epilobium augustifolium is the most characteristic species of the north-facing slope, where it competes favourably with Arnica cordifolia for dominance. This latter species has widespread occurrence but only local dominance,for example in the vicinity of pins 6 and 7 SE-D and 10 SE-C. On the north-facing slope grasses such as Agropyron albicans show localized dominance within the Epilobium zone and general widespread occurrence over the entire slope. The south-facing slope avalanche areas are dominated by grasses reflecting the open nature of such areas, together with Senecio sp., Carex sp. and Aster conspicuus as co-dominants. At the eastern edge of the avalanche complex, Epilobium again becomes dominant with Carex sp. and Cornus canadensis as localized co-dominants.

(3) Trees

An isoline map of the trees was compiled and from it certain conclusions can be drawn. The pattern present shows the dominance of

MAP 3. CHANGES IN SHRUB VEGETATION IN THE PERIOD 1972-1973



Key.

Limit of the study area.

Menziesia glabella -Ledum groenlandicum once Menziesia glabella only.

Menziesia glabella- Vaccinium scoparium once Menziesia glabella only.

Menziesia glabella-Sambucus melanocarpa once Menziesia glabella only.

Shepherdia canadensis once Menziesia glabella.

Menziesia-Ribes sp-Rubus
Once Menziesia only.

0 1600
METRES

Pinus contorta throughout the whole area, the highest numbers of trees being at pins 2 and 3 SW-A-C. The south-facing slope has rare occurrences of Populus tremuloides and Picea glauca-englemanii, for example at pins 14 SW-B and 17 SW-A. These two areas reflect the close proximity of the unburnt forest edge as a possible seed source.

Changes in Vegetation 1972 - 1973

In comparing the maps of Willard and Harris (1972) with present findings it is clear that dynamic changes have occurred in the vegetation and the area is still in the process of further change.

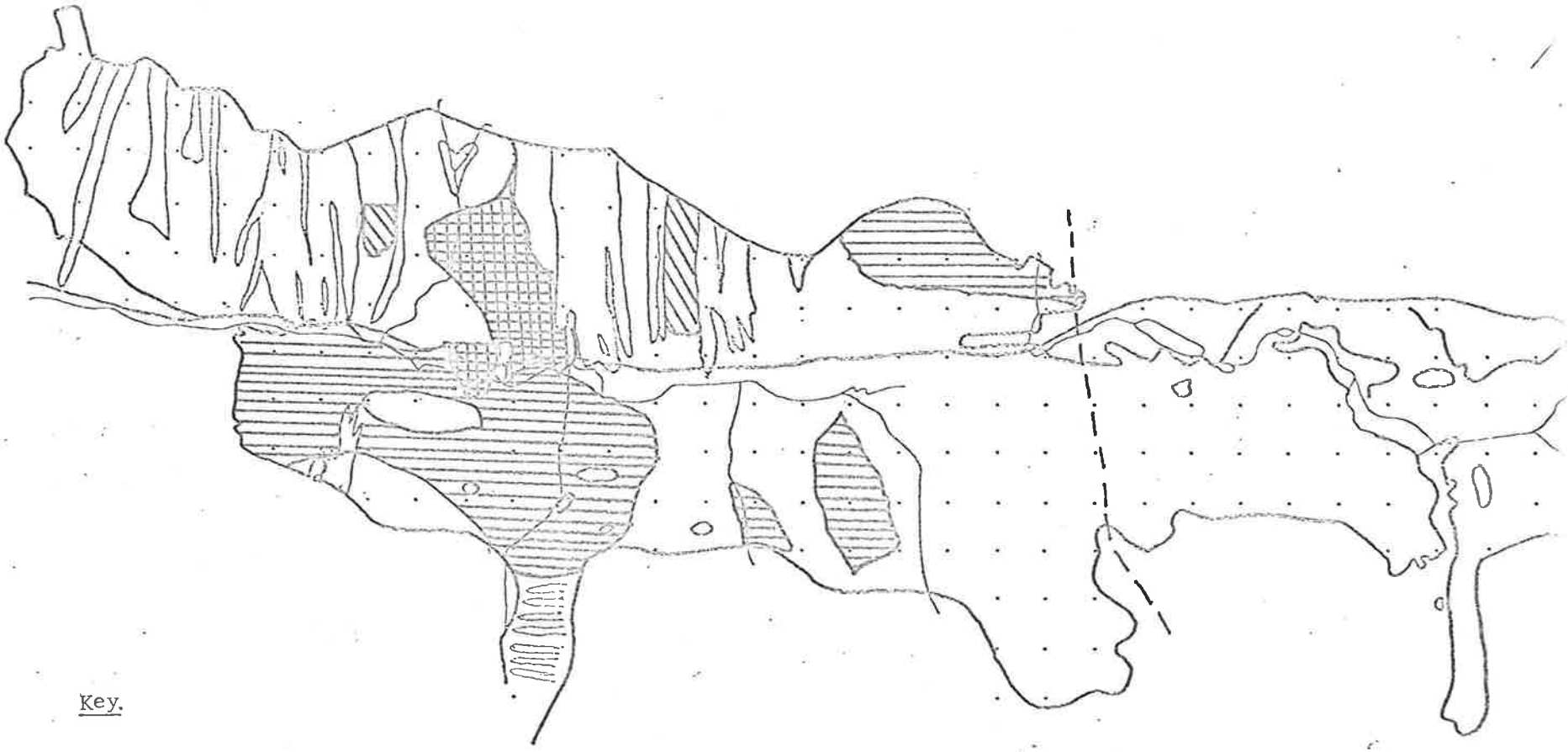
(a) Shrubs

The shrubs (Map 3) show very little change in dominance since Menziesia glabella still covers the greatest area of this section of the burn in 1973 as it did in 1972. What has emerged is that various other shrubs have appeared in sufficient numbers to be co-dominants, reflecting the growing aspect of competition in the burn as succession proceeds.

(b) Herbs

The herb species show the greatest amount of change in the one-year period (Map 4). Epilobium augustifolium has increased its area of dominance at the expense of Arnica cordifolia, for example areas 2 and 3 SW-C-D and 11 and 10 SE-A-D which were once predominantly Arnica are now Epilobium. Only one small area around pins 6 and 7 SE-D-E shows an increase in Arnica over Epilobium. Agropyron albicans at pin 12 SE-A is now dominant in an area which was originally Arnica and in the case of pins 8 SW-A and 14 SW-B, it is dominant in an area which was originally Epilobium.

MAP 4. CHANGES IN HERB VEGETATION IN THE PERIOD 1972-1973



Key.

Epilobium augustifolium area once Arnica cordifolia.

Agropyron albicans and other grasses once Epilobium augustifolium.

Agropyron albicans and Carex sp once Arnica cordifolia.

Limit of the study area.

0 1600

METRES

(c) Trees

A comparison of the 1972 and 1973 isoline maps reveals a very similar pattern, however in general in 1973 the numbers of trees were 5-10 percent higher. One area in the vicinity of pins 2 and 3 SW-A-D showed an increase of 20-25 percent in the number of trees. It is not possible to compare tree data on the avalanche areas since 1973 was the first year of study on this complex.

A comparison between Avalanche slope vegetation and that of the adjacent slopes.

The avalanche slopes show broadly similar zones to those of the surrounding areas. In the case of the shrubs, Rosa-Spiraea dominated the avalanche complex including the adjacent burnt slopes. All avalanche slopes have far more competing shrub species and the zonation in the lower avalanche areas is particularily complex. In terms of the herb species, grasses such as Agropyron albicans dominate the burnt slopes while the avalanche areas show a much finer zonation pattern from Agropyron albicans and Carex sp. on the lower slopes, giving way to Gaillardia aristata, Allium cernuum and Zygadenus elegans on the upper slopes. Again far more competing species are present on the avalanche slopes than on the adjacent burn. The transect on the burnt slope 14 SW-A-D averaged 6 herb species per plot while the adjacent avalanche area at the equivalent plot point averaged 16 species per plot. The avalanche slopes showed large numbers of Populus tremuloides which was not the case on the surrounding slopes. This indicated the preference of this species for open habitats as it is a shade intolerant species.

Conclusion

From the results of the survey, succession is proceeding in all plant species in the burn. This process appears most rapid in the herbs and less so in the shrubs and trees. Epilobium and Arnica are the two herb species most actively engaged in competition and this is where most changes in species dominance should be expected in a relatively short space of time. The comparison between the vegetation of the avalanche areas and the adjacent slopes indicates that avalanche areas have a more complex zonation pattern which is broadly similar to the surrounding slopes.

REFERENCES

Dube' D. (1972) Vermilion Pass Fire Project. Preliminary Reports A & B. Manuscript Report to Parks Branch. Dept. of Indian Affairs and Northern Development.

Freund, J.E. (1967) Modern Elementary Statistics. Third edition Prentice-Hall.

Olthof, P.J., (1971) Manuscript Report to Parks Branch. Dept. of Indian Affairs and Northern Development.

Willard, T. & Harris, S.A. (1972) - Vegetation Map of the Vermilion Burn (1972). Manuscript Report to Parks Branch, Dept. of Indian Affairs and Northern Development.

EXPLANATION OF TABLES

The following tables are designed to indicate: -

(1) Total number of plant species present on both burnt and non-burn avalanche slopes.

(2) Number of species per slope and per elevation zone.

(3) Relative number of species per slope per zone by comparing one slope with the next.

Zones 1, 2, 3, 4, and 5 indicate successive increases of 300 meters upslope based on the survey pins A, B, C, D, and E.

The unburnt slopes are lettered A-O based on their successive occurrence East to West along the 93 highway. Slope F is in fact a complex slope in which the various tongues are lettered F, G, H, I, and J hence the next slope westwards is slope K. The two unburnt slopes are lettered G and R.

In some cases the avalanche slope did not extend very far from cliff base and thus the lower zones were not represented. In this case the lower zones on the table carry the symbol - X - indicating that they do not exist. If the lower zones do not carry this symbol and show no plant species then it is to be assumed that vegetation cover is lacking but that these zones are in existence.

ADDITIONAL SPECIES

Shrubs

Juniperus communis

Herbs

Cornus canadensis
Equisetum arvense
Senecio sp.
Solidago decumbrens
Sanicula marilandica
Agrostis alba
Calamogrostis rubescens
Oxytropis sericea var *spicata*
Lathyrus ochroleucus
Sizene noctiflora

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES 1	2	3	4	SLOPE A
Trees	*Abies lasiocarpa*	X				
	Pinus albicaulis	X				
	Pinus contorta	X				
	Pinus flexilis	X				
	Picea glauca/englemanni (hybrid)	X				
	Populus balsamifera	X				
	Populus tremuloides	X				
Shrubs	*Amelanchier alnifolia*	X				
	Alnus sinuata	X				
	Betula Glandulosa	X				
	Ledum groenlandicum	X				
	Lornicera involucrata	X				
	Menziesia glabella	X				
	Potentilla fruticosa	X				
	Prunus pensylvanica	X				
	Ribes sp.	X				
	Rosa acicularis	X				
	Rubus acaulis	X				
	Rubus parviflorus	X				
	Rubus strigosus	X				
	Salix sp.	X	R			
	Sambucus	X				
	Shepherdia canadenis	X				
	Spiraea lucida	X				
	Vibernum edule	X				
	Viburnum trilobium	X	M	R		
	Juniperus communis	X				
	Arctostaphalos uva-ursi	X	R			
	Linnaea borealis	X				
	Vaccinium scoparium	X				
			3	1		

TOTAL SHRUBS 3

TOTAL TREES 0

TABLE 1. TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES 1	2	3	4	SLOPE B
Trees	*Abies lasiocarpa*	R		R		
	Pinus albicaulis			R		
	Pinus contorta	F	F	F		
	Pinus flexilis					
	Picea glauca/englemanni (hybrid)			R		
	Populus balsamifera					
	Populus tremuloides		F	F		
Shrubs	*Amelanchier alnifolia*	2 R	R	5 M		
	Alnus sinuata		R			
	Betula Glandulosa			R		
	Ledum groenlandicum					
	Lornicera involucrata	M				
	Menziesia glabella					
	Potentilla fruticosa		R			
	Prunus pensylvanica					
	Ribes sp.		R			
	Rosa acicularis	C	C	C		
	Rubus acaulis					
	Rubus parviflorus					
	Rubus strigosus		M	M		
	Salix sp.					
	Sambucus					
	Shepherdia canadenis		M	M		
	Spiraea lucida	C	C	C		
	Vibernum edule			R		
	Viburnum trilobium					
	Juniperus communis			R		
	Arctostaphalos uva-ursi			R		
	Linnaea borealis		R	R		
	Vaccinium scoparium	R	M			
		5	10	10		

TOTAL SHRUBS 15

TOTAL TREES 5

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES 1	2	3	4	SLOPE C
Trees	*Abies lasiocarpa*			R		
	Pinus albicaulis			R		
	Pinus contorta					
	Pinus flexilis					
	Picea glauca/englemanni (hybrid)			R		
	Populus balsamifera					
	Populus tremuloides		F	F		
			1	4		TOTAL TREES 4
Shrubs	*Amelanchier alnifolia*	C	C	C		
	Alnus sinuata					
	Betula Glandulosa		R			
	Ledum groenlandicum					
	Lornicera involucrata					
	Menziesia glabella					
	Potentilla fruticosa		M	M		
	Prunus pensylvanica					
	Ribes sp.					
	Rosa acicularis	C	C	C		
	Rubus acaulis					
	Rubus parviflorus					
	Rubus strigosus		R			
	Salix sp.			C		
	Sambucus					
	Shepherdia canadenis		F	F		
	Spiraea lucida	C	C	C		
	Vibernum edule		R			
	Viburnum trilobium					
	Juniperus communis			R		
	Arctostaphalos uva-ursi			C		
	Linnaea borealis		R	R		
	Vaccinium scoparium					
		3	9	9		TOTAL SHRUBS 12

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES 1	2	3	4	SLOPE D
Trees	*Abies lasiocarpa*			M		
	Pinus albicaulis			R		
	Pinus contorta	C	C	C		
	Pinus flexilis	R		R		
	Picea glauca/englemanni (hybrid)	F	F	F		
	Populus balsamifera					
	Populus tremuloides	F	F			
Shrubs	*Amelanchier alnifolia*	4	3 C	5 C		
	Alnus sinuata	F	F	F		
	Betula Glandulosa					
	Ledum groenlandicum	R				
	Lornicera involucrata	M				
	Menziesia glabella	R				
	Potentilla fruticosa	C	C	C		
	Prunus pensylvanica		F			
	Ribes sp.	F	F			
	Rosa acicularis	C	C			
	Rubus acaulis					
	Rubus parviflorus					
	Rubus strigosus	F	F			
	Salix sp.	C	C	C		
	Sambucus	R	R			
	Shepherdia canadenis	C	C	C		
	Spiraea lucida	F	F			
	Vibernum edule	M	M			
	Viburnum trilobium					
	Juniperus communis		R	R		
	Arctostaphalos uva-ursi	F	F			
	Linnaea borealis	F		F		
	Vaccinium scoparium		C	C		
		15	15	8		

TOTAL SHRUBS 19

TOTAL TREES 6

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES 1	2	3	4	SLOPE E
Trees	*Abies Lasiocarpa*		R			
	Pinus albicaulis					
	Pinus contorta	F	F	C		
	Pinus flexilis					
	Picea glauca/englemanni (hybrid)					
	Populus balsamifera					
	Populus tremuloides					
Shrubs	*Amelanchier alnifolia*	1	2	1	F	
	Alnus sinuata				F	
	Betula Glandulosa					
	Ledum groenlandicum					
	Lornicera involucrata			R		
	Menziesia glabella					
	Potentilla fruticosa			R	F	
	Prunus pensylvanica					
	Ribes sp.					
	Rosa acicularis		C	C	C	
	Rubus acaulis					
	Rubus parviflorus					
	Rubus strigosus					
	Salix sp.					
	Sambucus					
	Shepherdia canadenis					
	Spiraea lucida					
	Vibernum edule					
	Viburnum trilobium					
	Arctostaphalos uva-ursi					
	Linnaea borealis		C	C	R	
	Vaccinium scoparium				R	
			3	6	8	

TOTAL SHRUBS 9

TOTAL TREES 2

TABLE 1 TREES AND SHRUBS

SLOPE F
F-J

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES 1	2	3	4
Trees	*Abies lasiocarpa*	R		R	
	Pinus albicaulis			R	
	Pinus contorta	M			
	Pinus flexilis				
	Picea glauca/englemanni (hybrid)			R	
	Populus balsamifera		R		
	Populus tremuloides		C	C	
Shrubs	*Amelanchier alnifolia*	2 C	2 C	4 R	R"
	Alnus sinuata	R	R		
	Betula Glandulosa	C	R		
	Ledum groenlandicum		R		
	Lornicera involucrata	M	M	R	
	Menziesia glabella		M		
	Potentilla fruticosa			F	R
	Prunus pensylvanica				
	Ribes sp.		M	M	
	Rosa acicularis	M	C	C	C
	Rubus acaulis				
	Rubus parviflorus				
	Rubus strigosus		M	M	
	Salix sp.	C	C	C	C
	Sambucus		R		
	Shepherdia canadenis	M	M	M	M
	Spiraea lucida	M	M	M	M
	Vibernum edule		R		
	Viburnum trilobium		R		
	Juniperus communis	R	R	M	R
	Arctostaphalos uva-ursi	R	R		M
	Linnaea borealis	M	M	M	R
	Vaccinium scoparium	M	R		
		12	19	11	9

TOTAL SHRUBS 20

TOTAL TREES 6

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES				SLOPE
		1	2	3	4	G
Trees	*Abies lasiocarpa*		R	R	M	
	Pinus albicaulis				M	
	Pinus contorta				R	
	Pinus flexilis					
	Picea glauca/englemanni (hybrid)	R	R	R		
	Populus balsamifera	M	C	C	C	
	Populus tremuloides	M	C	C	C	
Shrubs	*Amelanchier alnifolia*	3 C	4 M	4 C	4 C	
	Alnus sinuata	R	C	C		
	Betula Glandulosa	R				
	Ledum groenlandicum					
	Lornicera involucrata				M	
	Menziesia glabella	R	R		M	
	Potentilla fruticosa	R		F	M	
	Prunus pensylvanica					
	Ribes sp.				R	
	Rosa acicularis	C	C	C	C	
	Rubus acaulis	C	C	M		
	Rubus parviflorus	M	C			
	Rubus strigosus					
	Salix sp.	C	C	M	C	
	Sambucus					
	Shepherdia canadenis	M	R	R	M	
	Spiraea lucida	C	C	C	C	
	Vibernum edule					
	Viburnum trilobium					
	Juniperus communis	R		R	M	
	Arctostaphalos uva-ursi				R	
	Linnaea borealis				R	
	Vaccinium scoparium				R	
		12	9	9	12	

TOTAL SHRUBS 16

TOTAL TREES 4

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES					SLOPE K
		1	2	3	4	5	
Trees	*Abies lasiocarpa*	X	X				
	Pinus albicaulis	X	X				
	Pinus contorta	X	X	C	C	C	
	Pinus flexilis	X	X				
	Picea glauca/englemanni (hybrid)	X	X				
	Populus balsamifera	X	X		C		
	Populus tremuloides	X	X		F		
Shrubs				1	3	1	
	Amelanchier alnifolia	X	X		F	F	
	Alnus sinuata	X	X				
	Betula Glandulosa	X	X			F	
	Ledum groenlandicum	X	X				
	Lornicera involucrata	X	X	F			
	Menziesia glabella	X	X				
	Potentilla fruticosa	X	X			F	
	Prunus pensylvanica	X	X				
	Ribes sp.	X	X				
	Rosa acicularis	X	X	C	C	C	
	Rubus acaulis	X	X				
	Rubus parviflorus	X	X				
	Rubus strigosus	X	X				
	Salix sp.	X	X	F			
	Sambucus	X	X				
	Shepherdia canadenis	X	X				
	Spiraea lucida	X	X	C	C	C	
	Vibernum edule	X	X				
	Viburnum trilobium	X	X				
	Arctostaphalos uva-ursi	X	X				
	Linnaea borealis	X	X	F			
	Vaccinium scoparium	X	X				
				5	3	5	

TOTAL SHRUBS 8

TOTAL TREES 3

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES					SLOPE M
		1	2	3	4	5	
Trees	*Abies lasiocarpa*	X	X				
	Pinus albicaulis	X	X				
	Pinus contorta	X	X			C	
	Pinus flexilis	X	X				
	Picea glauca/englemanni (hybrid)	X	X				
	Populus balsamifera	X	X		R		
	Populus tremuloides	X	X		C		
Shrubs	*Amelanchier alnifolia*	X	X		2	1	
	Alnus sinuata	X	X			F	
	Betula Glandulosa	X	X		F	C	
	Ledum groenlandicum	X	X				
	Lornicera involucrata	X	X				
	Menziesia glabella	X	X				
	Potentilla fruticosa	X	X		C	C	
	Prunus pensylvanica	X	X				
	Ribes sp.	X	X				
	Rosa acicularis	X	X	C	C	C	
	Rubus acaulis	X	X				
	Rubus parviflorus	X	X				
	Rubus strigosus	X	X				
	Salix sp.	X	X				
	Sambucus	X	X			F	
	Shepherdia canadenis	X	X		R	F	
	Spiraea lucida	X	X	C	F	F	
	Vibernum edule						
	Viburnum trilobium						
	Arctostaphalos uva-ursi	X	X				
	Linnaea borealis	X	X				
	Vaccinium scoparium	X	X				
				2	5	6	

TOTAL SHRUBS 6

TOTAL TREES 3

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES					SLOPE N
		1	2	3	4	5	
Trees	*Abies lasiocarpa*	R			R		
	Pinus albicaulis						
	Pinus contorta	F	M	R			
	Pinus flexilis						
	Picea glauca/englemanni (hybrid)	F	R				
	Populus balsamifera		R	M	R		
	Populus tremuloides		R	M	R		
Shrubs	*Amelanchier alnifolia*	3	4	3 M	3		
	Alnus sinuata		M	R			
	Betula Glandulosa		M				
	Ledum groenlandicum						
	Lornicera involucrata	R					
	Menziesia glabella						
	Potentilla fruticosa			R	R	R	
	Prunus pensylvanica						
	Ribes sp.	R					
	Rosa acicularis	C	C	C	C	C	
	Rubus acaulis						
	Rubus parviflorus						
	Rubus strigosus						
	Salix sp.						
	Sambucus						
	Shepherdia canadenis						
	Spiraea lucida						
	Vibernum edule						
	Viburnum trilobium						
	Arctostaphalos uva-ursi			C	C	R	
	Linnaea borealis				C		
	Vaccinium scoparium		R				
		6	5	6	6	5	

TOTAL SHRUBS 13

TOTAL TREES 5

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES				SLOPE L
		1	2	3	4	5
Trees	*Abies lasiocarpa*	x	X			
	Pinus albicaulis	X	X			
	Pinus contorta	X	X	R	R	
	Pinus flexilis	X	X			
	Picea glauca/englemanni (hybrid)	X	X		R	
	Populus balsamifera	X	X			
	Populus tremuloides	X	X	M		
Shrubs	*Amelanchier alnifolia*	X	X	2 F	2 R	
	Alnus sinuata	X	X			
	Betula Glandulosa	X	X			F
	Ledum groenlandicum	X	X			
	Lornicera involucrata	X	X			
	Menziesia glabella	X	X			
	Potentilla fruticosa	X	X		R	F
	Prunus pensylvanica	X	X			
	Ribes sp.	X	X			
	Rosa acicularis	X	X	C	C	C
	Rubus acaulis	X	X			
	Rubus parviflorus	X	X		R	
	Rubus strigosus	X	X			
	Salix sp.	X	X	F	F	
	Sambucus	X	X			
	Shepherdia canadenis	X	X			
	Spiraea lucida	X	X	C	C	C
	Vibernum edule	X	X			
	Viburnum trilobium	X	X			
	Juniperus communis	X	X		R	
	Arctostaphalos uva-ursi				R	R
	Linnaea borealis				R	
	Vaccinium scoparium			R		
				5	9	5

TOTAL SHRUBS 11

TOTAL TREES 3

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES					SLOPE 0
		1	2	3	4	5	
Trees	*Abies lasiocarpa*	X	X	X			
	Pinus albicaulis	X	X	X			
	Pinus contorta	X	X	X			
	Pinus flexilis	X	X	X			
	Picea glauca/englemanni (hybrid)	X	X	X			
	Populus balsamifera	X	X	X			
	Populus tremuloides	X	X	X			
Shrubs	*Amelanchier alnifolia*	X	X	X			
	Alnus sinuata	X	X	X			
	Betula Glandulosa	X	X	X	R		
	Ledum groenlandicum	X	X	X			
	Lornicera involucrata	X	X	X			
	Menziesia glabella	X	X	X			
	Potentilla fruticosa	X	X	X	R		
	Prunus pensylvanica	X	X	X			
	Ribes sp.	X	X	X			
	Rosa acicularis	X	X	X	M	M	
	Rubus acaulis	X	X	X			
	Rubus parviflorus	X	X	X			
	Rubus strigosus	X	X	X			
	Salix sp.	X	X	X	M	R	
	Sambucus	X	X	X			
	Shepherdia canadenis	X	X	X			
	Spiraea lucida	X	X	X	M	M	
	Vibernum edule	X	X	X			
	Viburnum trilobium	X	X	X			
	Arctostaphalos uva-ursi	X	X	X	R		
	Linnaea borealis	X	X	X			
	Vaccinium scoparium	X	X	X			
					6	3	

TOTAL SHRUBS 6

TOTAL TREES 0

TABLE 1 TREES AND SHRUBS

	SPECIES	RELATIVE ABUNDANCE/OCCURRENCE ZONES				SLOPE R
		1	2	3	4	5
Trees	*Abies lasiocarpa*		R	R	M	
	Pinus albicaulis					
	Pinus contorta				R	
	Pinus flexilis					
	Picea glauca/englemanni (hybrid)	C	M	R		
	Populus balsamifera		M	C	C	
	Populus tremuloides	R	C	C	C	
Shrubs		2	4	4	4	
	Amelanchier alnifolia			M	R	
	Alnus sinuata		C	C	C	
	Betula Glandulosa				R	
	Ledum groenlandicum					
	Lornicera involucrata	M		M	R	
	Menziesia glabella		R	R		
	Potentilla fruticosa	R		R	R	
	Prunus pensylvanica					
	Ribes sp.	C	M	M	R	
	Rosa acicularis	C	C	C	C	
	Rubus acaulis		C	C	R	
	Rubus parviflorus	M	M	R	R	
	Rubus strigosus				R	
	Salix sp.	C	C	C	C	
	Sambucus	M	M	R	R	
	Shepherdia canadenis			R	R	
	Spiraea lucida	M		M		
	Vibernum edule					
	Viburnum trilobium					
	Arctostaphalos uva-ursi				R	
	Linnaea borealis				R	
	Vaccinium scoparium					
		8	8	13	14	

TOTAL SHRUBS 17

TOTAL TREES 5