CHAPTER VIII

VEGETATION

EXECUTIVE SUMMARY

A premining vegetation inventory was conducted in the proposed permit area for the Wishbone Hill surface coal mining project to assess the current extent of vegetation types, plant species composition, diversity, successional relationships, and moose browse. The most extensive vegetation types were closed paper birch - aspen, open paper birch - white spruce, young birch, lowland meadows, and upland meadows. Five additional types were identified and mapped but were of minor extent. These included closed paper birch, closed poplar / alder - willow, closed poplar / alder, closed alder, closed willow, and wet low shrub. All of the minor types except the wet low shrub were associated with past mining or flooding or related disturbances. The wet low shrub was the only vegetation type that was clearly a wetland based on soils and hydrophytic vegetation, but it occupied only 0.5 ha.

The area was dominated by a relatively few plant species although over 100 vascular plant taxa were identified. The dominant tree species were paper birch (Betula papyrifera) and aspen (Populus tremuloides). Bluejoint (Calamagrostis canadensis) was the most important grass while common forbs included fireweed (Epilobium angustifolium) and bunchberry (Cornus canadensis). Oak-fern (Gymnocarpium dryopteris) was a prevalent fern. Understory vegetation was very similar among the forest types and was dominated by bluejoint, bunchberry, and oak-fern. Many birch trees have been heavily browsed and have retained a shrub growth form. The area has been disturbed in the past by mining, woodcutting, and recreation. The vegetation types are fairly common in the area, and most of the species occur widely throughout the state. No range extensions nor candidate threatened nor endangered plant species were found.

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10 INTRODUCTION

The proposed permit area for the Wishbone Hill surface coal mining project lies about 15 km north of Palmer along Moose Creek in the Matanuska Valley, Alaska (Figure 1). The premining baseline environmental studies included an inventory of vegetation within the permit boundaries. Objectives of this inventory were to determine the vegetation types, their extent and location within the area, and their species composition and successional relationships. All vascular plants encountered were identified to species level (where possible), and mosses and lichens were identified to genus. Vegetation types were mapped within the permit boundary and a surrounding 1000 ft buffer to determine their extent and location. The Alaska Division of Mining (1988) guidelines for premining vegetation inventories were followed. These data are used to create bond-release standards and to assess impact. This information also helps identify what types of plant material might be available for revegetation purposes and what species would be capable of growing in the area.

This potential coal mine also lies within the Matanuska Valley Moose Range (MVMR) and hence is subject to those management plan provisions (ADNR and ADF&G 1986). Alaska Department of Natural Resources (DNR) and Alaska Department of Fish and Game (ADF&G) are responsible for managing the area. Scoping meetings were held with personnel from the Division of Mining (DOM) within the DNR and from Divisions of Habitat and Game within ADF&G during June and July 1988 to insure that the vegetation inventory would satisfy both the Alaska Surface Coal Mining and MVMR management plan requirements. Also present at these meetings were personnel from McKinley Mining Consultants, Inc., and their consultants for vegetation and wildlife. As a result of these meetings and the potential mine being in the MVMR, it was decided to perform some measurement of

browse productivity which could be used to establish a bond-release criterion.

Despite its location near the most populated portion of the state, very few vegetation studies have been performed in the Matanuska valley. Vegetation inventories or studies in the nearby Susitna River valley and Hatcher Pass Management Area include USDA (1986), Helm et al. (1985), and Clark and Kautz (1985). One study by Reed and Harms (1956) investigated tree growth rates in the northern Cook Inlet region of Alaska. Lutz (1960) refers to early occurrences of moose in the area.

Parameters to be reported in this vegetation inventory to establish baseline data and revegetation criteria included:

1. Cover by species - vertical projection of living plant parts on ground
2. Density of dominant woody species - number of stems/area
3. Diversity - index of species richness and evenness calculated from cover data
4. Current twig growth - length or biomass of annual woody growth.

More detailed descriptions of these parameters occur in their respective sections under Methods. Dimensions of trees and other woody species were also measured to evaluate community structure and successional status. The area has been heavily disturbed in the past and is currently used for firewood cutting and timber production, recreation, and moose habitat. The current twig growth on dominant woody species on the project area was measured to assess the amount of browse potentially available to moose.

20 METHODS

2.1 Vegetation Mapping

Color aerial photography at the nominal scale of 1 in = 1000 ft (1:12000) dated 17 May 1984 and 22 June 1985 were used for initial reconnaissance. The 1985 photography covered most of the area to be mined while the 1984 photography was needed for the access road. Color infrared photography was used to obtain a broad view of topography and vegetation. Most vegetation had fully leafed out on the 1985 photographs although some phenologic differences could be seen. Many differences in degrees of leaf-out could be seen on the 1984 photographs, which made it easier to separate some shrubs from herbaceous understories. The photographs were enlarged to approximately 1 in = 500 ft for mapping purposes.

Vegetation mapping units were based on Level V of the Alaska Classification (Viereck et al. 1986). The initial divisions (Level I) in this classification system are based on dominant life form (tree, scrub, herbaceous), and lower divisions were based on type of species and crown closure. Closed forest canopies have > 60% cover by trees, while open canopies have between 25% and 60%, and woodland types have between 10% and 25%. Open and closed shrubs types are separated at 75% cover by shrub species. Dwarf trees are tree species less than 3 m tall at maturity, usually resulting from poor site conditions; while tall shrubs are shrub species taller than 1.5 m. Low shrubs are between 0.2 m and 1.5 m tall, and dwarf shrubs are < 0.2 m tall. Dwarf trees and shrubs form the scrub category at Level I.

Level II divisions within the Level I forest types are separated by needleleaf, broadleaf, or mixed needleleaf-broadleaf categories. Scrub types are separated by dwarf trees, tall shrubs, low shrubs, and dwarf shrubs. Level III divisions are based on

canopy cover. Level IV categories are based on canopy species, while Level V is based on understory species and is still evolving. A key based on the above cover values is used to identify a type to Level III. Level V is currently a list of vegetation types synthesized from the literature with appropriate citations. No criteria have been formally established for separation of communities at this level. The user is on his own for attaching a Level V name to a vegetation type.

Delineations among vegetation types were based initially on overstory species until field reconnaissance was possible. Understories were similar for a given overstory and sometimes for different overstories. Hence only one Level V community could be identified for each Level IV of Viereck et al. (1986) that could be identified on the photos. Differences among herbaceous communities were mapped according to topography and location of past disturbances. The lowland meadow type was located in concave areas among the eskers, while the upland meadow type was located on convex topography and generally on areas near the old mines that had been disturbed.

Vegetation was mapped within the permit area and 1000 ft around the perimeter. The smallest mapping unit was about 0.6 ha (1.4 acres). Field notes were taken on overlays on the 1:12000 photos then delineations made on overlays on the 1:6000 photos. A draftsman transferred this information to a 1:6000 topographic base map which was then digitized into a GIM (Geographic Information Management) system. Area estimates of each vegetation type were generated by this system.

The southeastern portion of the permit area was dominated by eskers and kettles between these eskers. The section along the western end has been disturbed by mining in past decades and by firewood cutting within the last 6 to 8 years. The uppermost end

at the north rises along the syncline toward Wishbone Lake. The eastern portion was dominated by birch-spruce forests which extend up and down the Matanuska Valley and are typical of much of southcentral Alaska.

2.2 Site Selection

Mapping information was used for initial vegetation stratification. A minimum of three stands was selected on the photographs for each dominant vegetation type. Minor types were sampled with only one or two stands. Frequently these stands had the same understory as the major types. Three or four randomly-located transects per stand were sampled in the major types depending on stand size. Each stand was a homogeneous portion of a mapping polygon and varied in size. Potential stands were selected from the photos based on size and similarities in photographic appearance to other locations with the same vegetation.

2.3 Reference Areas

A general location for the reference areas was selected during an informal meeting of the environmental manager, mine engineer, project manager, and vegetation ecologist. Areas within the permit boundary which were not planned to be disturbed by mining activities were identified. Sites with photo textures similar to that of the main habitat types were located within these potential reference areas. These sites were located in the field, and semi-permanent transects were marked at each end with electric conduit and foil tags. These were located in characteristic areas rather than randomly, because of road locations and some differences in vegetation at the southern end (reference area end) compared to the northern end.

2.4 Transect Placement

Transects were located randomly using two different methods depending on the size and shape of the stand being sampled. Random numbers representing coordinates of a rectangular coordinate axis and a direction were generated on a computer before hand. The observers paced to the starting point (random coordinates) and laid the transect out in the random direction. The shapes of some stands (e.g. doughnuts or crescents) did not lend themselves to this type coordinate system. In these the observers moved to one portion of the stand, and one person created an imaginary coordinate system. The second person "guessed" x and y coordinate numbers for pacing by selecting numbers between certain values. Similarly a direction was selected by selecting numbers between 1 and some number less than 10. The position of direction 1 and the order of the directions varied each time so the "guesser" could not bias the transect placement. This worked well. The system was not truly random but results were not biased. Most vegetation patterns repeated themselves throughout the stand which greatly reduced the potential for bias.

2.5 Floristics

Plant species were collected during the reconnaissance period and throughout the summer. Most species, except the most common, were represented by pressed specimens. Specimens were identified using Hultén (1968) for most forbs and some graminoids, Welsh (1974) for other graminoids, and Viereck and Little (1972) for woody plants. Hultén (1968) tends to split species while Welsh (1974) tends to lump them where divisions are not well defined. Populus balsamifera was used as recommended by Viereck and Foote (1970) because of the hybridization of P. balsamifera ssp. balsamifera and ssp. trichocarpa in the Matanuska and Susitna Valleys. Mitchell and Wilton (1965) was used to confirm the

identification of Bromus ciliatus. Schofield (1969) was used to identify mosses.

2.6 Cover

Cover was defined as the vertical projection on the ground surface of all living plant parts, primarily leaves. The sampling unit for estimating foliage cover consisted of a 20-m transect with systematic points spaced every 50 cm (Figure 2). The length and spacing were determined based on a short preliminary study in a lowland meadow stand (Stand 1) and in a closed paper birch - aspen stand (Stand 2). (These data were not reported since not all parameters in the stand were measured.) A pin was lowered through the multiple layers of plants at each point. Overstory was observed using cross-hairs of a sighting scope mounted on a pole. The observer recorded each species present at each point, and each species was recorded only once. The percentage cover for that transect was calculated by dividing the number of points where each species occurred by the total number of points per transect (40). This percentage value for each species counted as one observation in sample size calculations because the points were systematically located along the transect but the transects were randomly located.

The method was simple, reproducible, and data by life form could be calculated in the office even with overlapping vegetation because all species at each point were recorded. Life form cover (trees, tall shrubs, low shrubs, dwarf shrubs, graminoids, forbs, non-flowering vascular, mosses, lichens) was computed by counting (by FORTRAN computer program) the number of points within each transect where a species with this life form was recorded and dividing by the total number of points per transect (40).

Vascular plants were identified to species if possible. Sometimes mixes of similar species occurred, in which case they

were only identified to genus in the field. These samples were collected and identified in the office to species. Moss and lichen cover as reported may not be completely accurate to genus, but it was at least a closely related genus if not the correct one. DOM (1988) guidelines require only that the presence of mosses and lichens be recorded in the field.

Adequacy of sampling was based on 10% of the mean with 90% confidence (t=1.3) for total vascular vegetation cover and the dominant life forms. It is recognized that the t value changes with sample size, and that an iterative technique is most appropriate. However, because of the high total cover value and small variances and a minimum sample size of 9 transects in all major vegetation types, this was considered academic. The DOM guidelines (1988) use the t=1.3 value. Since vascular vegetation cover was almost complete in all of these types, one transect was needed for adequate sampling. Technically, two transects are needed since a minimum of two observations are needed to calculate a variance. The life form criteria was added as a method of ensuring sampling of the variability and diversity.

2.7 Density of Woody Vegetation

Density is the number of individuals per unit area. An individual shrub was defined as a contiguous grouping of stems which appeared to have a common origin. Clumps were more meaningful than stems emerging from the litter (another common definition of individual), since each clump probably resulted from one original stem. Densities of woody species greater than 0.2 m in height were counted in nested belt transects along the cover transects. Belt transects 2-m wide were used for low shrubs and small trees while 5-m wide plots were used for trees (Figure 2).

2.8 Basal Area

Basal area was the sum of the horizontal area of trunks of a species per area and was measured to estimate the timber resource in the study area. Basal area was obtained using an angle gauge (Ben Meadows) with basal area factor (BAF) 5 for white spruce (Picea glauca) and 10 for the deciduous species. These openings were about 1.8 and 2.0 cm, respectively, on a 62.7 cm chain. One end of the chain was held in the observer's mouth and the gauge held at chain's length from the body. The number of trees of a particular species that were larger than the opening were counted as the observer moved around the angle gauge, which was located over a fixed point. One observation was made per transect. Resultant numbers were multiplied by the appropriate BAF, and this number was converted from ft^2/acre to m^2/ha.

2.9 Woody Species Measurements

The nearest individual for each species (and size class, if appropriate) to each end of the transect was selected for dimensional measurements. This resulted in two individuals per species per transect if individuals were found at both ends of the transect. Tree heights were generally measured with a range finder, although ocular estimates were used at times in heavy rains. A diameter tape was used to measure diameter at breast height (dbh) for trees at least 2 m tall. Ages were estimated by coring the tree as close to ground level as possible, extracting the core, temporarily labelling and storing it in a straw, and counting the rings in the office. Good cores could not be obtained on many trees with rotten centers. Other trees were cored closer to breast height to avoid rotten portions. These ages should be regarded as a minimum.

Height, length, and width of crown, as well as basal stem diameter were obtained for dominant shrub species. Length was the

longest horizontal dimension, and width was the distance perpendicular to the length. Stem diameters were obtained with calipers on single stems. For most willows this dimension was unrelated to crown size since a clump with many stems was counted. This problem did not occur on rose (Rosa acicularis) and highbush cranberry (Viburnum edule) since they were primarily single-stemmed species.

2.10 Wetlands

Cowardin et al. (1979) outlined methods for wetland classification in the United States. Wetlands must have at least one of the following attributes:

(1) "At least periodically, the land supports predominantly hydrophytes."

(2) "The substrate is predominantly undrained hydric soil."

(3) "The substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year." (Cowardin et al. 1979).

Three areas were discussed as possible wetlands based on soils characteristics in the Wetland Soil Status subsection of the Soil Characterization and Classification section of the Soil Resources Chapter (XI). This section will document that only one of these types is dominated by hydrophytic vegetation by calculating a weighted average for prevalence of hydrophytic plant species (Wentworth and Johnson 1986, Reed 1988).

Data for each potential wetland based on soils was analyzed for prevalence of hydrophytic vegetation. The wetland indicator status for each species in these stands (10, 22) or types (wet low shrub, lowland meadow) was determined from Reed (1988). The indicator status is based on the frequency with which regional

reviewers observed (in course of other work, not actually a study for this purpose) a species to occur in wetlands naturally without being planted (Reed 1988). Frequency refers to the approximate percentage of time that an observer saw the species in a wetland situation. The weights for each category occur in the last column.

Code	Name	Frequency	Value	
OBL	Obligate	> 99% frequency	Always	1
FACW	Facultative wetland	67-99% frequency	Usually	2
FAC	Facultative	34-66% frequency	Sometimes	3
FACU	Facultative upland	1-33% frequency	Seldom	4
UPL	Upland	< 1% frequency	Not wet	5

The method of Wentworth and Johnson (1986) was used to calculate a prevalence index (PI) for hydrophytic vegetation. The cover values for each species were multiplied by their respective weight for their wetland status, then these numbers were summed (WTSUM). The cover values were also summed (COVSUM). Note that this sum of cover values does not correspond to total vascular plant species cover because of species overlap. The weighted sum (WTSUM) was then divided by the sum of cover values (COVSUM) to calculate PI. If PI < 3, there was a prevalence of hydrophytic vegetation.

2.11 Current Browse Production

Post-mining land use within the Matanuska Valley Moose Range will require reclamation to wildlife habitat (DNR and ADF&G 1986). To determine if moose browse productivity is at least as great after mining, baseline data were collected for current twig growth. Summer 1988 appeared to be an excellent growing season with wet periods alternating with warm periods. Shrub productivity might have been higher in such a year compared with a poor growing

season. Reference areas were established and sampled for browse to compare productivity at the time of bond release.

Accurate determination of current twig growth as a measure of browse productivity is most easily accomplished by clipping current twigs on shrubs that can be reached by moose and that would not be covered by snow (> 0.5 m tall). Although this is more expensive than double sampling in some cases, the preciseness and accuracy of the data are probably greater than using double sampling techniques. However, a nondestructive method of sampling was desired for postmining bond-release determination. The extent of clipping needed to adequately sample twig productivity on an area basis was initially believed to be too damaging to planted shrubs on reclaimed sites. Hence a relatively nondestructive method of sampling was developed based on the relation of twig weight to length and the number of twigs on each shrub.

Browse production per year was estimated using a destructive method on areas to be disturbed and a second, double sampling technique, on reference areas. Comparable double sampling data were also collected on the stands to be disturbed. Both techniques were based on sampling five random shrubs per species per habitat type (if that many individuals were readily available). A minimum of one and usually two individuals per species were randomly selected in most stands until a minimum of five shrubs per species per habitat type was sampled. Stands that contained few shrubs or that were distant from the main study area (access corridor) were not revisited for the browse study. Individuals were selected by pacing a random number of steps along imaginary coordinate axes within a chosen polygon, visually assigning numbers to the nearest three to ten individuals, and having a second person (who did not know how the numbers were assigned) select a number.

Habitat types included: 1) the closed deciduous type represented by closed paper birch - aspen, 2) open mixed forest represented by open paper birch - white spruce, 3) open deciduous forest represented by young birch, and 4) herbaceous represented by lowland meadow type. Habitat types corresponded more closely to wildlife usage than vegetation types did, so they were selected for the basis of the browse inventory. Sampling was limited to the dominant browse species: paper birch (Betula papyrifera), Bebb willow (Salix bebbiana), rose, and highbush cranberry.

2.11.1 Potentially Disturbed Sites

Every twig > 1 cm in length was clipped on each selected individual within the stands to be disturbed. Leaves were stripped in the field. On some large individuals only a fraction (usually 1/4 to 2/3) of the shrub was clipped. The dry weights of clipped twigs on these shrubs were divided by the fraction clipped to obtain the full shrub weight. Twigs were clipped for the full height of a shrub except where they were out of reach of moose. If we could not bend a trunk within our reach for clipping, it was considered out of reach. This corresponded to the usual criteria of being < 4 m tall and < 4 cm dbh if > 2 m tall.

In the office, twigs were divided according to "terminal" or "lateral" based on their relative size within each individual. This was intended as a statistical stratification rather than one based on true morphology. Many new growth twigs on Bebb willow were < 5 cm long, while others were > 1 m. Adequacy of sampling criteria seemed more appropriate to be based on a stratified sample, rather than combining very small with very large twigs.

Twigs within each group were counted. Two twigs per category per individual were measured for length, tagged, then oven dried at 65 C until a constant weight, usually 24 to 48 hr. The

remaining twigs for each shrub were also weighed so that a dry twig weight was obtained for each individual shrub. These twigs were weighed in a pan (tared) without a sack. Individual twigs were either weighed with their tag attached or were removed from an envelope. Eight tags were separately dried, weighed, and averaged. This was used as a correction factor for those twigs weighed with tags.

2.11.2 Reference Areas

Non-destructive techniques were desirable in the reference areas for monitoring purposes. Five shrubs (if available) were sampled and tagged for each species in each reference stand. All twigs on each selected shrub were counted as to terminal or lateral (large or small). Twig lengths were measured on at least two twigs per category per species. About 25 twigs per species were randomly selected from many shrubs in the stand, but not from the shrubs actually measured. These clipped twigs were returned to the office, fresh lengths determined, tagged, and oven dried. Dry weights were obtained to nearest mg.

2.12 Statistical Analysis

2.12.1 Simple Parameters and Sampling Adequacy

Variance calculations were based on a nested analysis-of-variance design where the transects were sampling units within stands (polygons) within vegetation types. Individual points along the transect were systematically placed so the transect rather than an individual point was the basic sampling unit. The error mean square (within mean square) was used as the variance estimate for complying with sampling adequacy criteria, although both the within mean square and the total variance and associated sample sizes were reported. These results were reported for all parameters although

sampling adequacy must be met only on percentage cover of total vascular vegetation and dominant life form (10% limits) and twig lengths (20% limits). Estimated sample sizes were calculated using the following formula:

$$n = \frac{(st)^2}{(d)^2}$$

where n was the number of sample units needed, s was the standard deviation, t = 1.3 = 1-sided t value for p=90% (or t = 0.86 for p=80%), d=0.1x (10% or d=0.2x for 20%). Limits of 10% were required for cover and 20% for twig lengths.

Cover by species for a transect was calculated by counting number of hits for that species along the transect and dividing by the number of points (40). Cover for life forms (groups of species) was calculated by doing the same for each species with that life form. This technique takes overlapping vegetation into account. This was accomplished with a FORTRAN program running on the raw point (0, 1) data. These percentage values for each transect were input into another FORTRAN program which calculated means, variances, and sample sizes and output cover data by vegetation type.

2.12.2 Diversity

Species composition or relative cover of vascular plants was calculated by summing cover percentages of all species in each stand or vegetation type and dividing each species cover percent by the total cover percent. The sum of relative cover percentages add to 100% by definition while the sum of actual cover percentages may be > 100% where species overlap.

Diversity indexes are a measure of species richness (number of species) and evenness (relative distribution of cover or other parameter among all species). More detailed discussion concerning use of diversity indexes in premining inventories may be found in Helm (1981), Permit Application for Poker Flats (Usibelli 1985), and ADOM (1988). The reciprocal of Simpson's dominance index was calculated in two ways for each vegetation type: (1) total - using the mean relative cover for each type and (2) local - averaging the diversity values for each stand within a type. Many indices, such as number of species, were strongly related to area size. The larger the area sampled, the larger the number of species sampled.

The primary diversity index was Simpson's reciprocal, calculated from the following formula:

$$SR = 1 / \Sigma p_i^2$$ Simpson (1949)

where p_i was the relative cover of species i. This has been interpreted as an effective number of species (Hill 1973) and was most sensitive to dominant species (Fager 1972). Shannon's exponential was also calculated for comparison purposes:

$$SE = \exp(- \Sigma p_i * \log(p_i)).$$

The exponential of Shannon's diversity index converted it into an "effective" number of species also (sensu Sheldon 1969), but is more sensitive to minor species. Simpson's emphasizes the major species and is preferred for management applications.

2.12.3 Browse Production from Twig Lengths

Scatter diagrams of weight versus length were plotted for each species within disturbed and reference areas. Additional

breakdowns were also made for vegetation types and terminal and lateral twigs. All data for one species were combined except for a split between disturbed and reference areas to increase the number of data points in the model. The assumption was made that data could be pooled among types because shrub growth forms were similar among habitat types. Many earlier studies throughout the United States used different equations for each habitat type or range site. However, these previously reported differences in equations might have been related to site conditions or some other variation that did not occur on this study area.

Models using stepwise regression methods were developed using twig length and various transformations as the independent variable and dry twig weight or transformations as the dependent variable. Significance of the equations was evaluated using the F test. Residuals were examined for goodness of fit of the model to the data. Dummy variables were used to represent the vegetation types in some models. The details of the methods are not being reported because a sufficiently good model was not developed for use as a standard.

After equations were developed, twig lengths in the reference area were inserted into the appropriate equation to obtain an estimated weight per twig. These four weights (2 each for lateral and terminal) were averaged for each shrub and class within shrub then multiplied by number of twigs per shrub per class (terminal, lateral). The weights per shrub per species within a vegetation type were averaged. Browse per unit area was obtained by multiplying density x browse/individual.

Calculated shrub weights were compared with actual shrub weights obtained for the disturbed areas. Two estimates of browse per unit area were calculated in the stands to be disturbed:

density x clipped weight per shrub
density x weight per shrub estimated from twig lengths.

T-tests were performed on the coefficients of the equations to determine that the same model was appropriate for both disturbed and reference areas.

30 RESULTS

3.1 Vegetation Mapping

Many of the vegetation types (Table 01) did not fit within a Level V grouping of the Alaska Vegetation Classification documented in Viereck et al. (1986). Other community descriptions were followed in creating names for these "new" types. Shortened names were used for mapping units as indicated in the following table.

Map Unit	Alaska Classification
Closed Birch - Aspen	Betula papyrifera - Populus tremuloides / Viburnum edule - Gymnocarpium dryopteris - Cornus canadensis (new type)
Closed Poplar / Alder	Populus balsamifera / Alnus sinuata
Closed Paper Birch	Betula papyrifera / Gymnocarpium dryopteris - Cornus canadensis (new)
Open Paper Birch - White Spruce	Picea glauca - Betula papyrifera / Gymnocarpium dryopteris - Cornus canadensis - Epilobium angustifolium
Young Birch	Betula papyrifera / Calamagrostis canadensis - Epilobium angustifolium (new)
Closed Poplar / Alder - Willow	Populus balsamifera / Alnus - Salix
Closed Alder	Alnus sinuata
Wet Low Shrub	Open low ericaceous shrub bog
	Eriophorum - Carex / Vaccinium oxycoccus / Sphagnum (new)
Lowland Meadow	Calamagrostis canadensis - Epilobium angustifolium
Upland Meadow	Calamagrostis canadensis / Epilobium angustifolium

Many of the new types resulted from the extent of oak-fern (Gymnocarpium) in the understory. The Alaska Vegetation Classification is still evolving and is based on published literature. Most vegetation studies in the Matanuska - Susitna

Valley area have been located more in the Susitna Valley. Hence it might be expected to find vegetation types that are common in the Matanuska Valley, but are not reported in the Alaska Vegetation Classification yet. However, Mitchell and Evans (1966) reported that oak-fern was very frequent in disclimax bluejoint stands.

Delineation of units on photographs was based on color and texture. Closed paper birch - aspen canopies had a very fine texture, while the closed birch, closed poplar / alder, and open birch - spruce were somewhat coarser. Young birch was coarser and had shorter trees. The alder and poplar / alder - willow were short and fine textured. Lowland and upland meadows were distinguished by location (Plate VIII-1).

The permit area contained approximately 609 ha (1500 acres). Hectares and percentage of the permit area are summarized for each vegetation type in Table 01. The most common communities were the open birch - spruce (25% of permit area) and closed birch - aspen (21% of permit area) (Table 01). The upland meadow and young birch types were the next most common, and each occupied about 14% of the permit area (Table 01). The main difference between these two types is the amount of birch cover so that understory essentially forms a major type in the permit area.

The mapped area just outside the perimeter contained similar vegetation communities which occupied comparable areas. The closed birch - aspen occupied only 6% of the outside area. Young birch and upland meadow occupied 9% and 21% of the area outside the boundary. The total percent cover for these types was similar inside and outside the boundary but the relative percentage differed. The difference in proportions may reflect site factors or land management practices. Closed poplar and closed birch were more common (12% and 13% respectively) outside the permit boundary.

This probably resulted from inclusion of more steep slopes along the river outside the permit area.

Most of these vegetation types are relatively common in southcentral Alaska. Reed and Harms (1956) commented on the extent of the birch - aspen - cottonwood to birch - white spruce succession in the Anchorage - Matanuska Valley area. Fires were probably common before settlement but became more widespread during the Alaska Railroad construction of 1916-1917 (Reed and Harms 1956). Fire suppression in more recent years has resulted in many stagnant forests.

3.2 Floristics

Even though most of the dominant vegetation was similar among vegetation types, 112 vascular plant taxa were identified in 37 families (Table 02). Most species were found in the Gramineae (Poaceae), Salicaceae, Ranunculaceae, Rosaceae, and Compositae (Asteraceae) families. Families which contributed significantly to the plant cover included Polypodiaceae (Gymnocarpium dryopteris), Cornaceae (Cornus canadensis), Onagraceae (Epilobium angustifolium), Rosaceae (Rosa acicularis and others), Gramineae (Calamagrostis canadensis), Betulaceae (Alnus and Betula papyrifera), and Salicaceae (Populus, Salix bebbiana, and other Salix). No range extensions have been found to date. Many of the minor species were found in the lowland meadow type, which was very diverse.

3.3 Threatened and Endangered Species

No plant species identified in the proposed permit area was listed as a candidate threatened and endangered species for Alaska (Murray and Lipkin 1987). Past disturbance and the commonness of the vegetation types would make the possibility of finding any candidate threatened or endangered species very low. Many rare

species are usually associated with rare habitats. The list contained two categories. Category 1 contained taxa for which there was sufficient information to propose the taxa as threatened or endangered. Category 2 included taxa for which current data suggested that a proposal for threatened or endangered status was appropriate, but sufficient data were not yet available.

The only Category 1 species, Polystichum aleuticum Christensen, is found in the western Aleutian Islands. Several Category 2 taxa are similar to species found on the proposed permit area and include the following species:

Category 2 taxa	Similar Wishbone taxa
Aster yukonensis Cronquist	Aster sibericus
Taraxacum carneocoloratum A. Nelson	Taraxacum spp.

Aster sibiricus does not have clasping stem leaves that A. yukonensis does. Although the Taraxacum on the permit area was not identified to species, it had yellow flowers in contrast to the deep pink or flesh-colored flowers of T. carneocoloratum.

3.4 Vegetation Descriptions

3.4.1 Closed Paper Birch - Aspen

The closed paper birch - aspen vegetation type was classed as Betula papyrifera - Populus tremuloides / Viburnum edule - Gymnocarpium dryopteris - Cornus canadensis at Level V of Viereck et al. (1986). It was represented by stands 8, 15, 18, 29, 32; 26 was reference. This was one of the most extensive types but reached its greatest development on tops and sides of eskers in the southern portion of the permit area. The dense tree cover averaging 85% (Table 03) limited the understory development and the resultant diversity to a few species such as oak-fern (Gymnocarpium

dryopteris), bunchberry (Cornus canadensis), fireweed (Epilobium angustifolium), bluejoint (Calamagrostis canadensis), highbush cranberry (Viburnum edule), and a few other species. No intermediate level such as saplings or tall shrubs existed between the tree canopy and the herbaceous and shrub layer. One stand (32) occurred on a flatter esker with a more open canopy and contained more shrub understory.

The reference area contained over 95% tree cover (Table 04) and less understory development than the areas to be disturbed. The additional tree cover resulted primarily from more paper birch (Betula papyrifera) in the canopy, which also affected the relative cover distribution (Table 05, 06). The reference stand was classified with the other closed paper birch - aspen stands on a multivariate discriminant analysis. These data were similar to closed birch/aspen stands of the Susitna River Study (USDA 1986), but the Wishbone stands contained more oak-fern, bunchberry, fireweed, and highbush cranberry. Their greatest cover was still bunchberry, bluejoint, and oak-fern.

The disturbed areas contained an average of 15 vascular plant species per stand while the reference area contained 18 (Tables 05, 06). The diversity indices were generally lower in the reference area compared with the areas to be disturbed because of the greater relative cover by birch. Additional species accounted for little cover. The number of species for all the birch - aspen stands to be disturbed was greater than for the reference area, but this resulted from the greater area sampled. Only one small fern has germinated in a small soil sample that was tested for buried propagules. This might indicate either a lack of propagules in the soil, or some soil properties that inhibit germination.

Total tree density averaged 1600 - 1700 stems / ha in both disturbed and reference areas although there was a slight trend

toward having more birch stems and fewer spruce stems on the reference stands (Tables 07, 08). Shrub density was lower and more variable on the reference site partly because the third transect went across a small depression.

Many white spruce trees in the understory of closed birch - aspen stands averaged less than 5 m tall and 32 yr, while birch and aspen averaged over 11 m tall and 40 yr (Table 09). Given problems with estimating the age from tree cores of the birch and aspen, it was very likely that they were at least 50 yr and perhaps older. Spruce cores were more easily obtained and read, and those estimates were probably closer to the true age. Hence spruce appeared to have become established after the birch and aspen. Birch and aspen ages were sufficiently close that they might have been established at the same time.

Moose browse production was low in the closed - birch aspen type because of comparatively small shrub size and low productivity. Dry current twig growth averaged only 1 g / shrub for birch, and Bebb willow stems were sufficiently rare that they were not sampled (Tables 11, 8-12). Fewer twigs occurred on each shrub, and they were relatively short (Table 11, 12).

The closed paper birch - aspen type appeared to be successional since little woody regeneration or deadfall occurred. Birch and aspen are some of the first trees to regenerate after fire (Reed and Harms 1956; USDA 1986). Spruce vigor was low in these stands but might improve in the future if canopy gaps develop when older birch and aspen die and fall. Only occasional aspen suckers were observed, probably resulting from two factors: intense moose browsing and possible intolerance to the degree of shade now present. Some young birch (about 11 years, Table 09) were heavily hedged by moose browsing. Except for some scars on the aspen trunks, the aspen appeared to be in relatively good

health compared to current woody regrowth which was heavily browsed. Aspen is a highly palatable moose browse. These trees must have become established before moose browsing became extensive.

3.4.2 Closed Poplar - Alder

Closed poplar - alder vegetation (stand 16) was relatively minor in the study area and was associated primarily with older areas along the floodplain or with old disturbances along roads near old mine sites. It would be classed as Populus balsamifera / Alnus sinuata in the Alaska Classification. The sampled stand was located on the Moose Creek floodplain. Tree cover was 92%, most of which was balsam poplar (Table 13). An intermediate layer consisted of 40% alder cover. Bluejoint provided the most herbaceous cover. Almost complete litter cover existed with little room left for mosses and lichens in the ground layer. The trees and tall shrubs were dominants both in the sense of controlling light access to the lower levels, but also in terms of relative cover (Table 14). Although 16 species were recorded along the transects, simpson's diversity was low (Table 14) because of extreme dominance of poplar and alder.

Tree stem densities were similar for closed birch - aspen and closed poplar / alder stands (Tables 07, 15). Shrub densities were much lower in the poplar / alder stands because of dense tree and tall shrub cover as well as occasional flooding. The basal area of balsam poplar was similar to that for trees in the birch - aspen stands even though the poplar trees tended to be larger (32.4 cm dbh vs 16.9 to 18.7 cm dbh for birch and aspen in the birch - aspen, Tables 09, 16). Estimated poplar ages were 68 yrs (Table 16).

Poplar stands were successional, probably to poplar - spruce or eventually to birch-spruce stands, along the river. A number of younger spruce stems (46 yr compared to 68 yr for poplar) were present in the stand. Assuming the same successional sequence and time frame here as along the Susitna River, birch would be expected to enter the stand as the poplars die (Helm et al. 1985). Birch need mineral soil and sunlight for establishment.

3.4.3 Closed Paper Birch

The closed paper birch type occurred on the steep slopes descending from the main portion of the permit area to the Moose Creek floodplain. It was classified as Betula papyrifera / Gymnocarpium dryopteris - Cornus canadensis community in the Alaskan Classification. Community composition was very similar to that of closed birch - aspen (Tables 03, 17), but the tree cover was concentrated in birch only rather than in birch and aspen. The Susitna study (USDA 1986) did not differentiate this type but included it in the closed deciduous (birch/aspen) mapping unit. Herbaceous species were dominated by oak-fern, bunchberry, and bluejoint in both cases (Tables 03, 17). The one area sampled contained 16 species and had a Simpson's diversity index of 5.39 (Table 18). Some of the additional tree species cover resulted from the larger number of shrub-sized birch trees (Table 19) that had been heavily browsed.

The tree-sized birch ages averaged 34 yr while the shrub-sized ones were only 15 yr (Table 20). The taller spruce trees were about 28 yr while the shrub-sized ones were about 15 yr. Hence the vegetation type appeared to contain relatively immature trees and an intermediate layer between the tallest trees and the lowest layer of plants. Charcoaled bark was present near the base of some trees.

3.4.4 Open Paper Birch - White Spruce

The open paper birch - white spruce vegetation type Stands 5, 7, 19, 21, 30; reference 31) was one of the most extensive vegetation types in the study area and represented an advanced stage of succession, possibly a disclimax. It was identified as an open mixed forest type Betula papyrifera - Picea glauca / Gymnocarpium dryopteris - Cornus canadensis - Epilobium angustifolium of the Alaskan Classification. Mean tree cover was 62% (Table 21), borderline between closed and open forest using standards of Viereck et al. (1986). However, the tree cover was considerably less in this type than it was in any of the closed forest types. The structure was more related to open forests than to the other closed forests. Additionally, most of the forest was a mosaic of more closed canopy areas with gaps of only shrub or herbaceous cover. It should definitely be a separate habitat type (open mixed compared to closed deciduous) for wildlife purposes. Additionally this type has been and is used for personal and commercial firewood cutting in conjunction with moose habitat improvement programs. Some paper birch stems have been browsed to the point where a shrub growth form was retained. The mosaic provided denser patches of vegetation for thermal and hiding cover while the more open areas had more understory and browse production in close association.

Overstory was dominated by paper birch with about 1/3 as much white spruce cover (Table 21). Low shrubs were dominated by highbush cranberry, rose, and mountain ash (Sorbus scopulina) in some stands. The most important herbaceous plant species were oak-fern, bunchberry, bluejoint, and fireweed. The reference stand was very similar to the stands to be disturbed with the exception of having less bluejoint cover (Tables 21, 22). This was probably an artifact of location of the reference areas. Along the main road above and adjacent to the old mines, bluejoint was a major factor

in the vegetation. In less disturbed areas, such as where the reference stands were located, bluejoint cover was less than in the more disturbed areas.

A total of 34 species were sampled in the stands to be disturbed, but this was an average of 21 species per stand (Tables 23, 24). The increased number of species in all disturbed stands combined resulted from the increased area. Variability of the minor species in several stands accounted for the large difference in mean number of species per stand compared with the total. Similar patterns were reflected with Shannon's exponential diversity index, which was sensitive to the minor species sampled in the larger area.

Tree density was somewhat less in these birch - spruce stands compared with the birch - aspen stands although birch density was similar (Tables 07, 25). Density of shrub-sized tree species was greater in the birch - spruce type (Table 25) as a result of reproduction in the gap portions of the mosaic and stunted growth caused by heavy moose browsing.

These stands were still immature as indicated by the larger number of spruce stems (Table 25) and their shorter stature (Table 27). No shrub-sized tree species were sampled in the reference stand density belt transects; however, Bebb willow was found there and not in disturbed stand density belts (Table 26). Both Bebb willow and shrub-sized birch were found in both sets of stands (Tables 27, 28). Birch trees appeared younger than the spruce, but this could be an artifact of birch trees having rotten centers.

Shrub-sized paper birch provided more browse in these stands than did Bebb willow because of greater density (Table 25). Although Bebb willow averaged more per shrub (87 g vs 57 g/shrub),

only two clumps were sampled, and the densities were lower (Table 25, 29). Shrubs in the reference area were smaller (Table 30).

Open birch - spruce type might be a disturbance disclimax in this portion of the state. In the short term (several hundred years) they appear to be self-reproducing with both birch and spruce regeneration in the gaps created by fallen trees (Reed and Harms 1956, Helm et al. 1985). Disturbance and possible warmer temperatures seem to prevent advancement to the spruce stage. An exception to this is firewood cutting where birch trees are totally or partially removed leaving a spruce stand. However, this is not a true spruce stand since the understory vegetation and soils would still reflect its birch - spruce nature.

3.4.5 Young Birch

The young birch vegetation type represented a successional stage after disturbance had occurred in birch - spruce stands. It was classified as Betula papyrifera / Calamagrostis canadensis - Epilobium angustifolium type according to Viereck et al. (1986). It was most important along the western half of the main permit area by the old mines and frequently surrounded some very old birch and spruce trees.

Young birch stands consisted primarily of birch, bluejoint, fireweed, oak-fern, and bunchberry (Table 31). Bluejoint was well over 1.5 m tall in many of these stands. The reference area was very similar although it had less oak-fern and more geranium (Tables 31, 32). Again this probably resulted from location differences. The young birch reference stand was adjacent to some of the lowland meadow stands between eskers. These contained a significant amount of geranium as well as some graminoids that did not appear in the other young birch stands.

The four dominant species accounted for 65% of the relative cover while no other species accounted for more than 6% relative cover (Table 33). The reference stand had a similar relationship except that oak-fern provided less cover and bunchberry and geranium were more important (Table 34). An average of 16 vascular plant species were sampled in the stands to be disturbed while a total of 32 species were found in this type. Twenty-six species were found in the reference young birch stand, probably reflecting species composition of the adjacent meadow (Table 34). The average local diversity was 7.1.

There were approximately four times as many shrub-sized birch trees in the young birch stands as in the birch - spruce stands, and spruce stems were much less important (Tables 25, 35). In spite of the reference stand being a young birch stand, all of the tree stems in the density plots were counted in the tree class, which was also reflected in the basal area estimates (Table 36).

The birch dbh's in the young birch stands were smaller than in birch - spruce stands reflecting their younger age and earlier successional status (Tables 37, 38). The reference stand was slightly older than the other stands (Tables 37, 38). The reference stand was a relatively small site between a lowland meadow and birch - spruce stand whereas the stands to be disturbed had already been disturbed in past decades and covered more area. Adjacent vegetation had less effect on them. The reference stand was structurally similar to the stands to be disturbed, but probably had a different site history. Buried propagules that germinated were primarily grasses.

Shrub-sized birch produced almost twice as much browse per shrub in the young birch stands as compared to open birch - spruce (Table 29, 39). Bebb willow production was still highly variable (Table 39). Browse production for rose was similar for all three

forest stands (Tables 11, 29, 39). Birch and Bebb willow production was lower in the reference stand (Table 40).

Many of the upland meadow stands also contained young birch stems, but not to the extent of these stands. Both the young birch and upland meadow types probably resulted from the same disturbances, the main difference being degree of disturbance and closeness to surviving pockets of mature vegetation. This affected speed of recovery. Fire scars were observed in some of the old birch - spruce pockets, and spruce trees were > 100 yr old. Many of the birch stems in the young birch type were heavily browsed, a primary hindrance to the birch stems growing into tree forms. Once leaders grew above the reach of moose, the top portion of the "tree" resumed normal growth.

3.4.6 Closed Poplar / Alder - Willow

The closed poplar / alder - willow stand (Stand 24) was a small patch of intermediate successional vegetation adjacent to the road by the old mining sites. These were classified as Populus balsamifera / Alnus - Salix in Viereck et al. (1986) and were included in the open deciduous forest habitat type. These were fairly simple communities consisting of poplar, alder,feltleaf willow (Table 41). The understory consisted of horsetail, fireweed, bluejoint, and very little else (Table 41) because of the thick woody overstory and small stand size. Only 11 species were recorded on that site and Simpson's diversity index was only 5.35, one of the lowest values (Table 42).

Approximately equal numbers of paper birch and alder stems were counted although the alder stems were of shrub-size (< 3m tall) (Table 43). The alder (4.6 m) were about half as tall as the poplar (9.5 m), but the poplar appeared slightly older (22 compared with 17 years, Table 44). The poplar were usually among the

earliest colonizers of coarse substrates in heavily disturbed areas. Alder might overtop it temporarily (closed alder type), but then poplar growth increased, and it attained the canopy again. This was similar to succession along the Susitna River (Helm et al. 1985) and could be expected to occur in the floodplain here, although we did not sample any of these stands.

The closed poplar / alder - willow vegetation type was a younger successional type than the closed poplar - alder. This was a very immature poplar stand that resulted from man-made disturbance in this case. Poplar was one of first species in a highly disturbed sites such as road sides and spoil piles. This developed into poplar / alder -willow. As the trees in this type matured, it could develop into the poplar / alder type. Even though the latter type was still immature, it was more developed than the present type.

3.4.7 Closed Alder

Closed alder stands (Stands 17, 25) were present both along the floodplain and along the disturbed mined areas. It also occurred in small patches like the poplar / alder - willow stands. It was classified in the closed tall shrub habitat type and as closed tall shrub Alnus sinuata in Viereck et al. (1986). The dominant cover was alder (86%) and all other species accounted for less than 11% cover on the average (Table 45). This was the only vegetation type with ground layer cover < 90%. Although 16 species were found in the two stands combined, Simpson's and Shannon's exponential indexes were only 2.2 and 4.0, respectively, because of the extreme concentration of cover in the alder (Table 46). An average of only 10 species were found in each stand, but 16 were found total. This resulted from somewhat different understories on the floodplain and along the road. The type was of minor extent so could not be separated by understory.

Alder densities were over 6000 stems/ha (Table 47). Even though heights averaged 3.8 m (Table 48), which would make them trees, stem counts were made in the 2-m wide belts because of the numbers of stems. A few tall poplar stems were also present, and they averaged about the same age as the alder stems, 13 - 14 yrs (Table 48). This stage generally succeeded to an immature poplar / alder - willow or poplar / alder after the poplar overtopped the alder (Helm et al. 1985).

3.4.8 Wet Low Shrub

One stand (12) of wet low shrub vegetation type was found at the northern end of the permit area and was the wettest type sampled. Standing water was present in July and August, and sphagnum cover was 98% (Table 49). Carex, cottongrass (Eriophorum sp.), and Labrador tea (Ledum palustre), and Vaccinium oxycoccus provided the most cover of any species (Table 49). Other species providing significant quantities of relative cover included Equisetum fluviatile and Vaccinium vitis-idaea (Table 50). The stand contained 16 different species, and Simpson's index was 8.6 (Table 50).

Because of the small stature of most of these shrubs, only a few species were counted in the density plots and dwarf birch was the only one with any significant density, 8667 stems/ha (Table 51). Some of the spruce stems recorded were actually trees about 35 yr old (Table 52) rooted in slightly drier portions of the bog.

3.4.9 Lowland Meadow

The herbaceous vegetation was divided into two types: lowland and upland meadows. Both were dominated by bluejoint and fireweed, but in differing relative amounts and were classed as graminoid

herbaceous habitat type. The lowland meadows (Stands 6, 13, 33, 36; reference 28) were the low, flat or depressed areas between the eskers with scattered young spruce trees. Vegetation varied from a shrub-dominated transect to a graminoid-dominated wetland within a given stand. However, these local variations could not be reliably separated on a photograph and were too small to sample individually in the field. The most reliable way to separate the lowland from upland meadows was by location among the eskers and nearness to disturbance from the old mines.

The lowland meadows (Stand 6, 13, 33, 37; reference 28) fell into the mesic graminoid bluejoint-herb type called Calamagrostis canadensis - Epilobium angustifolium in the Alaskan Classification (Viereck et al. 1986). The vegetation was dominated by bluejoint (39% cover) and fireweed (26%) with lesser quantities of bunchberry, geranium (Geranium erianthum), cow parsnip (Heracleum lanatum), tall bluebell (Mertensia paniculata), stinging nettles (Urtica dioica), and fescue (Festuca altaica) (Table 53). Nettles were common in one small stand that was just a depression between eskers. This site was moister than the others and contained more of the taller forbs. More mosses and lichens were present in these stands, particularly in some of the more disturbed sections, than most of the other vegetation types. Most cover by tree species was provided by white spruce. The reference area had the same general appearance as the sites to be disturbed, but contained more forb cover (Tables 53, 54).

This type was one of the most diverse with Simpson's index of 9.5 (Table 55). Relative cover by geranium was greater in the reference area, otherwise the relative composition of reference and areas to be disturbed were similar (Table 55, 56). The stands to be disturbed contained an average of 17 species per stand or a total of 37 for all these stands (Table 55). The reference stand

contained 26 species with a Simpson's index of 10.28 (Table 56).

Density of woody stems was low in this herbaceous type although some stands contained a number of willows or aspen reproduction (Table 57, 58). Basal area was negligible (Tables 57, 58). The few birch trees found on these sites averaged only 6.4 m tall and 20 yr of age while the aspen were over 55 yr and twice the dbh (Table 59). Spruce trees were more common and averaged 25 yr on stands to be disturbed and 20 yr on the reference stand. Heights and dbh's were also larger on the disturbed sites (Tables 59, 60). It should be emphasized that these were only scattered immature trees that varied from site to site.

Browse production was based on both lowland and upland meadow sites since they were both part of the mesic graminoid habitat type. They had fairly high browse production (Table 61). Many shrubs were open grown, and some birch and Bebb willow in the upland meadow type were very large. They would provide abundant browse even in a winter with deep snow. The reference stand was located in a lowland meadow site which had fewer of the larger shrubs so contained less browse (Table 62). The primary purpose of the reference area is to monitor changes in twig length rather than number of twigs per shrub.

This type appeared to be successional perhaps with multiple disturbances occurring. Many of the spruce trees exhibited good growth, indicating they might have become established in an area with little competition. All ages occurred. Evidence of fire was observed around some trees. Part of these sites had been scarified to increase shrub production for moose browse. Some deciduous tree cover was present, but usually as young stems. However, an occasional mature aspen tree apparently survived from some previous vegetation type or was able to grow to maturity on this site.

3.4.10 Upland Meadow

The upland meadows contained two kinds of stands with similar vegetation. Both were dominated by bluejoint and fireweed as with the lowland meadows, but here the bluejoint dominance was much stronger so the type would be classed as a Calamagrostis canadensis / Epilobium angustifolium type, rather than Calamagrostis canadensis - Epilobium angustifolium of the lowlands. In this case, the / denotes that species on the left are dominant over those on the right. The - indicates they have about the same level of dominance. One of the subtypes (Stands 20, 35) was on convex slopes near the past mining disturbances. The stands appeared well drained and the bluejoint over 1.5 m high. These stands had scattered paper birch "shrubs" heavily hedged by moose. One stand (35) had many indications of moose bedding down in the area, which in fact made locating 20-m long transects through untrampled vegetation quite difficult. A cow moose was observed near this site on August 29, 1988.

The other type of these upland meadows was along the drainage for Buffalo Creek. One stand (10) was believed to be seasonally wet based on soil mottles (Soil Resources Chapter XI) and small branches of the creek passed through the area. Dead birch trees were present in the stand, possibly having died when drainage changed at some time in the past. The other stand (22) like this was upstream a little bit and had an extensive area of bluejoint with patches containing different forbs. This also had small channels of Buffalo Creek running through it as well as many nettles.

Bluejoint cover in these stands was approximately 72% (Table 63) which result in 41% relative cover (Table 64). Only one other species, fireweed (26%), provided more than 7% relative cover

(Table 64). This resulted in one of the lowest diversities of any vegetation type: an average of 12 species, Simpson's index of 3.6 and Shannon's exponential of 5.2 (Table 64). The dominance of bluejoint and fireweed were also reported by Mitchell and Evans (1966). This type had the fewest woody stems of any vegetation type (Table 65), although some of the larger willow and birch stems provided large quantity of browse. The larger birch stems averaged 5.5 m tall and 23 yr old, while the shrub-sized stems averaged 145 cm tall and 10 yr of age (Table 66).

Some upland meadow stands are believed to have resulted from past disturbances. They represent either a more disturbed site or site that is slower to recover than young birch.

3.4.11 Willow

Small areas of willow (Salix alaxensis) occurred on islands in the floodplain. These were not extensive enough to sample. The stands observed were doghair stands of feltleaf willow with occasional stems of poplar and forbs, such as Artemisia tilesii. This type develops into alder or poplar / alder - willow stands.

3.4.12 Revegetated

One portion of the old Premier Mine was revegetated in 1984. The area sampled in the southwestern corner of the main study area contained the normal seed mix used as well as some tests for the Plant Materials Center (PMC), Division of Agriculture. The PMC seed mix consisted of the following cultivars on a percentage weight basis:

Siberian Wild Rye 345600	56%
'Arctared' Red Fescue	25%
'Norcoast' Bering Hairgrass	12%

'Alyeska' Polar Grass	6%
Artemisia tilesii T12052	.75%
Bluejoint 'Common'	.25%

The seed mix was seeded at the rate of 40 lb/acre, and 20-20-10 fertilizer was applied at 450 lb/acre. Seed and fertilizer were applied with hand-operated broadcast seeders, and neither was incorporated into the soil (State of Alaska 1987). Both sets of plots were on overburden-type material.

Both sets of transects contained 35 to 44% vascular plant cover, most of it in grass species (Tables 67, 68, 69). Arctared did well in both sets of plots, although Siberian wild rye provided more cover in the PMC plots. Brome provided a trace of cover in both sets. Artemisia tilesii cover was 2%, but it is one of the few forbs being used successfully in reclamation work. Traces of other grasses might have been present but not sampled because of their scarcity.

Sample sizes were provided for both 10% of mean with 90% confidence and 20% of mean with 80% confidence. Because of the size and relative uniformity of the area, sampling many more than eight transects did not seem meaningful. The 10% estimated sample sizes are greater than the actual number samples, but the 20% sizes are below the actual number. For purposes of this study, the site was considered reasonably sampled.

3.4.13 Adequacy of Sampling and Reference Area Comparisons

The estimated sample sizes needed to adequately sample total vascular vegetation cover within 10% of mean with 90% confidence were reported within each vegetation type. Sampling adequacy was considered only on the major vegetation types: closed birch - aspen, open birch - spruce, young birch, and lowland and upland

meadows. The other types were of minor extent and either very disturbed or similar to other vegetation.

In an effort to ensure sampling of the diversity, most types were sampled to within 10% of mean with 90% confidence for the dominant life form which were trees in the case of forest types and herbaceous species for the upland and lowland meadows. Although the young birch type was considered an open forest type, the herbaceous species were a more dominant characteristic of the vegetation, and sampling adequacy was based on this. The main difference between young birch and the upland meadow type was the presence of more tree cover. Many of the forest understories were similar with important quantities of cover by oak-fern, bunchberry, bluejoint, and fireweed. The major vegetation types were considered more than adequately sampled for vascular vegetation cover and species composition.

The other parameter that required adequate sampling was current twig length to within 20% of the mean with 80% confidence. These data were reported with each browse table. Twig lengths were also adequately sampled with or without stratification for size (terminal vs lateral).

Vascular cover for reference stands and stands to be disturbed for forest types varied only between 98 and 100%. Mean cover for meadow types varied between 96 and 98%. Hence reference area cover was not significantly lower than the cover for areas to be disturbed.

Similarity of reference stands to stands to be disturbed was based on a multivariate discriminant analysis (DA). DA requires that data be structured according to treatments (vegetation types). It then "develops" an equation based on the variables (species cover) specified which will result in the best separation of these

types. An initial classification was developed with cover data of dominant species in the stands to be disturbed. Reference area data (an independent data set) were then entered into the equation and tested to determine which vegetation type they were nearest. All reference stands were properly identified, that is, they were assigned to the same group as the stands to be disturbed for the same type.

3.5 Wetlands

Four potential stands or vegetation types could have been considered for wetland status based on soils data. One is the wet low shrub stand in the northeast corner of the permit area. Two additional stands dominated by bluejoint and fireweed abutted Buffalo Creek (Torpedo Lake Variant soil, Soils Resources Chapter XI). The last type included the lowland meadow communities in the depressions between the eskers (Lucile soil, Soils Resources Chapter XI).

The wet low shrub stand at the north end of the permit area was dominated by Sphagnum spp. moss (98%), OBL or FACW shrubs, and OBL graminoids (Table 70). The few FAC or FACU species that occurred were primarily on small microsites of higher land. This site is dominated by wetland species but is a small area.

The majority of species in the two sites along Buffalo Creek were FAC or FACU (Tables 71, 72). There were occasional small strips of vegetation along the drainage that contained FACW species such as Carex spp. or Salix spp. The actual above-ground drainages were generally considerably less than 1 m across. The Salix cover was too small to be encountered by any transects. The dominant species on these sites were Calamagrostis canadensis (bluejoint) (FAC) and Epilobium angustifolium (fireweed) (FACU), which are species characteristic of disturbed sites and are found throughout

the study area, especially on areas that have been burned or were influenced by old mining activities.

Bluejoint is sometimes found in wetland situations, but the vast majority of bluejoint stands in southcentral Alaska occur on more upland sites. The FAC indicator only means that it is found in wetland situations 34 to 66% of the time. Bluejoint is frequently grazed in natural meadows or grown for hay on managed lands (Mitchell and Evans 1966). The Buffalo Creek sites should be considered the non-wetland type of bluejoint occurrence. The vegetation was identified as Calamagrostis canadensis / Epilobium angustifolium, a mesic graminoid-forb type, according to Viereck et al. (1986). Bluejoint may dominate some wet graminoid types in Viereck et al. (1986), but the species composition in question puts these stands in the mesic category.

The kettle areas were covered by the mesic graminoid bluejoint - herb vegetation called Calamagrostis canadensis - Epilobium angustifolium of the Alaskan classification (Viereck et al. 1986) (Table 73). These sites were very diverse within each stand. Several sites graded from moister pockets containing sedges to well-drained higher areas. These pockets were too small to map separately. This diversity of microtopography partially accounts for the range in indicators for wetland species from OBL to UPL. The same arguments hold for the dominant bluejoint and fireweed in this type as in the previous stands.

Except for Sanguisorba stipulata and Urtica dioica, no OBL or FACW species provided more than 2% cover. Urtica's indicator status has varied from FACU to FACW nationwide, but no consensus has been reached in Alaska. Of species providing 5% or more cover, six are listed as FACU or UPL, three as FAC, and two as no consensus in Alaska. Hence these sites should not be considered as wetlands according to vegetation composition.

3.6 Disturbances

Numerous kinds of past and present disturbances have, are, and will be occurring on this study area aside from any mining activity. Vegetation types near the river experience flooding. Types near the old mines have been disturbed by earth-movement by early miners, passage of mining and related vehicles, construction, and fire. Recent efforts to improve moose habitat have resulted in personal and commercial firewood cutting, personal Christmas tree cutting, and habitat cuts by Division of Forestry.

Disturbances are believed to be responsible for creating the upland meadow and young birch vegetation types. Dense cover of bluejoint shows the entry of many species into these types.

Many habitat cuts to improve moose browse were made in August and September 1984 and 1985 by Alaska Division of Forestry and were about 1/4 to 1 acre in size. Aspen trees were hinge cut (2/3 of way through trunk) to encourage resprouting. Some of the larger shrubs in some of these areas were quite large with excellent leader growth in 1988. One current twig was about 1.5 m long. However, bluejoint growth is retarding shrub growth in some of these areas. In one lowland meadow near the southern portion of the proposed permit area, a small area had been scarified to improve shrub growth. This encouraged growth of Bebb willow but also of some fireweed and bluejoint.

The Baxter Mine firewood area has been cut for firewood in the early 1980's. Apparently the birch were only thinned in most areas except adjacent to the road, so a change in vegetation type did not occur there. However, current commercial logging in timber sales at the southern boundary are removing all birch trees. These sales are active so vegetation changes were not incorporated into these

results except as they had occurred in the past. Christmas tree cutting in designated areas removed spruce trees but had minimal impact on vegetation composition because of its low intensity and seasonality, namely when the ground was frozen.

3.7 Moose Browse Productivity

Scatter diagrams of twig lengths and weights for birch, Bebb willow, rose, and highbush cranberry are presented in Figure 3. The regression equations relating weight to length used in the disturbed and reference sites are reported in Table 74. Numerous linear, curvilinear, and transformed models were tried, but the most appropriate equation was a simple quadratic model across all vegetation types for each species. The same general model (same terms but different coefficients) was used for all species to simplify usage. There was no biological basis to assume that a different equation would be appropriate for each vegetation type. One preliminary model did indicate that slopes may be different within the different habitat types. This model used dummy variables for each vegetation type. This could have been related to sizes of shrubs: smaller shrubs were found in the more closed canopy types while larger shrubs were found in the more open types. None of the more complex models were sufficiently better than a simple model to make the increased complexity beneficial.

The final models did appear to differ somewhat between reference and disturbed areas as judged by comparing confidence intervals based on coefficient and standard error. These equations were used to estimate twig weight from twig length and ultimately the calculated browse weight per shrub and per area in the browse tables.

Tables 75 and 76 summarize the browse parameters as measured across all disturbed and reference habitat types, respectively.

Because of similar characteristics of shrub morphology across many of the habitat types, data on twig length and weight as well as clipped weight were combined across all types. Twig length was the criterion used for determination of adequate sampling. It was more than adequately sampled. Additionally the weight per twig and clipped weight per shrub were adequately sampled. Twig count per shrub was adequately sampled in most cases. However, the calculated weight differed from the clipped weight anywhere from 15% to 20% for birch and Bebb willow to 82% and 85% for rose and highbush cranberry. Twig lengths were more variable on rose and highbush cranberry than they were on birch and willow. Additionally the distribution of lengths was skewed: many more smaller twigs occurred on an individual compared to the number of average-sized twigs. Using a median or mode might be more appropriate than the average for these calculations.

Twig length was a reasonable parameter to estimate the weight per twig as evident by the high R^2 (Table 74). However, the level of inaccuracy (difference in means) for estimated weight for an entire shrub was unacceptable even without considering the precision problem (size of variance). Other sampling techniques will be considered for postmining bond release. These data did indicate that the variabilities among shrub individuals was not as great as originally believed. Destructive sampling of shrubs in a reclamation program would probably not cause excessive damage. Alternative methods will be proposed in the reclamation plan.

40 CONCLUSION

Vegetation in the permit area varied from relatively undisturbed sites, particularly in the eastern portion, to highly disturbed sites in the western portion. Disturbance has resulted from fires, woodcutting, moose habitat improvement, mining, and recreational activities such as mountain biking, powered off-road

vehicles, and moose hunting. Most of the vegetation types are characteristic of disturbed or glacial (eskers, kettles) environments. Most species were not uncommon, and none that have been identified so far represent a range extension as reported in Hultén (1968). In fact most of the species have fairly broad geographic ranges. Moose have heavily hedged most shrubs in the area. Many birch trees have been hedged to the point of assuming a shrub growth form. Renewed mining in the area would not be expected to cause the loss of any unique vegetation types or plant species.

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60 RESPONSIBLE PARTIES

Investigator
D.J. Helm
Plant Synecologist
Agricultural and Forestry Experiment Station
University of Alaska Fairbanks
533 E. Fireweed Ave.
Palmer, AK 99645

Technician support in the field and office measurements was provided by
Michelle Schumann
Joyce Restad

TABLES

TABLE 01

Vegetation types (habitat types) and their aerial coverage for the Wishbone Hill Project.

Map Code	Vegetation Type Name	Area (ha)	Percent of Permit Area
Closed Deciduous Habitat Type			
CBA	Closed birch-aspen	127.9	21.0%
CPA	Closed poplar / alder	34.5	5.7%
PAW	Closed poplar / alder - willow	11.1	1.8%
CPB	Closed paper birch (mature)	32.2	5.3%
Open Deciduous Habitat Type			
YB	Young birch (Open paper birch)	82.9	13.6%
Open Mixed Habitat Type			
OBS	Open paper birch - white spruce	147.7	24.3%
Closed Tall Shrub Habitat Type			
CA	Closed alder	15.0	2.5%
Low Shrub Habitat Type			
WLS	Wet low shrub scrub	0.5	0.1%
CW	Closed willow	1.9	0.3%
Herbaceous Habitat Type			
LM	Lowland meadows	30.8	5.1%
UM	Upland meadows	77.5	14.2%
Others			
RV	Revegetated	2.9	0.5%
D	Disturbed	7.3	1.2%
R	Riparian	13.1	2.2%
Predominantly Outside Permit Boundary but Some Within Mapping Area			
CD	Closed deciduous	0.7	0.1%
OS	Open white spruce	0.0	0.0%
OB	Open birch	5.3	0.9%
Total		591.3	98.8%

TABLE 02

Species identified on the Wishbone Hill permit area, summer 1988. These are arranged alphabetically by families within life forms.

Scientific Name	Common Name
MOSSES	
Hylocomium spp.	
Hypnum spp.	
Ptilium crista-castrensis	
Polytrichum spp.	
LICHENS	
Stereocaulon paschale	
Nephroma sp.	
Peltigera sp.	
CLUBMOSSES - Lycopodiaceae	
Lycopodium annotinum L.	Stiff clubmoss
Lycopodium complanatum L.	Ground cedar
HORSETAILS - Equisetaceae	
Equisetum fluviatile (L.)	Swamp horsetail
Equisetum pratense	Meadow horsetail
Equisetum silvaticum L.	
FERNS AND RELATIVES	
Aspidiaceae	
Dryopteris dilatata (Hoffm.) Gray	Spinulose shield-fern
Athyraceae	
Athyrium felix-femina (L.)Roth	Lady fern
Polypodiaceae	
Gymnocarpium dryopteris (L.)Newman	Oak-fern
Thelypteridaceae	
Thelypteris phegopteris (L.) Slosson	Northern beech-fern
Ophioglossaceae	
Botrychium lunaria (L.)Sw.	Moonwort

TABLE 02 CONTINUED

FORBS	
Boraginaceae	
Mertensia paniculata	Tall bluebell
Myosotis alpestris F.W.Shmidt	Forget-me-not
Caryophyllaceae	
Stellaria crassifolia Ehrh.	Flashy starwort
Stellaria longipes Goldie	Long-stalked starwort
Compositae	
Achillea borealis Bong.	Yarrow
Artemisia tilesii[1]	
Aster sibericus L.	Siberian aster
Erigeron acris L.	Fleabane daisy
Erigeron elatus Greene (acris?)	Daisy
Petasites frigidus (L.)Franch.	Arctic sweet coltsfoot
Senecio pauciflorus Pursh	
Solidago multiradiata Ait.	Goldenrod
Taraxacum sp.	Dandelion
Cornaceae	
Cornus canadensis L.	Bunchberry
Cruciferae	
Arabis arenicola (Richars.)Gelert OR	
Arabis lyrata L. or arenicola	
Geraniaceae	
Geranium erianthum DC.	Northern geranium
Leguminosae	
Trifolium pratensis L.	Clover
Liliaceae	
Streptopus amplexifolius (L.)DC.	
Onagraceae	
Epilobium angustifolium L.	Fireweed
Orobanchaceae	
Boschniakia rossica	Ground-cone
Polemoniaceae	
Polemonium acutiflorum Willd.	Jacob's ladder
Polygonaceae	
Rumex arcticus Trautv.	Arctic dock

TABLE 02 CONTINUED

Pyrolaceae	
Pyrola asarifolia Michx.	Liverleaf pyrola
Pyrola asarifolia or	
Pyrola grandifolia	
Pyrola secunda L.	One-sided wintergreen
Ranunculaceae	
Aconitum delphinifolium DC.	Monkshood
Anemone narcissiflora L.	
Aquilegia brevistyla Hook.	Small-flower columbine
Caltha sp.	
Delphinium glaucum S. Wats.	Glaucous larkspur
Ranunculus eschscholtzii Schlecht.	Eschscholtz buttercup
Ranunculus occidentalis Nutt.	Western buttercup
Ranunculus pensylvanicum L.F.	Bristly buttercup
Thalictrum sparsiflorum Turcz.	Meadow rue
Rosaceae	
Aruncus sylvester Kostel.	Goatsbeard
Geum macrophyllum Willd.	Large-leaf avens
Potentilla palustris (L.)Scop.	Marsh five-finger
Rubus arcticus L.	Nagoon berry
Rubus chamaemorus L.	Cloudberry
Rubus idaeus L.	Raspberry
Rubus spectabilis Pursh	Salmonberry
Sanquisorba stipulata Raf.	Sitka burnet
Rubiaceae	
Galium boreale (L.)	Northern bedstraw
Galium triflorum Michx.	Sweet-scented beds
Santalaceae	
Geocaulon lividum (Richards.)Fern.	
Scrophulariaceae	
Castilleja caudata (Pennell)Rebr.	Paintbrush
Mimulus guttatus DC.	Yellow monkey-flower
Pedicularis labradorica Wirsing	Labrador lousewort
Rhinanthus crista-galli L.	Rattlebox
Umbelliferae	
Heracleum lanatum Michx.	Cow parsnip
Urticaceae	
Urtica dioica L.	Stinging nettle

TABLE 02 CONTINUED

GRAMINOIDS	
Gramineae	
Agropyron caninum (L.) Beauv.	
Agrostis scabra Willd.	Ticklegrass
Alopecuris pratensis L.	Meadow foxtail
Arctagrostis latifolia[1]	Polargrass
Beckmannia syzigchne (teud.)Fern.	Sloughgrass
Bromus ciliatus L.	Fringed brome
Bromus inermis[1]	Smooth brome
Calamagrostis canadensis (Michx.)Beauv.	Bluejoint
Deschampsia beringensis[1]	Bering hairgrass
Elymus sibericus[1]	Russian wildrye
Festuca altaica Trin.	
Festuca rubra L.	Red fescue
Hordeum jubatum L.	Squirreltail grass
Phleum alpinum L.	Alpine timothy
Poa arctica R.Br. (?)	Arctic bluegrass
Poa pratensis L.	Bluegrass
Trisetum spicatum L.	Downy oatgrass
Cyperaceae	
Carex aquatilis Wahl.	Water sedge
Carex brunnescens (Pers.)Poir	Brownish sedge
Carex laeviculmis	
Carex praticola Rydb.	
Carex rhyncophysa? or rostrata	
Luzula parviflora (Ehrh.)Desv.	Small-flowered woodrush
Juncaceae	
Juncus bufonius L.	Toad rush
WOODY	
Araliaceae	
Echinopanax horridum	Devil's club
Betulaceae	
Alnus sinuata (Reg.)Rydb.	Sitka alder
Alnus tenuifolia Nutt.	Thinleaf alder
Betula glandulosa Michx.	Dwarf birch
Betula papyrifera Marsh.	Paper birch
Caprifoliaceae	
Linnaea borealis L.	Twin-flower
Sambucus callicarpa Greene	Elderberry
Viburnum edule (Michx.)Raf.	Highbush cranberry

TABLE 02 CONTINUED

Empetraceae	
Empetrum nigrum	Crowberry
Ericaceae	
Andromeda polifolia L.	Bog rosemary
Arctostaphylos alpina (L.)Spreng	Alpine bearberry
Ledum palustre (Ait.)Small	Labrador tea
Vaccinium uliginosum L.	Bog blueberry
Vaccinium vitis-idaea L.	Lowbush cranberry
Grossulariaceae	
Ribes glandulosum Grauer	Skunk currant
Ribes triste Pall.	American red currant
Pinaceae	
Picea glauca (Moench) Voss	White spruce
Rosaceae	
Rosa acicularis Lindl.	Rose
Sorbus scopulina Greene	Western mountain ash
Spiraea beauverdiana Schneid.	Beauverd spiraea
Salicaceae	
Populus balsamifera L.	Balsam poplar
Populus tremuloides Michx.	Aspen
Salix alaxensis (Anderss.)Coville	Feltleaf willow
Salix barclayi Anderss. ??	Barclay willow
Salix bebbiana Sarg.	Bebb willow
Salix fuscescens Anderss. ??	Brownish willow
Salix monticola Bebb ??	Park willow
Salix novae-angliae Anderss. ?	Tall blueberry willow
Salix planifolia Pursh	Diamondleaf willow
Salix scouleriana Barr. ?	Scouler willow

[1] These species had been seeded on the revegetated site and were not found in the native vegetation.

TABLE 03

Percentage cover for species and categories for disturbed closed paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 13)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	99.	1.	4.	13	1	3.	8	1	5
MOSS	3.	1.	21.	13	375	7.	8	126	5
Polytrichum	0.	0.	0.	13		1.	8		5
Hypnum	1.	0.	2.	13		3.	8		5
Moss spp.	2.	1.	18.	13		8.	8		5
LITTER	97.	1.	20.	13	1	15.	8	1	5
HERBACEOUS	79.	5.	312.	13	9	124.	8	4	5
NON-FLOWERING	45.	7.	614.	13	51	126.	8	11	5
Gymnocarpium dryopteris	45.	7.	598.	13		124.	8		5
Equisetum pratense	1.	1.	5.	13		5.	8		5
Equisetum silvaticum	0.	0.	0.	13		0.	8		5
FORBS	38.	4.	212.	13	26	273.	8	33	5
Cornus canadensis	21.	4.	233.	13		169.	8		5
Epilobium angustifolium	11.	3.	152.	13		51.	8		5
Geranium erianthum	5.	1.	21.	13		17.	8		5
Heracleum lanata	1.	1.	13.	13		16.	8		5
Mertensia paniculata	1.	0.	3.	13		3.	8		5
Pyrola sp.	1.	1.	8.	13		8.	8		5
Sanguisorba stipulata	0.	0.	0.	13		0.	8		5
Streptopus amplexifolius	1.	1.	6.	13		7.	8		5
Trientalis europaea	0.	0.	0.	13		0.	8		5
GRAMINOIDS	21.	4.	254.	13	96	193.	8	73	5
Calamagrostis canadensis	21.	4.	254.	13		193.	8		5
WOODY	90.	4.	160.	13	4	138.	8	3	5
DWARF SHRUBS	1.	0.	3.	13		3.	8		5
Linnaea borealis	1.	0.	3.	13		3.	8		5
LOW SHRUBS	43.	6.	434.	13	40	114.	8	11	5
Echinopanax horridum	6.	3.	152.	13		11.	8		5
Ribes spp.	1.	1.	5.	13		5.	8		5
Rosa acicularis	11.	2.	60.	13		68.	8		5
Salix bebbiana	1.	1.	8.	13		7.	8		5
Viburnum edule	28.	5.	385.	13		69.	8		5
TREES	85.	5.	326.	13	8	303.	8	8	5
Betula papyrifera	47.	8.	879.	13		601.	8		5
Populus balsamifera	1.	0.	2.	13		2.	8		5
Populus tremuloides	39.	8.	786.	13		918.	8		5
Picea glauca	9.	3.	135.	13		47.	8		5
TOTAL VASCULAR	100.	0.	0.	13	1	1.	8	1	5

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 04

Percentage cover for species and categories for reference closed paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	100.	0.	0.	3	1				
MOSS	14.	9.	227.	3	192				
Polytrichum	1.	1.	2.	3					
Hypnum	1.	1.	2.	3					
Moss spp.	13.	7.	156.	3					
LICHEN	4.	4.	52.	3	507				
Lichen spp.	4.	4.	52.	3					
LITTER	85.	9.	269.	3	7				
HERBACEOUS	68.	4.	56.	3	3				
NON-FLOWERING	13.	3.	27.	3	26				
Gymnocarpium dryopteris	13.	3.	27.	3					
FORBS	63.	5.	77.	3	4				
Cornus canadensis	51.	9.	265.	3					
Epilobium angustifolium	14.	4.	52.	3					
Geranium erianthum	3.	1.	6.	3					
Mertensia paniculata	1.	1.	2.	3					
Pyrola sp.	1.	1.	2.	3					
Rubus arcticus	1.	1.	2.	3					
GRAMINOIDS	2.	2.	8.	3	507				
Calamagrostis canadensis	2.	2.	8.	3					
WOODY	95.	1.	6.	3	1				
DWARF SHRUBS	1.	1.	2.	3					
Linnaea borealis	1.	1.	2.	3					
LOW SHRUBS	32.	16.	758.	3	128				
Rosa acicularis	10.	5.	81.	3					
Salix alaxensis	2.	2.	8.	3					
Salix bebbiana	2.	2.	8.	3					
Vaccinium uliginosum	3.	3.	19.	3					
Viburnum edule	18.	10.	277.	3					
TREES	95.	1.	6.	3	1				
Betula papyrifera	68.	11.	358.	3					
Populus balsamifera	1.	1.	2.	3					
Populus tremuloides	37.	11.	358.	3					
Picea glauca	9.	6.	102.	3					
TOTAL VASCULAR	98.	2.	8.	3	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 05

Relative cover (species composition) of species for disturbed paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$		Diversity Local	Diversity Total
HERBACEOUS				
NON-FLOWERING				
Gymnocarpium dryopteris	18.	No. of Species	15	23
Equisetum pratense	1.	Simpson	6.6	8.2
Equisetum silvaticum	0.	Shannon Exp	8.4	10.4
FORBS				
Cornus canadensis	8.			
Epilobium angustifolium	4.			
Geranium erianthum	2.			
Heracleum lanata	1.			
Mertensia paniculata	0.			
Pyrola sp.	1.			
Sanguisorba stipulata	0.			
Streptopus amplexifolius	0.			
Trientalis europaea	0.			
GRAMINOIDS				
Calamagrostis canadensis	8.			
WOODY				
SHRUBS				
Echinopanax horridum	2.			
Linnaea borealis	1.			
Ribes spp.	0.			
Rosa acicularis	4.			
Salix bebbiana	1.			
Viburnum edule	11.			
TREES				
Betula papyrifera	19.			
Populus balsamifera	0.			
Populus tremuloides	16.			
Picea glauca	4.			

TABLE 06

Relative cover (species composition) of species for reference paper birch - aspen vegetation type (Stand 3), summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Gymnocarpium dryopteris	6.	No. of Species	18
		Simpson	5.8
FORBS		Shannon Exp	8.0
Cornus canadensis	22.		
Epilobium angustifolium	6.		
Geranium erianthum	1.		
Mertensia paniculata	0.		
Pyrola sp.	0.		
Rubus arcticus	0.		
GRAMINOIDS			
Calamagrostis canadensis	1.		
WOODY			
SHRUBS			
Linnaea borealis	0.		
Rosa acicularis	4.		
Salix alaxensis	1.		
Salix bebbiana	1.		
Vaccinium uliginosum	1.		
Viburnum edule	8.		
TREES			
Betula papyrifera	29.		
Populus balsamifera	0.		
Populus tremuloides	16.		
Picea glauca	4.		

TABLE 07

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed closed paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 13)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	1692.	206.	549103.	13	4	362083.	8	3	5
Betula papyrifera	331.	115.	172308.	13		188021.	8		5
Populus tremuloides	985.	181.	426410.	13		294583.	8		5
Picea glauca	377.	131.	223590.	13		54271.	8		5
Shrub Density (tree species)	404.	271.	953526.	13	109	1115234.	8	127	5
Betula papyrifera	77.	52.	35256.	13		0.	8		5
Picea glauca	269.	269.	942308.	13		1148438.	8		5
Alnus sinuata	58.	42.	22436.	13		21484.	8		5
Shrub Density (other species)	8973.	789.	8102977.	13	2	3926720.	8	1	5
Salix bebbiana	19.	19.	4808.	13		3906.	8		5
Rosa acicularis	2769.	491.	3140224.	13		1583332.	8		5
Viburnum edule	6173.	619.	4983175.	13		2259768.	8		5
Total basal area	25.	3.	143.	13	5	113.	8	4	5
Betula papyrifera	6.	1.	26.	13		27.	8		5
Populus tremuloides	18.	4.	222.	13		175.	8		5
Populus balsamifera	1.	0.	2.	13		1.	8		5
Picea glauca	0.	0.	1.	13		1.	8		5

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 08

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for reference closed paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	1600.	200.	120000.	3	1				
Betula papyrifera	567.	120.	43333.	3					
Populus tremuloides	833.	240.	173333.	3					
Picea glauca	200.	58.	10000.	3					
Shrub Density (other species)	6597.	2848.	24334470.	3	11				
Salix bebbiana	500.	250.	187500.	3					
Rosa acicularis	2250.	1299.	5062500.	3					
Viburnum edule	3833.	1341.	5395834.	3					
Total basal area	27.	6.	108.	3	3				
Betula papyrifera	10.	5.	86.	3					
Populus tremuloides	12.	5.	65.	3					
Picea glauca	5.	4.	49.	3					

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 09

Dimensions of dominant woody species for disturbed closed paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 26)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	16.9	1.3	34.9	21	21	15.2	16	9	5
Betula papyrifera height (m)	11.6	.8	13.1	21	17	6.1	16	8	5
Betula papyrifera age	41.7	1.8	69.6	21	7	84.8	16	9	5
Populus tremuloides dbh (cm)	18.7	1.3	39.9	24	20	32.7	19	16	5
Populus tremuloides ht (m)	13.3	1.1	32.6	25	31	30.7	20	30	5
Populus tremuloides age	49.3	5.1	646.8	25	46	557.3	20	39	5
Picea glauca dbh (cm)	8.1	1.0	15.4	15	40	13.0	11	34	5
Picea glauca height (m)	4.6	.4	2.5	15	21	2.3	11	19	5
Picea glauca age	31.9	2.6	89.7	13	15	117.0	9	20	5
Alnus sinuata dbh (cm)	10.1	1.9	6.8	2	12	.0	0	1	5
Alnus sinuata height (m)	8.3	1.8	6.1	2	16	.0	0	1	5
Alnus sinuata age	33.0	6.0	72.0	2	12	.0	0	1	5
Alnus sinuata basal diam (cm)	2.2	.0	.0	1	1	.0	0	1	5
Alnus sinuata height (cm)	170.0	.0	.0	1	1	.0	0	1	5
Alnus sinuata length (cm)	130.0	.0	.0	1	1	.0	0	1	5
Alnus sinuata width (cm)	108.0	.0	.0	1	1	.0	0	1	5
Alnus sinuata age	9.0	.0	.0	1	1	.0	0	1	5
Betula papyrifera basal d (cm)	4.8	3.0	64.4	7	465	85.3	4	615	5
Betula papyrifera ht (cm)	117.9	9.9	682.1	7	9	-19877.1	4	-240	5
Betula papyrifera length (cm)	67.0	7.2	365.3	7	14	-787.4	4	-28	5
Betula papyrifera width (cm)	49.9	6.6	306.8	7	21	-760.7	4	-50	5
Betula papyrifera age	11.8	1.8	19.0	6	23	-97.0	3	-116	5
Rosa acicularis basal diam (cm)	.7	.1	.2	18	54	.1	13	32	5
Rosa acicularis height (cm)	50.5	4.6	500.1	24	34	358.4	19	24	5
Rosa acicularis length (cm)	30.0	2.4	133.4	24	26	91.4	19	18	5
Rosa acicularis width (cm)	22.0	2.3	126.0	24	45	87.9	19	31	5
Viburnum edule basal diam (cm)	1.1	.1	.1	18	21	.1	13	16	5
Viburnum edule height (cm)	78.2	4.3	438.8	24	13	338.1	19	10	5
Viburnum edule length (cm)	46.0	3.1	233.4	24	19	184.7	19	15	5
Viburnum edule width (cm)	31.1	2.3	126.9	24	23	80.4	19	15	5
Salix scouleriana basal d (cm)	.9	.0	.0	1	1	.0	0	1	5
Salix scouleriana ht (cm)	105.0	.0	.0	1	1	.0	0	1	5
Salix scouleriana length (cm	48.0	.0	.0	1	1	.0	0	1	5
Salix scouleriana width (cm)	32.0	.0	.0	1	1	.0	0	1	5
Salix scouleriana age	5.0	.0	.0	1	1	.0	0	1	5

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 10

Dimensions of dominant woody species for reference paper birch - aspen vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 6)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	9.7	.9	5.0	6	9	5.0	5	9	1
Betula papyrifera height (m)	9.8	1.6	15.4	6	27	15.4	5	27	1
Betula papyrifera age	35.5	4.4	115.5	6	16	115.5	5	16	1
Populus tremuloides dbh (cm)	16.7	1.0	5.8	6	4	5.8	5	4	1
Populus tremuloides ht (m)	12.8	.9	5.0	6	6	5.0	5	6	1
Populus tremuloides age	52.7	1.2	8.7	6	1	8.7	5	1	1
Picea glauca dbh (cm)	8.6	1.2	9.1	6	21	9.1	5	21	1
Picea glauca height (m)	7.5	.7	3.0	6	10	3.0	5	10	1
Picea glauca age	40.2	1.7	17.8	6	2	17.8	5	2	1
S. bebbiana basal diam (cm)	.7	.2	.2	3	56	.2	2	56	1
S. bebbiana ht (cm)	61.3	9.8	286.3	3	13	286.3	2	13	1
S. bebbiana len (cm)	33.3	8.8	233.3	3	36	233.3	2	36	1
S. bebbiana wid (cm)	21.3	1.9	10.3	3	4	10.3	2	4	1
S. bebbiana age	6.5	3.5	24.5	2	98	24.5	1	98	1
Rosa acicularis basal diam (cm)	.5	.0	.0	4	2	.0	3	2	1
Rosa acicularis height (cm)	62.8	4.9	96.9	4	5	96.9	3	5	1
Rosa acicularis length (cm)	40.5	4.3	73.0	4	8	73.0	3	8	1
Rosa acicularis width (cm)	33.3	3.7	54.9	4	9	54.9	3	9	1
Viburnum edule basal diam (cm)	.7	.1	.1	5	38	.1	4	38	1
Viburnum edule height (cm)	49.7	12.9	838.2	5	58	838.2	4	58	1
Viburnum edule length (cm)	30.0	4.9	118.5	5	23	118.5	4	23	1
Viburnum edule width (cm)	24.0	4.9	119.5	5	36	119.5	4	36	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 11

Browse parameters for disturbed closed deciduous forest habitat type (closed birch - aspen), summer 1988, Wishbone Hill.

	Twig Length (cm)				Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	29.5	3.5	15	4	594.2	146.9	15	17
Lateral	10.9	1.6	15	6	108.8	18.1	15	8
All	20.2	2.5	30	9	351.5	85.6	30	3
Salix bebbiana								
Terminal								
Lateral								
All								
Viburnum edule								
Terminal	14.6	1.8	16	5	401.9	85.5	16	14
Lateral	5.2	0.6	15	4	79.8	13.0	15	8
All	10.1	1.3	31	10	246.0	52.8	31	27
Rosa acicularis								
Terminal	21.9	4.9	10	10	559.6	203.5	10	25
Lateral	6.0	0.7	11	4	47.7	7.2	11	5
All	13.5	2.9	21	18	291.4	110.3	21	56

	Twig count/shrub				Calc Wt/ Shrub	Clipped Wt/ Shrub (g)				Estimated Browse/Area (kg/ha)	
	Mean	StdErr	N	NHAT	Mean	Mean	StdErr	N	NHAT	Calc	Clip
Betula papyrifera											
Terminal	9	3	7	15	5.35						
Lateral	17	10	8	53	1.85						
All	25	13	8	40	7.20	21.0	4.6	8	8	0.55	1.62
Salix bebbiana											
Terminal											
Lateral											
All											
Viburnum edule											
Terminal	2	1	9	8	0.80						
Lateral	2	0	9	7	0.16						
All	5	1	9	4	0.96	10.0	3.2	9	18	5.95	61.73
Rosa acicularis											
Terminal	1	0	7	7	0.56						
Lateral	4	1	6	6	0.19						
All	4	1	7	9	0.75	17.8	3.4	7	5	2.08	49.29

TABLE 12

Browse parameters for reference closed deciduous forest habitat type (closed birch - aspen), summer 1988, Wishbone Hill.

	Length (cm)				Est Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	20.5	4.2	12	10	390.0	131.9	12	26
Lateral	9.6	2.0	10	8	81.7	31.1	10	27
All	15.5	2.7	22	13	249.9	79.3	22	41
Salix bebbiana								
Terminal								
Lateral								
All								
Viburnum edule								
Terminal	20.4	1.0	6	1	822.1	82.8	6	2
Lateral	6.2	1.0	10	5	89.9	22.1	10	12
All	11.5	1.9	16	9	364.5	97.0	16	16
Rosa acicularis								
Terminal	11.0	0.0	1	1	115.9	0.0	1	1
Lateral	8.0	0.0	1	1	61.3	0.0	1	1
All	9.5	1.5	2	1	88.6	27.3	2	4

	Twig count/shrub				Calc Wt/Shrub (g)	Estimated Browse/Area (kg/ha)
	Mean	StdErr	N	NHAT	Mean	Calc
Betula papyrifera						
Terminal	10	3	4	8	3.90	
Lateral	9	5	4	19	0.74	
All	19	8	4	13	4.64	0.00
Salix bebbiana						
Terminal						
Lateral						
All						
Viburnum edule						
Terminal	2	1	4	14	1.64	
Lateral	3	0	4	1	0.27	
All	4	1	4	2	1.91	7.34
Rosa acicularis						
Terminal	1	0	1	1	0.12	
Lateral	1	0	1	1	0.06	
All	2	0	2	1	0.18	0.40

TABLE 13

Percentage cover for species and categories for disturbed closed poplar / alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	98.	1.	2.	3	1				
MOSS	4.	3.	27.	3	264				
Moss spp.	4.	3.	27.	3					
LICHEN	1.	1.	2.	3	507				
Lichen spp.	1.	1.	2.	3					
LITTER	96.	1.	2.	3	1				
HERBACEOUS	37.	7.	133.	3	17				
NON-FLOWERING	4.	2.	15.	3	142				
Gymnocarpium dryopteris	3.	2.	15.	3					
Fern spp.	1.	1.	2.	3					
FORBS	19.	6.	102.	3	47				
Artemisia tilesii	4.	3.	27.	3					
Epilobium angustifolium	3.	3.	19.	3					
Heracleum lanata	3.	2.	15.	3					
Pyrola sp.	8.	2.	15.	3					
Streptopus amplexifolius	1.	1.	2.	3					
Trientalis europaea	2.	1.	2.	3					
GRAMINOIDS	15.	3.	25.	3	19				
Calamagrostis canadensis	15.	3.	25.	3					
WOODY	97.	2.	8.	3	1				
LOW SHRUBS	17.	7.	165.	3	101				
Echinopanax horridum	5.	3.	19.	3					
Ribes spp.	3.	3.	19.	3					
Rosa acicularis	2.	2.	8.	3					
Viburnum edule	8.	6.	119.	3					
TALL SHRUBS	40.	8.	194.	3	21				
Alnus sinuata	40.	8.	194.	3					
TREES	92.	3.	27.	3	1				
Populus balsamifera	57.	28.	2415.	3					
Populus tremuloides	33.	33.	3169.	3					
Picea glauca	16.	6.	108.	3					
TOTAL VASCULAR	98.	2.	8.	3	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 14

Relative cover (species composition) of species for disturbed closed poplar / alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Gymnocarpium dryopteris	2.	No. of Species	16
Fern spp.	0.	Simpson	4.0
		Shannon Exp	6.5
FORBS			
Artemisia tilesii	2.		
Epilobium angustifolium	1.		
Heracleum lanata	2.		
Pyrola sp.	4.		
Streptopus amplexifolius	0.		
Trientalis europaea	1.		
GRAMINOIDS			
Calamagrostis canadensis	7.		
Echinopanax horridum	3.		
Ribes spp.	1.		
Rosa acicularis	1.		
Viburnum edule	4.		
WOODY			
SHRUBS			
Alnus sinuata	20.		
TREES			
Populus balsamifera	28.		
Populus tremuloides	16.		
Picea glauca	8.		

TABLE 15

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed closed poplar / alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	1633.	219.	143333.	3	1	143333.	2	1	1
Populus balsamifera	967.	88.	23333.	3		23333.	2		1
Picea glauca	667.	240.	173333.	3		173333.	2		1
Shrub Density (tree species)	3750.	144.	62500.	3	1	62500.	2	1	1
Alnus sinuata	3750.	144.	62500.	3		62500.	2		1
Shrub Density (other species)	1847.	581.	1014096.	3	6	1014096.	2	6	1
Rosa acicularis	333.	333.	333333.	3		333333.	2		1
Viburnum edule	1500.	382.	437500.	3		437500.	2		1
Total basal area	29.	4.	44.	3	1	44.	2	1	1
Populus balsamifera	27.	3.	33.	3		33.	2		1
Picea glauca	3.	2.	7.	3		7.	2		1

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 16

Dimensions of dominant woody species for disturbed closed poplar / alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 6)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Populus balsamifera dbh (cm)	32.4	2.6	40.1	6	7	40.1	5	7	1
Populus balsamifera ht (m)	15.3	.9	4.7	6	4	4.7	5	4	1
Populus balsamifera age	68.0	2.9	48.8	6	2	48.8	5	2	1
Picea glauca dbh (cm)	11.0	4.1	101.5	6	142	101.5	5	142	1
Picea glauca height (m)	5.3	1.0	5.5	6	34	5.5	5	34	1
Picea glauca age	46.2	6.1	221.4	6	18	221.4	5	18	1
Alnus sinuata dbh (cm)	6.9	.8	4.1	6	15	4.1	5	15	1
Alnus sinuata height (m)	3.8	.4	1.0	6	12	1.0	5	12	1
Alnus sinuata age	34.7	2.7	44.3	6	7	44.3	5	7	1
Rosa acicularis basal diam (cm)	.8	.0	.0	2	1	.0	1	1	1
Rosa acicularis height (cm)	63.5	.5	.5	2	1	.5	1	1	1
Rosa acicularis length (cm)	38.0	14.0	392.0	2	46	392.0	1	46	1
Rosa acicularis width (cm)	27.5	8.5	144.5	2	33	144.5	1	33	1
Viburnum edule basal diam (cm)	.7	.2	.2	6	55	.2	5	55	1
Viburnum edule height (cm)	61.5	17.9	1930.3	6	87	1930.3	5	87	1
Viburnum edule length (cm)	33.5	6.9	287.1	6	44	287.1	5	44	1
Viburnum edule width (cm)	26.5	5.3	170.7	6	42	170.7	5	42	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 17

Percentage cover for species and categories for disturbed closed paper birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 2)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	100.	0.	0.	2	1				
MOSS	15.	0.	0.	2	1				
Polytrichum	1.	1.	3.	2					
Hypnum	10.	0.	0.	2					
Moss spp.	4.	1.	3.	2					
LITTER	88.	3.	13.	2	1				
HERBACEOUS	65.	13.	313.	2	13				
NON-FLOWERING	41.	21.	903.	2	90				
Lycopodium	1.	1.	3.	2					
Dryopteris dilatata	8.	8.	113.	2					
Gymnocarpium dryopteris	33.	15.	450.	2					
FORBS	36.	6.	78.	2	11				
Cornus canadensis	25.	8.	113.	2					
Epilobium angustifolium	6.	1.	3.	2					
Pyrola sp.	3.	3.	13.	2					
GRAMINOIDS	9.	1.	3.	2	7				
Calamagrostis canadensis	9.	1.	3.	2					
WOODY	88.	3.	13.	2	1				
DWARF SHRUBS	4.	1.	3.	2					
Linnaea borealis	4.	1.	3.	2					
LOW SHRUBS	29.	16.	528.	2	108				
Echinopanax horridum	5.	5.	50.	2					
Ribes spp.	1.	1.	3.	2					
Rosa acicularis	13.	10.	200.	2					
Salix bebbiana	3.	3.	13.	2					
Viburnum edule	11.	11.	253.	2					
TALL SHRUBS	1.	1.	3.	2	338				
Alnus sinuata	1.	1.	3.	2					
TREES	81.	1.	3.	2	1				
Betula papyrifera	75.	3.	13.	2					
Picea glauca	10.	8.	113.	2					
TOTAL VASCULAR	100.	0.	0.	2	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 18

Relative cover (species composition) of species for disturbed closed paper birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Lycopodium	1.	No. of Species	16
Dryopteris dilatata	4.	Simpson	5.4
Gymnocarpium dryopteris	16.	Shannon Exp	8.3
FORBS			
Cornus canadensis	12.		
Epilobium angustifolium	3.		
Linnaea borealis	2.		
Pyrola sp.	1.		
GRAMINOIDS			
Calamagrostis canadensis	4.		
WOODY			
SHRUBS			
Echinopanax horridum	2.		
Ribes spp.	1.		
Rosa acicularis	6.		
Salix bebbiana	1.		
Viburnum edule	6.		
TREES			
Alnus sinuata	1.		
Betula papyrifera	36.		
Picea glauca	5.		

TABLE 19

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed closed paper birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 2)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	750.	250.	125000.	2	5				
Betula papyrifera	650.	150.	45000.	2					
Picea glauca	50.	50.	5000.	2					
Alnus sinuata	50.	50.	5000.	2					
Shrub Density (tree species)	1375.	1375.	3781250.	2	37				
Betula papyrifera	1375.	1375.	3781250.	2					
Shrub Density (other species)	12500.	5000.	49999970.	2	6				
Salix scouleriana	250.	0.	0.	2					
Rosa acicularis	5750.	500.	500000.	2					
Viburnum edule	6500.	5500.	60500000.	2					
Total basal area	1.	0.	0.	2	1				
Betula papyrifera	1.	0.	0.	2					

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 20

Dimensions of dominant woody species for disturbed closed paper birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 4)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	18.1	2.0	15.8	4	9	15.8	3	9	1
Betula papyrifera height (m)	15.8	.3	.3	4	1	.3	3	1	1
Betula papyrifera age	34.0	1.8	13.3	4	2	13.3	3	2	1
Picea glauca dbh (cm)	7.0	.7	1.0	2	4	1.0	1	4	1
Picea glauca height (m)	7.0	.0	.0	2	1	.0	1	1	1
Picea glauca age	27.5	.5	.5	2	1	.5	1	1	1
Betula papyrifera basal d (cm)	3.3	.7	1.8	4	29	1.8	3	29	1
Betula papyrifera ht (cm)	262.5	37.5	5625.0	4	14	5625.0	3	14	1
Betula papyrifera length (cm)	75.7	15.8	745.3	3	23	745.3	2	23	1
Betula papyrifera width (cm)	66.0	18.6	1036.0	3	41	1036.0	2	41	1
Betula papyrifera age	15.0	1.9	14.0	4	11	14.0	3	11	1
Rosa acicularis basal diam (cm)	.6	.1	.1	4	38	.1	3	38	1
Rosa acicularis height (cm)	63.5	8.8	307.7	4	13	307.7	3	13	1
Rosa acicularis length (cm)	36.5	7.5	225.7	4	29	225.7	3	29	1
Rosa acicularis width (cm)	32.5	7.6	229.7	4	37	229.7	3	37	1
Rosa acicularis age	1.5	.3	.3	4	26	.3	3	26	1
Viburnum edule basal diam (cm)	.9	.2	.1	2	30	.1	1	30	1
Viburnum edule height (cm)	77.3	12.2	449.3	3	13	449.3	2	13	1
Viburnum edule length (cm)	30.2	3.3	33.6	3	7	33.6	2	7	1
Viburnum edule width (cm)	18.5	4.8	68.3	3	34	68.3	2	34	1
Viburnum edule age	3.0	.6	1.0	3	19	1.0	2	19	1
Salix shrub basal diam (cm)	2.5	.0	.0	1	1	.0	0	1	1
Salix shrub height (cm)	130.0	.0	.0	1	1	.0	0	1	1
Salix shrub length (cm)	140.0	.0	.0	1	1	.0	0	1	1
Salix shrub width (cm)	87.0	.0	.0	1	1	.0	0	1	1
Salix scouleriana age	6.0	.0	.0	1	1	.0	0	1	1
Picea glauca basal diam (cm)	2.3	.1	.0	2	1	.0	1	1	1
Picea glauca height (cm)	136.5	16.5	544.5	2	5	544.5	1	5	1
Picea glauca length (cm)	35.5	27.5	1512.5	2	203	1512.5	1	203	1
Picea glauca width (cm)	59.0	4.0	32.0	2	2	32.0	1	2	1
Picea glauca age	14.5	4.5	40.5	2	33	40.5	1	33	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 21

Percentage cover for species and categories for disturbed open paper birch - spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 15)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	98.	1.	12.	15	1	9.	10	1	5
MOSS	6.	2.	56.	15	264	48.	10	224	5
Polytrichum	2.	1.	9.	15		9.	10		5
Hypnum	1.	0.	3.	15		3.	10		5
Moss spp.	4.	2.	45.	15		26.	10		5
LICHEN	0.	0.	0.	15	2535	0.	10	2535	5
Peltigera	0.	0.	0.	15		0.	10		5
LITTER	94.	2.	45.	15	1	34.	10	1	5
HERBACEOUS	89.	2.	64.	15	2	35.	10	1	5
NON-FLOWERING	37.	7.	703.	15	90	163.	10	21	5
Lycopodium	1.	0.	3.	15		3.	10		5
Dryopteris dilatata	3.	2.	36.	15		36.	10		5
Gymnocarpium dryopteris	30.	6.	469.	15		157.	10		5
Equisetum pratense	5.	2.	86.	15		98.	10		5
Equisetum silvaticum	1.	0.	2.	15		2.	10		5
FORBS	62.	6.	509.	15	23	165.	10	8	5
Achillea	0.	0.	0.	15		0.	10		5
Aconitum delphinifolium	0.	0.	0.	15		0.	10		5
Cornus canadensis	38.	5.	400.	15		96.	10		5
Epilobium angustifolium	23.	3.	170.	15		86.	10		5
Geranium erianthum	10.	3.	136.	15		110.	10		5
Mertensia paniculata	3.	1.	19.	15		20.	10		5
Pyrola sp.	1.	1.	5.	15		5.	10		5
Rubus arcticus	2.	1.	9.	15		9.	10		5
Sanguisorba stipulata	6.	2.	63.	15		30.	10		5
Streptopus amplexifolius	1.	1.	7.	15		6.	10		5
Trientalis europaea	1.	0.	2.	15		3.	10		5
GRAMINOIDS	25.	4.	232.	15	63	186.	10	51	5
Calamagrostis canadensis	25.	4.	233.	15		183.	10		5
Carex aquatilis	0.	0.	0.	15		0.	10		5
WOODY	75.	4.	264.	15	9	247.	10	8	5
DWARF SHRUBS	2.	1.	8.	15		5.	10		5
Linnaea borealis	2.	1.	8.	15		5.	10		5
LOW SHRUBS	29.	4.	277.	15	55	224.	10	44	5
Echinopanax horridum	3.	2.	48.	15		50.	10		5
Ribes spp.	3.	1.	11.	15		8.	10		5
Rosa acicularis	6.	2.	90.	15		51.	10		5
Salix bebbiana	2.	2.	42.	15		31.	10		5
Salix pulchra	1.	1.	7.	15		4.	10		5
Salix arbusculoides	0.	0.	2.	15		2.	10		5
Sorbus scopulina	5.	2.	76.	15		29.	10		5
Spiraea beauverdiana	1.	0.	3.	15		4.	10		5
Vaccinium uliginosum	0.	0.	0.	15		0.	10		5
Viburnum edule	11.	3.	120.	15		38.	10		5
TALL SHRUBS	0.	0.	2.	15	2535	2.	10	2535	5
Alnus sinuata	0.	0.	2.	15		2.	10		5

TABLE 21 CONTINUED

CATEGORY (N = 12)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
TREES	62.	5.	315.	15	14	276.	10	13	5
Betula papyrifera	49.	4.	280.	15		233.	10		5
Populus balsamifera	3.	2.	54.	15		39.	10		5
Populus tremuloides	0.	0.	0.	15		0.	10		5
Picea glauca	17.	4.	211.	15		253.	10		5
TOTAL VASCULAR	99.	0.	3.	15	1	3.	10	1	5

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 22

Percentage cover for species and categories for reference open paper birch - spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	98.	2.	8.	3	1				
MOSS	15.	5.	81.	3	62				
Polytrichum	1.	1.	2.	3					
Moss spp.	14.	5.	77.	3					
LICHEN	2.	1.	2.	3	127				
Lichen spp.	2.	1.	2.	3					
LITTER	93.	3.	33.	3	1				
HERBACEOUS	93.	1.	6.	3	1				
NON-FLOWERING	27.	10.	290.	3	69				
Gymnocarpium dryopteris	25.	10.	325.	3					
Equisetum pratense	3.	2.	15.	3					
FORBS	75.	9.	225.	3	7				
Cornus canadensis	43.	18.	925.	3					
Epilobium angustifolium	22.	2.	8.	3					
Geranium erianthum	18.	7.	158.	3					
Heracleum lanata	1.	1.	2.	3					
Mertensia paniculata	9.	3.	33.	3					
Polemonium acutiflorum	2.	2.	8.	3					
Pyrola sp.	2.	1.	2.	3					
Rubus arcticus	8.	3.	33.	3					
Sanguisorba stipulata	2.	1.	2.	3					
GRAMINOIDS	10.	4.	44.	3	74				
Calamagrostis canadensis	10.	4.	44.	3					
WOODY	73.	6.	119.	3	4				
DWARF SHRUBS	3.	2.	15.	3					
Linnaea borealis	3.	2.	15.	3					
LOW SHRUBS	28.	2.	15.	3	4				
Ribes spp.	1.	1.	2.	3					
Rosa acicularis	3.	2.	15.	3					
Sorbus scopulina	7.	2.	15.	3					
Vaccinium uliginosum	2.	2.	8.	3					
Viburnum edule	17.	3.	27.	3					
TREES	63.	8.	194.	3	9				
Betula papyrifera	44.	8.	190.	3					
Populus balsamifera	1.	1.	2.	3					
Picea glauca	29.	9.	233.	3					
TOTAL VASCULAR	99.	1.	2.	3	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 23

Relative cover (species composition) of species for disturbed open birch - spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{x}$		Diversity Local	Diversity Total
HERBACEOUS				
NON-FLOWERING				
Lycopodium	0.	No. of Species	21	34
Dryopteris dilatata	1.	Simpson	8.4	9.7
Gymnocarpium dryopteris	12.	Shannon Exp	11.4	14.0
Equisetum pratense	2.			
Equisetum silvaticum	0.			
FORBS				
Achillea	0.			
Aconitum delphinifolium	0.			
Cornus canadensis	15.			
Epilobium angustifolium	9.			
Geranium erianthum	4.			
Mertensia paniculata	1.			
Pyrola sp.	1.			
Rubus arcticus	1.			
Sanguisorba stipulata	2.			
Streptopus amplexifolius	1.			
Trientalis europaea	0.			
GRAMINOIDS				
Calamagrostis canadensis	10.			
Carex aquatilis	0.			
WOODY				
SHRUBS				
Echinopanax horridum	1.			
Linnaea borealis	1.			
Ribes spp.	1.			
Rosa acicularis	3.			
Salix bebbiana	1.			
Salix pulchra	0.			
Salix arbusculoides	0.			
Sorbus sp.	2.			
Spiraea beauverdiana	0.			
Vaccinium uliginosum	0.			
Viburnum edule	5.			
TREES				
Alnus sinuata	0.			
Betula papyrifera	19.			
Populus balsamifera	1.			
Populus tremuloides	0.			
Picea glauca	7.			

TABLE 24

Relative cover (species composition) of species for reference open birch - spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Gymnocarpium dryopteris	10.	No. of Species	21
Equisetum pratense	1.	Simpson	9.4
FORBS		Shannon Exp	12.1
Cornus canadensis	17.		
Epilobium angustifolium	9.		
Geranium erianthum	7.		
Heracleum lanata	0.		
Mertensia paniculata	4.		
Polemonium acutiflorum	1.		
Pyrola sp.	1.		
Rubus arcticus	3.		
Sanguisorba stipulata	1.		
GRAMINOIDS			
Calamagrostis canadensis	4.		
WOODY			
SHRUBS			
Linnaea borealis	1.		
Ribes spp.	0.		
Rosa acicularis	1.		
Sorbus sp.	3.		
Vaccinium uliginosum	1.		
Viburnum edule	7.		
TREES			
Betula papyrifera	18.		
Populus balsamifera	0.		
Picea glauca	12.		

TABLE 25

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed open paper birch - white spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 15)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	1093.	327.	1604952.	15	25	1633417.	10	26	5
Betula papyrifera	353.	57.	48381.	15		40583.	10		5
Populus balsamifera	20.	14.	3143.	15		2000.	10		5
Picea glauca	720.	329.	1626000.	15		1671500.	10		5
Shrub Density (tree species)	1367.	424.	2695238.	15	27	1647916.	10	17	5
Betula papyrifera	683.	263.	1039881.	15		321354.	10		5
Picea glauca	667.	355.	1889881.	15		1183854.	10		5
Alnus sinuata	17.	17.	4167.	15		4167.	10		5
Shrub Density (other species)	5876.	850.	10839700.	15	6	********	10	8	5
Salix bebbiana	367.	205.	632738.	15		547917.	10		5
Rosa acicularis	1600.	353.	1873214.	15		1490625.	10		5
Viburnum edule	3900.	653.	6391069.	15		7082808.	10		5
Total basal area	17.	2.	92.	15	6	29.	10	2	5
Betula papyrifera	11.	2.	41.	15		28.	10		5
Populus tremuloides	0.	0.	1.	15		1.	10		5
Populus balsamifera	2.	1.	22.	15		17.	10		5
Picea glauca	4.	1.	6.	15		2.	10		5

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 26

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for reference paper birch - white spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	1300.	153.	70000.	3	1	70000.	2	1	1
Betula papyrifera	433.	33.	3333.	3		3333.	2		1
Picea glauca	867.	133.	53333.	3		53333.	2		1
Shrub Density (other species)	8508.	1639.	8061252.	3	3	8061252.	2	3	1
Salix bebbiana	1083.	417.	520833.	3		520833.	2		1
Rosa acicularis	2000.	901.	2437500.	3		2437500.	2		1
Viburnum edule	5417.	546.	895831.	3		895831.	2		1
Total basal area	14.	1.	1.	3	1	1.	2	1	1
Betula papyrifera	8.	2.	7.	3		7.	2		1
Picea glauca	5.	1.	3.	3		3.	2		1

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 27

Dimensions of dominant woody species for disturbed open birch - spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 30)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	24.8	1.7	86.5	30	24	75.6	25	21	5
Betula papyrifera height (m)	11.0	.8	19.2	30	27	12.9	25	18	5
Betula papyrifera age	51.2	4.3	481.3	26	32	477.9	21	31	5
Populus balsamifera dbh (cm)	26.6	2.8	38.3	5	10	41.7	3	10	5
Populus balsamifera ht (m)	13.5	.7	2.8	5	3	3.4	3	4	5
Populus balsamifera age	67.0	12.5	779.0	5	30	1016.2	3	39	5
Picea glauca dbh (cm)	18.8	1.4	62.5	30	30	59.0	25	29	5
Picea glauca height (m)	9.7	.9	24.2	30	44	20.8	25	38	5
Picea glauca age	65.7	7.5	1618.3	29	64	888.7	24	35	5
Salix scouleriana dbh (cm)	29.6	1.1	2.6	2	1	.0	0	1	5
Salix scouleriana height (m)	10.0	2.0	8.0	2	14	.0	0	1	5
Salix scouleriana age	31.5	21.5	924.5	2	158	.0	0	1	5
Alnus sinuata dbh (cm)	10.0	.0	.0	1	1	.0	-1	1	5
Alnus sinuata height (m)	4.0	.0	.0	1	1	.0	-1	1	5
Alnus sinuata age	50.0	.0	.0	1	1	.0	-1	1	5
Betula papyrifera basal d (cm)	1.8	.2	.6	14	33	-14.6	9	-776	5
Betula papyrifera ht (cm)	126.3	6.3	586.4	15	7	-38313.7	10	-404	5
Betula papyrifera length (cm	82.9	8.5	870.8	12	22	-7206.6	8	-176	5
Betula papyrifera width (cm)	64.3	6.9	570.2	12	24	-4979.0	8	-202	5
Betula papyrifera age	12.6	1.7	39.5	14	43	-272.2	9	-290	5
Salix bebbiana basal diam (cm)	1.3	.1	.1	9	10	.1	7	11	5
Salix bebbiana height (cm)	75.0	13.8	1724.1	9	52	1969.0	7	60	5
Salix bebbiana length (cm)	63.2	4.7	197.7	9	9	204.0	7	9	5
Salix bebbiana width (cm)	44.4	3.3	98.0	9	9	72.0	7	7	5
Salix bebbiana age	7.9	.4	1.1	7	4	.6	5	2	5
Rosa acicularis basal diam (cm)	.7	.1	.1	18	25	.0	13	7	5
Rosa acicularis height (cm)	60.2	3.7	345.0	25	17	278.8	20	13	5
Rosa acicularis length (cm)	36.0	2.7	178.3	25	24	178.5	20	24	5
Rosa acicularis width (cm)	36.2	7.9	1563.3	25	202	1505.8	20	194	5
Viburnum edule basal diam (cm)	.8	.1	.1	16	29	-.3	11	-75	5
Viburnum edule height (cm)	68.9	4.0	425.4	27	16	486.8	22	18	5
Viburnum edule length (cm)	36.7	2.8	209.8	27	27	221.9	22	28	5
Viburnum edule width (cm)	24.6	1.6	75.0	28	21	77.8	23	22	5

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 28

Dimensions of dominant woody species for reference open birch - spruce vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 7)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	22.4	4.2	122.4	7	42	122.4	6	42	1
Betula papyrifera height (m)	10.1	1.0	6.6	7	12	6.6	6	12	1
Betula papyrifera age	56.3	2.8	45.9	6	3	45.9	5	3	1
Populus balsamifera ht (m)	12.0	.0	.0	1	1	.0	0	1	1
Picea glauca dbh (cm)	12.0	.7	2.6	6	4	2.6	5	4	1
Picea glauca height (m)	7.2	.2	.3	6	1	.3	5	1	1
Picea glauca age	32.5	1.4	11.5	6	2	11.5	5	2	1
Betula papyrifera basal d (cm)	20.9	18.5	1716.3	5	665	1716.3	4	665	1
Betula papyrifera ht (cm)	135.2	21.5	2305.2	5	22	2305.2	4	22	1
Betula papyrifera length (cm	46.6	20.2	2036.3	5	159	2036.3	4	159	1
Betula papyrifera width (cm)	49.8	13.9	966.2	5	66	966.2	4	66	1
Betula papyrifera age	13.8	4.4	95.7	5	85	95.7	4	85	1
Rosa acicularis basal diam (cm)	.6	.1	.1	5	26	.1	4	26	1
Rosa acicularis height (cm)	39.0	11.0	605.0	5	68	605.0	4	68	1
Rosa acicularis length (cm)	21.4	5.2	132.8	5	50	132.8	4	50	1
Rosa acicularis width (cm)	15.0	4.2	89.5	5	68	89.5	4	68	1
Viburnum edule basal diam (cm)	.7	.1	.0	6	8	.0	5	8	1
Viburnum edule height (cm)	57.0	5.6	185.2	6	10	185.2	5	10	1
Viburnum edule length (cm)	39.3	10.7	686.7	6	76	686.7	5	76	1
Viburnum edule width (cm)	26.0	5.4	176.4	6	45	176.4	5	45	1
Salix shrub basal diam (cm)	5.0	3.8	70.7	5	482	70.7	4	482	1
Salix shrub height (cm)	86.0	8.7	380.0	5	9	380.0	4	9	1
Salix shrub length (cm)	54.8	7.0	245.2	5	14	245.2	4	14	1
Salix shrub width (cm)	42.2	9.0	409.2	5	39	409.2	4	39	1
Salix shrub age	6.2	1.0	5.2	5	23	5.2	4	23	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 29

Browse parameters for disturbed open birch-spruce habitat type (open birch-spruce), summer 1988, Wishbone Hill.

	Length (cm)				Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	36.8	2.4	12	1	780.8	108.4	12	5
Lateral	15.9	1.9	13	4	186.6	30.9	13	7
All	25.9	2.6	25	5	471.8	80.7	25	14
Salix bebbiana								
Terminal	50.0	4.0	5	1	1996.7	301.6	5	3
Lateral	14.6	2.4	4	2	123.4	34.9	4	6
All	34.3	6.6	9	7	1164.1	365.8	9	17
Viburnum edule								
Terminal	15.9	2.1	18	6	563.4	118.5	18	15
Lateral	5.1	0.9	11	7	96.0	16.9	11	7
All	11.8	1.7	2	11	386.1	84.7	29	26
Rosa acicularis								
Terminal	34.9	10.2	9	15	1401.3	700.6	9	42
Lateral	8.2	1.8	7	6	109.6	28.0	7	9
All	23.2	6.6	16	24	836.2	418.1	16	74

	Twig count/shrub				Calc Wt/ Shrub	Clipped Wt/ Shrub (g)				Estimated Browse/Area (kg/ha)	
	Mean	StdErr	N	NHAT	Mean	Mean	StdErr	N	NHAT	Calc	Clip
Betula papyrifera											
Terminal	36	10	6	9	28.11						
Lateral	73	19	6	8	13.62						
All	109	28	6	8	41.73	57.2	10.7	6	4	28.50	39.07
Salix bebbiana											
Terminal	52	46	2	29	103.83						
Lateral	141	106	2	21	17.40						
All	193	152	2	23	121.23	87.3	50.9	2	13	44.49	32.04
Viburnum edule											
Terminal	3	0	9	3	1.69						
Lateral	5	2	6	10	0.48						
All	7	1	9	8	2.17	16.2	3.5	9	8	8.46	63.18
Rosa acicularis											
Terminal	2	0	5	2	2.80						
Lateral	7	3	3	7	0.77						
All	6	2	5	11	3.57	19.5	4.8	5	6	5.71	31.20

TABLE 30

Browse parameters for reference open birch-spruce habitat type (open birch-spruce), summer 1988, Wishbone Hill.

	Length (cm)				Est Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	17.8	3.8	10	9	285.6	115.2	10	31
Lateral	17.5	3.9	12	12	300.9	132.8	12	44
All	17.6	2.7	22	10	294.0	87.3	22	36
Salix bebbiana								
Terminal	16.9	4.1	11	13	339.6	143.1	11	37
Lateral	13.3	2.3	12	7	173.5	53.0	12	21
All	15.0	2.3	23	10	252.9	74.1	23	37
Viburnum edule								
Terminal	10.9	1.8	2	2	236.9	78.5	2	5
Lateral	9.4	1.9	4	4	195.3	76.2	4	12
All	9.9	1.3	6	3	209.2	51.2	6	16
Rosa acicularis								
Terminal	7.8	2.5	4	8	75.3	36.2	4	18
Lateral	9.6	3.0	6	11	131.2	72.9	6	35
All	8.9	2.0	10	10	108.8	45.1	10	32

	Twig count/shrub				Calc Wt/Shrub (g)	Estimated Browse/Area (kg/ha)
	Mean	StdErr	N	NHAT	Mean	Calc
Betula papyrifera						
Terminal	31	7	5	5	8.85	
Lateral	12	2	5	4	3.61	
All	43	8	5	4	12.46	0.00
Salix bebbiana						
Terminal	18	9	5	21	6.11	
Lateral	34	10	5	9	5.90	
All	52	18	5	12	12.01	13.01
Viburnum edule						
Terminal	3	1	5	7	0.71	
Lateral	3	1	4	5	0.59	
All	5	0	5	1	1.30	7.02
Rosa acicularis						
Terminal	2	1	4	7	0.15	
Lateral					0.00	
All	2	1	4	7	0.15	0.30

TABLE 31

Percentage cover for species and categories for disturbed young birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 14)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	
GROUND	99.	0.	2.	14	1	2.	9	1	5
MOSS	0.	0.	0.	14	2366	0.	9	2454	5
Moss spp.	0.	0.	0.	14		0.	9		5
LITTER	99.	0.	2.	14	1	2.	9	1	5
HERBACEOUS	95.	1.	20.	14	1	15.	9	1	5
NON-FLOWERING	54.	5.	349.	14	21	261.	9	16	5
Athyrium	13.	6.	554.	14		28.	9		5
Dryopteris dilatata	1.	1.	11.	14		12.	9		5
Gymnocarpium dryopteris	31.	6.	452.	14		255.	9		5
Fern spp.	3.	2.	41.	14		20.	9		5
Equisetum pratense	4.	2.	44.	14		33.	9		5
Equisetum silvaticum	5.	2.	76.	14		78.	9		5
FORBS	54.	4.	252.	14	15	196.	9	12	5
Aconitum delphinifolium	0.	0.	0.	14		0.	9		5
Cornus canadensis	15.	4.	207.	14		250.	9		5
Epilobium angustifolium	37.	4.	218.	14		171.	9		5
Geranium erianthum	4.	2.	45.	14		4.	9		5
Heracleum lanata	2.	1.	13.	14		12.	9		5
Mertensia paniculata	1.	1.	8.	14		7.	9		5
Pyrola sp.	0.	0.	2.	14		2.	9		5
Rubus arcticus	1.	0.	2.	14		2.	9		5
Rubus spp. (or Aruncus)	0.	0.	1.	14		0.	9		5
Sanguisorba stipulata	3.	1.	15.	14		14.	9		5
Streptopus amplexifolius	0.	0.	1.	14		1.	9		5
Trientalis europaea	0.	0.	0.	14		0.	9		5
GRAMINOIDS	45.	6.	445.	14	38	433.	9	37	5
Calamagrostis canadensis	45.	6.	445.	14		433.	9		5
WOODY	54.	5.	411.	14	24	501.	9	30	5
DWARF SHRUBS	0.	0.	2.	14	2366	2.	9	2454	5
Linnaea borealis	0.	0.	1.	14		1.	9		5
Vaccinium oxycoccus	0.	0.	2.	14		2.	9		5
LOW SHRUBS	20.	4.	174.	14	76	223.	9	96	5
Echinopanax horridum	1.	1.	29.	14		30.	9		5
Ribes spp.	3.	2.	68.	14		24.	9		5
Rosa acicularis	7.	2.	53.	14		32.	9		5
Salix bebbiana	0.	0.	0.	14		0.	9		5
Salix pulchra	4.	2.	58.	14		46.	9		5
Sorbus scopulina	1.	0.	2.	14		2.	9		5
Spiraea beauverdiana	0.	0.	1.	14		0.	9		5
Viburnum edule	4.	2.	61.	14		63.	9		5
TALL SHRUBS	1.	1.	12.	14	1326	9.	9	952	5
Alnus sinuata	1.	1.	12.	14		9.	9		5
TREES	41.	5.	370.	14	37	458.	9	46	5
Betula papyrifera	40.	5.	323.	14		408.	9		5
Picea glauca	4.	2.	47.	14		51.	9		5
TOTAL VASCULAR	99.	0.	1.	14	1	1.	9	1	5

TABLE 32

Percentage cover for species and categories for reference young birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	100.	0.	0.	3	1				
MOSS	13.	4.	56.	3	61				
Polytrichum	4.	3.	27.	3					
Moss spp.	8.	2.	8.	3					
LICHEN	2.	1.	2.	3	127				
Lichen spp.	2.	1.	2.	3					
LITTER	93.	4.	58.	3	2				
HERBACEOUS	95.	1.	6.	3	1				
NON-FLOWERING	11.	7.	152.	3	219				
Gymnocarpium dryopteris	10.	8.	175.	3					
Equisetum silvaticum	1.	1.	2.	3					
FORBS	72.	11.	352.	3	12				
Aconitum delphinifolium	1.	1.	2.	3					
Cornus canadensis	18.	3.	25.	3					
Epilobium angustifolium	42.	15.	658.	3					
Geranium erianthum	18.	3.	33.	3					
Heracleum lanata	3.	0.	0.	3					
Mertensia paniculata	3.	3.	19.	3					
Pyrola sp.	3.	1.	6.	3					
Rubus arcticus	3.	1.	2.	3					
Sanguisorba stipulata	8.	3.	27.	3					
GRAMINOIDS	47.	6.	108.	3	9				
Calamagrostis canadensis	45.	6.	119.	3					
Festuca altaica	2.	2.	8.	3					
Grass spp.	1.	1.	2.	3					
Carex spp.	2.	1.	2.	3					
WOODY	52.	6.	102.	3	7				
DWARF SHRUBS	1.	1.	2.	3					
Linnaea borealis	1.	1.	2.	3					
LOW SHRUBS	20.	5.	81.	3	35				
Ribes spp.	1.	1.	2.	3					
Rosa acicularis	3.	2.	15.	3					
Salix alaxensis	2.	1.	2.	3					
Salix arbusculoides	1.	1.	2.	3					
Sorbus	6.	3.	33.	3					
Vaccinium uliginosum	2.	2.	8.	3					
Viburnum edule	8.	2.	8.	3					
TREES	43.	3.	25.	3	3				
Betula papyrifera	38.	2.	15.	3					
Populus balsamifera	1.	1.	2.	3					
Picea glauca	8.	5.	81.	3					
TOTAL VASCULAR	100.	0.	0.	3	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. N is total number of observations.

TABLE 33

Relative cover (species composition) of species for disturbed young birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$		Diversity Local	Diversity Total
HERBACEOUS				
NON-FLOWERING				
Athyrium	6.	No. of Species	16	32
Dryopteris dilatata	1.	Simpson	7.1	8.3
Gymnocarpium dryopteris	13.	Shannon Exp	9.2	12.1
Fern spp.	1.			
Equisetum pratense	2.			
Equisetum silvaticum	2.			
FORBS				
Aconitum delphinifolium	0.			
Cornus canadensis	6.			
Epilobium angustifolium	16.			
Geranium erianthum	2.			
Heracleum lanata	1.			
Mertensia paniculata	1.			
Pyrola sp.	0.			
Rubus arcticus	0.			
Rubus spp. (or Aruncus)	0.			
Sanguisorba stipulata	1.			
Streptopus amplexifolius	0.			
Trientalis europaea	0.			
GRAMINOIDS				
Calamagrostis canadensis	19.			
WOODY				
SHRUBS				
Linnaea borealis	0.			
Vaccinium oxycoccus	0.			
Echinopanax horridum	1.			
Ribes spp.	1.			
Rosa acicularis	3.			
Salix bebbiana	0.			
Salix pulchra	2.			
Sorbus sp.	0.			
Spiraea beauverdiana	0.			
Viburnum edule	2.			
TREES				
Alnus sinuata	1.			
Betula papyrifera	17.			
Picea glauca	2.			

TABLE 34

Relative cover (species composition) of species for reference young birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Gymnocarpium dryopteris	4.	No. of Species	26
Equisetum silvaticum	0.	Simpson	8.3
FORBS		Shannon Exp	11.9
Aconitum delphinifolium	0.		
Cornus canadensis	8.		
Epilobium angustifolium	18.		
Geranium erianthum	8.		
Heracleum lanata	1.		
Mertensia paniculata	1.		
Pyrola sp.	1.		
Rubus arcticus	2.		
Sanguisorba stipulata	4.		
GRAMINOIDS			
Calamagrostis canadensis	20.		
Festuca altaica	1.		
Grass spp.	0.		
Carex spp.	1.		
WOODY			
SHRUBS			
Linnaea borealis	0.		
Ribes spp.	0.		
Rosa acicularis	2.		
Salix alaxensis	1.		
Salix arbusculoides	0.		
Sorbus sp.	3.		
Vaccinium uliginosum	1.		
Viburnum edule	4.		
TREES			
Betula papyrifera	17.		
Populus balsamifera	0.		
Picea glauca	3.		

TABLE 35

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed young paper birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 14)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	479.	104.	151044.	14	13	63519.	9	6	5
Betula papyrifera	429.	101.	143736.	14		36852.	9		5
Picea glauca	29.	22.	6813.	14		5185.	9		5
Alnus sinuata	21.	21.	6429.	14		6667.	9		5
Shrub Density (tree species)	3107.	824.	9506867.	14	19	2347221.	9	5	5
Betula papyrifera	2821.	744.	7744505.	14		2629629.	9		5
Picea glauca	161.	93.	121223.	14		64815.	9		5
Alnus sinuata	125.	107.	161058.	14		171296.	9		5
Shrub Density (other species)	2698.	524.	3839349.	14	10	2855741.	9	8	5
Salix bebbiana	107.	107.	160714.	14		166667.	9		5
Salix sp.	36.	24.	8242.	14		4630.	9		5
Rosa acicularis	1286.	329.	1517857.	14		574074.	9		5
Viburnum edule	768.	307.	1321772.	14		1375000.	9		5
Ribes triste	500.	302.	1278846.	14		54398.	9		5
Total basal area	2.	1.	6.	14	18	4.	9	13	5
Betula papyrifera	2.	1.	6.	14		4.	9		5
Picea glauca	0.	0.	0.	14		0.	9		5

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 36

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for reference young paper birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	1267.	353.	373333.	3	5	373333.	2	5	1
Betula papyrifera	967.	296.	263333.	3		263333.	2		1
Picea glauca	300.	58.	10000.	3		10000.	2		1
Shrub Density (other species)	4836.	1446.	6275352.	3	5	6275352.	2	5	1
Salix bebbiana	1167.	441.	583333.	3		583333.	2		1
Rosa acicularis	1333.	441.	583333.	3		583333.	2		1
Viburnum edule	2333.	982.	2895833.	3		2895833.	2		1
Total basal area	6.	5.	76.	3	38	76.	2	38	1
Betula papyrifera	5.	4.	54.	3		54.	2		1
Picea glauca	1.	1.	2.	3		2.	2		1

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 37

Dimensions of dominant woody species for disturbed young birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 28)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	11.2	1.2	42.2	28	57	25.3	23	35	5
Betula papyrifera height (m)	6.7	.5	7.3	28	28	3.7	23	15	5
Betula papyrifera age	27.6	2.5	138.0	22	31	121.7	17	28	5
Picea glauca dbh (cm)	9.5	1.6	19.6	8	37	-49.6	4	-91	5
Picea glauca height (m)	5.6	.5	1.7	8	10	-17.6	4	-94	5
Picea glauca age	22.6	1.5	19.1	8	7	-1610.2	4	-530	5
Alnus sinuata dbh (cm)	9.0	.0	.0	1	1	.0	-1	1	5
Alnus sinuata height (m)	4.0	.0	.0	1	1	.0	-1	1	5
Alnus sinuata age	20.0	.0	.0	1	1	.0	-1	1	5
Betula papyrifera basal d (cm)	6.1	2.1	86.0	20	389	82.4	15	373	5
Betula papyrifera ht (cm)	219.8	23.6	14514.1	26	51	11884.9	21	42	5
Betula papyrifera length (cm)	74.1	9.5	1275.1	14	40	873.2	10	27	5
Betula papyrifera width (cm)	56.8	7.3	738.8	14	39	514.0	10	27	5
Betula papyrifera age	10.8	.9	16.3	19	24	4.9	14	8	5
Salix bebbiana basal diam (cm)	1.0	.0	.0	1	1	.0	0	1	5
Salix bebbiana height (cm)	90.0	.0	.0	1	1	.0	0	1	5
Salix bebbiana length (cm)	40.0	.0	.0	1	1	.0	0	1	5
Salix bebbiana width (cm)	40.0	.0	.0	1	1	.0	0	1	5
Salix bebbiana age	2.0	.0	.0	1	1	.0	0	1	5
Salix sp. basal diam (cm)	11.9	8.7	302.7	4	360	453.3	2	539	5
Salix sp. ht (cm)	137.5	23.9	2291.7	4	21	-2205.2	2	-18	5
Salix sp. len (cm)	67.0	33.0	3267.0	3	123	3200.7	1	121	5
Salix sp. wid (cm)	83.3	16.7	833.3	3	21	301.3	1	8	5
Salix sp. age	9.3	1.7	11.6	4	23	-24.9	2	-48	5
Rosa acicularis basal diam (cm)	.7	.1	.1	6	20	-9.4	1	-3247	5
Rosa acicularis height (cm)	71.8	5.4	490.7	17	17	-2065.7	12	-66	5
Rosa acicularis length (cm)	37.5	2.6	117.1	17	15	-460.8	12	-54	5
Rosa acicularis width (cm)	26.1	2.3	89.1	17	23	-187.7	12	-45	5
Rosa acicularis age	4.0	.0	.0	1	1	.0	-1	1	5
Viburnum edule basal diam (cm)	1.5	.3	.2	2	14	.0	-3	1	5
Viburnum edule height (cm)	94.2	17.8	1900.6	6	37	-82252.5	1	-1566	5
Viburnum edule length (cm)	34.8	4.2	104.6	6	15	-30731.5	1	-4279	5
Viburnum edule width (cm)	19.2	4.3	110.6	6	51	-13253.0	1	-6095	5
Viburnum edule age	4.0	.0	.0	1	1	.0	-1	1	5

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 38

Dimensions of dominant woody species for reference young birch vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 6)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	14.8	5.2	161.8	6	126	161.8	5	126	1
Betula papyrifera height (m)	11.0	2.6	40.9	6	58	40.9	5	58	1
Betula papyrifera age	39.0	6.5	254.0	6	29	254.0	5	29	1
Picea glauca dbh (cm)	10.7	3.8	87.4	6	130	87.4	5	130	1
Picea glauca height (m)	7.9	2.6	40.4	6	111	40.4	5	111	1
Picea glauca age	27.6	6.6	217.3	5	49	217.3	4	49	1
Betula papyrifera basal d (cm)	2.9	.3	.5	6	10	.5	5	10	1
Betula papyrifera ht (cm)	133.3	10.5	666.7	6	7	666.7	5	7	1
Betula papyrifera length (cm	93.0	7.7	355.2	6	7	355.2	5	7	1
Betula papyrifera width (cm)	74.5	9.2	505.5	6	16	505.5	5	16	1
Betula papyrifera age	16.2	3.6	64.7	5	42	64.7	4	42	1
S. bebbiana basal diam (cm)	1.1	.1	.1	6	20	.1	5	20	1
S. bebbiana ht (cm)	92.8	9.2	505.8	6	10	505.8	5	10	1
S. bebbiana len (cm)	58.7	8.4	423.1	6	21	423.1	5	21	1
S. bebbiana wid (cm)	42.0	5.5	181.2	6	18	181.2	5	18	1
S. bebbiana age	5.8	.8	3.8	6	19	3.8	5	19	1
Rosa acicularis basal diam (cm)	.7	.1	.0	6	12	.0	5	12	1
Rosa acicularis height (cm)	41.8	1.2	9.4	6	1	9.4	5	1	1
Rosa acicularis length (cm)	30.5	2.8	47.1	6	9	47.1	5	9	1
Rosa acicularis width (cm)	22.7	1.9	21.1	6	7	21.1	5	7	1
Viburnum edule basal diam (cm)	.7	.1	.0	6	11	.0	5	11	1
Viburnum edule height (cm)	57.2	5.7	191.8	6	10	191.8	5	10	1
Viburnum edule length (cm)	22.8	2.2	30.2	6	10	30.2	5	10	1
Viburnum edule width (cm)	17.3	1.7	17.5	6	10	17.5	5	10	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 39

Browse parameters for disturbed open deciduous forest habitat type (young birch), summer 1988, Wishbone Hill.

	Twig Length (cm) Mean	StdErr	N	NHAT	Weight/twig (mg) Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	46.0	4.4	15	3	1725.1	493.3	15	23
Lateral	16.4	2.1	14	5	253.5	59.2	14	15
All	31.7	0.7	29	8	104.7	288.1	29	44
Salix bebbiana								
Terminal	64.2	6.6	10	2	3420.7	655.9	10	7
Lateral	16.1	2.8	8	5	203.7	64.0	8	15
All	42.8	6.9	18	9	1990.9	526.9	18	24
Viburnum edule								
Terminal	31.3	5.0	5	3	1839.7	631.0	5	11
Lateral	8.1	1.1	4	2	172.3	47.1	4	6
All	21.0	4.9	9	9	1098.6	443.6	9	28
Rosa acicularis								
Terminal	19.0	2.8	9	4	530.1	128.9	9	10
Lateral	7.9	1.5	9	6	116.3	29.9	9	11
All	13.4	2.0	18	8	323.2	81.5	18	22

	Twig count/shrub Mean	StdErr	N	NHAT	Calc Wt/ Shrub Mean	Clipped Wt/ Shrub (g) Mean	StdErr	N	NHAT	Estimated Browse/Area (kg/ha) Calc	Clip
Betula papyrifera											
Terminal	37	10	7	11	63.83						
Lateral	153	34	7	7	38.79						
All	190	33	7	4	102.61	113.9	22.3	7	5	28.83	32.01
Salix bebbiana											
Terminal	30	24	3	35	102.62						
Lateral	121	84	3	28	24.65						
All	151	108	3	29	127.27	121.4	59.8	4	18	13.62	12.99
Viburnum edule											
Terminal	4	2	2	10	7.36						
Lateral	6	0	2	1	1.03						
All	10	2	2	2	8.39	29.7	0.0	2	1	6.45	22.81
Rosa acicularis											
Terminal	5	2	5	18	2.65						
Lateral	10	3	5	9	1.16						
All	15	5	5	11	3.81	19.3	5.7	5	9	4.90	24.82

TABLE 40

Browse parameters for reference open deciduous forest habitat type (young birch), summer 1988, Wishbone Hill.

	Length (cm)				Est Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	32.7	2.9	11	2	735.9	137.6	11	8
Lateral	21.2	4.3	11	9	405.4	145.4	11	27
All	27.0	2.8	22	5	570.7	104.1	22	14
Salix bebbiana								
Terminal	36.8	3.9	14	3	1158.0	206.1	14	9
Lateral	28.6	6.9	14	16	1074.6	421.6	14	40
All	32.7	4.0	28	13	1116.3	230.4	28	23
Viburnum edule								
Terminal	18.0	4.1	10	10	930.7	378.6	10	31
Lateral	9.7	2.1	10	9	262.7	122.8	10	41
All	13.8	2.4	20	12	596.7	208.3	20	46
Rosa acicularis								
Terminal	6.5	3.5	2	11	52.2	43.6	2	26
Lateral	2.3	0.3	2	1	4.9	1.1	2	2
All	4.4	1.9	4	14	28.6	22.4	4	46

	Twig count/shrub				Calc Wt/Shrub (g)	Estimated Browse/Area (kg/ha)
	Mean	StdErr	N	NHAT	Mean	Calc
Betula papyrifera						
Terminal	29	9	5	10	21.34	
Lateral	23	6	5	11	9.32	
All	52	15	5	9	30.67	0.00
Salix bebbiana						
Terminal	17	4	7	7	19.69	
Lateral	33	6	6	4	35.46	
All	45	10	7	7	55.15	64.36
Viburnum edule						
Terminal	4	1	5	7	3.72	
Lateral	3	1	5	7	0.79	
All	7	1	5	4	4.51	10.52
Rosa acicularis						
Terminal	2	0	1	1	0.10	
Lateral	0	0	0	0	0.00	
All	2	0	1	1	0.10	0.14

TABLE 41

Percentage cover for species and categories for disturbed closed poplar / alder - willow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 2)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	99.	1.	3.	2	1				
MOSS	3.	3.	13.	2	338				
Polytrichum	1.	1.	3.	2					
Moss spp.	1.	1.	3.	2					
LITTER	96.	4.	28.	2	1				
HERBACEOUS	40.	30.	1800.	2	191				
NON-FLOWERING	23.	20.	800.	2	268				
Equisetum silvaticum	23.	20.	800.	2					
FORBS	14.	11.	253.	2	227				
Epilobium angustifolium	13.	10.	200.	2					
Aruncus	1.	1.	3.	2					
GRAMINOIDS	13.	8.	113.	2	122				
Calamagrostis canadensis	13.	8.	113.	2					
WOODY	99.	1.	3.	2	1				
LOW SHRUBS	35.	10.	200.	2	28				
Rosa acicularis	4.	4.	28.	2					
Salix alaxensis	33.	8.	113.	2					
Salix bebbiana	1.	1.	3.	2					
Salix scouleriana	1.	1.	3.	2					
TALL SHRUBS	46.	9.	153.	2	13				
Alnus sinuata	46.	9.	153.	2					
TREES	68.	0.	0.	2	1				
Betula papyrifera	13.	10.	200.	2					
Populus balsamifera	64.	4.	28.	2					
TOTAL VASCULAR	100.	0.	0.	2	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 42

Relative cover (species composition) of species for disturbed closed poplar / alder - willow vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Equisetum silvaticum	11.	No. of Species	11
Epilobium angustifolium	6.	Simpson	5.4
		Shannon Exp	6.6
FORBS			
Aruncus	1.		
GRAMINOIDS			
Calamagrostis canadensis	6.		
WOODY			
SHRUBS			
Rosa acicularis	2.		
Salix alaxensis	16.		
Salix bebbiana	1.		
Salix scouleriana	1.		
TREES			
Alnus sinuata	22.		
Betula papyrifera	6.		
Populus balsamifera	3.		

TABLE 43

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed closed poplar / alder - willow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 2)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	2700.	700.	980000.	2	3				
Betula papyrifera	200.	100.	20000.	2					
Populus balsamifera	2450.	850.	1445000.	2					
Picea glauca	50.	50.	5000.	2					
Shrub Density (tree species)	2250.	750.	1125000.	2	5				
Alnus sinuata	2250.	750.	1125000.	2					
Shrub Density (other species)	1251.	1.	2.	2	1				
Salix scouleriana	875.	375.	281250.	2					
Rosa acicularis	375.	375.	281250.	2					
Total basal area	2.	2.	11.	2	37				
Populus balsamifera	2.	2.	11.	2					

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 44

Dimensions of dominant woody species for closed poplar / alder - willow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 4)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	5.0	1.0	2.0	2	14	2.0	1	14	1
Betula papyrifera height (m)	8.0	.0	.0	2	1	.0	1	1	1
Betula papyrifera age	16.5	1.5	4.5	2	3	4.5	1	3	1
Populus balsamifera dbh (cm)	8.8	1.5	8.6	4	19	8.6	3	19	1
Populus balsamifera ht (m)	9.5	2.1	17.7	4	34	17.7	3	34	1
Populus balsamifera age	22.0	2.0	16.7	4	6	16.7	3	6	1
Picea glauca dbh (cm)	1.5	.0	.0	1	1	.0	0	1	1
Picea glauca height (m)	93.0	.0	.0	1	1	.0	0	1	1
Picea glauca age	11.0	.0	.0	1	1	.0	0	1	1
Salix scouleriana dbh (cm)	9.8	1.7	9.1	3	16	9.1	2	16	1
Salix scouleriana height (m)	7.0	2.7	21.8	3	76	21.8	2	76	1
Salix scouleriana age	14.0	3.1	28.0	3	25	28.0	2	25	1
Alnus sinuata dbh (cm)	5.7	1.1	4.8	4	26	4.8	3	26	1
Alnus sinuata height (m)	4.6	1.2	6.2	4	50	6.2	3	50	1
Alnus sinuata age	16.8	1.8	12.3	4	8	12.3	3	8	1
Betula papyrifera basal d (cm)	1.7	.4	.4	3	22	.4	2	22	1
Betula papyrifera ht (cm)	166.7	33.3	3333.3	3	21	3333.3	2	21	1
Betula papyrifera length (cm	38.3	6.7	134.3	3	16	134.3	2	16	1
Betula papyrifera width (cm)	33.7	4.1	50.3	3	8	50.3	2	8	1
Betula papyrifera age	13.5	1.5	4.5	2	5	4.5	1	5	1
Rosa acicularis basal diam (cm)	1.2	.0	.0	1	1	.0	0	1	1
Rosa acicularis height (cm)	100.0	.0	.0	1	1	.0	0	1	1
Rosa acicularis length (cm)	56.0	.0	.0	1	1	.0	0	1	1
Rosa acicularis width (cm)	47.0	.0	.0	1	1	.0	0	1	1

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 45

Percentage cover for species and categories for disturbed closed alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 4)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	83.	6.	139.	4	4	170.	2	5	2
MOSS	6.	3.	35.	4	154	41.	2	176	2
Polytrichum	1.	1.	6.	4		6.	2		2
Moss spp.	5.	3.	46.	4		41.	2		2
LICHEN	1.	1.	2.	4	676	2.	2	676	2
Stereocaulon	1.	1.	2.	4		2.	2		2
LITTER	77.	8.	256.	4	8	289.	2	9	2
HERBACEOUS	24.	8.	247.	4	71	352.	2	100	2
NON-FLOWERING	3.	2.	13.	4	338	6.	2	169	2
Dryopteris dilatata	1.	1.	2.	4		2.	2		2
Gymnocarpium dryopteris	1.	1.	2.	4		2.	2		2
Equisetum pratense	1.	1.	6.	4		6.	2		2
FORBS	13.	6.	129.	4	140	181.	2	197	2
Achillea	1.	1.	2.	4		2.	2		2
Artemisia tilesii	4.	2.	23.	4		6.	2		2
Epilobium angustifolium	6.	5.	119.	4		128.	2		2
Epilobium latifolium	1.	1.	2.	4		2.	2		2
Mertensia paniculata	1.	1.	2.	4		2.	2		2
Trifolium spp.	1.	1.	2.	4		2.	2		2
GRAMINOIDS	12.	4.	72.	4	87	70.	2	85	2
Calamagrostis canadensis	11.	4.	69.	4		53.	2		2
Grass spp.	1.	1.	2.	4		2.	2		2
WOODY	93.	2.	13.	4	1	6.	2	1	2
DWARF SHRUBS	6.	4.	69.	4	298	25.	2	109	2
Andromeda	6.	4.	69.	4		25.	2		2
LOW SHRUBS	7.	4.	72.	4	259	14.	2	51	2
Salix scouleriana	7.	4.	72.	4		14.	2		2
TALL SHRUBS	86.	4.	69.	4	2	25.	2	1	2
Alnus sinuata	86.	4.	69.	4		25.	2		2
TREES	4.	4.	52.	4	456	39.	2	345	2
Betula papyrifera	1.	1.	2.	4		2.	2		2
Populus balsamifera	4.	3.	35.	4		25.	2		2
TOTAL VASCULAR	96.	1.	2.	4	1	3.	2	1	2
ROCK	1.	1.	2.	4		2.	2		2

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 46

Relative cover (species composition) of species for disturbed closed alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$		Diversity Local	Diversity Total
HERBACEOUS				
NON-FLOWERING				
Dryopteris dilatata	1.	No. of Species	10	16
Gymnocarpium dryopteris	1.	Simpson	2.2	2.2
Equisetum pratense	1.	Shannon Exp	3.4	4.0
FORBS				
Achillea	1.			
Artemisia tilesii	3.			
Epilobium angustifolium	5.			
Epilobium latifolium	1.			
Mertensia paniculata	1.			
Trifolium (clover)	1.			
GRAMINOIDS				
Calamagrostis canadensis	9.			
Grass	1.			
WOODY				
SHRUBS				
Andromeda polifolia	5.			
Salix scouleriana	5.			
TREES				
Alnus sinuata	66.			
Betula papyrifera	1.			
Populus balsamifera	3.			

TABLE 47

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed closed alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 4)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	150.	119.	56667.	4	47	40000.	2	33	2
Populus balsamifera	150.	119.	56667.	4		40000.	2		2
Shrub Density (tree species)	6438.	1605.	10307290.	4	5	5890624.	2	3	2
Alnus sinuata	6438.	1605.	10307290.	4		5890624.	2		2
Shrub Density (other species)	1625.	938.	3520833.	4	25	781250.	2	6	2
Salix alaxensis	1313.	886.	3140625.	4		1265625.	2		2
Rosa acicularis	250.	177.	125000.	4		62500.	2		2
Viburnum edule	63.	63.	15625.	4		15625.	2		2

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 48

Dimensions of dominant woody species for disturbed closed tall alder vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 8)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Populus balsamifera dbh (cm)	7.7	1.2	4.1	3	12	-1732.3	1	-4979	2
Populus balsamifera ht (m)	9.0	1.2	4.0	3	9	-136.0	1	-282	2
Populus balsamifera age	13.5	3.5	24.5	2	23	.0	0	1	2
Alnus sinuata dbh (cm)	4.3	.7	3.2	7	29	2.9	5	27	2
Alnus sinuata height (m)	3.9	.4	1.0	7	11	.3	5	4	2
Alnus sinuata age	14.1	1.5	16.5	7	14	19.5	5	17	2
Alnus sinuata basal diam (cm)	2.2	.0	.0	1	1	.0	-1	1	2
Alnus sinuata height (cm)	3.0	.0	.0	1	1	.0	-1	1	2
Alnus sinuata length (cm)	106.0	.0	.0	1	1	.0	-1	1	2
Alnus sinuata width (cm)	80.0	.0	.0	1	1	.0	-1	1	2
Alnus sinuata age	19.0	.0	.0	1	1	.0	-1	1	2
Rosa acicularis basal diam (cm)	.6	.1	.0	4	10	-.3	2	-125	2
Rosa acicularis height (cm)	89.0	7.2	206.7	4	5	-1743.5	2	-36	2
Rosa acicularis length (cm)	51.5	6.5	169.7	4	11	-539.0	2	-33	2
Rosa acicularis width (cm)	39.0	5.9	139.3	4	16	-9959.2	2	-1105	2
Viburnum edule basal diam (cm)	.3	.0	.0	1	1	.0	-1	1	2
Viburnum edule height (cm)	26.0	.0	.0	1	1	.0	-1	1	2
Viburnum edule length (cm)	30.0	.0	.0	1	1	.0	-1	1	2
Viburnum edule width (cm)	28.0	.0	.0	1	1	.0	-1	1	2
Salix alaxensis basal diam (cm)	3.1	1.0	4.4	4	79	4.4	3	79	2
Salix alaxensis height (cm)	375.0	131.5	69166.7	4	84	69166.7	3	84	2
Salix alaxensis age	11.0	.6	1.3	4	2	1.3	3	2	2
Populus balsamifera bsl d(cm)	2.5	.0	.0	1	1	.0	0	1	2
Populus balsamifera ht (m)	100.0	.0	.0	1	1	.0	0	1	2
Populus balsamifera len (cm)	25.0	.0	.0	1	1	.0	0	1	2
Populus balsamifera wid (cm)	20.0	.0	.0	1	1	.0	0	1	2
Populus balsamifera age	8.0	.0	.0	1	1	.0	0	1	2

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 49

Percentage cover for species and categories for wet low shrub vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	99.	1.	2.	3	1				
MOSS	99.	1.	2.	3	1				
Sphagnum	98.	0.	0.	3					
Moss spp.	2.	1.	2.	3					
HERBACEOUS	52.	10.	277.	3	18				
NON-FLOWERING	7.	2.	8.	3	32				
Equisetum fluviatile	7.	2.	8.	3					
FORBS	4.	2.	8.	3	82				
Rubus arcticus	3.	1.	6.	3					
Rubus chamaemorus	2.	1.	2.	3					
GRAMINOIDS	43.	9.	244.	3	23				
Carex spp.	17.	4.	52.	3					
Eriophorum spp.	18.	8.	194.	3					
Trichophorum spp.	8.	6.	102.	3					
WOODY	51.	12.	402.	3	27				
DWARF SHRUBS	33.	8.	175.	3	28				
Vaccinium oxycoccus	23.	7.	152.	3					
Vaccinium vitis-idaea	9.	2.	15.	3					
LOW SHRUBS	23.	10.	325.	3	109				
Betula glandulosa	6.	4.	40.	3					
Ledum palustre	11.	4.	52.	3					
Salix fuscescens	4.	2.	15.	3					
Salix pulchra	2.	1.	2.	3					
Salix spp.	1.	1.	2.	3					
Spiraea beauverdiana	1.	1.	2.	3					
Vaccinium uliginosum	2.	2.	8.	3					
TREES	3.	3.	19.	3	507				
Picea glauca	3.	3.	19.	3					
TOTAL VASCULAR	92.	3.	27.	3	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 50

Relative cover (species composition) of species for disturbed wet low shrub vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Equisetum fluviatile	6.	No. of Species	16
FORBS		Simpson	8.6
Aruncus sylvester	2.	Shannon Exp	10.7
Rubus chamaemrus	2.		
GRAMINOIDS			
Carex sp.	15.		
Eriophorum sp.	15.		
Trichophorum sp.	7.		
WOODY			
SHRUBS			
Vaccinium oxycoccus	20.		
Vaccinium vitis-idaea	8.		
Betula glandulosa	5.		
Ledum groenlandicum	10.		
Salix fuscescens	4.		
Salix pulchra	2.		
Salix spp.	1.		
Spiraea beauverdiana	1.		
TREES			
Vaccinium uliginosum	2.		
Picea glauca	2.		

TABLE 51

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed wet low shrub vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Shrub Density (tree species)	167.	167.	83333.	3	56				
Picea glauca	167.	167.	83333.	3					
Shrub Density (other species)	9000.	5875.	103562500.	3	24				
Salix fuscescens	333.	220.	145833.	3					
Betula glandulosa	8667.	5918.	105083300.	3					

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 52

Dimensions of dominant woody species for disturbed wet low shrub vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 6)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Picea glauca dbh (cm)	11.0	.0	.0	1	1	.0	0	1	1
Picea glauca height (m)	7.0	.0	.0	1	1	.0	0	1	1
Picea glauca age	35.0	.0	.0	1	1	.0	0	1	1
S. fuscescens basal diam (cm)	1.0	.6	1.6	4	274	1.6	3	274	1
S. fuscescens height (cm)	95.0	24.7	2433.3	4	46	2433.3	3	46	1
S. fuscescens length (cm)	31.3	6.3	156.9	4	28	156.9	3	28	1
S. fuscescens width (cm)	23.0	8.6	294.7	4	95	294.7	3	95	1
S. fuscescens age	12.5	2.5	12.5	2	14	12.5	1	14	1
Betula glandulosa basal d (cm)	.7	.2	.1	2	28	.1	1	28	1
Betula glandulosa ht (cm)	27.8	6.7	271.0	6	60	271.0	5	60	1
Betula glandulosa length (cm	30.5	10.0	602.7	6	110	602.7	5	110	1
Betula glandulosa width (cm)	16.5	7.3	321.1	6	200	321.1	5	200	1
Betula glandulosa age	5.0	1.0	2.0	2	14	2.0	1	14	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 53

Percentage cover for species and categories for disturbed lowland meadows vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 12)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	97.	1.	11.	12	1	6.	8	1	4
MOSS	12.	6.	397.	12	445	430.	8	481	4
Polytrichum	2.	1.	15.	12		10.	8		4
Hypnum	1.	1.	6.	12		4.	8		4
Dicranum	0.	0.	1.	12		1.	8		4
Moss spp.	9.	5.	309.	12		370.	8		4
LICHEN	8.	2.	70.	12	199	29.	8	84	4
Nephroma	4.	2.	63.	12		40.	8		4
Peltigera	2.	1.	24.	12		20.	8		4
Lichen spp.	2.	1.	19.	12		20.	8		4
LITTER	91.	4.	233.	12	5	219.	8	5	4
HERBACEOUS	89.	3.	76.	12	2	47.	8	2	4
NON-FLOWERING	2.	1.	20.	12	790	21.	8	822	4
Dryopteris dilatata	1.	1.	19.	12		21.	8		4
Equisetum pratense	1.	1.	4.	12		0.	8		4
FORBS	65.	6.	433.	12	18	269.	8	11	4
Achillea borealis	0.	0.	2.	12		2.	8		4
Aconitum delphinifolium	4.	3.	131.	12		88.	8		4
Caltha sp.	0.	0.	1.	12		1.	8		4
Cornus canadensis	8.	3.	108.	12		117.	8		4
Epilobium angustifolium	26.	6.	474.	12		569.	8		4
Geranium erianthum	8.	3.	121.	12		89.	8		4
Geum macrophyllum	0.	0.	1.	12		1.	8		4
Heracleum lanata	8.	4.	238.	12		9.	8		4
Mertensia paniculata	7.	1.	16.	12		16.	8		4
Polemonium acutiflorum	1.	0.	3.	12		2.	8		4
Potentilla palustris	1.	1.	5.	12		2.	8		4
Pyrola sp.	1.	1.	8.	12		9.	8		4
Rubus arcticus	6.	2.	42.	12		14.	8		4
Aruncus sylvester	0.	0.	2.	12		2.	8		4
Sanguisorba stipulata	11.	3.	95.	12		77.	8		4
Taraxacum sp.	2.	1.	15.	12		10.	8		4
Thalictrum sparsiflorum	1.	0.	1.	12		1.	8		4
Urtica sp.	7.	5.	298.	12		77.	8		4
GRAMINOIDS	52.	7.	531.	12	34	501.	8	32	4
Calamagrostis canadensis	39.	7.	644.	12		445.	8		4
Festuca altaica	14.	6.	376.	12		149.	8		4
Phleum alpinum	1.	0.	2.	12		3.	8		4
Carex spp.	2.	2.	31.	12		27.	8		4

TABLE 53 CONTINUED

CATEGORY (N = 12)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
WOODY	18.	4.	185.	12	103	176.	8	98	4
DWARF SHRUBS	0.	0.	1.	12		1.	8		4
Linnaea borealis	0.	0.	1.	12		1.	8		4
LOW SHRUBS	9.	3.	79.	12	152	41.	8	80	4
Echinopanax horridum	0.	0.	1.	12		1.	8		4
Ledum groenlandicum	2.	1.	26.	12		26.	8		4
Rosa acicularis	1.	0.	2.	12		1.	8		4
Salix novae-angliae	0.	0.	2.	12		2.	8		4
Salix pulchra	0.	0.	1.	12		1.	8		4
Sorbus scopulina	3.	2.	44.	12		45.	8		4
Vaccinium uliginosum	1.	1.	5.	12		4.	8		4
Viburnum edule	1.	1.	4.	12		5.	8		4
TREES	9.	4.	188.	12	436	133.	8	308	4
Betula papyrifera	1.	0.	1.	12		1.	8		4
Populus tremuloides	2.	1.	15.	12		13.	8		4
Picea glauca	6.	4.	161.	12		94.	8		4
TOTAL VASCULAR	96.	1.	23.	12	1	2.	8	1	4

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 54

Percentage cover for species and categories for reference lowland meadows vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	97.	2.	15.	3	1				
MOSS	11.	3.	27.	3	39				
Polytrichum	1.	1.	2.	3					
Moss spp.	10.	3.	25.	3					
LICHEN	1.	1.	2.	3	507				
Lichen spp.	1.	1.	2.	3					
LITTER	90.	1.	6.	3	1				
HERBACEOUS	90.	3.	19.	3	1				
NON-FLOWERING	3.	1.	6.	3	169				
Gymnocarpium dryopteris	1.	1.	2.	3					
Equisetum pratense	1.	1.	2.	3					
Equisetum silvaticum	1.	1.	2.	3					
FORBS	85.	3.	25.	3	1				
Aconitum delphinifolium	2.	1.	2.	3					
Cornus canadensis	10.	4.	44.	3					
Epilobium angustifolium	38.	4.	58.	3					
Geranium erianthum	25.	4.	44.	3					
Heracleum lanata	2.	2.	8.	3					
Mertensia paniculata	17.	7.	133.	3					
Polemonium acutiflorum	3.	1.	2.	3					
Pyrola sp.	1.	1.	2.	3					
Rubus arcticus	18.	4.	40.	3					
Sanguisorba stipulata	18.	1.	2.	3					
Taraxacum	2.	1.	2.	3					
Thalictrum	1.	1.	2.	3					
GRAMINOIDS	28.	8.	194.	3	44				
Calamagrostis canadensis	21.	3.	27.	3					
Festuca altaica	4.	3.	27.	3					
Carex spp.	3.	3.	19.	3					
Luzula sp.	1.	1.	2.	3					
WOODY	31.	8.	190.	3	34				
LOW SHRUBS	18.	7.	131.	3	73				
Rosa acicularis	12.	3.	33.	3					
Spiraea beauverdiana	1.	1.	2.	3					
Vaccinium uliginosum	3.	3.	19.	3					
Viburnum edule	3.	3.	19.	3					
TREES	15.	9.	244.	3	184				
Betula papyrifera	3.	3.	19.	3					
Populus tremuloides	2.	2.	8.	3					
Picea glauca	12.	9.	252.	3					
TOTAL VASCULAR	97.	1.	2.	3	1				

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. N is total number of observations.

TABLE 55

Relative cover (species composition) of species for disturbed lowland meadows vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$		Diversity Local	Diversity Total
HERBACEOUS				
NON-FLOWERING				
Dryopteris dilatata	1.	No. of Species	17	36
Equisetum pratense	1.	Simpson	7.2	9.5
FORBS		Shannon Exp	9.8	15.4
Achillea borealis	0.			
Aconitum delphinifolium	2.			
Caltha sp.	0.			
Cornus canadensis	5.			
Epilobium angustifolium	16.			
Geranium erianthum	5.			
Geum macrophyllum	0.			
Heracleum lanata	5.			
Mertensia paniculata	4.			
Polemonium acutiflorum	1.			
Potentilla palustris	1.			
Pyrola sp.	1.			
Rubus arcticus	3.			
Aruncus sylvester	0.			
Sanguisorba stipulata	7.			
Taraxacum sp.	1.			
Thalictrum sparsiflorum	0.			
Urtica sp.	4.			
GRAMINOIDS				
Calamagrostis canadensis	23.			
Festuca altaica	9.			
Phleum alpinum	0.			
Carex sp.	1.			
WOODY				
SHRUBS				
Echinopanax horridum	0.			
Ledum palustre	1.			
Linnaea borealis	0.			
Rosa acicularis	1.			
Salix novae-angliae	0.			
Salix pulchra	0.			
Sorbus scopulina	2.			
Vaccinium uliginosum	1.			
Viburnum edule	1.			
TREES				
Betula papyrifera	0.			
Populus tremuloides	1.			
Picea glauca	4.			

TABLE 56

Relative cover (species composition) of species for reference lowland meadows vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$	Diversity Local	
HERBACEOUS			
NON-FLOWERING			
Gymnocarpium dryopteris	0.	No. of Species	26
Equisetum pratense	0.	Simpson	10.3
Equisetum silvaticum	0.	Shannon Exp	13.7
FORBS			
Aconitum delphinifolium	1.		
Cornus canadensis	5.		
Epilobium angustifolium	19.		
Geranium erianthum	13.		
Heracleum lanata	1.		
Mertensia paniculata	8.		
Polemonium acutiflorum	2.		
Pyrola sp.	0.		
Rubus arcticus	9.		
Sanguisorba stipulata	9.		
Taraxacum	1.		
Thalictrum	0.		
GRAMINOIDS			
Calamagrostis canadensis	10.		
Festuca altaica	2.		
Carex spp.	1.		
Luzula spp.	0.		
WOODY			
SHRUBS			
Rosa acicularis	6.		
Spiraea beauverdiana	0.		
Vaccinium uliginosum	1.		
Viburnum edule	1.		
TREES			
Betula papyrifera	1.		
Populus tremuloides	1.		
Picea glauca	6.		

TABLE 57

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed lowland meadow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 12)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	292.	89.	95379.	12	21	55000.	8	12	4
Betula papyrifera	58.	29.	9924.	12		3438.	8		4
Picea glauca	233.	74.	66061.	12		54063.	8		4
Shrub Density (tree species)	2063.	576.	3978693.	12	18	2050781.	8	9	4
Betula papyrifera	583.	214.	549242.	12		103516.	8		4
Populus tremuloides	1000.	573.	3943182.	12		2781250.	8		4
Populus balsamifera	21.	21.	5208.	12		5859.	8		4
Picea glauca	458.	204.	498106.	12		464844.	8		4
Shrub Density (other species)	2834.	602.	4344939.	12	11	3376906.	8	8	4
Salix bebbiana	1000.	425.	2170455.	12		1109375.	8		4
Salix novae-angliae	292.	199.	475379.	12		460938.	8		4
Salix sp.	292.	147.	259470.	12		101563.	8		4
Rosa acicularis	542.	298.	1066288.	12		939453.	8		4
Viburnum edule	708.	447.	2395833.	12		2855469.	8		4
Total basal area	0.	0.	1.	12	101	1.	8	105	4
Betula papyrifera	0.	0.	0.	12		0.	8		4
Populus tremuloides	0.	0.	0.	12		0.	8		4

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 58

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for reference lowland meadow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 3)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	533.	333.	333333.	3	22	333333.	2	22	1
Betula papyrifera	233.	186.	103333.	3		103333.	2		1
Picea glauca	300.	153.	70000.	3		70000.	2		1
Shrub Density (other species)	3585.	584.	1023169.	3	2	1023169.	2	2	1
Salix bebbiana	333.	83.	20833.	3		20833.	2		1
Rosa acicularis	2083.	167.	83333.	3		83333.	2		1
Viburnum edule	1167.	726.	1583333.	3		1583333.	2		1
Total basal area	2.	1.	4.	3	14	4.	2	14	1
Betula papyrifera	1.	1.	2.	3		2.	2		1
Picea glauca	2.	1.	3.	3		3.	2		1

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 59

Dimensions of dominant woody species for disturbed lowland meadow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 24)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	14.1	4.1	136.8	8	116	-1046.4	4	-885	4
Betula papyrifera height (m)	6.4	2.7	58.7	8	244	-114.1	4	-471	4
Betula papyrifera age	20.4	5.3	227.7	8	93	-7145.8	4	-2907	4
Populus tremuloides dbh (cm)	29.3	3.5	36.6	3	8	.0	-1	1	4
Populus tremuloides ht (m)	25.7	15.2	694.3	3	179	.0	-1	1	4
Populus tremuloides age	55.3	18.7	1045.3	3	58	.0	-1	1	4
Picea glauca dbh (cm)	11.7	1.4	35.6	19	44	-114.0	15	-139	4
Picea glauca height (m)	7.5	1.1	23.0	19	70	-58.8	15	-177	4
Picea glauca age	25.3	2.0	69.3	18	19	-3632.6	14	-955	4
Betula papyrifera basal d (cm)	8.8	.0	.0	1	1	.0	-3	1	4
Betula papyrifera ht (cm)	122.4	12.2	1043.1	7	12	-41858.4	3	-471	4
Betula papyrifera length (cm	68.3	10.3	740.6	7	27	-16469.9	3	-595	4
Betula papyrifera width (cm)	50.7	6.4	284.6	7	19	-10732.8	3	-704	4
Betula papyrifera age	16.4	3.8	102.9	7	65	-82.1	3	-50	4
Salix bebbiana basal diam (cm)	3.0	1.0	18.6	20	352	6.9	17	130	4
Salix bebbiana height (cm)	103.3	7.3	1069.2	20	17	1060.7	17	17	4
Salix bebbiana length (cm)	97.1	7.9	1247.0	20	23	1122.9	17	21	4
Salix bebbiana width (cm)	78.9	6.7	894.4	20	25	780.5	17	22	4
Salix bebbiana age	9.1	1.0	14.1	15	29	15.1	12	31	4
Salix sp. basal diameter (cm)	2.8	.0	.0	1	1	.0	0	1	4
Salix sp. height (cm)	100.0	.0	.0	1	1	.0	0	1	4
Salix sp. length (cm)	109.0	.0	.0	1	1	.0	0	1	4
Salix sp. width (cm)	55.0	.0	.0	1	1	.0	0	1	4
Rosa acicularis basal diam (cm)	3.0	.5	.8	3	15	.0	-1	1	4
Rosa acicularis height (cm)	41.4	6.1	371.2	10	37	-4905.7	6	-482	4
Rosa acicularis length (cm)	37.0	6.7	452.1	10	56	-1521.7	6	-186	4
Rosa acicularis width (cm)	23.0	3.2	104.2	10	34	-1131.1	6	-360	4
Viburnum edule basal diam (cm)	.6	.2	.1	2	38	.0	-2	1	4
Viburnum edule height (cm)	30.0	4.8	116.5	5	22	-31527.3	1	-5919	4
Viburnum edule length (cm)	18.0	1.3	8.0	5	5	-11537.0	1	-6016	4
Viburnum edule width (cm)	11.2	2.0	19.2	5	26	-5686.0	1	-7659	4
Salix novae-angliae bsl d(cm)	27.2	21.1	1336.0	3	306	1676.2	1	384	4
Salix novae-angliae ht (m)	79.0	6.1	112.0	3	4	200.0	1	6	4
Salix novae-angliae len (cm)	68.7	5.8	100.3	3	4	180.5	1	7	4
Salix novae-angliae wid (cm)	50.0	4.5	61.0	3	5	84.5	1	6	4
Salix novae-angliae age	4.0	1.0	2.0	2	22	.0	0	1	4
Populus tremuloides basal d(cm)	1.1	.4	.4	3	55	.4	2	55	4
Populus tremuloides ht (cm)	72.0	11.2	379.0	3	13	379.0	2	13	4
Populus tremuloides len (cm)	31.3	10.8	350.3	3	61	350.3	2	61	4
Populus tremuloides wid (cm)	27.3	9.7	280.3	3	64	280.3	2	64	4
Populus tremuloides age	6.0	.0	.0	1	1	.0	0	1	4

TABLE 59 CONTINUED

CATEGORY (N = 24)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Picea glauca basal diam (cm)	4.9	.5	2.4	8	18	1.0	6	8	4
Picea glauca height (cm)	173.0	8.0	510.9	8	3	-5614.8	6	-30	4
Picea glauca length (cm)	80.4	7.3	374.3	7	10	-55.0	5	0	4
Picea glauca width (cm)	64.9	6.6	300.5	7	13	-1031.8	5	-40	4
Picea glauca age	13.4	1.9	30.0	8	29	-35.1	6	-32	4

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 60

Dimensions of dominant woody species for reference lowland meadow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 6)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
TREES									
Picea glauca dbh (cm)	6.2	1.4	11.4	6	51	11.4	5	51	1
Picea glauca height (m)	5.3	.8	3.9	6	23	3.9	5	23	1
Picea glauca age	20.2	3.3	65.8	6	28	65.8	5	28	1
SHRUBS									
Betula papyrifera basal d (cm)	2.5	1.5	4.2	2	110	4.2	1	110	1
Betula papyrifera ht (cm)	98.5	1.5	4.5	2	1	4.5	1	1	1
Betula papyrifera length (cm)	89.5	10.5	220.5	2	5	220.5	1	5	1
Betula papyrifera width (cm)	82.5	17.5	612.5	2	16	612.5	1	16	1
Betula papyrifera age	5.5	.5	.5	2	3	.5	1	3	1
S. bebbiana basal diam (cm)	1.5	.2	.2	5	18	.2	4	18	1
S. bebbiana ht (cm)	79.8	5.0	126.2	5	4	126.2	4	4	1
S. bebbiana len (cm)	76.8	9.0	408.7	5	12	408.7	4	12	1
S. bebbiana wid (cm)	56.4	11.6	671.3	5	36	671.3	4	36	1
S. bebbiana age	6.2	.6	1.7	5	8	1.7	4	8	1
Rosa acicularis basal diam (cm)	.8	.1	.0	6	6	.0	5	6	1
Rosa acicularis height (cm)	50.5	4.6	125.9	6	9	125.9	5	9	1
Rosa acicularis length (cm)	23.5	3.0	52.3	6	17	52.3	5	17	1
Rosa acicularis width (cm)	18.8	3.0	52.6	6	26	52.6	5	26	1
Viburnum edule basal diam (cm)	.9	.2	.2	4	53	.2	3	53	1
Viburnum edule height (cm)	35.3	11.9	569.6	4	78	569.6	3	78	1
Viburnum edule length (cm)	21.0	5.0	102.0	4	40	102.0	3	40	1
Viburnum edule width (cm)	17.8	3.5	49.6	4	27	49.6	3	27	1
Populus tremuloides bsl d(cm)	10.0	.0	.0	1	1	.0	0	1	1
Populus tremuloides ht (cm)	70.0	.0	.0	1	1	.0	0	1	1
Populus tremuloides len (cm)	19.0	.0	.0	1	1	.0	0	1	1
Populus tremuloides wid (cm)	18.0	.0	.0	1	1	.0	0	1	1

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 61

Browse parameters for disturbed meadows habitat type (lowland meadow), summer 1988, Wishbone Hill.

	Length (cm)				Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	51.2	6.8	14	5	1957.5	587.6	14	24
Lateral	18.3	3.4	11	8	267.8	74.6	11	16
All	36.7	5.2	25	10	1214.0	367.5	25	43
Salix bebbiana								
Terminal	51.6	4.7	18	3	2107.4	402.4	18	13
Lateral	11.8	1.5	16	6	91.9	21.3	16	16
All	32.9	4.3	34	11	1158.9	273.7	34	36
Viburnum edule								
Terminal	11.2	2.3	7	6	509.7	162.6	7	14
Lateral	4.4	1.0	4	4	116.5	31.4	4	6
All	8.7	1.8	11	9	366.7	117.4	11	21
Rosa acicularis								
Terminal	42.7	7.8	9	6	1889.1	607.5	9	18
Lateral	7.3	1.5	7	6	95.0	29.8	7	13
All	27.2	6.3	16	16	1104.2	404.6	16	40

	Twig count/shrub				Calc Wt/ Shrub	Clipped Wt/ Shrub (g)				Estimated Browse/Area (kg/ha)	
	Mean	StdErr	N	NHAT	Mean	Mean	StdErr	N	NHAT	Calc	Clip
Betula papyrifera											
Terminal	55	27	6	28	107.66						
Lateral	146	56	6	17	39.10						
All	201	83	6	19	146.76	133.4	59.8	6	23	52.69	47.89
Salix bebbiana											
Terminal	49	16	8	16	103.26						
Lateral	222	62	8	12	20.40						
All	270	75	8	12	123.66	123.9	34.4	8	12	61.83	61.95
Viburnum edule											
Terminal	6	3	3	11	3.06						
Lateral	9	7	2	23	1.05						
All	12	8	3	22	4.11	20.1	10.3	3	15	1.49	7.31
Rosa acicularis											
Terminal	4	2	4	13	7.56						
Lateral	9	3	4	11	0.86						
All	10	4	5	17	8.41	30.6	3.8	5	2	5.43	19.77

TABLE 62

Browse parameters for reference disturbed meadows habitat type (lowland meadow), summer 1988, Wishbone Hill.

	Length (cm)				Est Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	15.6	3.0	9	7	200.7	65.9	9	18
Lateral	26.0	3.4	10	4	498.5	117.3	10	11
All	21.1	2.5	19	6	357.4	75.9	19	16
Salix bebbiana								
Terminal	16.8	3.3	9	7	273.5	114.0	9	29
Lateral	24.5	3.3	10	4	517.9	136.3	10	13
All	20.8	2.4	19	8	402.1	91.9	19	19
Viburnum edule								
Terminal	12.9	1.6	7	2	356.2	80.2	7	7
Lateral	13.5	0.7	3	1	360.4	40.3	3	1
All	13.1	1.1	10	2	357.5	55.8	10	5
Rosa acicularis								
Terminal	5.7	3.4	3	21	53.2	48.3	3	46
Lateral	8.7	1.9	8	8	96.5	39.8	8	26
All	7.9	1.6	11	9	84.7	31.2	11	28

	Twig count/shrub				Calc Wt/Shrub (g)	Estimated Browse/Area (kg/ha)
	Mean	StdErr	N	NHAT	Mean	Calc
Betula papyrifera						
Terminal	27	7	5	6	5.42	
Lateral	18	5	5	7	8.97	
All	45	12	5	7	14.39	0.00
Salix bebbiana						
Terminal	19	4	5	5	5.20	
Lateral	43	15	5	11	22.27	
All	62	18	5	8	27.47	9.15
Viburnum edule						
Terminal	4	2	2	7	1.42	
Lateral	1	2	2	1	0.36	
All	5	2	2	5	1.79	2.08
Rosa acicularis						
Terminal	3	1	4	14	0.16	
Lateral					0.00	
All	3	1	4	14	0.16	0.33

TABLE 63

Percentage cover for species and categories for disturbed upland meadows vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 13)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
GROUND	99.	0.	1.	13	1	1.	9	1	4
LITTER	99.	0.	1.	13	1	1.	9	1	4
HERBACEOUS	97.	1.	23.	13	1	17.	9	1	4
NON-FLOWERING	20.	6.	473.	13	197	401.	9	167	4
Athyrium sp.	1.	1.	9.	13		6.	9		4
Dryopteris dilatata	2.	1.	24.	13		22.	9		4
Gymnocarpium dryopteris	6.	3.	98.	13		95.	9		4
Fern spp.	7.	6.	487.	13		477.	9		4
Equisetum pratense	3.	1.	14.	13		16.	9		4
Equisetum silvaticum	1.	0.	2.	13		2.	9		4
Equisetum spp.	3.	1.	25.	13		3.	9		4
FORBS	56.	9.	1039.	13	57	611.	9	34	4
Aconitum delphinifolium	1.	0.	1.	13		1.	9		4
Cornus canadensis	0.	0.	0.	13		0.	9		4
Epilobium angustifolium	45.	8.	907.	13		335.	9		4
Geranium erianthum	0.	0.	0.	13		0.	9		4
Heracleum lanata	11.	4.	176.	13		175.	9		4
Mertensia paniculata	8.	3.	103.	13		107.	9		4
Potentilla palustris	0.	0.	0.	13		0.	9		4
Sanguisorba stipulata	0.	0.	2.	13		2.	9		4
Thalictrum sparsiflora	1.	0.	1.	13		1.	9		4
Urtica sp.	2.	2.	31.	13		30.	9		4
GRAMINOIDS	73.	5.	336.	13	11	196.	9	7	4
Calamagrostis canadensis	72.	5.	307.	13		199.	9		4
Carex spp.	2.	1.	29.	13		13.	9		4
WOODY	13.	5.	383.	13	379	211.	9	209	4
LOW SHRUBS	9.	5.	267.	13	578	159.	9	345	4
Ribes spp.	3.	2.	49.	13		52.	9		4
Rosa acicularis	6.	4.	234.	13		196.	9		4
TALL SHRUBS	1.	1.	11.	13	1032	6.	9	562	4
Alnus sinuata	1.	1.	11.	13		6.	9		4
TREES	3.	2.	36.	13	508	20.	9	281	4
Betula papyrifera	3.	2.	36.	13		20.	9		4
TOTAL VASCULAR	98.	1.	19.	13	1	10.	9	1	4
BARE GROUND	0.	0.	0.	13		0.	9		4

[1] NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands. WNHAT of dominant life form is criterion on which adequate sampling is based.

TABLE 64

Relative cover (species composition) of species for disturbed upland meadow vegetation type, summer 1988, Wishbone Hill.

CATEGORY	$\bar{X}$		Diversity Local	Diversity Total
HERBACEOUS				
NON-FLOWERING				
Athyrium sp.	1.	No. of Species	12	23
Dryopteris dilatata	1.	Simpson	3.6	4.1
Gymnocarpium dryopteris	3.	Shannon Exp	5.2	7.1
Fern spp.	4.			
Equisetum pratense	1.			
Equisetum silvaticum	0.			
Equisetum spp.	1.			
FORBS				
Aconitum delphinifolium	0.			
Cornus canadensis	0.			
Epilobium angustifolium	26.			
Geranium erianthum	0.			
Heracleum lanata	6.			
Mertensia paniculata	4.			
Potentilla palustris	0.			
Sanguisorba stipulata	0.			
Thalictrum sparsiflorum	0.			
Urtica sp.	1.			
GRAMINOIDS				
Calamagrostis canadensis	41.			
Carex spp.	1.			
WOODY				
SHRUBS				
Ribes spp.	2.			
Rosa acicularis	3.			
TREES				
Alnus sinuata	1.			
Betula papyrifera	2.			

TABLE 65

Density (stems/ha) of woody species and basal area (m^2/ha) of tree species for disturbed upland meadow vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 13)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Tree Density	162.	75.	72564.	13	52	22963.	9	17	4
Betula papyrifera	154.	76.	74359.	13		22222.	9		4
Picea glauca	8.	8.	769.	13		741.	9		4
Shrub Density (tree species)	192.	86.	95353.	13	48	81019.	9	41	4
Betula papyrifera	135.	83.	89744.	13		81019.	9		4
Populus tremuloides	19.	19.	4808.	13		4630.	9		4
Alnus sinuata	38.	38.	19231.	13		18519.	9		4
Shrub Density (other species)	923.	500.	3245516.	13	71	2172852.	9	48	4
Rosa acicularis	750.	502.	3281250.	13		2801505.	9		4
Viburnum edule	19.	19.	4808.	13		4630.	9		4
Ribes triste	154.	134.	234776.	13		259838.	9		4
Total basal area	1.	0.	2.	13	92	2.	9	83	4
Betula papyrifera	1.	0.	2.	13		2.	9		4
Picea glauca	0.	0.	0.	13		0.	9		4

[1] NHAT is number of observations needed to adequately sample within 20% of the mean with 80% confidence based on total variance. WITHIN MS is the variance within each stand, WN is degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations, and BN is number of stands.

TABLE 66

Dimensions of dominant woody species for disturbed upland meadows vegetation type, summer 1988, Wishbone Hill.

CATEGORY (N = 26)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT[1]	WITHIN MS	WN	WNHAT	BN
Betula papyrifera dbh (cm)	7.8	1.2	13.4	10	38	-821.0	6	-2267	4
Betula papyrifera height (m)	5.5	.8	7.0	10	40	-127.8	6	-712	4
Betula papyrifera age	22.6	2.0	40.7	10	14	-4861.3	6	-1607	4
Picea glauca dbh (cm)	25.1	14.2	400.4	2	107	.0	-2	1	4
Picea glauca height (m)	14.0	5.0	50.0	2	44	.0	-2	1	4
Picea glauca age	67.0	.0	.0	1	1	.0	-3	1	4
Alnus sinuata dbh (cm)	2.8	.4	.2	2	6	.0	-2	1	4
Alnus sinuata height (m)	2.0	.0	.0	2	1	.0	-2	1	4
Alnus sinuata age	14.0	.0	.0	1	1	.0	-3	1	4
Alnus sinuata basal diam (cm)	3.3	.0	.0	1	1	.0	-2	1	4
Alnus sinuata height (cm)	2.0	.0	.0	1	1	.0	-2	1	4
Betula papyrifera basal d (cm)	16.8	9.8	873.0	9	525	-279.2	5	-166	4
Betula papyrifera ht (cm)	145.4	19.2	3694.9	10	30	-12717.0	6	-100	4
Betula papyrifera length (cm	94.0	10.3	960.0	9	19	-1804.6	5	-33	4
Betula papyrifera width (cm)	62.6	9.5	805.2	9	35	-1621.6	5	-68	4
Betula papyrifera age	9.9	1.3	13.0	8	23	-220.2	4	-380	4
Rosa acicularis basal diam (cm)	.5	.0	.0	6	6	-2.1	2	-1401	4
Rosa acicularis height (cm)	63.0	8.0	381.6	6	17	-17255.0	2	-733	4
Rosa acicularis length (cm)	28.0	2.5	38.8	6	9	-7143.3	2	-1538	4
Rosa acicularis width (cm)	21.5	2.9	49.1	6	18	-13873.4	2	-5071	4
Viburnum edule height (cm)	31.0	.0	.0	1	1	.0	-3	1	4
Viburnum edule length (cm)	15.0	.0	.0	1	1	.0	-3	1	4
Viburnum edule width (cm)	5.0	.0	.0	1	1	.0	-3	1	4
Ribes triste basal diam (cm)	1.0	.0	.0	2	1	.0	1	1	4
Ribes triste height (cm)	100.0	.0	.0	2	1	.0	1	1	4
Ribes triste length (cm)	39.5	.5	.5	2	1	.5	1	1	4
Ribes triste width (cm)	30.0	.0	.0	2	1	.0	1	1	4

1 NHAT is number of observations needed to adequately sample within 10% of the mean with 90% confidence based on total variance. WITHIN MS is the variance within each stand, WN is number of degrees of freedom associated with WITHIN MS, and WNHAT is the number of observations needed when only variation within stands are being considered. N is total number of observations and BN is number of stands.

TABLE 67

Percentage cover for species and categories for Premier Mine revegetation, summer 1988, Wishbone Hill.

CATEGORY (N = 4)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT	WITHIN MS	WN	WNHAT	BN
GROUND	69.	9.	294.	4	11				
Moss	3.	1.	2.	4					
Litter	68.	9.	342.	4					
GRAMINOIDS	34.	6.	135.	4	20				
Bromus	2.	1.	6.	4					
Festuca	33.	7.	175.	4					
FORBS	1.	1.	2.	4	226				
Shrub	1.	1.	2.	4					
Forb	1.	1.	2.	4					
TOTAL VASCULAR	35.	6.	129.	4	18				
Bare	23.	8.	243.	4					

TABLE 68

Cover percentages by category and species for Plant Material Center plots, summer 1988, Wishbone Hill.

CATEGORY (N = 4)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT	WITHIN MS	WN	WNHAT	BN
GROUND	80.	6.	138.	4	4				
Moss	23.	8.	275.	4					
Litter	78.	6.	146.	4					
GRAMINOIDS	41.	6.	164.	4	17				
Bromus	1.	1.	2.	4					
Elymus	27.	6.	156.	4					
Festuca	16.	4.	56.	4					
Deschampsia	1.	1.	2.	4					
FORBS	4.	2.	10.	4	126				
Artemisia tilesii	2.	1.	6.	4					
Shrub	1.	1.	2.	4					
Extra	1.	1.	2.	4					
TOTAL VASCULAR	44.	7.	210.	4	19				
Bare	12.	5.	85.	4					

TABLE 69

Cover percentages by category and species for all revegetated sites, summer 1988, Wishbone Hill.

CATEGORY (N = 8)	$\bar{X}$	$S_{\bar{X}}$	S^2	N	NHAT	WITHIN MS	WN	WNHAT	BN
GROUND	74.	5.	221.	8	7	216.	6	7	2
Moss	13.	5.	226.	8		138.	6		2
Litter	73.	5.	238.	8		244.	6		2
GRAMINOIDS	38.	4.	139.	8	17	149.	6	18	2
Bromus	1.	1.	4.	8		4.	6		2
Elymus	13.	6.	273.	8		78.	6		2
Festuca	24.	5.	180.	8		115.	6		2
Deschampsia	0.	0.	1.	8		1.	6		2
FORBS	3.	1.	7.	8	194	6.	6	169	2
Artemisia tilesii	1.	1.	3.	8		3.	6		2
Shrub	1.	0.	1.	8		2.	6		2
Forb	0.	0.	1.	8		1.	6		2
Extra	1.	0.	1.	8		1.	6		2
TOTAL VASCULAR	39.	5.	167.	8	19	170.	6	19	2
Bare	18.	5.	177.	8		164.	6		2

TABLE 70

Wetland indicator status of vascular plant species and calculations in wet low shrub scrub vegetation type (stand 12), Wishbone Hill

CATEGORY (N = 3)	$\bar{X}$	Wetland Indicator Status	Wetland Community Status
HERBACEOUS	52.		
NON-FLOWERING	7.		
Equisetum fluviatile	7.	OBL	
FORBS	4.		
Aruncus	3.	UPL	
Rubus chamaemorus	2.	FACW	
GRAMINOIDS	43.		
Carex st 12	17.	OBL	
Eriophorum	18.	OBL	
Trichophorum	8.	OBL	
WOODY	51.		
DWARF SHRUBS	33.		
Vaccinium oxycoccus	23.	OBL	
Vaccinium vitis-idaea	9.	FAC	
LOW SHRUBS	23.		
Betula glandulosa	6.	FAC	
Ledum groenlandicum	11.	FACW	
Salix spp.	1.	FACW	
Salix fuscescens	4.	FACW	
Salix pulchra	2.	FACW	
Spiraea beauverdiana	1.	FAC	
Vaccinium uliginosum	2.	FAC	
TREES	3.		
Picea glauca	3.	FACU	
TOTAL VASCULAR	92.		
Wetland status[1]	1.64	Hydrophytic vegetation prevalent	

[1] This is a prevalence index (PI) calculated by the methods desribed in Section 2.10. If PI < 3, hydrophytic vegetation is prevalent.

TABLE 71

Wetland indicator status of vascular plant species and calculations in upland meadow vegetation type stand 10, Wishbone Hill

CATEGORY (N = 3)	$\bar{X}$	Wetland Indicator Status	Wetland Community Status
GROUND	100.		
LITTER	100.		
HERBACEOUS	92.		
NON-FLOWERING	6.		
Gymnocarpium dryopteris	1.	FACU	
Fern spp.	1.		
Equisetum pratense	4.	FACW	
FORBS	23.		
Aconitum delphinifolium	1.	FAC	
Epilobium angustifolium	19.	FACU	
Geranium erianthum	1.	UPL	
Heracleum lanata	1.	FACU	
Mertensia paniculata	2.	FACU	
Thalictrum sparsiflorum	1.	FACU	
GRAMINOIDS	86.		
Calamagrostis canadensis	80.	FAC	
Carex spp.	10.	FACW	
WOODY	8.		
TALL SHRUBS	6.		
Alnus sinuata	6.	FAC	
TREES	2.		
Betula papyrifera	2.	FACU	
TOTAL VASCULAR	92.		
Wetland status[1]	3.14	Hydrophytic vegetation not prevalent	

[1] This is a prevalence index (PI) calculated by the methods desribed in Section 2.10. If PI < 3, hydrophytic vegetation is prevalent.

TABLE 72

Wetland indicator status of vascular plant species and calculations in upland meadow vegetation type stand 22, Wishbone Hill

CATEGORY (N = 3)	$\bar{X}$	Wetland Indicator Status	Wetland Community Status
GROUND	99.		
LITTER	99.		
HERBACEOUS	100.		
NON-FLOWERING	42.		
Dryopteris dilatata	7.	FACU	
Fern spp.	27.		
Equisetum pratense	2.	FACW	
Equisetum spp.	11.		
FORBS	42.		
Aconitum delphinifolium	1.	FAC	
Epilobium angustifolium	23.	FACU	
Heracleum lanata	9.	FACU	
Mertensia paniculata	15.	FACU	
Sanguisorba stipulata	2.	FACW	
Thalictrum sparsiflorum	2.	FACU	
Urtica dioica	7.	FACU	
GRAMINOIDS	74.		
Calamagrostis canadensis	74.	FAC	
TOTAL VASCULAR	100.		
Wetland status[1]	3.14	Hydrophytic vegetation NOT prevalent	

[1] This is a prevalence index (PI) calculated by the methods desribed in Section 2.10. If PI < 3, hydrophytic vegetation is prevalent.

TABLE 73

Wetland indicator status of vascular plant species and calculations in lowland meadow vegetation type (all stands), Wishbone Hill

CATEGORY (N = 15)	$\bar{X}$	Wetland Indicator Status	Wetland Community Status
GROUND	97.		
MOSS	12.		
Polytrichum	2.		
Feather moss	1.		
Dicranum	0.		
Moss spp.	9.		
LICHEN	6.		
Nephroma	3.		
Peltigera	2.		
Lichen spp.	2.		
LITTER	91.		
HERBACEOUS	90.		
NON-FLOWERING	2.		
Dryopteris dilatata	1.	FACU	
Gymnocarpium dryopteris	0.	FACU	
Equisetum pratense	1.	FACW	
Equisetum silvaticum	0.	FACU	
FORBS	69.		
Achillea boreale	0.	UPL	
Aconitum delphinifolium	3.	FAC	
Caltha	0.	OBL	
Cornus canadensis	8.	FACU	
Epilobium angustifolium	29.	FACU	
Geranium erianthum	11.	UPL	
Geum macrophyllum	0.	FACW	
Heracleum lanata	6.	FACU	
Linnaea borealis	0.	UPL	
Mertensia paniculata	9.	FACU	
Polemonium acutiflorum	2.	FAC	
Potentilla palustris	1.	OBL	
Pyrola sp.	1.	FAC	
Rubus arcticus	8.	FAC	
Rubus spp. (or Aruncus)	0.	UPL	
Sanguisorba stipulata	13.	FACW	

TABLE 73 CONTINUED

CATEGORY	$\bar{X}$	Wetland Indicator Status	Wetland Community Status
Taraxacum	2.	FACU	
Thalictrum	1.	FACU	
Urtica	5.	FACU	
GRAMINOIDS	47.		
Calamagrostis canadensis	35.	FAC	
Festuca altaica	12.	FAC	
Phleum alpinum	1.	FACU	
Carex - most areas	1.	FACW	
Carex aquatilis	2.	FACW	
Luzula	0.	FAC	
WOODY	20.		
LOW SHRUBS	11.		
Echinopanax horridum	0.	FACU	
Ledum groenlandicum	2.	FACW	
Rosa acicularis	3.	FACU	
Salix novae-angliae	0.	UPL	
Salix planifolia	0.	FACW	
Sorbus	3.	FACU	
Spiraea beauverdiana	0.	FACU	
Vaccinium uliginosum	2.	FAC	
Viburnum edule	1.	FACU	
TREES	10.		
Betula papyrifera	1.	FACU	
Populus tremuloides	2.	UPL	
Picea glauca	7.	FACU	
TOTAL VASCULAR	96.		
Wetland status[1]	3.82	Hydrophytic vegetation NOT prevalent	

[1] This is a prevalence index (PI) calculated by the methods desribed in Section 2.10. If PI < 3, hydrophytic vegetation is prevalent.

TABLE 74

Estimates of coefficients using model wt = b * len^2 for browse in all habitat types, August 1988, Wishbone Hill.

Species	Est of b	Std Err of Est	Adj R^2	N
Sites to be Disturbed				
Betula papyrifera	0.6813	0.0149	.98	108
Salix bebbiana	0.7219	0.0242	.94	61
Viburnum edule	1.6780	0.0475	.94	80
Rosa acicularis	0.7454	0.0151	.97	71
Reference area				
Betula papyrifera	0.637	.0105	.96	137
Salix bebbiana	0.745	.0189	.94	103
Viburnum edule	1.956	.0510	.96	59
Rosa acicularis	0.958	.0581	.87	41

TABLE 75

Browse parameters for all disturbed habitat types, summer 1988, Wishbone Hill.

	Length (cm)				Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	40.9	2.5	56	4	1277.9	212.8	56	29
Lateral	15.1	1.1	53	6	199.1	24.7	53	16
All	28.4	1.9	109	9	753.4	121.2	109	53
Salix bebbiana								
Terminal	55.2	3.4	33	3	2488.6	311.7	33	10
Lateral	13.4	1.2	28	5	128.3	23.6	28	18
All	36.0	3.3	61	10	1405.2	226.3	61	30
Viburnum edule								
Terminal	16.4	1.4	46	7	637.8	106.4	46	24
Lateral	5.4	0.5	34	5	100.2	10.9	34	8
All	11.8	1.0	80	12	409.3	68.0	80	41
Rosa acicularis								
Terminal	29.4	3.7	37	11	1080.6	243.7	37	35
Lateral	7.2	0.7	34	6	88.4	12.3	34	13
All	18.8	2.3	71	21	605.5	139.5	71	70

	Twig count/shrub				Calc Wt/ Shrub	Clipped Wt/ Shrub (g)			
	Mean	StdErr	N	NHAT	Mean	Mean	StdErr	N	NHAT
Betula papyrifera									
Terminal	33	8	26	26	42.17				
Lateral	93	19	27	21	18.52				
All	125	25	27	20	60.69	78.1	16.4	27	23
Salix bebbiana									
Terminal	45	12	13	17	111.99				
Lateral	186	44	13	14	23.86				
All	231	55	13	14	135.85	118.0	25.3	14	12
Viburnum edule									
Terminal	3	0	23	9	1.91				
Lateral	4	1	19	16	0.40				
All	7	1	23	12	2.31	15.5	2.4	23	11
Rosa acicularis									
Terminal	3	1	21	22	3.24				
Lateral	7	1	18	11	0.62				
All	9	2	22	18	3.86	21.4	2.3	22	5

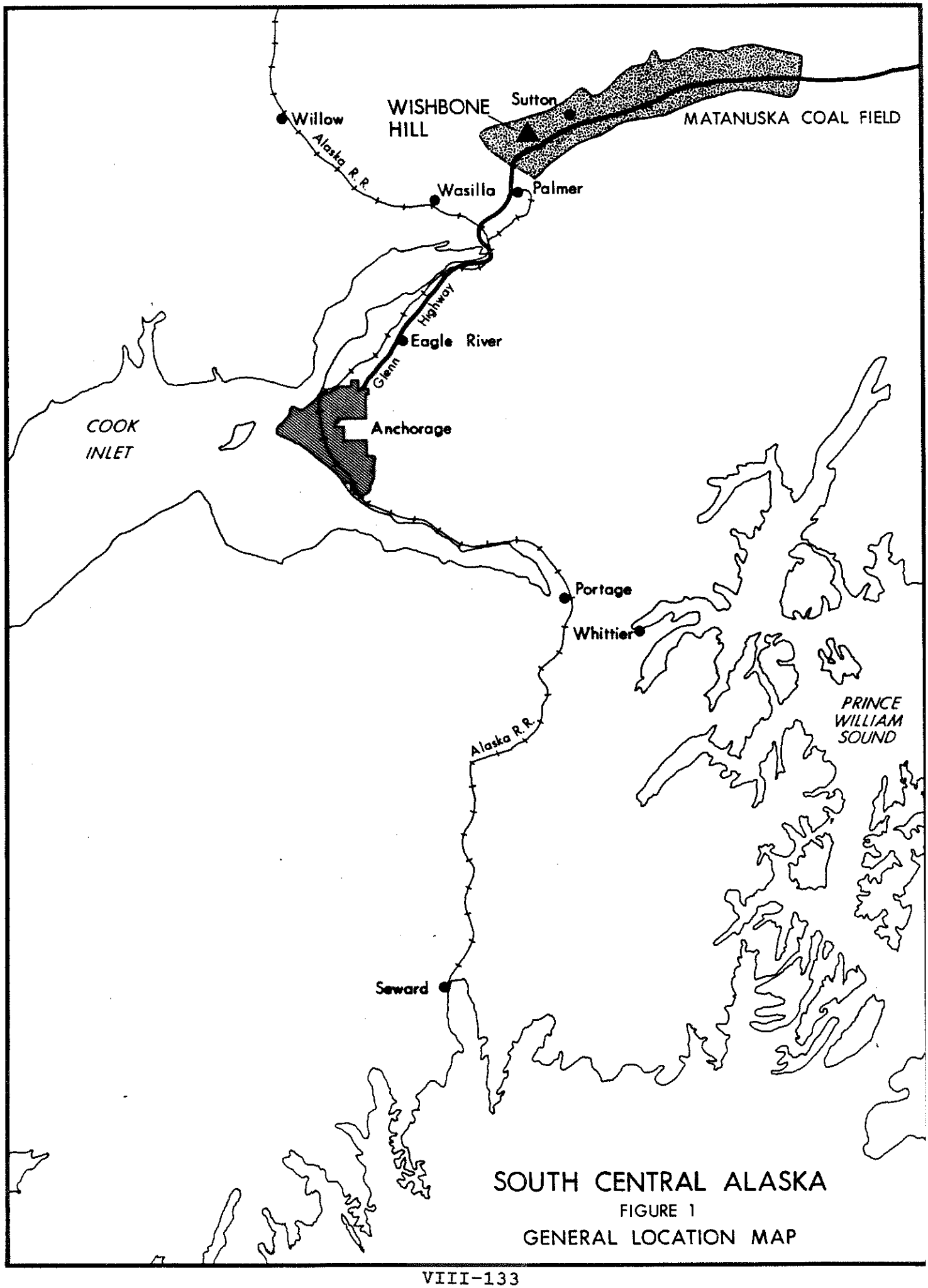
TABLE 76

Browse parameters for all reference habitat types, summer 1988, Wishbone Hill.

	Length (cm)				Est Weight/twig (mg)			
	Mean	StdErr	N	NHAT	Mean	StdErr	N	NHAT
Betula papyrifera								
Terminal	27.6	1.6	57	4	574.4	56.7	57	11
Lateral	10.9	0.7	54	4	91.3	10.7	54	14
All	19.5	1.2	111	8	339.4	37.4	111	25
Salix bebbiana								
Terminal	31.5	2.2	51	5	917.7	13.6	51	20
Lateral	10.8	0.7	45	4	102.6	13.7	45	15
All	21.8	1.6	96	10	535.6	81.8	96	42
Viburnum edule								
Terminal	14.9	1.3	36	6	559.7	115.5	36	29
Lateral	7.8	0.9	33	9	168.6	446	33	43
All	12.5	1.1	52	8	434.5	87.0	52	39
Rosa acicularis								
Terminal	15.8	3.3	23	19	464.5	234.9	23	109
Lateral	7.5	1.9	18	22	113.0	68.3	18	122
All	7.8	1.0	27	9	85.6	21.2	27	31

	Twig count/shrub				Calc Wt/Shrub (g)
	Mean	StdErr	N	NHAT	Mean
Betula papyrifera					
Terminal	25	4	19	9	14.36
Lateral	16	3	19	9	1.46
All	20	3	30	10	15.82
Salix bebbiana					
Terminal	18	3	17	9	16.52
Lateral	36	6	16	8	3.69
All	26	4	25	11	20.21
Viburnum edule					
Terminal	3	0	16	8	1.68
Lateral	3	0	15	6	0.51
All	3	0	24	7	2.18
Rosa acicularis					
Terminal	2	1	10	11	0.93
Lateral					
All	2	1	10	11	0.93

FIGURES



SOUTH CENTRAL ALASKA

FIGURE 1

GENERAL LOCATION MAP

FIGURE 2

Layout of vegetation sampling unit. Points located every 50 cm along transect were used for cover. The 2-m and 5-m wide belt transects were used for shrub and tree density respectively.

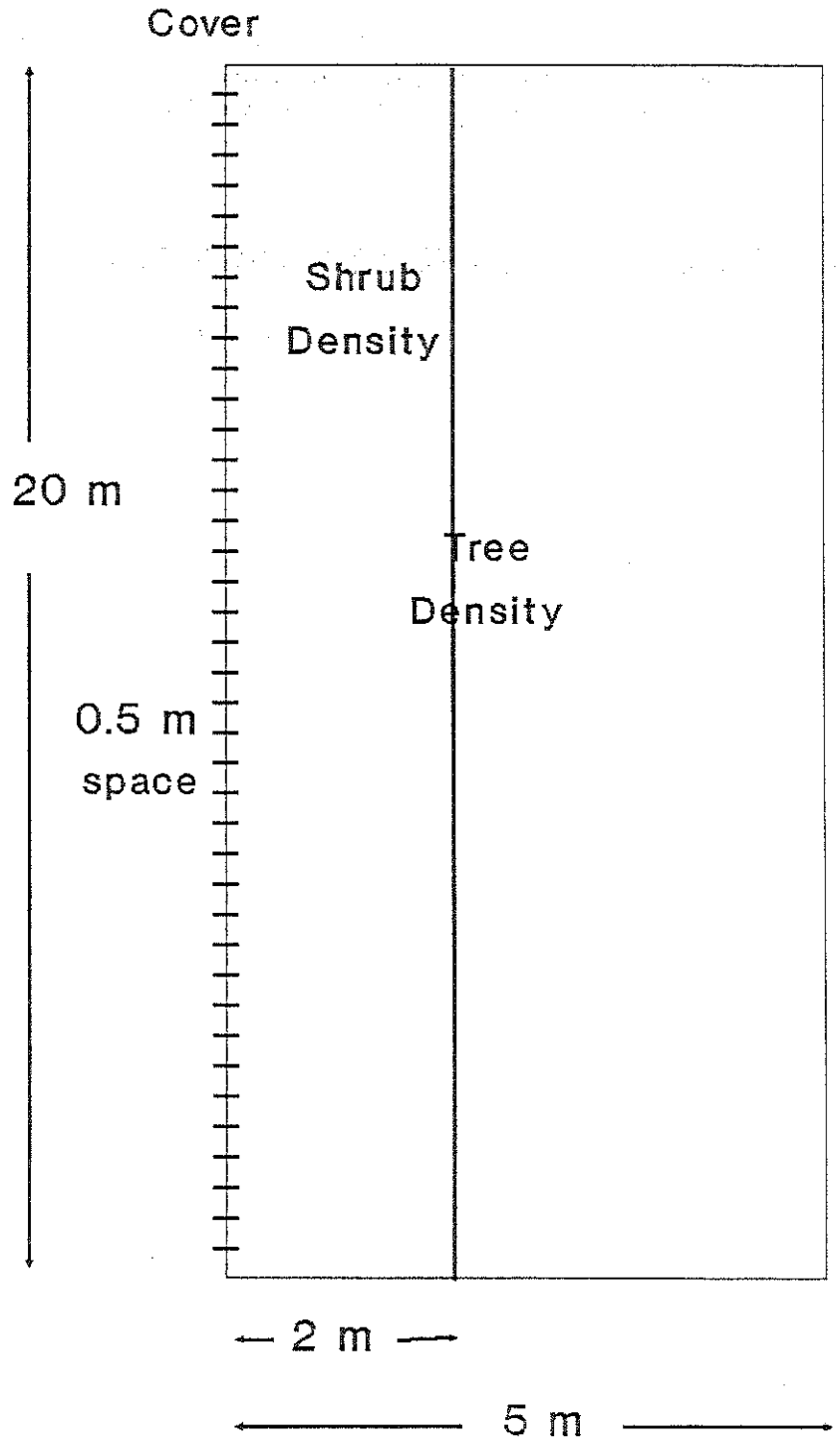
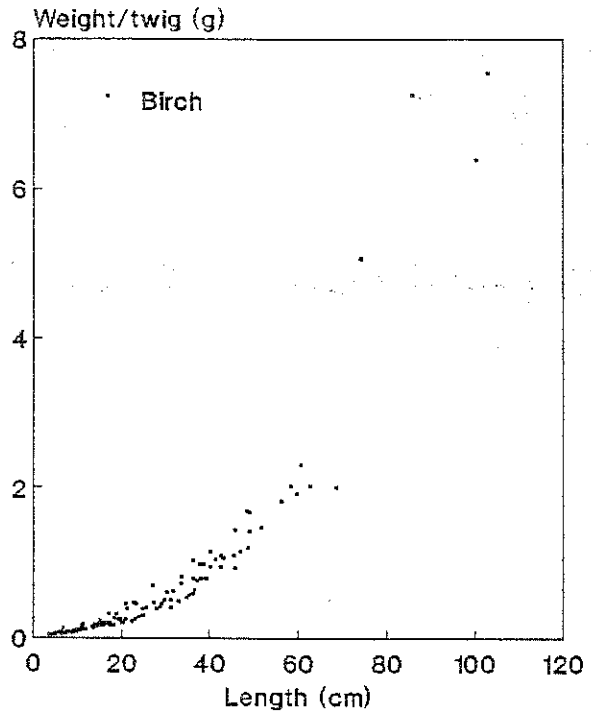
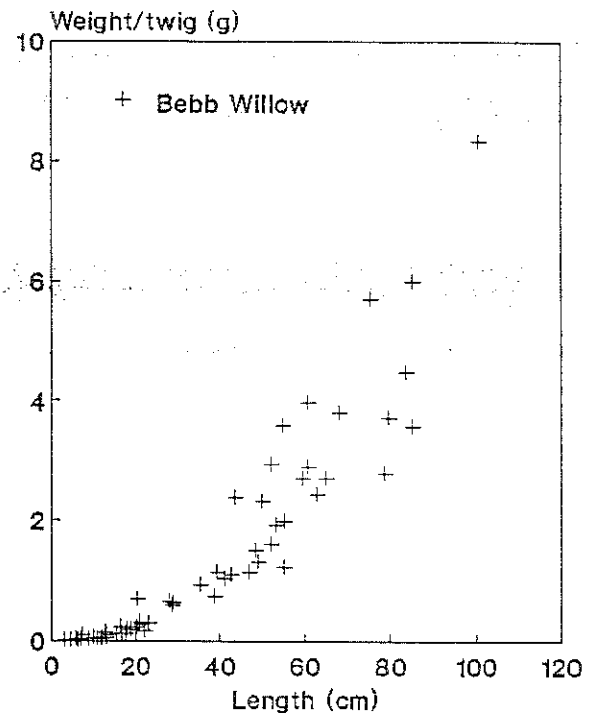
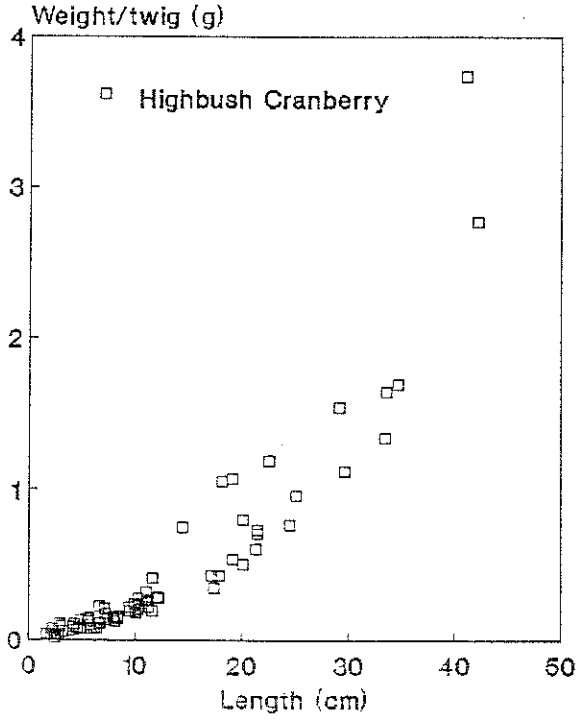

Cover
Shrub
Density
Tree
Density
20 m
0.5 m
space
2 m
5 m

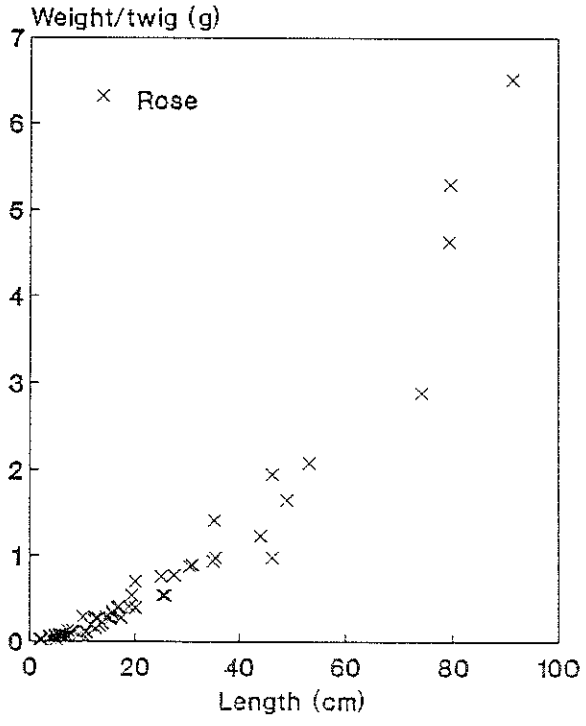
FIGURE 3

Scatter diagrams of lengths and weights of current growth of twigs for all species, Wishbone Hill, summer 1988.

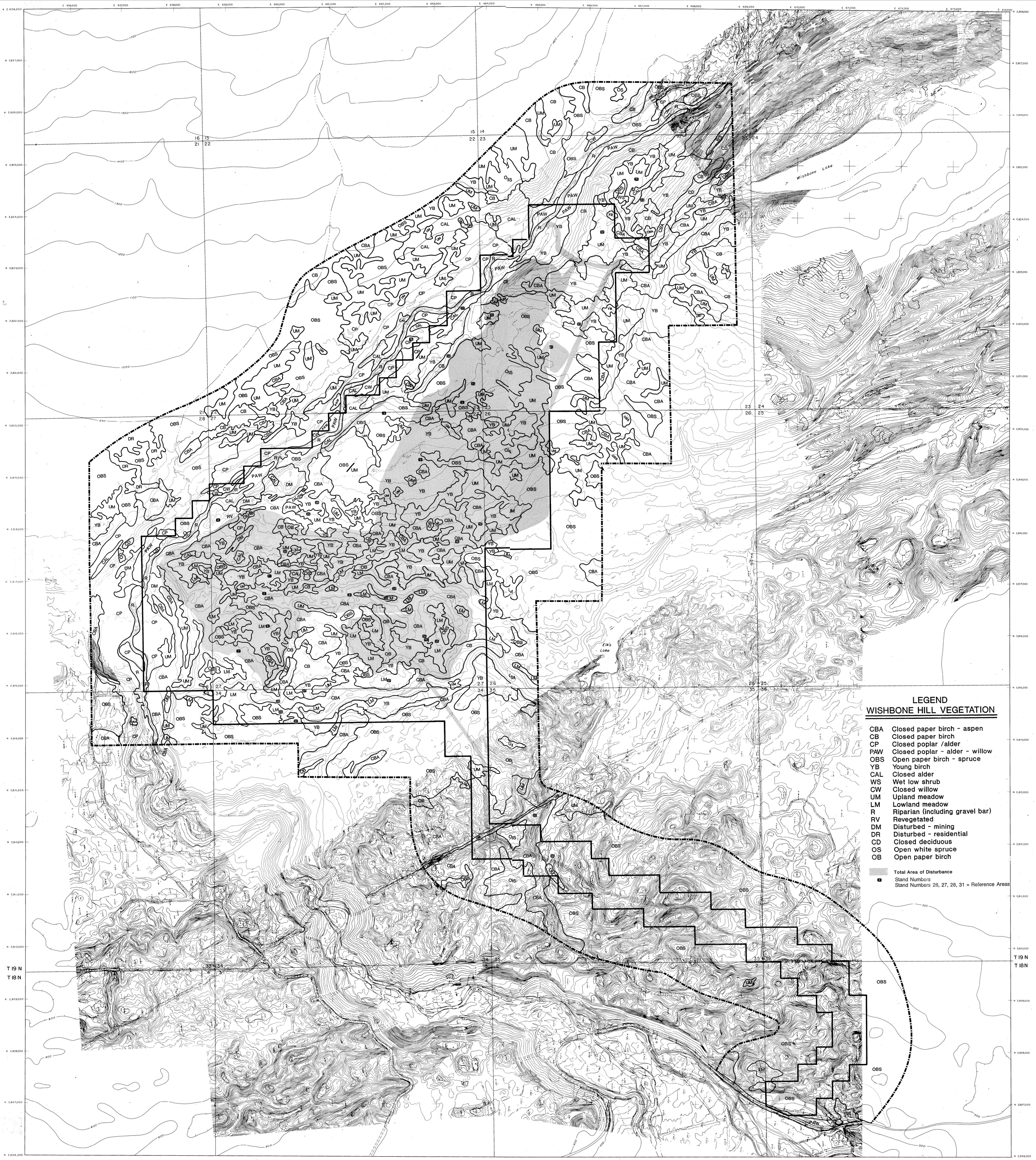

Weight/twig (g)
Birch
0
2
4
6
8
0
20
40
60
80
100
120
Length (cm)


Weight/twig (g)
Bebb Willow
0
2
4
6
8
10
0
20
40
60
80
100
120
Length (cm)


Weight/twig (g)
Highbush Cranberry
0
1
2
3
4
0
10
20
30
40
50
Length (cm)


Weight/twig (g)
Rose
0
1
2
3
4
5
6
7
0
20
40
60
80
100
Length (cm)

PLATES



LEGEND
WISHBONE HILL VEGETATION

CBA	Closed paper birch - aspen
CB	Closed paper birch
CP	Closed poplar /alder
PAW	Closed poplar - alder - willow
OBS	Open paper birch - spruce
YB	Young birch
CAL	Closed alder
WS	Wet low shrub
CW	Closed willow
UM	Upland meadow
LM	Lowland meadow
R	Riparian (including gravel bar)
RV	Revegetated
DM	Disturbed - mining
DR	Disturbed - residential
CD	Closed deciduous
OS	Open white spruce
OB	Open paper birch

Total Area of Disturbance

Stand Numbers

Stand Numbers 26, 27, 28, 31 = Reference Areas

The core map area was photogrammetricaly mapped from photography of 5/8/84, 5/8/83, 6/22/85 by Air Photo Tech, Inc. of Anchorage, Alaska.
The core map area meets National Map Accuracy Standards at 1"=200' and smaller scales.
Topographic and Planimetric features outside of the core area were taken from a photo enlarged 1" = 1 mile USGS Anchorage C-6 quad map of 1987.
Horizontal datum is Alaska State Plane, zone 4.
Vertical datum is based on USC & GS monumentation.

SUBJECT REVISIONS			
REV.	DATE:	BY:	DESCRIPTION
1	2009	JEH	MINOR REVISIONS

DESIGN BY:	
DRAWN BY:	
CHECK BY:	
DWG FILE:	
DATE DRAWN:	

WISHBONE HILL MINE — USIBELLI COAL MINE INC. — PERMIT NUMBER 01-89-796

WISHBONE HILL COAL PROJECT
VEGETATION MAP
WISHBONE HILL MINE

USIBELLI COAL MINE, INC.
P.O. BOX 1000, HEALY, ALASKA 99743
(907) 683-2226

PLATE No. VIII-1 — REV. 1
SHEET No. 1 OF 1