ESTABLISHMENT and CHARACTERIZATION of LONG-TERM MONITORING SITES on ELMENDORF AIR FORCE BASE, ALASKA

Prepared for:

Conservation and Environmental Planning Office
3 CES/CEVP
6326 Arctic Warrior Drive
Elmendorf Air Force Base, Alaska
99506-3204

By:

Gerald F. Tande
Principal Investigator/Vegetation Ecologist

Julie Michaelson
Program Data Manager
Susan C. Klein
Assistant Ecologist
Julia Lenz
Assistant Biologist

Alaska Natural Heritage Program
Environment and Natural Resources Institute
University of Alaska Anchorage
707 A Street
Anchorage AK 99501
April 1, 2001

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

ACKNOWLEDGEMENTS

The authors would like to gratefully acknowledge the cooperation and assistance of a number of people who have helped us in the completion of this project.

We would especially like to thank the following EAFB Conservation and Environmental Planning staff for their exceptional logistical support throughout the project and their discussions and input with regards to their natural resource knowledge of the Base: Kate Wedemeyer, Wildlife Biologist, Bob Morris, Forestry Technician, Tom Liebscher, Natural/Cultural Resource Manager, and Allen Richmond, Chief of Conservation and Planning.

Ms. Shannyn Scassero and Mr. Michael A. Younkins of the Special Projects Branch, U.S. Army Medical Research Acquisition Activity, Ft. Detrick, Maryland,were very helpful with contractual arrangements along the way.

We would like to acknowledge the assistance of Jim LaBau, Forestry Research Affiliate with the Environment and Natural Resources Institute (ENRI) who provided invaluable guidance along the way in field methods, data processing and data file management from which our methods are heavily modelled. Jim was responsible for the assembling and analysis of the forestry data subset.

Al Batten of the Alaska Science Museum (ALA), University of Alaska Fairbanks, provided us with plant specimen collection data to assist in the preparation of our initial plant species list for the Base.

Assistance in the preparations of ArcView GIS products was provided by Steven Drake, Center for the Ecological Management of Military Lands (CEMML), Colorado State University, Ft. Collins CO, through his association with Ft. Richardson Military Base.

Finally, the authors appreciate and would like to acknowledge the cooperation of the National Park Service and the U.S. Forest Service Pacific Northwest Research Station, Forestry Sciences Laboratory (AFSL), Anchorage and their staff who made themselves available early in the design of this project to share their monitoring techniques and experience.

This report was supported by the U.S. Air Force, Elmendorf Air Force Base Conservation and Environmental Planning Office, Anchorage, Alaska, and administered through the Special Projects Branch, U.S. Army Medical Research Acquisition Activity, Ft. Detrick, Maryland, under Contract Agreement No. DAMD17-99-2-9004.

Copies of this report and access to original data are available from the Elmendorf AFB Wildlife Biologist or Chief of Conservation and Environmental Planning:

Conservation and Environmental Planning Office
3 CES/CEVP
6326 Arctic Warrior Drive
Elmendorf Air Force Base, Alaska
99506-3204

(907)552-3853 or 552-1609

INTRODUCTION

In January 1999, the Alaska Natural Heritage Program (AKNHP) undertook a project to establish and characterize permanent monitoring sites on Elmendorf Air Force Base (EAFB), Alaska, under Contract Agreement No. DAMD17-99-2-9004. The purpose of the project was to establish permanent plots for monitoring long-term changes in EAFB natural resources; develop a method for monitoring long-term vegetation change; and provide a baseline description of the permanent monitoring sites. Base personnel will use baseline data and data from other multi-disciplinary studies established in the vicinity of the vegetation monitoring plots to periodically update the EAFB Integrated Natural Resource Management Plan (INRMP) as directed in AFI 327064 and 32 CFR 190.7, 16 USC5CSCII670a (Sikes Act). These documents require military installations to develop new, integrated, Natural Resource Plans and make substantive revisions at least every five years. The most current EAFB natural resource inventory (Rothe et al. 1983a, 1983b) is 18 years old and may not reflect the current resource conditions.

The proposal called for the establishment of permanent plots to satisfy a portion of the INRMP data requirements by developing the means for periodically monitoring and updating a natural resource information database rather than conducting an intensive base-wide inventory similar to the 1983 study. The approach developed and described here establishes a system of permanent vegetation monitoring plots to supply essential information leading to a better understanding of ecosystem health and functioning. Data gathered in this effort may also be used to supply supportive information for the management of wildlife, forest resources, threatened and endangered species, outdoor recreation resources and protected wetlands, through an integrated approach and the establishment of further multi-disciplinary monitoring studies in association with the vegetation plots.

In addition to the methods manual and the establishment and characterization of permanent monitoring sites, a rare plant inventory was conducted (Lipkin 2001), as was the collection of additional vegetation plot data from within monitored vegetation types and select early successional vegetation types (Tande et al. 2001). The objective of the latter projects was to increase the knowledge base leading to a better understanding of EAFB botanical resources, and vegetation dynamics in response to both natural and human-induced processes.

OBJECTIVES

The principal objectives of the study were to:

1) Develop a vegetation monitoring methodology outlining the design, establishment, and baseline description procedures for a system of permanent monitoring sites with applications to other natural resource disciplines.

2) Implement, test and refine the methodology by establishing and collecting baseline information from a series of monitoring plots in major vegetation types mutually agreed upon with EAFB Conservation and Environmental Planning staff.

3) Provide baseline descriptions and interpretations of the plots in so far as the baseline data would allow.

The secondary objectives of the study were to:

1) Establish an electronic system for archiving and retrieving permanent plot data.

2) Establish a GIS database layer of plot locations and prepare a description of its components for EAFB Conservation and Environmental Planning personnel.

3) Assess the variability in the vegetation represented by the established monitoring sites using additional plot data from similar vegetation map units.

Companion studies include a disturbed alder identification project (Tande et al. 2001), and a botanical survey (Lipkin 2001).

LOCATION

Elmendorf Air Force Base (EAFB) is situated on approximately 5314 hectares (13,130 acres) in Southcentral Alaska at the head of Cook Inlet. The establishment of monitoring plots was limited to the 3614 hectares (8,931 acres) of undeveloped land and 587 hectares (1,450 acres) of semi-developed land.

The Base is bounded by the Municipality of Anchorage to the south, the Knik Arm of Cook Inlet to the north and west, and Fort Richardson Army Base to the east. Elmendorf is located at 149 degrees, 48 minutes west longitude and 61 degrees, 15 minutes north latitude.

METHODS

Development of a Long-Term Monitoring Methodology

A long-term vegetation monitoring methodology was developed over a six-month period between January and June, 1999, through successive iterations involving a review of current multi-disciplinary monitoring literature, consultations with organizations currently conducting long-term monitoring on public lands in Alaska and the western United States, and successive consultations and meetings with Base Conservation and Environmental Planning staff to refine the methods to meet Base needs. The resulting finalized document was approved by Base Natural Resource personnel and delivered under separate cover in July 1999.

The completed methods manual in its entirety for locating, monumenting, and establishing baseline descriptions of the permanent sites through an assessment of the vegetation is found in Appendix 1. This methodology was implemented over the summer of 1999; minor changes and edits were made to the manual based on summer 1999 fieldwork. An overview of the methodology follows; the reader is referred to Appendix 1 for details.

Field Techniques

Data Collection Overview

The basic sampling unit was defined as the area on the USGS Anchorage Quadrangle Maps (B8-SE, SW) occupied by Elmendorf Air Force Base (EAFB). The sampling unit was further restricted to: 1) major vegetation types (strata) identified on existing vegetation maps (Tande 1983, CEMML 1998); and 2) that area occurring outside of developed areas and areas slated for future development based on the existing Land Use Plan (EAFB 1997) and Natural Resource's planning documents.

A two-phase (stratified random) sampling design was selected to sample the Base in a manner that would be more statistically efficient and rigorous than a simple random sample. This also allowed targeting specific strata of concern (major vegetation types or types identified with important management implications), and bypassing areas of less significance for long-term monitoring e.g., minor vegetation types, nonvegetated areas, developed areas and areas slated for development.

Sampling criteria which were recognizable or that could be delineated on 1:12,000-scale airphotos or on existing planning maps were used as drivers for the selection of long-term vegetation monitoring (LTVM) plot locations. The aerial photo points met criteria for minimal disturbance or distance from present or future activities that were predominantly related to vegetation characteristics, existing map classifications, and considerations of the Elmendorf Draft Land Use Plan (EAFB 1997).

Phase I of the sampling strategy was the selection of permanent sites using photo interpretation of color infra-red 1:12,000-scale aerial photography. It involved evaluating a grid of 15 photo points on each CIR photo, and assigning a photo classification to each point which would place the point either in or out of the key sampling criteria. Thirty-two CIR photos were available for evaluation in 1999, and 270 photo points were classified after allowing for elimination of points on criteria boundaries. Of these, 108 points occurred in undisturbed vegetated areas of the Base, and 85 of these provided the basis for choosing the Phase II sample of ground plots for long-term monitoring. This process would be repeated in any future selections of additional LTVM plots.

A second part of Phase I involved summarizing the photo point data and eliminating all points not meeting the established criteria. The remaining photo points that did satisfy the established criteria were sorted by major vegetation type, and from within each vegetation type, monitoring plots were systematically selected beginning from a random start for each type. The remaining plots in each type were held in reserve to be added to the overall sample for each vegetation type as time allowed for expanding the total number of monitoring plots. They also served as substitutes in situations where one of the first plots was determined to not meet the specified criteria during ground-truthing or by other information not readily apparent from the vegetation maps and airphotos. A minimum of three plots served as the basic LTVM plot dataset for each vegetation type.

Phase II of the sampling design was the collection of plot data. Long-term vegetation monitoring (LTVM) plot data were collected using standard vegetation monitoring and inventory techniques that focused on descriptions and tallies of understory vegetation, forest and shrub regeneration, and forest overstory live stock and mortality employed in previous and ongoing multi-disciplinary monitoring studies (Database Manager BNZ/CPCRW 2000, Denali National Park 2000, Elzinga et al. 1998, Helm 1999, Helm and Roland 1999, LaBau 1998, Mangold 1997, Mahan et al. 1998, USFS FIA 1998).

Sites were accessed by using surface transportation (automobile or foot). Standard photogrammetry and forestry mensuration techniques were used to compute distance and azimuth to a plot, starting from a reference point that was identifiable on the ground and airphoto. Using a compass and tape, the field team accessed the site, established and monumented a plot center point, and established an equidistant grid of four ground plots which served as the delimiter for collecting monitoring data (Appendix 1).

From the central sampling point, three satellite sampling points were established at a distance of 36.6 m and at 0, 120 and 240 degrees. At each of the four ground points, live tree data were sampled on a 1/24th acre (.02 ha) Macroplot. Tree mortality was recorded on a full 1 acre (A) (0.4 ha) Mortality Plot (Appendix 1).

Established seedlings and sapling trees were tallied on four 1/300th acre (.001 ha) Microplots within the Macroplot. Percent cover estimates of bryophytes, lichens, herbs, graminoids, and shrubs were also determined on each of these Microplots to document and provide a baseline for understory vegetation characteristics and change.

Collection of Supplemental Vegetation Data

Additional vegetation data were collected from within monitored vegetation types and select early successional vegetation types such as alder to assess plant community variability within monitored vegetation cover types. Data were collected in major vegetation types in which permanent plots were established utilizing previously completed vegetation mapping studies (Tande 1983, CEMML 1998) and soil type maps (Wikgren and Moore 1997), and by contrasting drainage, topography, and vegetation patterns from aerial photographs.

Site selection was based on stratified random sampling methods (Mueller-Dombois and Ellenberg 1974, Steel and Torrie 1960) and involved: (1) the broad stratification of EAFB using existing 1983 and 1998 vegetation map classes (Tande 1983, CEMML 1998), surficial geology (Miller and Dobrovolny 1959) and soils maps (Wikgren and Moore 1997); (2) randomly locating sampling points within these strata; and (3) sampling major vegetation communities found near the sampling point. The strengths of stratified random sampling are that stratification ensures sampling across the range of plant communities, and that locating the sampling points randomly within the strata allows a statistical error term to be assigned to any derived mean values (Mueller-Dombois and Ellenberg 1974, Steel and Torrie 1960). The use of total random placement of plots across the study area was precluded because of: (1) the clumped distribution of vegetation that could lead to oversampling or undersampling of some plant communities; and (2) rare or very specific communities might be overlooked.

Prior to field sampling; stratification of the Base by soils and major vegetation types > 121 ha was reviewed. Vegetation map delineations (Tande 1983, CEMML 1998) were further refined using the most recent infrared aerial photos (1995, scale 1:12,000). Strata were subdivided when they showed more than one distinct pattern of vegetation life form; these strata generally corresponded to defined landscapes. Cover types (map units) and airphoto signatures were prioritized to insure that a maximum number of different areas were visited across north-south and east-west gradients and across moisture, elevation and physical gradients within the major vegetation classes chosen for long-term monitoring.

Vegetation and physical site characteristics were described at each sample point within a homogeneous vegetation unit. Rapid survey techniques were employed to maximize data collection due to time constraints imposed by the length of time needed to complete the primary objective of establishing and characterizing permanent monitoring sites. All vegetation descriptions were made using sampling plot (relevé) techniques of Mueller-Dombois and Ellenberg (1974).

This approach had an added advantage in that it is a similar methodology to that employed in the original 1983 inventory, thus allowing more direct comparisons between datasets as well as an opportunity for the integration of datasets in future investigations.

Sampling plots (relevés) were nested as follows: trees - 500 m^2, shrubs - 50 m^2, herbaceous understory - 5 m^2, and mosses and lichens - 0.5 m^2. Within sites too narrow to enclose a plot (e.g., alder), it was necessary to use correspondingly narrow plots; in these cases, the total plot area was maintained.

In areas with homogenous vegetation that appeared to be representative of the map class and photo signature, visual estimates of dominant growth forms and percentage cover for all dominant plants were made, associated species noted, and physical site characteristics described.

Ocular estimates were used to estimate canopy cover for each species and was defined as the percentage of the ground in the plot covered by the gross outline of an individual plant's foliage (canopy), or the outline collectively covered by all individuals of a species or life form within the plot (Brown 1954, Daubenmire 1959). Summing of the cover values within each structural layer using these techniques may total greater than 100 percent indicating that the vegetation is layered and overlapping. Canopy cover classes were used for estimation as follows:

Tree (> 8 m)
Tall Shrub/dwarf tree (1.5 - < 3 m)
Low Shrub (0.5- < 1.5 m)
Dwarf Shrub (< 0.2 m)
Graminoids
Forb
Ferns/Fern Allies
Moss
Lichen

Six-letter codes were used to abbreviate species names on the data sheets (Appendix 2). The six-letter code for a species was the first three letters from both the genus and specific epithet and follows Hultén (1968) and Viereck and Little (1972).

Plant specimens not identified in the field were collected and identifications were completed in the laboratory by the AKNHP Chief Botanist. Field collection techniques and handling of specimens followed Tazik et al. (1992).

Physical site characteristics included descriptions or scale values for: terrain (slope, aspect, elevation); physiographic features; surficial geological features and classification; subjective site and soil moisture at 10 cm depth; flooding condition; plant community distribution patterns; successional comments; evidence for past fires or insect attack; and animal, bird and human activity.

The site record also included plot number, date, observer, general location, USGS quadrangle, airphoto number, and location information.

Laboratory Techniques

Monitoring Plot Summary and Description

LTVM plot data were edited for completeness and for illogical entries, and all errors or aberrations in the datasets were resolved in the laboratory over the winter and in subsequent revisits to two plots in summer 2000. A Hard-Copy Archive and Filing System was developed; all slides and photos were inventoried and reviewed, and a detailed Photo Record File was assembled and documented.

Plot establishment summaries of environmental and locational features were prepared and plot totals and averages were processed to obtain estimates describing species composition and cover for each LTVM plot. General analyses and summaries were used to provide a baseline description of the plots. These summaries describe the vegetation and associated attributes, and provide interpretations of vegetation dynamics for each plot as far as the first-year's monitoring data would allow.

A baseline description and summary was prepared for each established and fully-characterized LTVM plot. This "Site Description" included the following features:

Viereck et al. (1992) Classification

Tande (1983) Map Classification

CEMML (1998) Map Classification

Site Location

Topo Map
Latitude
Longitude

Slope
Aspect
Elevation

Site Description

Site History

Vegetation

Associated Plant Communities

Soil

Soil Classification
Soil Series
Parent Material
Rooting Depth
Depth to the Bottom of Live Moss
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material

Permafrost

Soil Profile Description

Site Environmental Measurements

Site Photographs

Vegetation physiognomy (structure), species dominance and cover data were summarized and used to classify and key each LTVM plot into the Viereck et al. (1992) vegetation classification system for Alaska.

The Site History section was used to summarize what was known and/or could be ascertained in the field about the origin of the stand, likely seral stage, and features which might likely affect natural versus human-induced successional changes on the monitored plant community.

Supplemental vegetation plot data were used to identify Associated Plant Communities representing some degree of Level 5 (Viereck et al. 1992) variability found in the map cover type class of the monitoring plot. Vegetation physiognomy, species dominance and cover values from the plot data were summarized and used to classify vegetation plots, and then key these through the Viereck et al. System. Ancillary environmental data were used to further refine the plant community in the key and compare it to the Viereck et al. (1992) type represented by the LTVM plot.

Data Management and Archiving of Monitoring Plot Data

A hard-copy Archive System was developed to store the 1999 baseline information to insure access to monitoring plot data in subsequent sampling years. This system was designed to include all monitoring site data, vegetation monitoring plot data, the Photo Record File, maps and aerial photo mylar overlays.

The LTVM plot dataset was electronically compiled, edited and archived using Microsoft Excel spreadsheets. Each LTVM plot was stored as a Microsoft Excel Workbook allowing unlimited storage and access to different datasets for comparisons and analysis within and between each monitoring plot in subsequent sampling years. A general knowledge of Microsoft Excel allows the user to easily access and manipulate selective sets of data.

A Geographic Information System (GIS) data layer was developed for the location of permanent plots. The U.S. Geological Survey (USGS) 1:25,000 scale map was selected as a base map to derive LTVM plot locations. The Digital Raster Graphic (DRG) data was purchased for the Anchorage B-8 SE and SW quadrangles in a .tif format. These base maps are projected in a UTM Projection, Alaska Zone 6.

Plot locations were carefully transferred from color infrared aerial photography to a hardcopy orthophoto basemap of the same scale. These points were then carefully transferred to the DRG using ArcView GIS software. This method was chosen in lieu of using global positioning coordinates since these were not obtainable on EAFB in 1999 (see Discussion). A Shape File of these points was created in ArcView. The northing and easting coordinates were calculated for each permanent plot. These coordinates were then converted using the ARC/INFO projection program into a geographic coordinate system, and these coordinates were entered into the Attribute File of the permanent plot Shape File. The plot identifying number was also entered as an attribute. This plot number can be used as a Join Item to which other associated data tables can be linked within a GIS context.

The ArcView Shape File and the two DRG files were integrated into an ArcView Project to provide a permanent electronic storage for the LTVM plot locations. This Shape File provides a base layer to which future information can be joined in preparation for GIS analysis, data comparison and queries of LTVM plot data. A Metadata File was prepared to Federal Geographic Data metadata standards to document the Plot Location Layer. The database was integrated to manage changes, additions, or deletions of data items. Various quality assurance methods common to GIS were utilized to minimize these concerns, including on-site verification and a comparison of features in aerial photos and related features in other data layers.

A hard copy and digitized map were produced for permanent plot locations; digital map data generated as a result of the project were developed and in a format compatible with the Elmendorf ArcView GIS system. A general knowledge of ArcView GIS allows the user to easily access and manipulate the GIS product.

Summary and Analysis of a Forestry Data Subset

To demonstrate the multi-disciplinary opportunity and versatility for extracting and analyzing data from the Electronic Archives, a forestry data subset consisting of live tree growth stock, seedling and sapling regeneration, and mortality data were summarized and analyzed to establish a baseline for estimating tree mortality (e.g., spruce) in terms of numbers of trees killed per acre (hectare) and the associated volumes per acre (hectare) of growing stock trees killed in the last five years. Forest regeneration data were summarized to establish a baseline for an estimation of seedling and sapling regeneration by vegetation cover types occurring in the sample area. As a management concern or objective, this Forestry Data Subset is useful for evaluating the impact of the recent Southcentral Alaska spruce bark beetle outbreak on the growing stock volume of conifer and mixed forest types and subsequent regrowth of the forest resource on EAFB and adjacent lands.

Forest overstory, seedling and sapling records were extracted from the LTVM Plot Electronic Archive and copied to a separate Excel Workbook for analysis. An edit evaluation was conducted to ascertain that the dataset did not contain anomalies in heights and diameters associated with the different plot sizes. **A note to future users:** The dataset was designed so that any changes to the original data would trickle through the data sheets to show up corrected in the overall Summary Worksheets.

Appendix 9 is a summary of functions that were inserted to derive standard forestry mensuration measurements and estimates as follows:

For the growing stock tally and mortality tally:

Trees per acre
Trees per hectare
Basal area per acre
Basal area per hectare
Cubic foot volume per acre
Cubic meter volume per hectare.

For the seedling and sapling tallies:

Trees per acre
Trees per hectare.

Overall summaries were made by monitoring plot, and then average per acre (A) and per hectare (ha) values were generated for all plots representing each major vegetation type (Table 1). A summary was also made by species within each LTVM plot and then by vegetation cover type for seedling, sapling, growing stock, and 5-year mortality data.

The Excel Workbook and subsequent analysis with imbedded formulas and functions are archived

Table 1. Monitoring plots established in major vegetation cover types identified in the original 1983 vegetation inventory (Tande 1983). (Number of fully characterized plots in parentheses).

No. of Plots	Map Code	Major Vegetation Map Unit	LTVM Plot No.
12 (9)	6, 8, 9, 14	Old-Growth White Spruce/Birch Mixed Forest	5, 9, 11, 12, 14, 15, 17, 19, 20, (26, 28, 30)
5 (3)	10	Young Birch/White Spruce Mixed Forest	1, 3, 6, (25, 29)
4 (3)	4	Young Birch Forest	2, 7, 13 (27)
3 (3)	1	Black Spruce Forest	4, 8, 10
3 (3)	20	Alder Shrub	18, 21, 22 (28*)
3 (3)	25, 26	Bluejoint Grass Meadow	16, 23, 24
30 (24)			

* Plot could be representative of both Alder and Old-Growth Mixed Forest since most trees have been replaced by a tall alder understory.

in the **LTVM plot** Electronic Archive files as the "Forestry Data Subset " (Forest_Anal.xls and Mortality_Anal.xls).

RESULTS

Long-Term Monitoring

Development of a Long-Term Monitoring Methodology

A Long-Term Monitoring Methodology Manual was developed over a six-month period between January and June, 1999, through successive iterations involving a review of current multi-disciplinary monitoring literature, consultations with organizations currently conducting long-term vegetation monitoring on public lands in Alaska and the western United States, and successive meetings with Conservation and Environmental Planning staff to refine the methods to meet EAFB needs. The resulting finalized document was approved by EAFB Conservation and Environmental Planning personnel and delivered under separate cover in July 1999. This completed manual in its entirety is presented in Appendix 1.

The Manual specifically details the design, layout and monumenting of permanent long-term monitoring plots. It also provides the physical site and vegetation sampling procedures to be implemented at each permanent plot or any other supplemental plots designated in the sampling design, and includes copies of all field data sampling forms used in the project in 1999, and recommended to be used in subsequent years. Detailed methods are also provided for directional notes and photo documentation to ensure future access and relocation of the LTVM plots. The Long-Term Monitoring Methodology provides for a statistical foundation for the collected sample data, assuring that the resulting data maintain statistical validity by employing a two-phase sampling design and providing for an adequate sample size through replicate samples within and between LTVM plots and cover types.

Establishment and Location of Long-Term Monitoring Plots

Long-term monitoring plots were established, monumented and characterized between June 15 and October 15, 1999. The following individuals participated in the 1999 field season:

Gerald (Jerry) Tande	(JT, TA)	Principal Investigator/Vegetation Ecologist
Susan Klein	(SK)	Field Assistant/Plant Ecologist
Julia Lenz	(JL)	Field Assistant/Assistant Data Manager
Rob Lipkin	(RL)	Botanist
Julie Michaelson	(JM)	Field Botanist/Ecologist/Data Manager/GIS Specialist

Abbreviations are provided for future reference to notations in the field data.

Thirty permanent monitoring plots were established; 24 of these were fully monumented and fully characterized to provide a baseline assessment for monitoring vegetation change. AKNHP staff believe that this number is adequate and representative for long-term monitoring (see Discussion). LTVM plots 25-30 were surveyed in, monumented, and recorded but no baseline characterization was completed. Initial site access and monumentation information is available in the Hard Archive and Electronic Archive Systems. EAFB Conservation and Environmental Planning personnel may choose to characterize these at later dates as time and budgets allow, and add them to the ongoing monitoring effort to strengthen the overall sample of particular cover types with specific management concerns as the latter are identified.

A map of the locations of all monitoring sites is found in Appendix 3. Plots were delineated on 1:25,000-scale USGS quads for EAFB and are stored in the "Hard Copy Archive System". They are also stored electronically in the ArcView GIS system developed for the project described further in the Data Management and Archive section below. Latitudes and longitudes with UTM equivalents for each plot are provided in their individual Site Descriptions below, and are summarized for all plots in Appendix 4.

The most precise locational data for permanent plots are the photogrammetry and forest mensuration distances and azimuths recorded in the field data, and corresponding locations pin pricked on the mylar airphoto overlays and 1995 airphotos used throughout this project. These products are stored in the Hard Archive System described later in this report.

Geographical Location Naming Conventions

All geographical naming conventions for deriving and documenting LTVM plot locations follow those used on the latest USGS 1:25,000-scale topo map selected as a basemap for the project's ArcView GIS component. It should be noted that a new system for naming streets was instituted on EAFB since the permanent plots were established, documented and all electronic records prepared. As a consequence, the following name changes are provided here for future cross-reference:

Burns Road	now	Airlifter Drive
Davis Road	now	Talley Avenue
Ridge Road	now	37th Street
Loop Road (running east and west north of Six Mile Lake)	now	46th Street
Loop Road (running north and south west of Lower Six Mile Lake)	now	Fairchild Avenue
Spring Lake and Antenna Field Road	now	42nd Street
Top of Hill Chalet Road	now	44th Street

Reference to these street changes are noted in the baseline plot descriptions that follow; however, they have not been changed in the original field data, the hard or electronic archives or the ArcView GIS.

Baseline Description and Characterization of Long-Term Monitoring Plots

Monitoring plots represent all major vegetation cover types greater than 300 A (122 ha) identified in the original 1983 vegetation inventory (Tande 1983) plus a smaller Bluejoint Grass Meadow cover type (Tande 1983) identified and requested for monitoring by EAFB Conservation and Environmental Planning staff as possessing significant management concerns.

All permanent plots were located away from areas of anticipated future disturbance and distributed to represent the various site types on the Elmendorf Moraine and Ground Moraine. Eight plots were located on the Elmendorf Moraine and 22 plots were located on the Ground Moraine. No permanent plots were situated on the Outwash Plain, Alluvium or Abandoned Channel Deposits (Figure 3, p. 10 in Tande 1983) due to current or anticipated disturbance, development or training activity.

A vegetation classification cross-walk (Appendix 5) was completed linking the 1983 EAFB mapping classification to the currently recognized state-wide classification of Alaska vegetation authored by Viereck et al. (1992). Although not formally recognized as part of the monitoring project, a very flexible, interactive GIS Attribute Table of the Viereck et al. (1992) alphanumeric EAFB cover type attributes was designed by AKNHP staff and provided to Base Conservation and Environmental Planning staff early in the project. This table was used to accompany the digitizing and production of an ArcView GIS database of the 1983 vegetation map by staff at the Center for the Ecological Management of Military Lands (CEMML), Colorado State University, Ft. Collins. The plant community-cover type cross-walk proved very useful in assisting in the location of permanent plots in major vegetation units, and identifying sites for a disturbed alder study (Tande et al. 2001).

Table 2 is a summary of the classification of LTVM plots within the Viereck et al. (1992) vegetation classification for Alaska. Once the CEMML GIS database is finalized (still in draft as of the preparation of this report), analyses of monitoring plot datasets by Base Conservation and Environmental Planning staff may be applied to specific locations and aerial estimates of any cover type attribute within and between cover types using the CEMML ArcView GIS system.

Site Descriptions

Site Descriptions are provided for the 24 fully monumented and characterized permanent monitoring plots in so far as the first year's baseline data would allow. Each plot Site Description is set up so each plot report may be removed as its own stand-alone report for future management and/or planning purposes.

In addition to the establishment of the 30 monitoring plots, 172 vegetation plots were used to characterize the variability of plant community types (Level 5 Viereck et al. 1992) within the major monitored vegetation cover types (Table 1). Forty-three Level 5 plant communities were identified and are summarized in Table 3. They were further incorporated into the permanent plot Site Descriptions below under "Associated Vegetation Types".

Baseline forest growing stock, regeneration and mortality data were summarized, and general results are reported in the Site Descriptions. Further summaries of this data in tabular form are reported later in this report.

Scientific nomenclature follows Hultén (1968) and Viereck and Little (1972). A complete list of scientific and common names for species encountered in all monitoring plots is found in Appendix 2. A complete species list for EAFB (Lipkin 2001) should be referred to when plots are remeasured in future years.

All representative photos for permanent plots reside in Appendix 6 and are reported by LTVM plot; additional photo documentation is available in the Hard Archive Files, EAFB Conservation and Environmental Planning Office.

Table 2. Classification of LTVM Plots within the Viereck et al. (1992) vegetation classification system for Alaska.

VIERECK CODE	DESCRIPTION	LTVM PLOT
I	Forest	
IA	**Needleleaf Forest**	
IA2F	Open Needleleaf Forest	
IA2F	Open Black Spruce Needleleaf Forest	
IA2F	Picea mariana/Equisetum sylvaticum/Sphagnum species-Pleurozium schreberi	4
IA2F	Picea mariana/Ledum groenlandicum/Equisetum sylvaticum/Sphagnum girgenshohnii	10
IA2F	Picea mariana/Equisetum sylvaticum/Pleurozium schreberi	8
IB	**Broadleaf Forest**	
IB1	**Closed Broadleaf Forest**	
IB1D	Closed Paper Birch Broadleaf Forest	
IB1D2	Betula papyrifera/Viburnum edule	2
IB1D7	Betula papyrifera/(Viburnum edule)/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis	7
IB1D99*	Betula papyrifera/Echinopanax horridum/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis	13
IB2	**Open Broadleaf Forest**	
IB2A	Open Paper Birch Broadleaf Forest	
IB2A99*	Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis	12
IC	**Mixed Forest**	
IC1	**Closed Mixed Forest**	
IC1A	**Closed Spruce-Paper Birch Mixed Forest**	
IC1A99*	Picea glauca-Betula papyrifera/Viburnum edule/Gymnocarpium dryopteris-Cornus canadensis-(Pyrola asarifolia)	1, 3
IC1A99*	Picea glauca-Betula papyrifera/Cornus canadensis	6
IC2	**Open Mixed Forest**	
IC2A	**Open Spruce-Paper Birch Mixed Forest**	
IC2A1	Picea glauca-Betula papyrifera/Menziesia ferrunginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium dryopteris-Dryopteris dilatata-Cornus canadensis	5
IC2A1	Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris	11, 17, 20
IC2A1	Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis	9
IC2A99*	Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/feathermoss	14, 15, 19

con't.

VIERECK CODE	DESCRIPTION	LTVM PLOT
II	**Shrub (Scrub)**	
IIB	**Tall Scrub**	
IIB1	**Closed Tall Scrub**	
IIB1B	**Closed Alder Tall Scrub**	
IIB1B99*	Alnus sinuata/Sambucus racemosa-Rubus idaeus-(Ribes triste)/Dryopeteris dilatata-(Gymnocarpium dryopteris)	18
IIB1B99*	Alnus sinuata/Rubus idaeus/Calamagrostis canadensis	21
IIB1B99*	Alnus tenuifolia/Rubus idaeus-(Ribes triste)/Calamagrostis canadensis-(Dryopteris dilatata)	22
III	**Herbaceous**	
IIIA	**Graminoid Herbaceous**	
IIIA2	**Mesic Graminoid Herbaceous**	
IIIA2A	**Bluejoint Meadow**	
IIIA2A1	Calamagrostis canadensis	24
IIIA2B	**Bluejoint-Herb**	
IIIA2B10	Rubus idaeus/Calamagrostis canadensis/Equisetum sylvaticum	16
IIIA2B99*	Calamagrostis canadensis-Agrostis scabra-Equisetum arvense-Sphagnum light green	23

*99. Level 5 type not currently/specifically reported in Viereck et al. (1992).

Table 3. Classification of LTVM Plots and additional plot data (Satellite Plots) within the Viereck et al. (1992) vegetation classification system for Alaska. Satellite Plots represent additional variability of Level 5 plant communities found within the vegetation map class (Tande 1983) in which the monitoring plots were established (Table 1).

VIERECK CODE	DESCRIPTION	LTVM PLOT	SATELLITE PLOT
I	**FOREST**		
IA	**Needleleaf Forest**		
IA1	**Closed Needleleaf Forest**		
IA1K	**Closed Black Spruce Needleleaf Forest**		
IA1K99*	Picea mariana/(Vaccinium vitis-idaea)/Pleurozium schreberi		JM006, 007,020
IA1K99*	Picea mariana/(Vaccinium vitis-idaea)/Ptilium crista-castrensis		JM039
IA2F	Open Needleleaf Forest		
IA2F	Open Black Spruce Needleleaf Forest		
IA2F	Picea mariana/Equisetum sylvaticum/Sphagnum species-Pleurozium schreberi	4	
IA2F	Picea mariana/Ledum groenlandicum/Equisetum sylvaticum/Sphagnum girgenshohnii	10	
IA2F	Picea mariana/Equisetum sylvaticum/Pleurozium schreberi	8	
IA2F1	Picea mariana/Betula gladulosa/(Rubus chamaemorus)/Sphagnum spp.		JM047
IA2F99*	Picea mariana/Ledum groenlandicum/Equisetum arvense/Sphagnum spp.		JM033
IA2F99*	Picea mariana/(Ledum groenlandicum)/Calamagrostis canadensis		JM048
IB	**Broadleaf Forest**		
IB1	**Closed Broadleaf Forest**		
IB1D	Closed Paper Birch Broadleaf Forest		
IB1D2	Betula papyrifera/Viburnum edule	2	
IB1D99*	Betula papyrifera/Viburnum edule-(Echinopanax horridum)/Calamagrostis canadensis		JM010
IB1D7	Betula papyrifera/(Viburnum edule)/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis	7	
IB1D99*	Betula papyrifera/Echinopanax horridum/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis	13	
IB1D99*	Betula papyrifera/Echinopanax horridum/Linnaea borealis		JM015
IB1D99*	Betula papyrifera/Echinopanax horridum-Viburnum edule/Gymnocarpium dryopteris-(Cornus canadensis)		JT1
IB1D99*	Betula papyrifera/Echinopanax horridum-Viburnum edule/Calamagrostis canadensis-Equisetum arvense		JM001
IB2	**Open Broadleaf Forest**		
IB2A	Open Paper Birch Broadleaf Forest		
IB2A99*	Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis	12	
IB2A99*	Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)		JM008, 009
IC	**Mixed Forest**		
IC1	**Closed Mixed Forest**		
IC1A	**Closed Spruce-Paper Birch Mixed Forest**		
IC1A99*	Picea glauca-Betula papyrifera/Viburnum edule/Gymnocarpium dryopteris-Cornus canadensis-(Pyrola asarifolia)	1, 3	
IC1A99*	Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Cornus canadensis/Pleurozium schreberi		JM057

VIERECK CODE	DESCRIPTION	LTVM PLOT	SATELLITE PLOT
IC1A99*	Betula papyrifera-(Picea glauca)/(Alnus sinuata)-Rosa acicularis/Equisetum arvense		JM062
IC1A99*	Betula papyrifera-(Picea glauca)/Dryopteris dilitata-Equisetum arvense-Lycopodium annotinum		JM003
IC1A99*	Picea glauca-Betula papyrifera/Cornus canadensis	6	
IC1A99*	Betula papyrifera-(Picea glauca)/Viburnum edule/Gymnocarpium dryopteris-Dryopteris dilitata		JM002
IC1A99*	Betula papyrifera-Picea glauca/Ledum groenlandicum-Vaccinium vitis-idaea/Cornus canadensis/Pleurozium schreberi		JM056
IC1A99*	Betula papyrifera-Picea glauca/Cornus canadensis/Pleurozium schreberi		JM055
IC1A99*	Betula papyrifera-(Picea glauca)/Pleurozium schreberi		JM029, 054
IC2	**Open Mixed Forest**		
IC2A	**Open Spruce-Paper Birch Mixed Forest**		
IC2A1	Picea glauca-Betula papyrifera/Menziesia ferrunginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis	5	
IC2A1	Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris	11,17, 20	
IC2A1	Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis	9	
IC2A99*	Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/feathermoss	14,15, 19	
IC2A99*	Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilitata)		JM060
IC2A99*	Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense		JM067
II	**SHRUB (SCRUB)**		
IIB	**Tall Scrub**		
IIB1	**Closed Tall Scrub**		
IIB1B	**Closed Alder Tall Scrub**		
IIB1B1	Alnus sinuata/Calamagrostis canadensis		JM042
IIB1B99*	Alnus sinuata/Calamagrostis canadensis (Osmorhiza depauperata)		JM034
IIB1B99*	Alnten/Calamagrostis canadensis (Equisetum fluviatile)		JM041
IIB1B99*	Alnus sinuata/Echinopanax horridum		JM063
IIB1B99*	Alnus sinuata/Equisetum arvense		JM066
IIB1B99*	Alnus sinuata/Sambucus racemosa-Rubus idaeus-(Ribes triste)/Dryopeteris dilatata-(Gymnocarpium dryopteris)	18	
IIB1B99*	Alnus sinuata/Rubus idaeus/Calamagrostis canadensis	21	
IIB1B99*	Alnus tenuifolia/Rubus idaeus-(Ribes triste)/Calamagrostis canadensis-(Dryopteris dilatata)	22	
III	**HERBACEOUS**		
IIIA	**Graminoid Herbaceous**		
IIIA2	**Mesic Graminoid Herbaceous**		
IIIA2A	**Bluejoint Meadow**		
IIIA2A1	Calamagrostis canadensis	24	
IIIA2B	**Bluejoint-Herb**		
IIIA2B10	Rubus idaeus/Calamagrostis canadensis/Equisetum sylvaticum	16	
IIIA2B99*	Calamagrostis canadensis-Agrostis scabra-Equisetum arvense-Sphagnum light green	23	

*99 Level 5 type not currently/specifically reported in Viereck et al. (1992).

Site Description

LTVMP 1

Viereck et al. (1992) Classification:

1C1A
Closed Mixed Paper Birch -White Spruce Forest (Closed *Betula papyrifera-Picea glauca / Viburnum edule / Gymnocarpium dryopteris-Cornus canadensis-Pyrola asarifolia*)

Tande (1983) Map Classification:

Map Class 10 (Closed Young Mixed Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IB1 (Paper Birch)

Location:

On the east central portion of the Base off Davis Road (Talley Avenue) south of Upper Six Mile Lake. The Reference Point (RP) is 103 m east along an established recreation vehicle trail that begins at Milepost 0.6 north on Davis Road from the intersection of Davis Road and Ridge Road (37th Street). Initial Point (IP) is 61 m north of the recreation trail from the Reference Point (RP).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 41′′
Longitude: 149° 46′ 07′′

Slope: 2 degrees
Aspect: N-NE
Elevation: 70 m msl

The Site

Description:

Gently rolling terrain of the Elmendorf Terminal Moraine. Site microtopography is micromounded: mounds are less than 0.3 m high.

History:

Long-term vegetation monitoring plot established July 12, 1999.

Stand origin unknown.

A bulldozed drainage for Davis Road (Talley Avenue) occurs between the plot and the road 25 m beyond the western perimeter of the mortality plot. The berm is covered with mixed forest with *Betula papyrifera* to 22 cm DBH.

Scattered collapsed military foxholes occur within and outside the mortality plot perimeter.

Vegetation:

In this 45-63 year old (DBH) stand, *Betula papyrifera* forms a closed canopy (80%) with a 4-7 m high open (35%) sapling layer of *Picea glauca*. The latter rarely penetrate the *Betula papyrifera* overstory. *Betula papyrifera* diameters range from 15-23 cm; *Picea glauca* diameters are 7-10 cm.

Viburnum edule dominates the low shrub layer. *Rosa acicularis* is occasionally present. The herbaceous cover of the site totals 75% with *Gymnocarpium dryopteris*, *Cornus canadensis* and *Pyrola asarifolia* being the dominant species. Conspicuous associated species include *Linnaea borealis* and *Trientalis europaea*. Litterfall is heavy in this predominantly deciduous stand effectively excluding most lichens and bryophytes. The moss *Eurynchium pulchellum* is commonly found on elevated downed wood and the bases of the *Betula papyrifera* trees but it has a very low cover value. Minimal mortality attributed to natural suppression and weather (e.g., snow bend, frost) characterizes the plot. The forest overstory is healthy with minimal wind, fungus or insect damage.

Associated Plant Communities:

Picea glauca-Betula papyrifera/Viburnum edule/Gymnocarpium dryopteris-Cornus canadensis-(Pyrola asarifolia)

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/(Alnus sinuata)-Rosa acicularis/Equisetum arvense Betula papyrifera-(Picea glauca)/Dryopteris dilatata-Equisetum arvense-Lycopodium annotinum

Picea glauca-Betula papyrifera/Cornus canadensis

Betula papyrifera-(Picea glauca)/Viburnum edule/Gymnocarpium dryopteris-Dryopteris dilatata

Betula papyrifera-Picea glauca/Ledum groenlandicum-Vaccinium vitis-idaea/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-Picea glauca/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/Pleurozium schreberi

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 261 - Deception - Kichatna -Disappoint Complex -complex-rolling
Soil Series: Deception - Kichatna -Disappoint
Parent Material: Loess over glacial outwash and loess over glacial till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 0.8 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 0.5 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 0.1 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 4 - damp to moist
Subjective Soil Moisture: 2 - dry

Photograph: Appendix 6, Plate 1

Site Description

LTVMP 2

Viereck et al. (1992) Classification:

IBID
Closed Paper Birch Forest (Closed *Betula papyrifera / Viburnum edule*)

Tande (1983) Map Classification:

Map Class 10 (Closed Young Paper Birch -White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IB1 (Paper Birch)

Location:

On the east central portion of the Base east of Davis Road (Talley Avenue). Accessed from a recreation trail at Milepost 0.3 mi. north of the junction of Davis Road and Ridge Road (37th Street). The Reference Point (RP) is 825 m east along the trail; the Initial Point (IP) is north upslope another 54 m.

Topo Map: Anchorage B 8 SE

Latitude: 61° 16′ 16′′
Longitude: 149° 45′ 52′′

Slope: 8 degrees
Aspect: S-SE
Elevation: 105 m msl

The Site

Description:

Gentle to steeply rolling in pitted terrain of the Elmendorf Terminal Moraine. Site is perched below a short north-south ridgeline on a gently sloping plateau, that drops off to a deep kettle depression or ice-block pit to the north. Site microtopography is slightly to moderately mounded: mounds are 0.3-1 m high and 3 m apart.

History:

Long-term vegetation monitoring plot established July 14, 1999. An insect trapping and monitoring station is located on the ridgeline west of the mortality plot.

Stand origin unknown.

Some windthrow of *Picea glauca* occur on the north ridge of the mortality plot. An ATV trail and a trail junction occur 100 m south of plot center, joining with a north-south hiking and ATV trail occupying a ravine 75 m east of the plot center. Four old eroding military foxholes occur within the mortality plot on the eastern edge of the ravine. A very old but standing military barbed wire fence runs down the ridge along the east side of the ravine.

Vegetation:

Betula papyrifera forms a nearly pure closed canopy (80%) forest of 45 to 75 year-old trees (dbh). Occasional clumps of large (22 cm) *Populus balsamifera* trees are scattered throughout the site; however , none occur on the LTVM plot. *Picea glauca* seedlings and saplings to 4 m are rare. A patchy tall shrub layer is dominated by *Echnopanax horridum* with a total cover of 15%. The low shrub layer consists primarily of *Viburnum edule* and occasionally *Sorbus scopulina* with a total cover of 21%. A drier phase of *Betula papyrifera* occurs on a south-facing slope at Subplot 4 and is dominated by *Shepherdia canadensis* (35%). There are a number of associated species, the most common being: *Linnaea borealis*, *Pyrola asarifolia*, *Actaea rubra*, *Trientalis europaea*, *Calamagrostis canadensis*, and *Osmorhiza depauperata*. Deciduous leaf and twig litter form a thick layer on the forest floor. On down logs and the bases of *Betula papyrifera* and *Populus balsamifera*, however, patches of *Polytrichum juniperinum* and *Eurynchium pulchellum* occur. Total cover is under 10%. The forest overstory is healthy with minimal wind, fungi or insect damage. Minimal mortality attributed to natural suppression and weather (e.g., snow bend, frost) characterizes the plot.

Associated Plant Communities:

Betula papyrifera/Viburnum edule

Betula papyrifera/Viburnum edule-(Echinopanax horridum)/Calamagrostis canadensis

Betula papyrifera/(Viburnum edule)/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Linnaea borealis

Betula papyrifera/Echinopanax horridum-Viburnum edule/Gymnocarpium dryopteris-(Cornus canadensis)

Betula papyrifera/Echinopanax horridum-Viburnum edule/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 262-Deception - Kichatna-Disappoint Complex - hilly
Soil Series: Deception - Kichatna-Disappoint
Parent Material: Loess or glacial outwash and loess over friable to firm, gravelly till
Rooting Depth: 50 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 1.4 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 1.3 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 3.1 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 4 - damp to moist
Subjective Soil Moisture: 3 - dry

Photograph: Appendix 6, Plate 2

Site Description

LTVMP 3

Viereck et al. (1992) Classification:

1C1A
Closed Mixed Paper Birch - White Spruce Forest (Closed *Betula papyrifera-Picea glauca / Viburnum edule / Gymnocarpium dryopteris-Cornus canadensis-Pyrola asarifolia*)

Tande (1983) Map Classification:

Map Class 10 (Closed Young Mixed Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IB1 (Paper Birch)

Location:

On the east central portion of the Base off Davis Road (Talley Avenue) south of Upper Six Mile Lake. Access the Reference Point (RP) 545 m east along an established recreation vehicle trail that begins at Milepost 0.6 north on Davis Road from the intersection of Davis Road and Ridge Road (37th Street). Proceed north of the recreation trail at 43 degrees for 137 m to the Initial Point (IP).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 37″
Longitude: 149° 45′ 48″

Slope: 3 degrees
Aspect: NE
Elevation: 70 m msl

The Site

Description:

Gently rolling terrain of the Elmendorf Terminal Moraine. Site microtopography is slightly mounded: mounds 0.3-1 m high and greater than 7 m apart.

History:

Long-term vegetation monitoring plot established July 19, 1999.

Stand origin unknown.

Vegetation:

In this 44-54 year old (dbh) stand, *Betula papyrifera* forms a closed canopy (80%) with scattered, large (22-26 cm DBH) *Populus balsamifera. Picea glauca* occupies an open (35%), 4-7 m high sapling layer. The latter only occasionally penetrate the *Betula papyrifera* overstory. *Betula papyrifera* diameters range from 15-26 cm; *Picea glauca* diameters are 7-14 cm.

Viburnum edule dominates the low shrub layer. *Rosa acicularis* is occasionally present. The herbaceous cover of the site totals 75% with *Gymnocarpium dryopteris*, *Cornus canadensis* and *Pyrola asarifolia* being the dominant species. Conspicuous associated species include *Linnaea borealis* and *Trientalis europaea*. Litterfall is heavy in this predominantly deciduous stand effectively excluding most lichens and bryophytes. The moss *Eurynchium pulchellum* is commonly found on elevated downed wood and the bases of trees but it has a very low cover value. Minimal mortality attributed to natural suppression and weather (e.g., snow bend, frost) characterizes the plot. The forest overstory is healthy with minimal wind, fungus or insect damage.

Associated Plant Communities:

Picea glauca-Betula papyrifera/Viburnum edule/Gymnocarpium dryopteris-Cornus canadensis-(Pyrola asarifolia)

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/(Alnus sinuata)-Rosa acicularis/Equisetum arvense Betula papyrifera-(Picea glauca)/Dryopteris dilatata-Equisetum arvense-Lycopodium annotinum

Picea glauca-Betula papyrifera/Cornus canadensis

Betula papyrifera-(Picea glauca)/Viburnum edule/Gymnocarpium dryopteris-Dryopteris dilatata

Betula papyrifera-Picea glauca/Ledum groenlandicum-Vaccinium vitis-idaea/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-Picea glauca/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/Pleurozium schreberi

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 261-Deception - Kichatna -Disappoint Complex -complex-rolling
Soil Series: Deception - Kichatna -Disappoint
Parent Material: Loess over glacial outwash and loess over glacial till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss : 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 1.3 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 2.1 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 2.9 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 4 - damp to moist
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 3

Site Description

LTVMP 4

Viereck et al. (1992) Classification:

IA2f
Open Black Spruce Forest (Open *Picea mariana /Equisetum sylvaticum /Sphagnum* spp.-*Pleurozium schreberi*)

Tande (1983) Map Classification:

Map Class 1 (Closed Black Spruce Forest)

CEMML (1998) Map Classification:

Map Class IA1 (Black Spruce)

Location:

On the east central portion of the Base off Davis Road (Talley Avenue) south of Upper Six Mile Lake; 125 m east of a hill cleared for a large antenna field at Milepost 0.7 from the junction of Davis Road with Ridge Road (37th Street).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 50″
Longitude: 149° 46′ 00″

Slope: flat
Aspect: flat
Elevation: 75 m msl

The Site

Description:

A shallow depression within gently rolling to nearly flat terrain of the Elmendorf Ground Moraine on the border with the Elmendorf Moraine.

Site microtography is moderately mounded; mounds are 0.3-1 m high and 3-7 m apart.

History:

Long-term vegetation monitoring plot established July 20, 1999. A meteorological station is maintained on an open hill at the antenna field complex 225 m west.

Stand origin unknown, although suspect forest fire, as a fire margin exists on the edge of the mortality plot at Subplot 2 to the north, and a 5 mm charcoal layer is evident in the fibric layer of the soil profile. A remnant stand of fire-scarred *Picea mariana* were dated at 127-166 years old dbh. More remnant patches of fire-scarred *Picea glauca* were found to the north near LTVMP 6.

A very old 1 m wide cutline traverses the site north to south near Subplots 1 and 2.

Vegetation:

LTVM plot 4 is an open forest of *Picea mariana*; total tree canopy is 43%. The stand exhibits extensive layering; the dominant size and height class is composed of 3-10 cm DBH sapling size trees 4-8 m high. A tall tree layer of 13-17 cm DBH and 14 m high individuals occurs as occasional remnant stands especially north near the border with the upland Closed *Betula papyrifera* Forest margin. The smaller size classes were aged at 41-43 at DBH; the larger 127-166 at DBH.

The stand has experienced fire in the past. The larger *Picea glauca* are fire-scarred, and numerous fallen, fire-charred snags of the previous forest are found under the moss layer. A 5 mm charcoal layer is found in the fibric layer of the soil profile.

The tall shrub layer (1.5 m-<3 m) is conspicuous with 11% cover and is composed of dwarf/stunted/layered *Picea mariana*. The low shrub layer is sparse (4% cover) and is composed primarily of *Picea mariana*, *Spiraea beauverdiana* and *Ledum groenlandicum*.

A dense cover of herbs and dwarf shrubs (66% cover) is dominated by *Equisetum sylvaticum*, *Cornus canadensis*, *Rubus chamaemorus* and *Vaccinium vitis-idaea*. Associated species include: *Epilobium angustifolium*, *Calamagrostis canadensis*, *Oxycoccus microcarpus* and *Andromeda polifolia*. The moss cover is nearly continuous with 70% cover and is principally *Sphagnum* spp. and *Pleurozium schreberi*. Associated species include *Rhytidiadelphus triquetrus* and *Tomenthypnum nitens*. Lichens are also common (15% cover) with *Peltigera canina*, *Peltigera aphthosa*, *Lobaria linita*, *Nephroma arcticum*, *Peltigera malacea* and *Cladonia* spp. being the most common.

Minimal active or standing mortality attributed to natural suppression and weather (e.g., snow bend, frost) characterize the plot. The forest overstory is generally healthy with minimal wind, fungus or insect damage. However, evidence of spruce bark beetles as exhibited by the presence of frass and pitching (resinosis) associated with bore holes was observed in the older-growth *Picea mariana* near Subplot 2.

Associated Plant Communities:

Picea mariana/(Vaccinium vitis-idaea)/Pleurozium schreberi

Picea mariana/(Vaccinium vitis-idaea)/Ptilium crista-castrensis

Picea mariana/Equisetum sylvaticum/Sphagnum species-Pleurozium schreberi

Picea mariana/Ledum groenlandicum/Equisetum sylvaticum/Sphagnum girgenshohnii

Picea mariana/Equisetum sylvaticum/Pleurozium schreberi

Picea mariana/Betula glandulosa/(Rubus chamaemorus)/Sphagnum spp.

Picea mariana/Ledum groenlandicum/Equisetum arvense/Sphagnum spp.

Picea mariana/(Ledum groenlandicum)/Calamagrostis canadensis

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 205 - Clam Gulch Silt Loam, 0-3% slopes
Soil Series: Clam Gulch
Parent Material: Old alluvium or lacustrine deposits
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 14.5 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 16.0 m
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 19.8 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 23.7 m
Permafrost: None. Remnant, late-summer ice layers are common at 5-10 cm in more closed portions of the plot.

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 6 - mesic
Subjective Soil Moisture: 5 - moist

Photograph: Appendix 6, Plate 4

Site Description

LTVMP 5

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Menziesia ferruginea-Echnopanax horridum-Viburnum edule-Rosa acicularis / Calamagrostis canadensis-Gymnocarpium dryopteris-Dryopteris dilatata-Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC2 (Spruce -Paper Birch)

Location:

On the eastern portion of the Base off Davis Road (Talley Avenue) south of Upper Six Mile Lake; 305 m east of a hill cleared for a large antenna field at Milepost 0.7 from the junction of Davis Road with Ridge Road (37th Street).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 52′′
Longitude: 149° 45′ 33′′

Slope: 1 degree
Aspect: NW
Elevation: 73 m msl

The Site

Description:

Moderately rolling to flat terrain of the Elmendorf Ground Moraine.

Site microtopography is moderately mounded: mounds are 0.3-1 m high and 3-7 m apart. Hummocky terrain is the result of extensive blowdown of old trees.

History:

Long-term vegetation monitoring plot established July 22, 1999.

Stand origin unknown.

Vegetation:

LTVM plot 5 is in a semi-open, old-growth forest of large, widely-spaced individuals of *Betula papyrifera* (diameters of 33-58 cm and heights to 22 m) and *Picea glauca* (diameters of 18-49 cm and heights to 33 m). Total tree canopy cover is 40%. *Picea glauca* are in two age cohorts: 53-60 years and > 217 years dbh. This forest element alternates or is interspersed with dense shrub patches of *Echnopanax horridum* and *Menziesia ferruginea.*

Fungal decay of *Betula papyrifera*, and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent, extensive blowdown across this plot. Standing *Betula papyrifera* have wind-snapped tops and numerous fungal conks (*Fomes* spp.). *Picea glauca* have been attacked by bark beetles leaving numerous dead, standing trees. The LTVM plot is littered with dead and down individuals from significant bark beetle kill over the past five years, hampering travel in this vegetation type. Microrelief is very hummocky due to clumps of *Calamagrostis canadensis* and the large numbers of fallen trees and upturned tree roots that have been covered by the forest floor vegetation over time.

The shrub layer is conspicuous with 43% cover and is dominated by *Echnopanax horridum*, *Menziesia ferruginea*, *Viburnum edule* and *Rosa acicularis*. The herb layer is continuous but not species rich. Dominant species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Dryopteris dilatata*, *Cornus canadensis* and *Equisetum arvense*. Other associated species include: *Lycopodium annotinum*, *Trientalis europaea*, *Equisetum sylvaticum*, *Vaccinium vitis-idaea* and *Linnaea borealis*. Moss and lichen cover is limited to fallen logs and tree bases. Many nurse logs are covered with the feather mosses *Hylocomium splendens*, *Pleurozium schreberi* and *Rhytidiadelphus triquetrus*. Drier logs support *Dicranum* spp. and *Polytrichum juniperinum*.

Regeneration of tree species is low. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings are filled by *Calamagrostis canadensis*, *Echnopanax horridum*, *Menziesia ferruginea*, and *Spiraea beauverdiana*. *Picea glauca* seedlings and saplings 0.3-1 m high are scattered throughout the plot on nurse logs but do not appear to be filling the gaps left by parent trees. *Betula papyrifera* seedling density is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. The seedlings, however, have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/(Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 262 - Deception-Kichatna-Disappoint Complex - hilly
Soil Series: Deception-Kichatna-Disappoint
Parent Material: Loess or glacial outwash and loess over friable to firm, gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.6 m
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 4.8 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 6.0 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 5

Site Description

LTVMP 6

Viereck et al. (1992) Classification:

IC1A
Closed Mixed Paper Birch -White Spruce Forest (Closed *Betula papyrifera-Picea glauca / Viburnum edule / Cornus canadensis-Equisetum sylvaticum*)

Tande (1983) Map Classification:

Map Class 10 (Closed Young Mixed Paper Birch -White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IB1 (Paper Birch)

Location:

On the east central portion of the Base off Davis Road (Talley Avenue) south of Upper Six Mile Lake; 122 m east of a hill cleared for a large antenna field at Milepost 0.7 from the junction of Davis Road with Ridge Road (37th Street).

Topo Map: Anchorage B 8 SE

Latitude: 61° 16′ 55″
Longitude: 149° 45′ 56″

Slope: 1 degree
Aspect: N
Elevation: 75 m msl

The Site

Description:

Gently rolling to nearly flat terrain of the Elmendorf Ground Moraine. Site microtopography is micromounded: mounds are less than 0.3 m high.

History:

Long-term vegetation monitoring plot established July 22, 1999. A meteorological station is maintained on an open hill at the antenna field complex 225 m west.

Stand origin unknown, although forest fire is suspected. A fire margin exists outside the mortality plot at Subplot 3 to the east. A remnant stand of fire-scarred *Picea glauca* were dated at 148-184 years old at dbh. More remnant patches of fire-scarred *Picea glauca* were found south of the Reference Point (RP) near LTVM plot 4.

Vegetation:

Betula papyrifera is 40-63 years old (DBH) and forms a closed canopy (85%) with a 5 m high, open (25%) sapling layer of *Picea glauca*. The latter rarely penetrate the *Betula papyrifera* overstory. *Betula papyrifera* diameters range from 13-24 cm DBH. A continuous shrub layer is conspicuously lacking although patches of *Viburnum edule* complimented by *Rosa acicularis* and *Ribes triste* occur throughout the plot.

The herbaceous layer is notably dominated by large patches of the dwarf shrub *Cornus canadensis* (25%), large areas of barren leaf litter, and occasional drier-site species that include: *Vaccinium vitis-idaea*, *Pyrola secunda*, *Equisetum arvense* and an upland unknown *Carex* spp. On slightly moisture sites, dense stands of *Equisetum sylvaticum* are equally co-dominant with *Cornus canadensis*. Associated species include: *Linnaea borealis*, *Trientalis europaea* and *Pyrola asarifolia*.

This younger forest is in an earlier, rapid stage of natural thinning and, consequently, the amount of dead and down tree cover is greater (13%). This has allowed for more moss and lichen habitat elevated above the forest floor which has a continuous dense layer of leaf litter. A 22% moss cover is dominated by *Pleurozium schreberi*, *Eurynchium pulchellum*, *Dicranum* spp. and *Polytrichum juniperinum*. Lichen cover (4%) is principally the leafy lichen species *Lobaria linita* and *Peltigera aphthosa*.

Minimal active or standing mortality attributed to natural suppression and weather (e.g., snow bend, frost) characterize the plot. The forest overstory is generally healthy with minimal wind, fungus or insect damage. However, numerous *Betula papyrifera* have experienced 75-90% girdling, 10 cm above the ground within the last couple years, possibly attributable to hare or porcupine. The irregular, elongate, rectangular scars though healing, have significantly affected tree health that is reflected in higher crown transparencies and lower crown densities of individual affected trees in the plot.

Associated Plant Communities:

Picea glauca-Betula papyrifera/Viburnum edule/Gymnocarpium dryopteris-Cornus canadensis-(Pyrola asarifolia)

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/(Alnus sinuata)-Rosa acicularis/Equisetum arvense Betula papyrifera-(Picea glauca)/Dryopteris dilatata-Equisetum arvense-Lycopodium annotinum

Picea glauca-Betula papyrifera/Cornus canadensis

Betula papyrifera-(Picea glauca)/Viburnum edule/Gymnocarpium dryopteris-Dryopteris dilatata

Betula papyrifera-Picea glauca/Ledum groenlandicum-Vaccinium vitis-idaea/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-Picea glauca/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/Pleurozium schreberi

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 261 - Deception - Kichatna- Disappoint Complex -complex-rolling
Soil Series: Deception - Kichatna- Disappoint
Parent Material: Loess over glacial outwash and loess over glacial till
Rooting Depth: > 30 cm
Depth to the Bottom of Live Moss: 1.1 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 1.8 cm

Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 2.4 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 2.3 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 6

Site Description

LTVMP 7

Viereck et al. (1992) Classification:

IB1D
Closed Paper Birch Forest (Closed *Betula papyrifera* /*Viburnum edule* /*Calamagrostis canadensis*-*Gymnocarpium dryopteris*-*Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 4 (Closed Paper Birch Forest)

CEMML (1998) Map Classification:

Map Class IB1 (Paper Birch)

Location:

On the south side of a recreational trail on the high ridgeline of the Elmendorf Moraine, south of Lower Six Mile Lake, and halfway between Loop Road (Fairchild Avenue) and Davis Road (Talley Avenue).

Topo Map: Anchorage B 8 SE

Latitude: 61° 16′ 52″
Longitude: 149° 47′ 36″

Slope: 6 degrees
Aspect: S
Elevation: 75 m msl

The Site

Description:

Undulating, gentle south-sloping terrain of the Elmendorf Terminal Moraine. Deep kettle depressions or ice-block pits occur to the north and south of the plot. Site microtopography is slightly mounded: mounds are 0.3-1 m high and more than 7 m apart. Hummocky terrain is the result of the blowdown of trees killed by past fires.

History:

Long-term vegetation monitoring plot established July 23, 1999.

Stand origin unknown; however, numerous charred stumps and fallen tree trunks long since covered by vegetation suggest a fire origin, date unknown. The stand is bordered to the east and west by abrupt margins with an open old-growth mixed forest further suggesting a fire origin for this plot.

Vegetation:

Betula papyrifera (15-26 cm dbh) forms a closed canopy (85%) with scattered large (to 37 cm DBH) *Populus balsamifera*. Ages of *Betula papyrifera* range from 53-67 years DBH. Numerous large, old *Betula papyrifera* logs and stumps overgrown with forest floor vegetation serve as nurse logs for the occasional *Picea glauca* seedlings or saplings that grow to 2-7 m high.

Viburnum edule dominates the shrub layer. Scattered patches of *Echnopanax horridum* occur throughout the plot. Associated shrub species include: *Sorbus scopulina*, *Sambucus racemosa* and *Rosa acicularis*.

The herbaceous understory is dominated by the oblique dominant *Calamagrostis canadensis*, *Gymnocarpium dryopteris* and *Cornus canadensis*. Associated species include: *Osmorhiza depauperata*, *Linnaea borealis*, *Trientalis borealis*, *Galium trifidum* and *Pyrola asarifolia*. Elevated old logs and stumps support a number of mosses (*Eurynchium pulchellum*, *Pleurozium schreberi*, *Polytrichum juniperinum*), *Cladonia* lichens and the leafy lichen *Peltigera aphthosa*.

The plot is characterized by minimal mortality attributable to natural suppression and weather (e.g., snow bend, frost). The forest overstory is healthy with little wind, fungus or insect damage.

Associated Plant Communities:

Betula papyrifera/Viburnum edule

Betula papyrifera/Viburnum edule-(Echinopanax horridum)/Calamagrostis canadensis

Betula papyrifera/(Viburnum edule)/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Linnaea borealis

Betula papyrifera/Echinopanax horridum-Viburnum edule/Gymnocarpium dryopteris-(Cornus canadensis)

Betula papyrifera/Echinopanax horridum-Viburnum edule/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 261 - Deception- Kichatna- Disappoint Complex -complex-rolling
Soil Series: Deception- Kichatna- Disappoint
Parent Material: Loess over glacial outwash and loess over glacial till
Rooting Depth: > 30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.0 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 3.9 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 0.8 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 7

Site Description

LTVMP 8

Viereck et al. (1992) Classification:

IA2f
Open Black Spruce Forest (Open *Picea mariana* / *Equisetum sylvaticum* / *Pleurozium schreberi*)

Tande (1983) Map Classification:

Map Class I (Closed Black Spruce Forest)

CEMML (1998) Map Classification:

Map Class IA1 (Black Spruce)

Location:

On the central portion of the Base south of Lower Six Mile Lake; 1.5 km east of the junction of Loop Road (Fairchild Avenue) and Top O' the Hill Chalet Road (44th Avenue).

Topo Map: Anchorage B8 SE

Latitude: 61° 17′ 14″
Longitude: 149° 48′ 17″

Slope: flat
Aspect: flat
Elevation: 40 m msl

The Site

Description:

Nearly flat terrain of the Elmendorf Ground Moraine.

Site microtography is moderately mounded; mounds are 0.3-1 m high and 3-7 m apart.

History:

Long-term vegetation monitoring plot established August 22, 1999.

Stand origin unknown, although forest fire played a role in the past as evidenced by old moss-covered charred snags.

Vegetation:

LTVM plot 8 is an open forest of old-growth *Picea mariana*. Total tree canopy is 56%. The stand exhibits extensive layering of predominately two size and height classes.

The dominant tall tree layer is composed of 13-24 cm dbh , 13-15 m high individuals with distinctive red, flaking bark characteristic of very old trees. A second dominant understory tree layer is composed of 3-12 cm DBH sapling-size trees 3.5-10 m high. The smaller size classes were aged at 43-98 years DBH; the larger overstory trees were aged at 129-224 years from cores collected at

20 cm above the ground. The stand has experienced fire in the past. The larger *Picea glauca* are fire-scarred, and numerous fallen, fire-charred snags of the previous forest are found under the moss layer. Charcoal fragments were found in the sapric layer of the soil profile.

A weak (8% cover) tall shrub layer (1.5 m-<3 m) is composed of dwarf/stunted/layered *Picea mariana*. The low shrub layer is sparse (6% cover) and is composed primarily of *Picea mariana*, *Ledum decumbens* and *Ledum groenlandicum*.

A weak herb layer (6% cover) and conspicuous dwarf shrub layer (30% cover) is dominated by *Cornus canadensis*, *Vaccinium vitis-idaea* , *Empetrum nigrum* , *Geocaulon lividum* and *Linnaea borealis*. The moss cover is nearly continuous with 90% cover and is principally *Sphagnum* spp., *Pleurozium schreberi* , and associated feathermosses *Hylocomium splendens* and *Ptilium crista-castrensis*. Other moss species include *Sphagnum girgenshohnii* and *Polytrichum juniperinum*. Lichens are also common (21% cover) with *Nephroma arcticum*, *Peltigera aphthosa* and *Peltigera membranacea* being the most common.

Minimal active or standing mortality attributable to natural suppression and weather (e.g., snow bend, frost) characterize the plot. The forest overstory is generally healthy with minimal wind, fungus or insect damage. However, evidence of spruce bark beetles as exhibited by the presence of frass and pitching (resinosis) associated with bore holes was observed in the older-growth *Picea mariana* on the mortality plot.

Associated Plant Communities:

Picea mariana/(Vaccinium vitis-idaea)/Pleurozium schreberi

Picea mariana/(Vaccinium vitis-idaea)/Ptilium crista-castrensis

Picea mariana/Equisetum sylvaticum/Sphagnum species-Pleurozium schreberi

Picea mariana/Ledum groenlandicum/Equisetum sylvaticum/Sphagnum girgenshohnii

Picea mariana/Equisetum sylvaticum/Pleurozium schreberi

Picea mariana/Betula glandulosa/(Rubus chamaemorus)/Sphagnum spp.

Picea mariana/Ledum groenlandicum/Equisetum arvense/Sphagnum spp.

Picea mariana/(Ledum groenlandicum)/Calamagrostis canadensis

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 260 - Kichatna - Purches Variant - Jacobsen Complex, nearly level and sloping
Soil Series: Kichatna - Purches Variant - Jacobsen
Parent Material: Loess over glacial outwash and colluvium over glacial outwash
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 5. 4 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.4 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 3.4 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 4.9 m
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 6 - mesic
Subjective Soil Moisture: 6 - moist to wet

Photograph: Appendix 6, Plate 8

Site Description

LTVMP 9

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca-Betula papyrifera /Viburnum edule / Calamagrostis canadensis-Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 8 (Closed Old-Growth Paper Birch-White Spruce Forest with Alder)

CEMML (1998) Map Classification:
Map Class IB2 (Paper Birch)

Location:

South of Lower Six Mile Lake and east of Spring Lake; east 180 m at Milepost 2.9 of Loop Road (Fairchild Avenue) from the Loop Road junction with Burns Road (Airlifter Drive).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 59″
Longitude: 149° 48′ 22″

Slope: 5 degrees
Aspect: Variable due to pitted terrain
Elevation: 50 m msl

The Site

Description:

Pitted to rolling terrain of the Elmendorf Ground Moraine.

Site microtopography is moderately mounded: mounds are 0.3-1 m high and 3-7 m apart. Hummocky terrain is the result of blowdown of old trees.

History:

Long-term vegetation monitoring plot established July 23, 1999.

Stand origin unknown.

Vegetation:

LTVM plot 9 in a semi-open, old-growth forest of large, widely-spaced individuals of *Picea glauca* (diameters of 13-40 cm dbh and heights to 19 m) and *Betula papyrifera* (diameters of 9-42 cm DBH and heights to 18 m). Total tree canopy cover is 51%. *Picea glauca* are in two age cohorts: ca. 68 years and 149-181 years DBH. This forest element alternates or is interspersed with dense shrub patches of *Alnus sinuata* or *Echnopanax horridum*, and forest openings dominated by *Calamagrostis canadensis*.

A locally dense tall shrub layer is dominated by *Alnus sinuata* and *Sambucus racemosa*. The low shrub layer is conspicuous with 39% cover and is dominated by *Echnopanax horridum*, *Viburnum edule*, *Rosa acicularis* and *Ribes triste*. The herb layer is continuous but not species rich. Dominant species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Dryopteris dilatata*, *Cornus canadensis Equisetum sylvaticum* and *Equisetum arvense*. Other associated species include: *Trientalis europaea*, *Vaccinium vitis-idaea* and *Linnaea borealis*. Moss and lichen cover is limited to fallen logs and tree bases. Many nurse logs are covered with the feather mosses *Hylocomium splendens*, *Pleurozium schreberi* and *Rhytidiadelphus triquetrus*. Drier logs support *Dicranum* spp. and *Polytrichum juniperinum*. *Eurynchium pulchellum* is common on the bases of trees, and stems of *Alnus sinuata* and *Echnopanax horridum*.

Fungal decay of *Betula papyrifera*, and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent, extensive blowdown across this plot. *Picea glauca* have been attacked by spruce bark beetles leaving numerous dead, standing trees. Standing *Betula papyrifera* have wind-snapped tops and many fungal conks (*Fomes* spp.). A large number of very tall (to 22 m) and large diameter (to 54 cm DBH) beetle-killed *Picea glauca* characterize this plot. Mortality appears to be ongoing though most trees were killed in 1994. The LTVM plot is littered with dead and down individuals from this significant bark beetle kill over the past five years, hampering travel in this vegetation type. Microrelief is very hummocky due to clumps of *Calamagrostis canadensis* and the large numbers of fallen trees and upturned tree roots that have been covered by the forest floor vegetation over time.

Regeneration of tree species is low. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings that are created are filled by *Calamagrostis canadensis*, *Alnus sinuata* and *Echnopanax horridum*. *Picea glauca* seedlings and saplings 0.3-1 m high are scattered throughout the plot on nurse logs but do not appear to be filling the gaps left by parent trees. *Betula papyrifera* seedling density is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. The seedlings, however, have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 159 - Kichatna - Deception Silt Loams, steep
Soil Series: Kichatna - Deception
Parent Material: Loess or glacial outwash and loess over friable to firm, gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.6 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 4.8 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.1 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 4 - moist
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 9

Site Description

LTVMP 10

Viereck et al. (1992) Classification:

IA2f
Open Black Spruce Forest (Open *Picea mariana* / *Ledum decumbens* / *Equisetum sylvaticum-Vaccinium vitis-idaea-Empetrum nigrum* / *Sphagnum girgenshohnii-Pleurozium schreberi*)

Tande (1983) Map Classification:

Map Class 1 (Closed Black Spruce Forest)

CEMML (1998) Map Classification:

Map Class IA1 (Black Spruce)

Location:

On the central portion of the Base on the north side of Loop Road north of Upper Six Mile Lake (46th Street), and east of Beebe Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 17′ 44″
Longitude: 149° 47′ 25″

Slope: flat
Aspect: flat
Elevation: 32 m msl

The Site

Description:

Nearly flat terrain of the Elmendorf Ground Moraine.

Site microtography is moderately mounded; mounds are 0.3-1 m high and 3-7 m apart.

History:

Long-term vegetation monitoring plot established July 28, 1999.

Stand origin unknown.

Area homesteaded by Harold Beebe in the 1930-1939 period.

Vegetation:

LTVM plot 10 is an open forest of old-growth *Picea mariana*. Total tree canopy is 36%. The stand exhibits extensive layering of predominately two size and height classes. The dominant tall tree layer is composed of 13-18 cm dbh, 11 m high individuals with distinctive red, flaking bark characteristic of old trees. A second dominant understory tree layer, perhaps the result of layering, is composed of sapling-size trees 1-9 m high. The smaller size classes were aged at 27-36 years

DBH; the larger overstory trees were aged at 121-138 years DBH.

A weak (6% cover) tall shrub layer (1.5 m-<3 m) is composed of dwarf/stunted/layered *Picea mariana*. The low shrub layer is nearly continuous (34% cover) and is composed primarily of *Picea mariana*, *Ledum decumbens*, *Rosa acicularis* and *Spiraea beauverdiana*. The dwarf shrub layer and herb layer are conspicuous with 45% and 49% cover, respectively. The former is dominated by *Rubus chamaemorus*, *Cornus canadensis*, *Vaccinium vitis-idaea* and *Empetrum nigrum*. The latter is dominated by *Equisetum sylvaticum*, *Calamagrostis canadensis*, *Geocaulon lividum* and *Epilobium angustifolium*.

The moss cover is nearly continuous with 74% cover and is principally *Sphagnum girgenshohnii*, *Pleurozium schreberi* and *Tomenthypnum nitens*. Associated species include *Polytrichum juniperinum* and *Hylocomium splendens*. Lichen cover is 10% with *Peltigera aphthosa*, *Nephroma arcticum*, *Lobaria linita* and *Peltigera membranacea* being the most common.

Minimal active or standing mortality attributable to natural suppression and weather (e.g., snow bend, frost) characterize the plot. The forest overstory is generally healthy with minimal wind, fungus or insect damage. However, evidence of spruce bark beetles as exhibited by the presence of frass and pitching (resinosis) associated with bore holes was observed in the older-growth *Picea mariana* on the mortality plot.

Associated Plant Communities:

Picea mariana/(Vaccinium vitis-idaea)/Pleurozium schreberi

Picea mariana/(Vaccinium vitis-idaea)/Ptilium crista-castrensis

Picea mariana/Equisetum sylvaticum/Sphagnum species-Pleurozium schreberi

Picea mariana/Ledum groenlandicum/Equisetum sylvaticum/Sphagnum girgenshohnii

Picea mariana/Equisetum sylvaticum/Pleurozium schreberi

Picea mariana/Betula glandulosa/(Rubus chamaemorus)/Sphagnum spp.

Picea mariana/Ledum groenlandicum/Equisetum arvense/Sphagnum spp.

Picea mariana/(Ledum groenlandicum)/Calamagrostis canadensis

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 217 - Doroshin Mucky Peat, 0-3% slopes
Soil Series: Doroshin
Parent Material: Organic material over loamy deposits
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 10.0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 4.6 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 7.4 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 9.6 cm
Permafrost:
None. Remnant, late-summer ice layers are common at 5-10 cm in more closed portions of the plot.

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 5 - dry to mesic
Subjective Soil Moisture: 6 - moist to wet

Photograph: Appendix 6, Plate 10

Site Description

LTVMP 11

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Alnus* spp.- *Viburnum edule -Rosa acicularis -Rubus idaeus / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC2 (Spruce-Paper Birch)

Location:

On the north part of the Base, north of Lower Six Mile Lake and Lake Beebe, west of the Small Arms Firing Range.

Topo Map: Anchorage B8 SE

Latitude: 61° 18′ 04″
Longitude: 149° 47′ 16″

Slope: 2 degrees
Aspect: E-NE
Elevation: 60 m msl

The Site

Description:

Gently rolling terrain of the Elmendorf Ground Moraine.

Site microtopography is extremely mounded: mounds are > 1 m high and > 3 m apart. This extreme mounding is the result of old tipups from blowdown of old trees.

History:

Long-term vegetation monitoring plot established July 28, 1999.

Stand origin unknown.

Vegetation:

LTVM plot 11 is in an open, old-growth forest of large, widely-spaced individuals of *Betula papyrifera* (diameters of 22-55 cm dbh and heights to 36 m) and *Picea glauca* (diameters of 13- 35 cm DBH and heights to 21 m). Total tree canopy cover is 21%. *Picea glauca* are in two age cohorts: 22-31 and > 191 years DBH. This forest element alternates or is interspersed with dense shrub patches of *Alnus* spp. or *Echnopanax horridum*, and forest openings dominated by

Calamagrostis canadensis to 2 m high.

A locally dense tall shrub layer is dominated by *Alnus crispa /sinuata*. The low shrub layer is conspicuous with 33% cover and is dominated by *Echnopanax horridum, Viburnum edule, Rosa acicularis, Rubus idaeus, Ribes triste* and *Sorbus scopulina*. The herb layer is continuous and species rich. Dominant species are *Calamagrostis canadensis, Gymnocarpium dryopteris, Dryopteris dilatata, Cornus canadensis* and *Equisetum arvense*. Other associated species include: *Trientalis europaea, Lycopodium annotinum* , *Equisetum sylvaticum* and *Linnaea borealis*. Moss and lichen cover is limited to fallen logs and tree bases. Many nurse logs are covered with the feather moss *Pleurozium schreberi*. Drier logs support *Dicranum* spp.; *Eurynchium pulchellum* is common on the bases of trees.

Fungal decay of *Betula papyrifera*, and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent, extensive blowdown across this plot. *Picea glauca* have been attacked by spruce bark beetles leaving numerous dead, standing trees. Standing *Betula papyrifera* have wind-snapped tops and many fungal conks (*Fomes* spp.). Most *Picea glauca* on the LTVM plot have succumbed to spruce bark beetle and were killed in 1994; mortality in the vicinity appears to be ongoing. The LTVM plot is littered with dead and down individuals from this significant bark beetle kill over the past five years, hampering travel in this vegetation type. Microrelief is very hummocky due to clumps of *Calamagrostis canadensis* and the large numbers of fallen trees and upturned tree roots that have been covered by the forest floor vegetation over time.

Regeneration of tree species is low. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings that are created are filled by *Calamagrostis canadensis, Alnus* spp.and *Echnopanax horridum. Picea glauca* seedlings and saplings 0.3-1 m high are scattered throughout the plot on nurse logs and appear to be filling the gaps left by parent trees. *Betula papyrifera* seedling density is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. The seedlings, however, have been browsed heavily by hare and moose, and as a result, do not contribute substantial new *Betula papyrifera* regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 128 - Deception-Estelle Silty Loams, undulating
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 4.5 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 5.0 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.5 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 4 - moist
Subjective Soil Moisture: 2 - very dry

Photograph: Appendix 6, Plate 11

Site Description

LTVMP 12

Viereck et al. (1992) Classification:

IB1
Open Birch Forest (Open *Betula papyrifera / Echnopanax horridum-Sambucus racemosa-Viburnum edule / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch -White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC1 (White Spruce-Paper Birch-Balsam Poplar)

Location:

On the north part of the Base, north of Lower Six Mile Lake and Lake Beebe, and east of the Ammunition Storage Facility (Ammo Land).

Topo Map: Anchorage B8 SE

Latitude: 61° 18′ 10″
Longitude: 149° 47′ 19″

Slope: 3 degrees
Aspect: N
Elevation: 65 m msl

The Site

Description:

Flat to gently rolling terrain of the Elmendorf Ground Moraine. Site microtopography is moderately mounded: mounds are 0.3-1 m high and 3-7 m apart. Hummocky terrain is the result of blowdown of old trees.

History:

Long-term vegetation monitoring plot established August 2, 1999.

Stand origin unknown.

Vegetation:

LTVM plot 12 is a semi-open, old-growth forest of large, widely-spaced individuals of *Betula papyrifera* with diameters of 45-66 cm and heights to 18 m. Total tree canopy cover is 30%. No *Betula papyrifera* ages are available; however, *Picea glauca* aged outside the LTVM plot are 138-181 years dbh. This forest element alternates or is interspersed with dense patches of *Alnus crispa* tall shrub; *Echnopanax horridum - Sambucus racemosa* midshrub; *Viburnum edule* low shrub; and *Calamagrostis canadensis* grass meadows. Microrelief is very hummocky due to clumps of *Calamagrostis canadensis* and large numbers of fallen trees and upturned tree roots that have been covered by the forest floor vegetation over time.

The tall shrub layer is predominantly *Alnus crispa* and *Sambucus racemosa*. The low shrub layer is conspicuous with 33% cover, consisting mainly of *Echnopanax horridum*, *Viburnum edule*, *Rosa acicularis*, *Rubus idaeus* and *Ribes triste*. Common herbs, grasses and dwarf shrubs are *Calamagrostis canadensis*, *Cornus canadensis*, *Equisetum arvense*, *Gymnocarpium dryopteris*, *Trientalis europaea*, and *Equisetum sylvaticum* giving a total ground cover of 92%.

Very little regeneration is found in this vegetation type. Scattered *Picea glauca* 4 m high were noted outside of the LTVM plot. *Betula papyrifera* suckers are found at the bases of old trees, but are browsed to 25 cm by hare. Alder and bluejoint grass dominate areas where the forest overstory has been removed or opened up.

Betula papyrifera exhibit numerous fungal conks (*Fomes* spp.), witch's brooms, severe frost cracking, and wind-snapped tops. Blowdown is predominately *Betula papyrifera*. Occasional *Picea glauca* occur in the vicinity outside of the LTVM plot and all have been killed by spruce bark beetle in the last five years.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 127 - Deception-Estelle Silty Loams, hilly
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 4. 4 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 6.0 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 6.8 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and

Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:
Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 12

Site Description

LTVMP 13

Viereck et al. (1992) Classification:

IB1D
Closed Paper Birch Forest (Closed *Betula papyrifera / Echnopanax horridum -Viburnum edule / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 4 (Closed Paper Birch Forest)

CEMML (1998) Map Classification:

Map Class IC1 (White Spruce-Paper Birch-Balsam Poplar)

Location:

On the north side of a recreational trail on the high ridgeline of the Elmendorf Moraine, south of Lower Six Mile Lake, and half way between Loop Road (Fairchild Avenue) and Davis Road (Talley Avenue).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 55″
Longitude: 149° 47′ 18″

Slope: 2 degrees
Aspect: S-SE
Elevation: 105 m msl

The Site

Description:

Undulating, south-sloping terrain at the crest of the Elmendorf Terminal Moraine. The site drops off steeply towards Lower Six Mile Lake to the north into deep kettle depressions or ice-block pits. Site microtopography is moderately mounded: mounds are 0.3 m-1 m high and 3-7 m apart. Hummocky terrain is the result of blowdown of trees from past fires.

History:

Long-term vegetation monitoring plot established August 3, 1999.

Stand origin unknown; however, charred stumps and fallen tree trunks long since covered by vegetation suggest a fire origin, date unknown. The stand is bordered to the east and west by abrupt stand margins with an open, old-growth mixed forest, further suggesting a fire origin for this plot.

Two old eroding military foxholes occur on the ridgeline on the border of the northwest edge of the mortality plot.

Vegetation:

Betula papyrifera (13-29 cm dbh) forms a closed canopy (85%) with scattered large (to 37 cm DBH) *Populus balsamifera*. Ages of *Betula papyrifera* ranged from 49-60 years DBH. Numerous large, old, *Betula papyrifera* logs and stumps are overgrown with forest floor vegetation and serve as nurse logs for the occasional *Picea glauca* seedlings or saplings that grow to 2 m high.

Echnopanax horridum dominates the shrub layer (40%) with an understory of *Viburnum edule*. Associated shrub species include *Rosa acicularis* and *Ribes triste*.

The herbaceous understory is dominated by the oblique dominant *Calamagrostis canadensis* , and *Gymnocarpium dryopteris* and *Cornus canadensis*. Associated species include: *Osmorhiza depauperata*, *Linnaea borealis*, *Trientalis borealis*, *Galium trifidum* and *Pyrola asarifolia*. Litterfall is heavy in this predominantly deciduous stand effectively excluding most lichens and bryophytes. The mosses *Eurynchium pulchellum* and *Pleurozium schreberi* are commonly found on elevated downed wood and the bases of *Betula papyrifera* trees but they have very low cover values.

The plot is characterized by minimal mortality attributable to natural suppression and weather (e.g., snow bend, frost). The forest overstory is healthy with little wind, fungus or insect damage.

Associated Plant Communities:

Betula papyrifera/Viburnum edule

Betula papyrifera/Viburnum edule-(Echinopanax horridum)/Calamagrostis canadensis

Betula papyrifera/(Viburnum edule)/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Linnaea borealis

Betula papyrifera/Echinopanax horridum-Viburnum edule/Gymnocarpium dryopteris-(Cornus canadensis)

Betula papyrifera/Echinopanax horridum-Viburnum edule/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 126 - Deception-Estelle Silt Loams, steep
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: > 30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.8 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 5.6 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.9 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and

Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements**:**

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 13

Site Description

LTVMP 14

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Viburnum edule / Calamagrostis canadensis -Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea* / Feathermoss)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC1 (White Spruce-Paper Birch-Balsam Poplar)

Location:

North of Lower Six Mile Lake, and northeast of the Ammunition Storage Area (Ammo Land); north of the Beluga Powerline, north of the Explosive Ordinance Disposal Area (EOD) on the border with Fort Richardson Military Reservation.

Topo Map: Anchorage B8 SE

Latitude: 61° 18′ 51″
Longitude: 149° 46′ 49″

Slope: 2 degrees
Aspect: W-NW
Elevation: 40 m msl

The Site

Description:

Gentle rolling terrain between occasional low drumlins and shallow kettle depressions or ice-block pits on the Elmendorf Ground Moraine.

Site microtopography is moderately to strongly mounded: mounds are 0.3-1 m high and 1-7 m apart. Hummocky terrain is the result of blowdown of old trees over time.

History:

Long-term vegetation monitoring plot established August 4, 1999.

Forest dates to the mid-late 1700s; stand origin unknown. A recent fire (ca. last 25 years, unidentified source) occurs south of the plot, 50 m north along the line from the Reference Point (RP) towards the plot center (Initial Point - IP).

Vegetation:

LTVM plot 14 is in an open, old-growth forest of large, widely-spaced individuals of *Picea glauca* (diameters of 13-36 cm dbh and heights to 18 m) and *Betula papyrifera* (diameters of 18-47 cm DBH and heights to 18 m). Total tree canopy cover is 30%. *Picea glauca* tree canopy is represented by two age cohorts: ca. 90 years and 143-215 years (taken at 30 cm above the ground). This forest element alternates or is interspersed with forest openings dominated by *Calamagrostis canadensis*.

Picea glauca saplings are locally dense occupying the tall shrub layer and have to two size class cohorts: 1) up to 3.5 m and 2) 3.5-9 m. The low shrub layer (28% cover) is dominated by *Viburnum edule* and *Rosa acicularis*. The understory is dominated by low herbs and feathermosses; pure carpets cover the forest floor and fallen decomposing trees. Dominant herbaceous species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Vaccinium vitis-idaea*, *Cornus canadensis* and *Linnaea borealis*. Associated species include: *Pyrola secunda*, *Equisetum arvense*, *Lycopodium annotinum* and *Geocaulon lividum*. Moss cover (49%) includes the feathermosses *Hylocomium splendens*, *Pleurozium schreberi* and *Rhytidiadelphus triquetrus*. Drier logs support *Dicranum* spp. and *Polytrichum juniperinum*. *Eurynchium pulchellum* is common on the bases of trees. Lichen cover of 7% is composed of leafy lichens (e.g., *Peltigera aphthosa*), *Cladina* spp. and *Cladonia* spp.

Fungal decay of *Betula papyrifera*, and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent and continued extensive blowdown across this plot. *Picea glauca* have been attacked by spruce bark beetles leaving numerous dead, standing trees. Standing *Betula papyrifera* have wind-snapped tops and many fungal conks (*Fomes* spp.). A large number of very tall and large diameter beetle-killed spruce characterize this plot. Mortality appears to be ongoing, though most trees were killed before 1994. The LTVM plot is littered with dead and down individuals from this significant bark beetle kill, hampering travel in this vegetation type. Microrelief is very hummocky due to the large numbers of fallen trees that have been covered by the forest floor vegetation over time, and clumps of *Calamagrostis canadensis* and occasional dense *Picea glauca* regeneration.

Regeneration of tree species is moderately high. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings that are created are filled by *Calamagrostis canadensis*, and occasional *Alnus sinuata* and *Echnopanax horridum*. *Picea glauca* seedlings and saplings to 7 m high are scattered or clumped throughout the plot on nurse logs and may be filling the gaps left by parent trees. *Betula papyrifera* seedling density, however, is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. The seedlings, however, have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/(Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium *dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/*feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 127 - Deception-Estelle Silty Loams, hilly
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 5.5 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.8 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 5.3 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.8 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 14

Site Description

LTVMP 15

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Viburnum edule / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea* / Feathermoss)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC1 (White Spruce-Paper Birch-Balsam Poplar)

Location:

Centrally located on the north side of the Beluga Powerline northeast of the Ammunition Storage Area (Ammo Land) north of Lower Six Mile Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 18′ 49′′
Longitude: 149° 47′ 27′′

Slope: nearly flat
Aspect: N
Elevation: 39 m msl

The Site

Description:

Gentle rolling terrain between occasional low drumlins and shallow kettle depressions or ice-block pits on the Elmendorf Ground Moraine.

Site microtopography is moderately to strongly mounded: mounds are 0.3-1 m high and 1-3 m apart. Hummocky terrain results from the blowdown of old trees over time.

History:

Long-term vegetation monitoring plot established August 4, 1999.

Stand origin unknown; forests on the northern portion of the Base date from the mid-late 1700s.

Vegetation:

LTVM plot 15 is in an open, old-growth forest of large, widely-spaced individuals of *Picea glauca* (diameters of 17-28 cm dbh and heights to 28 m) and *Betula papyrifera* (diameters of 14-43 cm DBH and heights to 18 m). Total tree canopy cover is 45%. *Picea glauca* tree canopy is represented by two age cohorts: ca. 43-66 years (taken at 30 cm above the ground) and an old-growth element dating to the late 1700s. This forest element alternates or is interspersed with forest openings dominated by *Calamagrostis canadensis*.

Picea glauca saplings are locally dense occupying the tall shrub layer and occur as two size classes: 1) up to 3.5 m and 2) from 3.5-9 m. A low shrub layer (14% cover) is dominated by *Viburnum edule* and *Rosa acicularis*. The understory is dominated by low herbs and feathermosses. Pure carpets cover the forest floor and fallen decomposing trees. Dominant herbaceous species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Vaccinium vitis-idaea*, *Cornus canadensis* and *Linnaea borealis*. Associated species include: *Pyrola asarifolia*, *Equisetum arvense*, *Lycopodium annotinum* and *Geocaulon lividum*. Moss cover (29%) includes the feathermosses *Hylocomium splendens*, *Pleurozium schreberi* and *Rhytidiadelphus triquetrus*. Drier logs support *Dicranum* spp. and *Polytrichum juniperinum*. *Eurynchium pulchellum* is common at the bases of trees. Lichen cover of 7% is composed of leafy lichens (e.g., *Peltigera aphthosa*, *Peltigera canina*, *Lobaria linita*), *Cladina* spp. and *Cladonia* spp.

Fungal decay of *Betula papyrifera* and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent and continued extensive blowdown across this plot. *Picea glauca* have been attacked by spruce bark beetles leaving numerous dead, standing trees. Standing *Betula papyrifera* have wind-snapped tops and many fungal conks (*Fomes* spp.). A large number of very tall and large diameter beetle-killed spruce characterize this plot. Mortality appears to be ongoing, though most trees were killed before 1994. The LTVM plot is littered with dead and down individuals from this significant bark beetle kill and occasional dense *Picea glauca* regeneration, hampering travel in this vegetation type. Microrelief is very hummocky due to the large numbers of fallen trees that have been covered by the forest floor vegetation over time, and clumps of *Calamagrostis canadensis* and the occasional dense *Picea glauca* regeneration.

Regeneration of *Picea glauca* is moderately high. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings that are created are filled by *Calamagrostis canadensis*, and occasional *Alnus sinuata* and *Echnopanax horridum*. *Picea glauca* seedlings and saplings to 7 m are scattered or clumped throughout the plot in forest openings and on nurse logs and may be filling the gaps left by parent trees. *Betula papyrifera* seedling density, however, is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. Seedlings have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/(Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/ feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil:

Soil Classification (Wikgren and Moore 1997): Map Unit 128 - Deception-Estelle Silty Loams, undulating
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 2.0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 2.8 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 4.3 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: None
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 15

Site Description

LTVMP 16

Viereck et al. (1992) Classification:

IIIA2B10
Mesic Graminoid Herbaceous Bluejoint Meadow (*Rubus idaeus / Calamagrostis canadensis / Equisetum sylvaticum*)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC2 (Spruce-Paper Birch)

Location:

In a clearcut north of Beebe Lake, north of Lower Six Mile Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 17′ 56′′
Longitude: 149° 47′ 33′′

Slope: 1 degree
Aspect: SW
Elevation: 54 m msl

The Site

Description:

Gentle rolling terrain of the Elmendorf Ground Moraine.

Site microtography is moderately mounded; mounds are 0.3-1 m high and 3-7 m apart. Clusters of old stumps are common and logging scarification from logging equipment is evident and common.

History:

Long-term vegetation monitoring plot established August 6, 1999. The area was nearly completely clearcut in 1994. Origin of the previous forested stand unknown.

Vegetation:

LTVM plot 16 is a dense Bluejoint Grass Meadow occupying an area of old-growth birch-white *Picea glauca* forest logged in 1994. Very scattered uncut *Betula papyrifera* and occasional *Picea glauca* seedstock dot the area but none occur within the monitoring plot. *Calamagrostis canadensis* is nearly continuous with 85% cover, reaching heights of 2.5 m. Small (2% cover) patches of *Sambucus racemosa*, *Alnus sinuata* and *Echnopanax horridum* stand above the grass.

Dead and down grass cover is high; however, a low shrub layer (14% cover) and dwarf shrub/herb layer (36% cover) are common throughout. Common low shrub species include: *Rubus idaeus*, *Ribes triste*, *Sambucus racemosa*, *Rosa acicularis* and *Viburnum edule*. The dwarf shrub/herb layer is predominantly *Equisetum sylvaticum*, *Gymnocarpium dryopteris* and *Epilobium angustifolium*. Associated species include: *Equisetum arvense*, *Trientalis europaea* and *Cornus canadensis*.

Areas more deeply scarified during logging have little to no graminoid cover although native and weedy species (e.g., *Taraxacum officinale*, *Rumex acetosa*) occur. These areas also provide sites for the reestablishment of *Betula papyrifera* seedlings. No seedlings or saplings were encountered in dense bluejoint stands. Only two *Betula papyrifera* seedlings 0.5 m high were counted on the Subplots in 1999.

Associated Plant Communities:

Calamagrostis canadensis

Rubus idaeus/Calamagrostis canadensis/Equisetum sylvaticum

Calamagrostis canadensis-Agrostis scabra-Equisetum arvense-Sphagnum light green

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 127 - Deception-Estelle Silty Loams, hilly
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 5. 4 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 5.6 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 8.5 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Tilling/scarification of the upper layers of the soil profile resulted from logging in 1994.

Environmental Measurements:

Subjective Site Moisture: 4 - dry
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 16

Site Description

LTVMP 17

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca-Betula papyrifera / Echnopanax horridum-Viburnum edule-Rosa acicularis / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC2 (Spruce-Paper Birch)

Location:

Near Knik Arm of Cook Inlet on the north side of the Beluga Powerline north of the Ammunition Storage Area (Ammo Land) north of Lower Six Mile Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 18′ 47″
Longitude: 149° 48′ 15″

Slope: 5 degrees
Aspect: N-NW
Elevation: 43 m msl

The Site

Description:

Gentle rolling terrain consisting of low drumlins and shallow kettle depressions or ice-block pits on the Elmendorf Ground Moraine.

Site microtopography is moderately mounded: mounds are 0.3-1 m high and 3-7 m apart. Hummocky terrain results from the blowdown of old trees.

History:

Long-term vegetation monitoring plot established August 16, 1999.

Stand origin unknown.

Vegetation:

LTVM plot 17 is in a very open, old-growth forest of large, widely-spaced individuals of *Betula papyrifera* (diameters of 42-67 cm dbh and heights to 22 m) and *Picea glauca* (diameters of 14-31 cm DBH and heights to 20 m). Total tree canopy cover is 28%. *Picea glauca* are in three size/age classes: 1) tallest old-growth - 22 m, >25 cm DBH, 202 years old; 2) 13-15 m, 15-25 cm DBH, 141-176 years old; 3) saplings to 4 m, 32-35 years old DBH. This forest element alternates or is interspersed with dense shrub patches of *Echnopanax horridum* and *Calamagrostis canadensis* grass meadows.

The shrub layer is conspicuous with 34% cover and is dominated by *Echnopanax horridum*, *Viburnum edule*, *Rosa acicularis* and *Rubus idaeus*. The herb layer is continuous but not species rich. Dominant species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Dryopteris dilatata*, *Cornus canadensis* and *Equisetum arvense*. Other associated species include: *Lycopodium annotinum*, *Pyrola asarifolia*, *Pyrola secunda*, *Trientalis europaea*, *Equisetum sylvaticum* and *Linnaea borealis*. Moss and lichen cover is limited to fallen logs and tree bases. Many nurse logs are covered with the feathermoss *Pleurozium schreberi*; *Eurynchium pulchellum* is commonly found on elevated downed wood and the bases of the trees but it has a very low cover value.

Fungal decay of *Betula papyrifera* and bark beetle damage have weakened or killed many trees. Consequently, winds have caused recent, extensive blowdown across this plot. Standing *Betula papyrifera* have wind-snapped tops and numerous fungal conks (*Fomes* spp.). *Picea glauca* has been attacked by bark beetles leaving numerous dead, standing trees. The LTVM plot is littered with dead and down individuals from a significant bark beetle epidemic over the past 10 years, hampering travel in this vegetation type. Microrelief is very hummocky due to clumps of *Calamagrostis canadensis* and the large number of fallen trees and upturned tree roots that have been covered by the forest floor vegetation over time.

Regeneration of tree species is low. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, resulting openings are created which are filled by *Calamagrostis canadensis* and *Echnopanax horridum*. *Picea glauca* seedlings and saplings to 4 m high are scattered throughout the plot on nurse logs but do not appear to be filling the gaps left by parent trees. *Betula papyrifera* seedling density is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. The seedlings, however, have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/ feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 127 - Deception-Estelle Silty Loams, hilly
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 1.1 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.8 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 4.9 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.5 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 17

Site Description

LTVMP 18

Viereck et al. (1992) Classification:

IIB1b
Closed Alder Tall Scrub (Closed *Alnus sinuata* / *Echnopanax horridum-Sambucus racemosa-Rubus idaeus* / *Dryopteris dilatata-Gymnocarpium dryopteris*)

Tande (1983) Map Classification:

Map Class 20 (Closed Alder Tall Shrub Scrub)

CEMML (1998) Map Classification:

Map Class 2B1 (Alder)

Location:

North of Ridge Road (37th Street) and south of Hillberg Ski Area, halfway between Loop Road (Fairchild Avenue) and the road access to Fish Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 15′′
Longitude: 149° 48′ 53′′

Slope: 4 degrees
Aspect: E
Elevation: 115 m msl

The Site

Description:

Site microtography is slightly to moderately mounded; mounds are 0.3-1 m high and 3 - >7 m apart.

History:

Long-term vegetation monitoring plot established August 10, 1999.

Stand origin unknown; however, a number of scattered, very large *Betula papyrifera* tree trunks were observed under the hummocky forest floor litter suggesting that a previous forest - perhaps open - existed on the site. Abrupt margins with surrounding forest types suggest a fire origin; however, no evidence for fire was found along the margins that were visited.

Dense alder with diameters 3-8 cm along the road bank near the Reference Point (RP) appeared to have been burned within the past five years.

Vegetation:

The vegetation of this LTVM plot is a dense, closed-canopy, 35-51 year-old *Alnus sinuata* forest with a dense tall shrub understory of *Sambucus racemosa* and *Echnopanax horridum*. The *Alnus* *sinuata* is clumped with stems bending and spreading out in all directions as the result of snowload and snowbend. Stem diameters range from 10-24 cm and reach tree heights of 8 m.

Leaf litterfall and woody debris are heavy in this stand due to the dense *Alnus sinuata* (85% cover), *Echnopanax horridum* and *Sambucus racemosa* (51% cover) canopies.

A low shrub layer of 31% cover is dominated by *Rubus idaeus*, *Ribes triste*, *Sambucus racemosa* and occasionally *Viburnum edule*. Herbaceous vegetation has 26% cover, primarily *Dryopteris dilatata* and *Gymnocarpium dryopteris* under the alder canopy, and openings of *Calamagrostis canadensis* meadow. All other herbs have less than 2% cover; the dominant species are *Trientalis europaea* and *Equisetum arvense*. The moss *Eurynchium pulchellum* is found on the bases of the tall shrubs but has very low cover value (1%). No tree seedlings were recorded in 1999; the stand appears to be healthy and self-maintaining.

Associated Plant Communities:

Alnus sinuata/Calamagrostis canadensis

Alnus sinuata/Calamagrostis canadensis (Osmorhiza depauperata)

Alnus tenuifolia/Calamagrostis canadensis (Equisetum fluviatile)

Alnus sinuata/Echinopanax horridum

Alnus sinuata/Equisetum arvense

Alnus sinuata/Sambucus racemosa-Rubus idaeus-(Ribes triste)/Dryopteris dilatata-(Gymnocarpium dryopteris)

Alnus sinuata/Rubus idaeus/Calamagrostis canadensis

Alnus tenuifolia/Rubus idaeus-(Ribes triste)/Calamagrostis canadensis-(Dryopteris dilatata)

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 126 - Deception-Estelle Silt Loam, steep
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 4.0 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 6.3 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 6.3 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - damp

Photograph: Appendix 6, Plate 18

Site Description

LTVMP 19

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera* / *Viburnum edule* / *Calamagrostis canadensis -Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea* / Feathermoss)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC2 (Spruce-Paper Birch)

Location:

Centrally located on the south side of the Beluga Powerline north of the Ammunition Storage Area (Ammo Land) north of Lower Six Mile Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 18′ 34″
Longitude: 149° 48′ 02″

Slope: 2 degrees
Aspect: W-SW
Elevation: 33 m msl

The Site

Description:

Gentle rolling terrain consisting of low drumlins and a shallow kettle depression or ice-block pit on the Elmendorf Ground Moraine.

Site microtopography is slightly to severely mounded: mounds are 0.3-1 m high and 0.3->7 m apart. Hummocky terrain results from the blowdown of old trees over time.

History:

Long-term vegetation monitoring plot established August 16, 1999.

Stand origin unknown; forests on the northern portion of the Base date from the mid-late 1700s.

Vegetation:

LTVM plot 19 is in an open, old-growth forest of large, widely-spaced individuals of *Picea glauca* (diameters of 14-31 cm dbh and heights to 25 m) and *Betula papyrifera* (diameters of 14-40 cm DBH and heights to 22 m). Total tree canopy cover is 31%. The *Picea glauca* tree canopy is represented by two age cohorts: ca. 58-63 years DBH and an old-growth element aged at 233 yrs (taken at 30 cm above the ground). This forest element alternates or is interspersed with forest openings and wet depressions dominated by *Calamagrostis canadensis*.

Picea glauca saplings are locally dense occupying the tall shrub layer and occur as two size classes: 1) up to 3.5 m, and 2) from 3.5-9 m. A low shrub layer (18% cover) is dominated by *Viburnum edule* and *Rosa acicularis*. The understory is dominated by low herbs and feathermosses. Pure carpets cover the forest floor and fallen decomposing trees. Dominant herbaceous species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Vaccinium vitis-idaea*, *Cornus canadensis* and *Linnaea borealis*. Associated species include: *Equisetum arvense*, *Lycopodium annotinum* and *Geocaulon lividum*. Moss cover (20%) includes the feathermosses *Hylocomium splendens*, *Pleurozium schreberi* and *Rhytidiadelphus triquetrus*. Drier logs support *Dicranum* spp. and *Polytrichum juniperinum* ; *Eurynchium pulchellum* is common at the bases of trees. Lichen cover of 7% is composed of leafy lichens (e.g., *Peltigera aphthosa*, *Peltigera canina*, *Lobaria linita*), *Cladina* spp. and *Cladonia* spp.

Fungal decay of *Betula papyrifera* and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent and continued extensive blowdown across this plot. *Picea glauca* have been attacked by spruce bark beetles leaving numerous dead, standing trees. Standing *Betula papyrifera* have wind-snapped tops and numerous fungal conks (*Fomes* spp.). A large number of very tall and large diameter beetle-killed *Picea glauca* characterize this plot. Mortality appears to be ongoing, though most trees were killed before 1994. The LTVM plot is littered with dead and down individuals from this significant bark beetle kill, hampering travel in this vegetation type. Microrelief is very hummocky due to the large numbers of fallen trees that have been covered by the forest floor vegetation over time, and clumps of *Calamagrostis canadensis* and occasional dense *Picea glauca* regeneration.

Regeneration of *Picea glauca* is moderately high. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings that are created are filled by *Calamagrostis canadensis*, and occasionally by *Alnus sinuata* and *Echnopanax horridum*. *Picea glauca* seedlings and saplings 7-14 m high are scattered or clumped throughout the plot in forest openings and on nurse logs and may be filling the gaps left by parent trees. *Betula papyrifera* seedling density, however, is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. Seedlings have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/ feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 127 - Deception-Estelle Silty Loams, hilly
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0.8 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.8 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 5.1 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.6 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 19

Site Description

LTVMP 20

Viereck et al. (1992) Classification:

IC2a
Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Viburnum edule / Calamagrostis canadensis -Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea* / Feathermoss)

Tande (1983) Map Classification:

Map Class 9 (Closed Old-Growth Paper Birch-White Spruce Forest)

CEMML (1998) Map Classification:

Map Class IC2 (Spruce-Paper Birch)

Location:

Centrally located on the north side of the Beluga Powerline northeast of the Ammunition Storage Area (Ammo Land) north of Lower Six Mile Lake.

Topo Map: Anchorage B8 SE

Latitude: 61° 19′ 00′′
Longitude: 149° 47′ 47′′

Slope: level
Aspect: level
Elevation: 38 m msl

The Site

Description:

Gentle rolling terrain between low drumlins on the Elmendorf Ground Moraine.

Site microtopography is moderately mounded: mounds are 0.3-1 m high and 3-7 m apart. Hummocky terrain results from the blowdown of old trees over time.

History:

Long-term vegetation monitoring plot established August 31, 1999.

Forest dates to mid-late 1700s; stand origin unknown.

Vegetation:

LTVM plot 20 is in an open, old-growth forest of large, widely-spaced individuals of *Picea glauca* (diameters of 15-34 cm dbh and heights to 16 m) and *Betula papyrifera* (diameters of 14-42 cm DBH and heights to 18 m). Total tree canopy cover is 55%. *Picea glauca* tree canopy is represented by two age cohorts: 43-64 years (taken at 30 cm above the ground) and an old-growth element dating to the mid-late 1700s. This forest element alternates or is interspersed with forest openings dominated by *Calamagrostis canadensis*.

Picea glauca saplings are locally dense occupying the tall shrub layer and have two size classes: 1) up to 4 m, and 2) from 4-12 m. A low shrub layer (13% cover) is dominated by *Viburnum edule* and *Rosa acicularis*. The understory is dominated by low herbs, dwarf shrubs and feathermosses. Pure carpets cover the forest floor and decomposing fallen trees. Dominant herbaceous species are *Calamagrostis canadensis*, *Gymnocarpium dryopteris*, *Vaccinium vitis-idaea*, *Cornus canadensis* and *Linnaea borealis*. Associated species include: *Pyrola secunda* , *Equisetum arvense* , *Lycopodium annotinum*. *Trientalis europaea*, *Dryopteris dilatata* and *Geocaulon lividum*. Moss cover (34%) includes the feathermosses *Hylocomium splendens*, *Pleurozium schreberi* and *Rhytidiadelphus triquetrus*. Drier logs support *Dicranum* spp. and *Polytrichum juniperinum*. *Eurynchium pulchellum* is common at the bases of trees. Lichen cover is low (3%) and is composed of leafy lichens (e.g., *Lobaria linita*), *Cladina* spp. and *Cladonia* spp.

Fungal decay of *Betula papyrifera*, and bark beetle damage in *Picea glauca* have weakened or killed many trees. Consequently, winds have caused recent and continued extensive blowdown across this plot. *Picea glauca* has been attacked by spruce bark beetles leaving numerous dead, standing trees. Standing *Betula papyrifera* have wind-snapped tops and numerous fungal conks (*Fomes* spp.). A large number of very tall and large diameter beetle-killed *Picea glauca* characterize this plot. Mortality appears to be ongoing, though most of these trees were killed before 1994. The LTVM plot is littered with dead and down individuals from this significant bark beetle event, hampering travel in this vegetation type. Microrelief is very hummocky due to clumps of *Calamagrostis canadensis* and the large numbers of fallen trees that have been covered by the forest floor vegetation over time.

Regeneration of *Picea glauca* is moderately high. As *Betula papyrifera* and *Picea glauca* cover declines in these stands, openings that are created are filled by *Calamagrostis canadensis*, and occasional *Alnus sinuata* and *Echnopanax horridum*. *Picea glauca* seedlings and saplings to 14 m high are scattered or clumped throughout the plot on nurse logs and may be filling the gaps left by parent trees. *Betula papyrifera* seedling density, however, is very low. They appear as suckers at the base of trees and in blowdown areas where upturned tree roots and stumps expose mineral soil. *Betula papyrifera* seedlings have been browsed heavily by hare and moose, and as a result, do not contribute substantial new regeneration to the forest structure.

Associated Plant Communities:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/ feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 128 - Deception-Estelle Silty Loams, undulating
Soil Series: Deception-Estelle
Parent Material: Loess over friable, to gravelly till
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 1.8 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.1 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 5.0 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 6.3 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 4 - moist
Subjective Soil Moisture: 3 - moist

Photograph: Appendix 6, Plate 20

Site Description

LTVMP 21

Viereck et al. (1992) Classification:

IIB1b
Closed Alder Tall Scrub (Closed *Alnus sinuata / Rubus idaeus / Calamagrostis canadensis-Galium trifidum*)

Tande (1983) Map Classification:

Map Class 20 (Closed Alder Tall Shrub Scrub)

CEMML (1998) Map Classification:

Map Class IB1 (Paper Birch)

Location:

Southeast of Lower Six Mile Lake and south of the Fish Viewing Platform near the north entrance to the Antenna Fields.

Topo Map: Anchorage B8 SW

Latitude: 61° 17′ 17″
Longitude: 149° 49′ 03″

Slope: flat
Aspect: flat
Elevation: 31 m msl

The Site

Description:

Gentle rolling to flat terrain on the Elmendorf Ground Moraine.

Site microtography is smooth; a few or no mounds with a level surface profile.

History:

Long-term vegetation monitoring plot established August 18, 1999.

Disturbed alder site; stand origin unknown. Shallow organic material layer (1-2 cm) and level microtopography suggest that the area was cleared and/or bulldozed in the recent past (n.d.).

Vegetation:

LTVM plot 21 is a very dense ("dog hair "), closed, low-canopy, *Alnus sinuata* shrub thicket that is 14-27 year-old. Alder exhibits clumped stems that bend and spread out in all direction as a result of snow loads/snowbend. Stem diameters are generally not greater than 3 cm; shrub heights on the Subplots ranged from 3-4.6 m. However, scattered diameters to 6.5 cm dbh and heights to 6.5 m occur on the Mortality Plot.

Heavy leaf litterfall and woody debris characterize the stand.

A weak low shrub layer of 6% cover is dominated by *Rubus idaeus*, and occasional *Ribes triste* and *Ribes hudsonianum*. Herbaceous vegetation has 21% cover, primarily *Calamagrostis canadensis* and *Galium trifidum*. All other herbs have less than 2% cover and include: *Epilobium angustifolium*, *Achillea millefolium*, *Taraxacum officinale*, *Carex canescens* and *Stellaria* spp. A higher number of weedy species were noted on this plot. No mosses or lichens characterize the plot. Two *Betula papyrifera* seedlings were recorded in the Subplots in 1999; the stand appears to be sterile but healthy, and self-maintaining.

Associated Plant Communities:

Alnus sinuata/Calamagrostis canadensis

Alnus sinuata/Calamagrostis canadensis (Osmorhiza depauperata)

Alnus tenuifolia/Calamagrostis canadensis (Equisetum fluviatile)

Alnus sinuata/Echinopanax horridum

Alnus sinuata/Equisetum arvense

Alnus sinuata/Sambucus racemosa-Rubus idaeus-(Ribes triste)/Dryopteris dilatata-(Gymnocarpium dryopteris)

Alnus sinuata/Rubus idaeus/Calamagrostis canadensis

Alnus tenuifolia/Rubus idaeus-(Ribes triste)/Calamagrostis canadensis-(Dryopteris dilatata)

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 152 - Kichatna Silt Loam, sloping
Soil Series: Kichatna
Parent Material: Loess over glacial outwash
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 1.5 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 2.3 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: none evident
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Undifferentiated below the soil profile hemic layer; gravel at 15-20 cm.

Environmental Measurements:

Subjective Site Moisture: 3 - dry
Subjective Soil Moisture: 2 - dry

Photograph: Appendix 6, Plate 21

Site Description

LTVMP 22

Viereck et al. (1992) Classification:
IIB1b
Closed Alder Tall Scrub (Closed *Alnus tenuifolia / Rubus idaeus -Ribes triste / Calamagrostis canadensis -Dryopteris dilatata*)

Tande (1983) Map Classification:

Map Class 20 (Closed Alder Tall Shrub Scrub)

CEMML (1998) Map Classification:

Map Class 2B1 (Alder)

Location:

North of Green Lake and northwest across the south Antenna Field Access Road from the parking lot for the Coastal Hiking Trail.

Topo Map: Anchorage B8 SW

Latitude: 61° 16′ 57″
Longitude: 149° 49′ 56″

Slope: flat
Aspect: flat
Elevation: 36 m msl

The Site

Description:

Gentle rolling to flat terrain on the Elmendorf Ground Moraine. May occupy a low drainageway from Spring Lake and its associated wetland complex draining west towards the coast.

Site microtography is moderately mounded; mounds are 0.3-1 m high and 1-7 m apart. Saturated substrate and/or standing water present between hummocks.

History:

Long-term vegetation monitoring plot established August 27, 1999.

Stand origin unknown. Portions of the area may have been cleared when the Antenna Fields were established (n.d.).

Vegetation:

The vegetation of this LTVM plot is an open-canopied, tall-shrub swamp of 21-35 year old dbh *Alnus tenuifolia*. The alder is clumped with stems that bend and spread out in all directions as a result of snow load/snowbend. Stem diameters range from 10-14 cm and reach tree heights of 8 m.

Leaf litterfall and woody debris are heavy in this stand due to the dense *Alnus tenuifolia / A. sinuata*

(44% cover) and *Calamagrostis canadensis* cover.

A low shrub layer of 14% cover is dominated by *Rubus idaeus*, *Ribes triste*, *Sambucus racemosa* and occasionally *Spiraea beauverdiana*. A dense herbaceous understory has 81% cover, composed primarily of the *Dryopteris dilatata* and *Calamagrostis canadensis* under the alder canopy, and openings of *Calamagrostis canadensis* meadow. Other herbs have less than 10% cover and include: *Epilobium angustifolium* , *Equisetum arvense* and *Equisetum sylvaticum*. The moss *Eurynchium pulchellum* is found on the bases of alder stems but has very low cover (4%). Only one *Betula papyrifera* seedling was recorded in 1999; the stand appears to be healthy and self-maintaining.

Associated Plant Communities:

Alnus sinuata/Calamagrostis canadensis

Alnus sinuata/Calamagrostis canadensis (Osmorhiza depauperata)

Alnus tenuifolia/Calamagrostis canadensis (Equisetum fluviatile)

Alnus sinuata/Echinopanax horridum

Alnus sinuata/Equisetum arvense

Alnus sinuata/Sambucus racemosa-Rubus idaeus-(Ribes triste)/Dryopteris dilatata-(Gymnocarpium dryopteris)

Alnus sinuata/Rubus idaeus/Calamagrostis canadensis

Alnus tenuifolia/Rubus idaeus-(Ribes triste)/Calamagrostis canadensis-(Dryopteris dilatata)

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 153 - Kichatna Silt Loam, steep
Soil Series: Kichatna
Parent Material: Loess over glacial outwash
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 3.5 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 4.8 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 5.3 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 7 - mesic to subhygric
Subjective Soil Moisture: 8 - very wet

Photograph: Appendix 6, Plate 22

Site Description

LTVMP 23

Viereck et al. (1992) Classification:

IIIA2B
Mesic Graminoid Herbaceous Bluejoint Meadow (*Calamagrostis canadensis-Agrostis scabra / Equisetum arvense / Sphagnum* light green spp.)

Tande (1983) Map Classification:

Map Class 26 (Wet Graminoid Herbaceous-Sedges / Bluejoint Grass)

CEMML (1998) Map Classification:

Map Class 2C2 (Willow)

Location:

North of Ridge Road (37th Street) at Milepost 0.1 west of the junction of Ridge Road with Davis Road (Talley Avenue).

Topo Map: Anchorage B8 SE

Latitude: 61° 16′ 25″
Longitude: 149° 47′ 02″

Slope: flat depression
Aspect: flat depression
Elevation: 90 msl

The Site

Description:

Occupies an open kettle depression in the heavily-pitted and rolling terrain of the Elmendorf Moraine.

Site microtography is micromounded ; mounds are < 0.3 m high.

History:

Long-term vegetation monitoring plot established August 17, 1999. Stand origin the result of natural lake/pond succession as a closed basin progressively dries out, gradually fills in, and becomes vegetated with more upland dry-site species over time.

Vegetation:

LTVM plot 23 is a dense Grass Meadow occupying a depression created when a large block of ice melted out following the last glaciation, creating a kettle depression or ice-block pit when it collapsed. Filling in of the depression with organic material over time leads to the current Grass Meadow. The basin is predominantly *Calamagrostis canadensis* with nearly continuous cover (83%), and heights to 1.5 m. Near the upland forest margin, it mixes and co-dominates with *Agrostis scabra* while *Carex utriculata* and *Potentilla palustris* co-dominate a small permanently-flooded area near the center of the depression.

Dead and down grass cover is high (91%); however, a weak low shrub layer (1% cover) and herb layer (6% cover) are common throughout. The low shrub layer consists of heavily browsed *Betula papyrifera* seedlings to 0.4 m. The herb layer is predominantly *Equisetum arvense*, *Potentilla palustris* and an unidentified *Carex* spp. *Carex utriculata*, although present in the basin, was not recorded in the Subplots. Moss cover is 5% and composed of a light green unidentified *Sphagnum* spp. Fluctuating water levels are indicated by dead *Picea glauca* seedlings to 2 m high and the invasion of the site by *Betula papyrifera* seedlings. The weedy species *Taraxacum officinale* was recorded on drying nonvegetated surfaces.

Associated Plant Communities:

Calamagrostis canadensis

Rubus idaeus/Calamagrostis canadensis/Equisetum sylvaticum

Calamagrostis canadensis-Agrostis scabra-Equisetum arvense-Sphagnum light green

Soil

Soil Classification (Wikgren and Moore 1997): Map Unit 243 - Starichkof Peat, 0-3% slopes
Soil Series: Starichkof
Parent Material: Organic materials consisting of partially decomposed sedge peat
Rooting Depth: 15.4 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 16. 4 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 10.0 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 10.6 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 8 - subhygric
Subjective Soil Moisture: 4 - damp to moist

Photograph: Appendix 6, Plate 23

Site Description

LTVMP 24

Viereck et al. (1992) Classification:

IIIA2B
Mesic Graminoid Herbaceous Bluejoint Meadow (*Calamagrostis canadensis*)

Tande (1983) Map Classification:

Map Class 26 (Wet Graminoid Herbaceous-Sedges / Bluejoint Grass)

CEMML (1998) Map Classification:

Map Class 2C2 (Willow)

Location:

Northeast of Upper Six Mile Lake between two low drumlins (small hills of glacial origin) along Otter Lake Road (Loop Road (46th Street) east into Fort Richardson Military Reservation).

Topo Map: Anchorage B8 SE

Latitude: 61° 17′ 47″
Longitude: 149° 45′ 30″

Slope: flat depression
Aspect: flat depression
Elevation: 59 msl

The Site

Description:

Occupies an open kettle depression between two low drumlins in the rolling terrain of the Elmendorf Ground Moraine.

Site microtography is moderately mounded; mounds are 0.3-1 m high and 3-7 m apart.

History:

Long-term vegetation monitoring plot established August 18, 1999. Stand origin the result of natural lake/pond succession as a closed basin progressively dries out, gradually fills in, and becomes vegetated with more upland dry-site species over time.

An active military training area occupies a large site to the south; a number of < 2 year old military foxholes are found in the basin.

Vegetation:

LTVM plot 24 is a *Calamagrostis canadensis* Grass Meadow occupying a moderately well-drained depression between two low drumlins. *Calamagrostis canadensis* is dense, forming large tussocks (1 m) with nearly continuous cover (85%), and reaching heights to 2 m. Dead and down grass cover is high (95%). No shrub layers are present and the herb layer is weak with 12% cover.

The only species recorded for the Subplots were *Epilobium angustifolium* and *Equisetum sylvaticum.* Although the site is moderately well-drained, no tree seedlings or saplings are present, perhaps due to the dense grass and litter cover.

Associated Plant Communities:

Calamagrostis canadensis

Rubus idaeus/Calamagrostis canadensis/Equisetum sylvaticum

Calamagrostis canadensis-Agrostis scabra-Equisetum arvense-Sphagnum light green

Soil

(Wikgren and Moore 1997): Map Unit 236 - Purches Variant Silt Loam, 0-3% slopes
Soil Series: Purches Variant
Parent Material: Loess over glacial outwash
Rooting Depth: >30 cm
Depth to the Bottom of Live Moss: 0 cm
Depth to the Bottom of Slightly Decomposed Oi (Fibric) Organic Material: 5.0 cm
Depth to the Bottom of Moderately Decomposed Oe (Hemic) Organic Material: 9.8 cm
Depth to the Bottom of Highly Decomposed Oa (Sapric) Organic Material: 13.5 cm
Permafrost: None

Soil Profile Description: No detailed soil description available from the site; see Wikgren and Moore (1997) for a description of soil map units and a pedon description for the range of characteristics of the soils in the Series.

Environmental Measurements:

Subjective Site Moisture: 6 - mesic
Subjective Soil Moisture: 4 - damp to moist

Photograph: Appendix 6, Plate 24

Data Management and Archiving of Permanent Plot Data

Hard-Copy Archive System

A Hard-Copy Archive System was developed to store the 1999 baseline information to insure access to permanent plot data in subsequent sampling years. This Archive is stored at the EAFB Conservation and Environmental Planning Office and consists of all plot data, the Photo Record File, Photo Log Record, maps, aerial photos and other project-related materials (Appendix 7).

Folder contents for individual monitoring plots consists of: the original data sheets, a copy of the 1995 aerial photo overlay, and a copy of the 1:25000-scale USGS quad map depicting the plot location.

The Photo Archive consists of approximately 1800 slides and additional prints. This was a very large undertaking but a necessary one for long-term monitoring studies (Mahan et al. 1998, Elzinga et al. 1999). All slides and prints were numbered and referenced to a Photo Log Record and verified in the LTVM plot field data sheets. All slides were ultimately grouped to by permanent plot or referenced to other project objectives and ecological features in the Photo Log Record.

Electronic-Copy Archive System

Each permanent plot dataset was electronically compiled, edited and archived using Microsoft Excel© spreadsheets. Each plot was stored as an Excel Workbook, and each Sheet within a Workbook as an individual data sheet, thus allowing unlimited storage and access to different datasets for comparisons and analysis within and between monitoring plots over subsequent sampling years.

The Electronic Archive is stored at the EAFB Conservation and Environmental Planning Office on Zip Disk and CD, and consists of all analytical plot data, and other project-related materials (Appendix 8).

The principal objective of the Electronic Archive was the creation of a storage system that would offer the opportunity for the convenient extraction of datasets for analysis; therefore, textural and pictorial treatments had lower priority for inclusion. The latter, e.g., maps, sketches, plot notes, etc., are available in the Hard Copy Archive.

The Electronic Archive represents the beginning of an extractable, analytical database offering the opportunity to select specific datasets and link these datasets to repeatable measurements for future analysis at intervals of 5-10 years. An example of the use of the Electronic Archive is the extraction and baseline analysis of forest mortality and regeneration presented later in this report.

Additional extracted databases were prepared including:

1) Vegetation data for all permanent plots;
2) All satellite vegetation plot data;
3) Combination of 1) and 2);
4) Alder plot data;
5) Various combinations of 4) analyzed in Tande et al. (2001).

Geographic Information System

The Geographic Information System (GIS) developed in support of the permanent plot data was compiled as an ArcView 3.2 Project labeled LTVM Plot. Within this Project, a View labeled EAFB was established that houses three Themes:

1) LTVMPLOTS.shp,
2)161149C6.tif, and
3)161149C7.tif DRGs (digital raster graphics).

LTVMPLOTS.shp is a Point Feature Layer containing permanent plot locations and possesses the following three Attribute Fields:

1) PLOT_ID is the plot identification number;
2) LAT_DMS is latitude in degrees minutes and seconds; and
3) LONG_DMS is longitude coordinate in degrees, minutes and seconds.

The 161149C6.tif and 161149C7.tif Layers are the DRGs of the Anchorage A8 SW, and SE 1:25,000-scale quadrangles.

A Metadata Layer labeled LTVMPLOTS.met was also developed using the ArcView 3.2 Metadata Module. Appendix 10 is a copy of the metadata created for the LTVMPLOTS.shp Theme. This file is compliant with the minimal documentation standards as defined for Federal Government agencies by the Federal Geographic Data Committee.

A hard copy map containing permanent plot locations (the LTVMPLOTS.shp Point Feature Layer) is found in Appendix 3. The Attribute File of the LTVM Plot layer is designed for future expansion should EAFB Conservation and Environmental Planning personnel choose to add additional data. This expansion can be performed by using the existing Plot Identification Attribute to link additional data tables containing the same Plot Identification Number and additional plot data. In this way, tables containing like data can be organized together and the full power of the GIS database integration functionality can be recognized. EAFB research and natural resource management needs will help direct the future information layer development of the GIS.

Example Extraction and Analysis of a Multi-Disciplinary Dataset: Forest Regeneration, Growing Stock and Mortality

The principal objective of the forestry data analysis was a demonstration of the ability to extract and analyze a subset of data from the permanent plot Electronic Data Record which has an immediate management application. Only general observations are reported here; further statistical treatment of this dataset may be in order as management concerns arise that may employ these results.

Tree diameters, basal areas and cubic volumes were calculated for living and dead trees. These are summarized by vegetation covertype and tree species in Table 4. Further summaries of this data in tabular form for individual plots and individual species are found in the Forestry Data Subset within the Project's Archive System on file at the EAFB Conservation and Environmental Planning Office.

In Table 4, note that in Old Growth White Spruce-Paper Birch Mixed Forest stands, 27% of the original spruce is now in mortality. This is arrived at as 31.33 Live white spruce per acre vs 11.67 white spruce Mortality per acre = 27% of the original stand (31.33 + 11.67 = 43; 11.67 / 43 = 27.1%).

Table 5 provides an overall summary of seedling and sapling regeneration by vegetation type and tree species within each vegetation type. Further summaries of this data in tabular form for individual plots and by species within each plot are again found in the Forestry Data Subset of the Electronic Archive on file at the Base Conservation and Environmental Planning Office.

General observations from Table 5 are as follows:

Old Growth Paper Birch-White Spruce Mixed Forests have a relatively modest number of

Table 4. An overall summary of live tree growing stock and mortality for EAFB LTVM Plot data, 1999.

Vegetation Type	Trees/Acre	Trees/Hectare	Bas. Area/Acre	Bas. Area/Hec.	Cu. Ft./Acre	Cu. Met./Hec.		Trees/Acre	Trees/Hectare	Bas. Area/Acre	Bas. Area/Hec.	Cu. Ft./Acre	Cu. Met./Hec.
	----------LIVE GROWING STOCK SUMMARY-----------							----FIVE-YEAR MORTALITY SUMMARY----					
YG BIRCH FOREST Overall	358.00	886.05	106.51	24.45	2093.61	146.55		1.33	3.29	0.42	0.10	6.93	0.49
YG BIRCH Stats: WS	2.00	4.95	0.82	0.19	16.77	1.17		0.33	0.82	0.16	0.04	3.04	0.21
YG BIRCH Stats: PB	356.00	881.10	105.69	24.26	2076.83	145.38		1.00	2.47	0.26	0.06	3.89	0.27
YG BIRCH-WS FOREST Overall	426.00	1054.35	116.16	26.67	2238.97	156.73		2.00	4.94	0.52	0.12	8.51	0.60
YG BIRCH-WS Stats: WS	24.00	59.40	5.15	1.18	86.04	6.02		2.00	4.94	0.52	0.04	8.51	0.60
YG BIRCH-WS Stats: PB	376.00	930.60	102.27	23.48	2020.44	141.43							
YG BIRCH-WS Stats: BP	24.00	59.40	8.45	1.94	130.29	9.12							
YG BIRCH-WS Stats: Alder	2.00	4.95	0.29	0.07	2.20	0.15							
OG BIRCH-WS FOREST Overall	76.00	188.10	77.19	17.72	1621.03	113.47		11.67	28.82	9.72	2.23	214.43	15.01
OG BIRCH-WS Stats: WS	31.33	77.55	13.36	3.07	230.70	16.15		11.67	28.82	9.72	2.23	214.43	15.01
OG BIRCH-WS Stats: PB	44.67	110.55	63.83	14.65	1390.33	97.32							
BLACK SPRUCE FOREST Overall	114.00	282.15	23.66	5.43	282.96	19.81		2.33	5.76	0.49	0.11	5.70	0.40
BLACK SPRUCE Stats: BS	102.00	102.00	102.00	102.00	102.00	102.00		2.00	4.94	0.39	0.09	4.31	0.30
BLACK SPRUCE Stats: WS	12.00	12.00	12.00	12.00	12.00	12.00		0.33	0.82	0.10	0.02	1.39	0.10
ALDER Overall	4.00	9.90	0.83	0.19	7.66	0.54		0.00	0.00	0.00	0.00	0.00	0.00
ALDER Stats: WS	4.00	9.90	0.83	0.19	7.66	0.54							
BLUEJOINT Overall	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Table 5. An overall summary of seedling and sapling regeneration for EAFB LTVM Plots, 1999.

Vegetation Type	Trees/Acre	Trees/Hectare	Trees/Acre	Trees/Hectare	Trees/Acre	Trees/Hectare
	------SEEDLINGS------		--------SAPLINGS-------		--------COMBINED------	
YG BIRCH FOREST Overall	776.86	1919.11	125.30	309.53	902.16	2228.64
YG BIRCH Stats: WS	50.12	123.81	0.00	0.00	50.12	123.81
YG BIRCH Stats: PB	726.74	1795.29	125.30	309.53	852.04	2104.82
YG BIRCH-WS FOREST Overall	426.02	1052.41	350.83	866.68	776.85	1919.10
YG BIRCH-WS Stats: WS	350.84	866.69	200.48	495.25	551.32	1361.94
YG BIRCH-WS Stats: PB	75.18	185.72	150.36	371.44	225.54	557.16
OG BIRCH-WS FOREST Overall	2823.43	6974.82	183.77	453.98	3007.20	7428.80
OG BIRCH-WS Stats: WS	41.77	103.18	183.77	453.98	225.54	557.16
OG BIRCH-WS Stats: PB	2773.31	6851.00	0.00	0.00	2773.31	6851.00
OG BIRCH-WS Stats: Salix	8.35	20.64	0.00	0.00	8.35	20.64
BLACK SPRUCEFOREST Overall	2355.64	5819.23	1353.22	3342.92	3708.86	9162.15
BLACK SPRUCE Stats: BS	1353.24	3342.96	1328.16	3281.02	2681.40	6623.98
BLACK SPRUCE Stats: WS	0.00	0.00	25.06	61.91	25.06	61.91
BLACK SPRUCE Stats: PB	1002.40	2476.27	0.00	0.00	1002.40	2476.27
ALDER SHRUB Overall	275.66	680.97	25.06	61.91	300.72	742.88
ALDER Stats: WS	0.00	0.00	25.06	61.91	25.06	61.91
ALDER Stats: PB	275.66	680.97	0.00	0.00	275.66	680.97
BLUEJOINT Overall	2581.18	6376.39	0.00	0.00	2581.18	6376.39
BLUEJOINT Stats: PB	2556.12	6314.48	0.00	0.00	2556.12	6314.48
BLUEJOINT Stats: Salix	25.06	61.91	0.00	0.00	25.06	61.91

seedlings and saplings; seedlings were predominantly paper birch whereas all saplings are white spruce. This was readily evident in the field where white spruce formed distinct height and age cohorts (see LTVM Plot Site Descriptions). Paper birch seedlings exhibited a scattered clumped distribution related to exposed mineral soils.

Bluejoint Meadow exhibited higher numbers of seedlings and saplings per acre (ha); however, the plots in which these values were achieved were: 1) in an area where seedlings were rapidly invading a kettle depression that was drying out (Plot 23); and 2) in a selectively logged, nearly clear cut forest where a seedbed for paper birch seedling establishment resulted from churning of the forest floor by harvest machinery (Plot 16).

Alder Shrub exhibited relatively low forest regeneration.

Table 6 summarizes overstory tree mortality by major vegetation type and by cause of death. Values show ratios between the live growing stock, backdated to 1995, and 5-year mortality (1999). The following is an overview of tree mortality results:

Young Growth Birch Forest

There were four mortality trees in these forests, approximating 1.1% of the 1994 growing stock. Three trees were birch with various causes of death; the other mortality was a white spruce killed by bark beetles.

Young Growth Paper Birch-White Spruce Mixed Forest

There were six mortality trees, all white spruce representing 1.4% of the 1994 growing stock. Three spruce were killed by bark beetle and three by other causes of death.

Old Growth Birch-White Spruce Mixed Forest

This was the most heavily affected vegetation type with respect to mortality. There were 105 mortality trees, all white spruce, and all killed by bark beetles. Mortality amounted to approximately 27% of all the 1994 white spruce growing stock. Because the mortality occurred in the larger trees, the white spruce killed amounted to about 42% of all 1994 white spruce growing stock basal area, and about 48% of all 1994 white spruce volume (cu. ft and cu. m).

Black Spruce Forest

There were seven mortality trees including six black spruce and one white spruce representing about 5.8% of the 1994 growing stock. Four of the black spruce and the one white spruce were killed by beetles. The other two black spruce were killed by other causes.

Alder Shrub

Very few mature trees characterize alder plots (Table 4). Only one white spruce was reported as killed by spruce bark beetle in this type.

In the preparation and analysis of the mortality and regeneration results, the following additional summaries were made in the Excel Workbook:

For the growing stock tally, mortality tally, and sapling tally:

Trees per acre
Trees per hectare

Table 6. An overview and comparison between live growing stock and mortality by vegetation type for EAFB LTVM Plots, 1999.

VEGETATION TYPE	Per Acre Live Growth Stock	Per Acre Mortality	Percent Loss Over five Years	Comments on Causes of Mortality
YOUNG BIRCH FOREST	358	4	1.1%	Three dead birch by varying deaths, and one beetle-killed white spruce
YOUNG BIRCH-WHITE SPRUCE MIXED FOREST	426	6	1.4%	All white spruce: three killed by beetles, one suppressed, two unknown death
OLD-GROWTH BIRCH-WHITE SPRUCE FOREST	31.33	11.67	27.1%	All white spruce killed by beetles. Equals 42.1% of basal area and 48.2% of volume
BLACK SPRUCE FOREST	114	7	5.8%	Six black spruce, one white spruce: all but two black spruce killed by beetles
ALDER SHRUB	4	1	20.0%	One white spruce, killed by beetles
BLUEJOINT GRASS MEADOW	none	none	none	No overstory trees present

Basal area per acre
Basal area per hectare
Cubic foot volume per acre
Cubic meter volume per hectare.

For the seedlings tally:

Trees per acre
Trees per hectare.

These may be extracted and analyzed further for different natural resource management issues as the objective or need arises. The Excel Workbook and subsequent analysis with imbedded formulas are stored in the Permanent Plot Electronic Archive files as the "Forestry Data Subset" (Forest_Anal.xls and Mortality_Anal.xls).

DISCUSSION

The major long-term multi-disciplinary monitoring methods drawn upon for this study included the following state, national and international efforts:

U.S. Forest Service (USFS) Bonanza and Caribou Creek Watershed forest sites for Long-Term Ecological Research (LTER) (Database Manager - BNZ/CPCRW 2000, Van Cleve and Viereck 1993);

USFS Forest Health Monitoring Program (FHMP) (Hansen and Burke 1998, LaBau 1998, Mangold 1997, Max et al. 1996, USFS FIA 1998);

U.S. National Park Service (USNPS) Model Long-Term Ecological Monitoring Program (LTEM) for Denali National Park and Preserve (Denali National Park 1997, 2000, Helm 1999, Helm and Roland 1998);

International Tundra Experiment (ITEX), Toolik Lake (Jones 1998);

Canadian research at Wolf Creek Research Basin, Yukon Territory (Wolf Creek Research Station 1998);

USNPS multi-disciplinary monitoring for ecosystem biodiversity profile assessment (Mahan et al. 1998);

U.S. Army Land Condition-Trend Analysis (LCTA) plot inventory methods (Tazik et al. 1992).

Most of the monitoring efforts in Alaska remain quite dynamic (e.g., Denali LTEM), and many of their monitoring study methods have undergone significant changes since the EAFB monitoring plots were established in 1999. The EAFB monitoring plan is modelled most closely after the widely-accepted USFS FHMP/FIA and LTER programs which have proven to be quite stable. The USNPS Denali LTEM has recently adopted the FHMP/FIA techniques. Widespread acceptance and use of similar techniques allows for and promotes more direct comparisons of the data at local and regional scales. It also provides for the potential of combining similar datasets for specific management or research purposes as plots are revisited over time.

Elmendorf permanent monitoring plots were established to accommodate other natural resource monitoring studies. Various datasets may be drawn upon for specific management and planning needs as those needs are identified by EAFB Conservation and Planning staff. A forestry dataset was extracted and analyzed as an example of one specific use that might be made of the vegetation database given the current spruce bark beetle epidemic and resultant management issues facing EAFB and Southcentral Alaska.

Vegetation and physical features were characterized to provide a baseline for future work at a site. Permanent monitoring plots and their respective baseline descriptions represent points on the landscape within major vegetation types from which further multi-disciplinary monitoring efforts might be established and conducted. The wildlife studies included or associated with reviewed monitoring methods (see below) utilized transects (and occasionally plots) for counts to document and monitor changing populations or habitat use, and were established as their own separate sampling areas in the immediate vicinity of the vegetation plot so as to minimize disturbance within the latter. Changes in wildlife values/measurements might be related to vegetation changes determined by continued remeasurement of the vegetation plots over time.

The following sources of monitoring methods for specific species groups were reviewed for the current study and may have potential multi-disciplinary applications on EAFB:

Birds: Benson and Springer (1998), Blondel and Ferry (1981), Cooperrider, et al. (1986), DeSante and Walker (1994), DeSante et al. (1993), Institute for Bird Populations (1998), Johnson (1998), Mahan et al. (1998), Patton (1997), Patton and Pogson (1996), Ralph et al. (1993);

Small Mammals (including hare, coyote, wolf): Adams and Viereck (1998), Barnes and Barnard (1979), Brooks (1990), Cook and Rextad (1992), Cooperrider et al. (1986), Davis (1983), Furtsch (1995), Mahan et al. (1998), Rextad (1996, 1998), Rextad and Debevec (1998, 1999);

Large Mammals (including bear, moose): Barnes (1979), Barnes and Barnard (1979), Brooks (1990), Conner et al. (1983), Cooperrider et al. (1986), Davis (1983), Densmore et al. (1998), Lindzey and Knowlton (1975), Mahan et al. (1998), Roughton and Sweeney (1982), Van Vallenberge et al. (1989).

Complementary, multi-disciplinary, monitoring efforts should be conducted on their own plot(s) in the vicinity of a plot center represented by the LTVM plot to minimize disturbance on the LTVM plot established to document physical site and vegetational changes within the specified vegetation or site type.

All additional monitoring efforts should be documented using standard forest mensuration techniques similar to those used to document and layout the LTVM plot, and a site map for the monitoring area should be prepared to illustrate the location of different studies. It is recommended that the mapping procedures follow those employed at the Bonanza Creek LTER site near Fairbanks (Database Manager, BNZ/CPCRW 2000, Van Cleve and Viereck 1993). An example is provided in Appendix 11 and available from a site map for the Bonanza Creek Experimental Forest <http://www.lter.alaska.edu/maps/bcefbasemap.htm>.

Permanent Plot Monitoring Methodology

The methods established and implemented for monitoring long-term vegetation changes on EAFB (Appendix 1) employ a 2-phase sampling design insuring a degree of statistical validity for subsequent plot visits and remeasurements, and analysis of the comparative monitoring data. The first phase provided a randomized sample across the dominant vegetation cover types of the Base. A second phase utilized these plots to provide a sample meeting specific criteria minimizing such things as current or anticipated disturbance.

These plots were designed wherein they could be used to meet multiple management and research objectives using currently recognized and accepted methods (Hansen and Burke 1998, Helm 1999, LaBau 1998, USFS FIA 1998). They may be used to monitor or gain a better understanding of forest health issues, e.g. mortality and regeneration of the forest resource for such things as the spruce bark beetle currently affecting Southcentral Alaska. They may also be utilized to monitor vegetation species, cover, life history, and population changes within and between major vegetation types, and to facilitate further studies of successional stages, vegetation history and recovery following natural and unnatural perturbations.

The methodology developed and employed on EAFB is advantageous because it is modelled after techniques currently being used nationally and within the state of Alaska by the U.S. Forest Service and National Park Service, allowing direct comparisons to these local studies or incorporation into larger monitoring datasets at a statewide or national level (Helm 1999, Helm and Roland 1999, LaBau 1998, Max et al. 1996, Mangold 1997, Mead 2000, USFS FIA 1998, van Hees 1999).

It is important to note that in the final review of this study, the density of permanent plots on EAFB is very high compared to other monitoring studies using comparable methods in Alaska. The EAFB monitoring effort has established a monitoring plot density of 1 plot/433 A (24 fully-characterized plots over 10,381 A). The U.S. Forest Service established 282 plots in Southwestern Alaska covering 72 million acres representing approximately 1 plot/255,320 A (van Hees 1999), and 130 plots on the Kenai Peninsula covering the entire Peninsula (482,000 A) representing 1 plot/370 A (van Hees and Larson 1991). In 1998, 28 plots were established by LaBau for forest health and bark beetle studies covering 1,232,587 acres on the Kenai Peninsula or 1 plot/44,021 A. These comparisons should be considered in the future when determining whether more effort be directed towards the establishment of new and additional plots on EAFB vs returning to established plots for remeasurement.

Phase I: Permanent Plot Selection Techniques

The Phase I sampling technique for initial site selection is an intensive and time-consuming part of the overall methods meant to add an increased degree of randomness to the permanent plot sample on EAFB. The sometimes laborious procedure resulted from the high degree of heterogeneity of EAFB landscapes induced by more intensive land-use practices within the small aerial extent of the Base. Rejection of sites not meeting the rigid set of plot acceptance criteria was more frequently encountered in this relatively small, fragmented landscape, with a higher degree of disturbance activities than might be found elsewhere in Alaska. Phase I techniques may be more effectively implemented in larger units of the state such as an area of land the size of the Kenai Peninsula or Southcentral Alaska which possess larger units of undisturbed area.

Investigators in this study occasionally experienced problems meeting all of the prerequisite criteria for plot selection especially when arriving at the site, due to localized disturbances not visible on the airphotos or anticipated to occur in a particular area. These instances were occasionally solved by utilizing a random numbers table to generate a distance to go back along the plot access line we came in on, or by going left or right of the Initial Point (plot center) to insure that all our criteria were met for an LTVM plot. In either case, new routes needed to be established between the Reference Point and the new Initial Point. Future sampling crews establishing new plots should be aware that these issues add a significant amount of time for the initial establishment of permanent plots.

Phase II: Collection of Baseline Data

General Field Methods

For future work, the monitoring plot field manual (Appendix 1) should be reduced in size and made into a bound field book on waterproof paper for easy reference in the field. A convenient size is 4-5/8 x 7 in, which is the same size as a Write-In-The-Rain-Notebook©. It is also beneficial to produce copies of the crown transparency and density estimating cards on see-through mylar sheets so that they may be held above one's head when making these estimates under different weather conditions.

It may also be worthwhile in the future to consider field computers for data recording and collection. The U.S. Forest Service Alaska Forestry Sciences Laboratory (AFSL) utilizes Husky© field data loggers preprogrammed with field data sheets similar to those employed in this investigation (e.g., USFS FIA 1998). The future may also hold promise for currently popular Palm© handheld-computing devices (Busing et al. 1999).

Division of Labor for Data Collection

A field crew of three people is recommended consisting of a professional Plant Ecologist or Forest Ecologist and two Biological/Forestry/Field Assistants. The Ecologist takes the lead in establishing the Reference Point and the Initial Point (plot center). Once the plot center is established, the Plant Ecologist completes LTVM plot locational data and Subplot 1 physical site and vegetation descriptions, while Field Assistants begin the process of monumenting the site and recording witness tree data.

Once the Plant Ecologist has finished Subplot 1 measurements, one of the Assistants assists the Ecologist in the layout of the other three Subplots and Microplots. The two Assistants work together to collect live tree, regeneration, and mortality data on the Subplots. The Plant Ecologist continues to collect description information and vegetation data at each Subplot visited. Prior to leaving the Subplot, he/she lays out and flags the Mortality Plot boundary in each direction from that particular Subplot before proceeding back to the plot center and on to the next Subplot to repeat the same process.

The Field Assistants continue to collect growth stock, regeneration and mortality data, and once all four Subplots are completed, return to the plot center and begin the process of recording mortality on the Mortality Plot. One Assistant at plot center determines azimuths and records data while the second Assistant locates, blazes, and numbers mortality trees, and measures and calls distance and tree parameters.

We found that with this division of labor, all three individuals completed their individual or coordinated tasks at approximately the same time. Any additional time on the Ecologist's part was devoted to reviewing the field data sheets and helping to complete the Mortality Plot. NOTE: <u>It is critical that all field data be reviewed for completeness and for any irregularities while still in the field so they may be rectified before moving on to the next plot</u>.

It is recommended that professional biological staff be employed for specific tasks when establishing and revisiting LTVM plots. A qualified Botanist and/or Plant/Forest Ecologist should be part of the monitoring field team. A qualified Botanist or Ecologist are needed to field identify nearly all the species at each site including many locally rare species and invasive species. Following adequate training, Biological Assistants may be employed to collect forest mensuration data on a regular basis.

Monumenting Permanent Plots

The monumenting techniques employed in 1999 were very successful. The 1"x2.5" (2.5x6.4 cm) aluminum tags and nails worked well, and the tree screw-anchors were adequate for marking plot centers.The 84 cm screw anchors were not successfully set in past about 60 cm so a switch was made to 40 cm anchors to keep the posts as near to the ground as possible. Each Subplot was also successfully marked with a 60 cm x 6.5 mm surveyor's fiberglass rod sunk to within 15 cm of the surface. Gravel and/or hardpan was encountered at about 30 cm on most sites, including black spruce wetlands.

Weather

Weather played a major factor in establishing and characterizing LTVM plots in 1999. It was a cooler,wetter year effectively shifting the growing season and peak greenup by approximately 0.5 month and thus shortening the total field season by about the same amount of time. Conversely, the 2000 field season was early by approximately two weeks, although no new plots were established in 2000.

Rain slows travel and data recording, and cloudy conditions affect the time it takes to estimate vegetation cover and crown density-transparency measurements. On the other hand, sunny days sometimes make determination of crown death difficult in conifers. Field crews in the future should be aware of these weather-related anomalies.

GPS

In 1999, the EAFB Conservation and Environmental Planning and Heritage Program GPS units did not give adequate readings in forested environments. No readings were possible from any of the RPs and IPs despite the use of sophisticated units. Satellite signals did not reliably penetrate the vegetation. We therefore relied on accurate forest mensuration techniques on the 1" =1000'-scale airphotos and conversions from the topographical map record. In many instances, the investigators could actually see Reference Point (RP) witness tree(s) on the airphotos.

Nonvascular Plant Sampling Within LTVM Plots

Early in the monitoring design, Base personnel elected not to place a major effort into nonvascular species due to the increased costs of species identifications. Heritage staff agreed to note only total covers and record major, easily recognized bryophytes and lichens. These species and species groups have been given little attention in many investigations, even though in more recent times they have been noted to play major roles in boreal forest ecosystems. It is recommended that future LTVM plot establishment, characterization and remeasurement devote a significant effort to these life forms.

Most estimates of bryophytes have been made using qualitative surveys of a particular study area (Pursells 1975). More recently, however, a quantitative methodology for counting species and estimating percent cover for bryophytes and lichens has been developed (Battles et al. 1996, Mahan et al. 1998). Some level of expertise and training is required in order for investigators to recognize lichens and bryophytes in the field. For that reason, these protocols may be more costly than for vascular plants.

A recommended technique is to determine bryophyte composition and abundance using a 1 x 0.5-m nested quadrat located within each of the vegetation characterization Subplots (Mahan et al. 1998, Battles et al. 1996). All species present within the quadrat along with their percent cover and the substrate on which they are growing are recorded. In addition, opportunistic bryophyte sampling is used to capture a greater amount of species diversity in the stand. Opportunistic bryophyte sampling includes identifying the nearest rock, dead wood, and live wood to the center of the quadrat plot and estimating bryophyte composition and cover on each substrate using a 10 x 20 cm flexible, gridded frame centered on the most bryophyte-rich area of the substrate. If no rocks, dead wood, or live wood are located within a 5 m radius of the bryophyte quadrat, that substrate is not sampled at that point (Battles et al. 1996). A good bryophyte and lichen species list has been prepared for the neighboring Fort Richardson Army Base by Dr. Barbara Murray of the Alaska Science Museum (ALA),University of Alaska Fairbanks (Lichvar et al. 1997).

Estimated Time to Complete LTVM Plots

The methodology for establishing and characterizing an LTVM Plot worked well although proved more time consuming than was originally anticipated. We estimated completing one plot/day and made this an "establishment criteria" for choosing a site. However, it was generally difficult to hold to this: Phase I criteria of plot selection and establishment generally precluded this one plot/day criteria (see Phase I Discussion above).

The time and efficiency of establishing a plot varied from 1.25 to 3.4 hours and tended towards a minimum of 2.5 hours/plot once we had parked the car. This amount of time was attributed to:

1. Navigating to a point on the airphoto as determined in as objective a manner as possible from the Phase I methods.

2. Proceeding in the most direct route to the Reference Point/Initial Point based on the initial airphoto interpretation. We sometimes found a better route after the fact and ultimately

established a second, more efficient route to access Reference Point and/or Initial Point.

3. Difficulty in estimating the disturbance factor from airphotos. This was also occasionally an issue on the ground. In one instance, a plot was adjusted to fit a vegetation type between major trails. On a few plots, a number of foxholes was found scattered across the plot only after we had completed all plot measurements. A considerable amount of time and effort was essentially spent attempting to meet the criteria for no disturbance, especially randomness that met the minimal disturbance requirement on a military base that has experienced active training since the 1940s.

4. Difficulty in navigating dense vegetation types and dragging a chain on a bearing. Generally this occurred in dense conifer cover such as black spruce, or in much denser, open, old-growth mixed forest with alder and devil's club openings, where large beetle-killed spruce were blown over and covered with bluejoint grass to 1-2 m high.

Completion time for a LTVM plot averaged 26.6 person hours/plot varying between vegetation cover types and location on the Base. It was possible to complete dense Black Spruce Forest types in as little as 15 person hours with good road access. These values do not include lab time for laying out the Plot and preparing for the field at the beginning of the day, or processing the field data, gear, etc. at the end of a day.

The most time-consuming plots were healthy, heavily-forested types such as Young Closed Birch and Mixed Forest types, followed by the Open Old-Growth Forests with fewer trees but which were much more difficult to traverse due to hummocky terrain, devil's club, alder and grass-covered dead and fallen trees. The latter type was also more time-consuming due to numerous dead trees to tally and measure.

Because plots took more than one normal work day to complete, additional time was utilized accessing and departing a plot on a second visit, which increased the more remote the plot was on the Base.

These factors not only reflect on the time and budget to establish and initially characterize the monitoring plot, but also would be anticipated to have a similar effect on future revisits making the monitoring effort more expensive, and perhaps prohibitive, depending on the budget climate at a later time. It is therefore recommended that new and additional plots be established in a less random manner during Phase I, and located nearer Phase I points possessing more advantageous access. It is further suggested that the Phase I photo points continue to be used as an initial starting point for establishing a permanent plot in a vegetation type in a general area. An actual azimuth and distance could/would be determined randomly to a plot center in the vegetation type convenient to its access and where there is/was no perceivable present or anticipated disturbance.

In terms of seasonality, changing fall colors and associated leaf fall influence how late in the field season deciduous forest and shrub vegetation types may be sampled and characterized. Some coniferous types (e.g., Black Spruce Forest), and seedling/sapling growth stock and stand mortality observations may be scheduled into September and on into October if the need arises. Additional LTVM plots can be established and monumented until early snowfall, perhaps as late as October; frozen ground, however, will hamper attempting the latter early in a field season.

Remeasurement of LTVM Plots

The following constitute a number of observations regarding the remeasurement of LTVM plots. These are anticipated to evolve as the Base Conservation and Environmental Planning Office is confronted with changing management or research issues that warrant revisiting plots at different return intervals.

Use of the Techniques Manual for the Remeasurement of Monitoring Plots in Subsequent Years

For relocation and subsequent remeasurement of LTVM plots in future years, no Phase I plot location techniques would be required. All of the Phase II Field Measurement Techniques would be employed except the actual monumenting of the plot covered by Data Sheet 2 (DS 2). An exception might be the addition of notes or measurements necessary or required for monuments or markers lost or destroyed in the years between remeasurement. It would also be important to report on other multi-disciplinary plots established in the vicinity of the LTVM plot so as to minimize disturbance of all monitoring efforts taking place in the immediate vicinity of the original LTVM plot.

Time and Person Power Estimates

The estimated time to complete the remeasurement of a permanent plot, and the necessary manpower and expertise needs and divisions of field labor are not anticipated to be significantly different than those estimates reported here for the initial establishment and characterization of LTVM plots. A degree of reinterpretation of the relocation, laying out and marking of microplots, subplots and mortality plots; the relocation of specific trees and a determination of changes in tree diameters; changing mortality and regeneration and appropriate data sheets; the completion of the understory vegetation remeasurements, etc., would all combine to keep the time and labor estimates close to those discussed above.

Interval

The remeasurement interval of the LTVM plots will depend on the overall goals of the EAFB Conservation and Environmental Planning Program and its subsequent incorporation of additional monitoring components such as wildlife or ecosystem level research elements. Return interval may also be variable within an LTVM plot, according to the vegetation classes of interest. For example, Subplots used to tally seedlings might be remeasured every two years, while the overstory Subplots might be remeasured every five years. In the case of Southcentral Alaska and the ongoing incidence of the spruce bark beetle epidemic, the tree seedling, sapling, growing stock and mortality plots could be remeasured annually for a number of years to monitor forest overstory changes while the understory vegetation profile Subplots may only be revisited every 5-10 years. This is an option up to the researcher or as dictated by EAFB Conservation and Environmental Planning's programs and budgets. Younger, more dynamic vegetation types on recently disturbed sites (e.g., bluejoint or alder) might need to be monitored more frequently in order to accurately assess changes in those vegetation classes (e.g., 3-5 years).

Frequent remeasurements, every year or two, will record more chance variability, (i.e. noise in the system). This may be evened out by a longer sampling interval, often many years, but the chance still exists that the year which is used will turn out to be atypical (Elzinga et al. 1998).

Realistically, annual or even biennial sampling is unlikely due to budgets and availability of the necessary expertise, and if the plots are maintained and remeasured at longer intervals, e.g., 10-15 years, the data will still be very valuable. A sampling interval of no more than 10 years is recommended, although certainly the interval will depend on any project or ecosystem concern or objective (e.g., spruce bark beetle epidemic or regeneration following clearing), and the budget available to revisit permanent plots.

One approach to interval is that of the USFS FHM Program (Mangold 1997). This method involves sampling all plots during the first year of establishment and then divides the plots up into a number of panels to be revisited annually depending on the final number of permanent plots. If 4 panels were decided upon (e.g., every 4th point), then during year 2, plots on Panel I and 1/4 of those on Panel 2 would be revisited. During year 3, all points on Panel 2 and 1/4 of those on Panel 3 would be sampled, and so on. This 4 panel approach would take 5 years to complete the initial analysis and one complete cycle of 4 years of monitoring. The 4 year monitoring cycle is then continued. It results in all points being sampled at least every 4 years, and 1/4 of them being sampled every 2 years (Helm 1998).

In many vegetation types, little change may be expected in two years so this would help continuously revalidate the amount of sampling needed and reproducibility of sampling. This continual rotation of revisiting the plots ensures a steady stream of monitoring data and keeps the overall workload in any one year within manageable limits. The land manager is not faced with coming up with what could be a large budget in any one year to meet long-term monitoring goals.

Time of Year

If possible, remeasurements should be made at about the same time of year as the original measurements, but deviations from this rule should not seriously compromise the data. The more important factor determining when to remeasure the plot may be whether or not leaves are present in order to accurately identify plants, or to complete canopy cover, and crown transparency and density estimates.

Tallying New and Dead Overstory Trees

During a remeasurement, some saplings tallied during the last visit will have grown enough during the interval to now be tallied as overstory trees. These new overstory trees must be tagged with a number and entered on the Overstory Data Form with the corresponding data.

Similarly, an overstory tree that was tallied last time as live may now be dead, or a sapling tallied last time may have grown enough to be classified as an overstory tree, but died before the remeasurement. In the first case, care must be taken to change the status of the overstory tree on the remeasurement data form. In the second case, the dead tree must be tagged with a new number, and entered on the Overstory Data Form with the corresponding data.

Remeasuring DBH

In the field, one must check the remeasured dbh against the dbh recorded from the previous occasion(s). In the process of growth, a tree usually gets larger, so a dbh that has "shrunk" should be checked immediately. The dbh must be measured at the proper point on the tree (see Appendix 1), and the tape must be positioned correctly, pulled tight, and not caught on branch stubs. A tree may actually "shrink" due to sloughing of bark or the dbh could have been measured or recorded incorrectly during the previous occasion.

Laboratory Techniques

Data entry was a labor-intensive effort requiring a series of thorough edits before incorporating the data into the Electronic Database Record. Excel computer software was heavily utilized to screen the plot data by checking columns of information for data irregularities such as heights and diameter classes expected to be represented within a particular plot size. As mentioned previously under the discussion of "Division of Labor for Data Collection", it is critical that <u>all field data be reviewed</u> for completeness and for any obvious irregularities <u>while still in the field</u> so that they may be rectified before moving on to the next plot in order to minimize the amount of editing later in the office, or the need to revisit the LTVM plot at a later date to clarify any discrepancies.

Vegetation Development of Monitoring Plot Cover Types

Twenty-four permanent plots were established and characterized in six major vegetation cover types of EAFB (Table 1). A variety of plant community types (Level 5, Viereck et al. 1992) were identified within these mapping units (Table 3). These plant communities indicate a level of variability one might anticipate across different sites or that might indicate or represent different phases of a site's vegetation development. The following represents a short review and interpretation of current literature on vegetation development pertaining to the overall cover type represented by LTVM plots (Table 1).

Young Paper Birch Forest

Viereck et al. (1992): IB1d
LTVM Plots: 2, 7, 13
Level 5 Plant Community Types Observed on EAFB, 1999:

Betula papyrifera/Viburnum edule

Betula papyrifera/Viburnum edule-(Echinopanax horridum)/Calamagrostis canadensis

Betula papyrifera/(Viburnum edule)/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis

Betula papyrifera/Echinopanax horridum/Linnaea borealis

Betula papyrifera/Echinopanax horridum-Viburnum edule/Gymnocarpium dryopteris-(Cornus canadensis)

Betula papyrifera/Echinopanax horridum-Viburnum edule/Calamagrostis canadensis-Equisetum arvense

Speculation on the origin of large areas of paper birch in Southcentral Alaska has included catastrophic wildfire, past insect infestations, and preferential harvesting of spruce at the start of the 20th century (Berg 2000, USDA Soil Conservation Service 1986).

Following disturbance, these stands will usually be replaced by open or closed white spruce, black spruce, or black spruce-white spruce communities after passing through several types of spruce-birch mixtures. In Southcentral Alaska, open mixtures of white spruce and birch with grassy openings may be climax on some sites (Neiland and Viereck 1977).

White spruce and paper birch may become established at the same time; however, the birch will generally grow faster than the spruce. When the birch reach a very old age and die, the spruce is already present. It is more difficult for spruce to invade after a birch forest is well established, because the heavy leaf litter prevents the survival of spruce seedlings (Gregory 1966). Eventually, however, a few spruce become established as the aging birch weaken and die. This scenario is discussed at length by Tande (1983) for forests of EAFB.

Mature birch can survive low-intensity ground fires, however, the aerial parts are easily killed by moderate and severe fires. If the roots survive the fire, the stumps sprout vigorously, which leads to an abundance of multiple-stemmed trees in the resulting forest. This phenomenon is evident in many parts of EAFB; one of the best examples occurs in the northwest portion of the Base on the south-southeast slopes of the drumlin separating Ammo Land from Loop Road. The forest here is principally composed of multiple stemmed trees 15-30 cm in dbh.

The principal author did not observe any qualitative or quantifiable changes in this vegetation cover type or its associated plant communities in 1999 that may have occurred since conducting the first vegetation mapping and inventory of EAFB in 1982-1983 (Tande 1983).

Young Mixed Paper Birch-White Spruce Forest

Viereck et al. (1992): IC1a
LTVM Plots: 1, 3, 6
Level 5 Plant Community Types Observed on EAFB, 1999:

Picea glauca-Betula papyrifera/Viburnum edule/Gymnocarpium dryopteris-Cornus canadensis-(Pyrola asarifolia)

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/(Alnus sinuata)-Rosa acicularis/Equisetum arvense Betula papyrifera-(Picea glauca)/Dryopteris dilatata-Equisetum arvense-Lycopodium annotinum

Picea glauca-Betula papyrifera/Cornus canadensis

Betula papyrifera-(Picea glauca)/Viburnum edule/Gymnocarpium dryopteris-Dryopteris dilatata

Betula papyrifera-Picea glauca/Ledum groenlandicum-Vaccinium vitis-idaea/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-Picea glauca/Cornus canadensis/Pleurozium schreberi

Betula papyrifera-(Picea glauca)/Pleurozium schreberi

Speculation on the origin of large areas of this forest type in Southcentral Alaska has included catastrophic wildfire, past insect infestations, and preferential harvesting of spruce at the start of the 20th century (Berg 2000, Soil Conservation Service 1986, Holsten et al. 1995).

Following disturbance, spruce-birch stands usually develop from stands of pure or nearly pure birch as the slower growing spruce reach the birch canopy, and as the relatively short-lived birch begin to mature and die. In some areas, the birch and spruce establish at the same time, and the stand is dominated for many years by the faster growing birch. In other stands, only birch is present at the outset, and the spruce slowly comes into the stand over a long period (Viereck et al. 1992).

Spruce-birch stands eventually develop into stands of pure spruce as the birch trees continue to drop out without replacement. In some cases, the resultant spruce stands may be fairly open if spruce regeneration is insufficient to maintain a closed overstory canopy (Viereck at al. 1983, 1986). Young mixed forests on EAFB currently exhibit a closed overstory of paper birch with a white spruce cohort, 25-75 per cent of the height of the birch, invading the birch canopy. These forests develop towards an open old-growth mixed forest as described by Tande (1983). Mature stands become interspersed with invading bluejoint grass and alder tall shrub communities.

The principal author did not observe any qualitative or quantifiable changes in this vegetation cover type or its associated plant communities in 1999 that may have occurred since conducting the first vegetation mapping and inventory of EAFB in 1982-1983 (Tande 1983).

Old-Growth White Spruce-Paper Birch Mixed Forest

Viereck et al. (1992): IC1a
LTVM Plots: 5, 9, 11, 12, 14, 15, 17, 19, 20
Level 5 Plant Community Types Observed on EAFB, 1999:

Betula papyrifera/Echinopanax horridum-Rosa acicularis/Calamagrostis canadensis-Cornus canadensis

Betula papyrifera-(Picea glauca)/(Alnus sinuata)/Calamagrostis canadensis-(Equisetum sylvaticum)

Picea glauca-Betula papyrifera/Menziesia ferruginea-Echinopanax horridum-Viburnum edule/ (Calamagrostis canadensis)-Gymnocarpium drypoteris-Dryopteris dilatata-Cornus canadensis

Picea glauca-Betula papyrifera/Rosa acicularis-Viburnum edule/Calamagrostis canadensis-Cornus canadensis-Gymnocarpium dryopteris

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Cornus canadensis

Picea glauca-Betula papyrifera/Viburnum edule/Calamagrostis canadensis-Gymnocarpium dryopteris-Vaccinium vitis-idaea-Cornus canadensis-(Linnaea borealis)/ feathermoss

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis (Dryopteris dilatata)

Betula papyrifera-(Picea glauca)/Alnus sinuata/Calamagrostis canadensis-Equisetum arvense

Successional relations of these communities are poorly understood (Viereck et al. 1992). Many appear to be stable and may be climax on some sites. On other sites, the birch is replaced by white or black spruce over time(Viereck et al.1983, 1986).

Speculation on the origin of large areas of this forest type in Southcentral Alaska has included catastrophic wildfire, past insect infestations, and preferential harvesting of spruce at the start of the 20th century (Berg 2000, Soil Conservation Service 1986, Holsten et al. 1995).

Following disturbance, spruce-birch stands usually develop from stands of pure or nearly pure birch as the slower growing spruce reach the birch canopy, and as the relatively short-lived birch begin to mature and die. In some areas, the birch and spruce establish at the same time, and the stand is dominated for many years by the faster growing birch. In other stands, only birch is present at the outset, and the spruce slowly comes into the stand over a long period.

Spruce-birch stands eventually develop into pure spruce stands as the birch trees continue to drop out without replacement. In some cases, the resultant spruce stands may be fairly open if spruce regeneration is insufficient to maintain a closed overstory canopy (Viereck et al. 1983, 1986). Young mixed forests on EAFB appear to develop towards a closed mixed forest followed by an open old-growth mixed forest as described by Tande (1983). Mature stands become interspersed with invading bluejoint grass and alder tall shrub communities as older trees fall out of the forest overstory structure.

The principal qualitative change observed in this cover type/plant community since the 1983 vegetation mapping and inventory (Tande 1983) is the extensive mortality of white spruce from an ongoing spruce bark beetle epidemic in Southcentral Alaska. Of particular significance is how this affects the author's interpretation of forest succession in Southcentral Alaska since his model was developed and reported in the original EAFB inventory (Tande 1983).

Whereas the model centered around infrequent, stand-replacing fires to create the mosaic of even-aged stands across the Base, climate change and resultant bark beetle infestations with or without the addition of subsequent sanitizing and rejuvenating fires probably has played a significant role in the forest history of the Anchorage area. These hypotheses are currently the center of much forest ecology research in Southcentral Alaska and in particular on the Kenai Peninsula (Berg 2000, LaBau 1998, 2000).

Black Spruce Forest

Viereck et al. (1992) code: IA1k, IA2k
LTVM Plots: 4, 8, 10
Level 5 Plant Community Types Observed on EAFB, 1999:

Picea mariana/(Vaccinium vitis-idaea)/Pleurozium schreberi

Picea mariana/(Vaccinium vitis-idaea)/Ptilium crista-castrensis

Picea mariana/Equisetum sylvaticum/Sphagnum species-Pleurozium schreberi

Picea mariana/Ledum groenlandicum/Equisetum sylvaticum/Sphagnum girgenshohnii

Picea mariana/Equisetum sylvaticum/Pleurozium schreberi

Picea mariana/Betula glandulosa/(Rubus chamaemorus)/Sphagnum spp.

Picea mariana/Ledum groenlandicum/Equisetum arvense/Sphagnum spp.

Picea mariana/(Ledum groenlandicum)/Calamagrostis canadensis

Most black spruce communities are considered climax on cold, poorly-drained sites. They burn frequently in the Interior of Alaska, and stands older than 100 years are considered rare (Viereck et al. 1992). Black spruce forests of EAFB range in age from 50 - >224 years, reflecting a longer fire return interval for Southcentral Alaska (Gabriel and Tande 1983).

Post-fire succession is complex and ranges from direct reestablishment of black spruce to successional seres involving various moss-herb, shrub, and tree communities (Post 1996). Many of these stands appear to be stable until they are burned. After fire, they eventually return to nearly their original composition. In the long term, they may be transitional between white spruce forests and open black spruce stands common on wetter and colder soils. This transition to open black spruce is probably driven by a tendency for the soil to become more poorly drained and for the depth of seasonal thaw in cold soils to rise as a moss mat becomes thicker and the soil becomes colder (Post 1996, Viereck et al. 1983, 1986).

The principal author did not observe any qualitative or quantifiable change in this vegetation cover type or its associated plant communities in 1999 that may have occurred since conducting the first vegetation mapping and inventory of EAFB in 1982-1983 (Tande 1983).

Spruce bark beetles, however, were noted to be attacking some old-growth black spruce during the establishment and characterization of monitoring plots (LTVMP 4, 8). The beetle is normally specific to white and Lutz spruce. What this impact may be to black spruce on EAFB is unknown. It may indicate a denser beetle population shifting from a shrinking white spruce resource to a less desirable host as has been noted on the Kenai Peninsula (LaBau 1998; author's personal observation).

Alder Shrub

Viereck et al. (1992): IIB1b
LTVM Plots: 18, 21, 22
Level 5 Plant Community Types Observed on EAFB, 1999:

Alnus sinuata/Calamagrostis canadensis

Alnus sinuata/Calamagrostis canadensis (Osmorhiza depauperata)

Alnus tenuifolia/Calamagrostis canadensis (Equisetum fluviatile)

Alnus sinuata/Echinopanax horridum

Alnus sinuata/Equisetum arvense

Alnus sinuata/Sambucus racemosa-Rubus idaeus-(Ribes triste)/Dryopteris dilatata-(Gymnocarpium dryopteris)

Alnus sinuata/Rubus idaeus/Calamagrostis canadensis

Alnus tenuifolia/Rubus idaeus-(Ribes triste)/Calamagrostis canadensis-(Dryopteris dilatata)

Three shrub species of alder occur in Southcentral Alaska: Sitka alder (*Alnus sinuata*), thinleaf alder (*A. tenuifolia*, sometimes referred to as *A. incana*), and green alder (*A. Crispa,* Viereck and Little 1972).

Tall closed alder stands are common at forest edges, on floodplains and along stream banks. In Southcentral Alaska, green alder commonly dominates on upland and well-drained floodplain sites, and Sitka alder dominates well-drained uplands and avalanche tracks (Viereck and Little 1972). Thinleaf alder occasionally will be dominant, but most thinleaf alder stands are shrub swamps (Viereck and Little 1972). On EAFB, Sitka alder is the dominant alder type followed by thinleaf alder and occasional stands of green alder. Thinleaf alder dominates the wet shrub swamps and forest depressions common along the north side of the Elmendorf Moraine from Cook Inlet north to Green and Spring Lakes, around the Elephant Cage Communications Center and northeast to Hillberg Ski Area.

Very little work has been published on the successional status of alder species in Southcentral Alaska outside of its role in succession on river bars and glacial outwash plains (Collins and Helm 1997, Helm et al. 1984, Helm and Allen 1995, Helm and Collins 1997). Wurtz (1995, 2000) has recently investigated the silvicultural applications of alder transplants for a natural nitrogen enhancement of white spruce revegetation on Southcentral and Interior Alaska logging sites.

Closed tall alder stands are a topoedaphic climax on many sites, including avalanche tracks, subalpine uplands and steep alpine slopes. Subarctic lowland alder communities eventually will be replaced by forests in most instances; many have established themselves on sites disturbed by fire or land-clearing activities (Viereck et al. 1992).

Successional relations of thinleaf alder tall shrub swamp stands are for the most part unknown. The defining characteristic of these stands is an excess of moisture with standing water present throughout much of the growing season. These communities probably represent topoedaphic climaxes in many cases, and will persist as long as hydrologic conditions causing seepage and flooding exist on a site (Viereck et al. 1992).

Wurtz (2000) provided the following summary on alder succession most applicable to EAFB:

> "On primary successional sites as reported from the Tanana River floodplain in the Interior of Alaska, alders and willows (*Salix* spp.) colonize newly deposited surfaces quickly; after 10 years, there may be as many as 40,000 stems per acre (100,000 stems per ha) (Van Cleve and Viereck 1981)… The dominant role of alders continues for the first 60 to 80 years of floodplain succession, until the balsam poplar (*Populus balsamifera*), and later white spruce (*Picea glauca*), canopies close overhead. Then, though their abundance and vigor decline, alders persist in the understory. Individual alder stems can be long lived (Wilson et al. 1985); the oldest stem for which age was determined ... was 75 years old. As individual stems mature and die back,

new ones sprout from the same root crown...

On upland sites in interior Alaska, the most common disturbance is wildfire. In such secondary successional sequences, alders occur as a scattered shrub layer beneath paper birch (*Betula papyrifera*) and aspen (*Populus tremuloides*). They reach their greatest influence 50 to 100 years after fire. Soil nitrogen reserves double during this period (Van Cleve and Viereck 1981). As the upland forest becomes dominated by white spruce, the importance of alder declines. But just as on floodplain sites, alders on upland sites persist throughout the later stages of succession as common, though scattered, components of the understory...

Not all alders found in the understory of mature forests originate(d) in an earlier successional stage. New individuals can establish from seed where localized disturbances such as windthrow have exposed mineral soil (Gilbert and Payette 1982) and created openings in the canopy. These new establishment events, however, seem infrequent (Huenneke 1987, Huenneke and Marks 1987). For the most part, alder stems in the understory of mature boreal forests are the most recent aboveground generation of a genetic individual that has occupied that spot for decades or even centuries...

...On many sites in the boreal forest of Alaska, ... alders... grow rapidly... In Interior Alaska, both green and thinleaf alders rapidly colonize new roadsides and gravel pits. Green alder wildlings collected along roadsides grew rapidly after being planted in a tilled agricultural field and kept free of competing vegetation (Wurtz 1995). In the first year after planting, the wildlings doubled or tripled in height, and in the second year, many doubled again. At the same time, they were sprouting vigorously from the base of the main stem, so that after 3 years, individual plants had as many as 10 stems curving out and up from the base and a dense, rounded growth form.

Although dense stands of *Calamagrostis canadensis* can prevent spruce from becoming established in a secondary successional site, white spruce seems to tolerate competition from alder. In many boreal forest successional sequences, white spruce grows naturally beneath a canopy of shrubby alder for years before gradually overtopping it and becoming the dominant species (Van Cleve and Viereck 1981)..."

More detailed information for alder on EAFB is reported in a disturbed alder identification and mapping project conducted concurrently with the current permanent plot monitoring study (Tande et al. 2001). The principal author could not make any quantifiable estimates of change in this vegetation cover type or its associated plant communities in 1999 that may have occurred since conducting the first vegetation mapping and inventory of EAFB in 1982-1983 (Tande 1983). However, one qualitative observation would be the obvious increase in alder shrub heights in borrow pits such as the area outside the entrance to Ammo Land at the northwest corner of Lower Six Mile Lake. In 1983, this area was open with scattered low alders to .05 m high. In 1999, the area was covered by a dense alder shrub to 3 m high.

Bluejoint-Herb Meadow

Viereck et al. (1992): IIIA2A, IIIA2b
LTVM Plots: 16, 23, 24
Level 5 Plant Community Types Observed on EAFB, 1999:

Calamagrostis canadensis

Rubus idaeus/Calamagrostis canadensis/Equisetum sylvaticum

Calamagrostis canadensis-Agrostis scabra-Equisetum arvense-Sphagnum light green

Most of the mesic bluejoint and bluejoint-herb plant communities in forested parts of Alaska have developed when fire, land-clearing, or some other disturbance destroyed forest communities. If disturbance is not renewed, most of these stands eventually are invaded by shrubs (alder or willow, or both) and transformed to shrub vegetation and ultimately forest. Where drainage and soil development are adequate, the bluejoint may eventually suppress the herbs thereby resulting in a bluejoint-alder grassland climax as reported for Southwest Alaska (Griggs 1936). If shrub invasion is delayed long enough, the bluejoint may crowd out other herbs, thereby producing a bluejoint meadow.

Wet bluejoint-herb community types may be derived from wet sedge meadows or wet herb marshes (e.g., LTVM Plots 23, 24). In turn, they eventually are invaded by shrubs and become shrub communities.

In Southcentral Alaska, development of bluejoint meadow communities is generally thought to be initiated by disturbance such as fire or land-clearing. Bluejoint communities may be preceded by a bluejoint-herb stage. Though bluejoint meadows may persist for some time, most probably will evolve through alder or willow shrub to a forest community if disturbance is not renewed (Mitchell and Evans 1966).

In forested parts of the State, bluejoint-shrub communities probably develop when shrubs invade bluejoint meadows or bluejoint-herb stands, though sometimes they may develop directly after fire or other disturbance. If disturbance is not renewed, bluejoint-shrub communities probably develop into shrub and then forest communities.

Griggs (1936) considered a landscape mosaic of bluejoint meadows and tall alder copses (much like is evident along the Cook Inlet shoreline of EAFB today) to be climax in southwestern Alaska beyond the treeline. He believed it to be the endpoint of both wet (via bluejoint-herb communities) and dry seres (via bluejoint-herb communities) on sites where soil development could proceed toward a mesic condition (Mitchell and Evans 1966, Viereck et al. 1992).

On many sites in the boreal forest of Alaska, the biggest obstacle to the successful regeneration of white spruce after timber harvest is competition from bluejoint grass (Eis 1981, Hauessler and Coates 1986, Hogg and Lieffers 1991). Small amounts of bluejoint grass occur naturally in openings of mature white spruce forests (Reynolds 1990, Viereck et al. 1983, Tande 1983). When the trees are harvested, this grass spreads rapidly via a network of roots and rhizomes; this aggressive growth is most likely triggered by a sudden increase in available light (Powelson and Lieffers 1992). Bluejoint can dominate a harvested site in 3-4 years, accounting for 70 percent of the plant cover present, and producing a thick, impenetrable belowground mat. In the Trapper Creek area of Southcentral Alaska, bluejoint grass has been reported to grow to 1.8 m (6 ft) tall (Wurtz 2000, this study); when the grass dies back at the end of summer, it effectively buries any tree seedlings beneath it. Slow-growing spruce seedlings cannot survive in this severely competitive environment.

The principal author did not observe any qualitative or quantifiable changes in this vegetation cover type or its associated plant communities in 1999 that may have occurred since conducting the first vegetation mapping and inventory of EAFB in 1982-1983 (Tande 1983).

General Biology Notes and Observations

All Young Birch or Birch-Spruce Mixed Forests visited in 1999 appeared to be very healthy, exhibiting little to no fungal attack and possessed good to excellent crown density-transparency values. An interesting hare/porcupine tree bole damage in LTVM plot 6 demonstrated the accuracy of crown density-transparency values. Those trees that were nearly girdled exhibited dramatically increased crown transparency values and decreased crown density values. No insect infestations were encountered in these younger forests; however, a serious defoliation was observed in the balsam poplar forests west of the community gardens. Very little seedling or sapling regeneration was evident in these younger forest types. These observations were supported by the Forestry Data Subset (Tables 4, 5, 6).

The 1983 vegetation map classes (Tande 1983) for Old-Growth Forest types (i.e., 8, 9, 12, 14, 16) were merged into a single map class for this study and are more aptly called an Open Old-Growth Forest of paper birch and some living white spruce. This is due to the loss of the spruce to spruce bark beetle. It as a type approaches a park-like or savanna-like appearance of widely-spaced old birch with openings of tall shrub thickets of alder, devil's club and elderberry, and bluejoint grass meadows.

In Old-Growth Mixed Forest, spruce bark beetle mortality amounted to approximately 27% of all the 1994 white spruce growing stock. Because the mortality occurred in the larger trees, the white spruce killed amounted to about 42% of all 1994 white spruce growing stock basal area, and about 48% of all 1994 white spruce volume (cu. ft. and cu. m; see Results, Table 6; Note: age of spruce mortality can only be reliably estimated for five years: field work year 1999 less 5 yr=1994; see Appendix 1).

Mortality continues in the remaining older spruce; more significantly, we also found younger, healthier white spruce in the 6-8 in (15-20 cm) dbh class exhibiting some signs of spruce bark beetle attack. In addition to white spruce, a number of cases were observed where old black spruce had been attacked. This latter condition was reported from the Kenai Peninsula in 1997 (LaBau 1998; author's personal experience). These observations may be further quantified by a more thorough analysis of the Forestry Data Subset.

It is the authors' experience that there is significantly more regeneration to be reported in 1999 for these Old-Growth Forests than reported in the original EAFB natural resources inventory (Tande 1983). The 1999 observations are quantifiable and may be compared to the 1983 forestry data on file at the Conservation and Environmental Planning Office.

In 1999, three remnant forests stands were found which possessed fire scars (Subplots 6.3, 4.2) and within the very old black spruce forest on the southwest of Lower Six Mile Lake (Plot 8). Further vegetation history work on the Base would be of benefit by returning to these sites for increment cores and fire-scar collections. Dr. Ed Berg, plant ecologist for the Kenai National Wildlife Refuge, Kenai, Alaska, has offered to measure ring widths of increment cores collected in 1999. This collection may potentially add significant information to a lengthy tree-ring record he has begun for Southcentral Alaska with regards to an analysis of climate change and its role in the recent bark beetle epidemic.

RECOMMENDATIONS

At the request of the EAFB Wildlife Biologist, the following are offered as suggestions, recommendations and additional observations resulting from this study to establish and characterize permanent monitoring sites on the Base. No priority is implied by their order.

1) The first recommendation is to continue monitoring the permanent plots established in 1999, potentially expanding the number of plots and sample size to other vegetation types as funding permits (e.g., see 7B,C below), and to amass a record of vegetation change and dynamics, and physical site changes for major vegetation types on EAFB.

2) This monitoring design should be considered the baseline of a much broader, and continually changing, monitoring plan (e.g., see 7G below). The broader scheme should involve a wide spectrum of disciplines and potentially outside cooperators whose specific disciplines and individual monitoring programs would be conducted independently, but in a manner complementary to the others. Wildlife population and habitat monitoring plots should be established in the vicinity of the vegetation monitoring (control) plots so that their results might be more readily incorporated with each other and related to vegetation and other environmental changes over time.

3) Natural Resource and Planning staff should seek cooperative efforts to integrate EAFB monitoring data with ongoing monitoring efforts that employ similar techniques: U.S. National Park Service (NPS) Monitoring and Inventory Program; U.S. Forest Service (USFS) Long-Term Ecological Research (LTER) Program at Bonanza Creek, Interior Alaska; and USFS Pacific Northwest Research Station, Forestry Sciences Laboratory (AFSL), Anchorage. The EAFB monitoring design should be considered as one iteration of a much broader, and continually changing, monitoring plan in a larger more regional context. The broader scheme should involve a wide spectrum of cooperators whose individual monitoring programs would be conducted independently, but in a manner complementary to the others.

Remeasurement of monitoring plots, establishment of additional plots, and the training of personnel might be coordinated with ongoing USFS Forest Health and Inventory programs and the NPS Denali National Park and Preserve Model LTEM Program.

Cooperative efforts employing similar methods may have the additional benefit of lowering overall monitoring costs as integrated results become more applicable to individual programs around the State.

4) EAFB Natural Resource and Planning staff should consider the utility of the baseline LTVM plot data prior to the establishment of additional plots and the future remeasurement of plots. Various datasets from the original 1999 monitoring data may be projects with their own merit (see 5 below). Opportunities include but are not limited to the following general uses or applications of multi-resource inventory and forest health monitoring plot data summarized here from Max et al. (1996) and Mead and LaBau (1990):

VEGETATION:

- Vegetation classification
- Cover and species associations
- Successional relationships within the classification data
- Understory biomass estimation; coefficients for various species and plant groups have been previously developed (see also Yarie and Mead 1988, LaBau and Mead 2000, Mead 2000).

FORESTRY:

Estimations of stand volumes using height and cover coupled with aerial photo interpretation and available vegetation maps

Tree measurements in conjunction with mapped cover type estimates to determine:
- Timberland area
- Volumes
- Growth
- Mortality
- Tree biomass estimates

Downed woody debris and fuel loading (see also Busing et al. 1999, LaBau and Mead 2000, Maxwell and Ward 1981)

Forest health:
- Bark beetle infestation estimates
- Beetle death estimates
- Other causes/issues affecting forest health, e.g. fungal and insect attack; wind

WILDLIFE:

Plant species and cover (Height-Vertical (H-V) Profile Assessments) data may be used for:

Wildlife food/cover species associations
Wildlife use assessment (see also Bate et al. 1999)

Wildlife habitat assessment and classification (see also Platts et al. 1987). USFS Forest Health and Monitoring (FHMP) Program methods were modified in the late 1980's to accommodate Terrestrial Habitat Evaluation Criteria Manual (HEP) considerations (Ecological Services, USFWS 1980).

Understory biomass estimation: coefficients for various species and plant groups have been previously developed (see also Yarie and Mead 1988, LaBau and Mead 2000, Mead 2000). These may eliminate the need for costly forage and browse production plots.

OTHER:

Measuring and monitoring biodiversity (see also Busing et al. 1999, Gaines et al. 1999, Slaughter et al. in press)

Soil description data
Soils descriptors may be tied more specifically to vegetation and site productivity
Changes in duff layer depth

Wildland fire hazard estimation and mapping , e.g., forest fire fuel loading associated with bark beetle mortality to provide data for use by public safety managers, and develop crosswalks to State of Alaska Forest Fire Dynamics and Production Models

5) Specific opportunities presented by the LTVM plot data collected in this project include but are not limited to:

A. LTVM Microplot and satellite plot vegetation data could be analyzed for plant community successional relationships. These datasets were extracted from the field data and are available in the Electronic Database files. Such an analysis would have direct applications to multi-disciplinary studies, e.g., moose and bear habitat use, prey habitat, and predicting current and future habitat.

B. Budgetary constraints prevented a more detailed analysis of the Forestry Data Subset presented in this report. It represents only a cursory look at the extent and interpretation of the dataset. This data warrants further analysis and statistical validation. Analysis of the forestry data subset might also include:

1) Applications of 1999 data to cover type extents to determine EAFB total acreage estimates (with statistical tests for validity);

2) Comparison to 1983 forestry data (Tande 1983); and

3) Comparisons of EAFB results to recent and earlier regional studies (Hutchinson (1997, LaBau 1998, 2000, Van Hees and Larson 1991).

C. An evaluation can be made of the relationship between total growth stock stand tables and the annual mortality stand tables for spruce species. These data may show little mortality impact on a year to year basis, but when multiplied over successive years may indicate the total loss of larger trees, and a mortality effect moving into successively smaller diameter classes.

D. A stand age analysis across all tree species would do much towards our understanding of old-growth dynamics in Southcentral Alaska. Significant differences may exist from those reported from Interior Alaska. A good place to accomplish this research would be the forest clearcut north of Beebe Lake where stump ages could be determined for different tree size classes.

E. Continue the evaluation of spruce bark beetle impact on EAFB forests and implications for forest management.

F. Continue the evaluation of forest regeneration with a focus on spruce, including evaluations on the role of competing vegetation (e.g., grasses and shrubs).

G. Conduct a forest health assessment and monitoring of residual forest stands, particularly paper birch, which were found to contain a great amount of decay in the older stands, and a high degree of moose damage in younger stands.

6) Recommendations specific to the long-term vegetation monitoring methodology:

A) Remeasurement priorities: There are no specific recommendations for the priority in which vegetation types warrant remeasurement. Long and short range management objectives and year to year budgets of the Conservation and Environmental Planning Office will be important in prioritizing remeasurements and determining these objectives.

B) Permanent plot monitoring methodology:

1. Complementary, multi-disciplinary, monitoring efforts should be conducted in the vicinity of the site represented by the LTVM plot to minimize disturbance on the vegetation plot established to document physical site and vegetational changes within the specified vegetation or site type.

All additional monitoring efforts should be documented using standard forest mensuration techniques similar to those used to document and layout the LTVM plot, and a site map for the monitoring area should be prepared to illustrate the location of different studies. It is recommended that these site mapping procedures follow those employed at the Bonanza Creek LTER near Fairbanks (Database Manager BNZ/CPCRW 2000, Van Cleve and Viereck 1993). An example is found in Appendix 11 and available from a site map for the Bonanza Creek Experimental Forest <http://www.lter.alaska.edu/maps/bcefbasemap.htm>.

2. For future work, the monitoring plot field manual (Appendix 1) should be reduced in size and made into a bound field book on waterproof paper for easy reference in the field. A convenient size is 4-5/8 x 7 in, which is the same size as a Write-In-The-Rain-Notebook©.

3. It is also beneficial to produce copies of the crown transparency and density estimating cards on see-through mylar sheets so that they may be held above one's head when making these estimates under different weather conditions.

4. It may also be worthwhile in the future to consider field computers for data recording and collection. The U.S. Forest Service Alaska Forestry Sciences Laboratory (AFSL) utilizes Husky© field data loggers preprogrammed with field data sheets similar to those employed in this investigation (e.g., USFS FIA 1998). The future may also hold promise for currently popular Palm© handheld-computing devices (Busing et al. 1999).

5. Staffing: A field crew of three people is recommended consisting of a professional Plant Ecologist or Forest Ecologist and two Biological/Forestry/Field Assistants.

6. It is recommended that professional biological staff be employed for specific tasks when establishing and revisiting LTVM plots. A qualified Botanist and/or Vegetation Ecologist should be part of the monitoring field team.

7. A major effort was not put into nonvascular species due to the increased costs of taxonomic identifications. Heritage staff agreed to note only total covers and record major, easily recognized bryophytes and lichens. These species and species groups have been given little attention in many investigations, even though in more recent times they have been noted to play major roles in boreal forest ecosystems. It is recommended that future LTVM plot establishment, characterization and remeasurement devote a significant effort to these life forms (see Discussion for a recommended methodology).

8. New and additional plots should be established in a less random manner during Phase I, and located nearer Phase I points possessing more advantageous access. It is further suggested that the Phase I photo points continue to be used as an initial starting point for establishing a permanent plot in a vegetation type in a general area. An actual azimuth and distance could/would be determined randomly to a plot center in the vegetation type convenient to its access and where there was no perceivable present or anticipated disturbance.

7) Other study recommendations:

A. It is recommended that the EAFB vegetation map (Tande 1983) be updated and remapped. This effort should be modeled after current efforts underway for neighboring Fort Richardson Military Reservation using ecological survey techniques of Jorgenson et al. (1999). Vegetation plot data from the current monitoring study could be directly applied in this effort given the detail of the information and the precise locational information registered to current aerial photography.

B. Conduct a field study of the extent and biological structure of Wet Thinleaf Alder Shrub Swamp and Mixed Forest. These common natural associations occur southwest from Lower Six Mile Lake between the coast and the north side of the Elmendorf Moraine, and in riparian areas such as the Ship Creek corridor. Swamp forests are reported to make one of the most significant contributions to boreal forest biodiversity in an otherwise impoverished forest landscape (Hörnberg et al. 1998).

C. Establish additional permanent plots in Wet Thinleaf Alder Swamps and Mixed Forest in the Ship Creek riparian corridor based on the results of 7B.

D. Some anecdotal observations made while conducting the study relate to wildlife interfacing with the explosive bark beetle population. Woodpeckers, other birds, and squirrels were observed actively feeding on bark beetles. It is recommended that some form of bark beetle/wildlife interface studies be implemented before the bark beetle populations go into drastic decline, as they eat their way through the remaining spruce stands.

E. No evaluation has been made of the forest health data collected on tree crowns and tree damage. These data need be examined to see if trends exists between the beetle-attacked trees and crown condition, and for damage on trees (conks, wounds, etc.) predisposing them to insect attack. It is recommended that standard forest health monitoring evaluation procedures be applied (LaBau 1993).

F. It is recommended that a study be conducted to look at old homestead boundaries and military landuse history in relation to alder shrub and bluejoint grass meadows, especially along the coast, using aerial photography series, old maps, photos, plat maps and the homesteading report prepared for the Base (Daugherty and Saleeby 1998).

G. Utilize current stream monitoring techniques (Major 1999) to incorporate aquatic habitat monitoring with terrestrial monitoring and create an overall long-term monitoring plan for EAFB.

8) Monitoring measurements not recommended for EAFB at this time:

Other long-term ecological monitoring efforts in Alaska have concerned themselves with a number of generally labor-intensive and costly measurements related to a variety of monitoring objectives. The following are presented here but not recommended for the EAFB monitoring effort because of labor intensity, temporal scale of repeatability, maintenance needs, overall cost and data management.

1. Installation of meteorological stations for meteorological and micro-meteorological data for measuring forest productivity and climate change. Most plots at the Bonanza Creek LTER, for example, record the following parameters at specified intervals and relay the data electronically to the University of Alaska Fairbanks:

- Logged hourly:
  - Air temperature
  - Relative humidity
  - Soil temperatures at various depths to 200 cm
  - Precipitation (rain & snow)
  - Wind speed & direction
  - Solar radiation (global, PAR, UV)
  - Evaporation
- Logged weekly:
  - Snow depth
  - Depth of thaw (spring only)
  - Soil moisture
  - Precipitation- rain (summer only)
  - Precipitation- snow (winter only)
- Logged seasonally:

Sun photometer (all summer)

Similar stations are maintained at the Denali National Park LTEM and International Tundra Experiment (ITEX) at Toolik Lake with more or less similar data being collected.

2. Installation of soil temperature probes to monitor depth of thaw for climate change (hourly/seasonally parameter)

3. Installation of dendrometers to measure white spruce annual growth (annual parameter; initial instrumentation expense: estimated at $50/tree in 1999)

4. White spruce cone productivity (annual parameter; labor intensive)

5. White spruce seed traps for seed viability (annual parameter; labor intensive)

6. Mapping dead and downed trees (5-10 yr parameter; labor intensive)

7. Collecting and measuring litterfall (annual parameter; labor intensive)

8. Measuring berry production (annual parameter; no reliable method developed to date)

9. Conducting phenology investigations (daily/weekly annual parameter; labor intensive)

LITERATURE CITED

Adams, P. C. and L. A. Viereck. 1998. Litterfall and hare pellet summary at BCEF control plots. (BNZP00080). Bonanza Creek Experimental Forest LTER Site. University of Alaska, Fairbanks, AK.

Barnes, R.B. 1979. Wildlife habitat from a forest resource inventory: is it possible? Trans. Northeast Sect., The Wildlife Society 36:151-159.

Barnes, R. B. and J. E. Barnard. 1979. A wildlife habitat survey as part of a multi-resource evaluation procedure. pp.77-89. In: W. E. Frayer. Forest resource inventories, Vol. 1. Dept. Forest. and Wood Science, Colorado State University, Fort Collins, CO.

Bate, L.J., E.O. Garton and M.J. Wisdom. 1999. Estimating snag and large tree densities and distributions on a landscape for wildlife management. Gen. Tech. Rep. PNW-GTR-425. U.S. Forest Service, Pacific Northwest Research Station, Portland, OR. 76 p

Battles, J J., N. Cleavitt and T. J. Fahey. 1996. Quantitative inventory of understory vegetation of two eastern hemlock (*Tsuga canadensis*) stands in Delaware Water Gap National Recreation Area. Draft Final Rep. Prep. for USDI, National Park Service, Mid-Atlantic Region.

Benson, A. and S. Springer. 1998. Monitoring land birds in Denali National Park. Draft Annual Report. Alaska Bird Observatory, Fairbanks, AK. Prep. for Denali National Park and Preserve Long-Term Monitoring Program. Denali, AK. 23 p.

Berg, E. 2000. Studies in the wilderness areas of the Kenai National Wildlife Refuge: fire, bark beetles, human development and climate change. USDA Forest Service Proceedings. RMRS-P-O. 5 p.

Bickford, C.A. 1952. The sampling design used in the forest survey of the Northeast. Jour. Forestry 50(4):290-293.

Blondel, J. and C. Ferry. 1981. Point counts with unlimited distance. Studies in Avian Biology 6:414-4 20.

Bonham, C.D.,1989. Measurements for terrestrial vegetation. John Wiley and Sons, NY. 338 p.

Brooks, R.T. 1990. State-of-the-art methodology of forest inventory: wildlife habitat assessment in the northeastern United States. pp. 538-543. In: State -of-the-art forest methodology of forest inventory: a symposium proceedings. Gen. Tech. Rep. PNW-G T R-263. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR.

Brown, D. 1954. Methods of surveying and measuring vegetation. Bull. 42. Commonwealth Agricultural Bureau, Bucks, England.

Busing, R., K. Rimar, K.W. Stolte and T.J. Stohlgren. 1999. Forest health monitoring. Vegetation pilot field methods guide: vegetation diversity and structure, down woody debris and fuel loading. National Forest Service Health Monitoring Program. U.S. Forest Service, Research Triangle Park, P.O. Box 96090, Washington, DC. 28 p.

Collins, W.B. and D.J. Helm. 1997. Moose, *Alces alces*, habitat relative to riparian succession in the boreal forest, Susitna River, Alaska. Can. Field Nat. III(4):567-574.

Conner, M.C., R.F. Labisky and D.R. Progulske, Jr. 1983. Scent-station indices as measures of population abundance for bobcats, raccoons, gray foxes and opossums. Wildlife Society Bulletin 11:146-152.

Cook, J. and E. Rextad. 1992. Sampling protocol for small mammal monitoring in Denali National Park and Preserve. Institute of Arctic Biology, University of Alaska Fairbanks, AK. 18 p.

Cooper, S.V.; K.E. Neiman and D.W. Roberts. 1991. Forest habitat types of northern Idaho: a second approximation. Gen. Tech. Rep. INT-236. U.S. Forest Service, Intermountain Forest and Range Experiment Station. Ogden, UT. 143 p.

Cooperrider, A.Y., R.J. Boyd and H.R. Stuart. 1986. Inventory and monitoring of wildlife habitat. USDI Bureau Land Management. Supt. of Docs., U.S. G.P.O.Washington, D.C.

Database Manager, BNZ/CPCRW. 2000. Bonanza Creek Experimental Forest/Caribou-Poker Creeks Research Watershed (BNZ/CPCRW) Homepage: < http://www.lter.alaska.edu/ > .

Daubenmire, R. F. 1959. A canopy-coverage method. Northwest Science 33: 43-64.

Daugherty, P.M. and B.M. Saleeby. 1998. Elmendorf Air Force Base homestead study. 1998. NPS D336. National Park Service, Alaska Support Office, Anchorage, AK. 82 p. +Appendices.

Davis, D.E. 1983. ERC handbook of census methods for terrestrial vertebrates. CRC Press, Inc., Boca Raton, Fla.

Denali National Park. 2000. Denali National Park & Preserve Long-term Ecological Monitoring Program Homepage: < http://www.absc.usgs.gov/research/Denali_USGS/research.htm > .

Denali National Park and Preserve and USGS Biological Resources Division. 1997. Strategic Plan Long-Term Ecological Monitoring Program, Denali National Park and Preserve. Denali, AK. 24 p.

Densmore, R.V., M.B. Cook and P. Adams. 1998. Inventory and monitoring project. Vegetation protocol. Denali National Park and Preserve. Prep. for LTEM. Prep. by Division, B.R. 47 p.

DeSante, D.F., K.M. Burton and O.E. Williams. 1993. The Monitoring Avian Productivity and Survivorship (MAPS) Program Second (1992) Annual Report. Bird Populations 1:1-28.

DeSante, D.F. and B.L. Walker. 1994. The 1994 annual report of the Monitoring Avian Productivity and Survivorship (MAPS) Program in Denali National Park. Final Rep. Prep. for National Biological Service, Anchorage, AK. 19 p.

Develice, R. and C. Hubbard. 1993. Vegetation reconnaissance level sampling procedure, version 93A. Chugach National Forest. Unpubl. Rept. On file with: U.S. Forest Service, Alaska Region, Chugach National Forest, C Street, Suite 300, Anchorage, AK 99503-3998. 15 p.

EAFB. 1997. Draft General Plan for Elmendorf Air Force Base. On File: Conservation and Environmental Planning, 3 CES/CEVPW, 6326 Arctic Warrior Drive, Elmendorf AFB, AK.99506-3204.

Ecological Services, USFWS. 1980. Terrestrial habitat evaluation criteria manual. Division of Ecological Services. U.S. Fish and Wildlife Service. Anchorage, AK.

Eis, S. 1981. Effect of vegetative competition on regeneration of white spruce. Can. Jour. For. Res.11: 1-8.

Elzinga, C. L., D.W. Salser and J.W. Willoughby. 1998. Measuring and monitoring plant populations. BLM Tech. Ref. 1730-1. Bureau of Land Management, National Business Center, BC-650B, P.O. Box 25047, Denver, CO. 80225-0047. 477 p.

Furtsch, P. 1995. Techniques for monitoring density and correlates of inter-annual variation for northern red-backed voles (*Clethrionomys rutilus*) in Denali National Park and Preserve. MSc. thesis. University of Alaska, Fairbanks, AK. 131 p.

Gabriel, H.W. and G.F. Tande. 1983. A regional approach to fire history in Alaska. BLM Tech. Rep. 9. Bureau of Land Management, Anchorage, AK. 34 p.

Gaeng, P. 1993. EXCEL for science and technology. Abacus Books, Grand Rapids, Michigan, 329 p.

Gaines, W. L., R.J. Harrod and J.F. Lehmkuhl. 1999. Monitoring biodiversity: quantification and interpretation. Gen. Tech. Rep. PNW-GTR-443. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 27 p.

Gilbert, H. and S. Payette. 1982. Ecologie des populations d'aulne (*Alnus crispa* (Ait.) Pursh) a la limite des forts, Quebec nordique. Geographie et Physique Quaternaire. 36: 109-124.

Gregory, R.A. 1966. The effect of leaf litter upon the establishment of white spruce beneath paper birch. Forest. Chron. 42: 251-255.

Hansen, M. and T. Burke (eds.). 1998. Integrated tools for natural resources inventories in the 21st century. Gen. Tech. Rep. NC-212. U.S.Forest Service North Central Research Station.

Hansen, P.L., R.D. Pfister, K. Boggs, and others. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana. Missoula, MT. 646 p.

Helm, D. J. 1999. Draft study plan for development of a long-term ecological monitoring program at Denali National Park and Preserve (SIS #5001243): Vegetation. Submitted to: USGS-Alaska Biological Science Center, 1011 East Tudor Rd, Anchorage AK 99503. Agreemnt. No. 98WRAG1017. 32 p.

Helm, D.J. and E.B. Allen. 1995. Vegetation chronosequence near Exit Glacier, Kenai Fjords National Park, Alaska, U.S.A. Arctic and Alp. Res. 27(3): 246-257.

Helm, D.J. and W.B. Collins. 1997. Vegetation succession and disturbance on a boreal forest floodplain, Susitna River, Alaska. Can. Field Nat. III(4):553-566.

Helm, D.J., W. Collins and J. McKendrick. 1984. Floodplain succession in southcentral Alaska. Pp. 114-118. In: LaBau, V.J. and C.L. Kerr (eds.). Inventorying forest and other vegetation of the high latitude and high altitude regions: Proceedings of an international symposium, Society of American Foresters Regional Technical Conference; July 23-26, 1984; Fairbanks, AK. Society of American Foresters. Bethesda, MD.

Helm, D.J. and C. Rowland. 1999. An evaluation of existing vegetation protocols for Denali long-term ecological monitoring. Unpub. Rent .Prep. for: Denali Long-Term Ecological Monitoring, USGS-BRD, 1011 East Tudor Rd, Anchorage AK 99503. 29 p.

Hill, M.D. 1979. TWINSPAN: A Fortran program for arranging multivariant data in an ordered two-way table by classification of the individuals and attributes. Cornell University, Ecology and Systematics Department. Ithaca, NY.

Hill, M.D. and H.G. Gauch, Jr. 1980. Detrended correspondence analysis: an improved ordination technique. Vegetatio 42: 47-58.

Holsten, E.H. 1994. The role of spruce beetle pheromones as management strategies in Alaska. Pp. 11-15. In: Gen. Tech. Rep. PSW-GTR-150, U.S. Forest Service, Pacific Southwest Research Station, Albany, CA.

Holsten, E. H., R. A. Werner and R. L. DeVelice. 1995. Effects of a spruce beetle (Coleoptera: Scolytidae) outbreak and fire on Lutz spruce in Alaska. *Environmental Entomology* 24(6):1539-1547.

Holsten, E. H., R. A. Werner and H.L. Thomas. 1980. Insects and diseases of Alaskan forests. U.S. Dept. of Agriculture, Washington, DC, Alaska Regional Report No. 75, 187 p.

Haeussler, S. and D. Coates. 1986. Autecological characteristics of selected species that compete with conifers in British Columbia: a literature review. FRDA Rep. 001. Vancouver, BC: British Columbia Ministry of Forests and Lands.

Hogg, E.H. and V.J. Lieffers. 1991. The impact of *Calamagrostis canadensis* on soil thermal regimes after logging in northern Alberta. Can. Jour. of For. Res. 21: 387-394.

Huenneke, L.F. 1987. Demography of a clonal shrub, *Alnus incana* ssp. *rugosa* (Betulaceae). Am. Midl. Nat. 117(1): 43-55.

Huenneke, L.F. and P.L. Marks. 1987. Stem dynamics of the shrub *Alnus incana* spp. *rugosa*: transition matrix models. Ecology 68(5): 1234-1242.

Hultén, E. 1968. Flora of Alaska and neighboring territories. Stanford University Press. Stanford, CA. 1008 p.

Husch, B., C. I. Miller and T. W. Beers. 1972. Forest mensuration. 2d ed. Ronald Press, NY. 410 p.

Institute for Bird Populations. 1998. Monitoring Avian Productivity and Survivorship (MAPS) in Denali National Park. A handbook of the field and analytical techniques needed to monitor primary demographic parameters of landbirds, January 28, 1998. The Institute for Bird Populations, P.O. Box 1346, Point Reyes Station, CA. 94956-1346. 36 p.

Johnson, A.K. 1998. Breeding bird density and species diversity in relation to primary productivity in the Tanana River floodplain. (BNZP00057). Bonanza Creek Experimental Forest LTER Site. Fairbanks, AK.

Jones, M. 1998. International Tundra Experiment (ITEX) Homepage: <http://www.Colorado.EDU/INSTAAR/TEAML/brochure/research/itex.html >.

Jorgenson, T.M., J.E. Roth, M.K. Raynolds, M.D. Smith, W. Lentz, A.L. Zusi-Cobb and C.H. Racine. 1999. An Ecological land survey of Fort Wainwright, Alaska. CRREL Report 99-9. U.S. Army Cold Regions Research Engineering Laboratory, 72 Lyme Road, Hanover, NH. 92 p.

LaBau, V.J. 2000. Updated results of a pilot study to evaluate spruce bark beetle-induced tree mortality on the Kenai Peninsula, 1997-1998. Draft. Rep. Prep. for: Natural Resources Fund, University of Alaska Anchorage. Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK. 99501.

LaBau, V. J. 1998. Results of a pilot study to evaluate spruce bark beetle-induced tree mortality on the Kenai Peninsula, 1997. Unpub. Rep. Prep. for: Natural Resources Fund, University of Alaska Anchorage. Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK. 99501.

LaBau, V. J. 1993. Regional monitoring with plot networks. Environmental Monitoring and Assessment 26: 283-294.

LaBau, V.J. and B.R. Mead. 2000. Phytomass associated with the spruce bark beetle (*Dendroctonus rufipennis* Kirby) epidemic on the Kenai Peninsula and other Alaska studies. Manuscript in Prep. Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK. 99501.

Larson, F. 1987. Field procedures for the 1987 Kenai bark beetle inventory, Kenai Peninsula, Alaska. U.S. Forest Service, Pacific Northwest Research Station, Anchorage Forestry Sciences Laboratory, Field Manual. 112 p.

Larson, F. R. and K. Winterberger. 1988. Tables and equations for estimating volumes of trees in the Susitna River basin, Alaska. Res. Note PNW-RN-478. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 20 p.

Lichvar, R., C. Racine, B. Murray, G.F. Tande, R. Lipkin and M. Duffy. 1997. A floristic inventory of vascular and cryptogam plant species at Fort Richardson, Alaska. U.S. Army Corps of Engineers Tech. Report EL-97-4. Waterways Experiment Station, Vicksburg, MS. 155p.

Lindzey, F.G. and F.F. Knowlton. 1975. Determining the relative abundance of coyotes by scent station lines. Wildlife Society Bulletin 3:119-124.

Lipkin, R. 2001. A floristic inventory of vascular plant species on Elmendorf Air Force Base, Alaska. Prep. for: Conservation and Environmental Planning, 3 CES/CEVP, 6326 Arctic Warrior Dr., Elmendorf AFB, AK. Contract No. DAMD17-99-2-9004. U.S. Army Medical Research and Material Command, Ft. Detrick, MD. 21702-5012. Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A St., Anchorage AK.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology. John Wiley and Sons, Inc., NY, NY. 337 p.

Mahan, C., K. Sullivan, K. C. Kim, R. Yahner and M. Abrams. 1998. Ecosystem profile assessment of biodiversity: sampling protocols and procedures. USDI National Park Service Coop Agreemt. #4000-3-2012. Center for Biodiversity Research, Environmental Resources Research Institute, Pennsylvania State University, University Park, PA 16802. 92 p. +Appendices.

Major, E. 1999. Biological Monitoring and Assessment Program for Alaska. Environment and Natural Resources Institute, University of Alaska Anchorage, Anchorage, AK. Homepage: < http://www.uaa.alaska.edu/enri/bmap/index.html >.

Mangold, R. 1997. Forest health monitoring field methods guide (West Coast 1997). USDA Forest Service. National Forest Health Monitoring Program. Research Park, NC. 27709.

Max, T.A., H.T. Schreuder, J.W. Hazard, D. Oswald, D. Daniel, J. Teply and J. Alegria. 1996. The Pacific Northwest Region vegetation and inventory monitoring system. Res. Pap. PNW-RP-493. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 22 p.

Maxwell, W.G. and F.R. Ward. 1981. Fuels and fire in land management planning: Part 1. Forest-fuel classification. Gen. Tech. Rep. PNW-131. U.S. Forest Service, Pacific Northwest Research Station, Portland, OR. 12 p.

Mead, B.R. 2000. Phytomass in southwest Alaska. Res. Pap. PNW-RP-523. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 164 p.

Mead , B.R. and V.J. LaBau. 1990. Multiresource inventories in Alaska.pp. 522-528. In: State -of-the-art forest methodology of forest inventory: a symposium proceedings. Gen. Tech. Rep. PNW-G T R-263. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR.

Myers, Lewis H. 1989. Inventory and monitoring riparian areas. U.S. Bureau of Land Management, Denver Service Center. Denver, CO.

Miller, R.D. and E. Dobrovolny. 1959. Surficial geology of Anchorage and vicinity, Alaska. US Geol. Survey Bull. 1093.

Mitchell, W.W. and J. Evans. 1966. Composition of two disclimax bluejoint stands in southcentral Alaska. J. Range Manage. 19(2):65-68.

Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, NY. 547 p.

Neiland, B.J. and L.A. Viereck. 1977. Forest types and ecosystems. Pp. 109-136. In: North American forest lands at latitudes north of 60 degrees: Proceedings of a symposium; 1977 September 19-22; Fairbanks, AK. Univ. of Alaska, School of Agriculture and Land Resources Management, Agricultural Experiment Station, Cooperative Extension Service, Fairbanks, AK.

Patton, P.W.C. 1997. Draft passerine monitoring handbook, Denali National Park and Preserve. Prep. for Denali National Park and Preserve Long-Term Monitoring Program. Denali, AK.

Patton, P.W. and T.H. Pogson. 1996. Relative abundance, migratory status, and habitat use patterns of birds breeding in Denali National Park, Alaska. Canad. Field Naturalist 110 (4):599-606.

Pfister, R.D. and S.F.Arno. 1980. Classifying forest habitat types based on potential climax vegetation. Forest Science 26(1): 52-70.

Pfister, R.D., B.L. Kovalchik, S.F. Arno and R.C. Presby. 1977. Forest habitat types of Montana. Gen. Tech. Rep. INT-34. U.S. Forest Service. Intermountain Forest and Range Experiment Station. Ogden, UT. 175 p.

Platts, W.S., C. Armour, G.D. Booth, M. Bryant, J.L. Bufford, P. Cuplin, S. Jensen, G.W. Lienkaemper, G.W. Minshall, S.B. Monsen, R.L. Nelson, J.R. Sedell and J.S. Tuhy. 1987. Methods for evaluating habitats with applications to management. Gen. Tech. Rept. 221. U.S. Forest Service. Intermountain Forest and Range Experiment Station. Ogden, UT. 177 p.

Podani, J. 1993. SYN-TAX-pc: computing programs for multivariate data analysis in ecology and systematics. Version 5.0. Scientia Publishing, Budapest, Hungary. 104 p.

Post, R.A. 1996. Functional profile of black spruce wetlands in Alaska. EPA 910/R-96-006. U.S. Environmental Protection Agency. Alaska Operations Office. Region 10, 1200 Sixth Ave. Seattle, WA. 170 p.

Powelson, R.A. and V.J. Lieffers. 1992. Effect of light and nutrients on biomass allocation in

Calamagrostis canadensis. Ecography. 15(1): 31-36.

Pursells, R.A. 1975. Distributional records of rare or infrequently collected species of mosses in Pennsylvania. Bryologist 78:93-95.

Ralph, C.J., G.R. Geupel, P. Pile, T.E. Martin and D.F. DeSante. 1993. Handbook of field methods for monitoring land birds. Gen. Tech. Rep. PSW-GTR-144. U.S. Forest Service, Pacific Southwest Research Center, Albany, CA. 41 p.

Raup, H. M. 1969. The relation of the vascular flora to some factors of site in the Mesters Vig District, NE Greenland. Medd. Om Grønland 176(5). 80 p.

Reynolds, K.M. 1990. Preliminary classification of forest vegetation of the Kenai Peninsula, Alaska. Res. Pap. PNW-RP-424. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 67 p.

Reynolds, K.M., E.H. Holsten and R.A. Werner. 1994. Sbexpert users guide (version 1.0): a knowledge-based decision-support system for spruce bark beetle management (new revised version 2.0 available in 1996). Gen. Tech. Rep. PNW-345. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 20 p.

Rexstad, E. 1996. Small mammal sampling protocol for Long-Term Ecological Monitoring Program Denali National Park and Preserve. Institute of Arctic Biology, University of Alaska, Fairbanks, AK.

Rexstad, E.A. 1998. The response of small mammals to fire disturbance. (Project No. BNZP00073). Bonanza Creek Experimental Forest LTER Site. University of Alaska, Fairbanks, AK.

Rexstad,E. and E. Debevec. 1998. Small mammal monitoring at the landscape scale, 1998. Annual Rep. Prep. for Denali National Park and Preserve Long-Term Monitoring Program. Denali, AK. 12 p.

Rexstad, E. and E. Debevec. 1999. Scaling up of small mammal research in Denali National Park and Preserve: extending the Denali Long-Term Ecological Monitoring Program. Institute of Arctic Biology, University of Alaska, Fairbanks, AK.

Ritter, D.F. 1986. Process geomorphology. Wm. C. Brown Publishers, Dubuque, IA. 577 p.

Rothe, T.C., S.H. Lanigan, P.A. Martin and G.F. Tande. 1983a. Natural resource inventory of Elmendorf Air Force Base, Alaska: Part I. U.S. Fish and Wildlife Service, Region 7, Special Studies, Anchorage, AK. 368 p.

Rothe, T.C., S.H. Lanigan, P.A. Martin and G.F. Tande. 1983b. Natural resource inventory of Elmendorf Air Force Base, Alaska: Part II. U.S. Fish and Wildlife Service, Region 7, Special Studies, Anchorage, AK. 43 p.

Roughton, R.D. and M.W. Sweeney.1982. Refinements in scent-station methodology for assessing trends in carnivore populations. Jour. Wildlife Manage. 46:217-229.

Slaughter, C.W., K. Spaeth, L. Viereck, and C. Hanson. In press. Watershed research: opportunities for long-term biodiversity monitoring and research. Pp. 339-359 In: Dallmeier, F. International symposium on measuring and monitoring forest biological diversity: the international network of biodiversity plots. Smithsonian Institution/Man and the Biosphere Biodiversity Program. Smithsonian Institution, Washington, D.C.

Smith, B. 1990. Ecoaid. U.S. Forest Service, Pacific Northwest Region, Portland, OR.

Soil Conservation Service (with U.S. Forest Service, and Alaska Department of Natural Resources). 1986. Susitna River Basin land cover type map atlas.

Steel, R.G.D. and J.H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Company, Inc., N.Y. 481 p.

Tande, G.F. 1983. Vegetation. Pp. 14-85. *In:* Rothe, T.C., S.H. Lanigan, P.A. Martin and G.F. Tande. 1983. Natural resource inventory of Elmendorf Air Force Base, Alaska: Part I. U.S. Fish and Wildlife Service, Region 7, Special Studies, Anchorage, AK. 368 p.

Tande, G.F. 1979. Fire history and vegetation pattern of coniferous forests in Jasper National Park, Alberta. Can. J. Bot. 57: 1912-1931.

Tande, G. F., R. Lipkin and M. Duffy. 1995. Results of a floristic inventory of Fort Richardson Military Reservation, Alaska. Report to U.S. Army Corps of Engineers Waterways Experiment Station,Vicksburg, MS, and Cold Regions Research and Engineering Laboratory, Hanover , NH. Alaska Natural Heritage Program, University of Alaska, Anchorage. 74 p.

Tande, G.F., S.C. Klein and J. Michaelson. 2001. Identification and characterization of disturbed alder sites on Elmendorf Air Force Base, Alaska. Rep. Prep. for: Conservation and Environmental Planning, 3 CES/CEVP, 6326 Arctic Warrior Dr., Elmendorf AFB, AK. Contract No. DAMD17-99-2-9004. U.S. Army Medical Research and Material Command, Ft. Detrick, MD. 21702-5012. Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A St., Anchorage AK.

Tazik, D.J., S.D. Warren, V.E. Diersing, R.B. Shaw, R.J. Brozka, C. F. Bagley and W.J. Whitworth. 1992. U.S. Army land condition-trend analysis (LCTA) plot inventory field methods. USACERL Tech. Rep. N-92/03. Colorado State University, Ft. Collins, CO. 62 p.

Thorsteinson, L. and D. Taylor. 1997. Watershed ecosystem approach to monitoring in Denali National Park and Preserve. J. American Water Resources Association 33 (4):795-810.

U.S. Department of Agriculture, Soil Conservation Service. 1986. Timber and vegetation resources of the Sustain River basin—Alaska report. Anchorage, AK. 8 p.

CEMML. 1998. Vegetation map for Elmendorf Air Force Base, Alaska. Unpub. Draft. Center for Ecological Management of Military Lands, Colorado State University, Ft. Collins, CO.

USFS FIA. 1998. Field procedures for the 1997 southeast Alaska inventory. Field Manual. USDA, Forest Service, Pacific Northwest Research Station, Anchorage Forestry Sciences Laboratory, Anchorage, AK. 245 p.

Van Ballenberghe, V.D.G. Miquellee and J.G.MacCracken. 1989. Heavy utilization of woody plants by moose during summer at Denali National Park, Alaska. Alces 25:31-35.

Van Cleve, K. and L.A.Viereck. 1981. Forest succession in relation to nutrient cycling in the boreal forest of Alaska. Pp. 179-211. In: West, D.C., H.H. Shugart and D.B. Botkin, eds. Forest succession: concepts and application. Springer-Verlag, New York, NY.

Van Cleve, K. and L.A. Viereck. 1993. Long-Term Ecological Research at the Bonanza Creek Experimental Forest. Arctic Research of the United States 7:10-17.

Van Hees, W.W.S. 1999. Vegetation resources of southwest Alaska: development and application of an innovative, extensive sampling design. Res. Pap. PNW-RP- 507. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 51 p.

Van Hees, W.W.S. and F.R. Larson. 1991. Timberland resources of the Kenai Peninsula, Alaska, 1987. USDA For. Ser. Res. Bull. PNW-RB-180. 56 p.

Viereck, L.A., C.T. Dyrness, A.R. Batten and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 278 p.

Viereck, L.A., C.T. Dyrness, K. Van Cleve and M.J. Foote. 1983. Vegetation, soils, and forest productivity in related forest types in interior Alaska. Can. J. Forest Res. 13(5):703-720.

Viereck, L.A. and E.L. Little, Jr. 1972. Alaska trees and shrubs. Agriculture Handbook No. 410. U.S. Forest Service, Washington, DC. 265 p.

Viereck, L.A., K. Van Cleve and C.T. Dyrness. 1986. Forest ecosystem distribution in the taiga environment. Pp. 22-43. In: Van Cleve, K., F.S. Chapin, III, P.W. Flanagan, L.A. Viereck and C.T. Dyrness (eds.). Forest ecosystems in the Alaskan taiga: a synthesis of structure and function. Springer Verlag, New York, NY.

Wilson, B.F., W.A. Patterson III and J.F. O'Keefe. 1985. Longevity and persistence of alder west of the tree line on the Seward Peninsula, Alaska. Can. J. Bot. 63: 1870-1875.

Wikgren, K.R. and J.P. Moore. 1997. Soil survey of Elmendorf Air Force Base, Alaska (an interim report). USDA Natural Resources Conservation Service, Anchorage, AK. 97 p.

Wolf Creek Research Station. 1998. Wolf Creek Research Station Homepage: <http://www.taiga.net/wolfcreek/ >.

Wurtz, T. L. 2000. Interactions between white spruce and shrubby alders at three boreal forest sites in Alaska. Gen. Tech. Rep. PNW-GTR-481. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 29 p.

Wurtz, T.L. 1995. An efficient design for studies of plant species interactions: an example with white spruce and alder. In: Mead, D.J. and I.S. Cornforth (eds.). Proceedings of the trees and soil workshop; 1994 February 28-March 2; Canterbury, New Zealand. Spec. Publ.10. Canterbury, New Zealand: Agronomy Society of New Zealand, Lincoln University Press.

Yarie, J. and M.B. Mead. 1988. Twig and foliar biomass estimation equations for major plant species in the Tanana River Basin and interior Alaska. Res. Pap. PNW-RP-401. U.S. Forest Service, Pacific Northwest Research Station. Portland, OR. 20 p.

Youngblood, A.P., W.G. Padgett and A.H. Winward. 1985. Riparian community type classification of eastern Idaho and western Wyoming. Ecol. Rep. 8501. U.S. Forest Service, Intermountain Research Station, Ogden, UT. 78 p.

Appendices

Appendix 1.

PROCEDURES for ESTABLISHING and CHARACTERIZING LONG-TERM MONITORING SITES on ELMENDORF AIR FORCE BASE, ALASKA

A Note Regarding the Use of These Techniques for the Remeasurement of Monitoring Plots in Subsequent Years

For relocation and subsequent remeasurement in future years, no Phase I plot location techniques would be required.

All of the Phase II Field Measurement Techniques would be employed except the actual monumenting of the plot covered by Data Sheet 2 (DS 2).

An exception might be the addition of notes or measurements necessary or required for monuments or markers lost or destroyed in the years between remeasurement.

It would also be important to report on other multi-disciplinary plots established in the vicinity of the LTVM plot so as to minimize disturbance of all monitoring efforts taking place in the immediate vicinity of the original LTVM plot.

PROCEDURES

for

ESTABLISHING and CHARACTERIZING LONG-TERM MONITORING SITES

on

ELMENDORF AIR FORCE BASE, ALASKA

Prepared for:

Conservation and Environmental Planning Office
3 CES/CEVP
6326 Arctic Warrior Drive
Elmendorf Air Force Base, Alaska
99506-3204

By:

Gerald F. Tande
Vegetation Ecologist

Alaska Natural Heritage Program
Environment and Natural Resources Institute
University of Alaska Anchorage
707 A Street
Anchorage AK 99501

October 1, 2000

The Alaska Natural Heritage Program

TABLE OF CONTENTS

LIST OF APPENDICES

INTRODUCTION

The Alaska Natural Heritage Program (AKNHP) undertook a project to establish and characterize long-term vegetation monitoring plots on Elmendorf Air Force Base (EAFB), Alaska under Contract Agreement No. DAMD17-99-2-9004. The purpose of the project was to provide information necessary to monitor long-term changes and update the EAFB Integrated Natural Resource Management Plan (INRMP) as directed in AFI 327064 and 32 CFR 190.7, 16 USC5CSCI1670a (Sikes Act). These documents require military installations to develop new, integrated, natural resource plans and make substantive revisions at least every five years. The first EAFB vegetation inventory was conducted in 1982 (Tande 1983) and does not necessarily reflect current vegetation conditions.

It was proposed that rather than conducting a similar base-wide vegetation inventory, long-term plots would be established to satisfy a significant portion of the INRMP data requirements by developing the means for periodically monitoring and updating the natural resource information database. Rather than conducting a vegetation inventory every 10 years, the proposed approach would establish a system of permanent vegetation monitoring plots to supply essential information leading to a better understanding of ecosystem health and functioning. Through an integrated approach, data gathered in this effort would also supply supportive information for the management of wildlife, forest resources, threatened and endangered species, outdoor recreation resources, and protected wetlands.

This document outlines the design, establishment, and baseline description procedures for a system of long-term vegetation inventory plots. The study was designed to incorporate data from previous vegetation inventory surveys, vegetation maps, wetland maps, and soil surveys. In addition, the design incorporates monitoring concerns of other disciplines such as forestry, wildlife biology, and conservation biology.

These procedures were reviewed and accepted for implementation by Base Natural Resources staff in June 1999 and implemented over the summer of 1999. Minor changes have been incorporated based on the 1999 fieldwork. The methodology is intended to be applied not only to the revisit of the established plots but for the establishment of additional plots as time and budgets and needs allow/dictate.

OBJECTIVE

The overall goal of the project was the establishment and characterization of long-term vegetation monitoring plots for the assessment of existing vegetation conditions in order to provide a baseline against which future vegetation change could be measured.

LOCATION

Elmendorf Air Force Base (EAFB) is situated on approximately 5314 hectares (13,130 acres) in south central Alaska. The approximate area of the monitoring study includes 3614 hectares (8,931 acres) of undeveloped land and 587 hectares (1,450 acres) of semi-developed land.

The Base is bounded by the Municipality of Anchorage to the south, the Knik Arm of Cook Inlet to the north and west, and Fort Richardson Army Base to the east. Elmendorf is located at 61 degrees, 48 minutes west longitude.

LONG-TERM VEGETATION MONITORING METHODS

Overview

Establishing the Sampling Unit:

The basic sampling unit is defined as the area on the USGS Anchorage Quadrangle Maps (B8-SE, SW) occupied by Elmendorf Air Force Base. The sampling unit is further restricted to: 1) major vegetation types (strata) identified on existing vegetation maps (Tande 1983, USARAK ITAM/GIS 1998); and 2) that area occurring outside of developed areas and areas slated for future development based on
the existing Land Use Plan (EAFB 1997) and natural resource planning documents. Vegetation maps are available in an Arc-Info (ArcView) GIS database through the Base Natural Resources office from which areas of vegetation types within the sampling unit can be determined.

Selecting a Sampling Design:

A two-phase (stratified random) sampling design was selected to sample the area in a manner more statistically efficient and more rigorous than a simple random sample. This also allows targeting specific strata of concern (major vegetation types or types identified with important management implications), and bypassing areas of less significance for long-term monitoring (e.g., minor vegetation types, nonvegetated areas, developed areas slated for development, water, rock).

Selecting Sampling Strata Using Aerial Photo Interpretation:

Sampling strata (criteria) which are recognizable or that can be deliniated on 1:12,000 scale airphotos or on existing planning maps are used as drivers for the selection of long-term vegetation monitoring plot (LTVMP) locations. These are predominantly related to vegetation characteristics and existing map classifications, and considerations of the Elmendorf draft Land Use Plan (EAFB 1997) where the aerial photo points meet criteria for minimal disturbance or distance from present or future activities.

Implementing the Sampling Strata Into the Phase I Photo Interpretation Process:

Phase I of the sampling strategy is a photo interpretation of color infra-red 1:12,000 scale aerial photography. It involves evaluating a grid of 15 photo points on each CIR photo, and assigning a photo classification to each point which would place the point either in or out of the above identified key strata. As an example, 32 CIR photos were available for evaluation in 1999, and after allowing for eliminating points for photos riding on unit boundaries, 270 photo points were classified. Of these, 108 points occurred in undisturbed vegetated areas of the Base. In 1999, 85 photo points provided the basis for drawing the Phase II sample of ground plots for long-term monitoring. This process would be repeated in future selections for additional LTVMPs.

Selecting the Phase II Ground Plot Sample:

The second part of Phase I involves summarizing the photo point data and eliminating all points not meeting established criteria.

The remaining photo points satisfying the established criteria are sorted by major vegetation type. From these vegetation types, monitoring plots are systematically selected beginning from a random start for each type. The number of plots is proportional to the acreage of each vegetation type, accessible by vehicle and by foot via roads, trails and right-of-ways, and that can be established and measured within one day's time.

The first plots in each vegetation type are primary candidates for ground measurements. The remaining plots in each strata are held in reserve to be added to the overall sample for each vegetation type as time allows for expanding the total number of monitoring plots, or serve as substitutes where there are situations where one of the first plots in each class is determined to not meet the specified criteria as determined by ground-truthing or by information not readily apparent from the vegetation maps and airphotos. A minimum of three plots for any vegetation type serves as the basis for a LTVMP data set.

Collecting Phase II Plot Data:

Long-term vegetation monitoring plot data is collected using standard vegetation monitoring and inventory techniques (Busing, et al. 1999, Elzinga, et al. 1998, USFS FIA 1998, Mangold 1997), focusing on descriptions and tallies of understory vegetation, forest and shrub regeneration, and forest overstory mortality. Plots are accessed by using surface transportation (automobile or foot). Standard photogrametry and forestry mensuration techniques are used to compute distance and azimuth to the plot, starting from a reference point that is identifiable on the ground and airphoto. Using a compass and tape, the field team accesses the plot, establishes and monuments a plot center point, and establishes an equidistant grid of four ground plots which serve as the delimiter for collecting monitoring data.

From the central sampling point, three satellite sampling points are established at a distance of 36.6 m and at 0, 120 and 240 degrees. At each of the four ground points, live tree data is sampled for trees on a 1/24th acre (.02 ha) Macroplot. Tree mortality is recorded on a full 1 acre (A) (.4 ha) Mortality Plot.

Established seedlings and sapling trees are tallied on four 1/300th acre (.001 ha) Microplots. Percent cover estimates of bryophytes, lichens, herbs, graminoids, and shrubs are also determined on each of these Microplots to document and provide a baseline for understory vegetation characteristics.

Sampling Design

A two-phase sampling design (stratified random sampling) is used whereby air photo interpreted plot locations within major vegetation types are determined during Phase I, and these ground points are subsequently sampled during Phase II. This is a common approach to collecting vegetation inventory and monitoring data (Bickford 1952, Bonan 1989, Labau 1998, Mueller-Dombois and Ellenberg 1974, Husch, et al. 1972, USFS FIA 1998).

PHASE I: DETERMINING THE LOCATION OF LONG-TERM MONITORING PLOTS

Phase I of the process utilizes 1995 color infra-red and 1981 true-color aerial photographs (scale 1:12,000, 1 in=1000 ft), in conjunction with vegetation maps produced in 1983 (Tande 1983) and 1998 (USARAK ITAM/GIS 1998). Biological, physical, and land-use sources of information are incorporated and used to insure that selected sites meet specific criteria such as minimal disturbance and distance from current or anticipated development activities.

A grid of 15 sample points (Appendix 1) is systematically distributed over the "effective area" of each 1:12,000-scale color-infrared air photo, and each sampled point is evaluated for specified criteria and recorded on Microsoft Excel spreadsheets.

In order to delineate a sample of photo plot locations, the following criteria are interpreted as potential data variables from the air photos, existing vegetation map resources, and planning documents for the Base. A sample of the Phase I Data Record is found in Appendix 2; a list of valid or acceptable data codes for each data item is found in Appendix 3:

Header Data

Date
Interpreter

Point Data

Air Photo ID

Flight year--year photos were flown
Flight line--roll number for flight line of photos
Photo number--sequential number of photo within flight line

Plot Point Number

Determine from the systematic overlay transparency grid of 15 points per photo

Vegetation Type

Determine 1983 Vegetation Type: Level IV/V Viereck et al. (1992 from Tande (1983)
Determine 1998 Vegetation Type: Level IV Viereck et al. (1992) from USARAK ITAM/GIS (1998)

Major or Minor Vegetation Type

Determine whether the vegetation type is greater than 121 ha.

Minimum Map Polygon Size

Determine whether plot fits minimum map polygon size of 2 ha.

Distance from Vegetation Border

Determine whether the plot point center occurs a minimum of 137 m from the edges of all adjoining vegetation types (equal to twice the LTVMP diameter of 36.6 m.

Land Use Plan Considerations:

Determine whether LTVMP location meets criteria for minimal disturbance or distance from present or future activities. Is it inside or outside of the Cantonment Area? Review the following maps and descriptions from the draft EAFB Land Use Plan (EAFB 1997):

1. Semi-Improved/Improved Grounds (Cantonment Area and various other areas)

Operational Constraints:

2. Clear Zone
3. Accident Potential Zone I (no LTVMPs)
4. Accident Potential Zone II (limited LTVMPs)
5. Explosive Safety-Quantity Distance Arc (no LTVMPs within the arc)
6. Electro-Magnetic Compatibility Zone (check with Base Natural Resources staff on case by case basis)

7. Hazardous Waste Storage Sites/Accumulation Points
8. Hazardous Waste Sites
9. Cleanup Sites (Bioremediation Sites)
10. Fuel Storage Sites
11. Military Construction Plan
12. Historical Preservation Sites

Landuse:

13. Industrial
14. Outdoor Recreation
15. Restricted Use Areas

Other:

Using Base Natural Resource Documents, determine if LTVMP is affected by:

16. Environmental Restoration Program Sites (Review with Base Personnel)
17. Firewood Cutting Areas
18. Past and future cutting areas from Timber Harvest Map

19. Homestead History

20. Proposed New Alaska Railroad Realignment Corridor

21. Other

The photo interpreted and land use data are reviewed to select plots which meet the following established criteria:

1. The plot point must occur within a major vegetation type to be monitored for long-term change. A major vegetation type is defined as a previously identified mapped vegetation type (Tande 1983, USARAK ITAM/GIS 1998) covering >300 acres (121 ha), or a type with important management considerations as mutually identified and agreed upon by AKNHP and Base Natural Resource staff (e.g., alder, bluejoint grass).

2. The vegetation map polygon must be greater than 2 ha (4.94 A).

3. The plot point center must occur a minimum of 57 m from the edges of all adjoining vegetation types which is equal to 1.5 times the long-term monitoring plot diameter of 36.6 m. Exceptions to this rule will be made where the vegetation type is of a linear nature less than the minimum (e.g., alder margin around a lake or wetland; bluejoint meadow occupying a glacial ice-block or kettle depression).

4. The plot point center must occur outside of the Cantonment Area.

5. The plot point center must occur a minimum of 57 m from all road, trail, and railroad right of ways, or any other manmade structures or disturbance identified from the airphotos or planning and natural resource documents.

6. The plot point center must occur outside of any anticipated manmade modifications to the landscape as determined from a review of the draft Land Use Plan (EAFB 1997) maps and natural resource documents, and a review of the sample points by Base Natural Resource staff.

7. Plot locations are subject to rejection or modification if ground-truth data indicates a situation where the plot does not meet the above criteria visible on the aerial photos or determined from planning and natural resource documents.

The study area is covered by 18 1995 CIR photo work areas and 270 potential plot point locations (18 photos x 15 points/photo). From this list, 45 points are randomly selected proportional to the acreage of major vegetation types that can be accessed by vehicle and by foot via roads, trails and right-of-ways, and that can be measured within one day's time per plot.

A minimum of three plots in each major vegetation type serve as the basis for a long-term monitoring plot data set. The next points in each class, in order of their draw, may be added to the overall sample for each vegetation type. They also serve as substitutes in situations where one of the first plots in each class does not meet the specified criteria as determined by ground-truthing or by information not readily apparent from the vegetation maps and the available airphotos.

Field plot measuring procedures are applied to the chosen LTVMPs utilizing standard forest inventory and monitoring methods (Busing, et al. 1999, LaBau 1993, 1998, Larson 1987, USFS FIA 1998) and are outlined below in Phase II.

PHASE II: SAMPLING METHODS FOR LONG-TERM MONITORING PLOTS

An overview of Phase II sampling follows; detailed methods accompany data sheet recording instructions in subsequent sections.

Locating the LTVM Plot

The study team drives and walks to the general area of each Long-Term Vegetation Monitoring Plot (LTVMP) using 1:12,000 scale aerial photos; 1983 and 1998 vegetation maps; and 1:25,000 scale USGS quad maps. Navigation is done from stereo pairs of aerial photos once the team is at a point where walking is necessary to finally access the plot.

Photogrammetry and forestry mensurational techniques are employed to navigate from a **Reference Point (RP)** when the field crew nears the approximate LTVMP location (the closer, the better). Reference Points are identifiable on the photo and on the ground, and are monumented with aluminum tags. GPS and photo records are completed for the location as an aid for relocation. Navigating to the plot requires computing an azimuth and taping a distance from the Reference Point to the plot center, or **Initial Point (IP)**.

After running and measuring the line in from the access Reference Point to the plot center, this Initial Point is monumented as LTVMP center with aluminum tags on two trees and a steel post. GPS and photo records are used to document the site.

LTVM Plot Configuration

The LTVMP design follows the system utilized by the USFS Forest Inventory and Analysis (FIA) and National Forest Health Monitoring (FHM) programs which have been ongoing in Alaska and the lower 48 states with various modifications since ca.1986 (Busing, et al. 1999, LaBau 1997, 1998, Larson 1987, Mangold 1997, USFS-FIA 1998).

The LTVMP (Appendix 4) is a cluster configuration consisting of: 1) a central Subplot at the IP and an associated Microplot; 2) three satellite Subplots and Microplots; 3) and a Forest Mortality Plot encompassing these four Subplots.

The three satellite Subplot centers are located 36.6 m (120 ft) from the central Subplot center at angles of 0, 120 and 240 degrees. Each of these Subplots is 1/60 ha (0.04 A) in size with a radius of 7.32 m (24.0 ft) and is used to record tree data > 12.7 cm (5 in) dbh.

Microplots are additionally established in each Subplot to record seedling and sapling data, and ground cover of shrubs, graminoids (grass-like species), herbs, bryophytes, and lichens. These Microplots are 1/750 ha (1/300th A) with a radius of 2.07 m (6.8 ft).The center of these Microplots are offset 90° and 3.7 m (12 ft) from the Subplot center because of potential disturbance due to the activity required for data collection from the central point of the Subplot.

Bryophyte and lichen composition and abundance are determined utilizing a 1 x 0.5 m quadrat centrally placed in the Microplot along and on the north side of the 90° axis from the Subplot (Mahan et al. 1998).

Finally, a Mortality Plot is established to measure mortality of trees 12.7 cm and larger that have died within the past five years. The Mortality Plot has a radius of 35.68 m (117.75 ft) with a size of 0.4 ha (1 A).

Monumenting the LTVM Plots

The center of the LTVMP (IP) is permanently marked with a screw-type earth anchor 1.4 cm diameter and up to 76 cm long. Once the IP is established, the carbon steel anchor is screwed into the ground to 15 cm above the surface, and a metal tag is attached to the 3 cm eye at the top of the anchor. The tag is inscribed with:

DO NOT DISTURB

Long-Term Vegetation Monitoring Study Plot
EAFB Natural Resources Branch

LTVM Plot No:______ Survey Date:________

For added insurance, four 15 cm nails are buried exactly 0.5 m from the primary monument on the four magnetic compass directions. A metal detector can be used in the future to assist in relocating the nails if the primary monument is disturbed or removed.

LTVM Plot Data Measurements

All live trees greater than or equal to 12.7 cm diameter at breast height (dbh) are tallied and measured by species on each Subplot. All tree saplings 2.54 -12.7 cm dbh are tallied on the Microplot. Tree measurements and observations include species, dbh (to .25 cm) and live/dead tree codes. Distances (to 3 cm) and azimuths (to the nearest degree) are recorded from plot centers to the center of all trees and saplings at the 30 cm stump height.

Microplot measurements include counts by species of seedlings that are at least 30 cm high but smaller than 2.54 cm dbh, and an ocular estimate of the percent cover for all shrub, graminoid, herb, bryophyte and lichen species by decimeter height classes to 70 cm.

All 5-year mortality trees at least 12.7 cm dbh are tallied by species and measured to the nearest .25 cm dbh for the entire 0.4 ha Mortality Plot and within the Subplots. A year of death estimate is completed using standard mortality guides (USFS-FIA 1998, 1999).

Photo records are completed for Subplots and Microplots.

All data is recorded on waterproof paper hard copy and transferred to Microsoft Excel spreadsheets in the laboratory.

The LTVMP data recording sheets are provided in Appendices 6-13. A list of necessary or suggested field equipment and supplies is found in Appendix 22.

Methods for Data Recording

DATA SHEET 1 (DS 1) : GENERAL LTVM PLOT DOCUMENTATION RECORD

(Refer to APPENDIX 6)

LTVM Plot Number

Enter a numeric code between 001 and 999, indicating the LTVMP number.

USGS Map

Enter an alpha code assigning the USGS Map and Quad number, such as Anchorage A- 1 to 8.

Crew Names

Provide the name of field survey members, such as Tande, J., Lenz, J., or Klein, S.

Date of Field Visit

Enter all dates the LTVMP is visited and measured using the format: mm/dd/yy.

Times

Enter times associated with measuring the plot (AM/PM), with a: Start Time, indicating the time the plot measurements are actually started, not including time getting to the plot; Stop Time, indicating the time the plot data recording is completed, not including egress time; and Lunch Time, indicating how many minutes are taken for lunch break.

Weather

Enter text describing weather conditions for that day. These are especially important as the condition of the sky may greatly affect describing the upper tree trunk damages, crown deaths, crown densities, transparencies, and, to a degree, measuring and estimating tree heights, and ocular estimates of ground cover.

Phase I Air Photo Information

Photo Number

Enter three and four digit codes, recording the air photo flight year, roll and image numbers (e.g. 95-15.8).

Air Photo Point Number

Enter a two digit code from 01 through 15, indicating the photo grid number used in the Phase I, Photo Interpretation Phase.

Vegetation Type

Enter an alpha-numeric code (Viereck et al., 1992) and/or description for vegetation type from the 1983 and 1998 vegetation maps, as determined in Phase I interpretations.

Vegetation Cover

Record alpha codes indicating levels of forest cover, in terms of percent foliar cover, as determined in Phase I photo interpretation. Codes include:

Well (over 66%)
Moderate (33-66%)
Poor (10-33%)

Elevation

Enter a four digit code, recorded to the nearest 10 m, with an acceptable range from 0010 to <1000, as determined from USGS 1:25,000 scale maps.

Phase II Ground Observation Information

Vegetation Type

Enter an alpha-numeric code (Viereck et al. 1992) and/or description for vegetation type, as determined in Phase II field interpretations . If ground plots change vegetation type since the photos were flown, such as in areas cut or flooded, etc., codes may include Non-forest, Water, etc.

General Notes to Access the LTVM Plot

Provide text narrative on how to get to the general plot location. These generally describe starting from a well known geographic point, (e.g., along a roadway), and use mileages derived from a vehicle odometer to access the general plot area and Reference Point.

Access Photo Documentation (35 mm)

Enter camera Roll and Frame Numbers documenting access point.

Sketch Map

Provide a graphic sketch of how to get to the general LTVMP area depicting what is described in General Notes above.

DATA SHEET 2 (DS 2) : LTVM PLOT LOCATION DOCUMENTATION RECORD

(Refer to APPENDIX 7)

Reference Point (RP)

Enter a text narrative describing the Reference Point (RP) Witness Tree, including its location at the site (i.e. edge of forest, fork in stream, etc.), and the tree species and diameter, as well as any other special features. The RP tree is tagged with aluminum tags.

The RP Witness Tree should be healthy and likely to survive several years, and be at least 15 cm diameter or larger if possible. Two aluminum tags are hung with aluminum nails on the tree facing the azimuth to plot center (IP), one at dbh, and a second at the 30 cm stump height--the latter for use should the tree be cut down. The heads of the tag nails are pointed downwards with about 2.54 cm protruding to allow for tree growth. This also allows the tag to slide to the head of the nail, reducing the chance that it will be enveloped by the bark.

These metal tags are scribed with a ball-point pen indicating that this is an "EAFB Natural Resources LTVM Study Plot", and showing plot number, as well as azimuth and distance from the reference tree (RP) to the plot center (IP).

See Appendix 5 for details on marking the RP.

RP Photo Record (35mm)

Enter camera Roll and Frame Number(s) documenting access to the Reference Point itself and the Reference Point on the ground. See Appendix 14 for general photo procedures.

RP GPS Reading

Record GPS Readings. Diagram and comment on where the GPS coordinates are collected at the RP; e.g., closed canopy; forested opening; number of satellites, etc. See Appendix 15 for general procedures and considerations.

Azimuth to Plot Center

Enter the magnetic azimuth from the Reference Point to the plot as determined using photogrammetric evaluations (photo scale protractor). The valid values are 001 to 360.

Distance to Plot Center

Record the distance in meters from the Reference Point to the plot center as determined using photogrammetric evaluations (e.g., photo scale protractor). The valid values are 001 to 1000.

Air Photo Baseline Azimuth

Record the magnetic azimuth for the baseline used in photogrammetric evaluations (e.g., photo scale protractor). The valid values are 001 - 360.

Air Photo Scale

Enter the photo scale of the primary photo which has the ground plot on it. The photo scale can be determined using photogrammetric evaluations; for 1999 evaluations, the scale is 1:12,000 for the color infrared and true color air photos.

Witness Trees (Subplot 1 at LTVMP Center) (DS 2)

Two Witness Trees are selected at Subplot 1 for the purposes of relocating or re-measuring the LTVMP at a later date. Other objects living or inanimate can be used in nonforested plots. The Witness Trees should be healthy, likely to survive several years, be at least 15 cm diameter or larger if possible, and not be on the Subplot (> 7.3 m from the Subplot center). An attempt should be made to have these trees separated by an azimuth of between 45 and 135 degrees. Two metal tags are hung with aluminum nails on each tree, one at dbh, facing the Subplot center, and a second at the 30 cm stump height, facing plot center--the latter for use should the tree be cut down. The heads of the tag nails will be pointed downwards with about 2.54 cm protruding to allow for tree growth. This also allows the tag to slide to the head of the nail, reducing the chance that it will be enveloped by the bark.

These metal tags are scribed with a ball-point pen indicating that this is an "EAFB Natural Resources LTVM Study Plot", and showing plot number, as well as azimuth and distance to the Witness Tree from plot center.

See Appendix 5 for details on marking the Witness Trees. The following data are recorded on the plot form for each of the two trees:

Species, Tree 1

Enter an alpha, two-three digit code with one of the following abbreviated codes:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

DBH, Tree 1

Enter a numeric, 4 digit code giving the diameter of the tree at breast height 1.37 m above the ground, expressed to the nearest millimeter, i.e. 0100 - 9999.

Distance from Tree 1

A numeric, 3 digit code giving the distance from the center of the 30 cm stump of the tree to the Subplot center, expressed to the nearest decimeter, i.e. 073 - 200.

Azimuth from Tree 1

Enter a numeric, 3 digit code, giving the magnetic azimuth from the Subplot center to the center of the tree at the 30 cm stump height expressed to the nearest degree, i.e. 001 to 360.

Species, Tree 2

Enter the same species codes and criteria as for Witness Tree 1.

DBH, Tree 2

Enter the same dbh codes and criteria as for Witness Tree 1.

Distance from Tree 2

Enter the same distance codes and criteria as for Witness Tree 1.

Azimuth from Tree 2

Enter the same azimuth codes and criteria as for Witness Tree 1.

Monument Description

Describe the type of monument used to establish the LTVMP center. How deep is it buried? Are additional materials used and what are they? Provide drawing below.

IP Photo Record (35mm)

Enter camera Roll and Frame Number(s) documenting the Initial Point (plot center for the LTVMP) itself. See Appendix 14 for general photo procedures.

IP GPS Reading

Record GPS readings. Diagram and comment on where the GPS coordinates are collected; e.g., closed canopy; forested opening; number of satellites, etc. See Appendix 15 for general procedures and considerations.

Reference Point to Plot Center Sketch (DS 2)

Provide a sketch showing the general location of the Reference Point with respect to that of the IP plot center, including prominent land features.

DATA SHEET 3 (DS 3) : LTVM SITE DATA RECORD : ON 2.07 M RADIUS NESTED SUBPLOT (MICROPLOT)

(Refer to APPENDIX 8)

For each 2.07 m radius nested Microplot, record:

LTVM Plot Number

Enter a three digit code between 001 and 999, indicating the LTVMP number.

Subplot Point Number

Enter a numeric one digit code from 1 through 4 for the Subplot.

Vegetation Type

Enter an alpha-numeric code for the vegetation type at each Subplot to Level IV or V of the Viereck et al. (1992) key to Alaska vegetation types.

Forest Stand Size Class

Enter an alpha code of four digits for the predominating stand size class:

Sawt = Saw-timber size (predominately over 27.9 cm at dbh)
Pole = Pole-timber size (predominately 12.7 to 27.9 cm at dbh)
Saps = Seedlings and saplings(predominately under 12.7 cm at dbh)
Nons = Non-stocked (less than 10% foliar cover in trees, any size)

Age of Site Tree

Enter a numeric, three digit code, indicating age of a tree bored at dbh. The preference will be to select spruce trees for which yield tables have been constructed for south central Alaska. These trees should preferably be dominants or co-dominants, free growing for most of their lives, unforked, and with no damaged tops. Trees must also be free of heart rot so ages can be determined to the center of the tree. Ages will be recorded at dbh and adjustments will be made later in the ages to reflect the number of years taken for the tree to grow from seedling to 1.37 m. At least two trees should be sampled over the four Subplots. The bored trees should preferably be off the Subplot (more than 7.3 m from Subplot center) to avoid possibly infecting live trees with rot through bore hole ports of entry, and thus adversely affecting future tree health of sampled trees. See Appendix 16 for details on increment borers and collecting and processing the cores.

Slope at Subplot Center

Enter a numeric, three digit code, showing percent slope at the Subplot center, as measured with a clinometer or similar slope measuring instrument. Acceptable codes are 000 -150.

Aspect at Subplot Center

Enter a numeric, three digit code, showing general aspect at the Subplot center, as measured with a compass, and expressed as magnetic azimuth. Acceptable codes are 001 - 360.

Disturbance (DS 3)

First Disturbance

Enter an alpha code, up to six digits in size, indicating types of the oldest disturbance that have affected the Subplot in recent times (up to 100 years ago). Examples of disturbance include: Logged, Burned, Beetles, Blowdown, Homesteading, Military Training, and Other.

Year of First Disturbance

Enter a two digit, numeric code, indicated the historically determined or estimated year of the first disturbance recorded above. Examples include 00 through 99 = 1900 through 1999.

Second Disturbance

Enter the same coding as for First Disturbance, above, but for Second Disturbance.

Year of Second Disturbance

Enter the same coding as for First Disturbance, above, but for Second Disturbance.

Third Disturbance

Enter the same coding as for First Disturbance, above, but for Third Disturbance.

Year of Third Disturbance

Enter the same coding as for First Disturbance, above, but for Third Disturbance.

Soil Record (DS 3)

Soil Type

Record from EAFB soils report (Wikgren and Moore 1997).

Soils Field Data

Record site and soil features from a sample taken outside of the Microplot within a 10 m radius of every Subplot. The profile should best represent a 67 m^2 area (2.07 m radius) around the Microplot. All measurements are recorded in centimeters and depths are taken from the ground-air surface. Small strands and extended clumps of bryophytes or lichens are disregarded; measuring begins at the surface where bryophytes or lichens become a continuous mat on the surface. Unusual hummocks, tussocks of bryophytes or mounds from buried, decomposing limbs or roots will be disregarded. All depth measurements include moss and organic layers but not twigs and undecomposed woody debris on the surface. Measurements are made down to 30 cm below the top of mineral soil or to a maximum total depth of 50 cm, whichever is shallower.

Slope Shape Horizontal

Enter the dominant horizontal (parallel to contours) slope shape of the landform at the Microplot. Code descriptions are:

B Broken, e.g., V-notches, rock outcrops
C Concave, e.g., slope curving inward (swale)
X Convex, e.g., slope curving outward (hummock)
F Flat, e.g., no slope
S Straight or Smooth, e.g., slope is straight or smooth
U Undulating, e.g., combination of concave and convex

Slope Shape Vertical

Enter the dominant vertical (perpendicular to contours) slope shape of the landform at the Microplot. Code descriptions are:

B Broken, e.g., benches or ledges
C Concave, e.g., slope curving inward (swale)
X Convex, e.g., slope curving outward (hummock)
F Flat, e.g., no slope
S Straight or Smooth, e.g., slope is straight or smooth
U Undulating, e.g., combination of concave and convex

Microtopography

Enter a code characterizing the variability of the soil surface form. The intent is to estimate the amount of soil mixing; in south central Alaska, this mixing is primarily due to uprooting of trees. Care should be taken to exclude fallen logs and decayed stumps from the determination of class. Code descriptions are:

SM Smooth — few or no mounds; surface profile is linear
MI Micromounded — mounds are less than 0.3 m in height
SL Slightly mounded — mounds are 0.3 m - 1 m high and > 7 m apart
MO Moderately Mounded — mounds are 0.3 m - 1 m high and 3 - 7 m apart
ST Strongly Mounded — mounds are 0.3 m - 1 m high and 1-3 m apart
SE Severely Mounded — mounds are 0.3 m - 1 m high and 0.3 - 1 m apart
EX Extremely Mounded — mounds are > 1 m high and > 3 m apart
UL Ultra Mounded — mounds are > 1 m high and < 3 m apart

Slope Position

Enter a slope position for the Microplot determined by macrosite. As an example, the Microplot is recorded as falling on the UPPER one-third of the slope when the plot falls on the upper part of a long side slope even if the plot is located on the toe slope of a small escarpment or break in slope. Code descriptions are:

1 LOWER one-third
2 MIDDLE one-third
3 UPPER one-third
4 RIDGETOP
5 SADDLE
6 DRAINAGE, small
7 VALLEY, narrow bottom
8 FLAT, < 5% slope

Rooting Depth

Enter a measurement from the surface to a maximum depth of 80% of the live roots. Code descriptions are:

1 to 50	Depth, in cm, to 80% of live root depth
99	Not Applicable

Depth To Bottom Of Live Moss

The live moss includes all living green mosses, lichens and liverworts. Depth is measured from the surface to either dead fibrous materials, decomposed organics, or mineral soil, depending on which occurs first (some of the organic materials listed above may be absent in a profile). Code descriptions are:

1 to 50	Depth, in cm, to bottom of live moss
99	Not Applicable

Depth To Bottom Of Slightly Decomposed Oi (Fibric) Organic Material

The Fibric organic materials are composed of dead mosses, lichens, grasses and decomposing twigs and wood debris. The materials retain a fiber content of $\geq 75\%$ after being rubbed 10 times between the thumb and fingers. Code descriptions are:

1 to 50	Depth, in cm, to bottom of fibric layer as measured from the **bottom** of live moss
99	Not Applicable

Depth To Bottom Of Moderately Decomposed Oe (Hemic) Organic Material

The Hemic organic materials will have 17% - 75% visible fibers by volume after being rubbed 10 times. Code descriptions are:

1 to 50 Depth, in cm, to bottom of the hemic layer as measured from the **bottom** of live moss
99 Not Applicable

Depth To Bottom Of Highly Decomposed Oa (Sapric) Organic Material

The sapric organic material is highly decomposed with less than 17% visible fiber content by volume. It is dark and fingers are often stained from the organics. NOTE: It is sometimes difficult to determine the boundary between the decomposed organic materials and mineral soil that has much organics incorporated into it at the surface. Code descriptions are:

1 to 50 Depth, in cm, to bottom of the hemic layer as measured from the **bottom** of live moss
99 Not Applicable

Site Moisture

Record a subjective value for site moisture from the following prompts (after Raup 1969):

1 - <u>extremely xeric sites</u> - almost no moisture; no plant growth
2 - <u>very xeric sites</u> - very small amount of moisture; e.g., dry sand dunes
3 - <u>xeric sites</u> - small amount of moisture; e.g., stabilized sand dunes, dry ridge tops
4 - <u>subxeric</u> - noticeable amount of moisture; e.g., well-drained slopes, ridges
5 - <u>subxeric to mesic sites</u> - very noticeable amount of moisture; e.g., flat, gently sloping surfaces
6 - <u>mesic sites</u> - moderate amount of moisture; e.g., flat shallow depressions
7 - <u>mesic to subhygric sites</u> - considerable amount of moisture; e.g., depressions
8 - <u>subhygric sites</u> - very considerable amount of moisture; saturated but with <5% standing water <10 cm deep
9 - <u>hygric sites</u> - large amount of moisture; up to 100% surface under water 10 to 50 cm; e.g., deep lake margins, shallow ponds and streams
10 - <u>hydric sites</u> - very large amount of moisture; 100% of surface under water 50 - 150 cm deep; e.g., lakes, streams

Soil Moisture

Record a subjective value for soil moisture from the following prompts (after Raup 1969):

1 - very dry - very small amount of moisture, soil does not stick together
2 - dry - small amount of moisture, soil somewhat sticks together
3 - damp - noticeable amount of moisture, soil sticks together but crumbles
4 - damp to moist - very noticeable amount of moisture, soil clumps
5 - moist - moderate amount of moisture, soil binds but can be broken apart
6 - moist to wet - considerable amount of moisture, soil binds and sticks to fingers
7.0 - wet - very considerable amount of moisture, drops of water can be squeezed out of soil
8 - very wet - large amount of moisture can be squeezed out of the soil
9 - unsaturated - out of soil very large amount of moisture, water drips
10 - very saturated - extremely large amount of moisture, soil is more liquid than solid

Animal Sign

Animal sign is recorded that is observed within the 2.07 m radius Microplot. A code of 20 is added if sign is observed outside the 2.07 m plot and in the same vegetation type. A corresponding **Animal Species Code** will be recorded for the animal producing the observed sign.

01 scat, pellet group
02 track
03 trail, runway
04 den: hollow/fallen tree
05 den: rock cavity
06 den: excavated soil
07 burrow, tunnel
08 lodge, bedding area
09 food cache/midden
10 rubbed tree
11 clawed tree
12 feeding on vegetation
13 nest: over water
14 nest: on ground
15 nest: raised in stump
16 nest: suspended in vegetation
17 nest: live tree branches
18 nest: dead tree branches
19 cavity nest
20 animal sighting/hearing
50 remains (antlers, bones)

Animal Species (DS 3)

Enter a code for a specific animal (or apparent group if specific animal cannot be identified) producing recorded animal sign. Groups are capitalized below.

10 RODENT
01 beaver
02 porcupine
11 ground squirrel
12 flying squirrel
13 tree squirrel
14 marmot
17 muskrat
18 lemming
19 vole/mouse
20 BEAR
21 black bear
22 brown bear
30 LAGOMORPH
32 hare
40 FURBEARER
41 wolf
42 coyote
43 fox
44 lynx
45 river otter
46 wolverine
47 mink
48 marten
49 weasel, ermine
50 UNGULATE
51 moose
60 GAME BIRD
61 grouse
62 ptarmigan
63 duck
64 goose
65 crane
70 NON-GAME BIRD
71 water shorebird
72 woodpecker
73 passerine (perching bird)
74 RAPTOR
75 eagle
76 hawk
77 falcon
78 owl
79 osprey
80 OTHER
81 shrew
82 bat
83 amphibian
85 fish
86 domestic
99 UNKNOWN

Animal Comments

Enter comments on animal sign or use within or in the vicinity of the plot. Abundant hare sign might be more evident in one year than another or, perhaps, a game trail traverses the site.

DATA SHEET 4 (DS 4) : LTVM UNDERSTORY VEGETATION PROFILE RECORD : ON 2.07 M RADIUS NESTED SUBPLOT (MICROPLOT)

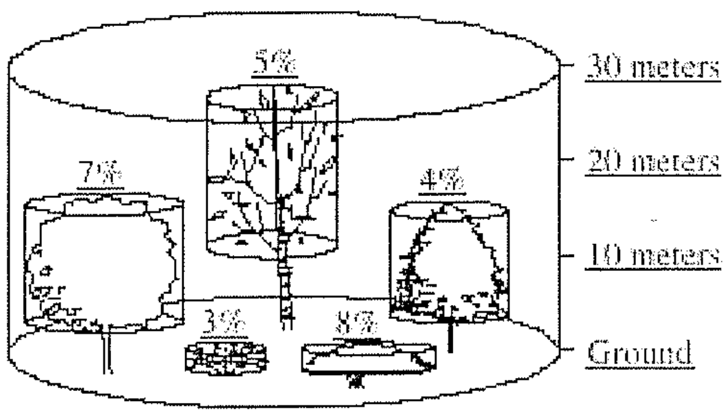
(Refer to APPENDIX 9)

The 2.07 m nested Microplots are used to inventory and monitor the horizontal and vertical distribution, density, diversity, and composition of plants and non-living material. Data is collected on these plots for shrubs, graminoids, forbs, mosses, lichens, tree seedlings, saplings and tree-like shrubs (e.g., alder and willow) not recorded on the tree plot.

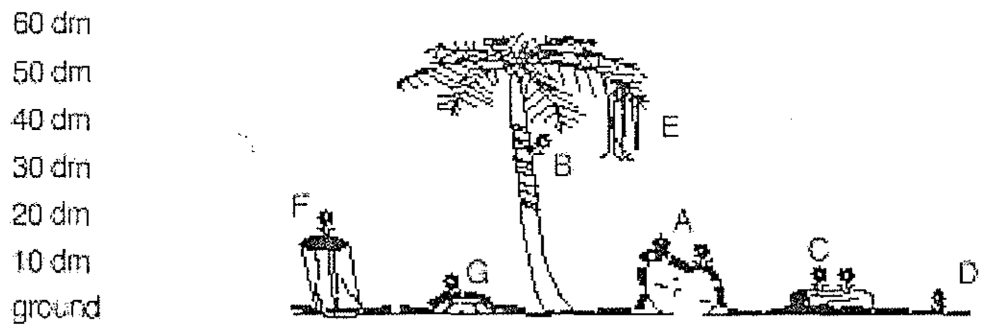
Vegetation is classified into layers starting at ground level. Each layer's vertical dimensions are estimated using the natural layer breaks observed on the Microplot. Data on trees > 2.5 cm dbh are measured and recorded on the Sapling and Tree Record data forms (see Tree Record and Sapling Record Sections). However, the Vegetation Profile Record does include arboreal lichens and mosses no matter their substrate. Note: The only exception to these rules are in forested wetland stands where trees may grow in a stunted shrub-like form. These stands are treated as shrubland and all trees that appear to never grow to > 4 m are not measured in the tree tally. In measuring these stands for the vegetation profile, the foliar cover of the stunted trees is measured regardless of their diameter. By combining the data from trees > 2.5 cm dbh measured on the tree/sapling plots with the ground vegetation profile data, an overall horizontal and vertical profile can be generated for the sampled vegetation type.

The Cover Concept

Ocular estimates of cover are used to record the distribution of live vegetation and non-living material occurring within the bounds of the Microplots using the space occupancy concept illustrated below (USFS FIA 1998). The purpose is to describe the average amount of space occupied by specific vegetation.



Ground level includes the inorganic (rock, mineral soil) or humus substrate in which the plant is rooted. The cover of plants growing on boulders is estimated treating the boulder as ground level; however, plants growing on stumps will be recorded in the layer which corresponds to the height of the stump above ground level. Therefore, when "ground cover" plants are elevated on stumps or logs, it is possible to record them in the same layer as the crowns of tall shrubs (see drawing below from USFS FIA 1998). Severely decomposed logs are considered part of the soil; logs which still retain their original shape are considered as occurring above ground level.



Plant A Growing on boulder occurs between ground level and 2 dm
Plant B Growing on bark of tree is at 35 dm
Plant C Growing on sound log occurs between 5 and 9 dm
Plant D Occurs between ground level and 2 dm
Lichen E In tree occurs between 32 and 47 dm
Plant F On stump occurs between 15 and 20 dm
Plant G Growing on decomposed stump occurs between ground level and 2 dm.

(FROM USFS FIA 1998)

Record the following for the Understory Vegetation Profile Record (DS 4):

LTVM Plot Number

Enter a three digit code between 001 and 999, indicating the LTVMP number.

Subplot Point Number

Enter the numeric code for the four-point cluster Subplot that the vegetation profile plot is installed on. Valid codes are 1 through 4.

Vegetation Type

Record the code to the Level IV or V for the Alaska vegetation classification (Viereck et al. 1992) that best describes the plot. If the vegetation at the point is not described at the Viereck et al. (1992) Level V, enter a description to Notes/Comments for laboratory classification.

Special Case: Inclusions

Note whether inclusions of other vegetation types (areas > 0.2 ha and < 0.4 ha) occur within the area of the LTVMP and Microplot. It is important that the vegetation data recorded for the vegetation profile reflect the major vegetation type being monitored.

Recorders Initials

Enter the initials of the field team member estimating and recording vegetation profile data.

Date

Enter the date that the vegetation profile plot is completed using the format: mm/dd/yy.

Vegetation Physionomy

For each point, record the following physiognomic characteristics as a numeric, two digit code, indicating the percent foliar cover for the vegetation layer, with a range from 00 - 99, expressed in the raindrop effect for that level.

Tree (> 8 m)
Tall Shrub/dwarf tree (1.5 - < 3 m)
Low Shrub (0.5- < 1.5 m)
Dwarf Shrub (< 0.2 m)
Graminoids
Forb
Ferns/Fern Allies
Moss
Lichen

Top of Layer Height

The Top of Layer Height is an estimate of the height of the top of a particular layer. For each layer, the height of the foliage is recorded as a 3-digit code to the nearest decimeter (dm). The first layer, starting at the ground surface, has a Top Height of 000 and includes most mosses, lichens, and special components (see description below). Succeeding layers always run from the top of the preceding layer to the next natural height break. Layer heights should include all major breaks in the vegetation excluding trees that are > 2.5 cm dbh (or larger trees in dwarf tree stands).

Percent Cover By Layer

The Percent Cover By Layer describes the combined cover of all vegetation and special components on the 2.07 m radius plot in the layer being recorded. Record the percent cover to the nearest percent (%). Note that Layer 1, (ground) will always have 100% cover, and that tall plants can contribute to more than one layer. Valid codes: 001 through 100.

Vegetation Species

Within each layer, the percent composition (percent cover) and composite cover of all plants and non-living components in that layer are estimated and recorded.

Alphanumeric codes describe the plants present on the vegetation profile Microplot. Plant taxonomy follows USDA Natural Resources Conservation Service - PLANTS database (1998/99). A valid alphabetical plant species code list developed for field reference in 1999 is found in Appendix 17.

Special Components

In addition to cataloging plant species and their cover, Special Components are listed as default categories in a space above where the plant species can be entered. Note: many of the special components exist only in the ground layer, Layer 1.

Water, standing - lakes and ponds
Water, flowing - Streams and creeks
Rock, solid - includes exposed large boulders
Rock, broken - < 2 m in size
Residue and litter - includes decomposing litter, not mineral soil
Downed wood - all dead and down woody debris on ground and above
Basal vegetation - only ground level stems of all live vascular plants except trees >2.5 cm dbh (generally < 5% cover)
Stumps - (<1.37 m tall, no dia limit)
Snags - (>1.37 m tall, no dia limit)

Plant Species Codes and Protocols

Six-letter codes are used to abbreviate species names on the data sheets consisting of the first three letters from both the genus and specific epithet (Appendix 17). Only one record is entered per species. Unknown species are recorded to the genus level if possible (It is better to generalize and be correct than to guess and be wrong). All unknown vascular and nonvascular species are collected, and a systematic unknown collection number is assigned to track processing of the specimens and data in the lab. Collection of unknown species should occur outside of the Subplot boundaries whenever possible.

Percent Composition By Species Within Layer

The Percent Composition By Species Within a Layer is a numeric code describing the percent composition occupied by each species within each layer (1 through 7). The composition percentages for each species and special component within the layer must add up to 100%. For example a layer that has a 50% total cover might be composed of 45% *Vac vit*, 35% *Rub cha*, and 20% *Car liv* which added up make 100% of the composition for the 50% cover of that layer. Valid codes: 001 through 100.

Composite Cover

Composite Cover describes the percent cover of a recorded plant species or special component considering all layers that the plant or special component falls in. Composite cover for each species is independent of the cover of other species. If a plant species or special component falls in only one layer, its composite cover is equivalent to its total percent cover in that layer. It is usually not equal to Percent Composition within Layer (see examples below).

Example 1 - If Species A is the sole component of Layer 3 (100% composition) and Percent Cover By Layer = 35, Composite Cover for Species A = 35

Example 2 - If there are 2 species composing Layer 3 (and only occurring in Layer 3) e.g., Species A with 36% and Species B with 64% composition, and Percent Cover By Layer = 50, Composite Cover for Species A = 18, (.36 x 50) and Composite Cover for Species B = 32, (.64 x 50).

For plants or special components that exist in several layers the composite cover will have to be estimated. This is done by visualizing looking down on the plot from above and estimating the cover of the component, ignoring all other components. It is important to note that any portion of a component's cover from one layer that overtops the cover in another layer will cause the total composite cover for that plant or special component to be reduced.

Plant Notes and Field Notes

Notes are taken for any peculiarity on the vegetation profile plot. If it is associated with individual species, or layers, the Notes field, next to the Species field, can be used. For general notes on the vegetation profile, the Field Notes section along the side of the form is used.

Layer Totals

Layer Totals is a numeric code for the cumulative cover of all species and special components within an individual layer. Layer Totals must add up to 100 and are checked in the final edit of the vegetation profile to ensure they add up to 100%. Valid code: 100.

DATA SHEET 5 (DS 5) : LTVM TREE SEEDLING RECORD : ON 2.07 M RADIUS NESTED SUBPLOT (MICROPLOT)

(Refer to APPENDIX 10)

LTVM Plot Number

Enter a three digit code between 001 and 999, indicating the LTVMP number.

Subplot Point Number

Enter a numeric code for the four-point cluster Subplot that the vegetation profile plot is installed on. Valid codes are 1 through 4.

Small Tree Seedling Data

For each Microplot, record species and count of seedlings up to and at 30 cm (1.0 ft) tall, as follows:

Species Code:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

Count by Species

Enter a numeric one or two digit code showing the count of seedlings under 30 cm present for each species group recorded above, i.e. 01-30.

Large Seedling Data

For each Microplot, record species and count of seedlings equal to or over 30 cm (1.0 ft) tall and less than or equal to 2.54 cm in diameter as follows:

Species Code:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

Count by Species

Enter a numeric one or two digit code showing the count of seedlings equal to or greater than 30 cm and less than or equal to 2.54 cm for each species group recorded above, i.e. 01-30.

Height of Seedlings

A numeric two digit code showing the height in decimeters of large seedlings for each recorded species group, i.e. 03 through 20.

Age of Seedlings

A numeric one or two digit code showing the estimated age of the seedlings for each recorded species. Estimation of age is attempted, based on whorls present, each representing one year of growth. This is very difficult to estimate in slow growing or heavily browsed seedlings. These data may be important to ascertain if regeneration was present prior to insect attacks such as spruce bark beetle, and to what degree.

Comments

Record comments relative to impacts on the seedlings, such as snow-bend, moose or snowshoe hare browse, etc.

DATA SHEET 6 (DS 6) : LTVM SAPLING RECORD : ON 2.07 M RADIUS NESTED SUBPLOT (MICROPLOT)

(Refer to APPENDIX 11)

LTVM Plot Number

Enter a code between 001 and 999 indicating the LTVM ground plot number.

Tree Sapling Data

Record the following for all trees with dbh's between 2.5-12.7 cm on the 2.07 m radius nested Subplot (Microplot),

Subplot Point Number

Enter a numeric one digit code corresponding to the Subplot number from 1 through 4.

Tree Number

Enter a numeric, ascending two digit code indicating the progressive tree number for the sapling trees tallied at a given Subplot. Code ranges will generally be from 01 up to 10. Enter NONE if no sapling trees are tallied at a point.

Distance to Tree

Enter a numeric, three digit code indicating the distance in decimeters from the sapling tally tree to the Subplot center (center of the tree at the 30 cm stump height). Trees with stumps beyond 2.07 m from the Subplot center are not tallied even though dbh may lean into the plot. Acceptable codes are 001 - 021.

Azimuth to Tree

Enter a numeric, three digit code indicating the magnetic azimuth to the nearest degree from the Subplot point center to the sapling tally tree (center of the tree at the 30 cm stump height). Acceptable codes are 001 - 360.

Species Code

Enter an alpha, two-three digit code with one of the following abbreviated codes:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

Diameter Breast Height

Enter a numeric, three digit code in millimeters (mm), indicating the diameter of the sapling tally tree at dbh. Appropriate methods for measuring diameters of forked trees, and trees with abnormal dbh are followed (Appendix 18). Appropriate codes are 025 - 126 (mm).

Dominance

Enter a one digit numeric code indicating the relative position of the sapling in the stand, relative to the general level of the stand canopy. Appropriate codes are as follows:

1 Dominant, indicating a tree with a crown extending above the general level of the canopy of the stand.

2 Co-dominant, indicating a tree with a crown topping out at the general level of the canopy of the stand.

3 Intermediate, indicating a tree with a crown not reaching to the general level of the canopy of the stand, but a tree that is not suppressed in its height growth.

4 Suppressed or overtopped tree with a top that is well below the general level of the canopy, and is suppressed in its height growth.

Height

Enter a numeric, three digit code to the nearest 0.5 m (5 decimeters), indicating the total height of the tree. Tree heights are measured with a clinometer or similar height measuring instrument for the first few trees tallied, and then heights may be estimated to the nearest half meter, once a basis for the estimation is established in the previously measured trees. Acceptable codes for saplings are 015 through 100 (dm).

Sapling Crown Data

Tree crown data determinations follow established forest health and monitoring procedures (Mangold 1997, USFS FIA 1998).

Crown Live Ratio

Enter a two digit numeric code indicating what percent of the total height of the sapling is in **live** crown. Acceptable codes are 05 through 99. Code 99 is used to indicate a crown going all of the way to the ground.

Crown Dead Ratio

A two digit numeric code indicating what percent of the total height of the sapling is in **dead** crown. Acceptable codes are 05 through 99. Code 99 is used to indicate a crown going all of the way to the ground.

Crown Diameter

Enter an average estimate of diameter from the center of the trunk to the widest portion of the crown and record to the nearest decimeter See Appendix 19 for determining radius.

Crown Form

Enter a crown form code for the tree which best approximates its shape. Shapes and codes are provided in Appendix 19.

Crown Density

Enter a two digit numeric code indicating the relative density of the green foliage and branches in the crown of the tree and recorded to the nearest five percent. A crown density estimation guide developed for Forest Health Monitoring is found in Appendix 19. Acceptable codes are 05 through 95.

Crown Dieback

Enter a two digit numeric code indicating the percent of live branches in the upper and outer third of the live crown that shows dieback and record to the nearest 5 percent. Excessive dieback reflects negatively on crown and tree health. Acceptable codes are 00 - 95, but will generally be greater than 30.

Crow Transparency

Enter a two digit numeric code indicating the relative transparency of the green foliage in the crown of the tree, and record to the nearest 5 percent. A crown transparency estimation guide developed for Forest Health Monitoring is used to facilitate this estimation (Appendix 19). Acceptable codes are 00 - 95, but generally do not exceed 35. Transparency reflects light passing through the foliage, and can be increased by defoliating insects, hail damage, etc., thus reflecting negatively on crown and tree health.

Sapling Damage Data

Damage, Location 1

Enter a numeric, one digit code indicating the lowest location of significant damage on a tree. The trunk of the tree is that portion below the crown, and is divided half and half between lower and upper trunk. The following codes are used to indicate location of the damage on the tree:

0	No damage on the tree
1	Damage on roots
2	Damage on roots and the lower trunk
3	Damage on the lower trunk only
4	Damage on the lower and upper trunk
5	Damage on upper trunk only
6	Damage to the crown stem (stem within the crown, up to the tip of the tree)
7	Damage to branches
8	Damage to buds and shoots
9	Damage to foliage

Damage, Type 1

Enter a numeric, two digit code indicating the type of damage identified in the Damage Location 1 category above. Refer to Holsten et al. (1980) for forest insects and disease. The following codes are used to indicate type of damage (% relates to Severity; see below):

01 Canker or gall (20%)
02 Conks / advanced decay (0%)
03 Open wounds (20%)
04 Resinosis (20%)
11 Broken trunk or roots (0%)
12 Brooms on the trunk (0%)
13 Broken roots (>3 ft, (20%)
21 Loss of apical dominance (1%)
22 Broken branches (20%)
23 Excess branches or brooms
24 Damaged foliage (30%)
25 Discolored foliage (30%)
31 Other

Damage, Severity 1

Enter a two digit numeric code indicating the extent of the damage, expressed to the nearest 5% of some total index, shown in parentheses above. Accepted codes are 00 - 95.

Damage, Location 2

Enter the same coding and logic as for Damage, Location 1, except this pertains to the second lowest location of significant damage to the tree.

Damage, Type 2

Enter the same coding and logic as for Damage, Type 1, except this pertains to the second lowest location of significant damage to the tree.

Damage, Severity 2

Enter the same coding and logic as for Damage, Severity 1, except this pertains to the second lowest location of significant damage to the tree.

Sapling Beetle Data

Beetle Type

Enter an alpha, four digit code, reflecting one of the following three conditions relative to presence or absence of bark beetles (Refer to Holsten et al. (1980) for forest insect characteristics):

None	No evidence of bark beetles present (or leave blank)
SPBL	Evidence of spruce bark beetles as exhibited by the presence of frass or pitching (resinosis) associated with boring holes
IPS	Evidence of Ips engraver beetles on the trunk of the tree.

Sapling Comments

Enter text comments denoting special situations on a tree that may not be covered in the damage coding data, e.g., unknown insect damage, forked trees, extreme lean, snow-bend, etc.

DATA SHEET 7 (DS 7) : LTVM LIVE TREE (> 12.7 cm DBH) RECORD : ON 7.32 M RADIUS NESTED SUBPLOT

(Refer to APPENDIX 12)

LTVM Plot Number

Enter a numeric three digit code between 001 and 999, indicating the LTVMP number.

Record the following for all live trees > 12.7 cm (5 in) dbh on the 7.32 m radius Subplot:

Subplot Point Number

Enter a numeric one digit code corresponding to the Subplot number from 1 - 4.

Tree Number

Enter a numeric, ascending two digit code indicating the progressive tree number for all live trees > 12.7 cm dbh tallied at a given Subplot. Code ranges will generally be from 01 up to 99. Enter NONE if no growing stock trees are tallied at a point.

SUGGESTION: To expedite live tree inventory, begin at 0^0 and progress clockwise successively numbering trees with a red timber marker.

Distance to Tree

Enter a numeric, three digit code indicating the distance in decimeters from the growing stock tally tree (center of the tree at the 30 cm stump height) to the Subplot center. Trees with stumps beyond 7.32 m from the Subplot center are not tallied, even though dbh may lean into the plot. Acceptable codes are 001 - 073 (dm).

Azimuth to Tree

Enter a numeric, three digit code indicating the magnetic azimuth to the nearest degree from the Subplot point center to the tally tree (center of the tree at the 30 cm stump height). Acceptable codes are from 001 through 360.

Species Code

Enter an alpha, two-three digit code with one of the following abbreviated codes:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

Diameter Breast Height

Enter a numeric, four digit code in millimeters, indicating the diameter of the tally tree at dbh. Appropriate methods for measuring diameters of forked trees, and trees with abnormal dbh are followed (Appendix 18). Codes are 0127 - 4000 (mm).

Dominance

Enter a numeric, one digit code indicating the relative position of the tree in the stand, relative to the general level of the stand canopy. The appropriate codes are as follows:

1. Dominant, indicating a tree with a crown extending above the general level of the canopy of the stand.
2. Co-dominant, indicating a tree with a crown topping out at the general level of the canopy of the stand.
3. Intermediate, indicating a tree with a crown not reaching to the general level of the canopy of the stand, but a tree that is not suppressed in its height growth.
4. Suppressed or overtopped tree with a top that is well below the general level of the canopy, and is suppressed in its height growth.

Height

Enter a numeric, three digit code to the nearest 0.5 m (5 decimeters), indicating the total height of the tree. Tree heights are measured with a clinometer or similar height measuring instrument for the first few trees tallied, and then heights may be estimated to the nearest half meter, once a basis for the estimation is established in the previously measured trees. Acceptable codes for trees are 015 - 500 (dm).

Live Tree Crown Data

Tree crown data determinations follow established forest health and monitoring procedures (Mangold 1997, USFS FIA 1998).

Crown Live Ratio

Enter a two digit numeric code indicating what percent of the total height of the tree is in **live** crown. Acceptable codes are 05 through 99. Use code 99 to indicate a live crown going all of the way to the ground.

Crown Dead Ratio

Enter a two digit numeric code indicating what percent of the total height of the tree is in **dead** crown. Acceptable codes are 05 through 99. Use code 99 to indicate a crown going all of the way to the ground.

Crown Diameter

Enter an average estimate of diameter from the center of the trunk to the widest portion of the crown and record to the nearest decimeter. See Appendix 19 to determine crown radius.

Crown Form

Enter a crown form code for the tree which best approximates its shape. Shapes and codes are provided in Appendix 19.

Crown Density

Enter a two digit numeric code indicating the relative density of the green foliage and branches in the crown of the tree, and record to the nearest five percent. A crown density estimation guide developed for Forest Health Monitoring is used to facilitate this estimation (Appendix 19). Acceptable codes are 05 - 95.

Crown Dieback

Enter a two digit numeric code indicating the percent of live branches in the upper and outer third of the live crown that shows dieback, and record to the nearest 5 percent. Excessive dieback reflects negatively on crown and tree health. Acceptable codes are 00 - 95, but will generally be greater than 30.

Crown Transparency

Enter a two digit numeric code indicating the relative transparency of the green foliage in the crown of the tree, and record to the nearest 5 percent. A crown transparency estimation guide developed for Forest Health Monitoring is used to facilitate this estimation (Appendix 19). Acceptable codes are 00 - 95, but generally do not exceed 35. Transparency reflects light passing through the foliage, and can be increased by defoliating insects, hail damage, etc., thus reflecting negatively on crown and tree health.

Live Tree Damage Data

Damage, Location 1

Enter a numeric, one digit code indicating the lowest location of significant damage on a tree. The trunk of the tree is that portion below the crown, and is divided half and half between lower and upper trunk. The following codes are used to indicate location of the damage on the tree:

0	No damage on the tree
1	Damage on roots
2	Damage on roots and the lower trunk
3	Damage on the lower trunk only
4	Damage on the lower and upper trunk
5	Damage on upper trunk only
6	Damage to the crown stem (stem within the crown, up to the tip of the tree)
7	Damage to branches
8	Damage to buds and shoots
9	Damage to foliage

Damage, Type 1

Enter a numeric, two digit code indicating the type of damage identified in the Damage, Location 1 category above. Refer to Holsten et al. (1980) for forest insects and disease. The following codes are used to indicate type of damage (% relates to Severity; see below):

01 Canker or gall (20%)
02 Conks/ advanced decay (0%)
03 Open wounds (20%)
04 Resinosis (20%)
11 Broken trunk or roots (0%)
12 Brooms on the trunk (0%)
13 Broken roots >3 ft, (20%)
21 Loss of apical dominance (1%)
22 Broken branches (20%)
23 Excess branches or brooms
24 Damaged foliage (30%)
25 Discolored foliage (30%)
31 Other

Damage, Severity 1

Enter a two digit numeric code indicating the extent of the damage identified in the Damage, location 1 variable noted above, and expressed to the nearest 5% of some total index in parentheses above. Accepted codes are 00 - 95.

Damage, Location 2

Enter the same coding and logic as for Damage, Location 1, except this pertains to the second lowest location of significant damage to the tree.

Damage, Type 2

Enter the same coding and logic as for Damage, Type 1, except this pertains to the second lowest location of significant damage to the tree.

Damage, Severity 2

Enter the same coding and logic as for Damage, Severity 1, except this pertains to the second lowest location of significant damage to the tree.

Live Tree Beetle Data (DS 7)

Beetle Type

Enter an alpha, four digit code, reflecting one of the following three conditions relative to presence or absence of bark beetles (Refer to Holsten et al. (1980) for forest insect characteristics):

None No evidence of bark beetles present (or leave blank)
SPBL Evidence of spruce bark beetles as exhibited by the presence of frass or pitching (resinosis) associated with boring holes.
IPS Evidence of Ips engraver beetles on the trunk of the tree.

Live Tree Comments (DS 7)

Enter text comments denoting special situations on a tree that may not be covered in the damage coding, e.g., unknown insect damage, forked trees, extreme lean, snow-bend, etc.

DATA SHEET 8 (DS 8) : LTVM TREE MORTALITY RECORD : ON 7.32 M RADIUS TREE SUBPLOT *AND* 35.68 M RADIUS PLOT

(Refer to APPENDIX 13)

Suggestion: To assist in expediting recording mortality trees on the Mortality Plot, it is recommended that the Mortality Plot be laid out when the data collector is at Subplots 2, 3 and 4.

From the Subplot center, the outer circumference of the Mortality Plot is set back towards the IP by 0.95 m. The data collector then flags the outer perimeter of the Mortality Plot at equal intervals in each direction from this Subplot halfway to each of the neighboring subplots (e.g., while at SP 2, work the quadrant halfway to SP 3 and then halfway to SP 4. Repeat at each Subplot effectively closing the perimeter of the Mortality Plot).

Beginning at 90^0 (or 270^0) from the line between the IP to the Subplot center, the investigator turns 10 degrees towards the IP every 6.22 m (20.42 ft.) which may be done by accurately pacing this distance. Each flag is marked with the appropriate azimuth to aid the investigator in remembering where he/she is at on or near the circumference of the plot.

A physical reference is thus created to visualize the plot and to assist in determining whether dead trees are in or out of the plot when near the outside of the Mortality Plot. It is also helpful where the undergrowth is dense, and the recorder at the center of the plot has difficulty in seeing where the team member near the perimeter is at while shooting azimuths, and in dragging the distance tape in a straight line from plot center to determine accurate distances to trees. Where trees are close to the edge of the plot, a tape must still be used to determine whether the dead tree is in or out of the plot.

LTVM Plot Number

Enter a numeric code between 001 and 999, indicating the ground plot number.

SUBPLOT TREE MORTALITY RECORD ON 7.32 M RADIUS SUBPLOT

Mortality trees are blazed with a hand axe on the side of the tree towards plot center and marked and numbered with a felt pen to more easily keep track of the tally and ease relocation in future years of monitoring.

Record the following for all mortality trees 2.5 cm dbh and larger, that have died within the past 5 years on the 2.07 and the 7.32 m radius Subplots. Criteria for determining 5-year mortality are found in Appendix 20:

Subplot Point Number

Enter a numeric one digit code corresponding to the Subplot number from 1 through 4.

Tree Number

Enter a numeric, ascending two digit code indicating the progressive tree number for mortality trees **(> 2.5 cm) tallied at a given Subplot.** Code ranges are generally from 01 up to 99. Enter NONE if no mortality trees are tallied at a point.

SUGGESTION: To expedite dead tree inventory, begin at 0^0 and progress clockwise successively blazing mortality trees and numbering with a black magic marker.

Distance to Tree

Enter a numeric, three digit code indicating the distance in decimeters from the mortality tally tree (center of the tree at the 30 cm stump height) to the Subplot center. Trees with stumps beyond 7.32 m from the Subplot center are not tallied here, even though dbh may lean into the plot. **If the mortality tree is on the acre Mortality Plot, it will be tallied there.** Acceptable codes are from 001 - 073 (dm).

Azimuth to Tree

Enter a numeric, three digit code indicating the magnetic azimuth to the nearest degree from the Subplot point center to the mortality tally tree (center of the tree at the 30 cm stump height). Acceptable codes are from 001 - 360.

Species Code

Enter an alpha, two-three digit code with one of the following abbreviated codes:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

Diameter Breast Height

Enter a numeric, four digit code in millimeters, indicating the diameter of the mortality tally tree at dbh. Appropriate methods for measuring diameters of forked trees, and trees with abnormal dbh are followed (Appendix 18). Codes are 0025 - 4000 (mm).

Dominance

Enter a one digit numeric code indicating the relative position of the tree in the stand, relative to the general level of the stand canopy. The appropriate codes are as follows:

1 Dominant, indicating a tree with a crown extending above the general level of the canopy of the stand.

2 Co-dominant, indicating a tree with a crown topping out at the general level of the canopy of the stand.

3 Intermediate, indicating a tree with a crown not reaching to the general level of the canopy of the stand, but a tree that is not suppressed in its height growth.

4 Suppressed or overtopped tree with a top that is well below the general level of the canopy, and is suppressed in its height growth.

Height

Enter a numeric, three digit code to the nearest 0.5 m (5 decimeters), indicating the total height of the tree. Tree heights are measured with a clinometer or similar height measuring device for the first few trees tallied, and then heights may be estimated to the nearest half meter, once a basis for the estimation is established in the previously measured trees. Acceptable codes for growing stock trees are 015 - 500 (dm).

Mortality Death Data

Year of Death

Enter a numeric, two digit code indicating the estimated year a tree died. A 5-year mortality guide by species is found in Appendix 20. Acceptable codes in 1999 are/were 94 through 99 = 1994 - 1999.

Cause of Death

Enter a three digit, numeric code, indicating what caused the tree to die. Refer to Holsten et al. (1980) for forest insects and disease. For all mortality trees, record one of the following, depending on perceived cause of death:

100	Insects
200	Disease
300	Fire
400	Animal
500	Weather (wind, lightning)
600	Suppression
700	Logging
800	Unknown
999	Other (e.g., flooding)

Off Acre Plot ?

Enter a one digit alpha code (Y or N) indicating if a tree is on or off the one acre portion of the Subplots. The N code is used only for Subplots 2, 3, or 4 at the outside edges. Refer to the plot diagram in Appendix 4.

Mortality Tree Beetle Data

Beetle Type

Enter an alpha, four digit code, reflecting one of the following three conditions relative to the presence of bark beetles in the mortality tree (Refer to Holsten et al. (1980) for forest insect characteristics):

None No evidence of bark beetles present (or leave blank)

SPBL Evidence of spruce bark beetles as exhibited by the presence of frass or pitching (resinosis) associated with boring holes

IPS Evidence of Ips engraver beetles on the trunk of the tree

Tree Mortality Comments

Record comments for special situations on a tree that may not be covered in the damage coding, e.g., forked trees, downed trees, etc.

ONE-ACRE TREE MORTALITY RECORD : on 35.68 m Radius Plot

Tree Mortality Data

Record the following for all mortality trees >12.7 cm dbh, having died within the past 5 years on the 35.68 m radius Mortality Plot:

Subplot Point Number

All mortality trees on the acre plot are referenced to Subplot 1, so the only valid code is 1.

Tree Number

Enter a numeric, ascending three-digit code indicating the progressive tree number for mortality trees >12.7 cm tallied on the full acre. Code ranges begin at 001. Enter NONE if no mortality trees are tallied at a point.

SUGGESTION: To expedite dead tree inventory on the one acre plot, begin at 0^0 and progress clockwise successively blazing mortality trees and numbering with a black magic marker.

Distance to Tree

Enter a numeric, three-digit code indicating the distance in decimeters from the mortality tally tree (center of the tree at the 30 cm stump height) to the center of Subplot 1. Trees with stumps beyond 35.68 m from the center of Subplot 1 are not tallied, even though dbh may lean into the plot. Acceptable codes are from 001 - 357 (dm).

Azimuth to Tree

Enter a numeric, three-digit code indicating the magnetic azimuth to the nearest degree from the center of Subplot 1 to the mortality tally tree (center of the tree at the 30 cm stump height). Acceptable codes are 001 - 360.

Species Code

Enter an alpha, two-three digit code with one of the following abbreviated codes:

ASP - aspen
BC - black cottonwood
BP - balsam poplar
BS - black spruce
PB - paper birch
WS - white spruce

Diameter Breast Height

Enter a numeric, four digit code in millimeters, indicating the diameter of the mortality tally tree at dbh. Appropriate methods for measuring diameters of forked trees and trees with abnormal dbh are found in Appendix 18. Codes are 0127 - 4000.

Dominance

Enter a one-digit numeric code indicating the relative position of the tree in the stand, relative to the general level of the stand canopy. The appropriate codes are as follows:

1 Dominant, indicating a tree with a crown extending above the general level of the canopy of the stand.

2 Co-dominant, indicating a tree with a crown topping out at the general level of the canopy of the stand.

3 Intermediate, indicating a tree with a crown not reaching to the general level of the canopy of the stand, but a tree that is not suppressed in its height growth.

4 Suppressed or overtopped tree with a top that is well below the general level of the canopy, and is suppressed in its height growth.

Mortality Death Data

Height

Enter a numeric, three-digit code to the nearest 0.5 m (5 decimeters), indicating the total height of the tree. Tree heights are measured with a clinometer or similar height measurer for the first few trees tallied, and then heights may be estimated to the nearest half meter, once a basis for the estimation is established in the previously measured trees. Acceptable codes for mortality trees are 015 - 500 (dm).

Year of Death

Enter a enter a numeric, two-digit code indicating the estimated year a tree died based on a 5-year mortality guide by species (Appendix 20). Acceptable codes in 1999 are/were 94 - 99 = 1994 -1999.

Cause of Death

Enter a numeric, three-digit, code, indicating what caused the tree to die. Refer to Holsten et al. (1980) for forest insects and disease. For all mortality trees, record one of the following, depending on perceived cause of death:

100	Insects
200	Disease
300	Fire
400	Animal
500	Weather
600	Suppression
700	Logging
800	Unknown
999	Other

Off Acre Plot ?

All mortality trees are on the Mortality Plot; therefore, this code defaults to a one digit, alpha code (N), the only acceptable code.

Tree Mortality Beetle Data

Beetle Type

Enter an alpha, four-digit code, reflecting one of the following three conditions relative to the presence of bark beetles in the mortality tree (Refer to Holsten et al. (1980) for forest insect characteristics):

None	No evidence of bark beetles present (or leave blank)
SPBL	Evidence of spruce bark beetles as exhibited by the presence of frass or pitching (resinosis) associated with boring holes
IPS	Evidence of Ips engraver beetles on the trunk of the tree

Tree Mortality Comments

Enter text comments for special situations on a tree that may not be covered in the damage coding, e.g., forked trees, downed trees, etc.

LITERATURE CITED

Bickford, C.A. 1952. The sampling design used in the forest survey of the Northeast. Journ. Forestry 50(4):290-293.

Bonham, C.D.,1989. Measurements for terrestrial vegetation. John Wiley and Sons, NY. 338 p. Borland International. 1993. Paradox.

Brown, D. 1954. Methods of surveying and measuring vegetation. Bull. 42. Commonwealth Agricultural Bureau, Bucks, England.

Busing, R., K. Rimar, K.W. Stolte, and T.J. Stohlgren. 1999. Forest health monitoring. Vegetation pilot field methods guide: vegetation diversity and structure, down woody debris and fuel loading. National Forest Service Health Monitoring Program. U.S. Department of Agriculture, Forest Service, Research Triangle Park, P.O. Box 96090, Washington, DC. 28 p.

Daugherty, P.M. and B.M. Saleeby. 1998. Elmendorf Air Force Base homestead study. 1998. NPS D336. National Park Service, Alaska Support Office, Anchorage, AK. 82 p. +Appendices.

EAFB. 1997. Draft General Plan for Elmendorf Air Force Base. Draft Unpub. Rep. Natural Resources Branch, 3 CES/CEVPW, 6326 Arctic Warrior Drive, Elmendorf AFB, AK, 99506-3204.

Elzinga, C. L., D.W. Salser and J.W. Willoughby. 1998. Measuring and monitoring plant populations. BLM Tech. Ref. 1730-1. Bureau of Land Management, National Business Center, BC-650B, P.O. Box 25047, Denver, CO. 80225-0047. 477 p.

Gaeng, P. 1993. EXCEL for science and technology. Abacus Books, Grand Rapids, Michigan, 329 p.

Holsten, E.H. R.A. Werner and T.H. Laurent. 1980. Insects and Diseases of Alaskan Forests. U.S. Dept. of Agriculture, Washington, DC, Alaska Regional Report No. 75, 187 p.

Hulten, E. 1968. Flora of Alaska and neighboring territories. Stanford University Press. Stanford, CA. 1008 p.

Husch, B., C. I. Miller and T. W. Beers. 1972. Forest mensuration. 2d ed. Ronald Press, NY. 410 p.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology. John Wiley and Sons, Inc., N.Y. 337 p.

LaBau, V. J. 1993. Regional monitoring with plot networks. Environmental Monitoring and Assessment 26:283-294.

LaBau, V. J. 1998. Results of a pilot study to evaluate spruce bark beetle-induced tree mortality on the Kenai Peninsula, 1997. Unpub. Rep. Prep.for Natural Resources Fund, University of Alaska Anchorage. Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK. 99501.

Larson, F. 1987. Field procedures for the 1987 Kenai bark beetle inventory, Kenai Peninsula, Alaska. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Anchorage Forestry Sciences Laboratory, Field Manual. 112 p.

Mahan, C., K. Sullivan, K. C. Kim, R. Yahner and M. Abrams. 1998. Ecosystem profile assessment of biodiversity: sampling protocols and procedures. USDI National Park Service Coop Agreemt. #4000-3-2012. Center for Biodiversity Research, Environmental Resources Research Institute, Pennsylvania State University, University park, PA 16802. 92 p. +Appends.

Mangold, R. 1997. Forest health monitoring field methods guide (West Coast 1997). National Forest Health Monitoring Program. U.S. Department of Agriculture, Forest Service, Research Triangle Park, P.O. Box 96090, Washington, DC.

Raup, H. M. 1969. The relation of the vascular flora to some factors of site in the Mesters Vig District, NE Greenland. Medd. Om Grønland 176(5). 80 p.

Rothe, T.C., S.H. Lanigan, P.A. Martin, and G.F. Tande. 1983a. Natural resource inventory of Elmendorf Air Force Base, Alaska: Part I. U.S. Fish and Wildlife Service, Region 7, Special Studies, Anchorage, AK. 368 p.

Rothe, T.C., S.H. Lanigan, P.A. Martin, and G.F. Tande. 1983b. Natural resource inventory of Elmendorf Air Force Base, Alaska: Part II. U.S. Fish and Wildlife Service, Region 7, Special Studies, Anchorage, AK. 43 p.

Steel, R.G.D. And J.H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Company, Inc., N.Y. 481 p.

Tande, G.F. 1983. Vegetation. Pp. 14-85. *In:* Rothe, T.C., S.H. Lanigan, P.A. Martin and G.F. Tande. 1983. Natural resource inventory of Elmendorf Air Force Base, Alaska: Part I. U.S. Fish and Wildlife Service, Region 7, Special Studies, Anchorage, AK. 368 p.

Tazik, D.J., S.D. Warren, V.E. Diersing, R.B. Shaw, R.J. Brozka, C. F. Bagley and W.J. Whitworth. 1992. U.S. Army land condition-trend analysis (LCTA) plot inventory field methods. USACERL Tech. Rep. N-92/03. Colorado State University, Ft. Collins, CO. 62 p.

USARAK ITAM/GIS. 1998. Vegetation map for Elmendorf Air Force Base, Alaska. Unpub. Draft. Center for Ecological Management of Military Lands, Colorado State University, Ft. Collins, CO.

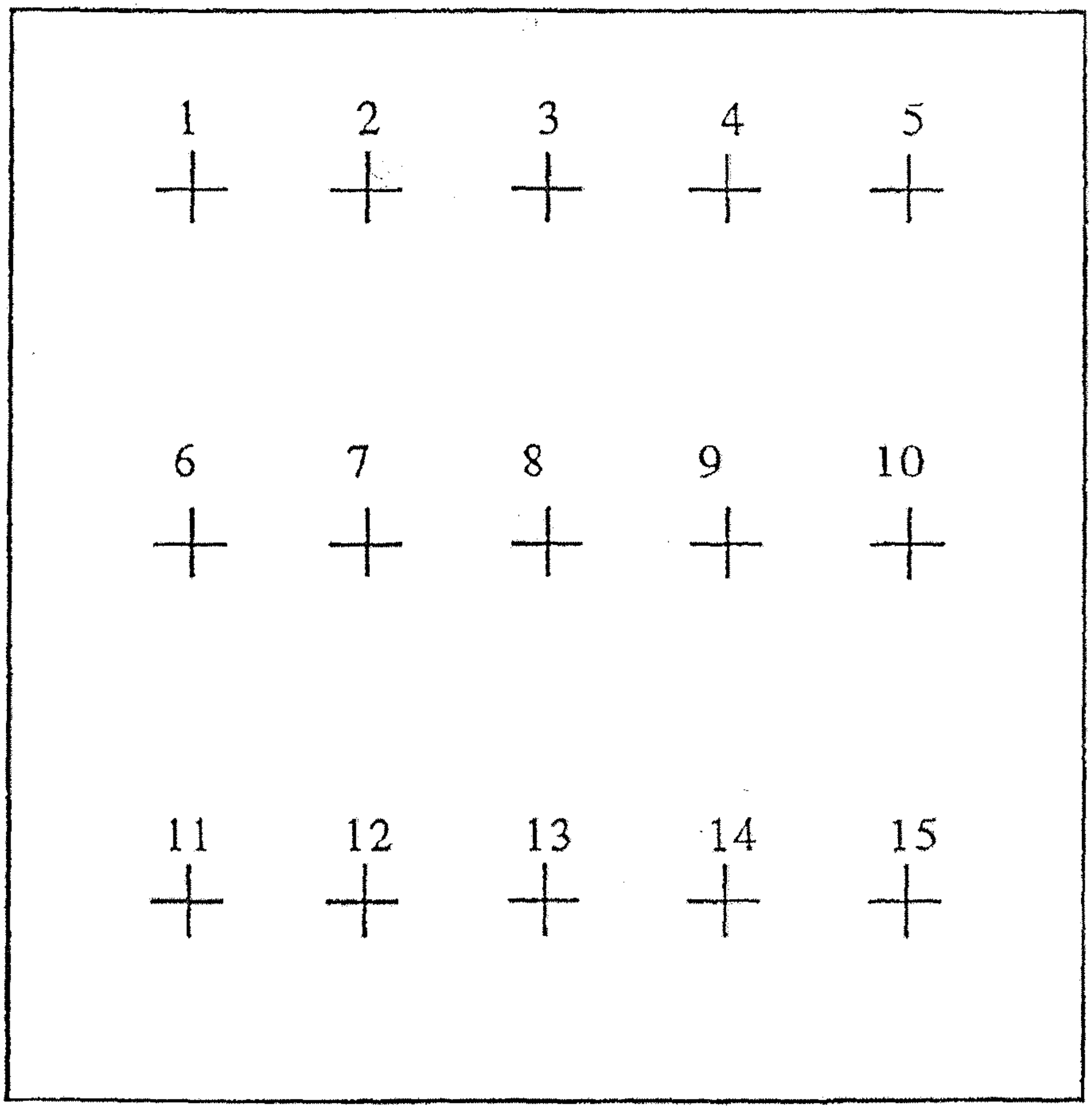
USFS FIA. 1998. Field procedures for the 1997 southeast Alaska inventory. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Anchorage Forestry Sciences Laboratory, Field Manual. 245 p.

Viereck, L.A., C.T. Dyrness, A.R. Batten and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. 278 p.

Wikgren, K.R. and J.P. Moore. 1997. Soil survey of Elmendorf Air Force Base, Alaska (an interim report). USDA Natural Resources Conservation Service, Anchorage, AK. 97 p.

APPENDICES

Appendix 1. Phase I air photo sampling frame.



Appendix 2. Phase I summary for choosing long-term monitoring sampling locations, EAFB LTVM Project, 1999.

No.	Photo. Ident.			Photo. Pt. No.	Vegetation			Map Polygon	Distance from Edge	Land Use Consideration (See Reverse)																				Disturb. (Year)	Comments
	Year	Roll	No.		1983 Type	1998 Type	Major type > 300A	> 4.91 A	> 450 ft.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		

Appendix 3. Summary of Valid Codes for Phase I.

Data Variable	Acceptable Coding
Date	June 15-September 30, 1999
Interpreter	AKNHP Staff Initials
Photo Year	1981 or 1995 -1995 = 95
Flight Line	Example: 17 (2 digits)
Photo Number	Example: 04 (2 digits)
Plot Point Number	1-15
Vegetation Type	Example: IA3b (Level IV Viereck et al. 1992)
Major or Minor Vegetation Type based on acreage determination or management consideration	(Y/N)
Distance from Vegetation Border	< or > 454 ft (137 m)
Map Polygon Size	< or > 4.94 acres (2 ha)

Border (b denotes a point falling so close to a vegetation type change that the ground plot may include two vegetation types)

Minimal Disturbance or distance from present or future activities	< or > 454 ft (137 m) (Y/N)

Consider the following as Yes or No (Y/N); note dates if appropriate (e.g., if related to vegetation history as a timber area or homestead clearing (Daugherty and Saleeby 1998) if dates known)

1.Semi-Improved/Improved Grounds (e.g., Cantonment Area)

Operational Constraints:

2. Clear Zone
3. Accident Potential Zone I (no LTVMPs)
4. Accident Potential Zone II (limited LTVMPs)
5. Explosive Safety-Quantity Distance Arc (no LTVMPs within arc)
6. Electro-Magnetic Compatibility Zone

7. Hazardous Waste Storage Sites/Accumulation Points
8. Hazardous Waste Sites
9. Cleanup Sites (Bioremediation Sites)
10. Fuel Storage Sites
11. Military Construction Plan
12. Historical Preservation Sites

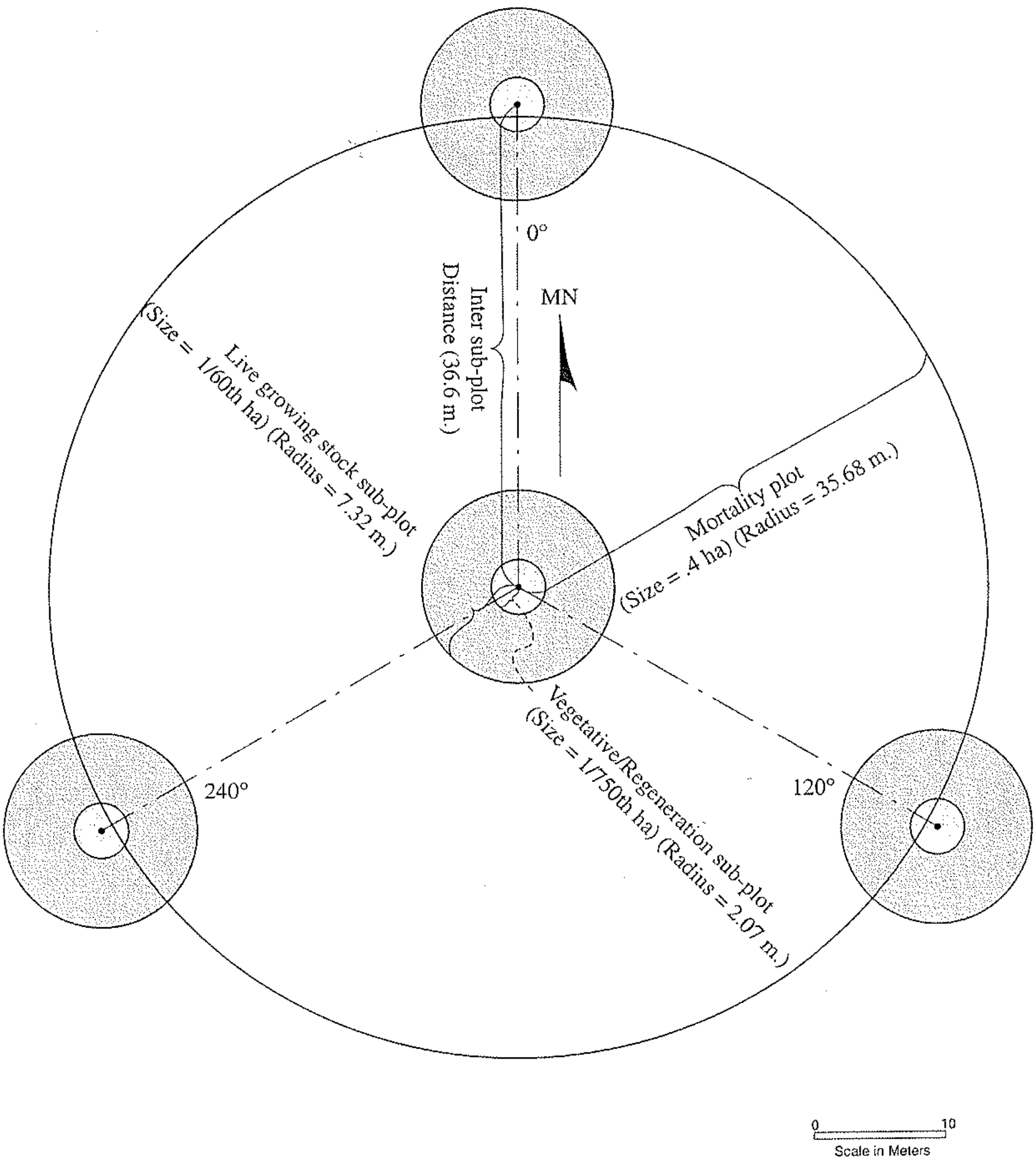
Landuse:

13. Industrial
14. Outdoor Recreation
15. Restricted Use Areas

16. Environmental Restoration Program Sites
17. Firewood Cutting Areas

18. Timber Harvest Map
19. Homestead History
20. Proposed New Alaska Railroad Right -of-Way Corridor
21. Other

Appendix 4. Configuration of Long-Term Vegetation Monitoring Plot.



Appendix 5. Details for marking Witness Trees at the Reference Point (RP) and LTVMP center (IP) (After USFS FIA 1998).

Reference Point (RP)

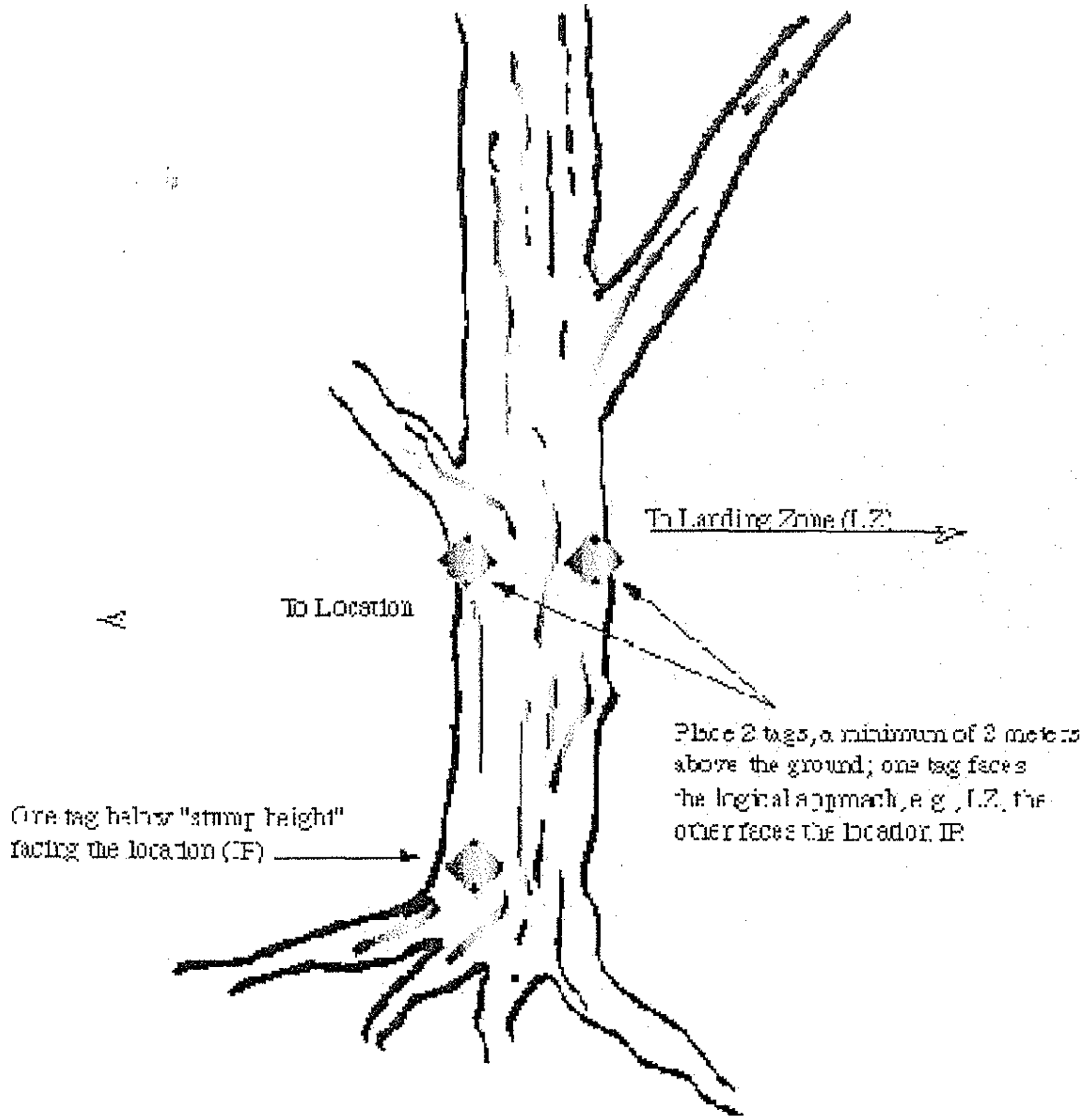
An enduring, easily identified object should be located near the plot as a **Reference Point (RP)**. The RP will help in reestablishing the plot in the event of fire, timber cutting, growth of understory or some other change which would make future visual location of the plot difficult. It should be easily recognizable both on the air photo and on the ground. A tree, rock, road, or trail intersection, etc. can be used but a durable tree is preferred. An RP **must** be established even if the plot is visually located (witness trees can be also used as reference trees in this case).

Reference Point Guidelines

1. A durable tree (or other object if a tree is not available) should be selected that is visible on the air photos and will still be present in 10 years.

2. Record the RP tree species, diameter (nearest mm), azimuth, and distance (nearest dm) from RP to IP on the Location Record data sheet, the back of an air photo or on an air photo overlay, and on three aluminum tags. If a landmark other than a tree is used as a Reference Point, it should be described on the Location Record sheet.

3. Place one reference tag on the side of the tree facing the logical means of approach. Place others on the side facing toward the plot, one at 2 m and one below stump height. Leave 2.5 cm of nail exposed.



Marking the Initial Point (IP) LTVM Plot Center

Place a steel monument at the end of the line measured from the Reference Point (RP). If this point is obviously not the IP delineated on the photo, and the correct location can be determined, place a second monument at the correct location. Measure azimuth and distance from the first monument to the second monument and record this information under "Comments" on the Location Record data sheet. Remove the first monument. The second monument becomes the IP.

If the IP (or any of the other points at the LTVMP location) falls within a tree trunk, shift the point location back along the approach line 0.5 m from the edge of the tree trunk and mark this point with a marker. Point measurements will be taken from the marker; however, distance to the next point should be measured from where the point should have fallen.

WITNESS TREES

Two witness trees (or other durable objects) must be located for the LTVMP's Initial Point (IP) center. These trees should preferably be:

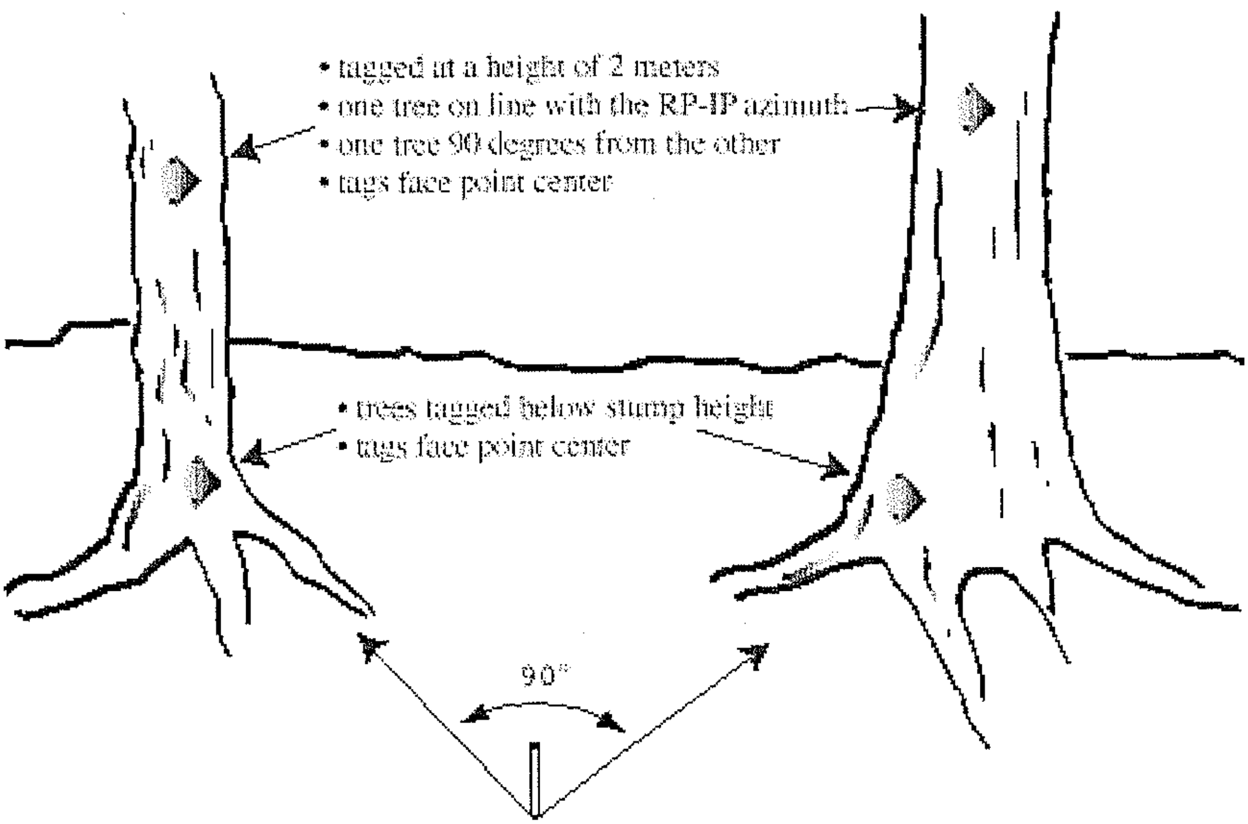
1. Unlikely to die or be cut within 10 years.
2. A species easily located in the stand.
3. At least 10 cm dbh.
4. One tree in line with RP-IP azimuth, second tree at a 90 angle.

If no trees exist that meet these specifications, pick the best witness tree, shrub, or rock available. Record the following information on the Location Record data sheet and on two aluminum tags for each witness tree:

1. Azimuth from monument to center of the tree at DBH (or an obvious point on an object).
2. Horizontal distance (nearest decimeter) from the center of the tree (or object) to a point plumb with plot monument.

On the location sheet also record species and DBH (nearest mm) for each tree.

Tag each witness tree with two metal location tags on the side of the tree facing the sample point one tag at a height of 2 m and the other below stump height. Make a sketch of the area on the location sheet if it would help in relocation. If either tree is a tally tree put a remark in the notes for the tree in the Tree Record.



Appendix 6. DATA SHEET 1: GENERAL LTVM PLOT DATE RECORD

LTVM PLOT: __________

USGS MAP: __________

CREW NAMES : __________________ __________________ __________________

DATE OF INITIAL VISIT:

START TIME: _________ STOP: _________ LUNCH: _________

DATE SUBSEQUENT VISIT:

START TIME: _________ STOP: _________ LUNCH: _________

WEATHER:

PHASE I AIR PHOTO INFORMATION:
AIR PHOTO NO: 1995
PHOTO POINT NO:
VEGETATION TYPE:

	1983	1998	
VEGETATION COVER:	well	moderate	poor

ELEVATION ((m):

PHASE II GROUND INFORMATION:
VEGETATION:

GENERAL NOTES TO ACCESS THE PLOT:

ACCESS PHOTO RECORD:

OBS.	ROLL	FRAME	FRAME	FRAME	FRAME	FRAME	FRAME	FRAME

SKETCH MAP (ACCESSING THE PLOT):

Appendix 7. DATA SHEET 2: LTVM PLOT LOCATION DOCUMENTATION

LTVM PLOT NO: ____________

REFERENCE POINT (RP): TREE SPECIES: ___________ DBH: _______

SPECIAL FEATURES/DESCRIPTION:

PHOTO RECORD:

OBS. ROLL FRAME FRAME FRAME FRAME FRAME FRAME

PHOTO NOTES:

GPS at RP: ZONE EASTING NORTHING

_________/ _________/ _________

FILE:

GPS COMMENTS:

REFERENCE POINT TO INITIAL POINT (IP) (SUBPLOT 1):

AZIMUTH MAGNETIC TO PLOT: DISTANCE TO PLOT (METERS):

PHOTO BASELINE AZIMUTH: PHOTO SCALE: 1:12,000

(a) 1:12000 base distance ____units on 40 scale

(b) Photo base distance ____units on 40 scale

Scale = (a/b) x 12000 ____________PSR

WITNESS TREES (SUBPLOT 1):

SPECIES: _________ DBH: _________ TO CENTER: AZIMUTH: _________ DISTANCE: _________dm

SPECIES: _________ DBH: _________ TO CENTER: AZIMUTH: _________ DISTANCE: _________dm

MONUMENT DESCRIPTION:

IP PHOTO RECORD:

OBS. ROLL FRAME FRAME FRAME FRAME FRAME FRAME FRAME

PHOTO NOTES:

GPS at IP: ZONE EASTING NORTHING

_________/ _________/ _________

FILE:

GPS COMMENTS:

SKETCH MAP OF REFERENCE POINT TO PLOT CENTER:

Appendix 8. DATA SHEET 3: LTVM SITE DATA RECORD, SIDE 1

		VEGETATION			SITE TREE					DISTURB. 1		DISTURB. 2		DISTURB. 3		COMMENTS
PLOT	SUBPLOT	TYPE	NOTES	FOR. STD SIZE	SPP	DBH	AGE	SLOPE	ASPECT	TYPE	YEAR	TYPE	YEAR	TYPE	YEAR	
	1															
	2															
	3															
	4															

Appendix 8. DATA SHEET 3: LTVM SITE DATA RECORD, SIDE 2

LTVM PLOT NO: OBSERVER: DATE:

PHOTO NO: SUBPLOT 1: INIT. ROLL FRAME FRAME FRAME SUBPLOT 2: INIT. ROLL FRAME FRAME FRAME

SUBPLOT 3: INIT. ROLL FRAME FRAME FRAME SUBPLOT 4: INIT. ROLL FRAME FRAME FRAME

SOILS

SOILS TYPE (Wikgren & Moore, 1997):

Subplot No.	Hz-shape	Vt-shape	Top	position	RootDpth	MossDpth	Fibric Dpth	Hemic Depth	Sapric Dpth

SOIL/SITE MOISTURE:

SUB PLOT NO.	SITE MOISTURE	SOIL MOISTURE
1		
2		
3		
4		

ANIMAL SIGN:

SUB PLOT NO.	Sign 1	Spec. 1	Sign 2	Spec. 2	Sign 3	Spec. 3	Sign 4	Spec. 4	Sign 5	Spec. 5
1										
2										
3										
4										

SOILS COMMENTS:

ANIMAL COMMENTS:

General Notes:

Appendix 9. DATASHEET 4: UNDERSTORY VEGETATION PROFILE RECORD

LTVM PLOT: SUBPLOT: VEGETATION TYPE: OBSERVER:

DATE:

PHYSIOGNOMY	% COVER
Tree (>8m)	
Tall Shrub/dwarf tree (1.5 - < 3m)	
Low Shrub (0.5 - <1.5m)	
Dwarf Shrub (<0.2m)	
Graminoids	
Forb	
Ferns/Fern Allies	
Moss	
Lichen	

PHOTO RECORD:

INIT.	ROLL	FRAME	FRAME	FRAME	FRAME

Field Notes:

		LAYERS							
		L1 Ground	L2	L3	L4	L5	L6	L7	COMP COVER
	Top of layer (000 dm)								
	%cover of layer								
Notes	Species	%Composition by species within layer							
	Water-standing								
	Water-flowing								
	Ground (soil)								
	Rock (solid)								
	Rock (broken)								
	Residue (liiter)								
	Downwood								
	Basal Vegetation								
	Stumps (<1.37m)								
	Snags								
	Layer totals (100%)								

Appendix 10. DATA SHEET 5: SEEDLING RECORD

LTVM PLOT NO: __________ OBSERVER: __________________

DATE: ______________

SMALL SEEDLING TALLY

Seedlings UNDER 30 cm tall

SUBPLOT NO.	% SEEDLING	SPECIES 1	COUNT	SPECIES 2	COUNT	SPECIES 3	COUNT
	XX %	XXXX	XX	XXXX	XX	XXXX	XX
1							
2							
3							
4							

COMMENTS:

LARGE SEEDLING TALLY

Seedlings OVER 30 cm tall and <2.54 cm diameter

Heights (in dm) and Ages

SUBPLOT NO.	% SEEDLING	SPECIES 1	COUNT	SPECIES 2	COUNT	SPECIES 3	COUNT		HEIGHT	AGE	HEIGHT	AGE	HEIGHT	AGE
	XX %	XXXX	XX	XXXX	XX	XXXX	XX		XXX (dm)	XXX (yrs)	XXX (dm)	XXX (yrs)	XXX (dm)	XXX (yrs)
1														
2														
3														
4														

REGENERATION REMARKS:

Appendix 11. DATA SHEET 6: SAPLING RECORD

LTVM Plot No.:______________ Date: ______________________

Observer: ____________________

Specifics								Crowns							Damage							
SUBPLOT #	TREE #	DIST. TO TREE	AZIM TO TREE	SPECIES	DBH (025-126 mm)	DOMINANCE	HEIGHT	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	DIEBACK	TRANSP	LOCATION	DAMAGE	SEVERITY	LOCATION	DAMAGE	SEVERITY	BEETLE TYPE	COMMENTS
x	xx	xxx	xxx	xxx	xxx	x	xxx	xx	xx	xx	x	xx	xx	xx	x	xx	xx	x	xx	xx	xxxx	
1																						
1																						
1																						
1																						
2																						
2																						
2																						
2																						
3																						
3																						
3																						
3																						
4																						
4																						
4																						
4																						

Appendix 12. DATA SHEET 7: LIVE TREE (>5 inch DBH) RECORD

LTVM Plot No.:______________ SubPlot No.__________________

Observer: ___________________ Date: ______________________

Specifics							Crowns							Damage								
TREE #	DIST. TO TREE	AZIM TO TREE	SPECIES	DBH >0127mm	DOMINANGE	HEIGHT	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	DIEBACK	TRANSP	LOCATION	DAMAGE	SEVERITY	LOCATION	DAMAGE	SEVERITY	BEETLE TYPE	COMMENTS
xx	xxx	xxx	xxx	xxx	x	xxx	xx	xx	xx	x	xx	xx	xx	x	xx	xx	x	xx	xx	xxxx	

Appendix 13. DATA SHEET 8: TREE MORTALITY RECORD

LTVM Plot No.:______________ DATE: ______________
Observer: ___________________

Specifics								Crowns			Death				
SUBPLOT #	TREE #	DIST. TO TREE	AZIM TO TREE	SPECIES	DBH	DOMINANCE	HEIGHT	DEAD RATIO	CROWN DIAM	CROWN FORM	YEAR	CAUSE	OFF ACRE ?	BEETLE TYPE	COMMENTS
x	xx	xx.x	xxx	xxx	xx.x	x	xxx	xx	xx	x	xx	xxx	x	xxxx	
TALLY ON SUBPLOTS (All trees saplings & larger)															
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
TALLY ON FULL-ACRE ONLY (Dead Trees > 127mm & larger)															
1	1							-	-	-			N		
1	2							-	-	-			N		
1	3							-	-	-			N		
1	4							-	-	-			N		
1	5							-	-	-			N		
1	6							-	-	-			N		
1	7							-	-	-			N		
1	8							-	-	-			N		
1	9							-	-	-			N		
1	10							-	-	-			N		
1	11							-	-	-			N		
1	12							-	-	-			N		
1	13							-	-	-			N		
1	14							-	-	-			N		
1	15							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		

OVER FOR PAGE 2

LTVM Plot No.:_______________

Specifics								Crowns			Death				
SUBPLOT #	TREE #	DIST. TO TREE	AZIM TO TREE	TREE SPECIES	DBH	DOMINANCE	HEIGHT	DEAD RATIO	CROWN DIAM	CROWN FORM	YEAR	CAUSE	OFF ACRE ?	BEETLE TYPE	COMMENTS
x	xx	xxx	xxx	xxx	xx.x	x	xxx	xx	xx	x	xx	xxx	x	xxxx	
TALLY ON FULL-ACRE ONLY (Dead Trees > 5" & larger)															
1	21							-	-	-			N		
1	22							-	-	-			N		
1	23							-	-	-			N		
1	24							-	-	-			N		
1	25							-	-	-			N		
1	26							-	-	-			N		
1	27							-	-	-			N		
1	28							-	-	-			N		
1	29							-	-	-			N		
1	30							-	-	-			N		
1	31							-	-	-			N		
1	32							-	-	-			N		
1	33							-	-	-			N		
1	34							-	-	-			N		
1	35							-	-	-			N		
1	36							-	-	-			N		
1	37							-	-	-			N		
1	38							-	-	-			N		
1	39							-	-	-			N		
1	40							-	-	-			N		
1	41							-	-	-			N		
1	42							-	-	-			N		
1	43							-	-	-			N		
1	44							-	-	-			N		
1	45							-	-	-			N		
1	46							-	-	-			N		
1	47							-	-	-			N		
1	48							-	-	-			N		
1	49							-	-	-			N		
1	50							-	-	-			N		
1	51							-	-	-			N		
1	52							-	-	-			N		
1	53							-	-	-			N		
1	54							-	-	-			N		
1	55							-	-	-			N		
1	56							-	-	-			N		
1	57							-	-	-			N		
1	58							-	-	-			N		
1	59							-	-	-			N		
1	60							-	-	-			N		

Appendix 14. Field photographs (adapted from Tazik et al. 1992, USFS 1998).

Photographs provide a visual record to supplement the LTVMP data in assessing change or documenting location. The latter may be necessary to aid in future relocation if significant changes have occurred in the surrounding landscape. Archival reference photographs may be developed as 3.5 x 5 in color prints from 35 mm slide film shot in the field.

Photos are taken to document: accessing the Reference Point (RP); the RP itself; the approach to the LTVMP; and the four subplots. Other photographs are taken as necessary to serve as an aid in relocation of the LTVMP in the future and to document the state of the vegetation at the time of the survey or revisit.

Stereo photos may be acquired on the LTVM Subplots where horizontal-vertical vegetation profile data is collected. General type photographs are taken to include a view that is typical of the vegetation type.

A 9 x 12 in. folder is used to organize all field information pertinent to an LTVMP and utilized in the field investigation. This **"Location Folder"** is used to write a large, legible plot and subplot number to be photographed at each subplot to chronologically keep track of field photos as they are acquired.

Initial Point (IP) Photo with Plot Folder

Two photos are taken, preferably looking across the LTVMP at the IP, with the Location Folder (and location ID) clearly visible in the viewfinder. Frame numbers for these photos are recorded.

Note: If the plot is not completed in one day and the camera is used in the interim, the site should be re-photographed with the Location Folder when returning to the plot. Additional frames will be noted in the Comments section.

General Type Photos

At least one photo pair (left then right) of the general area is taken. The photos should typify the vegetation of the LTVMP or subplot. The photo frame numbers and appropriate notes are recorded.

Stereo Photos

Stereo photos may be easily acquired using the following procedures: Take the first photo of the subject making sure to note which part of the subject falls in the center of the frame. Move the camera horizontally to the right (do not move it up or down) approximately 2 dm and take the second photo with the same part of the subject centered in the viewfinder. Depending on how far one is from the subject, small deviations from the above methods will not detract from a stereo effect. A simple aid in taking these photos in forested areas is to select a tree about a decimeter in diameter and take the left and right stereo photos on opposite sides of the tree.

Microplot Stereo Photos

At each vegetation profile Microplot, a stereo pair is taken of the profile panel as viewed from left to right across the width of the plot. Oblique shots of the understory vegetation plots can be useful to determine or monitor cover changes.

In extreme cases, where terrain or a dense understory potentially leads to a poor photo, the oblique pair may be taken in any of the cardinal directions across the plot. This should be noted in the Comments section of where the photo was taken and why. The photo frame numbers are recorded.

Miscellaneous Photos

Miscellaneous photos should be taken to help illustrate unusual situations, uncommon vegetation, etc. The frames of the photos taken are recorded and Comments are noted about the photo subject(s).

Photo Tips

Labeling

Film rolls and storage canisters are marked with a unique roll number to be carried to the Record sheets.

Coding for photos is: Crew Member Initials:__Year:__/Roll No.:__ - Slide No.:__ ,__(e.g., TA99-21-32).

Switching Rolls of Film within a Location:

Care should be taken to try and take all the photos for a location on one roll of film. If there are less than eight (8) exposures left on the field camera before the location is started, the film roll will be rewound and a new roll will be started before taking any pictures at the new plot.

Lighting:

Occasionally in forest conditions the lighting is low. Even though 200 ASA film will be used for forest photos, slow shutter speeds may be encountered. Great care will need to be taken to keep the camera steady. If a tree is convenient it should be used to steady the camera.

Horizontal vs. Vertical Format:

The camera can be turned on its side to capture taller subjects in a vertical format. The horizontal format should be used to take photos of wider, shorter subjects. The format that best covers the subject, or both may be used to capture unique situations.

Post-Field Processing

Care should be taken in the development process to insure that roll numbers are accurately transferred to development envelopes for the photo developers.

After developing the film, each slide and photograph is labelled and properly recorded in the Photo Record database (Appendix 21) for date, roll and frame number, plot number and view description. A rubber stamp may be prepared to assist in labeling each slide or print.

Slides are stored in transparent, archival-quality plastic pages in a separate volume with a title identifying the contents. Following the title page will be a Photo Log containing the year, roll and frame number for contents of the volume. The negatives for each roll are stored separately. The Photo Log record prepared from the field notes, contains a short description of each photo. Additional negatives, slides or photos may also be stored in the notebook, thus providing a library of supplemental photo records for the LTVMPs.

Appendix 15. Using GPS to Document the Sample Location (Modified from USFS FIA 1998).

Every LTVMP is located accurately and documented so that they can be located again in the future and also be compared to other levels of information such as aerial photo interpretation and 35 mm photography.

At each location, USGS topo maps, and color- and color-infrared aerial photos are used to aid the field crew in navigating to a Reference Point (RP) and then from the RP to the Initial Sampling Location (IP).

A GPS receiver may be used after location establishment to obtain a precise set of coordinates for the location at the RP, IP, or any other object that can be physically tied to the sample location. A distance and azimuth from the location of the GPS receiver to one of these points is recorded on the Location Record. This azimuth and distance information is to be used with GPS coordinates to calculate the coordinates of the LTVMP's IP.

It should be noted here that the GPS receivers employed in 1999 failed in all attempts to use them in forested situations. All LTVMPs were accurately located on aerial photos and topography maps using established photogrammetry and forestry mensuration techniques.

GPS Record Information

GPS coordinates are collected for each LTVMP. Ideally, coordinates are collected at the RP and the IP of the location. Items to be recorded include the GPS File Number, distance (in decimeters), and the azimuth (in degrees, magnetic) from the GPS receiver to the point.

GPS to RP: The GPS file number, distance (dm), and azimuth (magnetic) from the GPS to the RP are recorded. If the GPS readings are obtained at or within 3 m of the RP, then 000 for azimuth and 0000 for distance is recorded.

GPS to IP: The GPS file number, distance (dm), and azimuth (magnetic) from the GPS to the IP are recorded. If the GPS readings are obtained at or within 3 m of the RP, then 000 for azimuth and 0000 for distance is recorded.

GPS to (_____): The GPS file number, distance (dm), and azimuth (magnetic) from the GPS to the sample location to where a GPS reading can be collected. If the GPS readings are obtained at or within 3 m of the RP, then 000 for azimuth and 0000 for distance are recorded. Notes are added to the Comments section.

GPS Comments/Description

This field is used to diagram or comment on where the GPS coordinate file was collected on the sample location.

Using GPS to Document the Sample Location

Tips for easy GPS data collection:

1) Make sure GPS receiver is properly configured using the configuration section of the GPS manual.

2) Batteries: The GPS receiver utilizes a rechargeable battery pack. Make sure the battery pack is charged before going to the field. There is a small backup battery that will hold the data in the memory but the backup battery will not run the receiver.

Always turn off the GPS receiver when not in use to conserve the battery.

3) Collecting Data: Collect data in the open whenever possible!! Find as large an opening as possible, preferably with an unobstructed horizon to the south.

4) Make sure your body or other objects do not obstruct the GPS antenna.

5) Write down the names of the data files and any waypoints collected. There is a space on the location record for this information.

Field GPS Data Collection Protocol

GPS position data is collected preferably at or near the RP or IP for each LTVMP location. It is also acceptable to collect the data at or near other points for the location if the RP or IP does not work out. If the data is not collected within a few meters of the RP, IP or other points, then the distance and azimuth may be solely determined by ground measurements and photo interpretation of the available CIR imagery.

Appendix 16. Tree core extraction, handling and storage protocols (after USFS FIA 1998).

EQUIPMENT AND PROCEDURES:

Borers and Bits: A Haglöf increment borer is used with a borer that has a 30.5 cm, two or three-thread bit with a 4.3 mm core diameter. The field crew will note that these bits are expensive and must be maintained to maximize longevity and core quality.

Bee's wax helps reduce friction between the bit and the tree. It is applied immediately after removing the bit from the tree while the bit is still warm (hot!). At the end of each day's use, the increment borer should be cleaned and the interior sprayed with WD-40.

The most important single factor in prolonging bit life and maintaining a quality surface on the extracted core is to take care of the bit tip!! The steel of the bit is high-quality, high-carbon steel and it chips easily. When coring is completed, the bit is carefully placed in the handle by holding the handle horizontally and slowly sliding the bit in, without dropping it down into the handle because this will eventually result in a chipped cutting edge. Resharpening, even if done by the manufacturer, never results in a "like-new" edge.

Extractors: A properly used extractor can remain serviceable for a couple seasons while the "life expectancy" of one in the hands of a novice can be reduced to a matter of hours.

Extracting Tips:

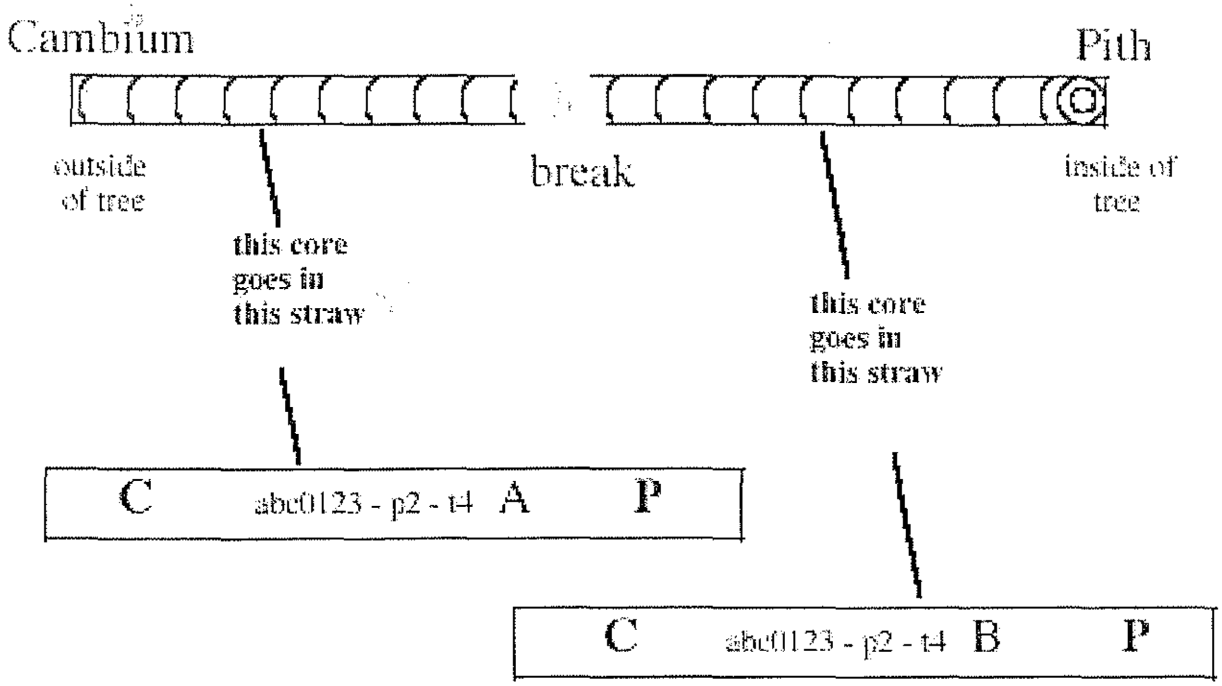
1) An extractor often will not slip in under a core on the first try. One may need to attempt to insert the extractor at several points around the circumference of the core before it will slide all the way in.

2) Care must be taken to push from the back of the extractor; it bends/breaks easily and more than one person has skewered his/her hand on an extractor! It is best to push the extractor in with your fingers from a point on the extractor close to the increment bore handle.

3) When one attempts to pull the extractor out and it will not budge, unhook the handle latch from the bit and give a short, controlled pull straight back (to avoid bending).

Core Collection and Storage: A minimum of two trees are cored for age on each LTVMP. All tree cores are saved. Paper straws and plastic core trays are used for field storage. In most cases, cores can be kept intact on a core tray or by sliding them into multiple straws and carefully connecting the straws by crimping one straw and sliding the end of the other straw over the crimped end. In some cases, cores will need to be carefully broken to fit in the straws. The orientation of the core, as "loaded" into the straw, should be recorded on the tray or straw as described below.

Plot ABC0123, Point 2, Tree 4
core example



Straw Labeling: Straws are labeled with LTVMP location number, subplot number, and tree number. If two straws must be used to hold an entire core, the straw holding the core piece closest to the cambium will be labeled A and the core piece closest to pith will be labeled B. Each straw will have its ends labeled C and P to correspond with the cores orientation with end closest to the cambium marked C and end closest to the pith marked P. It is a simple but important task to properly and clearly label cores. Without a label, a core is useless. Staedtler Lumocolor 313 pens seem to work best for labeling straws as the pen has a fine point and is indelible. The only drawback is that the surface being written on must be dry. Straws are to be stored in a plastic bag or in the clipboard.

Post-Field Storage: The main aspect of handling and storage of cores is that the cores not be too roughly handled to the point where they are broken further or separated from their labeling. It is best if cores are transferred daily from field pack to lab space.

Processing: Following the field season, cores are mounted in core trays with white glue, sanded and polished, and the rings are counted, and the ages entered to the Tree Record forms for data analysis. Cores are preserved and archived for reference and possible future use in other studies.

Appendix 17. A list of plant species encountered on LTVMPs in 1999 with their respective codes, scientific epithets and common names.

CODE	SCIENTIFIC NAME	COMMON NAME
VASCULAR SPECIES		
ACHI MILL	Achillea millefolium	Yarrow
ACTA RUBR	Actaea rubra	Baneberry
AGRO SCAB	Agrostis scabra	Hair bentgrass
ALNU CRIS	Alnus crispa	American green alder
ALNU SINU	Alnus crispa ssp. sinuata	Sitka alder
ALNU TENU	Alnus tenuifolia	Thinleaf alder
ANDR POLI	Andromeda polifolia	Bog rosemary
ANEM SPPC	Anemone species	Anemone
ANGE LUCI	Angelica lucida	Wild celery
ARCT UVAU	Arctostaphylos uva-ursi	Bearberry
ARNI AMPL	Arnica amplexicaulis	Arnica
ARTE TILE	Artemisia tilesii	Tall wormwood
ATHY FILI	Athyrium filix-femina	Lady fern
BETU PAPY	Betula papyrifera	Paper birch
BETU PASA	Betula papyrifera sapling	Paper birch sapling
BETU PASE	Betula papyrifera seedling	Paper birch seedling
BOSC ROSS	Boschniakia rossica	Broomrape
CALA CANA	Calamagrostis canadensis	Bluejoint grass
CARE CANA	Carex canescens	Silvery sedge
CARE SPE1	Carex species 1	Sedge species 1
CARE SPE2	Carex species 2	Sedge species 2
CARE UTRI	Carex utriculata	Beaked sedge
CICU MACK	Cicuta mackenzeii	Water hemlock
CORN CANA	Cornus canadensis	Dwarf dogwood
DELP GLAU	Delphinium glaucum	Larkspur
DRYO DILA	Dryopteris dilatata	Wood fern
ECHI HORR	Echnopanax horridum	Devil's club
EMPE NIGR	Empetrum nigrum	Crowberry
EPIL ANGU	Epilobium angustifolium	Fireweed
EPIL PALU	Epilobium palustre	Willow herb
EQUI ARVE	Equisetum arvense	Common horsetail
EQUI FLUV	Equisetum fluviatile	Horsetail
EQUI SILV	Equisetum sylvaticum	Horsetail
GALI BORE	Galium boreale	Northern bedstraw
GALI TRID	Galium trifidum	Small bedstraw
GALI TRIF	Galium triflorum	Sweet-scented bedstraw
GEOC LIVI	Geocaulon lividum	Pumpkin berry
GEUM MACR	Geum macrophyllum	Large-leaf avens

CODE	SCIENTIFIC NAME	COMMON NAME
GOOD REPE	Goodyera repens	Rattlesnake plantain
GYMN DRYO	Gymnocarpium dryopteris	Oak fern
HERA LANA	Heracleum lanatum	Cow parsnip
LEDU DECU	Ledum palustre ssp. decumbens	Narrow-leaf Labrador tea
LEDU GROE	Ledum groenlandicum	Labrador tea
LINN BORE	Linnaea borealis	Twin flower
LUPI NOOT	Lupinus nootkatensis	Nootka lupine
LUZU MULT	Luzula multiflora	Rush
LYCO ANNO	Lycopodium annotinum	Stiff club moss
LYCO CLAV	Lycopodium clavatum	Club moss
MENZ FERR	Menziesia ferruginea	Rusty menziesia
MOEH LATE	Moehringia lateriflora	Grove starwort
OSMO DEPA	Osmorhiza depauperata	Sweet cicely
OXYC MICR	Oxycoccus microcarpus	Bog cranberry
PARN PALU	Parnassia palustris	Grass of Parnassus
PEDI LABR	Pedicularis labradorica	Labrador lousewort
PEDI SPPC	Pedicularis species	Lousewort species
PICE GLAU	Picea glauca	White spruce
PICE GLSA	Picea glauca sapling	White spruce sapling
PICE GLSE	Picea glauca seedling	White spruce seedling
PICE MARI	Picea mariana	Black spruce
PICE MASA	Picea mariana sapling	Black spruce sapling
PICE MASE	Picea mariana seedling	Black spruce seedling
PLAN SPPC	Plantago species	Plantain
POAA PRAT	Poa pratensis	Grass
POLE ACUT	Polemonium acutiflorum	Tall Jacob's ladder
POPU BALS	Populus balsamifera	Balsam poplar
POPU TREM	Populus tremuloides	Quaking aspen
POPU TRSA	Populus tremuloides sapling	Quaking aspen sapling
POTE PALU	Potentilla palustris	Marsh five-finger
PYRO ASAR	Pyrola asarifolia	Pink pyrola/Wintergreen
PYRO SECU	Pyrola secunda	Sidebells pyrola
PYRO SPPC	Pyrola species	Wintergreen/Pyrola
RANU SPPC	Ranunculus species	Buttercup
RIBE BRAC	Ribes bracteosum	Stink currant
RIBE HUDS	Ribes hudsonianum	Northern black currant
RIBE LAXI	Ribes laxiflorum	Trailing black currant
RIBE TRIS	Ribes triste	American red currant
ROSA ACIC	Rosa acicularis	Prickly rose
RUBU CHAM	Rubus chamaemorus	Cloudberry
RUBU IDEA	Rubus idaeus	American red raspberry
RUBU PEDA	Rubus pedatus	Five-leaf bramble

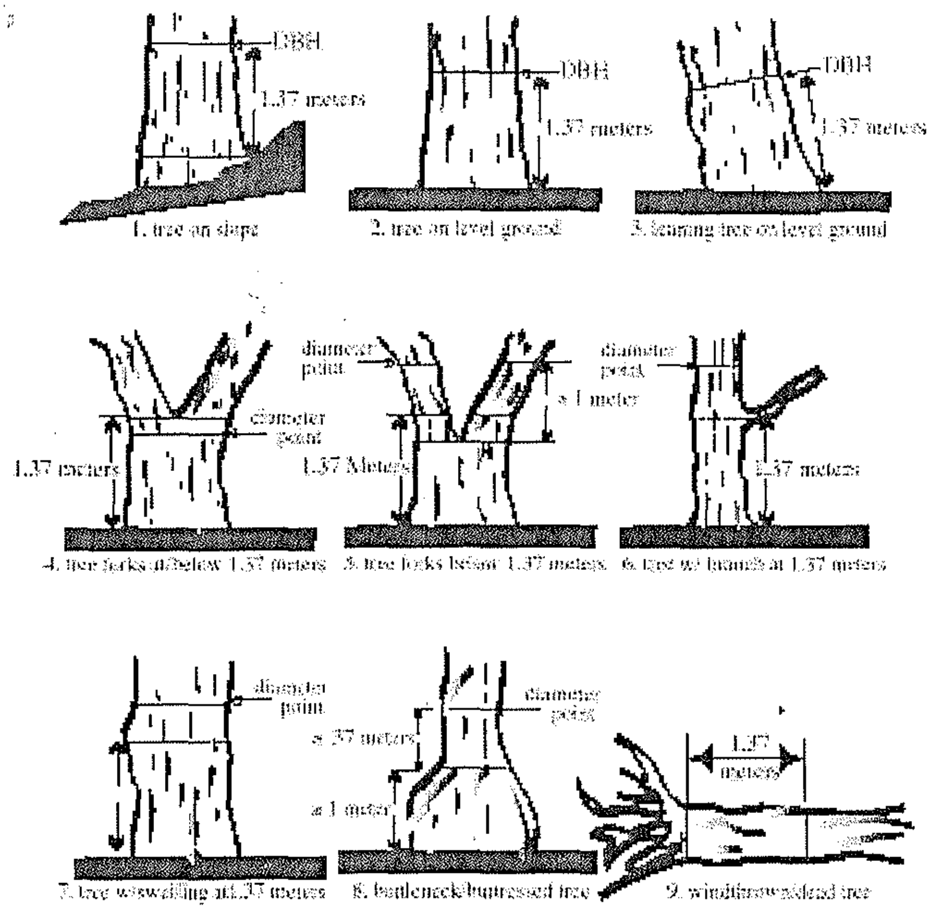
CODE	SCIENTIFIC NAME	COMMON NAME
RUBU SPPC	Rubus species	Raspberry
RUME ACET	Rumex acetosa	Sorrel
SALI BEBB	Salix bebbiana	Bebb willow
SALI SPPC	Salix species	Willow
SAMB RACE	Sambucus racemosa	Pacific red elder
SANG STIP	Sanguisorba stipulata	Sitka burnet
SHEP CANA	Shepherdia canadensis	Soapberry
SORB SCOP	Sorbus scopulina	Mountain ash
SPIR BEAU	Spiraea beauverdiana	Beauverd spirea
STEL SPPC	Stellaria species	Chickweed
STRE AMPL	Streptopus amplexifolius	Twisted stalk
TARA OFFI	Taraxacum officinale	Dandelion
THAL SPAR	Thalictrum sparsiflorum	Few-flowered meadow rue
TRIE EURO	Trientalis europaea	Star flower
TRIF SPPC	Trifolium species	Clover
UNKN GRAM	Unknown grass	Grass
URTI GRAC	Urtica dioica spp. gracilis	Stinging nettle
VACC ULIG	Vaccinium uliginosum	Bog blueberry
VACC VITI	Vaccinium vitis-idaea	Lowbush cranberry
VIBU EDUL	Viburnum edule	Highbush cranberry
MOSSES		
CERA PURP	Ceratodon purpureus	Fire moss
DICR SPPC	Dicranum species	Broom moss
DREP SPPC	Drepanocladus species	Hook moss
EURY PULC	Eurynchium pulchellum	Common beaked moss
HYLO SPLE	Hylocomium splendens	Stair/Step feathermoss
MNIU SPPC	Mnium species	Leafy moss
MOSS SPP1	Moss species 1	Moss species 1
PARM SPPC	Parmelia species	
PLEU SCHR	Pleurozium schreberi	Red-stemmed feathermoss
POLY JUNI	Polytrichum juniperinum	Juniper moss
POLY SPPC	Polytrichum species	
PTIL CRIS	Ptilium crista-castrensis	Knight's plume feathermoss
RHYT TRIQ	Rhytidiadelphus triquetrus	
SPHA GIRG	Sphagnum girgenshohnii	White-toothed peat moss
SPHA GREE	Sphagnum green	Green peat moss species
SPHA SPPC	Sphagnum species	Peat moss species
TOME NITE	Tomenthypnum nitens	Golden fuzzy fen moss
LICHENS		
CLAD RANG	Cladina rangiferina	Grey reindeer lichen
CLAD SPPC	Cladonia species	Lichen

CODE	SCIENTIFIC NAME	COMMON NAME
LOBA LINI	Lobaria linita	Lung lichen
LOBA SPPC	Lobaria species	Lung lichen species
NEOH ARCT	Nephroma arcticum	Kidney lichen
PELT APHT	Peltigera aphthosa	Studded leather lichen
PELT CANI	Peltigera canina	Dog lichen
PELT MALA	Peltigera malacea	Box board felt lichen
PELT MEMB	Peltigera membranacea	Felt lichen
PELT NEOP	Peltigera neopolydactyla	Finger felt lichen
PELT SPPC	Peltigera species	Felt lichen
UNKN YELL	Unknown yellow lichen	Unknown yellow lichen

5/23/2000

Appendix 18. Considerations in measuring tree diameter (after USFS FIA 1998).

In the simplest case, diameter at breast height (DBH) is tree diameter to the nearest millimeter at 1.37 m above ground level (breast height).



The following are examples of some of the standards for measuring diameter on nonstandard trees. Every variation cannot be covered. In difficult cases, common sense must be used and questionable DBH location documented in the Comments field of the Tree or Sapling Record form.

Irregularities at breast height: If the tree has an irregularity in the trunk at breast height, diameter must be measured immediately above the irregularity at a point where stem form is no longer affected. Record the height of the diameter measurement in the Comments field of the Tree Record.

Leaning trees: Distance and DBH are measured at a point 1.37 m above the root collar **along the trunk.**

Down trees: DBH will be measured 1.37 m from the root collar and distance at a point where the tree would have been measured if standing.

Trees with missing portions at breast height: Record "reconstructed" DBH. Make a note of this reconstruction in the Comments field of the Tree Record.

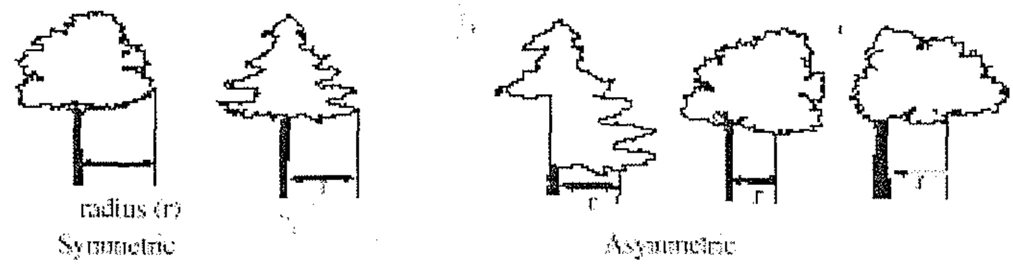
Forked trees: If the tree forks at or above 1.37 m (open crotch of the fork at or above 1.37 m), the

the tree is considered as one tree and DBH is measured below the swell as near 1.37 m as possible. If the tree forks below 1.37 m, consider it two trees. Measure the diameters as near 1 m above the fork as possible. Record the height of diameter measurement in the Comment field of the Tree Record.

Appendix 19. Codes and determinations for crown diameter, form, density and transparency following established forest health and monitoring procedures (Mangold 1997, USFS FIA 1998).

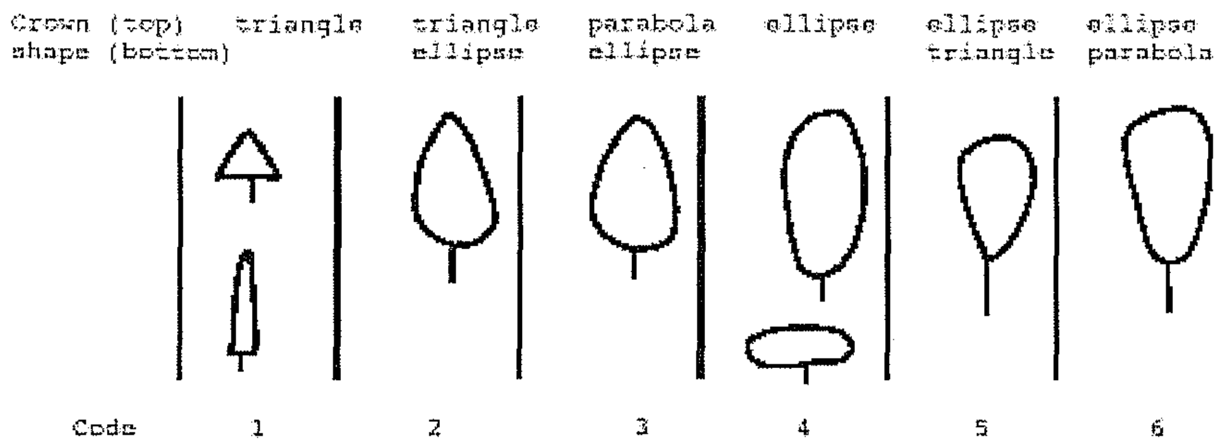
Crown Diameter

An average estimate of diameter (2r) from the center of the trunk to the widest portion of the crown and recorded to the nearest decimeter.



Crown Form

A crown form code is entered for the tree which best approximates its shape.

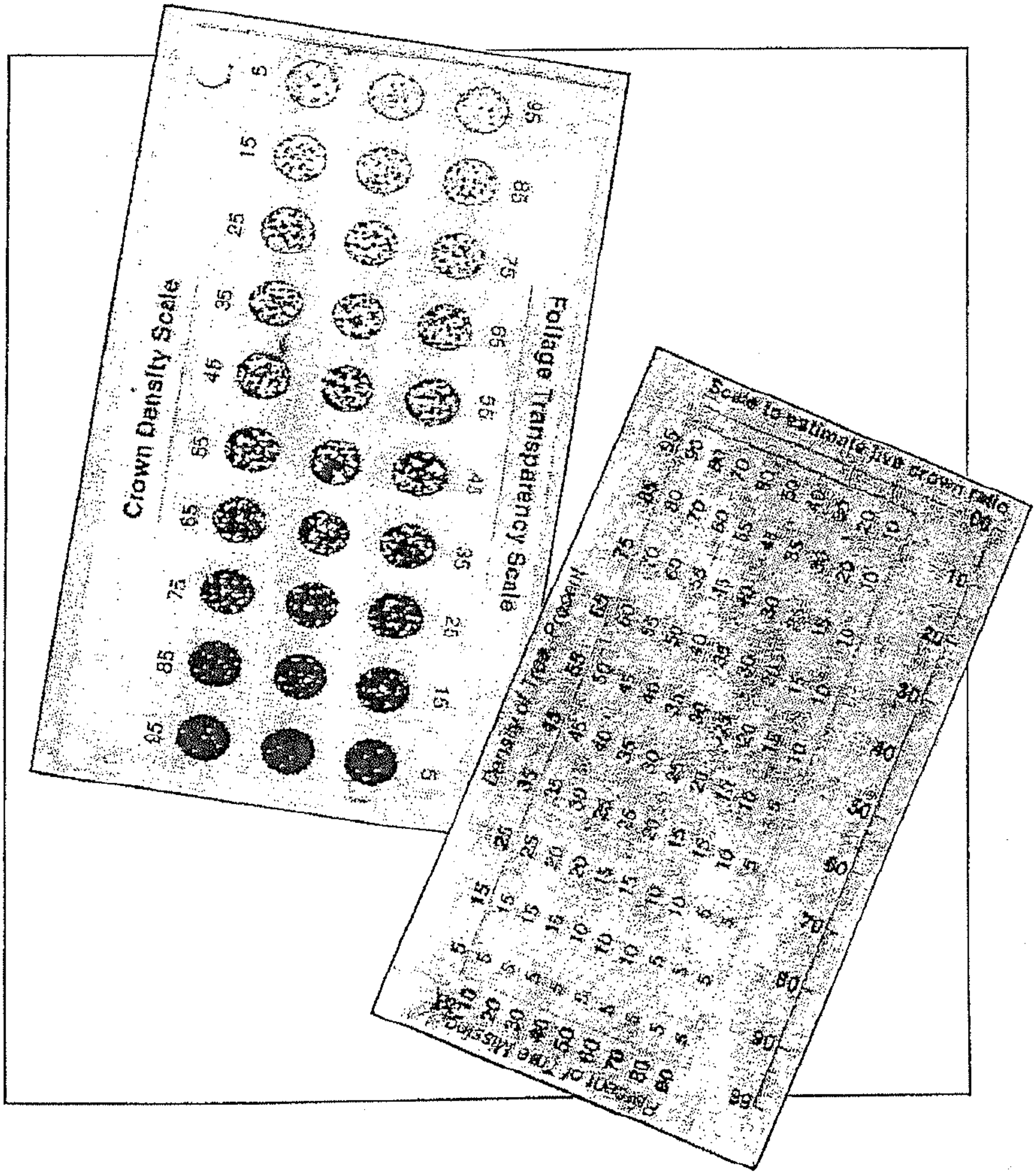


Crown Density

A code indicating the relative density of the green foliage and branches in the crown of the tree, and recorded to the nearest five percent.

Crown Transparency

Relative transparency of the green foliage in the crown of the tree is a measure of the light passing through the foliage, and can be increased by defoliating insects, hail damage, etc., thus reflecting negatively on crown and tree health.


Crown Density Scale
Foliage Transparency Scale
Scale to estimate live crown ratio

Appendix 20. Guide to estimating time since tree death (after LaBau 1998, USFS FIA 1998).

White Spruce and Black Spruce

Trees dead < five years have:

1. Some needles remaining
2. > 30% of branchlets remaining
3. Little sloughing of bark
4. > 50% of branches remain

Trees dead > five years have:

1. No needles
2. < 30% of branchlets remain
3. Considerable bark sloughing
4. < 50% of branches remain
5. Large limbs falling
6. Sporophores of *Fomes pinicola* and other fungi common

Birch

Trees dead < five years have:

1. A few persistent leaves remaining
2. > 50% of branchlets remaining
3. Bark curling abnormally
4. Occasional secondary branch falling

Trees dead > five years have:

1. No foliage
2. < 50% of secondary branches remaining
3. Bark shows abnormal curling

Other Hardwoods

Trees dead < five years have:

1. > 50% of the bark still attached in some degree to the trunk. May or may not have foliage remaining.

Trees dead > five years have:

1. No foliage remaining
2. Bark has fallen completely free of trunk, or less than 50% remains attached in any degree.

Appendix 21. Photo Record for archiving slides and prints for LTVMPs.

Photo Log

Film Type____________ Roll No.____________

ASA ____________

Field Data Sheet Exposure No.	Development Exposure No.	Plot No.	Location/Description
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			
38			
39			
40			

Appendix 22. List of field supplies and sampling instrumentation.

Silva Range Compass-2
Handheld GPS Unit
Suunto GPS Plotter

100 m Cloth Tape
30 m Cloth Tape
15 m Spencer Metric Logger Distance Tape
Spare Replacement Tape
Survey Pins

Suunto Clinometers (with back azimuth)-2
Metric Diameter Tape-2
Increment Borer (12 in)
Steel Replacement Bit for Increment Borer
Replacement Increment Borer Extractor
Plastic Increment Core Holder/Trays
Drinking Straws
Increment Core Dye-Phloroglucinol
Sharpening Stones
Borer Beeswax
Handlens (Hastings Triplex)

Tree Sounding Axe/Sheath
Tree Tags, Aluminum
Aluminum Nails, 5 cm
Lumber Crayons
Magic Markers
Sharpies
Survey Flagging Tape
Screw-Type Tree Anchors for Monuments

Soil Test Kit
Soil Color Chart
Soil Shovel
Soil Probe
Soil Sample Bags/Canisters
pH Meter

Clip Boards (tatum)
Pens/Pencils

Waterproof Date Forms
Waterproof Data Books
Base Topo Maps
Air Photos
Forestry Cruiser Vests-2
Day Packs-2
Bear Repellant
Insect Repellant
Headnets
Rain Jackets

Rain Pants

Hultén's <u>Flora of Alaska</u>
Viereck and Little's <u>Trees and Shrubs of Alaska</u>
Plant Collection Tools
Collection Bags, Plastic
Plant Collection Tupperware Containers
Plant Presses
Paper/Blotters

Pocket Stereoscope
Plastic Airphoto Field Protector
Overlay Materials
Mapping Pens/Points
Ink
Cotton Swabs/Tissues
Drafting Tape
Pen Cleaner
Staedtler Lumocolor 313 Pens
Field Pencils
Aquaseal
Duct Tape

Appendix 2. A list of plant species encountered on LTVMPs in 1999 with their respective codes, scientific epithets and common names.

CODE	SCIENTIFIC NAME	COMMON NAME
VASCULAR SPECIES		
ACHI MILL	Achillea millefolium	Yarrow
ACTA RUBR	Actaea rubra	Baneberry
AGRO SCAB	Agrostis scabra	Hair bentgrass
ALNU CRIS	Alnus crispa	American green alder
ALNU SINU	Alnus crispa ssp. sinuata	Sitka alder
ALNU TENU	Alnus tenuifolia	Thinleaf alder
ANDR POLI	Andromeda polifolia	Bog rosemary
ANEM SPPC	Anemone species	Anemone
ANGE LUCI	Angelica lucida	Wild celery
ARCT UVAU	Arctostaphylos uva-ursi	Bearberry
ARNI AMPL	Arnica amplexicaulis	Arnica
ARTE TILE	Artemisia tilesii	Tall wormwood
ATHY FILI	Athyrium filix-femina	Lady fern
BETU PAPY	Betula papyrifera	Paper birch
BETU PASA	Betula papyrifera sapling	Paper birch sapling
BETU PASE	Betula papyrifera seedling	Paper birch seedling
BOSC ROSS	Boschniakia rossica	Broomrape
CALA CANA	Calamagrostis canadensis	Bluejoint grass
CARE CANA	Carex canescens	Silvery sedge
CARE SPE1	Carex species 1	Sedge species 1
CARE SPE2	Carex species 2	Sedge species 2
CARE UTRI	Carex utriculata	Beaked sedge
CICU MACK	Cicuta mackenzeii	Water hemlock
CORN CANA	Cornus canadensis	Dwarf dogwood
DELP GLAU	Delphinium glaucum	Larkspur
DRYO DILA	Dryopteris dilatata	Wood fern
ECHI HORR	Echinopanax horridum	Devil's club
EMPE NIGR	Empetrum nigrum	Crowberry
EPIL ANGU	Epilobium angustifolium	Fireweed
EPIL PALU	Epilobium palustre	Willow herb
EQUI ARVE	Equisetum arvense	Common horsetail
EQUI FLUV	Equisetum fluviatile	Horsetail
EQUI SILV	Equisetum sylvaticum	Horsetail
GALI BORE	Galium boreale	Northern bedstraw
GALI TRID	Galium trifidum	Small bedstraw
GALI TRIF	Galium triflorum	Sweet-scented bedstraw
GEOC LIVI	Geocaulon lividum	Pumpkin berry
GEUM MACR	Geum macrophyllum	Large-leaf avens

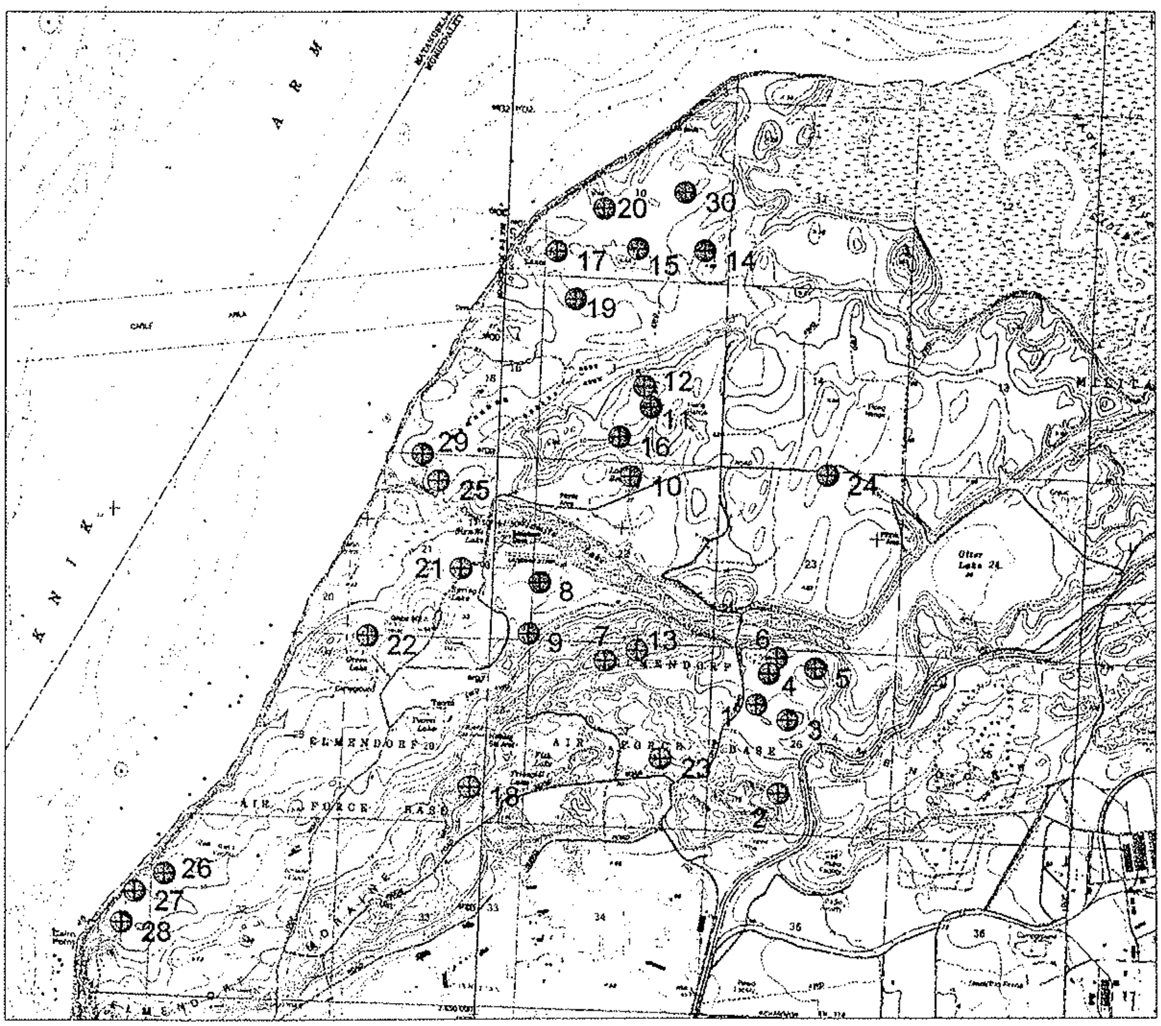
CODE	SCIENTIFIC NAME	COMMON NAME
GOOD REPE	Goodyera repens	Rattlesnake plantain
GYMN DRYO	Gymnocarpium dryopteris	Oak fern
HERA LANA	Heracleum lanatum	Cow parsnip
LEDU DECU	Ledum palustre ssp. decumbens	Narrow-leaf Labrador tea
LEDU GROE	Ledum groenlandicum	Labrador tea
LINN BORE	Linnaea borealis	Twin flower
LUPI NOOT	Lupinus nootkatensis	Nootka lupine
LUZU MULT	Luzula multiflora	Rush
LYCO ANNO	Lycopodium annotinum	Stiff club moss
LYCO CLAV	Lycopodium clavatum	Club moss
MENZ FERR	Menziesia ferruginea	Rusty menziesia
MOEH LATE	Moehringia lateriflora	Grove starwort
OSMO DEPA	Osmorhiza depauperata	Sweet cicely
OXYC MICR	Oxycoccus microcarpus	Bog cranberry
PARN PALU	Parnassia palustris	Grass of Parnassus
PEDI LABR	Pedicularis labradorica	Labrador lousewort
PEDI SPPC	Pedicularis species	Lousewort species
PICE GLAU	Picea glauca	White spruce
PICE GLSA	Picea glauca sapling	White spruce sapling
PICE GLSE	Picea glauca seedling	White spruce seedling
PICE MARI	Picea mariana	Black spruce
PICE MASA	Picea mariana sapling	Black spruce sapling
PICE MASE	Picea mariana seedling	Black spruce seedling
PLAN SPPC	Plantago species	Plantain
POAA PRAT	Poa pratensis	Grass
POLE ACUT	Polemonium acutiflorum	Tall Jacob's ladder
POPU BALS	Populus balsamifera	Balsam poplar
POPU TREM	Populus tremuloides	Quaking aspen
POPU TRSA	Populus tremuloides sapling	Quaking aspen sapling
POTE PALU	Potentilla palustris	Marsh five-finger
PYRO ASAR	Pyrola asarifolia	Pink pyrola/Wintergreen
PYRO SECU	Pyrola secunda	Sidebells pyrola
PYRO SPPC	Pyrola species	Wintergreen/Pyrola
RANU SPPC	Ranunculus species	Buttercup
RIBE BRAC	Ribes bracteosum	Stink currant
RIBE HUDS	Ribes hudsonianum	Northern black currant
RIBE LAXI	Ribes laxiflorum	Trailing black currant
RIBE TRIS	Ribes triste	American red currant
ROSA ACIC	Rosa acicularis	Prickly rose
RUBU CHAM	Rubus chamaemorus	Cloudberry
RUBU IDEA	Rubus idaeus	American red raspberry
RUBU PEDA	Rubus pedatus	Five-leaf bramble

CODE	SCIENTIFIC NAME	COMMON NAME
RUBU SPPC	Rubus species	Raspberry
RUME ACET	Rumex acetosa	Sorrel
SALI BEBB	Salix bebbiana	Bebb willow
SALI SPPC	Salix species	Willow
SAMB RACE	Sambucus racemosa	Pacific red elder
SANG STIP	Sanguisorba stipulata	Sitka burnet
SHEP CANA	Shepherdia canadensis	Soapberry
SORB SCOP	Sorbus scopulina	Mountain ash
SPIR BEAU	Spiraea beauverdiana	Beauverd spirea
STEL SPPC	Stellaria species	Chickweed
STRE AMPL	Streptopus amplexifolius	Twisted stalk
TARA OFFI	Taraxacum officinale	Dandelion
THAL SPAR	Thalictrum sparsiflorum	Few-flowered meadow rue
TRIE EURO	Trientalis europaea	Star flower
TRIF SPPC	Trifolium species	Clover
UNKN GRAM	Unknown grass	Grass
URTI GRAC	Urtica dioica spp. gracilis	Stinging nettle
VACC ULIG	Vaccinium uliginosum	Bog blueberry
VACC VITI	Vaccinium vitis-idaea	Lowbush cranberry
VIBU EDUL	Viburnum edule	Highbush cranberry
MOSSES		
CERA PURP	Ceratodon purpureus	Fire moss
DICR SPPC	Dicranum species	Broom moss
DREP SPPC	Drepanocladus species	Hook moss
EURY PULC	Eurynchium pulchellum	Common beaked moss
HYLO SPLE	Hylocomium splendens	Stair/Step feathermoss
MNIU SPPC	Mnium species	Leafy moss
MOSS SPP1	Moss species 1	Moss species 1
PARM SPPC	Parmelia species	
PLEU SCHR	Pleurozium schreberi	Red-stemmed feathermoss
POLY JUNI	Polytrichum juniperinum	Juniper moss
POLY SPPC	Polytrichum species	
PTIL CRIS	Ptilium crista-castrensis	Knight's plume feathermoss
RHYT TRIQ	Rhytidiadelphus triquetrus	
SPHA GIRG	Sphagnum girgenshohnii	White-toothed peat moss
SPHA GREE	Sphagnum green	Green peat moss species
SPHA SPPC	Sphagnum species	Peat moss species
TOME NITE	Tomenthypnum nitens	Golden fuzzy fen moss
LICHENS		
CLAD RANG	Cladina rangiferina	Grey reindeer lichen
CLAD SPPC	Cladonia species	Lichen

CODE	SCIENTIFIC NAME	COMMON NAME
LOBA LINI	Lobaria linita	Lung lichen
LOBA SPPC	Lobaria species	Lung lichen species
NEOH ARCT	Nephroma arcticum	Kidney lichen
PELT APHT	Peltigera aphthosa	Studded leather lichen
PELT CANI	Peltigera canina	Dog lichen
PELT MALA	Peltigera malacea	Box board felt lichen
PELT MEMB	Peltigera membranacea	Felt lichen
PELT NEOP	Peltigera neopolydactyla	Finger felt lichen
PELT SPPC	Peltigera species	Felt lichen
UNKN YELL	Unknown yellow lichen	Unknown yellow lichen

5/23/2000

Appendix 3. Location of LTVMPs established on Elmendorf Air Force Base, summer 1999.



Appendix 4. Latitude - longitudes and corresponding UTMs for LTVMPs established on EAFB in summer 1999.

PLOT #	Latitude (DMS)*	Longitude (DMS)*	UTM6 NORTHING	UTM6 EASTING
1	61 16 41	149 46 07	6796727.39	351585.77
2	61 16 16	149 45 52	6795947.29	351781.84
3	61 16 37	149 45 48	6796581.39	351869.44
4	61 16 50	149 46 00	6796998.55	351698.4
5	61 16 52	149 45 33	6797040.27	352107.23
6	61 16 55	149 45 56	6797127.88	351773.49
7	61 16 52	149 47 36	6797111.19	350271.69
8	61 17 14	149 48 17	6797807.86	349696.01
9	61 16 59	149 48 22	6797353.15	349600.05
10	61 17 44	149 47 25	6798725.63	350509.47
11	61 18 04	149 47 16	6799334.69	350676.34
12	61 18 10	149 47 19	6799526.59	350626.28
13	61 16 55	149 47 18	6797202.97	350547.02
14	61 18 51	149 46 49	6800756.84	351125.55
15	61 18 49	149 47 27	6800728.04	350567.85
16	61 17 56	149 47 33	6799080.22	350405.18
17	61 18 47	149 48 15	6800703.01	349854.52
18	61 16 15	149 48 53	6796009.87	349078.59
19	61 18 34	149 48 02	6800290.01	350025.56
20	61 19 00	149 47 47	6801086.8	350275.86
21	61 17 17	149 49 03	6797933.01	349016.01
22	61 16 57	149 49 56	6797353.15	348194.19
23	61 16 25	149 47 02	6796251.82	350747.26
24	61 17 47	149 45 30	6798738.14	352228.21
25	61 17 41	149 49 18	6798700.6	348824.12
26	61 15 47	149 51 50	6795267.31	346408.71
27	61 15 42	149 52 07	6795112.95	346150.07
28	61 15 33	149 52 14	6794841.79	346033.26
29	61 17 49	149 49 28	6798938.39	348678.11
30	61 19 06	149 47 01	6801224.47	350976.7

* DMS : Degrees, Minutes, Seconds

Appendix 5. A vegetation classification cross-walk between the 1983 Elmendorf mapping classification (Tande 1983) and the Alaska statewide vegetation classification system (Viereck et al. 1992).

Code	Vegetation Mapping Cover Type (Tande 1983) Descriptor	Viereck Code	Viereck, et al. (1992) Descriptor
1	Closed Black Spruce Needleleaf Forest	IAlk	Closed Black Spruce Needleleaf Forest
2	Closed White Spruce Needleleaf Forest	IAlj	Closed White Spruce Needleleaf Forest
3	Open Black Spruce Needleleaf Forest	IA2f	Open Black Spruce Needleleaf Forest
4	Closed Paper Birch Broadleaf Forest	IB1d	Closed Paper Birch Broadleaf Forest
5	Closed Balsam Poplar Broadleaf Forest	IB1c	Closed Balsam Popular Broadleaf Forest
6	Open Paper Birch Broadleaf Forest	IB2a	Open Paper Birch Broadleaf Forest
7	Broadleaf Woodland (Upland Forest Regeneration)	IB3_*	Broadleaf Woodland Forest
8	Closed Paper Birch/White Spruce Mixed Forest (Old-Growth with Alder)	IC1a	Closed Spruce-Paper Birch Mixed Forest
9	Closed Paper Birch/White Spruce Mixed Forest (Old-Growth)	IC1a	Closed Spruce-Paper Birch Mixed Forest
10	Closed Paper Birch/White Spruce Mixed Forest (Young)	IC1a	Closed Spruce-Paper Birch Mixed Forest
11	none		
12	Closed Black Cottonwood/White Spruce Mixed Forest (Floodplain)	IC1b	Closed White Spruce-Paper Birch-Balsam Poplar Mixed Forest
13	Closed Trembling Aspen/White Spruce Mixed Forest	IC1d	Closed Quaking aAspen-Spruce Mixed Forest
14	Open Paper Birch/White Spruce Old-Growth Mixed Forest (Old-Growth with Alder)	IC2a	Open Spruce-Paper Birch Mixed Forest
15	Open Trembling Aspen/White Spruce Mixed Forest	IC2b	Open Quaking Aspen-Spruce Mixed Forest
16	Open Black Cottonwood/White Spruce Mixed Forest (Floodplain)	IC2d	Open Spruce-Balsam Poplar Mixed Forest
17	Trembling Aspen/White Spruce Mixed Woodland	IC3_*	Mixed Woodland Forest
18	Open Black Spruce Dwarf Tree Scrub	IIA2a	Open Black Spruce Dwarf Tree Scrub
19	Open Black Spruce Dwarf Tree Scrub Woodland	IIA3a	Dwarf-Tree Black Spruce Woodland
20	Closed Alder Tall Scrub	IIB1b	Closed Alder Tall Scrub
21	Open Alder Tall Scrub (Upland Forest Regeneration)	IIB2b	Open Alder Tall Scrub
22	Open Low Ericaceous/Sweetgale Scrub	IIC2d/j	Open Low Scrub
23	Wet Graminoid Herbaceous Subarctic Lowland Sedge-Moss Bog	IIIA3k	Subarctic Lowland Sedge-Moss Bog Meadow
24	Wet Forb Herbaceous Subarctic Lowland Herb Wet Meadow	IIIB3c	Subarctic Lowland Herb Bog Meadow
25	Mesic Graminoid Herbaceous Subarctic Lowland Sedge Wet Meadow (Sedge Species or Bluejoint Grass)	IIIA2a	Bluejoint Meadow
26	Mesic Graminoid Herbaceous Subarctic Lowland Sedge Wet Meadow (Sedge Species or Bluejoint Grass)	IIIA3f	Subarctic Lowland Sedge Wet Meadow
27	Floating and Submerged Freshwater Aquatic Herbaceous	IIID1_*	Freshwater Aquatic Herbaceous
28	Coastal Mudflats	_*	
	Open Water	_*	
De	Development	_*	

_* NO LEVEL IV or V identified in Viereck, et al. (1992).

Appendix 6. Representative pictures of LTVMPs established on EAFB, summer 1999. See Results Section: Site Descriptions.

Plate 1. LTVMP 1 established in a Closed Mixed Paper Birch -White Spruce Forest (Closed *Betula papyrifera-Picea glauca / Viburnum edule /Gymnocarpium dryopteris-Cornus canadensis-Pyrola asarifolia*).

Plate 2. LTVMP 2 established in a Closed Paper Birch Forest (Closed *Betula papyrifera* / *Viburnum edule*).

Plate 3. LTVMP 3 established in a Closed Mixed Paper Birch - White Spruce Forest (Closed *Betula papyrifera-Picea glauca /Viburnum edule / Gymnocarpium dryopteris-Cornus canadensis-Pyrola asarifolia*).

Plate 4. LTVMP 4 established in an Open Black Spruce Forest (Open *Picea mariana* /*Equisetum sylvaticum* /*Sphagnum* spp.-*Pleurozium schreberi*).

Plate 5. LTVMP 5 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera /Menziesia ferruginea-Echnopanax horridum-Viburnum edule-Rosa acicularis / Calamagrostis canadensis-Gymnocarpium dryopteris-Dryopteris dilatata-Cornus canadensis*).

Plate 6. LTVMP 6 established in a Closed Mixed Paper Birch -White Spruce Forest (Closed *Betula papyrifera-Picea glauca* /*Viburnum edule* / *Cornus canadensis-Equisetum sylvaticum*).

Plate 7. LTVMP 7 established in a Closed Paper Birch Forest (Closed *Betula papyrifera* / *Viburnum edule* /*Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*).

Plate 8. LTVMP 8 established in an Open Black Spruce Forest (Open *Picea mariana* / *Equisetum sylvaticum* / *Pleurozium schreberi*).

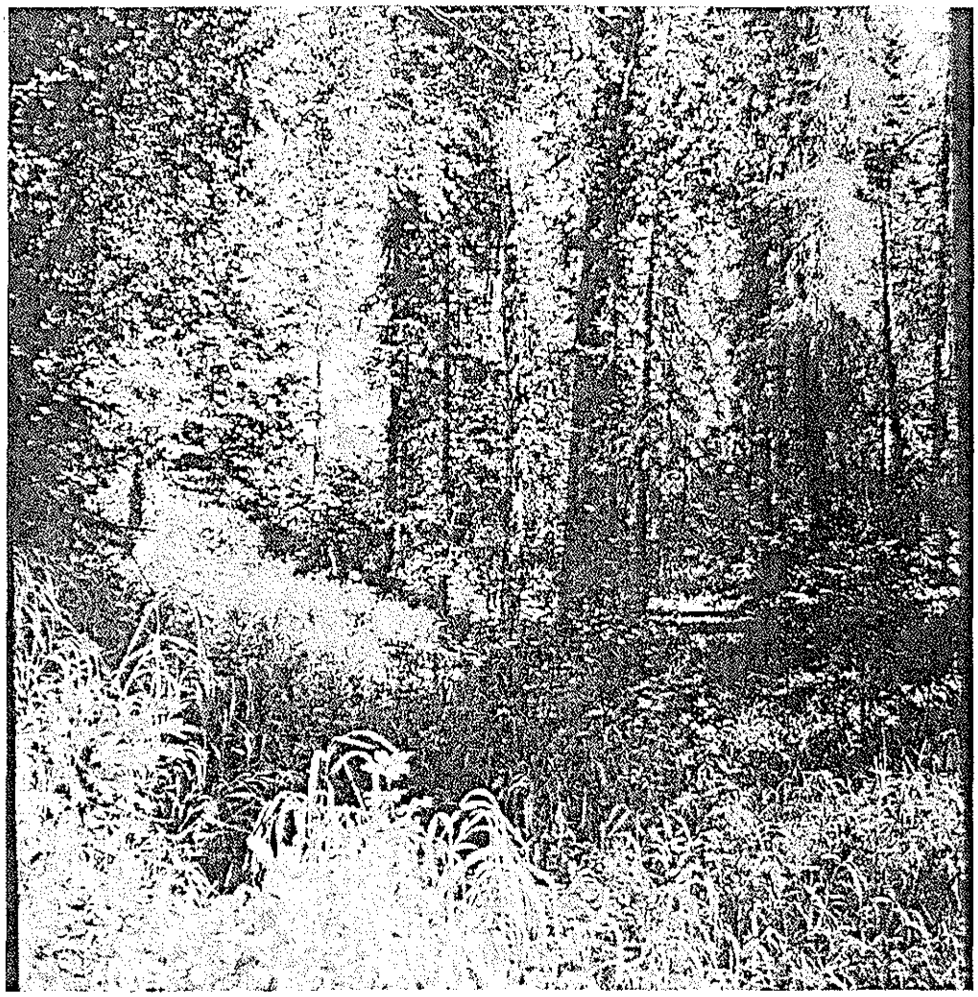


Plate 9. LTVMP 9 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca-Betula papyrifera /Viburnum edule / Calamagrostis canadensis-Cornus canadensis*).

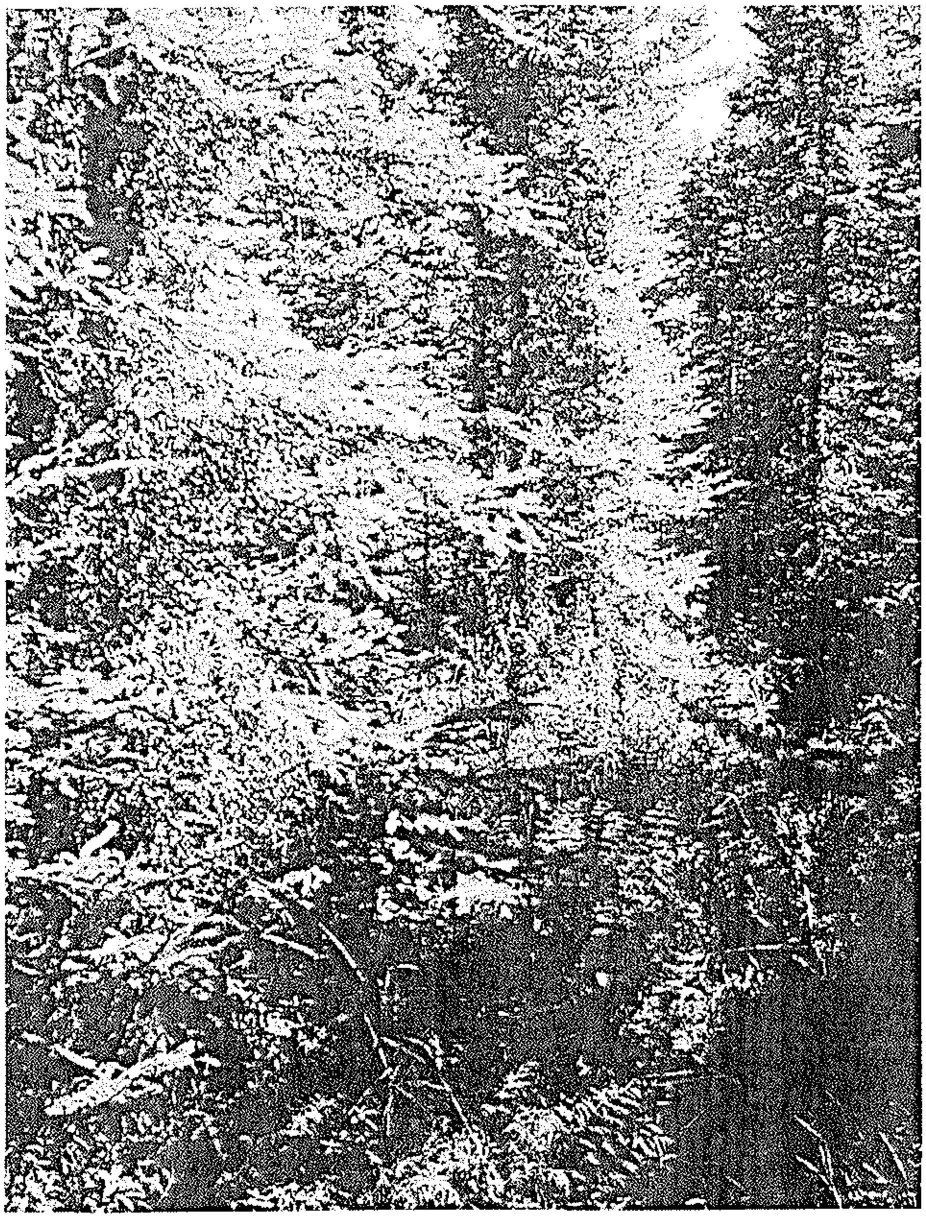


Plate 10. LTVMP 10 established in an Open Black Spruce Forest (Open *Picea mariana* / *Ledum decumbens* / *Equisetum sylvaticum*-*Vaccinium vitis-idaea*-*Empetrum nigrum* / *Sphagnum girgenshohnii*-*Pleurozium schreberi*).

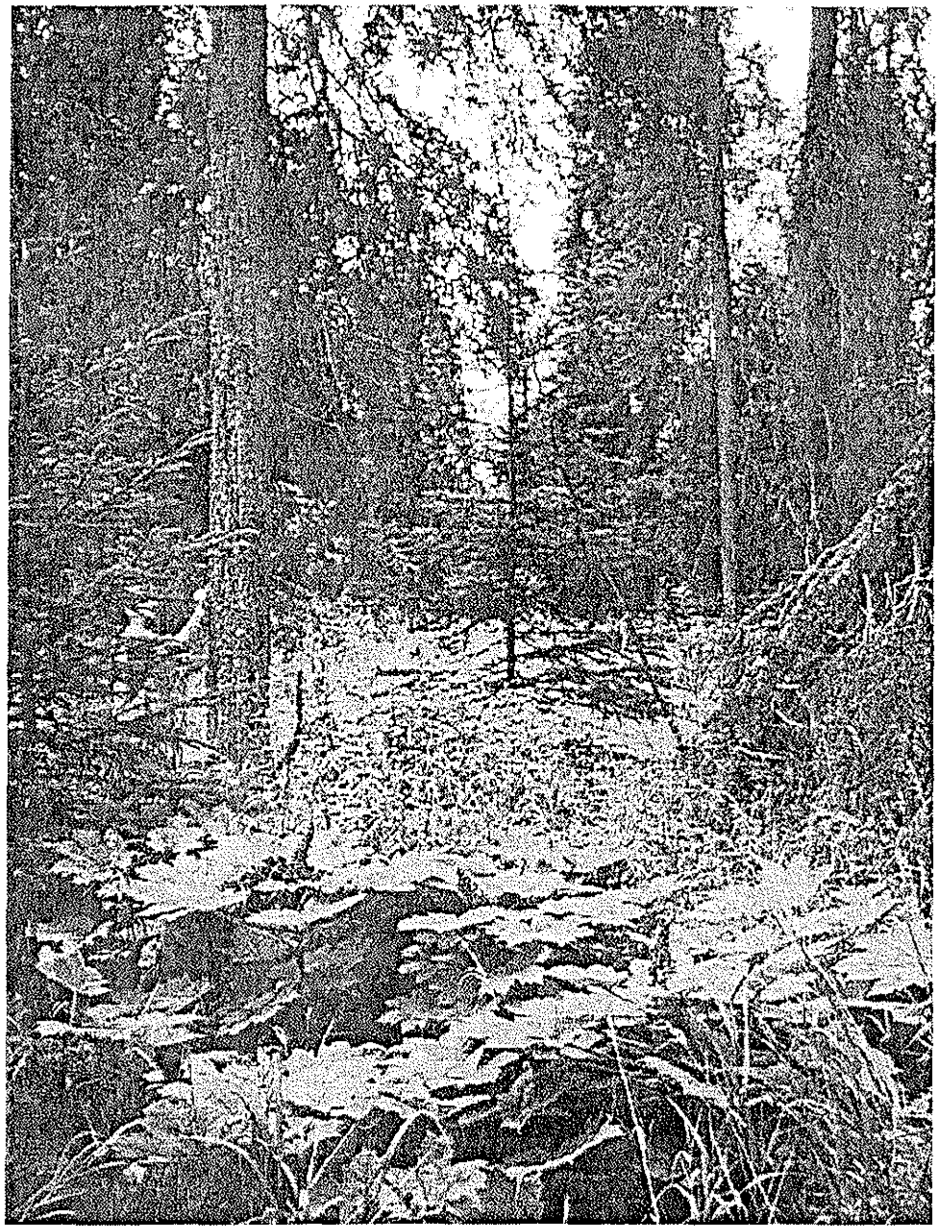


Plate 11. LTVMP 11 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca - Betula papyrifera / Alnus* spp.-*Viburnum edule -Rosa acicularis - Rubus idaeus / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*).

Plate 12. LTVMP 12 established in an Open Birch Forest (Open *Betula papyrifera / Echnopanax horridum-Sambucus racemosa-Viburnum edule / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*).

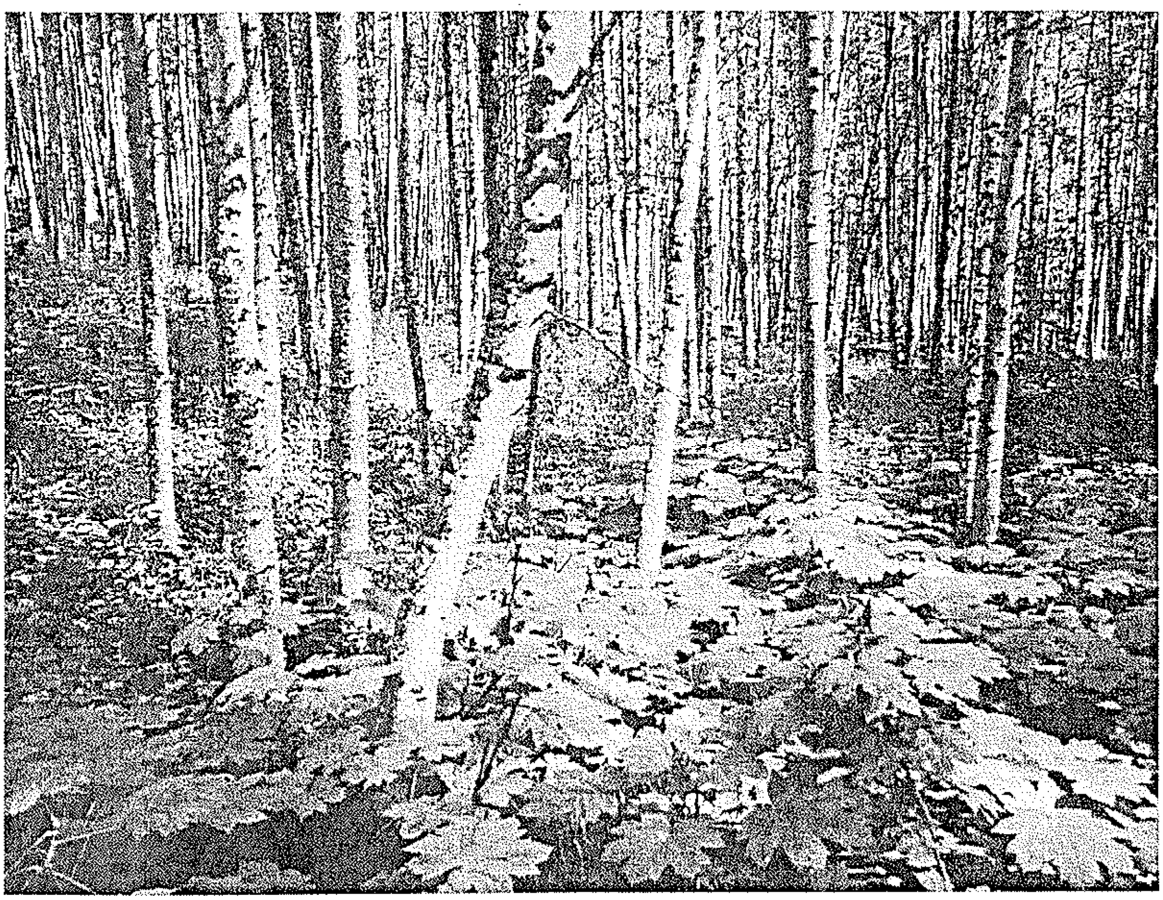


Plate 13. LTVMP 13 established in a Closed Paper Birch Forest (Closed *Betula papyrifera / Echnopanax horridum -Viburnum edule / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*).

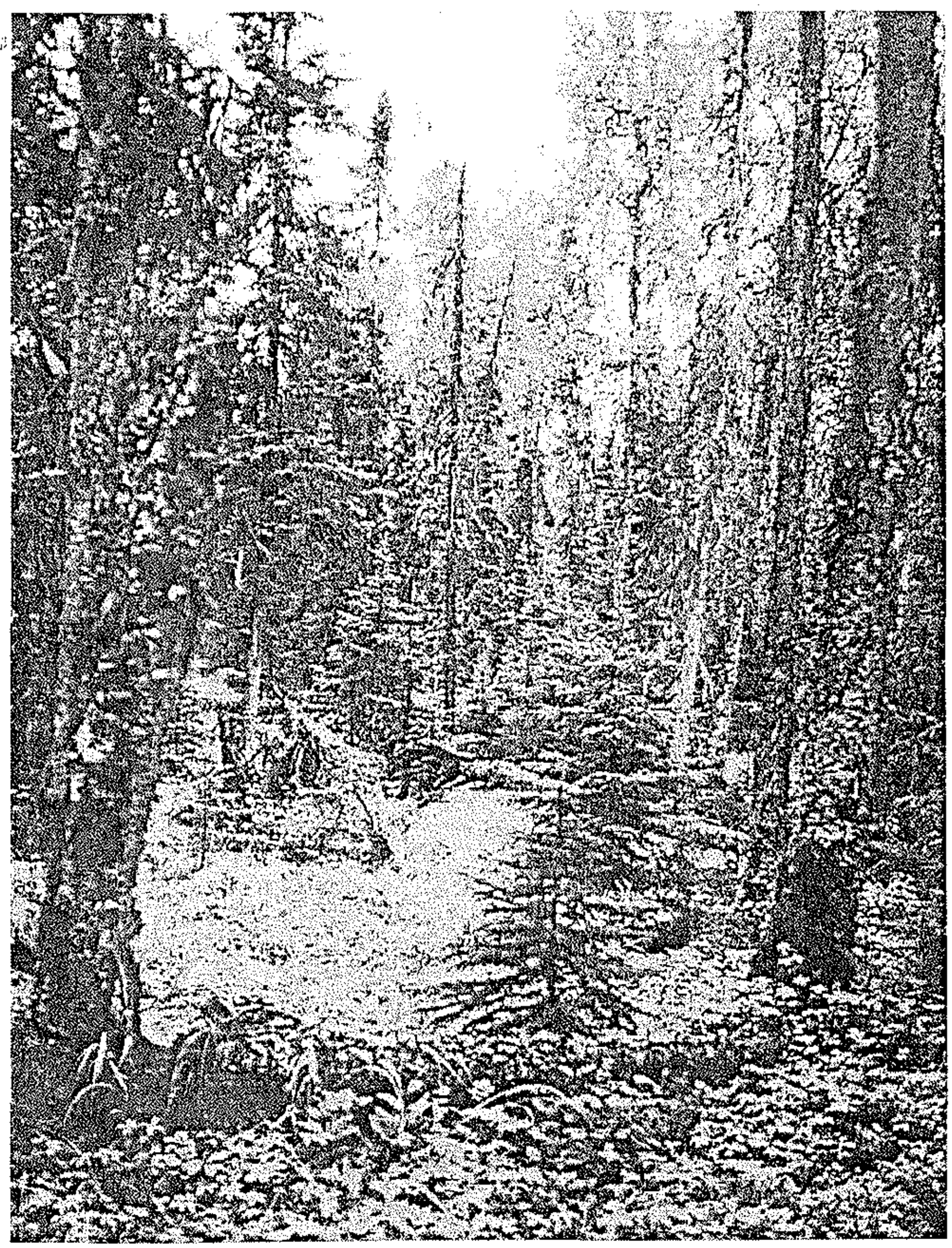


Plate 14. LTVMP 14 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca - Betula papyrifera / Viburnum edule / Calamagrostis canadensis - Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea /* Feathermoss).

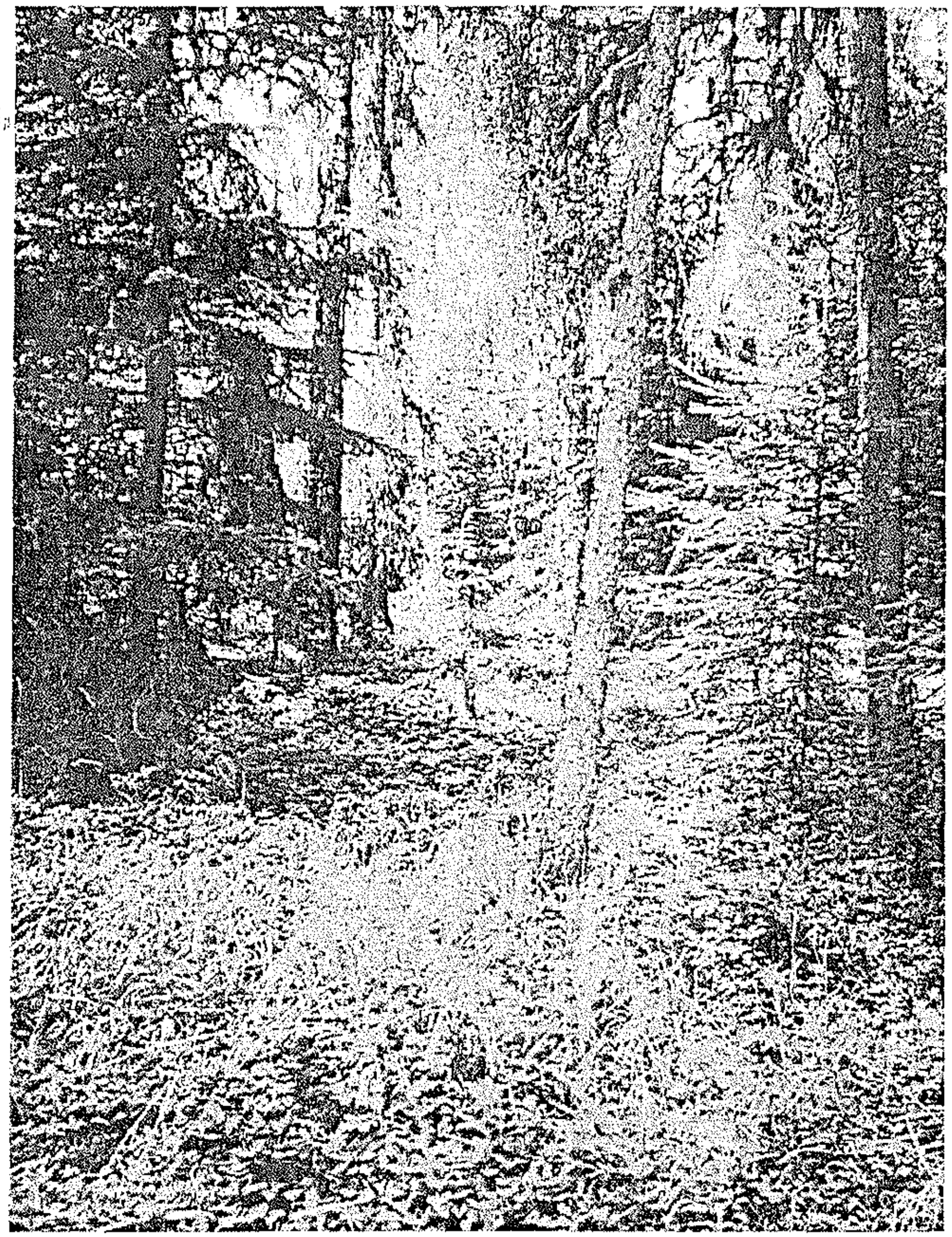


Plate 15. LTVMP 15 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Viburnum edule / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea /* Feathermoss).

Plate 16. LTVMP 16 established in a Mesic Graminoid Herbaceous Bluejoint Meadow (*Rubus idaeus* / *Calamagrostis canadensis* / *Equisetum sylvaticum*).

Plate 17. LTVMP 17 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca-Betula papyrifera / Echnopanax horridum-Viburnum edule-Rosa acicularis / Calamagrostis canadensis-Gymnocarpium dryopteris-Cornus canadensis*).

Plate 18. LTVMP 18 established in a Closed Alder Tall Scrub (Closed *Alnus sinuata* / *Echnopanax horridum-Sambucus racemosa-Rubus idaeus* / *Dryopteris dilatata-Gymnocarpium dryopteris*).

Plate 19. LTVMP 19 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Viburnum edule / Calamagrostis canadensis - Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea /* Feathermoss).

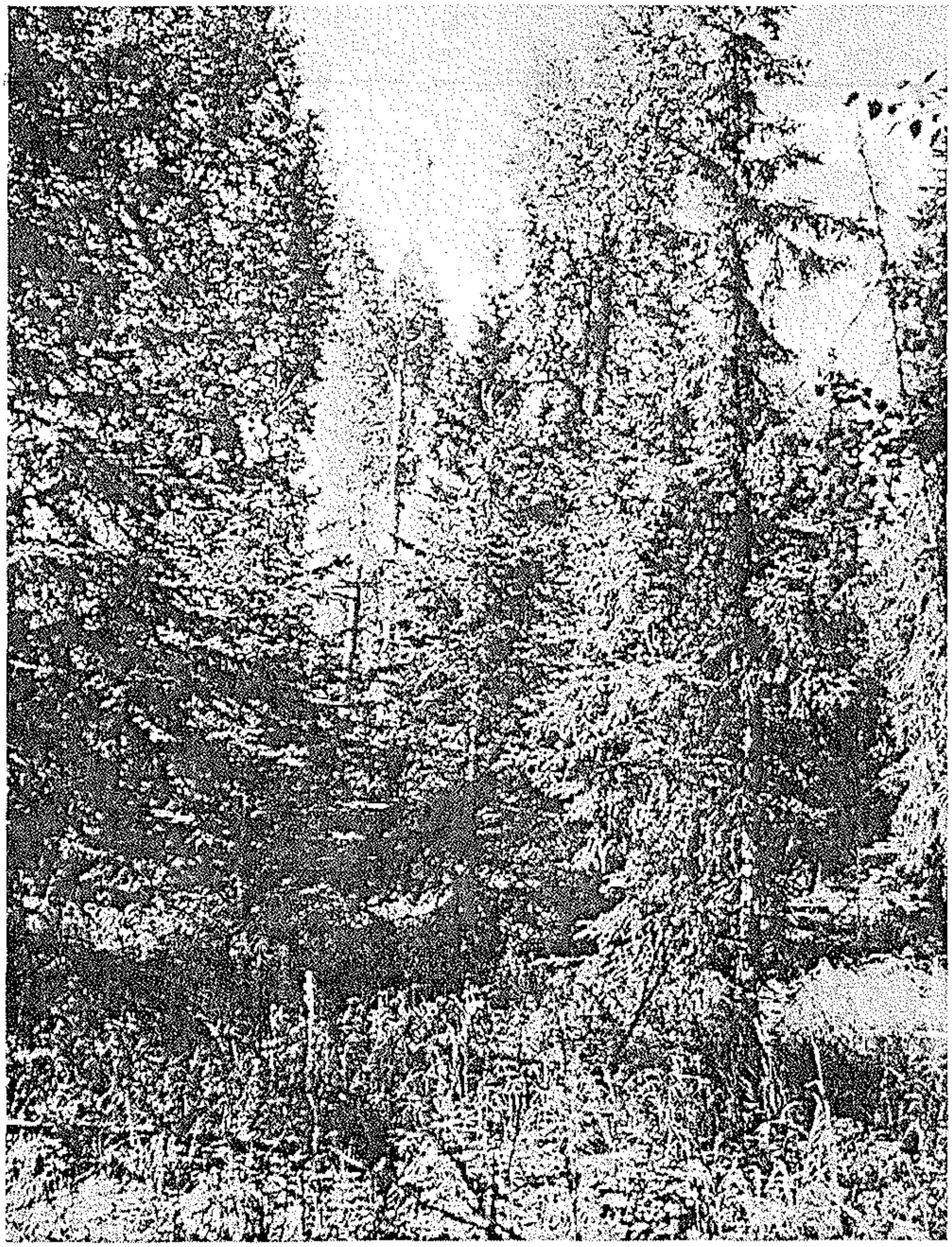


Plate 20. LTVMP 20 established in an Open Mixed Spruce-Paper Birch Forest (Open *Picea glauca -Betula papyrifera / Viburnum edule / Calamagrostis canadensis -Gymnocarpium dryopteris-Cornus canadensis -Vaccinium vitis-idaea /* Feathermoss).

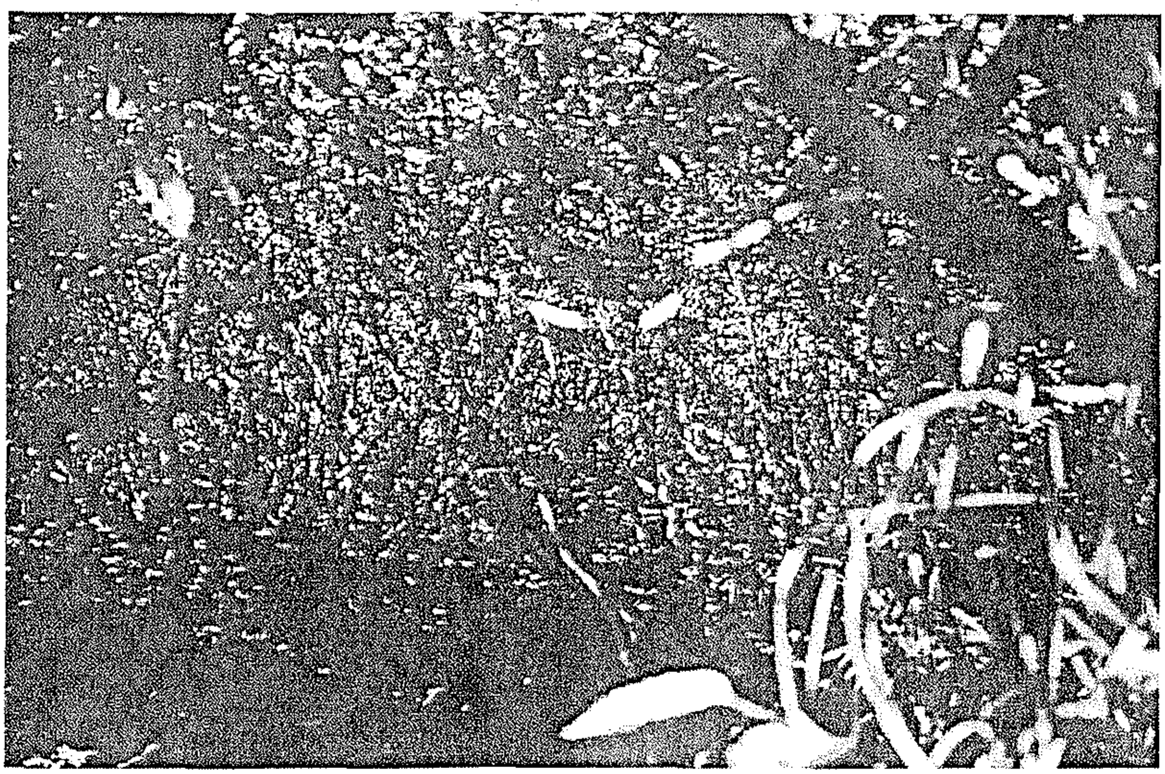


Plate 21. LTVMP 21 established in a Closed Alder Tall Scrub (Closed *Alnus sinuata* / *Rubus idaeus* / *Calamagrostis canadensis* -*Galium trifidum*).

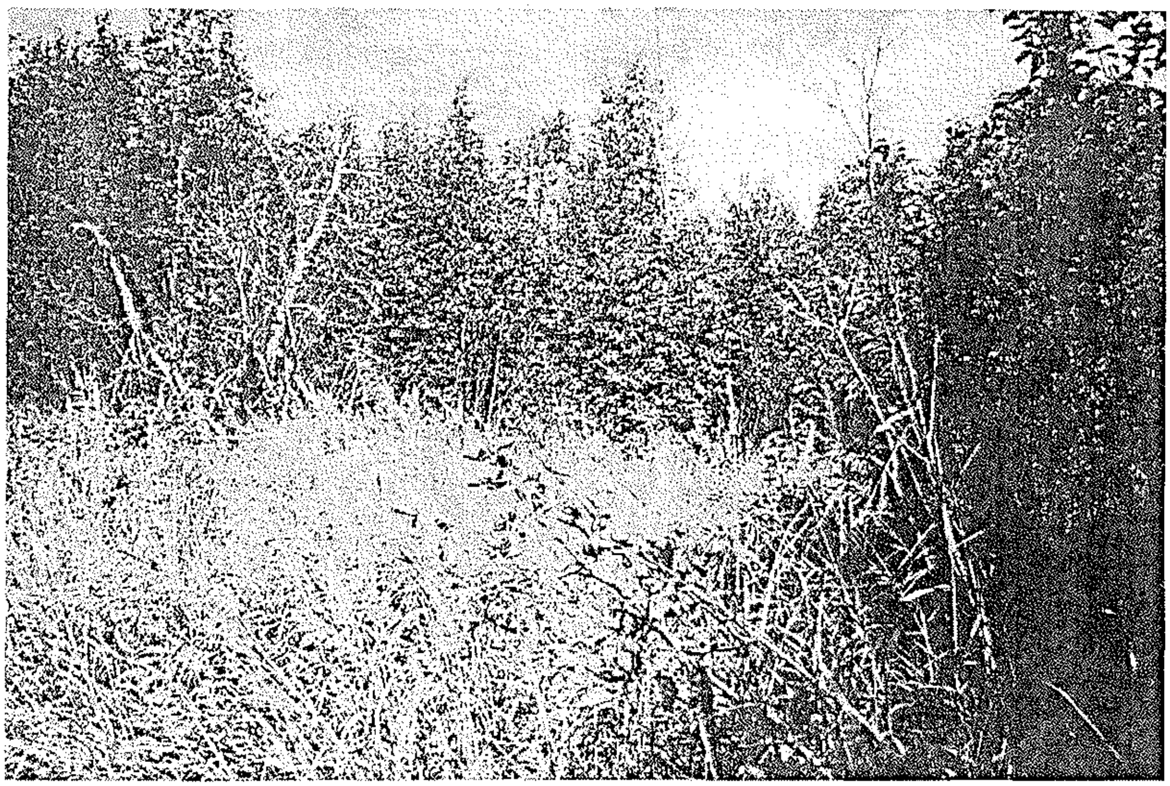


Plate 22. LTVMP 22 established in a Closed Alder Tall Scrub (Closed *Alnus tenuifolia / Rubus idaeus -Ribes triste / Calamagrostis canadensis -Dryopteris dilatata*).

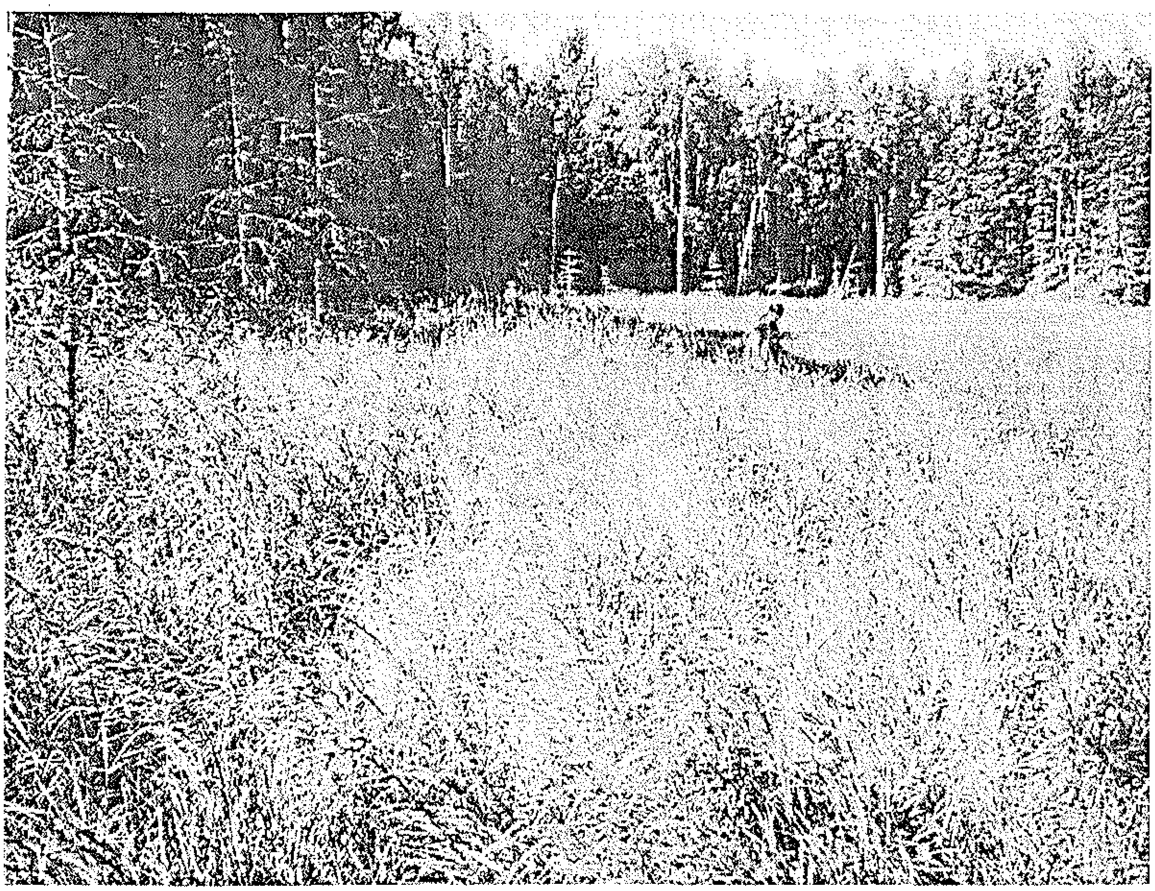


Plate 23. LTVMP 23 established in a Mesic Graminoid Herbaceous Bluejoint Meadow (*Calamagrostis canadensis-Agrostis scabra / Equisetum arvense / Sphagnum* light green spp.).

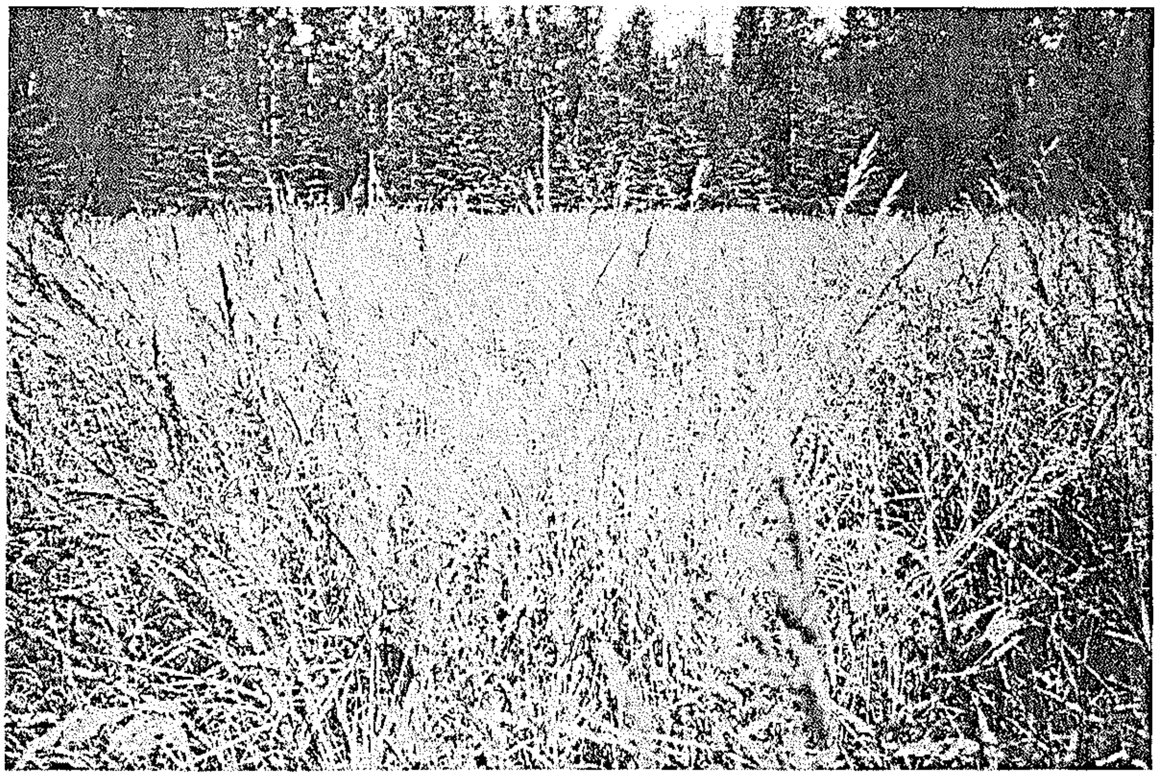


Plate 24. LTVMP 24 established in a Mesic Graminoid Herbaceous Bluejoint Meadow (*Calamagrostis canadensis*).

Appendix 7. A List of the Contents of the Hard Archives.

Note To Users

Addendum re. Geographical Naming Conventions

Original 1999 LTVM Plot Field Data Sheets

Copy of the Electronic Database:

- LTVM Plot Data
- Forestry Growth Stock Data Analysis (Forest_Anal.xls)
- Forestry Mortality Data Analysis (Mortality_Anal.xls)

CD of Scanned Photos Used in the Final Report

Photo Archives

Photo Log Record

USGS Map with LTVM Plot Locations (photocopies enclosed; full quads delivered in map tube)

ArcView GIS Map with LTVM Plot Locations and Table of Latitude-Longitudes / UTMs

Photo Overlays for 1995 Aerial Photos

Summary of LTVM Plot and Supplemental Vegetation Plots by Aerial Photo No.

List of the Vascular Plants Species of EAFB

Supplemental Vegetation Plot Data

Disturbed Alder Plot Data

Monitoring Plot Species List and Codes

Notes on Abbreviations used on LTVM Plot Data Sheets

List of Measurements and Codes Used on Data Sheets

Photo Log Data Sheet Original

LTVM Plot Data Sheet Originals

Supplemental Vegetation Plot Data Sheet Originals (Alder Plot Data Forms)

Miscellaneous Field Notes

Con't.

Miscellaneous Data Summaries and Notes:

- EAFB Alder Speciation and Identification
- Classification of monitoring plots into USARAK (1998) Map Classes
- Soil Summaries
- Monitoring plots in Relation to Forestry Compartment Numbers
- Dendrochronology and Tree Ring History Summary

Appendix 8. A List of the Contents of the Electronic Archives.

0

111 items, 56.8 MB available

Name	Date Modified
App 8. Electronic Record	Today, 9:24 AM
LTVMP FILLED IN DATASHEETS	Today, 9:17 AM
LTVM plot 1	Fri, Dec 8, 2000, 7:48 AM
LTVM plot 2	Fri, Dec 8, 2000, 8:00 AM
LTVM plot 3	Mon, Oct 2, 2000, 3:01 PM
LTVM plot 4	Mon, Oct 2, 2000, 3:04 PM
LTVM plot 5	Mon, Jun 12, 2000, 1:00 PM
LTVM plot 6	Fri, Dec 8, 2000, 8:35 AM
LTVM plot 7	Wed, May 31, 2000, 4:41 PM
LTVM plot 8	Sun, Sep 10, 2000, 12:12 PM
LTVM plot 9	Thu, Sep 21, 2000, 11:44 AM
LTVM plot 10	Mon, Oct 2, 2000, 3:04 PM
LTVM plot 11	Wed, May 31, 2000, 4:50 PM
LTVM plot 12	Mon, Jul 10, 2000, 3:07 PM
LTVM plot 13	Mon, Oct 2, 2000, 3:15 PM
LTVM plot 14	Thu, Sep 21, 2000, 11:57 AM
LTVM plot 15	Thu, Sep 21, 2000, 12:23 PM
LTVM plot 16	Wed, May 31, 2000, 3:30 PM
LTVM plot 17	Wed, May 31, 2000, 3:23 PM
LTVM plot 18	Wed, May 31, 2000, 3:20 PM
LTVM plot 19	Wed, May 31, 2000, 3:05 PM
LTVM plot 20	Thu, Sep 21, 2000, 12:28 PM
LTVM plot 21	Wed, Aug 30, 2000, 10:35 AM
LTVM plot 22	Wed, May 31, 2000, 2:15 PM
LTVM plot 23	Wed, May 31, 2000, 2:09 PM
LTVM plot 24	Wed, May 31, 2000, 2:05 PM
Plots w. monuments, no veg	Wed, May 31, 2000, 4:54 PM
VEGETATION DATA SPREADSHEETS	Today, 9:17 AM
LTVMP_veg_data.xls	Thu, Feb 17, 2000, 12:15 PM
LTVMP VDB x-Walks	Sun, Aug 6, 2000, 9:47 AM
LTVMSub_P_HERB_X_Walk.XLS	Mon, Jun 12, 2000, 2:56 PM
LTVMSub_P_SCRUB_X_Walk.XLS	Mon, Jun 12, 2000, 2:53 PM
LTVMSub_P_TREES_X-Walk.XLS	Mon, Jun 12, 2000, 2:26 PM

111 items, 56.8 MB available

Name	Date Modified
▽ Vegetation for Syntax Analysis	Mon, Dec 11, 2000, 9:26 AM
▽ Alder Plots	Mon, Feb 21, 2000, 9:14 AM
▽ Alder Files for Input	Wed, Apr 5, 2000, 2:01 PM
▽ Alder Shrubs Removed	Wed, Apr 5, 2000, 3:01 PM
ald no spp._5% tab.xls	Wed, Apr 5, 2000, 1:48 PM
alder no ald, no spp. _5%.xls	Wed, Apr 5, 2000, 2:55 PM
alder plots no spp. _5%.xls	Wed, Apr 5, 2000, 1:48 PM
alder plots w_o alder tab.xls	Wed, Apr 5, 2000, 1:29 PM
alder plots w_o alder.xls	Wed, Apr 5, 2000, 1:33 PM
alder w_o alder no spp_5%.xls	Wed, Apr 5, 2000, 3:01 PM
Eigenvalues no Ald no _5%	Wed, Apr 5, 2000, 2:57 PM
Object scores no ald no_5%	Wed, Apr 5, 2000, 2:57 PM
Resemblance matrix no Ald_5%	Wed, Apr 5, 2000, 2:57 PM
Variable scores no ald _5%	Wed, Apr 5, 2000, 2:57 PM
alder no text2 tab.xls	Wed, Feb 16, 2000, 12:29 PM
alder no text2.xls	Wed, Feb 16, 2000, 12:29 PM
alder plots 5.0.xls	Wed, Apr 5, 2000, 8:36 AM
alder plots 21600.xls	Wed, Feb 16, 2000, 12:27 PM
sinuata no tex tab.xls	Wed, Feb 16, 2000, 2:05 PM
sinuata no text.xls	Wed, Feb 16, 2000, 2:05 PM
sinuata plots 5.0.xls	Wed, Apr 5, 2000, 8:37 AM
sinuata plots 21600.xls	Wed, Feb 16, 2000, 2:07 PM
▽ Alder Output	Wed, Apr 5, 2000, 1:50 PM
▷ ALDER 2	Thu, Nov 30, 2000, 1:43 PM
▷ ALDER 3	Wed, Feb 16, 2000, 3:56 PM
▷ ALDER 4	Wed, Feb 16, 2000, 3:56 PM
alder stand range of rows	Wed, Feb 16, 2000, 3:43 PM
▷ Alder, no alder shrubs	Wed, Apr 5, 2000, 2:00 PM
▷ Alder, no spp. _5%	Wed, Apr 5, 2000, 3:11 PM
alderstd div by row total	Wed, Feb 16, 2000, 3:13 PM
Dendrogram alder stand	Wed, Feb 16, 2000, 1:47 PM
▷ SINUATA	Thu, Nov 30, 2000, 1:43 PM
▽ All Plot Data	Mon, Dec 11, 2000, 9:42 AM

111 items, 56.8 MB available

Name	Date Modified
All_Veg_Plots.xls	Thu, Feb 17, 2000, 12:15 PM
Vegetation Type Spreadsheets	Mon, Dec 11, 2000, 8:47 AM
Alder_veg_types_by_map_clas.xls	Sun, Nov 12, 2000, 9:46 AM
All_data_veg_types_map_clas.xls	Mon, Dec 11, 2000, 8:47 AM
copy_sat_veg_for_final_anal.xls	Sun, Nov 12, 2000, 11:03 AM
LTVMP_veg_types_by_VDB_clss.xls	Wed, Nov 29, 2000, 10:28 AM
Satellite_veg_types_by_VDB.xls	Wed, Nov 29, 2000, 9:42 AM
Table_SatPlots_x_walk_VDB.XLS	Mon, Nov 13, 2000, 3:00 PM
FOREST DATA SUBSET	Today, 9:17 AM
Forest Formulas.xls	Fri, Dec 15, 2000, 1:28 PM
Forest_Anal.xls	Fri, Dec 15, 2000, 1:36 PM
Mortality_Anal.xls	Fri, Dec 15, 2000, 1:37 PM
KATE'S PDFs FOR MAP AND PLOT	Today, 9:22 AM
LTVMP_Layout.pdf	Fri, Feb 16, 2001, 1:01 PM
LTVMP_Map.pdf	Fri, Feb 16, 2001, 12:59 PM
LTVMP LOCATION MAP MATERIALS	Today, 9:17 AM
App_4_lat_longs.xls	Fri, Nov 24, 2000, 1:29 PM
Maps of LTVMP Locations	Mon, Dec 11, 2000, 9:59 AM
North half LTVMPs.pdf	Mon, Dec 11, 2000, 9:59 AM
South Half LTVMPs.pdf	Sat, Aug 5, 2000, 9:59 AM
MISC. SUMMARIES	Today, 9:17 AM
App 5 83_veg_to_viereck.xls	Fri, Nov 24, 2000, 1:29 PM
SPECIES CODES AND TABLES	Today, 9:17 AM
3-letter genus-spec_analys.doc	Tue, May 23, 2000, 4:45 PM
LTVMP_Spp_List.xls	Wed, Aug 23, 2000, 8:37 AM
TEMPLATES	Today, 9:17 AM
Read Me--	Mon, Dec 11, 2000, 9:24 AM
Dendrochron_Sum.xls	Mon, Mar 20, 2000, 9:59 AM
LTVMP Dsheets as Individual Sht	Mon, Mar 6, 2000, 9:30 AM
Data sheet 1 for entering.xls	Mon, Feb 28, 2000, 1:40 PM
Data sheet 1 general data.xls	Mon, Feb 28, 2000, 1:41 PM
Data sheet 2 for entering.xls	Mon, Mar 6, 2000, 8:59 AM
Data sheet 2 plot location.xls	Fri, Mar 17, 2000, 10:30 AM

111 items, 56.8 MB available

Name	Date Modified
Data sheet 3 for entering.xls	Wed, Feb 23, 2000, 8:30 AM
Data sheet 3 site data.xls	Mon, Feb 21, 2000, 3:25 PM
Data sheet 4 for enterting.xls	Wed, Feb 23, 2000, 2:05 PM
Data sheet 4 understory.xls	Fri, Mar 17, 2000, 10:30 AM
Data sheet 5 seedling.xls	Wed, Feb 23, 2000, 9:02 AM
Data sheet 6 sapling.xls	Wed, Feb 23, 2000, 8:43 AM
Data sheet 7 live tree.xls	Wed, Feb 23, 2000, 8:42 AM
Data sheet 8 tree mortality.xls	Mon, Mar 6, 2000, 9:30 AM
LTVMP_Dsht_as_Wkbk.xls	Mon, Apr 3, 2000, 4:11 PM
LTVM_Phase_I_Form.xls	Tue, Dec 21, 1999, 3:02 PM
Photolog.xls	Thu, Feb 17, 2000, 12:15 PM
Photo_logs_spreadsheet.xls	Wed, Aug 16, 2000, 10:41 AM

Appendix 9. Summary of forest mensuration formulae and procedures used for function conversions (after LaBau 1998).

Workup of Basal Area Derivation Comparisons, English (per acre) vs. Metric (per hectare)

English DBH (in)	Per tree expander (square feet/tree)	Basal Area Value (sq. ft.)	Metric DBH (met)	Per tree expander (square meters/tree)	Basal Area Value(sq met)
12	(DBH in.)2 x .005454154=	0.78540	0.3048	(DBH met.)2 x .760858	0.070685836
36	(DBH in.)2 x .005454154=	7.06858	0.9144	(DBH met.)2 x .760858	0.636172523
39.3701	(DBH in.)2 x .005454154=	8.45396	1.00000054	(DBH met.)2 x .760858	0.760856826
40	(DBH in.)2 x .005454154=	8.72665	1.016	(DBH met.)2 x .760858	0.785398176
100	(DBH in.)2 x .005454154=	54.54154	2.54	(DBH met.)2 x .760858	4.9087386

Given diameters in mm's, (305 mm = 0.305 meters, = 12.0 inches):

Square feet per tree = (DBH in)*(DBH in)*.005454154

Square feet per tree = (305/25.4)*(305/25.4)*.005454154

Square feet per tree = (DBH mm x DBH mm) x .000008454 — For 12 " tree (304.8 mm)= 0.7854023

Also: Square feet per tree = ((DBH mm)/25.4) x (DBH mm)/25.4))x (3.1415156 / 576) — For 12 " tree (304.8 mm)= 0.785375

To convert square feet per acre to square meters per hectare:

1 inch = 2.54 cm
1 foot = .3048 meters
1 square foot per acre = .0929 square meters per acre
1 acre = 43,560 square feet = 4046.724 square meters
1 hectare = 10,000 square meters = 2.47 acres

Therefore, 1 square foot/ acre = 2.47 square feet per hectare, or .229568 square meters per hectare (2.47 x .0929)

A 12 inch tree with .7854 sq. ft. of basal area per acre equates to 0.1803 square meters per hectare

.7854 x .229568 = 0.1803

To convert cubic feet to cubic meters per hectare:

1 foot = .3048 meters
1 cubic foot per acre = .0283 cubic meters per acre

Therefore, 1 cubic foot/acre = 2.47 cubic feet per hectare, or .0699 square meters per hectare (2.47 x .0283)

A 12 inch tree with 13 cu. ft. of basal area per acre equates to 0.9087 square meters per hectare

(con't.)

Appendix 9. (Continued)

AREA EXPANSION FACTORS

	Plot Radius	4-Plot Area	Expansion to an acre	Expansion to a hectare
Sapling Trees	6.8 ft.	581.0629376	74.96606165	185.1661723
	2.07 met.	53.84508178	75.17863965	185.7179833
Live Growing Stock	24 ft.	7238.15424	6.018108838	14.86472883
	7.32 met.	673.3292982	6.011917216	14.85157415
Mortality (one-acre)	117.45	43336.25727	1.005162945	2.482752475
	35.9	4048.873944	0.999784151	2.469822509
Mortality (1.5 acres)	144 ft.	65143.38816	0.66867876	1.651636537
	43.92 met.	6059.963684	0.667990802	1.650174906

The following tree volume formulae were used for the Kenai Bark Beetle and Fuels Loading Analysis by species:

Species	Function	Source
White Spruce	(.00189*(DBH/25.4)*(DBH/25.4)*(TH/3.048))-0.21849	Table 7 (Larson/Winterberger 1988)
Black Spruce	(.00189*(DBH/25.4)*(DBH/25.4)*(TH/3.048))-0.21849	Table 7 (Larson/Winterberger 1988)
Paper Birch	(.00211*(DBH/25.4)*(DBH/25.4)*(TH/3.048))-0.7126)	Table 8 (Larson/Winterberger 1988)
Aspen	(.00211*(DBH/25.4)*(DBH/25.4)*(TH/3.048))-0.7126)	Table 8 (Larson/Winterberger 1988)
Poplar/Cottonwood	(.00188*(DBH/25.4)*(DBH/25.4)*(TH)/3.048))-1.3976)	Table 9 (Larson/Winterberger 1988)

DBH = Diameter in millimeters; TH = Total height in decimeters

Appendix 10. ArcView GIS Metadata for EAFB long-term vegetation monitoring plots established in 1999 (LTVMPLOTS.MET).

The source for the USGS Anchorage quad Metadata:

http://adgc.usgs.gov/data/usgs/geodata/drg/temp/metadata/l61149c6.html

http://adgc.usgs.gov/data/usgs/geodata/drg/temp/metadata.l61149c7.html

Metadata originating with this monitoring study is as follows:

IDENTIFICATION_INFORMATION

Citation:
Citation_Information:
Originator: Alaska Natural Heritage Program
Publication_Date: 20001230
Title: Elmendorf Air Force Base Long Term Vegetation Monitoring Plot Locations
Edition: 2000
Geospatial_Data_Presentation_Form: Digital File
Publication_Information:
Publication_Place:
Publisher:
Other_Citation_Details:
Online_Linkage:
Larger_Work_Citation:
Citation_Information:
Originator: Alaska Natural Heritage program
Publication_Date: 20001230
Title: Establishment and Characterization of Long-term Vegetation Monitoring Plots on Elmendorf Air Force Base, Alaska
Publication_Information:
Publication_Place:
Publisher:
Online_Linkage:

Description:
Abstract:
The LTVMPLOTS.shp file is a point feature shape file representing the locations of 30 Long-Term Vegetation Monitoring Plots on Elmendorf Air Force Base established in 1999.

Locations were placed using the Anchorage B-8 SW and SE 1:25,000 Digital Raster Graphic by USGS and georeferenced to a UTM grid Alaska Zone 5.

Purpose:

The plot shape file is used to reference the location of 30 Long-Term Vegetation Monitoring plots to which plot data can be linked to track vegetation change data over time.

Supplemental_Information:

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 199906

Ending_Date: 200008

Currentness_Reference:

Status:

Progress: Complete

Maintenance_and_Update_Frequency: As needed

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: 346032.5949

East_Bounding_Coordinate: 352223.6588

North_Bounding_Coordinate: 6801215.7900

South_Bounding_Coordinate: 6794837.1181

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: VEGETATION

Theme_Keyword: PLOTS

Theme_Keyword: MONITORING

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: ELMENDORF AFB

Place_Keyword: ALASKA

Access_Constraints:

Approved for public release. Distribution unlimited.

Use_Constraints:

None

Point_of_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: Natural Resources Branch Elmendorf AFB

Contact_Person: Ms. Kate Wedemeyer
Contact_Position: Wildlife Biologist
Contact_Address:
Address_Type: mailing and physical address
Address: 6326 Arctic Warrior Drive
City: Elmendorf Air Force Base
State_or_Province: Alaska
Postal_Code: 99506
Country: USA
Contact_Voice_Telephone:
Contact_Facsimile_Telephone:
Contact_Electronic_Mail_Address:
Hours_of_Service:

Native_Data_Set_Environment:
ArcView version 3.2 shapefile format
c:\elmendorf\ltvm\ltvmplots.shp

DATA_QUALITY_INFORMATION

Attribute_Accuracy:
Attribute_Accuracy_Report:
Logical_Consistency_Report:
Completeness_Report:
The LTVMPLOTS shape file is a faithful reproduction of the original source map. Locations were placed using the USGS Digital Raster Graphics 1:25,000 scale Anchorage B8 SW and SE as a digital basemap. Locations where transferred from a hardcopy map.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
Unknown
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report:
Lineage:

Source_Information:

Source_Citation: Tande, G.F., J.Michaelson, S.C. Klein and J. Lenz 2000. Establishment and characterization of long term vegetation monitoring plots on Elmendorf Air Force Base, Alaska. Rep. Prep. For: Natural Resources Branch, 3/CES/CEVPW, 6326 Arctic Warrior Dr., Elmendorf AFB, AK. Contract No. DAMD17-99-2-9004. U.S. Army Medical Research and Material Command, Ft. Detrick, MD. 21702-5012. Alaska Natural Heritage Program, Environment and

Natural Resources Institute, University of Alaska Anchorage, 707 A St., Anchorage, Alaska.
Citation_Information:
Originator: Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage
Publication_Date: 20001230
Title: Establishment and Characterization of Long Term Vegetation Monitoring Plots on Elmendorf Air Force Base, Alaska
Edition:
Geospatial_Data_Presentation_Form: Digital Map
Publication_Information:
Publication_Place: Anchorage, Alaska
Publisher:
Other_Citation_Details:
Online_Linkage:
Larger_Work_Citation:
Citation_Information:
Originator:
Publication_Date:
Title:
Publication_Information:
Publication_Place:
Publisher:
Online_Linkage:
Source_Scale_Denominator: 25000
Type_of_Source_Media: electronic
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 199906
Ending_Date: 200008
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: map
Source_Contribution:
The sourcemap is transferred to digital DRG basemap
Process_Step:
Process_Description:
Point locations were transferred from hardcopy USGS 1:25000 scale basemap to electronic Digital Raster Graphic at the same scale. Points were generated to create a ARCVIEW shapefile. The coordinates were read from the UTM northing easting coordinates from the DRG which is in an UTM Alaska

Zone 5 projection. These coordinates were then projected into geographic degrees minutes and seconds using the ARC/INFO projection program. Plot identification numbers and geographic coordinates were entered into the attribute table of the shape file.
Source_Used_Citation_Abbreviation:
Process_Date: 20001015
Source_Produced_Citation_Abbreviation:
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Organization: Alaska Natural Heritage Program
Contact_Person: Julie Michaelson
Contact_Position: Data Manager
Contact_Address:
Address_Type: mailing and physical address
Address: 707 A Street
City: Anchorage
State_or_Province: Alaska
Postal_Code: 99503
Country: USA
Contact_Voice_Telephone: (907)257-2781
Contact_Facsimile_Telephone:
Contact_Electronic_Mail_Address: anjam1@uaa.alaska.edu
Hours_of_Service:

SPATIAL_DATA_ORGANIZATION_INFORMATION

Direct_Spatial_Reference_Method: Point
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 30

SPATIAL_REFERENCE_INFORMATION

Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: Coordinate pair

Coordinate_Representation:
Abscissa_Resolution: 2.540000000000
Ordinate_Resolution: -2.54000000000
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6,378,206.4
Denominator_of_Flattening_Ratio: 294.98

ENTITY_AND_ATTRIBUTE_INFORMATION

Detailed_Description:
Entity_Type:
Entity_Type_Label: ltvmplots.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None
Attribute:
Attribute_Label: Id
Attribute_Definition:
Attribute_Definition_Source:
Attribute_Domain_Values:
Unrepresentable_Domain: Numeric Field
Attribute:
Attribute_Label: Plot_id
Attribute_Definition: 1 of 30 plot identification numbers
Attribute_Definition_Source: Alaska Natural Heritage program
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Lat_dms
Attribute_Definition: Latitude in degrees minutes and seconds
Attribute_Definition_Source: AKNHP
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field
Attribute:
Attribute_Label: Long_dms
Attribute_Definition: Longitude in degrees minutes and seconds
Attribute_Definition_Source: AKNHP
Attribute_Domain_Values:
Unrepresentable_Domain: Character Field

DISTRIBUTION_INFORMATION

Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Natural Resources Branch Elmendorf Air Force Base
Contact_Person: Kate Wedemeyer
Contact_Position: Wildlife Biologist
Contact_Address:
Address_Type: mailing and physical address
Address: 6326 Arctic Warrior Drive
City: Elmendorf Air Force Base
State_or_Province: Alaska
Postal_Code: 99506
Country: USA
Contact_Voice_Telephone:
Contact_Facsimile_Telephone:
Contact_Electronic_Mail_Address:
Hours_of_Service:
Resource_Description:
Distribution_Liability:
Although these data have been processed successfully on a computer system at AKNHP no warranty expressed or implied is made by AKNHP regarding the use of the data on any other system, nor does the act of distribution constitute such warranty.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name:ArcView shape file
Digital_Transfer_Option:
Offline_Option:
Offline_Media:
Recording_Format: 3.2
Compatibility_Information:
ArcView GIS
Fees:
Ordering_Instructions:
Contact EAFB - Natural Resources Branch

METADATA_REFERENCE_INFORMATION

Metadata_Date: 20001218
Metadata_Review_Date: 20001219
Metadata_Contact:
  Contact_Information:
    Contact_Organization_Primary:
      Contact_Organization: Alaska Natural Heritage Program
      Contact_Person: Julie Michaelson
    Contact_Position: Data Manager
    Contact_Address:
      Address_Type: Mailing and physical address
      Address: 707 A Street
      City: Anchorage
      State_or_Province: Alaska
      Postal_Code: 99503
      Country: USA
    Contact_Voice_Telephone: (907)257-2781
    Contact_Facsimile_Telephone:
    Contact_Electronic_Mail_Address:
    Hours_of_Service:
Metadata_Standard_Name: FGDC CSDGM
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 11. An example of a map prepared for a permanent long-term monitoring site. In this case, each monitoring site on the Bonanza Creek Long-Term Ecological Research (LTER) area near Fairbanks has a vegetation plot (control); other natural resource monitoring plots or transects are documented in the vicinity of the control using forest mensuration techniques to insure minimal disturbance to the entire monitoring site.