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

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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 USC5CSCIl670a (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 90º 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 90º 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 Conservation and Environmental Planning

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 >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 - extremely xeric sites - almost no moisture; no plant growth
2 - very xeric sites - very small amount of moisture; e.g., dry sand dunes
3 - xeric sites - small amount of moisture; e.g., stabilized sand dunes, dry ridge tops
4 - subxeric - noticeable amount of moisture; e.g., well-drained slopes, ridges
5 - subxeric to mesic sites - very noticeable amount of moisture; e.g., flat, gently sloping surfaces
6 - mesic sites - moderate amount of moisture; e.g., flat shallow depressions
7 - mesic to subhygric sites - considerable amount of moisture; e.g., depressions
8 - subhygric sites - very considerable amount of moisture; saturated but with <5% standing water <10 cm deep
9 - hygric sites - large amount of moisture; up to 100% surface under water 10 to 50 cm; e.g., deep lake margins, shallow ponds and streams
10 - hydric sites - 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	11 clawed tree
02 track	12 feeding on vegetation

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
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)

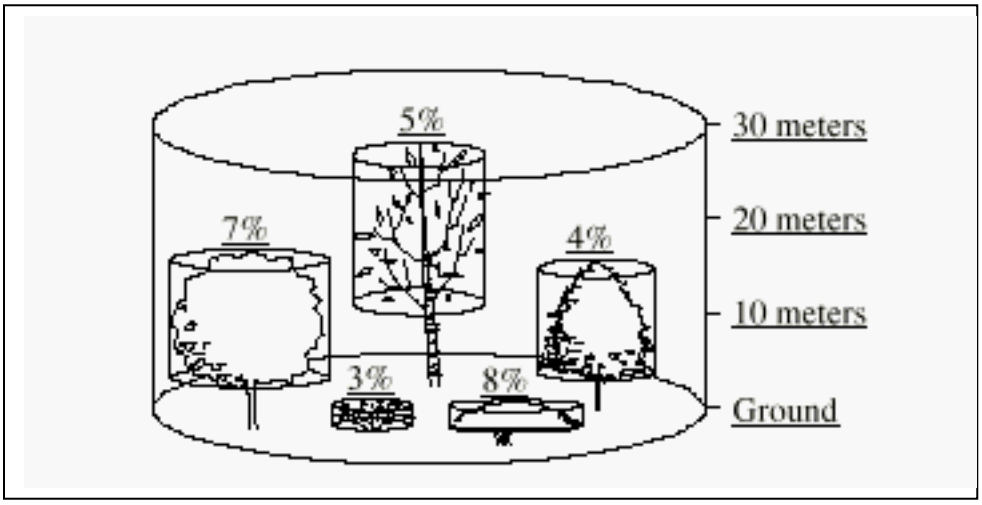
(Refer to APPENDIX 9)

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.

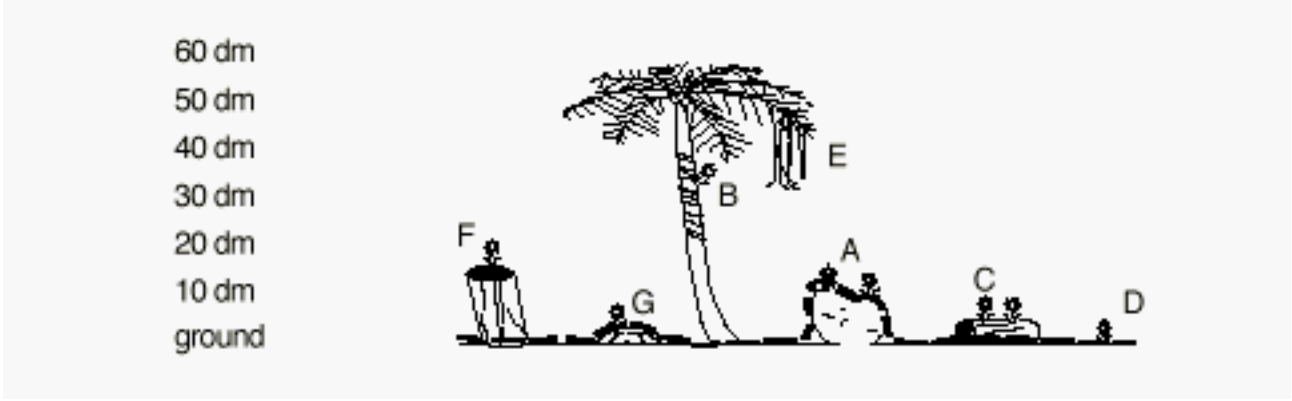
Vegetation is classified into layers starting at ground level. Each layer's vertical dimensions are estimated using the natural layer breaks observed on the Microplot. Data on trees > 2.5 cm dbh are measured and recorded on the Sapling and Tree Record data forms (see Tree Record and Sapling Record Sections). 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.

<u>DATA SHEET 5 (DS 5)</u> : 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) a
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.

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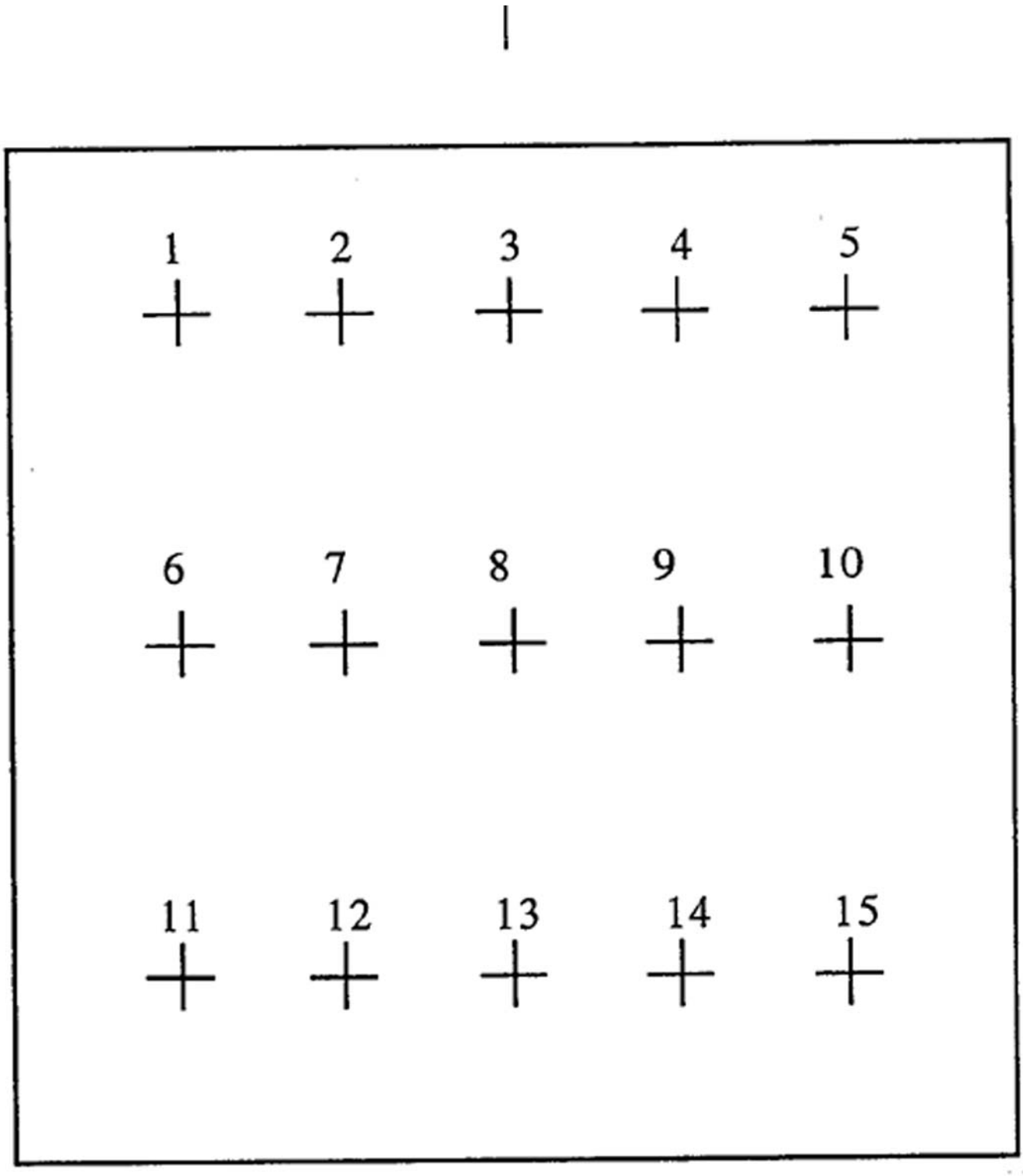
APPENDICES

Appendix 1. Phase I air photo sampling frame.



Appendix 2. Phase I Data Record.

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. LTVM PLOT

Appendix 5. Details for marking Witness Trees at the Reference Point (RP) and LTVMP center (IP) (After USFS FIA 1998).

Reference Point (RP)

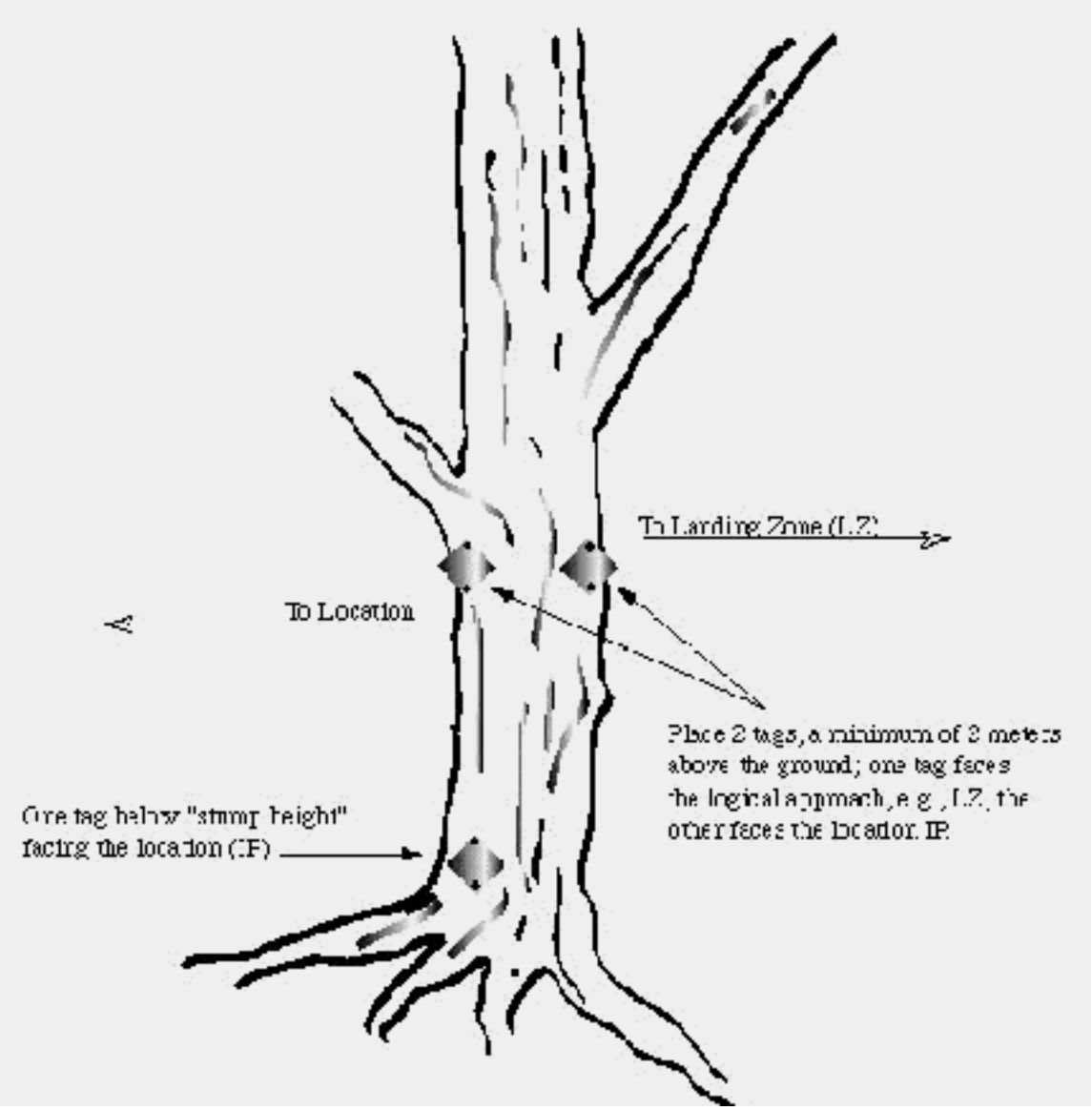
An enduring, easily identified object should be located near the plot as a **Reference Point (RP)**. The RP will help in reestablishing the plot in the event of fire, timber cutting, growth of understory or some other change which would make future visual location of the plot difficult. It should be 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:

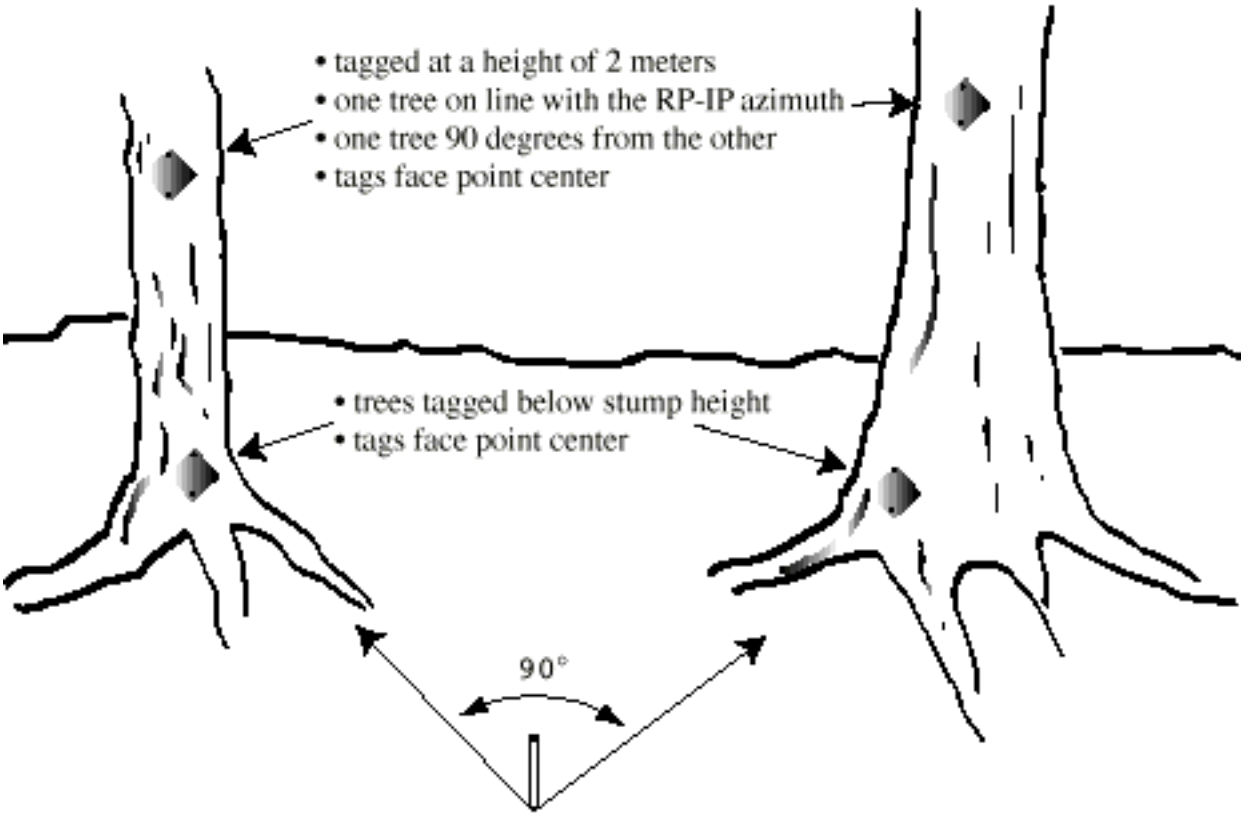
1. Unlikely to die or be cut within 10 years.
2. A species easily located in the stand.
3. At least 10 cm dbh.
4. One tree in line with RP-IP azimuth, second tree at a 90 angle.

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.



Appendices 6 - 13. Phase II data sheets.

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.

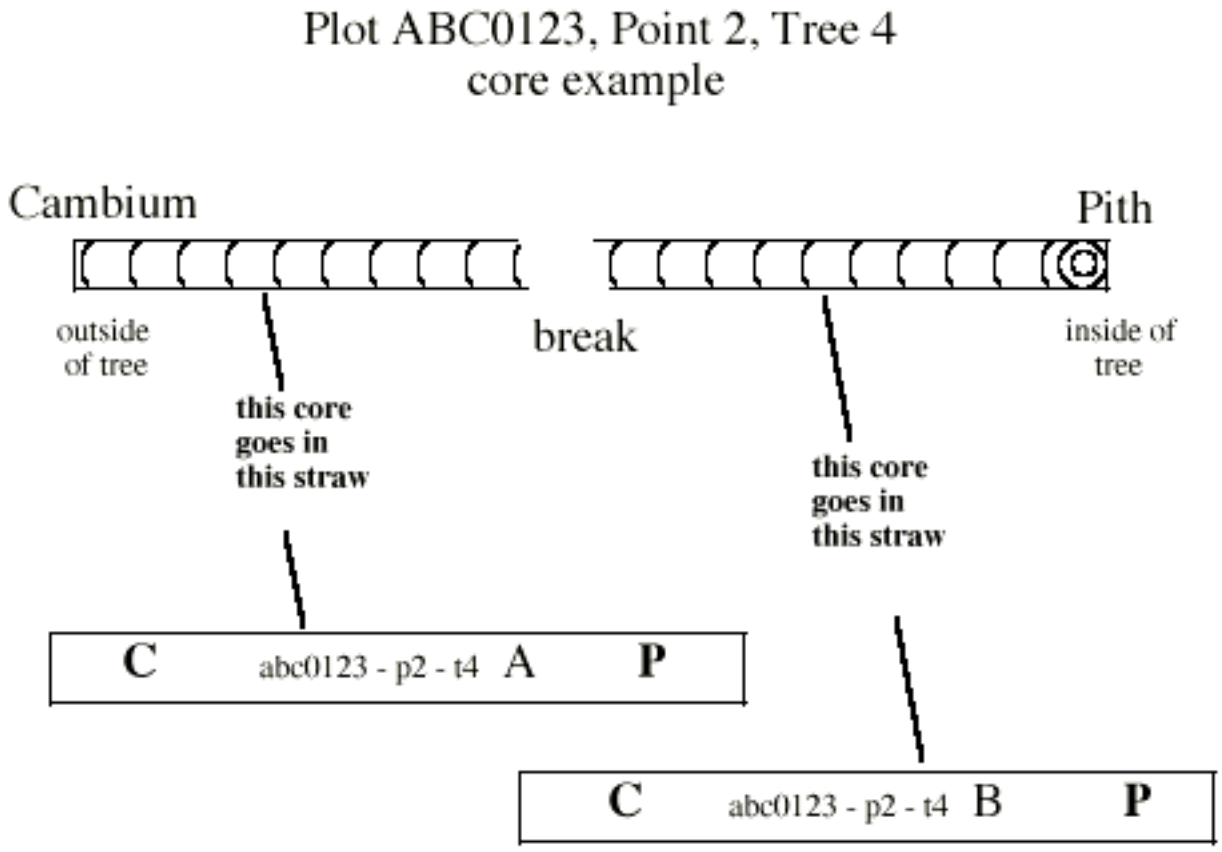
Extracting Tips:

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, <u>controlled</u> pull <u>straight back</u> (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.



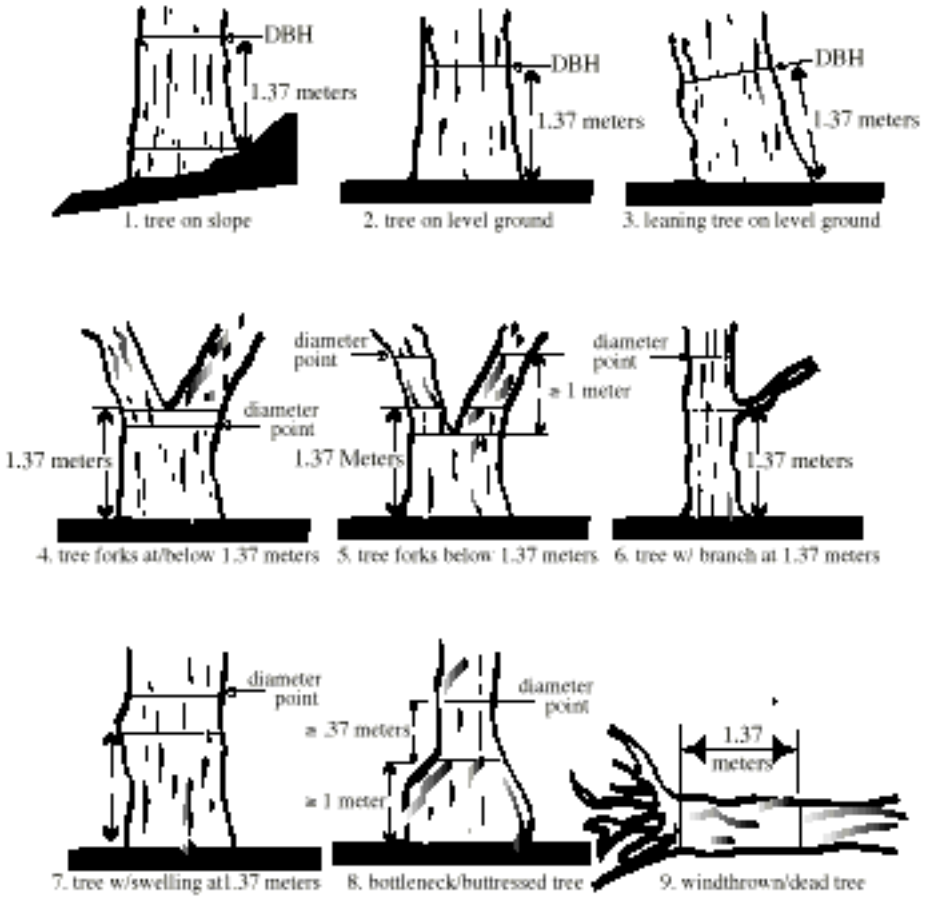
Straw Labeling: Straws are labeled with LTVMP location number, subplot number, and tree number. If two straws must be used to hold an entire core, the straw holding the core piece closest to the cambium will be labeled A and the core piece closest to pith will be labeled B. Each straw will have its ends 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 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.

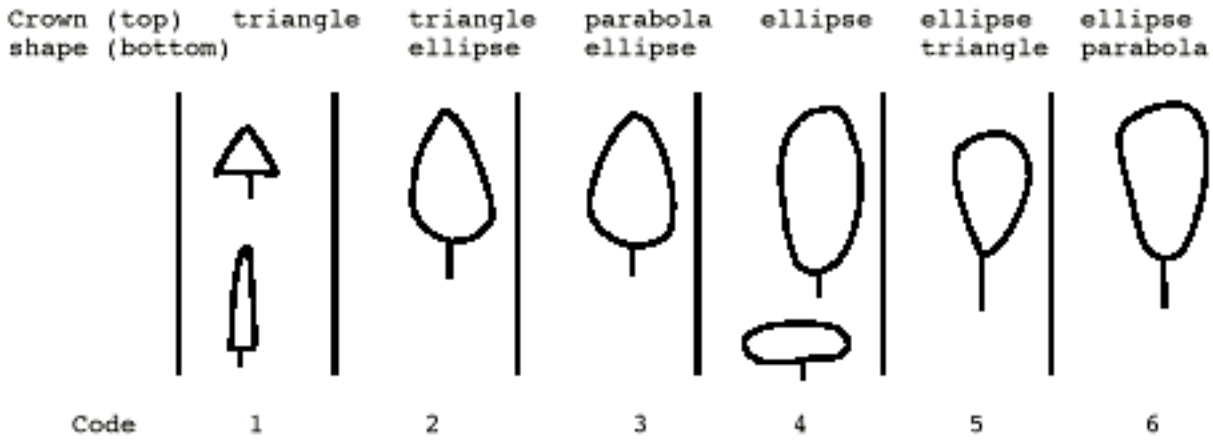
Appendix 19. Codes and determinations for crown diameter, form, density and transparency following established forest health and monitoring procedures (Mangold 1997, USFS FIA 1998).

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.

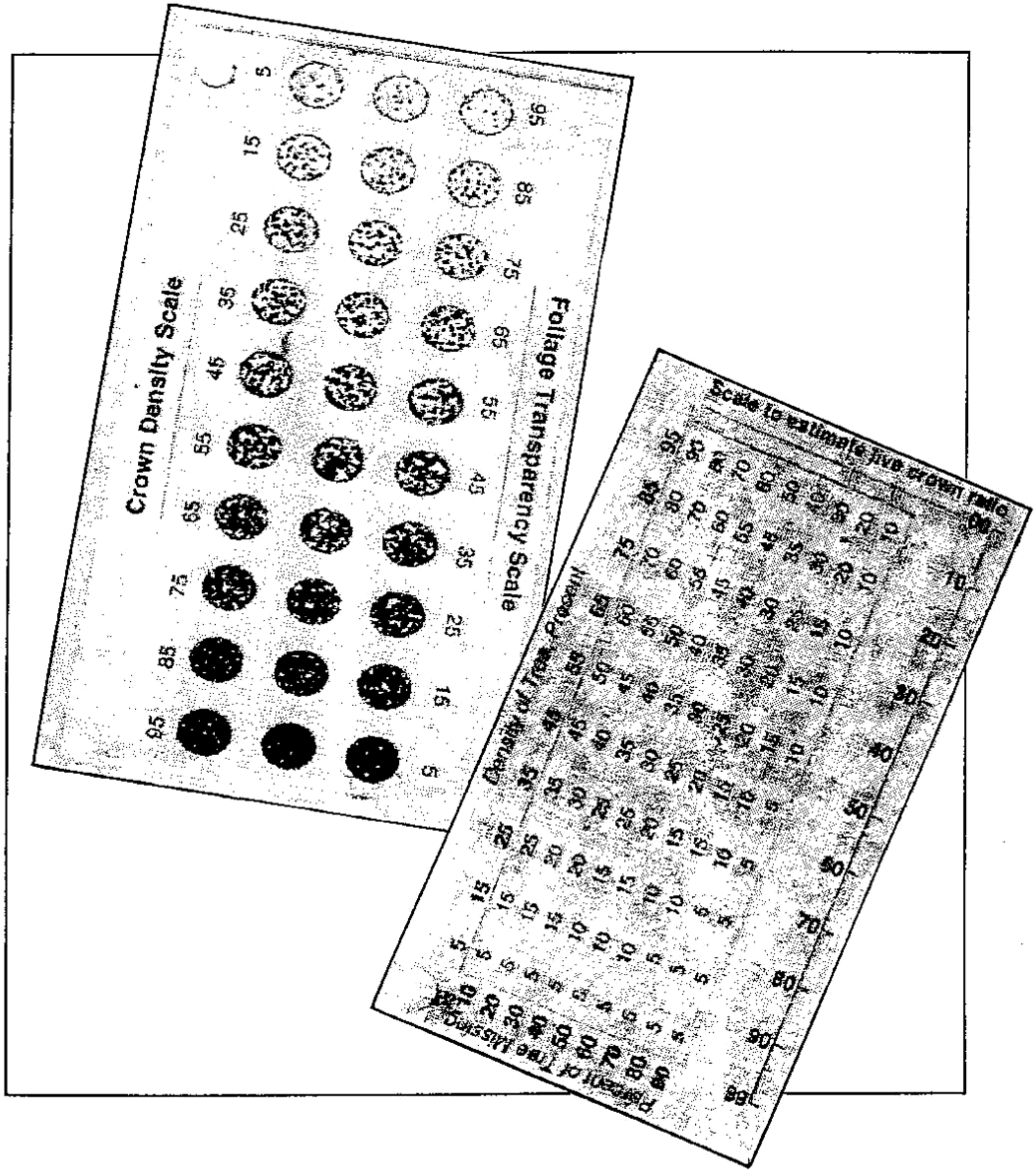


Crown Density

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
Density of Tree, Percent
Percent of Tree Missing

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 Log.

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 Flora of Alaska
Viereck and Little's Trees and Shrubs of Alaska
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