LTER Terrestrial Vegetation Plots

PURPOSE

The terrestrial vegetation plots are designed to meet a number of LTER needs in mature and old growth forests. These include:

1. Tree growth and mortality information.

2. Biomass information for both overstory and understory.

3. Leaf area estimates to test leaf area hypothesis

In addition the sampling must include baseline environmental information to evaluate the measurements.

METHODS

I Sampling Strategy

To obtain an unbiased sample, plots will be regularly located at 100 meter intervals along transect lines. Regular spacing was selected because it assures a good distribution of plots and shouldn't bias the sample. In the mature forests of the Hagan Block Research Natural Area the transect lines are spaced at 400 meter intervals provides about 110 plots and a 2.5% sample of the watershed. In the old growth forests of Watershed 2 at the H. J. Andrews Experimental Ecological Reserve The transect lines will be spaced at 200 meter intervals which results in about 80 plots and a 5% sample of the watershed. The difference in sampling intensity was necessary to balance the number of plots between the two areas. For analyses which may be sensitive to sampling density, we propose to exclude the data from every other transect line in Watershed 2 starting from the west (transect 1).

The transect lines in the Hagan Block run northwest to southeast across the drainage, while in Watershed 2 they run North-South between the ridge and the road. The ends of all transects are marked with a 4' tall PVC stake and metal tags on painted trees. The plots are marked with 4' stakes of PVC pipe and flagging. The location of the first plot on each transect is located a random distance between 1 and 100 meters from the transect origin. The approximate locations of the transects are indicated on maps 1 and 2.

II Plot Design

A fixed size plot was chosen because the sampling objectives require remeasurements and mortality checks, which are virtually impossible with plotless sampling methods. The plots used in this study are 1000 square meter circular plots, which are non-

slope corrected . This size was selected because smaller plots are unable to provide good estimates of basal area, tree densities, and tree volume. The biomasses of herbs and shrubs will be estimated on four 2 meter radius subplots within the main plot. Although rectangular plots are generally superior to circular plots, they are considerably more difficult to establish. Since the time necessary to establish the plots is critical, the non slope corrected circular design was chosen. In addition, circular plots similar to this design have been used extensively in the Pacific Northwest and provide extensive information for comparision.

Plot boundaries are established at 8 points (with, across, and diagonial to the slope) by measuring 17.84 meters from the center stake. The stakes marking the subplots for shrub and herb biomass will be inserted 10 meters from the center along the diagonals (see diagram on Site Characteristics data sheet).

III Site Measurements

Basic plot information including date, elevation, slope, aspect, landform, and community type will be collected. Community type will usually be assigned following data collection using IBP Bulletin #4 (Dyrness, Franklin, and Moir, 1974). The physical measurements describing the plot are recorded on the Site Characteristics data sheet (figure 1) and for compatiblity with existing data sets TP56 card type 1 will be used. TP56 card type 2 is included on the Site Characteristics data sheet only for summary purposes and will not be used in the field.

A subjective measure of slope position will be made for each plot. It is weighted strongly (about 80%) toward the position of the plot on the local topography but also includes a macrotopographic factor. When local topography is relatively gentle the macrotopographic factor becomes dominant. Slope position is scaled 0 to 10, with 10 being to ridgetop.

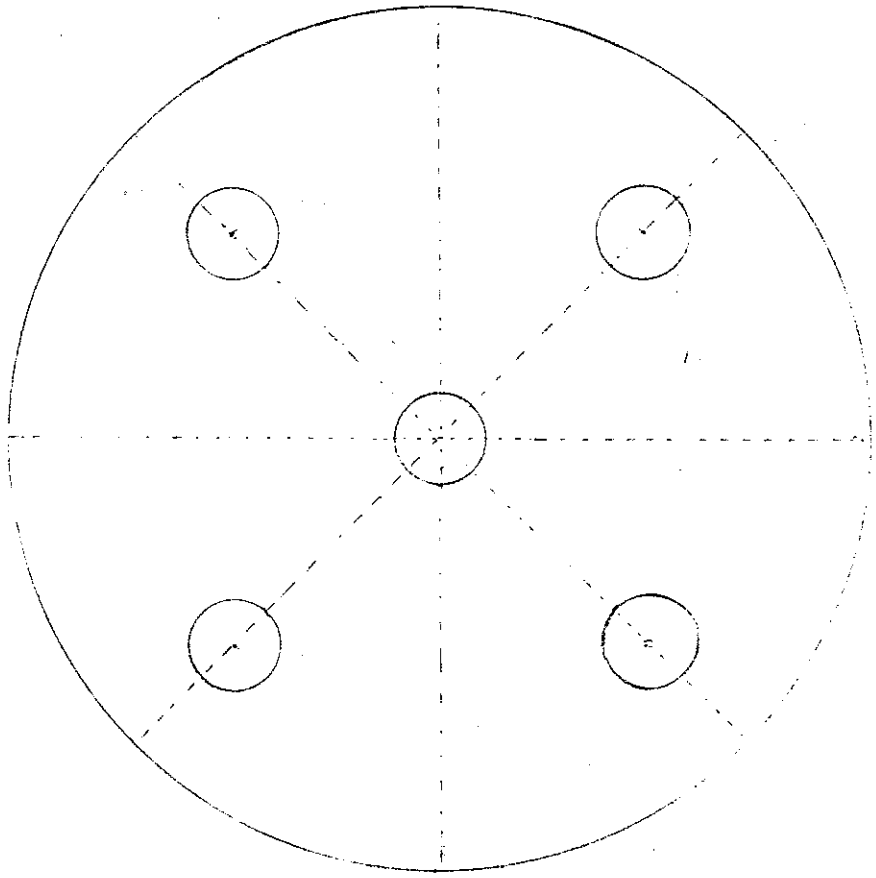
The plot diagram on the Site Characteristics data sheet is used to record additional comments and non-computerized information about the plot. Landform comments indicate any major deviations (in meters) from the plane described by aspect and slope. Any ridgelines or rock outcrops should also be mapped and distances from plot edges to major slope breaks should be noted. These non-computerized comments should be collected quickly without undue detail.

Soils are strongly related to vegetation in this area, so several soils parameters will be measured. Soil moisture holding capacity and parent material appear to be the most important factors, thus soil parameters relating to them will receive the most attention. The moisture holding capacity is primarily related to soil depth and the proportion of coarse fragments.

SITE CHARACTERISTICS

Personnel

Deck ID T P 5 6 _ 1
Study ID _ _ _ _
Plot # _ _ _ _
Sequence # _ _
Area ID _ _ _ _
Date (YYMMDD) _ _ _ _ _ _
Plot type code FS
Plot area (m^2) _ 1 0 0 0
Elevation (m) _ _ _ _
Slope (%) _ _ _
Aspect (degrees) _ _ _
Landform _ _ _ _ _ _
Habitat type _ _ _ _ _ _



Slope position _._

Deck ID T P 5 6 _ 2
Study ID _ _ _ _
Plot # _ _ _ _
Sequence # _ _

Ground covers (%) -
- Bedrock _ _
- Loose rock (>7cm) _ _
- Mineral soil _ _
- Coarse lit (>1cm) _ _
- Fine lit (<1cm) _ _
- Moss (ground only) _ _
- Lichens (grn only) _ _

Group	# of spp	Cover %
Trees	_ _	_ _
Tall shrubs	_ _	_ _
Low shrubs (<.5m)	_ _	_ _
Herbs (inc. grass, etc.)	_ _	_ _
Mosses	_ _	_ _
Lichens	_ _	_ _

BRIEF SOIL DESCRIPTION

Deck ID TP5608 Study ID _ _ _ _ Tran # _ _ Plot # _ _

Depth to bedrock (cm) _ _ _ Pit depth (cm) _ _ _

Litter thickness (cm) _ _ Ph (20cm) _._

Thickness (cm)	Texture	Coarse particles %	Color	Comments

Tree Condition Codes:

Canopy class
one letter indicating the tree's position in the canopy:

D = dominant
C = codominant
I = intermediate
S = suppressed

Overall vigor
one digit which indexes the overall health of the tree. Consider foliage color and density, conks and other signs of rot, fullness of crown, witches brooms, etc. This code is defined differently for trees in different canopy classes. For example, a codominant with full vigor might have good vigor if it was suppressed. The codes are:

1 = good
2 = fair
3 = poor

Crown conditions

one to three digits describing the stem above the first foliated branches:

1 = OK
2 = broken top
3 = multiple tops or leaders
4 = dead top
5 = unKnown top
6 = half crwoned
7 = crook(s) in stem
8 = unsuitble for a site index tree
9 = suitble for a site index tree

Bole conditions
one to three digitss describing the stem below the first foliated branches:

1 = good (straight and without a grouse ladder)
2 = pistol butt
3 = butt swell (abnormal for this species)
4 = forked or multiple bole
5 = leaning bole
6 = grouse ladder (occurs on open grown wolf trees)
7 = sweeping bole

Rooting condition
one or two digits describing the primary (and secondary when it is significant) medium(s) in which the tree is rooted:

1 = mineral soil rooted (include non-woody litter)
2 = rooted in rotten wood
3 = unKnown rooting medium

Disturbance condition
one or two digits describing scars seen on the bole:

1 = none
2 = fire scar(s)
3 = log fall scar(s) (caused by a falling log which struck the tree)
4 = scar(s) of unKnown origin
5 = scar(s) directly caused by animals

Landform codes
a 6-character code depicting geomorphic, hydrological and topographic characteristics of the plot.

Character 1: Primary ridge position
T = topslope
M = midslope
B = bottom slope

Character 2: geomorphic unit (general lie of the land)

R = ridgetop 0 - 4 degrees (0-7%) slope
C = creep slope, 4-45 degrees (7-100 % slope, usually the edge of the ridge or a bench.
F = fall face, greater than or equal to 45 degrees (100%) slope. Includes cliffs, scarps and very steep slopes.
T = upper transport slope, usually 25-35 degrees (47-70%) but up to 45 degrees (100%) slope. Includes areas of active transport of surface materials (slides, slumps or creep). It is located on the upper third of the transport slope.
M = middle transport slope. Same as t but on middle third of transport slope.
B = botton transport slope. Same as T but on lower third of transport slope.
D = colluvial top slope, 5-25 degrees (9-47%) slope. Colluvial or depositional area, including surfaces of inclined slump benches and terrain of gentle relief. It occurs on the upper one third of the colluvial slope.
E = colluvial midslope. Same as D but on middle of colluvial slope.
C = colluvial bottom slope. Same as D on bottom third of colluvial slope.
A = alluvial topslope, includes areas of gentle relief where alluvial deposition of sediments is or has recently occurred to form terraces or plains.
S = stream channels, including the bed and walls of present streams, rivers or annually wet oxbows of nearby streams.

Character 3: primary hydrological feature of the plot

D = "dry", no visible annual or perennial streams in or near the plot. (Near = 3 plot radii from plot center. Use 1/2 ave dimension of rectangular plot.)
A = annual stream channels in or near plot. Water need not be present during dry season.
P = perennial stream present. Water must be present all year long.
S = seeps common, indicated by local groups of riparian plants.
W = standing water present in or near plot. This may be a lake, pond, marsh, bog, or water within 25 cm of surface in soil pit.

Character 4: secondary hydrological feature code, includes features described under character 3 above which occur as inclusions of greater 20%.

Character 5: describes topography in the horizontal (across slope) plane.

C = extreme concavity
B = slight concavity
S = smooth terrain
R = rolling terrain with both concavity and convexity
V = slight convexity
W = extreme convexity

Character 6: describes topography in the vertical (up and down slope) plane with character 5 codes.

Parent material can often be determined by soil color and pH in our area. Soil texture and structure seldom differ noticeably from site to site and will receive minor attention.

Soil sampling will be conducted by digging a quick soil pit about 2 meters below the center stake of the plot and should be at least 80 cm deep or reach bedrock. Usually a pit of this type should not require more than 10 minutes to dig and 10 minutes to describe. The measurements are recorded on the brief soil description portion of the Site Characteristics data sheet. Estimated depth to bedrock, pit depth, litter thickness, and pH are recorded and a description of the major soil horizons will be made. In most cases only a crude estimate of depth to bedrock can be given. This estimate is made from the characteristics of the soil pit, nearby rock outcrops, and general topography. pH will be measured at 20cm using a crude chemical pH kit. The general horizon description including horizon thickness, texture, % coarse particles (>2mm), and Munsel color. Texture will be determined in the field by feel. Comments may be made about the structure, presence of charcoal, rooting patterns, mottling, etc.

A nutrient sample will be collected by homogenizing soil samples from just below the litter from the soil pit and downslope from the shrub-herb microplots. If any subsample lacks soil will be neglected and additional soil will be collected from the other subsamples. At least 750cc of soil will be collected for the nutrient sample. These samples will be air dried as soon as possible after collection to reduce deterioration. Cobbles and gravel should be removed to reduce sample bulk. Walkley-Black Carbon, mineralizable nitrogen, extractable NH_3 and Kjeldaul nitrogen tests will be run on each sample.

A bulk density measurement of the surface horizon (about 0-20cm) will be made at the soil pit. It wil be determined by excavating a sample and measuring the volume of sand required to fill the hole. The removed soil and rock would be oven dried and weighed. This method was chosen because it works even in soils which contain large amounts of gravel and cobbles. Approximately 1000cc of sample must be excavated with care to avoid loosening the surrounding soil. The hole is lined with a plastic bag, filled with sand to the original soil level. The sand should be pressed firmly to insure that all cavities are filled and any loosened soil is recompacted. The volume of sand is then measured and recorded on the sample bag. These measurements should allow crude estimation of soil moisture holding capacity and nutrient reserves.

IV. Vegetation Measurements

Vegetation measurements include estimations of both cover and biomass for live trees, understory vegetation, and dead wood. Since identification of individual trees is important to meet growth and mortality objectives, all trees >5cm diameter at

140cm were tagged at that height. In addition to diameter, the canopy class, overall vigor, and a series of condition codes were recorded for each tree. This information was recorded using the "Referance Stand Tree Data Form (790209)" which is described fully in the Vegetation Manual. The inclusion of trees which border the plot will be settled by measuring out from the center stake, with trees more than half way in will being included.

Four trees will be selected on each plot for age, sapwood, height, and growth analysis. These will usually be selected from near the bottom of the plot and should include a dominant tree. The selected trees should be be chosen from the associates of the dominant tree, unless it would ignore important components of the overstory. It is desirable but not essential that these trees be located on the plot itself. This method should provide a good cross-section of tree diameters and species to make estimates of fire dates, net production of wood, and leaf area.

Cover was estimated for all plant species on the on the four 12.5 m_2 subplots and the whole plot using the standard Daubenmire method. General cover for the whole plot is useful, as species not accurately represented the subplots because they are rare or unevenly distributed are recorded. The whole plot covers are comparible to those estimated for many plots in the Pacific Northwest. Hopefully, the comparison between the biomass results and whole plot covers will allow rough estimations of biomasses from previous data sets. Cover estimates and biomass measures for the subplots would be done by crews of two people. The plot would be divided into quarters with four 2 meter measuring poles. Since the plots are not slope corrected the poles should be placed parallel to the ground. For accuracy each crew member would estimate 50% of the plot and the results would be combined.

In addition to vegetation cover estimates, cover will be estimated for LOG, LITTER, STONE, and B.G. (bare ground). LOG is defined as coarse woody debris >10cm in diameter. LITTER is defined as organic material <10cm in diameter. When moss, lichen, and creeping plants function as groundcover, they are counted as litter. Bare ground refers to mineral soil which is <50% covered with litter. STONE is bedrock or cobbles with a minimum dimension of 7.5cm. Talis slopes covered with gravel are considered to be STONE if the deep coarse gravel is functionally similar. The sum of these catagories is assumed to equal 100% unless suspended logs are present, which should be noted to avoid confusion when proofing data.

Estimated cover of vegetation strata will also be recorded. These catagories will be TREE, TSHRUB, LSHRUB, HERB, MOSS, and LICHEN. TREE cover is the cover of all tree species including TABR and CONU. The cover of understory plants with woody stems will be divided into two catagories with TSHRUB being the tall shrubs >.5 meters and LSHRUB the lower shrubs. TSHRUB would include very tall Gaultheria shalon up to Acer circinatum and Acer glabrum. LSHRUB includes most GASH, BENE, SYMO, CHUM, and WHMO. HERB would encompass forbes, grasses and sedges. MOSS

refers to all bryophytes (mosses and leafy liverworts). MOSS and LICHEN cover is estimated on a surface area basis, so their cover can easily exceed 100%. Surface area was selected because it should have the highest correlation with biomass. Mosses and lichens growing on the base of trees to the height of 1 meter is included in the estimate. of the vegetation

Daubenmire cover is estimated by imagining the leaf or plant completely covers the area formed by drawing a line around the boundary of the foliage. The question always arises about how large a gap or opening can be included within the estimate area. We will excluding areas which are about 10cm square.

Biomass measures for many plants can be calculated from cover. Additional non-destructive measurements will be made on the biomass subplots for those components not adaquately estimated by cover. If additional measures are required they shall be recorded on the Shrub Data Sheet 800420. When two measurements must be recorded they are placed in the following order: diameters before lengths before numbers.

Most herbs require only cover for biomass estimation. The exceptions include:

BLSP, ATFI, ADPE which require frond length and # of fronds.
PTAQ which requires diameter at base and # of stems.
ARCA 3 which requires diameter at base for each stem.
XETE which requires clump diameter and leaf length.

Most shrubs require only diameter at base to estimate biomass. The major exception is that most of the low shrubs (GASH, BENE, SYMO, WHMO, etc) can be estimated by cover alone. CEVE is the only shrub which also requires a stem length. For species without existing biomass equations it would be best to collect both basal diameter and stem length in case it is needed. A basal diameter will be measured for all trees in the subplots too small to be tagged. The biomass of the larger trees would be estimated from the whole plot measurements.

To study decay rates of snags, all standing dead trees >10 cm will be tagged and diametered. The condition of the snag will be described using % bark, crown and branch condition codes and the presence of conks or cavities. The codes for the crown and branch conditions are shown on the back of the "STANDING DEAD FORM". The height of the trees will be estimated so the extent of top breakage can be caloulated.

Dead wood was mapped on every other to obtain an estimate for the biomass woody debris. The odd plots on even transects and even plots on odd transects will be mapped to avoid bias. Mapping will be done on the plot diagram of the Site Characteristics sheet. The location, species, end diameters, and decay class of each log was recorded. Since the mapping is intended only to estimate log lengths and detect new material, minimal effort will be devoted to getting log locations exact. If the

species on a log is questionable the species code will be enclosed in "()". This should reduce the number of "unknowns" and still provide future researchers with positive identifications for at least some of the logs. The decay classes are indicated in Appendix IV of the Vege Manual.

V. Scheduling Considerations

Sampling is done with crews of 2 or more people. The cover and biomass measurements for the subplots requires two people, each measuring half the plot. Not only does this simplify sampling but the interaction between the two estimators greatly improves the accuracy of the measurements. The tree sampling also requires two people. One person tags, diameters, and examines the base of the tree, while the other checks the crown and records data. The soil pit and detailed tree measurements require about the same amount of time and can each be done by one person. Depending on accessiblity two people should be able to complete about two plots per day.

LTER VEGETATION PLOT COVER DATA SHEET (810614) Page __ of __

Deck ID TP5609 Study ID LTV _ Area ID _ _ _ _

Transect # _ _ Plot # _ _ 2x Date (YYMMDD) _ _ _ _ _ _

Lifeform	Species Alpha	whole plot cover	Q1 cover	Q2 cover	Q3 cover	Q4 cover	Comments

S H R U B   D A T A   S H E E T   8 0 0 4 2 0

Date ___ ___ ___ ___ ___ ___ (Y Y M M D D)   Watershed # _ _ _   Transect # _ _   Plot # _ _

Quadrat	Species Alpha	Sequence Number	Plant Cover	************************** Biomass Measures **************************											
				Stem 1		Stem 2		Stem 3		Stem 4		Stem 5		Stem 6	
				B1	B2	B1	B2	B1	B2	B1	B2	B1	B2	B1	B2

REFERENCE STAND TREE DATA FORM (790209)

Personnel ______________________________ Page ____ of ____

DECK ID T P 5 6 _ 6 STUDY ID L T V _ PLOT # _ _ _ _
(Ref.Stand)

Sequence # (Grid Section)	Date Y Y M M	Tree Tag #	Species Alpha Code	DBH (137cm) cm	Canopy Class	Overall Vigor	Crown Conditions			Bole Conditions			Rooting Conditions		Disturbance Conditions		Comments
							1	2	3	1	2	3	1	2	1	2	

Tree Condition Codes:

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one letter indicating the tree's position in the canopy:

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MORTALITY FORM 810416 PERSONNEL _____

DECK ID _____ STUDY ID _____ DATE (YYMM) _____

STAND #	Subplot Number	TAG #	Species Alpha	DBH (cm)	SNAG INFORMATION: TOTAL HEIGHT (m)	SLOPE DIST (m)	ANGLE UP %	ANGLE DOWN %	(Adjust (m)	Crown	Branches	LOG INFORMATION: LARGE DIA. (cm)	LENGTH (m)	SMALL DIA. (cm)	MORTALITY CAUSES: Gen.	Damage	Fungi	Insect	COMMENTS

GENERAL INSTRUCTIONS

This data sheet is designed to record information about the tree identification, snag size, down log size, and possible causes of death. The snag information includes height, top diameter, crown conditon, and branch condition. The codes for crown and branch condition are included below. The top diameter of broken snags is recorded as LARGE DIA. under LOG INFORMATION. The log information consists of two end diameters and length. The large diameter should correspond to either the DBH of wind-thrown trees or the large end of logs formed by broken boles. LENGTH corresponds to the composite length of logs which break when falling. The small diameter is simply the diameter of the small end of the log. The mortality factors are coded using the codes described below. Specify all of the factors you feel contributed to the death of the tree. Each category has two columns so two components of each category may be specified. The most important component in each category should be listed first. If only one component applies in a category it should be placed in the left column.

VARIABLE CODES

CROWN CONDITION CODES

1=Crown intact
2=Crown broken but more than 1/2 of the crown remains
3=Some but less than 1/2 of the crown remains
4=None of the crown remains

BRANCH CONDITION CODES

1=Fine foliage branches remain
2=Medium < 4cm branches remain
3=Coarse branches only
4=No branches (except stobs) remain

MORTALITY FACTOR CODES

GENERAL FACTORS

1=Suppression	The tree appeared to be under competitive stress.
2=Mistletoe	
3=Unknown disease	Unspecified disease caused death
9=Unknown cause	The cause of death is completely unknown could be damage or disease

DAMAGE

1=Windthrow	The tree is tipped over
2=Wind snapped	The tree is broken off
3=Top gone	A portion of the crown is missing
4=Crushed	Smashed by falling trees, rocks, etc.
5=Scarring	Scar from mechanical cause
6=Fire	Fire contributed to death
7=Animals	Vertibrate activity aided death

DISEASE

FUNGAL and INSECT have the same codes for location of damage
1=Foliage and Buds
2=Twigs and branches
3=Bole (Heartwood)
4=Sapwood and Bark
5=Root