TFW-003-90-005

CHARACTERIAZATION OF RIPARIAN MANAGEMENT ZONES AND UPLAND MANAGEMENT AREAS WITH RESPECT TO WILDLIFE HABITAT

FIELD PROCEDURES HANDBOOK

By the

Washington Department of Wildlife

TIMBER FISH & WILDLIFE

SECOND EDITION

MAY 18, 1990

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COOPERATIVE MONITORING, EVALUATION, AND RESEARCH PROGRAM

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for the TFW Study Entitled:

"Characterization of Riparian Management Zones and Upland Management Areas with respect to Wildlife Habitat"

prepared by the

Washington Department of Wildlife

under the direction of the

Wildlife Steering Committee

a subcommittee of the

T/F/W Cooperative Monitoring, Evaluation,

and Research Committee

18-May-90

RMZ/UMA Characterization Study

FIELD PROCEDURES HANDBOOK

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I. GENERAL SPECIFICATIONS

Description

Work will consist of locating, establishing, and measuring physical characteristics within strip sample sites (macro plots and subplots) of Riparian Management Zones (RMZs) and Upland Management Areas (UMAs), with respect to wildlife habitat. Data will be recorded on several types of field cards, as described in Section IV. The project will provide a detailed information base for documenting the physical and botanical characteristics of RMZs and UMAs.

Macro plots will be used for measurements and tallies of sound trees, snags, and stumps. Macro plot strips will be located as described in Section II.

Rectangular subplots will be used to measure the percentage of the shrub and the percentage of the herb canopy closure, as well as the percentage of ground cover (including downed woody material). Subplots are 5 x 10 feet and located every 10 feet along the strip centerline as described in section III.

Stream measurements will consist of stream depth, width, gradient, flow direction, substrate (bed) material, large organic debris (LOD), and canopy closure as described in section IV.

Site Selection

Due to site selection depending on site availability, a completely random sampling effort is not possible. In order to assure the maximum randomness in site selection, the following procedure is followed:

Sites sampled are limited to harvested areas which meet the requirements of the Timber/Fish/Wildlife (TFW) Agreement of January 1988. Sites which meet T/F/W standards, but which were harvested prior to January of 1988, are also sampled. The intent of the sampling is to provide an unbiased, stratified, view of RMZs/UMAs as they occur throughout the State of Washington. RMZs sampled are limited to those that occur on type 1, 2, and 3 waters.

Only RMZs/UMAs left post harvest are sampled. Before beginning the field season a list of Forest Practice Applications (FPAs) on which the timber tax has been paid is requested from the Department of Revenue. This list provides a rough approximation of which FPAs have been harvested. The FPAs from this list are then requested from the individual Department of Natural Resource (DNR) Regional Offices. These FPAs are screened to select those which contain either RMZs or UMAs. FPAs with RMZs/UMAs are then photo copied, along with their harvest unit maps, and collected at the WDW headquarters in Olympia.

In the future we anticipate the ability to query DNR databases to select only those applications containing either RMZs or UMAs.

In order to account for FPAs not found at the regional DNR offices, FPAs containing RMZs/UMAs are also requested from private land owners (industrial and non-industrial), and Washington Department of Wildlife (WDW) regional TFW biologists. By using WDW biologists we are also able to sample those RMZs/UMAs which may not have been declared on the original FPAs.

Once the FPAs have been collected they are mapped to determine where harvest has occurred. From this map, and a map showing where previous sampling has occurred, a sampling schedule is established. Emphasis is placed on sampling new areas, according to the annual schedule shown below. FPAs are then filed by their DNR region and stored until field sampling begins.

Subsequent years' samples will include a mix of new and older RMZs and UMAs as follows:

Year 1 - (1988) 39 new areas sampled

Year 2 - (1989) 105 new areas sampled

Year 3 - new areas and 20% of 1st year areas

Year 4 - new areas and 20% of 2nd year areas

Year 5 - new areas, 20% of 1st year areas, and 20% of 3rd year areas

Year 6 - new areas, 20% of 2nd year areas, and 20% of 4th year areas

Equal sampling is attempted on both the West and East side of the Cascade Mountain Range, as well as between water types 1, 2, and 3. RMZs are more numerous than UMAs; therefore, they tend to receive a greater sampling effort.

Equipment and Supplies

a. Field Procedures Handbook
b. Diameter tapes (diameters in terms of inches and tenths of inches)
c. 75 foot retractable tape
d. 100 foot plastic survey chain
e. Tatum or clipboard
f. Azimuth compass (adjusted for local declination)
g. Percent clinometer
h. Pencils (non-smearing lead type for plot cards),
i. Indelible marking pen (for wooden laths)
j. Plastic flagging
k. Vicinity and project maps, aerial photos
l. Data cards and tatum aids containing field codes
m. Five-foot range poles graduated at six-inch intervals
n. Spherical densiometer
o. Cruiser's vests
p. Wooden survey laths
q. Write in the rain notebook
r. Plant association keys
s. Plant identification field guides and systematic key

II. STRIP PLOT (MACRO PLOT) LOCATION AND ESTABLISHMENT

PROCEDURE:

1. Establishment of the First Strip Centerline.

RMZs: Locate strips perpendicular to the stream channel, or, in the case of a pond or lake, perpendicular to the shoreline (see Figure 1). These perpendicular strips are the strip centerlines. Begin at the upstream end of the RMZ. If measurements are begun at the downstream end of an RMZ, this must be noted in the remarks section of Card 1A. Measure 50 feet, horizontally, along the stream channel, or 50 feet around a lake perimeter, to establish the first centerline. The 50 foot measurement is to avoid any adjacent activity to the RMZ or UMA. Record the azimuth of each centerline. (See Appendix C for magnetic declinations).

UMAs: Locate strip centerlines perpendicular to a line transecting the UMA, and connecting the two farthest points, called the axis; or, strip centerlines can originate perpendicular to the UMA edge (see Figure 2). Measure 50 feet into the UMA along the axis, or along the UMA edge, to establish the first strip centerline. Record the azimuth of each strip centerline.

Both: Identify each strip centerline origin with a wooden lath stake, and two pieces of differently colored flagging, at the ordinary high water mark on an RMZ, or at the UMA axis or edge. Drive lath into the ground such that it can withstand environmental conditions throughout the winter. Write the RMZ or UMA number and strip number from Fields 3 and 28 on the stake with an indelible marker. Remember to flag the centerline at the strip origin and the strip end.

When a strip cannot be sampled due to safety concerns (e.g., steep slopes) record this in the remarks section. Complete as much of Card 2A as possible to assure an accurate strip count.

2. Establishment of Subplots and Macro Plots.

Subplots: Establish and measure subplots first, being careful not to disturb cover until after data have been recorded. Create 10 X 5 foot subplots every ten feet along the strip centerline (Figures 1 and 2), as follows:

Beginning on the upstream side of the centerline (or in the case of a UMA the side nearest the axis or edge origin) place a small piece of flagging on the ground at the centerline origin and five feet (perpendicular) to the centerline to mark the subplot corners. Next measure ten feet (horizontal) along the centerline from the ordinary high water mark of an RMZ, or from the axis or edge of a UMA. Place flagging on the ground at the ten foot mark. At the ten foot mark measure out five feet (perpendicular) on both sides of the centerline. Flag both of these five-foot measurements to mark the subplot corners.

The first subplot sampled will be either the upstream side of the centerline in the case of an RMZ, or the side closest to the axis or edge origin in the case of a UMA. Subsequent subplots will alternate sides along the centerline at 10 foot intervals. Subplot data is recorded on cards 3A and 3B. Continue measuring and sampling at ten foot intervals along the centerline, and five feet perpendicular to the centerline, until the edge of the RMZ/UMA has been reached.

If the last subplot is less than ten feet long, record the length to the nearest foot in Field 40, Card 2A. Two different colors of flagging should be used to mark the inside and outside of the subplot corners, i.e. one color to mark the ten-foot measurements and a second color to mark the five-foot measurements.

All subplot measurements can be made with the five foot range poles. Flag all subplot corners so they can be easily seen.

Again, the centerline origin and end should be flagged clearly and as permanently as possible so they can be found when the site is resampled.

Macro Plots: Locate macro plot boundaries 25 feet horizontal distance, perpendicular from both sides of the centerline, at the ordinary high water mark of an RMZ, or from the UMA axis or edge. The outside edge of the strip plot will parallel the centerline. Continue macro plot boundaries 25 feet perpendicular to the centerline until the edge of the RMZ/UMA is reached.

All tree data within the area between the centerline and the macro plot edges shall be recorded on cards 2A and 2B. Flagging shall be positioned at points 25 feet perpendicular from both sides of the centerline, such that it can be easily seen while recording tree data. This is accomplished by tying similarly colored strands of flagging to tree branches at eye level. Use pink or other bright colored flagging to increase visibility through brush and trees. Include edge trees if the center of the trunk is within the 25-foot boundaries. Continue macro plots for the width of the RMZ or UMA (Figures 1 and 2).

3. Establishment of Remaining Strip Centerlines and Subplots.

Remaining strip plot centerlines are located 250 feet apart. Again, all measurements are taken from centerlines extending perpendicular from the stream, around the perimeter of the lake/pond, or along the axis or edge of the UMA to the harvest unit. Mark each centerline origin with a wooden lath and multicolored flagging as described in Section II. #1. Flag all subplots and macroplots as described in #2.

If the last strip centerline will be located within 25 feet from the RMZ/UMA end do not sample this strip. If this situation should occur, leave accurate comments in the remarks section of Card 1A. The final distance to the end of the RMZ/UMA is then recorded on Card 1A.

4. RMZ Large Organic Debris/Substrate.

Measure large organic debris (LOD) for the distance specified by the stream bed substrate (i.e., gravel/cobble or boulder/bedrock). LOD is measured as follows:

Begin at the first strip centerline and work downstream. While measuring the 250 foot increments between plot centerlines record the stream bed substrate and each piece of LOD. Details on LOD measurements and the measurement distances required by stream bed substrate are described in Section IV and Appendix B.

III. FIELD EXAMINATION INSTRUCTIONS

As a general rule, record subplot information before measuring the trees in the larger macro plots. This is accomplished by recording subplots as you move away from the centerline origin, then record the macro plots as you return to the stake. Avoid walking in subplots until they have been recorded. When working in groups of two have one person record subplot data while the other person records macro plot data (tree data).

A. Tree, Snag, and Stump Measurements

Record all live trees taller than 4.5 feet. Live trees less than 4.5 feet tall and within the subplot are recorded as shrubs on Cards 3A and 3B. Use Cards 2A and 2B to record live trees, snags, and stumps. Record trees by their respective species codes and diameter at breast height (dbh). Tree and snag dbh are recorded in four inch size increments: i.e. 0 - 3.9, 4 - 7.9... etc. Record recently cut stumps (less than five years) by an "R" and older stumps are recorded with an "S". Do not record stump species code or diameters.

B. Cover Type Measurements (including dead and downed woody material)

Use Cards 3A and 3B to record the species present and their percent of coverage within individual subplots (Section II, Part 2). Record the first and second dominant shrubs, and the first and second dominant herbs, by their <u>genus</u> <u>species</u> code names. Code names are created by ordering the first two letters of the <u>genus</u> and the first two letters of the <u>species</u> name together.

For example: The species code for <u>Oregon</u> <u>oxalis</u> is <u>OXOR</u>. Species codes were adopted from Garrison et. al. 1976. Once two dominants have been identified for the shrubs and herbs, ocularly estimate their total percent coverage. Follow the same procedure for the following categories: total shrubs, total forbs, total graminoids (grasses and grass-like plants), downed wood (three classes), organic ground cover (including litter, duff, mosses, and lichens), water, rock, and bare mineral soil. Record percentage of downed woody material, four inches in diameter or greater, using the log decomposition classes found in Appendix H.

C. Remarks

Use Card 1A for remarks. Remarks can include: descriptions of the best way to find the site in the future, including directions for easiest access, comments about condition of the stand that may be useful in characterizing RMZs and UMAs, observations on soils, insect infestations, mechanical damage to trees, disease infection centers, animal damage, and the general vigor of the stand. Note any inter-planting within RMZs and UMAs, rock outcrops, mass movement, streams, severe exposure, dry or wet areas, wildlife use or fish sightings. When wildlife, wildlife sign, or fish are seen, record species, activity, total numbers, etc.

IV. DESCRIPTION OF FIELD MEASUREMENTS AND USE OF PLOT CARDS

There are three types of data cards (Each with side A and B):

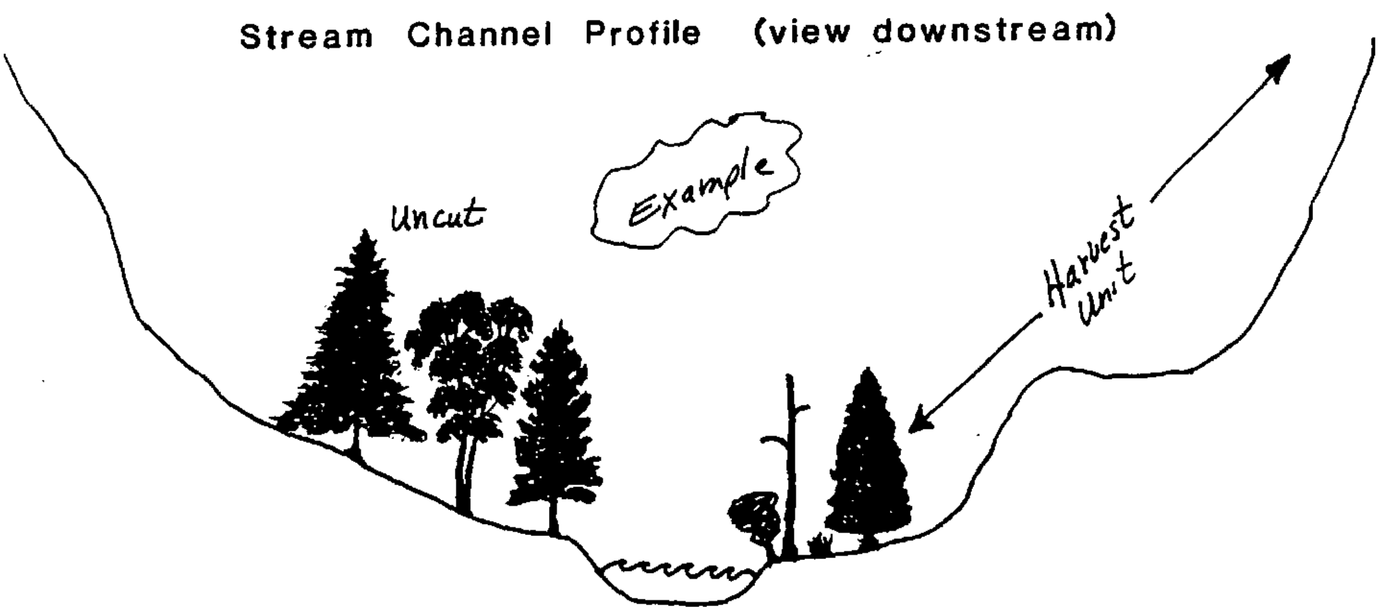
Card 1 -- RMZ/UMA LOCATION, GENERAL INFORMATION, AND LOD
Card 2 -- STRIP PLOT DATA
Card 3 -- SUBPLOT DATA

Use only one Card 1A (and 1B, if necessary) for each RMZ or UMA. Circle whether it is an RMZ or UMA that is being sampled on Card 1. Use Cards 2 and 3 (and their continuation cards, as necessary) for each strip. Number all cards for an RMZ or UMA consecutively in the upper right corners. Duplicate Card 3's may be required within a strip. Instructions and codes for filling out data fields are provided in this section and Appendix A.

When filling out cards, **USE LEADING ZEROS THROUGHOUT.** Fill in all fields. The only time a field should be left blank is when it was not possible to measure the variable. In this case a circle should be drawn around the field to indicate it was left blank on purpose. A "0" means "there was a measurement taken and the value was 0".

Card 1 - RMZ/UMA LOCATION, GENERAL INFORMATION AND LOD

Complete one Card 1A/B for each RMZ/UMA. Draw a sketch of the RMZ/ UMA being sampled in the RMZ/UMA profile area. For an RMZ, draw the downstream view of the stream and streambank as viewed from the stream channel. For UMAs an aerial view is drawn approximating the UMA shape. Here is an example:



Field 1 - RMZ or UMA Number (3 characters)
Indicates which RMZ or UMA is being sampled. RMZ/UMA numbers begin at 001 and continue, one at a time, as new sites are sampled. Circle RMZ or UMA to properly identify which is being sampled.

Field 2 - FPA Number (7 characters)
Use the 5 digit number preceded by the 2 digit DNR region identification number. Example: for the Central Region: 0 4 1 7 2 3 4.

Field 3 - Date (6 characters)
Record the month, day, and year of sampling effort. For example: record June 20, 1988 as 0 6 2 0 8 8.

Field 4 - Landowner (25 characters)
Record from FPA.

Field 5 - Field Crew (eight characters)
Record the first two letters of your first and last names. Do this for all the crew members who helped sample that portion of the RMZ/UMA.

Field 6 - Location
Record township, range, and section: T 1 5 R 4 8 E S 0 2.

Field 7 - Elevation (2 characters)
Enter the elevation at the midpoint of the RMZ or UMA to the nearest 100 feet. This measurement is recorded from U.S.G.S. Quadrant Maps or the harvest unit map.

Code	Actual Elevation
0 5	500 feet
3 6	3,570 feet
3 5	3,540 feet

Field 8 - Stream (15 characters)
Print the name of the stream here. Enter the name as designated on the USGS 7 1/2 or 15 minute Quadrant Maps or official water type maps. In some cases, no name will be available. On others, a named stream might branch into an unnamed tributary. If no name is given, record stream as "Unknown". In the case of unnamed tributaries, identify each by "Trib1," "Trib2," etc., on Card 1 and the FPA map.

Field 9 - Water Type (1 character)
Codes 1-5. Record from FPA or water type map. On Type 1 water of statewide significance, add a "+" to the water type.

Field 10 - Stream Substrate (1 character)
Record the dominant substrate in the stream bottom where the LOD sample was taken, as follows:

Code	Substrate
G	Gravel/cobble (Less than 50% of the dominant stones are <10 inches in diameter)
B	Boulder/bedrock (More than 50% of the dominant stones are > 10 inches in diameter and/or unbroken bedrock)

Field 11 - Harvest Unit Area (3 characters)
Record acres of harvest from FPA.

Field 12 - LOD distance (4 characters)
Record the distance in feet required to collect the LOD data.

<u>Field 13 - RMZ Length Measured</u> (5 characters)
Determine total length (feet) sampled. This is accomplished by multiplying the (number of strips - 1) by 250.

<u>Field 14 - RMZ 1 or 2 sided</u> (1 character)
Record whether the RMZ sampled is one or two sided.

<u>Field 15 - Distance to RMZ/UMA end</u> (3 characters)
Record the remaining distance in feet from the last strip to the end of the RMZ/UMA.

<u>Field 16 - UMA Area</u> (2 characters)
Record acres from FPA.

<u>Field 17 - UMA type</u> (2 characters)
Record the code best describing the dominant UMA vegetational characteristics:

UF = Upland Forest
FW = Forested Wetland
B = Bog (carex, sedge, etc.)

<u>Field 18 - UMA length measured</u> (3 characters)
Determine total length (feet) sampled. This is accomplished by multiplying the (number of strips - 1) by 250.

<u>Field 19 - Distance to Nearest Road</u> (4 characters)
Record distance from RMZ or UMA to nearest passable road in increments of 50 ft. Determine by either measuring while in the field or from U.S.G.S. Quadrant Maps. Code measurements as follows:

1 = 0 to 50 ft.
2 = 51 to 100 ft.
3 = 101 to 150 ft.
4 = 151 to 200 ft.
5 = 201 to 250 ft.
Etc.

<u>Fields 20 and 21 - Distance to Nearest Water and Water Type</u>
Do this for UMAs only.

Field 20 - (4 characters) Record distance (feet) from UMA to nearest stream or water body that is typed a 1, 2, 3, or 4 water.

Field 21 - (1 character) Record water type from official water type maps.

Fields 22 and 23 - Distance to Nearest Vegetative Type Change and Type

Do this only for UMAs surrounded by a clear-cut.

Field 22 - (4 characters) Record distance (feet) from UMA to the nearest vegetative type change.

Field 23 - (2 characters) Record the vegetative type as follows:

Use the first character to describe vegetative type.

Code	Vegetative Type
1	Grass-forb
2	Shrub-seedling
3	Sapling (<3" dbh)
4	Pole
5	Uneven-aged mature
6	Even-aged mature
7	Riparian
8	Other (Specify type in Remarks Section.)

Use the second character to specify the following characteristics of the vegetation:

Code	Characteristic
1	Open coniferous
2	Open deciduous
3	Open mixed coniferous/deciduous
4	Closed coniferous
5	Closed deciduous
6	Closed mixed coniferous/deciduous

For example, an open stand of mixed pole timber would be described as 4 3.

Fields 24, 25, and 26 - LOD

Measure each piece of LOD within the required distance, by stream substrate, within the ordinary high water marks from the beginning of the RMZ. Record LOD lengths in Field 24, diameters in Field 25, and type in Field 26. See Appendix B for details and illustrations.

Field 24 - (4 characters) Record LOD length to the nearest foot. Measure from the larger end toward the narrower end of the log to the point where the diameter is 4 inches. Record "X" (the distance within the highwater mark) and "Y" (the distance outside the highwater mark) separately. "Y" lengths can be estimated to five foot increments. Always measure the "X" length to the nearest foot.

Field 25 - (2 characters) Record the diameter taken at the larger end of the log, and within the highwater mark.

Field 26 - (1 character) Specify the type of log with the following codes:

Code	Log Type
C	Conifer
H	Hardwood
U	Unknown

NOTE: If you run out of space on Card 1A, use Card 1B to continue recording LOD pieces. Make sure you fill out Field 1 and the page numbers on all continuation cards.

Card 2 - STRIP PLOT DATA

Use one Card 2A and multiple Cards 2B, if necessary, for each strip plot. Fill out Field 1 as on Card 1A.

Field 27 - Stream direction (3 characters)
Measure stream direction where the strip centerline meets the water. Record direction of flow to the nearest degree (1-360), using leading zeros. Be sure to adjust the compass to the declinations provided in Appendix C.

Field 28 - Strip Number (3 characters)
Where an RMZ is located on both sides of the creek, or when measuring strip plots on both sides of a UMA axis, use separate sets of Cards 2 and 3 for each side. The first 2 characters (digits) refer to the strip within the UMA or RMZ. The last character (alphabetical) identifies which side of the stream or UMA axis the strip plot is on, as follows:

RMZs: Facing downstream, use "L" or "R" to identify which streambank strip is on.

UMAs: Facing along the axis or edge, use "L" or "R" to identify the side of axis or edge the strip is located.

For example, 0 3 R is the third strip in this RMZ or UMA, and it is on the right streambank as you face downstream, or to the right of the UMA axis or edge as you travel away from the UMA axis origin or edge.

Field 29 - Canopy (2 characters)
Record percent of canopy closure over the center of the stream. Ex: 100% = total canopy coverage. Canopy is measured in 5% increments. See Appendix D for canopy calculation instructions.

Field 30 - Stream Width (3 characters)
Measure stream width, between highwater marks, at all strip centerline origins and record depth to the nearest foot.

Field 31 - Stream Depth (2 characters)
Measure depth with graduated rod to the nearest tenth of a foot at four points across stream, as described in Appendix E, directly under where the strip centerline would cross. NOTE: Depth is averaged between the ordinary high water marks. If depth can not be determined circle the field and leave it blank.

Field 32 - Stream Gradient (2 characters)
Standing at water's edge, determine average stream gradient (percent) between strip boundaries (i.e., from 25 ft. above to 25 ft. below the strip center line).

Field 33 - RZ (Riparian Zone) Width (3 characters)
Record the Riparian Zone (RZ) width (feet) along strip centerline between points where the vegetation changes from a wetland to an upland plant community.

Field 34 - Strip Azimuth (3 characters
Record azimuth from stake along strip centerline.

Field 35 - Slope (3 characters)
Measure slope (percent) from stake along steepest gradient up slope. If there are multiple slopes calculate an average. Slope adjustment tables and conversion of steep slopes to horizontal distances are provided in Appendices F and G.

Field 36 - Slope Aspect (1 character)
Record the aspect of the hillside where you measured slope.

Code	Aspect	Code	Aspect
1	North	5	South
2	Northeast	6	Southwest
3	East	7	West
4	Southeast	8	Northwest
		9	Level or Rolling

NOTE: If there are multiple slopes make a note on Card 2 of the different slope aspects. Do not record a single aspect unless one aspect is in the vast majority. Again make note of this on Card 2.

Field 37 - Topographic Site (Physiographic Location) (1 character)
Topographic site provides a description of the sample plots with regard to water concentration or dispersion characteristics as indicated by the local physiographic variations within the stand. Scale of recognition is that of spur ridges and draws.

Code	Description
1	Sharp ridgetop
2	Flat ridgetop
3	Sidehill - upper 1/3
4	Sidehill - middle 1/3
5	Sidehill - lower 1/3
6	Canyon bottom
7	Bench or Terrace
8	Broad flat

NOTE: Codes 1, 3, 4, and 5 can only be applied to UMAs.
Codes 2, 6, 7, and 8 can be applied to either RMZs or UMAs.

Field 38 - Rz plant association (8 characters)
Plant associations are used to characterize the habitat sampled. Using Forest Service Plant Association Keys, when applicable, the habitat is characterized into associations. Here the species code for the associated riparian vegetation is recorded. An example of the Forest Systems Association Concept is provided in Appendix H. The Gifford Pinchot National Forest is exampled with the method to key out the TSHE/LYAM plant association is shown by an asterisks.

Field 39 - Upland plant association (8 characters)
By using Forest Service Association Keys, again when possible, record the species code for the associated upland vegetation. An example of the Forest Systems Association Concept is provided in Appendix H. The Gifford Pinchot National Forest is exampled with the method to key out the TSHE/POMU plant association is shown by an asterisks.

Field 40 - Final subplot length (1 character)
If the final subplot is 10 feet long record a 0 in this space. If the final length is not 10 feet record the distance in feet here. Ex: If the last subplot is 2 feet long record the final subplot length as 2.

Field 41 - Tree Class (1 character)
Tree class is used to describe physical conditions of each sample tree. See Appendix I for snag types. (Record downed wood as cover on Card 3.)

Code	Tree Class
1	Live tree, undamaged
2	Snag Type 1 - Recent dead
3	Snag Type 2 - Live tree, 1/3 to 1/2 of the top broken out.
4	Snag Type 3 - Live tree, dead top.
5	Snag Type 4 - Older dead, bark tight
6	Snag Type 5 - Older dead, no bark
S	Stump 5 yr old or older
R	Stump < 5 yr old

Field 42 - Species (3 characters)
For each tree (not including stumps), use the following codes to identify species: Example, 2 0 2 for Douglas-fir.

Alaska cedar	042	Pacific yew	231
big leaf maple	312	ponderosa pine	122
bitter cherry	760	quaking aspen	746
black cottonwood	747	red alder	351
Douglas-fir	202	Sitka spruce	098
Engleman spruce	093	subalpine fir	019
grand fir	017	western hemlock	263
lodgepole pine	108	western larch	073
mountain hemlock	264	western paper birch	376
Noble fir	022	western red cedar	242
Oregon white oak	815	western white pine	119
Pacific dogwood	492	white fir	015
Pacific madrone	361	willow	920
Pacific silver fir	011	all other hardwoods	999

<u>Field 43 - Size class</u> (1 character)
Record the diameter at breast height (4.5 feet above ground level on the uphill side of the tree) of the trees sampled in four inch increments. See appendix J. Methods to measure forked trees can be found in Appendix K. Use the following coding scale:

Size class	Diameter increment (in.)
1	0 - 3.9
2	4 - 7.9
3	8 - 11.9
4	12 - 15.9
5	16 - 19.9
6	20 - 23.9
7	24 +

<u>Field 44 - Total</u> (1 character)
Record the total number of trees, by species, within the same size class and tree class, per strip.

Card 3 - SUBPLOT DATA

For each subplot, record data as explained below. Use as many continuation cards (Cards 3A and 3B) as needed to sample all subplots. For each continuation card, fill out Fields 1, 5 and 28 as on Cards 1 and 2.

<u>Field 45 - Subplot Number</u> (2 characters)
Number subplots consecutively along strip centerline, beginning at streambank, on the upstream side for an RMZ, or the equivalent upstream side of the axis on a UMA (strip centerlines on UMAs begin at the "upstream" end). All length measurements are horizontal measurements. Slope correction is required on all slopes.

<u>Field 46 - Canopy</u> (2 characters)
Record percent of canopy closure from the center of each subplot. See Appendix D for instructions.

<u>Field 47 - Dominant Shrub</u> (5 characters)
Use standard plant identification codes (Garrison et al., 1976) based on the first two letters of the genus and species. There are two fields to record the dominant shrubs. The first field is for the most dominant shrub species found within the subplot. The second field is for the second most dominant shrub species. Dominance is determined by the shrub that covers the largest percentage of the subplot, not by the physical size of the shrub.

Field 48 - Domshrub (1 character)
Record the coverage class of the two dominant shrubs as follows:

Coverage class	Percentage of plot covered
1	0 - 5%
2	5 - 25%
3	25 - 50%
4	50 - 75%
5	75 - 95%
6	95 - 100%

Field 49 - Shrubs (1 character)
Record the total (combined) coverage class of all shrubs within the subplot. Use coverage classes listed for field 48.

Field 50 - Dominant herbs (5 characters)
Use standard plant identification codes (Garrison et al., 1976) based on the first two letters of the genus and species. There are two spaces for dominant herbs. The first field is for the most dominant herb species found within the subplot. The second field is for the second most dominant herb species. Dominance is determined by the herb that covers the largest percentage of the subplot, not by the physical size of the herb.

Field 51 - Domherb (1 character)
Record the coverage class of the two dominant herbs with codes found in Field 48.

Field 52 - Forbs (1 character)
Record the total coverage of all forbs, not including grasses or shrubs, in the coverage class codes listed in Field 48.

Field 53 - Graminoids (1 character)
Record the total coverage of all grasses and sedges in the coverage class codes listed in Field 48.

Fields 54 to 60 Cover Type (1 character)
These fields describe cover at the ground level exclusive of living vascular plants. DW1, DW2, and DW3 are downed woody material in different stages of decomposition. An explanation of these three classes is provided in Appendix L. Water cover is based on open water. Rock coverage is based on exposed rock. Soil coverage is based on exposed soil. OGC is organic ground cover and includes litter, duff, mosses, lichens, and fungi. OGC does not include the downed woody coverage that was recorded earlier.

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Figure 1. Riparian Management Zone (RMZ) Main strip plot

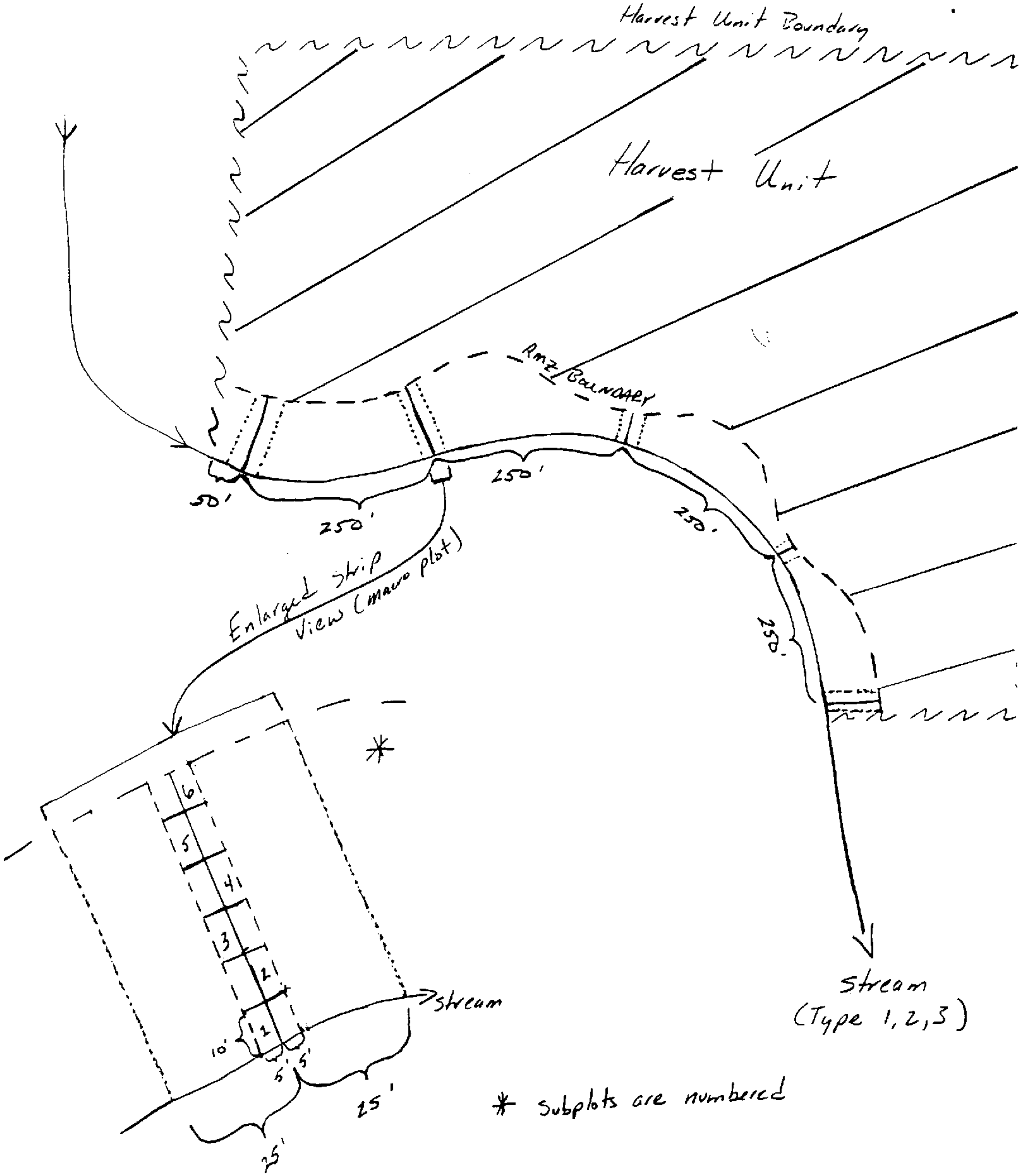
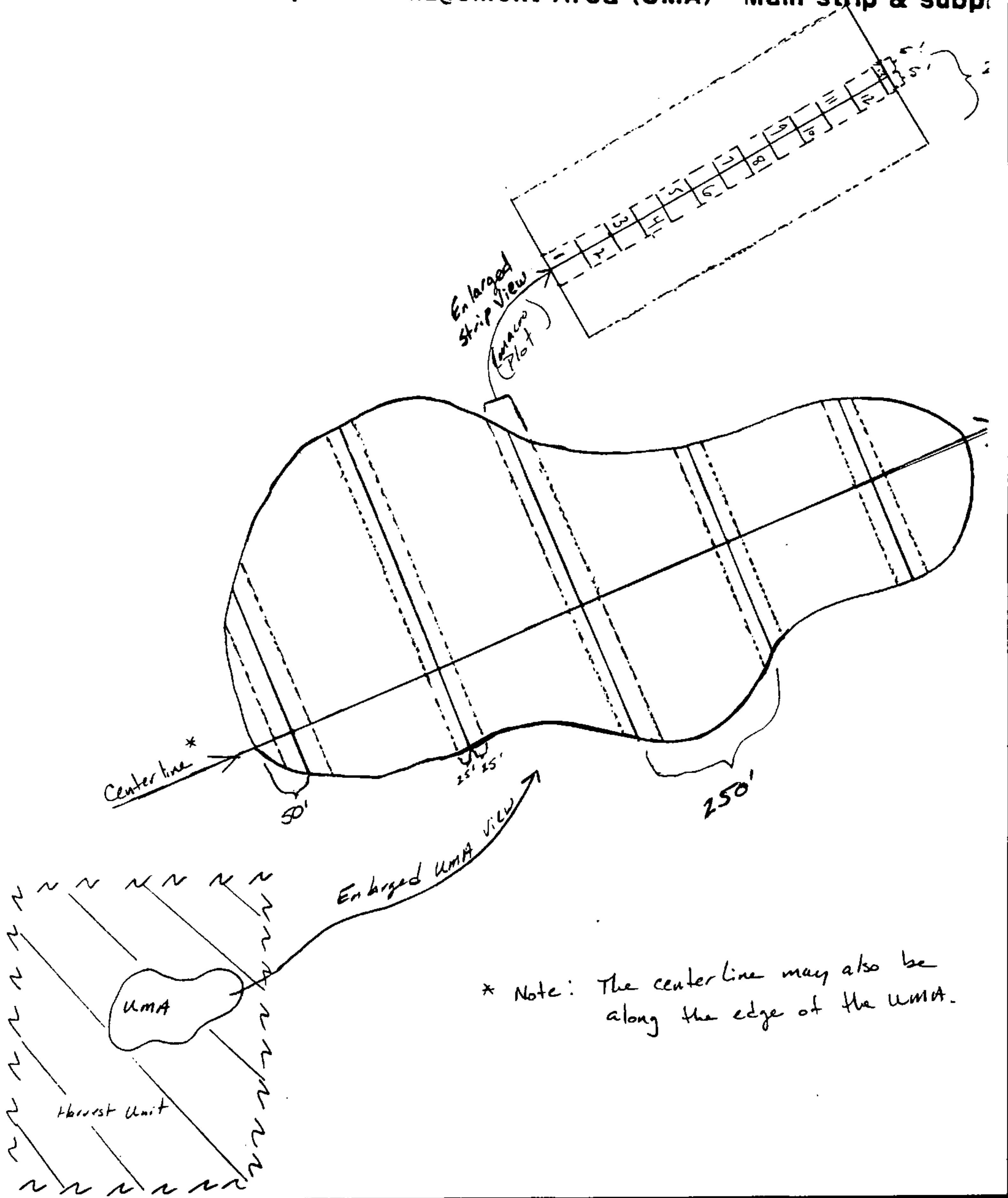


Figure 2. Upland Management Area (UMA) Main strip & subp



FIELD DATA SHEETS

There are three types of data cards:

Card 1A -- RMZ/UMA LOCATION, GENERAL INFORMATION
Card 1B -- RMZ/UMA LOD
Card 2A -- STRIP PLOT DATA
Card 2B -- STRIP PLOT TREE DATA (continued)
Card 3A -- SUBPLOT DATA
Card 3B -- SUBPLOT DATA (continued)

Use only one Card 1 (and 1A, if necessary) for each RMZ or UMA. Use a separate set of Cards 2 and 3 (and their continuation cards, as necessary) for each strip. Number all cards for an RMZ or UMA consecutively in the upper right corners. Multiple cards may sometimes be required within a strip. Instructions and codes for filling out each data field are provided in Section IV of the Field Procedures Handbook.

Examples of field sheets are included in the following pages. Small digits under fields refer to field numbers in the handbook, Section IV.

NOTE: When filling out cards, USE LEADING ZEROS THROUGHOUT.

Card 1 - RMZ/UMA LOCATION , GENERAL INFORMATION AND LOD

Complete one Card 1 for each RMZ or UMA. Use the reverse side to draw a sketch of the RMZ or UMA being sampled and for any remarks. Also, for an RMZ, draw a representative profile (cross-section) of the streambank as viewed from the stream channel looking downstream. See illustrations in handbook.

Card 2 - STRIP PLOT DATA

Use one Card 2A and multiple Cards 2B, if necessary, for each strip plot.

Card 3 - SUBPLOT DATA

Cards 3A/B are used to record subplot data. Use as many continuation cards as needed to complete sampling all subplots.

* Example

CARD 1A -- RMZ/UMA LOCATION, GENERAL INFORMATION

*RMZ/UMA |1|4|5| (number) 1   *FPA |0|9|1|2|3|4|5| (number) 2   *Date |9|9|0|5|2|1| (Y Y M M D D) 3   pg 1 of 4

*Landowner |D|W|R|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| 4   *Field Crew |A|W|G|A| |M|O|J|O| 5

*Location T|1|5|R|4|8|E|S|0|2| 6   *Elevation |1|0| 7 (100s of ft)

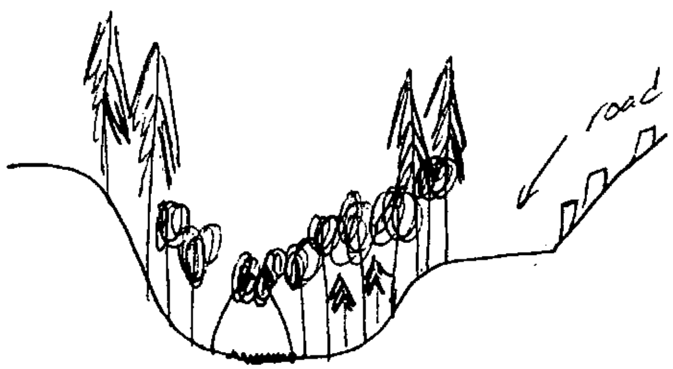
*Stream |U|N|K|N|O|W|N|_|_|_|_|_|_|_|_| 8   *Type |3| 9   *Stream Substrate |G| 10

Sizes	From FPA	Measured
* Harvest Unit area (acres)	|0|5|5| 11	
* LOD distance		|0|6|0|0| 12
* RMZ length (feet)		|0|3|2|5|0| 13
* RMZ 1 or 2 sided		1 14
* Distance to RMZ end		|0|5|0| 15
* UMA area	|_|_| 16	
* UMA type		|_|_|_| 17
* UMA length measured (feet)		|_|_|_| 18

Distances (ft) to nearest:

Road |0|1|0|0| 19   Water |_|_|_|_| 20   Type |_| 21   Vegetation |_|_|_|_| 22   Type |_|_| 23

RMZ Profile (Downstream view)



Remarks: ____________________

CARD 1B -- RMZ/UMA LOD

(RMZ)/UMA |2|4|5|
1 (number)

Large Organic Debris (LOD)

Length 24 X	Length 24 Y	Diameter 25	Type 26	Length 24 X	Length 24 Y	Diameter 25	Type 26	Length 24 X	Length 24 Y	Diameter 25	Type 26
1 0	2 0	1 0	4								
3 0	2 5	0 9	C								
2 8	1 0	0 5	W								
										50 PIECES	
(ft)	(ft)	(in)		(ft)	(ft)	(in)		(ft)	(ft)	(in)	

CARD 2A -- STRIP PLOT DATA

RMZ/UMA |1|4|5| (number)
1

Stream direction |2|1|Ø| 27 (degrees) Strip |Ø|1|8| 28 (number) Canopy |9|5| 29 (%) Width |Ø|L|Ø| 30 (ft)

Depth |Ø.|4| 31 (ft) Gradient |Ø|2| 32 (%) RZ Width |Ø|2|3| 33 (ft) Strip azimuth |3|Ø|Ø| 34 (degrees)

Slope |Ø|3|4| 35 (%) Slope aspect |2| 36 Topographic site |8| 37

Rz Plant Association |T|S|H|E|/|L|Y|A|M| 38 Final Subplot Length |4| 40 (ft)

Upland Plant Association |T|S|H|E|/|P|O|M|U| 39 Field Crew |A|N|L|A| |M|O|T|O| 5

TREE DATA

Class 41	Species 42	Size Class 43	Total 44	Class 41	Species 42	Size Class 43	Total 44
1	351	6	3				
1	351	2	2				
2	2Ø2	1	6				
5	Ø11	3	2				
5		1	1				
8			5				

Size Class: 1 = ≤4; 2 = 4 - 7.9; 3 = 8 - 11.9; 4 = 12 - 15.9; 5 = 16 - 19.9; 6 = 20 - 23.9; 7 = >24 (Range)

CARD 2B -- STRIP PLOT TREE DATA (continued)

RMZ/UMA |_|_|_| (number)
1

pg __ of __

Strip |_|_|_|
28 (number)

TREE DATA

Size Classes: ≤4 4 - 7.9 8 - 11.9 12 - 15.9 16 - 19.9 20 - 23.9 ≥24

Class 41	Species 42	Size Class 43	Total 44	Class 41	Species 42	Size Class 43	Total 44

CARD 3A -- SUBPLOT DATA

RMZ/UMA |1|4|5| (number)

Field Crew |A|N|C|A| |M|O|J|O|

Strip |Ø|1|4| (28) — Subplot |Ø|1| (45) — Canopy |9|5| (46) (%)

Cover Codes: 1=trace-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%

Dominant Shrub (47)	RHUSP	DomShrub (48)	6	Shrubs (49)	6	Forbs (52)	6	Graminoids (53)	1
Dominant Shrub (47)	OPHO	DomShrub (48)	2	DW1 (54)	Ø	DW2 (55)	Ø	DW3 (56)	2
Dominant Herb (50)	LYAM	DomHerb (51)	5	Water (57)	1	Rock (58)	1		
Dominant Herb (50)	T9ME	DomHerb (51)	2	Soil (59)	Ø	OGC (60)	5		

Subplot |Ø|2| (45) — Canopy |9|9| (46) (%)

Cover Codes: 1=trace-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%

Dominant Shrub (47)	MEFE	DomShrub (48)	3	Shrubs (49)	5	Forbs (52)	6	Graminoids (53)	1
Dominant Shrub (47)	COCO2	DomShrub (48)	2	DW1 (54)	1	DW2 (55)	Ø	DW3 (56)	Ø
Dominant Herb (50)	LYAM	DomHerb (51)	5	Water (57)	Ø	Rock (58)	1		
Dominant Herb (50)	HEMI	DomHerb (51)	3	Soil (59)	1	OGC (60)	6		

Subplot |Ø|3| (45) — Canopy |8|9| (46) (%)

Cover Codes: 1=trace-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%

Dominant Shrub (47)	MEFE	DomShrub (48)	2	Shrubs (49)	3	Forbs (52)	6	Graminoids (53)	1
Dominant Shrub (47)	ALLNUS	DomShrub (48)	1	DW1 (54)	Ø	DW2 (55)	2	DW3 (56)	Ø
Dominant Herb (50)	OXOR	DomHerb (51)	5	Water (57)	Ø	Rock (58)	Ø		
Dominant Herb (50)	POMU	DomHerb (51)	4	Soil (59)	Ø	OGC (60)	6		

CARD 3B -- SUBPLOT DATA (continued)

RMZ/UMA |_|_|_|
1 (number)

pg __ of __

Field Crew |_|_|_|_| |_|_|_|_| 5

==

Strip |_|_|_| 28 Subplot |_|_| 45 Canopy |_|_| 46

Cover Codes: 1=trace-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%

Dominant Shrub |_|_|_|_|_|_| 47 DomShrub |_| 48 Shrubs |_| 49 Forbs |_| 52 Graminoids |_| 53

Dominant Shrub |_|_|_|_|_|_| 47 DomShrub |_| 48 DW1 |_| 54 DW2 |_| 55 DW3 |_| 56

Dominant Herb |_|_|_|_|_|_| 50 DomHerb |_| 51 Water |_| 57 Rock |_| 58

Dominant Herb |_|_|_|_|_|_| 50 DomHerb |_| 51 Soil |_| 59 OGC |_| 60

==

Subplot |_|_| 45 Canopy |_|_| 46

Cover Codes: 1=trace-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%

Dominant Shrub |_|_|_|_|_|_| 47 DomShrub |_| 48 Shrubs |_| 49 Forbs |_| 52 Graminoids |_| 53

Dominant Shrub |_|_|_|_|_|_| 47 DomShrub |_| 48 DW1 |_| 54 DW2 |_| 55 DW3 |_| 56

Dominant Herb |_|_|_|_|_|_| 50 DomHerb |_| 51 Water |_| 57 Rock |_| 58

Dominant Herb |_|_|_|_|_|_| 50 DomHerb |_| 51 Soil |_| 59 OGC |_| 60

==

Subplot |_|_| 45 Canopy |_|_| 46

Cover Codes: 1=trace-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%

Dominant Shrub |_|_|_|_|_|_| 47 DomShrub |_| 48 Shrubs |_| 49 Forbs |_| 52 Graminoids |_| 53

Dominant Shrub |_|_|_|_|_|_| 47 DomShrub |_| 48 DW1 |_| 54 DW2 |_| 55 DW3 |_| 56

Dominant Herb |_|_|_|_|_|_| 50 DomHerb |_| 51 Water |_| 57 Rock |_| 58

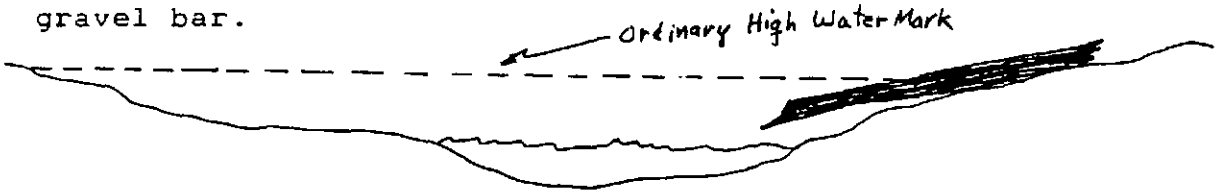
Dominant Herb |_|_|_|_|_|_| 50 DomHerb |_| 51 Soil |_| 59 OGC |_| 60

Appendix B

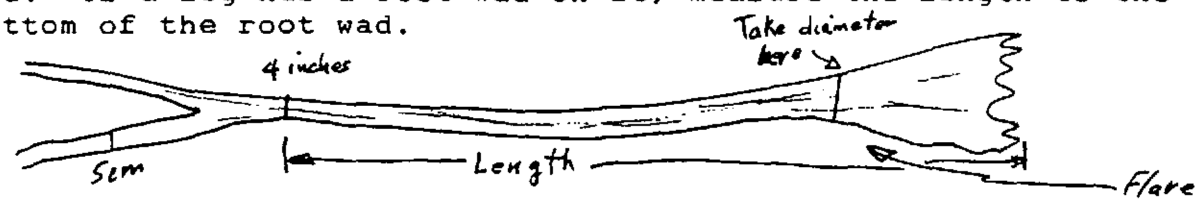
MEASURING LARGE ORGANIC DEBRIS (LOD)

Any piece of wood at least 4 inches in diameter at the small end and 10 feet long is considered LOD, including live trees. The log (or tree) must be partially or completely within the ordinary high water marks. In other words, it must have potential to influence flow during ordinary high water conditions.

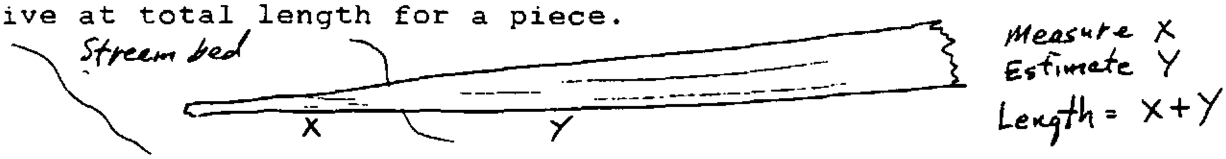
NOTE: The ordinary high water mark is distinguished by the vegetation line, and the soil surface should be organic, not a gravel bar.



Measure log diameter (Field 23) at the widest part, but avoid going beyond the "flare" at the big end of a log. Measure length (Field 22) from the 4-inch diameter point to the large end. If a log has a root wad on it, measure the length to the bottom of the root wad.



If a single log is broken into two separate pieces, it counts as two pieces of LOD. If the pieces are still attached, count it as one piece. Always measure lengths within ordinary high water mark, but you may estimate portions of LOD logs that extend for a long distance on shore and add the measurement and estimate to arrive at total length for a piece.



If an obviously long piece of LOD is buried with less than 10 feet showing, record the length as 10 feet.

The substrate type will determine how many pieces must be measured within the 500-foot plot, as follows.

Gravel/cobble -- at least 50 pieces
Boulder/bedrock -- at least 25 pieces

If you don't get the required number of pieces in 500 feet, extend the study by 25-foot increments until you reach the minumum number. Don't go beyond 1,000 feet in any case.

If the study length is different from 500 feet, note that in the Remarks Section and write "See remarks" on Card 1 at the top of the LOD section. This could occur when the RMZ is shorter than 500 feet or when the number of LOD pieces is not enough.

Appendix C

COMPASS
Local Declinations

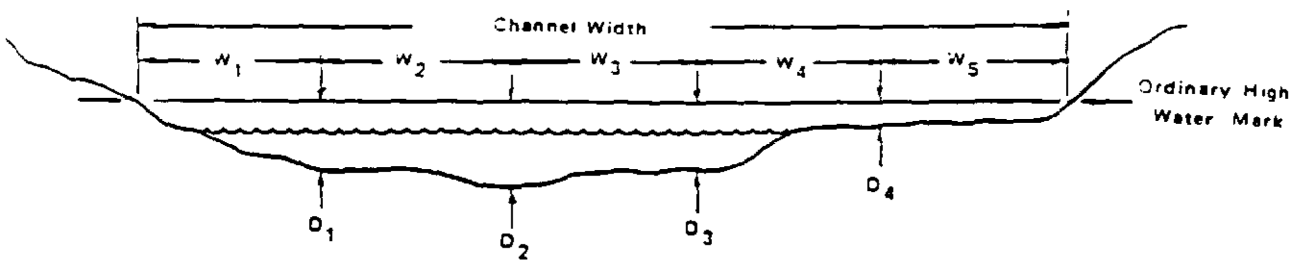
Adjust for magnetic declination by county.

East County	decl	East County	decl
Adams	21 1/2	Klickitat	21
Asotin	20 1/2	Lewis	22
Benton	21	Lincoln	23
Chelan	22 1/2	Mason	22 1/2
Clallam	23	Okanogan	22 1/2
Clark	21 1/2	Pacific	22
Columbia	20 1/2	Pend Oreille	22 1/2
Cowlitz	22	Pierce	22
Douglas	22 1/2	San Juan	23 1/2
Ferry	22 1/2	Skagit	23
Franklin	22 1/2	Skamania	21
Garfield	21	Snohomish	22 1/2
Grant	21 1/2	Spokane	21 1/2
Grays Harbor	22 1/2	Stevens	22 1/2
Island	23	Thurston	22 1/2
Jefferson	23	Wahkiakum	22
King	22	Walla Walla	21
Kitsap	22 1/2	Whatcom	23 1/2
Kittitas	21 1/2	Whitman	21
		Yakima 21 1/2	

TREE CANOPY CLOSURE
SPHERICAL DENSIOMETER

At each measurement point (every 10 feet along the strip centerline), the densiometer is set up according to the manufacturer's instructions. Each of the points on the densiometer is viewed to determine whether it intercepts sky or trees. The densiometer uses a 96 dot grid. On the average, each dot intercept represents 1% canopy closure. This estimate will give an error of less than 5% (Hays et al., 1981). The measurement should be taken four times at each point, facing in each of the cardinal directions (north, south, east, and west). These values should be averaged before entry on the data sheet.

To calculate the stream depth, first divide the stream width into at least 4 equal segments. At each dividing point measure the height from the bottom of the stream to the ordinary high-water mark. (Some artificial method of marking the high-water mark in the middle of the stream may be required.) Care should be taken to avoid measuring near boulders, in large pools or other bottom irregularities. Add up all the depths and divide the total by the number of measurements. This is the average stream depth at this point. An example calculation is shown below.



D1 = 0.35 ft.
D2 = 0.65 ft.
D3 = 0.35 ft.
D4 = 0.10 ft.

DT = 1.45 ft.

$$\text{Stream Depth} = \frac{\text{Sum of Depths (DT)}}{\text{\# of measurements}} = \frac{1.45 \text{ ft.}}{4} = 0.36 \text{ ft.}$$

Figure 8. Determination of stream depth.

The average stream depth for a given reach can be calculated as the average of the individual stream depths in that reach (Figure 7). For application of this measurement, see WAC 222-24-020 and WAC 222-24-040.

Appendix E
F-1

Table 1 - SLOPE ADJUSTMENT IN ONE PERCENT INCREMENTS

Slope	Expansion Factor	Expansion Factor Reciprocal	Slope	Expansion Factor	Expansion Factor Reciprocal
5	1.000		44	1.093	.914
6	1.001		45	1.097	.910
7	1.002		46	1.101	.906
8	1.003		47	1.105	.902
9	1.004		48	1.110	.898
10	1.005	1.000	49	1.114	.894
11	1.006	.998	50	1.118	.890
12	1.007	.996	51	1.123	.888
13	1.008	.994	52	1.127	.886
14	1.009	.992	53	1.132	.884
15	1.010	.990	54	1.136	.882
16	1.012	.988	55	1.141	.880
17	1.014	.986	56	1.146	.876
18	1.016	.984	57	1.151	.872
19	1.018	.982	58	1.156	.868
20	1.020	.980	59	1.161	.864
21	1.022	.978	60	1.166	.860
22	1.024	.976	61	1.172	.856
23	1.026	.974	62	1.177	.852
24	1.028	.972	63	1.183	.848
25	1.031	.970	64	1.188	.844
26	1.034	.968	65	1.194	.840
27	1.036	.966	66	1.199	.836
28	1.039	.964	67	1.205	.832
29	1.041	.962	68	1.210	.828
30	1.044	.960	69	1.216	.824
31	1.047	.956	70	1.221	.820
32	1.050	.952	71	1.227	.816
33	1.054	.946	72	1.233	.812
34	1.057	.944	73	1.238	.808
35	1.060	.940	74	1.244	.804
36	1.063	.938	75	1.250	.800
37	1.067	.936	76	1.256	.796
38	1.070	.934	77	1.262	.792
39	1.074	.932	78	1.269	.788
40	1.077	.930	79	1.275	.784
41	1.081	.926	80	1.281	.780
42	1.085	.922	81	1.287	.776
43	1.089	.918	82	1.293	.772

Table 1 - SLOPE ADJUSTMENT (con't)

Slope	Expansion Factor	Expansion Factor Reciprocal
83	1.300	.768
84	1.306	.764
85	1.312	.760
86	1.319	.756
87	1.325	.752
88	1.332	.748
89	1.338	.744
90	1.345	.740
91	1.352	.736
92	1.359	.732
93	1.365	.728
94	1.372	.724
95	1.379	.720
96	1.386	.716
97	1.393	.712
98	1.400	.708
99	1.407	.704
100	1.414	.700
101	1.421	.698
102	1.428	.696
103	1.436	.694
104	1.443	.692
105	1.450	.690
106	1.457	.686
107	1.464	.682
108	1.472	.678
109	1.479	.674
110	1.486	.670
111	1.494	.668
112	1.501	.666
113	1.509	.664
114	1.516	.662
115	1.524	.660
116	1.532	.656
117	1.539	.652
118	1.547	.648
119	1.554	.644
120	1.562	.640
121	1.567	.636
122	1.578	.632
123	1.585	.628
124	1.593	.624
125	1.601	.620
126	1.609	.618
127	1.617	.616
128	1.624	.614
129	1.621	.612
130	1.640	.610
131	1.648	.608
132	1.656	.606
133	1.664	.604
134	1.672	.602
135	1.680	.600
136	1.688	.596
137	1.696	.592
138	1.704	.588
139	1.712	.584
140	1.720	.580
141	1.728	.578
142	1.736	.576
143	1.745	.574
144	1.753	.572
145	1.761	.570
146	1.769	.566
147	1.778	.562
148	1.786	.558
149	1.795	.554
150	1.803	.550

DISTANCE CORRECTION

a. Slope dist. x % slope exp. factor = adj. slope dist.

b. Slope dist. x exp. factor recip. = Hor. dist.

c. Slope dist. x Cos. of vert. angle = Hor. dist.

TREE HEIGHT CALCULATION

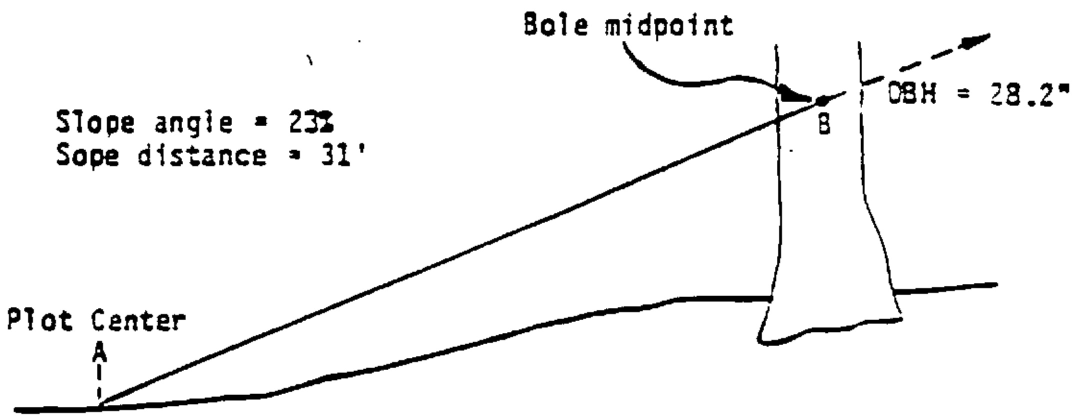
a. Hor. dist. x (Upper % ± Lower %) = Total Height

b. $Tan_1 \pm Tan_2$ x hor. dist. = Total Height

Slope Distance Measurement with Conversion to Horizontal Distance - Measure the slope distance and slope angle from point A to point B as shown below.

Measure slope in percent and consult the slope tables to determine the expansion factor reciprocal of that angle. Multiply the reciprocal times the measured slope distance to find the equivalent horizontal distance.

\- - - - - - - - - Example A - - - - - - - - -



From) the expansion factor reciprocal for 23 percent slope = .974.

.974 x 31'(slope distance) = 30.2'(horizontal distance)

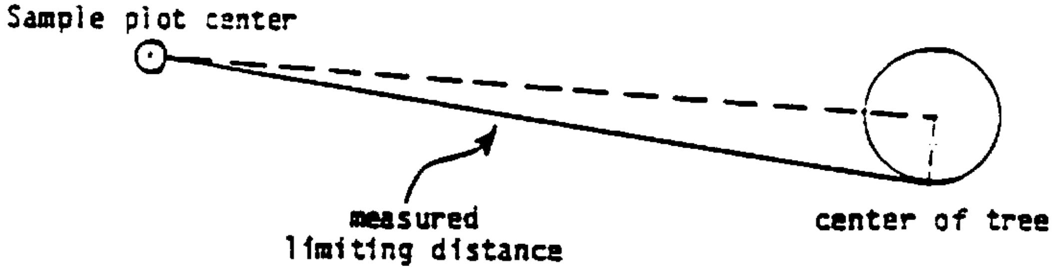
\- - - - - - - - - Example B - - - - - - - - -

If the angle of the slope from eye level above the stake to eye level on the tree bole is measured in degrees instead of percent take the COS of the angle, times the slope distance to find horizontal distance. Using the figure in Example A:

23% = 13^{0}
COS 13° x 31'(slope distance) = 30.2'(horizontal distance)

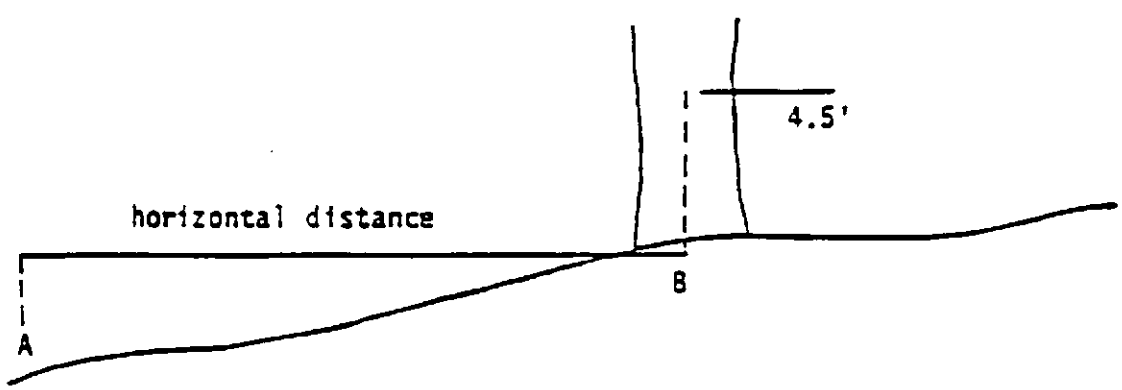
Trees with oblong, egg shaped or irregular boles should always be checked with a tape whenever questionable. The irregular shape of these boles does not give a true image of tree diameter.

The limiting distance to all questionable trees must be checked with a tape. Hold the tape at DBH at the "center of the tree", perpendicular to a line from the sample plot center to the tree.



Determine the limiting distance and compare it to the horizontal or slope distance from the sample plot center to the center of the tree by one of the following methods:

Direct horizontal distance measurement - Measure the horizontal distance from point A to point B as illustrated below, and compare to tree's tabular limiting distance (Table 2, page M9).



Plumb lines should be dropped to point A and B to insure perpendicular measurements (two to four ounce fishing sinkers on nylon cord make good plumb bobs).

Appendix H
Armour H-1

United States
Department of
Agriculture

Forest Service

**Pacific
Northwest
Region**

R6 – ECOL – 230A – 1986

Plant Association and Management Guide for the Western Hemlock Zone

Gifford Pinchot National Forest

Introduction

Plant associations are groupings of plant species which reoccur on the landscape within particular environmental tolerances. Knowledge of plant associations can greatly aid land managers to "read" and understand environmental variability. This leads to more accurate treatment response prediction and analysis of resource potential.

Associations can serve as particularly useful tools for the land manager:

(1) by indicating environmental features of sites;
(2) by providing greater site specificity and applicability when communicating research results and management experience;
(3) by predicting management response and better prescription of suitable activities;
(4) by serving as a natural inventory system of land resources.

This guide presents the plant association classification for the Western Hemlock Zone of the Gifford Pinchot National Forest. The bulk of the Forest below about 3000 feet in elevation is included in this zone, comprising about one half of the entire land base. Much of this area is blanketed with productive stands of Douglas-fir.

What is the Western Hemlock Zone?

The Western Hemlock Zone is biologically defined as those lands where western hemlock is expected to be the dominant tree species given an opportunity to achieve a long-term stable state. In practice, it includes areas where western hemlock is the primary regenerating tree species in mature stands. The Western Hemlock Zone is further delineated by the relative lack of regeneration by tree species which indicate harsher environments: Pacific silver fir, mountain hemlock and subalpine fir at higher elevations and Douglas-fir, grand fir and Oregon white oak on drier sites.

What is in this guide?

This guide is designed to present and to document the properties of Western Hemlock Zone plant associations. This chapter first discusses classification concepts which help explain fundamental terminology and biological processes. We then outline our study methods and highlight some of the uses of this association classification. Chapter two provides an ecosystem perspective to the chief factors affecting the vegetation resource. This includes an overview of the entire Western Hemlock Zone, and more detailed presentations on physical (climate, geology, soils) and biological (forest floor, snag and fallen tree, forage, and timber) properties of the plant associations.

The dichotomous key to plant associations in Chapter 3 helps us determine the particular association present at any given site. Detailed descriptions form the body of this guide (Chapter 4). They are the basic reference to the classification system and should always be consulted before designating the association at a locale.

Plant Association Names and Ecoclass Codes

Plant associations are complex groupings of plant species. We name associations after the more prominent tree, shrub or herb species present in mature stands. The named species are usually those characteristic of a particular environment: they need not be the most abundant species present. We have tried to use common English names for all species. The associations are more conveniently referenced by the 4 letter computer codes derived from the Latin names (Garrison et al. 1976). This shorthand system is very useful for regular users. Casual users of the plant association classification system should not be scared off by this jargon; it can be avoided if you so wish. Major tree, shrub and herb species are listed in Table 17 by their common, Latin and code names.

Plant association designations are coordinated within the Pacific Northwest Region (R6) of the Forest Service by the Regional Ecologist. Associations are given specific Ecoclass codes (Hall 1984) which form the basis of documenting the land base with the Total Resource Information (TRI) systems on each National Forest.

The plant associations and their distributions are listed in Table 1. Throughout this guide the order of the associations follows an approximate moisture gradient from wet to dry.

Table 1. Names, abbreviations, Ecoclass codes and general geographic locations of the Western Hemlock Zone Plant Associations of the Gifford Pinchot National Forest.

PLANT ASSOCIATION	SCIENTIFIC NAME	ABBREVIATION	ECOCLASS CODE	GEOGRAPHIC LOCATION
Wet Group:				
Western hemlock/ Skunk-cabbage	Tsuga heterophylla/ Lysichitum americanum	TSHE/LYAM	CHM1-21	saturated sites, GP and MH NF's
Western hemlock/ Ladyfern	Tsuga heterophylla/ Athyrium filix-femina	TSHE/ATFI	CHF4-21	very moist sites, west and north ends of GP
Western hemlock/ Devil's Club/ Swordfern	Tsuga heterophylla/Oplopanex horridum/Polystichum munitum	TSHE/OPHO/POMU	CHS5-24	very moist sites, especially west side of GP NF
Moist group:				
Western hemlock/ Swordfern-Oregon Oxalis	Tsuga heterophylla/Polystichum munitum-Oxalis oregana	TSHE/POMU-OXOR	CHF1-24	moist sites, mostly lower elevations, GP and MH NF's
Western hemlock/ Alaska huckleberry/Oregon oxalis	Tsuga heterophylla/ Vaccinium alaskaense/Oxalis oregana	TSHE/VAAL/OXOR	CHS6-13	western edge of GP and mid elev of Bull Run, MH NF
Western hemlock/ Coolwort foamflower	Tsuga heterophylla/ Tiarella trifoliata	TSHE/TITR	CHF2-22	moist sites, higher elev TSHE zone, west side of GP NF
Western hemlock/ Swordfern	Tsuga heterophylla/ Polystichum munitum	TSHE/POMU	CHF1-25	moist sites, lower slopes widespread; GP type
Mesic group:				
Western hemlock/Dwarf Oregon grape/Swordfern	Tsuga heterophylla/Berberis nervosa/Polystichum munitum	TSHE/BENE/POMU	CHS1-26	very widespread, mesic sites GP and MH NF's

PLANT ASSOCIATION	SCIENTIFIC NAME	ABBREVIATION	ECOCLASS CODE	GEOGRAPHIC LOCATION
Mesic group (cont.):				
Western hemlock/ Alaska huckleberry/dogwood bunchberry	Tsuga heterophylla/Vaccinium alaskaense/Cornus canadensis	TSHE/VAAL/COCA	CHS6-15	higher elevations of TSHE zone GP and MH NF's
Western hemlock/ Alaska huckleberry- Salal	Tsuga heterophylla/Vaccinium alaskaense-Gaultheria shallon	TSHE/VAAL-GASH	CHS6-14	higher elevations of TSHE zone GP and MH NF's
Western hemlock/ Vanilla-leaf	Tsuga heterophylla/ Achlys triphylla	TSHE/ACTR	CHF2-21	widespread throughout TSHE zone, GP and MH NF's
Western hemlock/ Dwarf Oregon grape	Tsuga heterophylla/ Berberis nervosa	TSHE/BENE	CHS1-25	higher elevations of TSHE zone upper slopes, GP and MH NF's
Western hemlock/ Dwarf Oregon grape-salal	Tsuga heterophylla/Berberis nervosa-Gaultheria shallon	TSHE/BENE-GASH	CHS1-27	widespread but more on east GP ridges and upper slopes
Dry group:				
Western hemlock/ Salal	Tsuga heterophylla/ Gaultheria shallon	TSHE/GASH	CHS1-28	more on east TSHE zone, ridges and upper slopes
Western hemlock/ Dogwood/ Vanilla-leaf	Tsuga heterophylla/Cornus nuttallii/Achlys triphylla	TSHE/CONU/ACTR	CHS2-24	southern GP NF, south slopes lower elevations
Western hemlock-Douglas-fir/ Oceanspray	Tsuga heterophylla-Pseudotsuga menziesii/Holodiscus discolor	TSHE-PSME/HODI	CHC2-12	ridges, S slopes, SE GP TSHE zone, cliffs on MH NF
Western hemlock-Douglas-fir-Madrone	Tsuga heterophylla-Pseudotsuga menziesii-Arbutus menziesii	TSHE-PSME-ARME	CHC2-13	rock outcrops, especially above Cowlitz River Valley

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Plant Associations as Indicators of Environment

A mountain ecosystem is a mosaic of different environments, each having its own unique physical and biotic characteristics. Plant communities that occupy these different sites are a function of the land's topography, geology, climate, herbivorous animals and those which disperse seeds, pathogens, and the habitat requirements of the plants available to vegetate the land.

In a sense, the environment acts as a screen (illustrated in Fig. 1) to prevent reproductive success of species unsuited to a given site. In a typical stream drainage for instance, seed from a wide variety of plants makes up the "seed rain" that falls on a given piece of ground. In extremely hot, cold, wet, dry or nutrient-poor sites, only those species that can tolerate such conditions survive to reproduce themselves. On the other hand, where more moderate conditions prevail, a larger number of species is able to reproduce, and competitive ability becomes more important in determining which species eventually become dominant.

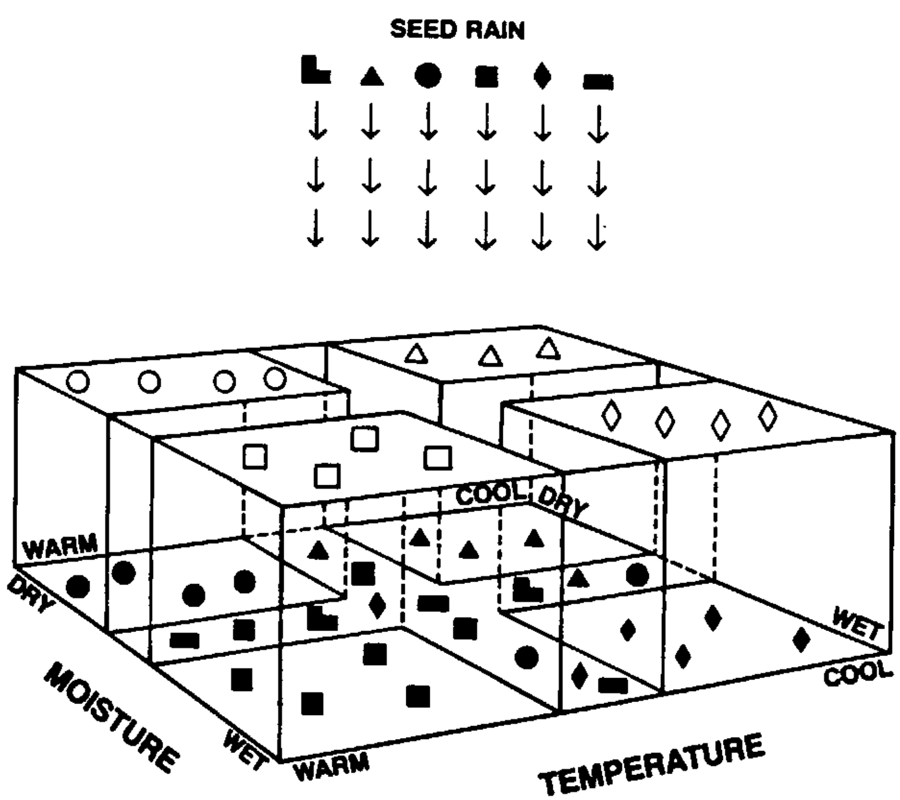

Fig 1. Only species suited to extreme conditions survive and reproduce in environments at the ends of moisture and temperature gradients.

An extremely important concept follows from this perception of the environment as a screen to reproductive success: **Areas with an equivalent environment will, in general, eventually support roughly the same combination of plant species.** A corollary concept is that **the group of species that eventually becomes dominant on a site acts both as an indicator of environmental conditions, and as a means of comparing different sites to each other.** For these reasons, plant associations can be seen as one important tool in the prediction and control of effects of forest management activities.

Association Boundaries: In Space and Time

It's fairly easy to see that plant associations have boundaries in **space**, since soil characteristics, topography and climate vary across the landscape. In most forested areas boundaries between areas having different plant associations are quite gradual, because environmental conditions change slowly over a relatively long distance. This often makes mapping distinct lines between communities virtually impossible. This "continuum" nature of vegetation on the west slope of the Cascades must be recognized by anyone trying to use this guide. There are many stands where the vegetation is transitional between two or more plant associations, and a judgment must be made as to which description fits best. These sites may be treated by mixing the management recommendations of the different types.

It is also true that plant communities have boundaries in **time**. Groups of different plant species succeed each other over time on a particular piece of ground because the physical and biological conditions of the land change temporally as well as spatially.

For example, in managed forests there are many different-aged communities of herbs and shrubs giving way to new stands of trees. As a young stand of trees grows, the ground surface becomes increasingly shaded and many light-loving species are eliminated from the plant community because they cannot perpetuate themselves.

As this development of vegetation in a disturbed area progresses, eventually the species composition stabilizes into a community that reproduces itself, rather than being replaced by something else. This ultimate community, which prevails unless it is disturbed again, is called the **climax plant community**, or **plant association**, and the process of different communities replacing each other until the climax

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community is reached is called <u>**succession**</u>. The plant communities that precede the climax association are called <u>**seral stages**</u>. Some readers may be familiar with the term <u>**habitat type**</u>. It is used to refer to the combination of a plant association and the physical/climatic habitat in which it occurs (Pfister et al. 1977). A <u>**zone**</u> is the area within which a particular tree species is the stand dominant in the climax plant community. For example, the Western Hemlock Zone encompasses forests where western hemlock would eventually dominate the overstory (assuming no disturbance takes place). Forests that today have Douglas-fir in the overstory with western hemlock in the understory are considered to be within the Western Hemlock Zone because the Douglas-fir is not reproducing itself, while western hemlock is.

Plant associations for forested areas must initially be identified in mature stands, since that is where the vegetation has more or less stabilized. In many cases, however, the climax plant association for earlier seral stages can be inferred from the presence of indicator plants. By this means, environmentally equivalent areas can be identified even though they may be at different places on the successional route. Conversely, the composition of seral stages can often be predicted from the climax plant association, making it possible to know whether undesirable species are likely to be present following disturbance.

The complex of associations or communities that occur within a zone can be referred to as a <u>series</u>. Often we use the terms <u>zone</u> and <u>series</u> interchangeably, though "series" describes a group of associations and "zone" the land on which the associations occur. A similar relationship exists between the terms "habitat type" and "plant association" as exists between "zone" and "series".

Vegetation zones are of interest because they generally represent major large-scale climatic differences within a region. A discussion of the forest zones found on the Gifford Pinchot National Forest is presented in Chapter 3 of this guide.

Intergradation among associations is most pronounced in the transition area between the forest zones (i.e., Western Hemlock Zone/ Pacific Silver Fir Zone transition). We do not describe separate transition zones, as do some authors. The simplicity of our system requires flexibility by users working in the transition area between forest zones.

Methods

The classification is based on a relatively standard vegetation analysis procedure of our study plots established throughout the Gifford Pinchot National Forest. Our sampling scheme involves selecting undisturbed stands which include the natural vegetation variation found within the Western Hemlock Zone. These plots are in stands preferably at least 60 years old so the understory vegetation has had some time in which to become established and reflect the future potential of the site. We measured percent cover of all vascular plant species within 500 m^2 plots. We also collected detailed information on timber, soils and wildlife features of the plot area; techniques for each are mentioned separately in Chapter 2. Figure 2 displays the distribution of our plots. Appendix 1 provides a detailed breakdown of plots in each association by Ranger Districts, township and range.

The association classification is the result of a dynamic interaction between subjective and objective multivariate statistical procedures. We tested initial plot ordering results (Volland and Connelly 1978) with results from detrended correspondance analysis (DECORANA) (Gauch 1977 plus supplements; Gauch 1982). Two-step indicator species analysis (TWINSPAN) was used to examine the classification value of various species and plot groups. Results were checked to re-order the subjective association groupings. Old-growth plots were more heavily weighted as they better reflect the eventual floristic composition which define associations. Preliminary keys were field-tested and the final classification modified. We carefully compared final association classifications of different National Forests. Nine associations were identical between the Gifford Pinchot and Mt. Hood National Forests, so combined data are presented for these types (see Halverson et al. 1986). These associations (2 of which are very uncommon on the G.P.) are listed in Appendix 3.

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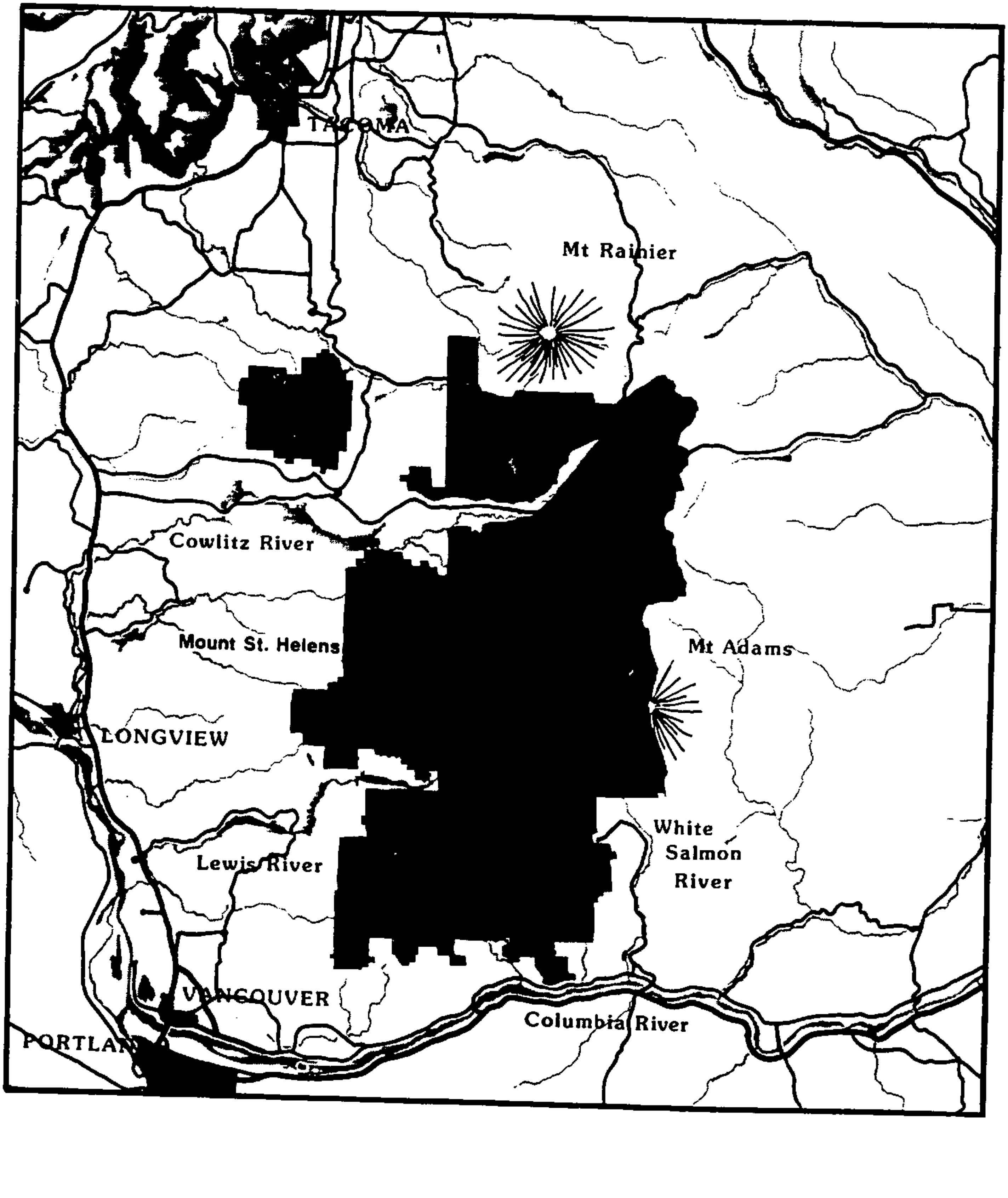

Figure 2. Western Hemlock Zone plot locations on the Gifford Pinchot National Forest

Uses of Plant Associations in Forest Management

The underlying value of plant association guides is that, because plant associations are indicators of their environment, they allow one to make inferences about a wide range of ecosystem factors (i.e., moisture, temperature, soil and hydrologic condition, wildlife, etc.). The association concept helps reduce complex vegetation patterns to an understandable and managable set of types. This helps users to more easily "read" the landscape, and communicate that information to others in an organized fashion.

This association classification should be widely used on the Forest. Engineers can use plant associations to locate high water table areas. Recreation planners can locate campsites in plant associations that quickly recover from trampling and resist soil compaction. Silviculturists can use them to help decide where shelterwood harvest rather than clearcutting will produce the best results, where severe brush competition may follow broadcast burning, or where cold-tolerant species should be used in reforestation. Plant associations differ in their ability to provide forage and hiding cover for wildlife, an important consideration in managing big game. Some associations may be particularly prone to development of damage through disease or windthrow. Fuels managers can infer site moisture gradients useful to area fuel management plans.

At a broader level, plant associations provide a framework for storing and retrieving data on response of different kinds of sites to different forms of management, and for applying research results or recommendations to actual land areas. As our knowledge about plant associations increases, their value as tools for management will increase as well. The patterns of associations we see in nature are the result of the year-in and year-out struggle of plants with their environment, responding to far more physical and biological variables than we could ever hope to accurately measure. And it is just this resource (the vegetation) that we, as land managers, are largely interested in, both for its own merits and its enormous effects on most other valued attributes of a National Forest.

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OVERVIEW OF THE ASSOCIATIONS

The dominant environmental features which affect the distribution and appearance of plant associations in the western Cascades are effective moisture and temperature. Figure 3 displays an idealized interpretation of the distribution of the plant associations described in this guide along temperature and effective moisture axes. Temperature is largely a function of elevation, but topographic position relative to cold air drainages can also be important. Effective moisture measures the relative amount of soil water available to plants. This is just as much a function of soil water holding and sub-irrigation processes as it is a function of incident precipitation. Physiographic features of Western Hemlock Zone associations on the Gifford Pinchot National Forest are summarized in Table 2.

Wet-site Plant Associations

The wettest areas in the Western Hemlock Zone include forested wetlands characterized by skunk cabbage (TSHE/LYAM). The other very moist forested associations are Western hemlock/Ladyfern (TSHE/ATFI) and Western hemlock/devil's club/swordfern (TSHE/OPHO/POMU). The former occupies very moist and shaded lower slopes and bottomlands whereas the latter includes a variety of very moist forests from riparian to near-riparian to excessively wet areas prevalent on the western slopes of the Randle Ranger District.

Moist-site Plant Associations

Four associations indicate moist (not wet) conditions. Two are characterized by the presence of Oregon oxalis: Western hemlock/ swordfern- Oregon oxalis (TSHE/POMU-OXOR) (at warm sites in the western portions of Wind River and Randle RD's and St. Helens N.V.M.), and Western hemlock/ Alaska huckleberry/ Oregon oxalis (TSHE/VAAL/OXOR)(rare, restricted to the western tip of the G.P.). The other two moist-site associations are more widespread: Western Hemock/swordfern (TSHE/POMU) and Western hemlock/ foamflower (TSHE/TITR). These have a rich herbaceous flora and high timber productive potential, though moist soils can limit management activities.

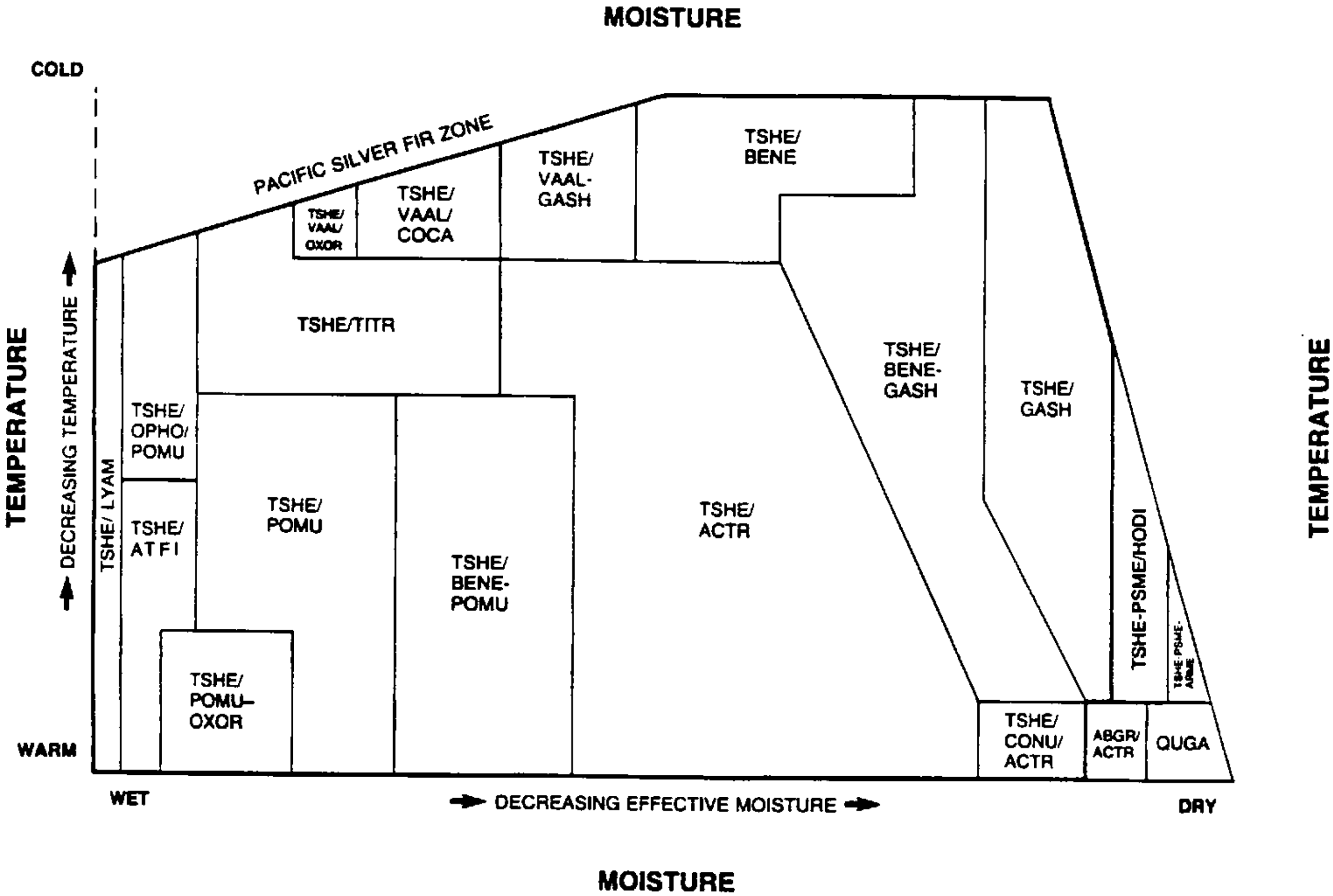

Figure 3. Idealized environmental relationships of the plant associations of the Gifford Pinchot National Forest Western Hemlock Zone. Abbreviations are described in Table 1. The grand fir (ABGR) and oak (QUGA) types will be described in future publications.

Table 2. Mean elevation and slope, and percent of study plots on the Gifford Pinchot National Forest of each Western Hemlock Zone association by elevation, slope, aspect and topographic microposition classes.

Association:	TSHE/ LYAM	TSHE/ ATFI	TSHE/ OPHO/ POMU	TSHE/ VAAL/ OXOR	TSHE/ POMU-OXOR	TSHE/ TITR	TSHE/ POMU	TSHE/ BENE/ POMU
Elevation (ft.)								
Mean	2200	1785	1876	1830	1606	1788	1639	1794
% < 1500		38	24		43	37	50	25
% 1500-1999		13	47	50	43	31	25	44
% 2000-2499	100	50	24	50	14	23	13	19
% 2500-2999							13	13
% > 3000			6			8		
Slope (%)								
Mean	0	34	32	40	33	27	40	39
% 0-15%	100	25	35		21	44	13	13
% 16-30%		13	18	50	29	19	31	13
% > 30%		63	47	50	50	37	56	75
Aspect								
% North (316°-45°		50	35	50	50	15	25	38
% East (46°-135°)		13	12		7	22	25	25
% South(136°-225°)		38	29		7	41	31	19
% West (226°-315°)	100		24	50	36	22	19	19
Topographic Microposition								
% Ridgetops			6					6
% Slope upper 1/3			25				20	13
% Slope mid 1/3		14	38		43	26	40	38
% Slope lower 1/3		57	6	50	14	39	27	25
% Bench				50	7	22		6
% Toe of Slope			13		14	4		6
% Bottom	100	29	13		21	9	13	6

Association:	TSHE/ VAAL/ COCA	TSHE/ VAAL-GASH	TSHE/ ACTR	TSHE BENE	TSHE/ BENE-GASH	TSHE/ GASH	TSHE/ CONU/ ACTR	TSHE-PSME/ HODI	TSHE-PSME-ARME
Elevation (ft.)									
Mean	2347	2151	2024	2552	1996	2110	1934	2173	1940
% < 1500	15	13	22	3	21	25	20		
% 1500-1999	15	38	28	6	24	20	30	50	50
% 2000-2499	23	25	28	37	43	20	40	50	50
% 2500-2999	38	25	14	34	10	30	10		
% > 3000	8		9	20	2	5			
Slope (%)									
Mean	26	26	35	49	39	39	40	42	44
% 0-15%	38	38	28	9	17	19	20		
% 16-30%	31	38	22	6	21	14	10	13	
% > 30%	31	25	51	86	62	67	70	87	100
Aspect									
% North (316°-45°		13	26	26	19	43	20	13	
% East (46°-135°)	46	63	15	6	10	14	20	13	
% South(136°-225°	31	13	29	37	40	19	20	50	
% West (226°-315°	23	13	30	31	31	24	40	25	100
Topographic Microposition									
% Ridgetops		13	4		5	10			50
% Slope upper 1/3	8	13	18	15	24	15	50	63	50
% Slope mid 1/3	15	25	27	48	19	25	10		
% Slope lower 1/3	31	38	27	30	36	35	20	38	
% Bench	31		5	3	10	10	10		
% Toe of Slope	15		6		2		10		
% Bottom		13	12	3	5	10			

Intermediate (mesic) Plant Associations

The greatest area of the Western Hemlock Zone on the Gifford Pinchot National Forest has intermediate moisture availability, and is occupied by associations indicative of "mesic" (or moderate) conditions. These are quite productive and fairly robust with respect to harvest activities. The Western hemlock/dwarf Oregon grape/ swordfern type (TSHE/BENE/POMU) has abundant herbs and shrubs, but lower productivity than the similar, but more moist and herb-rich, TSHE/POMU association. The most widespread association in this zone is Western hemlock/ vanilla-leaf (TSHE/ACTR). This association is quite productive and its abundance is a substantial reason for the fame of the Gifford Pinchot National Forest as a timber producing area.

TSHE/BENE is characterized by an absence of herbs and a sparse shrub layer, except for the dwarf Oregon grape, and fairly low timber productivity for this zone. It may be an intergrade association to the Pacific silver fir series. TSHE/BENE-GASH is a very widespread type which indicates fairly dry conditions, typically occurring on upper slopes and in areas away from the very rainy western portion of the G.P. NF.

Two Alaska huckleberry associations complete the mesic portion of the environmental grid (see Figure 3): Western hemlock/Alaska huckleberry/dogwood bunchberry (TSHE/VAAL/COCA) and Western hemlock/Alaska huckleberry-salal (TSHE/VAAL-GASH). These associations are restricted to cool areas, either close to the Pacific silver fir zone or on benches where cold air may accumulate. They are somewhat less productive than most other Western Hemlock Zone plant associations.

Dry-site Plant Associations

The Western hemlock/Salal (TSHE/GASH) association is fairly common on the dry portions of the Packwood Ranger District, especially on steep slopes where shallow, coarse soils predominate. On rock outcrops near the Cowlitz valley, the presence of madrone indicates the the Western hemlock-Douglas-fir -madrone (TSHE-PSME-ARME) association. Western hemlock- Douglas-fir/ Oceanspray (TSHE-PSME/HODI) is a very dry association characterized by rocky soils, upper slope or ridge positions, and low precipitation. Near the Columbia River hot and dry sites may exhibit the Western hemlock/Dogwood/Vanilla-leaf (TSHE/CONU/ACTR) association. Though difficult to reforest, it has fairly deep soils and good timber productivity.

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HOW TO USE THE KEYS

The keys below are for use in relatively undisturbed, mature forest stands. A fairly homogeneous area should be used to determine plant associations, and care should be taken to avoid locating the area too close to a road, stand edge or other artificial phenomenon that would influence the species present. A good plot configuration for this purpose would be a roughly circular area between 40 and 50 feet in radius.

After selecting the plot area, a list of all species present (including trees, shrubs and herbaceous plants) should be made, and their percent cover recorded. Table 17 presents a list of all the plant species mentioned in this guide. Percent cover is determined by projecting the total crown perimeter for a species to a plane surface, then estimating the percent of the plot area it constitutes. Appendix 1 includes a helpful guide for visualizing per cent cover.

After the plot area has been thoroughly examined, the results may be run through the keys that follow. In some stands, the canopy may be so dense that the understory may be severely limited. In such cases, relative dominance rather than actual cover percentages may be used to determine the association.

A general key to forest zones of the entire Gifford Pinchot National Forest is provided. Brief descriptions of the Forest Zones is provided. See the plant association and management guide for the Pacific silver fir zone when you are in or near that zone (Brockway et. al 1983).

Appendix 5 includes a discussion of the relationship between Forest Zones and the working groups utilized in the current Gifford Pinchot National Forest comprehensive management planning process.

```
**************************************************
*                                                *
*   NOTE:  THE KEY IS NOT THE CLASSIFICATION!!!  *
*                                                *
*   Before accepting the results of keying out   *
*   an association, be sure the vegetation de-   *
*   scription  fits.  If in doubt, consult       *
*   the species tables found in Appendix 3.      *
*                                                *
**************************************************
```

KEY TO FOREST ZONES

1a Subalpine fir ≥ 2% cover in understory and ≥ 5% cover in canopy, discontinuous forest cover Subalpine Fir Zone

1b Subalpine fir ≤ 2% cover in understory and < 5% cover in canopy, continuous forest cover 2

2a Mtn. hemlock ≥ 2% cover in understory or ≥ 10% cover in canopy, has continuous forest canopy . . . . . . Mountain Hemlock Zone[1]

2b Mtn. hemlock < 2% in understory and < 10% in canopy 3

3a Pacific silver fir ≥ 2% in understory or ≥ 10% in canopy . . . . Pacific Silver Fir Zone[1]

3b Pacific silver fir < 2% in understory and < 10% in canopy 4

4a Grand fir ≥ 2% cover in understory and ≥ 10% in canopy 5

4b Grand fir < 2% cover in understory and < 10% in canopy 6

5a West of Cascade crest, alluvial terrace: Western Hemlock Zone

5b East of Cascade crest or dry upland site on Wind River District: Grand Fir Zone[2]

6a Lodgepole pine ≥ 2% in understory and ≥ 10% in canopy: Lodgeole Pine Zone

6b Lodgepole pine < 2 in understory and < 10% in canopy 7

✗ 7a western hemlock present . . . **Western Hemlock Zone: see page 64**

7b western hemlock absent: go to 1 and try key again with relaxed % values. If Douglas-fir cover is > 10%, try Western Hemlock Zone Key

1. See Brockway et. al 1983, Plant association and management guide for the Pacific Silver Fir Zone, Gifford Pinchot National Forest.

2. See Mt. Adams Ranger District Grand Fir Zone plant association draft guide (in preparation).

FOREST ZONE DESCRIPTIONS

Western Hemlock Zone

This zone is moist and warm. It is ideal for the growth of trees. Dense stands of Douglas-fir invade following catastrophic wildfires. These stands include lesser amounts of red alder, western redcedar, bigleaf maple and western hemlock. Without further disturbance the Douglas-fir is replaced by western hemlock after many centuries. This zone resonds most favorably to most management activities. It provides considerable quantities of timber and is of vital importance for many wildlife species and for high quality watersheds.

Pacific Silver Fir Zone

Persistent winter snow packs help delimit this zone. It spans the gradient between the warm, moist Western Hemlock Zone and the very cold, moist Mountain Hemlock Zone. The forests are dominated by Douglas-fir and noble fir folcwing large fires, but these species are eventually replaced by Pacific silver fir. This zone provides high values of many resources, but the prevailing cold climates dictate the type of management activities.

Grand Fir Zone

This zone reflects dry, continental climates with extremes in temperature and moisture. It is highly productive and offers many opportunities for wildlife, recreation and timber utilization. The relatively dry climates dictate different management strategies than in the Western Cascade areas under the maritime climatic influence.

Mountain Hemlock Zone

The harsh, high elevations include this zone. Most of the year snow-packs prevail and frost can occur at any time of the year. The forest canopy provides a generally a continuous cover. Biological processes are slow and result in fragile ecosystems. The proximity to spectacular alpine areas and the relatively open understory characteristics of the forests make this zone a favorite for many recreationists.

Subalpine Fir Zone

This zone includes the coldest and harshest forested sites near and at treeline. Snow and ice dominate the climate for much of the year. Trees generally exist in a discontinous distribution of ribbons and patches interlaced with alpine meadows.

Lodgepole Pine Zone

Many very different situations lead to the hostile environments for plant growth which characterize the Lodgepole Pine Zone. This zone is not at all widespread, but it offers special problems. It is found in sites which are either very frosty year-around, very droughty and nutrient poor (such as the Kalama Mudflow and various recent lava flows) or very moist and cold (such as high elevation bogs).

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KEY TO WESTERN HEMLOCK ZONE ASSOCIATIONS

See Table 1 and 17 for English names of plant association species codes.
See Halverson et al. 1986 for photos and descriptions of these species.

1a	Skunk-cabbage (LYAM) cover $\geq$ 2%	**TSHE/LYAM**	(p 70)
1b	Skunk-cabbage cover < 2%		2
2a	Devil's club (OPHO) cover $\geq$ 3%	**TSHE/OPHO/POMU**	(p 74)
2b	Devil's club cover < 3%		3
3a	Lady fern (ATFI) cover $\geq$ 5%	**TSHE/ATFI**	(p 72)
3b	Lady fern cover < 5%		4
4a	Oregon oxalis (OXOR) cover $\geq$ 5%		5
4b	Oregon oxalis cover < 5%		6
5a	Alaska huckleberry (VAAL) cover $\geq$ 3%	**TSHE/VAAL/OXOR**	(p 78)
5b	Alaska huckleberry cover < 3%	**TSHE/POMU-OXOR**	(p 76)
6a	Coolwort foamflower (TITR,=TIUN) plus inside-out flower (VAHE) cover $\geq$ 5%	**TSHE/TITR**	(p 80)
6b	Coolwort foamflower & VAHE COVER < 5%		7
7a	Alaska huckleberry (VAAL) cover $\geq$ 5%		8
7b	Alaska huckleberry cover < 5%		9
8a	Salal (GASH) cover $\geq$ 5%	**TSHE/VAAL-GASH**	(p 88)
8b	Salal cover < 5%	**TSHE/VAAL/COCA**	(p 86)
9a	Swordfern (POMU) cover $\geq$ 10%		10
9b	Swordfern cover < 10%		11
10a	Dwarf Oregon grape (BENE) cover $\geq$ 10%	**TSHE/BENE/POMU**	(p 84)
10b	Dwarf Oregon grape cover < 10%	**TSHE/POMU**	(p 82)
11a	Madrone (ARME) cover $\geq$ 2%	**TSHE-PSME-ARME**	(p 105)
11b	Madrone cover < 2%		12
12a	Oceanspray (HODI) cover $\geq$ 3%	**TSHE-PSME/HODI**	(p 102)
12b	Oceanspray cover < 3%		13

KEY TO WESTERN HEMLOCK ZONE ASSOCIATIONS (con't)

13a	Vanillaleaf (ACTR) cover $\geq$ 10%	14	
13b	Vanillaleaf cover < 10%	15	
14a	Dogwood (CONU) cover $\geq$ 10%	**TSHE/CONU/ACTR**	(p 100)
14b	Dogwood cover < 10%	**TSHE/ACTR**	(p 90)
15a	Salal (GASH) cover $\geq$ 10%	16	
15b	Salal cover < 10%	17	
16a	Dwarf Oregon grape (BENE) cover $\geq$ 10% . . .	**TSHE/BENE-GASH**	(p 95)
16b	Dwarf Oregon grape cover < 10% . . .	**TSHE/GASH**	(p 97)
17a	Mesic site herbs (ACTR+ADBI+ANDE+COCA+SMST+VAHE+TITR*) cover $\geq$ 5%	18	
17b	(ACTR+ADBI+ANDE+COCA+SMST+VAHE+TITR*) cover < 5%	19	
18a	Dogwood (CONU) cover $\geq$ 10%	**TSHE/CONU/ACTR**	(p 100)
18b	Dogwood cover < 10%	**TSHE/ACTR**	(p 90)
19a	Dwarf Oregon grape (BENE) cover $\geq$ 10%	**TSHE/BENE**	(p 93)
19b	Dwarf Oregon grape < 10% : go back to #1 ease up on cover decision criteria use relative cover instead of absolute canopy cover		

If the plot does not fit the association description go back to the beginning of the key and check each choice carefully. Be sure you have taken the corect dichotomy.

* vanillaleaf (ACTR), pathfinder (ADBI), three-leaved anemone (ANDE) dogwood bunchberry (COCA), star-flowered Solomens seal (SMST), inside-out flower (VAHE), coolwort foamflower (TITR, =TIUN)

TSHE/LYAM

CHM1-21

WESTERN HEMLOCK/SKUNK-CABBAGE

Tsuga heterophylla/Lysichitum americanum

Structure and Composition

This association is found in very wet sites, and is rich in moisture-loving herbaceous species. The dominants are lady-fern, skunk cabbage, betony, a variety of sedges and rushes, wild ginger and piggy-back plant. The major shrub is vine maple. The canopy is generally a mix of Douglas-fir, red alder, western hemlock and western redcedar. Species composition in all layers (overstory, shrubs and herbs) varies considerably from site to site, as this group is somewhat of a "catch-all" for swampy Western Hemlock Zone sites. A notable feature of this association is the open, broken canopy, caused by a combination of disease-related top damage, windthrow and treeless patches of standing water. Summary vegetation data are in Appendix 3.

Often the TSHE/LYAM association is either transitional to non-forest wetland, or represents small "pockets" of swampy conditions within a larger, more mesic area.

Environment and Distribution

The TSHE/LYAM association occurs in the wettest parts of the Western Hemlock Zone. It also occurs on the Mt. Hood National Forest (Halverson et al. 1986). It is found at moderate elevations in riparian areas, such as alluvial bottoms or other wet, poorly-drained sites. There may be standing water, and soils tend to have a very high organic matter content with peat-like surface layers.

Productivity and Management

The TSHE/LYAM association represents moderate to low productivity. Stocking, standing volume and volume growth are generally lower than average (Table 18, 16 and App. 2).

Because these sites are excessively moist, decreased productivity due to soil erosion and/or compaction can result from ground disturbance. In addition, poorly aerated soils with high organic material content may be difficult to reforest following logging. Such soils are not only physically hard to work in, but may have chemical conditions unfavorable to the growth of Douglas-fir. In addition, shallow rooting may contribute to a greater potential for windthrow in certain sites. Western redcedar, red alder or black cottonwood should be used for reforestation where "swampy" conditions prevail.

TSHE/LYAM sites frequently occur as small patches within continuous western hemlock zone stands of upland associations. This pattern diversity leads to very high wildlife diversity. These moist patches may have far greater value than their small size suggests because many moisture-requiring species, such as amphibians, can use these sites as safe home bases from which they may forage into the nearby upland associations.

Similar Associations

The TSHE/LYAM association is easily distinguished from other riparian types by the presence of skunk-cabbage. It is not likely to be confused with any other associations. The Western Hemlock/ Lady fern (TSHE/ATFI) association is also very moist but lacks the excessive water which characterizes the skunk-cabbage sites.

TSHE/LYAM has not been formally described in previous western Cascade plant association studies.

Table 18. Timber Productivity Statistics - TSHE/LYAM

Species	Site Index[1] (feet)		Current 10-yr. Radial Increment (20ths)		Growth Basal Area[2] (ft^2/ac)		Mean Annual Inc. at Culmination[3] (ft^3/ac/yr)		Current Overstory Vol. Inc.[4] (ft^3/ac/yr)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Douglas-fir	120	-	23	22	408	294	124	-	n.d.	n.d.
Western redcedar	102	-	27	-	812	-	113	-	75	-

1. Indexed to age 100. References: Douglas-fir, McArdle et al. 1961; Western redcedar, Hegyi et al. 1981.
2. Hall 1983.
3. See discussion of Timber Productivity in Chapter 2 for references.
4. Methods after Hemstrom 1983.

TSHE/POMU

CHF1-25

WESTERN HEMLOCK/SWORDFERN

Tsuga heterophylla/Polystichum munitum

Structure and Composition

The Western Hemlock/Swordfern Association includes warm and moist sites which have substantial herb cover dominated by swordfern. Species indicative of more moist associations, such as devil's club, Oregon oxalis and coolwort foamflower may be present, but in low abundance. Most of the fairly dense overstory is Douglas-fir, often associated with western hemlock, bigleaf maple, red alder and western redcedar. This is one of the best associations for bigleaf maple growth. Except for fairly substantial vine-maple cover, the shrub layer is usually not dense. Dwarf Oregon grape is present in small amounts. Red huckleberry and trailing blackberry also frequently occur. Salal, dogwood, Alaska huckleberry and oceanspray are occasionally present in very small amounts. Besides swordfern, three-leaved anemone, inside-out flower, sweet-scented bedstraw, trillium and pathfinder sometimes cover fairly large areas. Wet site ferns (oak fern, deer fern, lady fern) may exist sporadically. Appendix 3 summarizes vegetation data representative of this association.

Environment and Distribution

This association is found on moist sites which may recieve some sub-surface irrigation, a reflection of the concave, lower slope positions it most commonly occupies. We found it mainly at low elevations, away from the western edge of the Forest. Slope steepness on our plots averaged 40%, but this association also may occur in flat areas near streams. Physiographic data are summarized in Table 2. Steeper sites may have some bare ground caused by colluvial action.

Productivity and Management

This is another of the moist-site, high-productivity plant associations of the western hemlock zone. Douglas-fir site index (100 years, McArdle) averaged 161 feet. Tables 24 and 16 and Appendix 2 summarize productivity data from our plots.

The presence of seeps or super-saturated soils indicates that land-managers need to be cautious concerning soil

Table 24. Timber Productivity Statistics - TSHE/POMU

Species	Site Index[1] (feet)		Current 10-yr. Radial Increment (20ths)		Growth Basal Area[2] (ft^2/ac)		Mean Annual Inc. at Culmination[3] (ft^3/ac/yr)		Current Overstory Vol. Inc.[4] (ft^3/ac/yr)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Douglas-fir	161	22	14	6	504	161	182	30	65	58
Western hemlock	137	19	13	5	431	169	202	37	38	19
Western redcedar	125	30	25	12	936	606	150	48	33	14

1. Indexed to age 100. References: Douglas-fir, McArdle et al. 1961; Western redcedar, Hegyi et al. 1981.
2. Hall 1983.
3. See discussion of Timber Productivity in Chapter 2 for references.
4. Methods after Hemstrom 1983.

compaction or erosion due to heavy equipment or road-building. Because of the abundant moisture, red alder may become readily established on clear cuts, so prompt reforestation is a must. The general presence of deep soils and rapidly decomposing forest floor layers suggests that slash burning should have little effect on long-term productivity. The Western Hemlock/Swordfern Association provides great opportunities for intensive forest management. Tree improvement, fertilization, pre-commercial and commercial thinning are all especially appropriate when managing this association because the high timber production potential suggests that a high return on investment is likely. Because bigleaf maple and western redcedar are well represented in natural stands, sites with this association should play an important role for the long-term maintenance of these species on the Forest.

Similar Associations

The TSHE/POMU association is similar to the other moist-site types described in this paper (Western hemlock/ Devil's club/ Swordfern, Western hemlock/ Lady fern, Western hemlock/ Swordfern- Oregon oxalis, Western hemlock/ Coolwort foamflower) but it lacks an abundance of Devil's club, lady fern, Oregon oxalis or coolwort foamflower.

Similar plant associations exist on moist sites throughout much of western Washington and Oregon. Similarly named associations, which are nearly identical to our TSHE/POMU, are found in Mt. Rainier National Park (Franklin et al. 1979), on the Mt. Baker-Snoqualmie (Henderson and Peter 1981b), Willamette (Hemstrom et al. 1985) and Siuslaw (Hemstrom and Logan 1984) National Forests, and on the H.J. Andrews Experimental Forest (Dyrness et al. 1974). The TSHE/POMU-MTH association found on the Mt. Hood National Forest (Halverson et al. 1986) has a substantially lower productive potential. It occurs primarily on steep, rocky slopes and includes several plant species indicative of drier environments than TSHE/POMU occupies on the Gifford Pinchot National Forest.

Guidelines for Selecting Live and/or Dead Standing Wildlife Trees.

Objectives

Administer National Forest timber sales to meet wildlife tree management goals and logging safety standards.

Introduction

Standing dead and live defective trees, commonly referred to as snags, are an important forest wildlife habitat component. Wildlife trees are used by nearly 100 species of birds and mammals for nesting, feeding, perching, and shelter in the Forests of Oregon and Washington. Fifty-three wildlife species: 39 birds, and 14 mammals depend on wildlife tree cavities for survival. (Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington. 1985. p. 130.) Suitable wildlife tree is a dead, partially dead, or defective live tree at least 12 inches D.B.H. and a minimum of 6 feet tall.

State Workman Compensation Laws and OSHA rules require that a safe work area be provided for forest workers during timber harvest activities. Oregon and Washington logging safety codes require felling of danger trees which lean toward and within reach of landings, haul roads, rigging, or work areas. "A danger tree is any standing live or dead tree with evidence of deterioration or physical damage to the root system or trunk. Direction and degree of lean are also one of the factors to be considered." (Washington Department of Labor and Industries, chapter 296-54 WAC) (Oregon Admin. Rules, chapter 437, Division 80 Logging.)

Retention of wildlife trees in the commercial forest is accomplished during logging. Prior to logging, a team effort by all resource specialists involved with timber sale planning must occur to insure adequate design and planning objectives are incorporated in the final timber sale plan. During the sale operation, specialists involved with timber sale administration, logging safety, and the timber sale purchasers and loggers must coordinate their work to achieve established wildlife tree management objectives.

Before preparing a timber sale requiring retention of wildlife trees, the reader is referred to:

Regional Policy FSM 2630.3

East Side

Wildlife Habitats in Managed Forests. The Blue Mountains of Oregon and Washington, chapter 5, p. 60, Ag. Handbook No. 553, 1979.

West Side

Management of Wildlife and Fish Habitat in the Forests of Western Oregon and Washington, chapter 7, 1985.

During logging operations the "wildlife tree" can present a hazard to forest workers. Dead and defective trees can be unsafe as a result of:

a. Weakened tops which exhibit rot or breaks.
b. Defective root systems.
c. Lean into work area or equipment.
d. Large branches which exhibit decay or fracture.

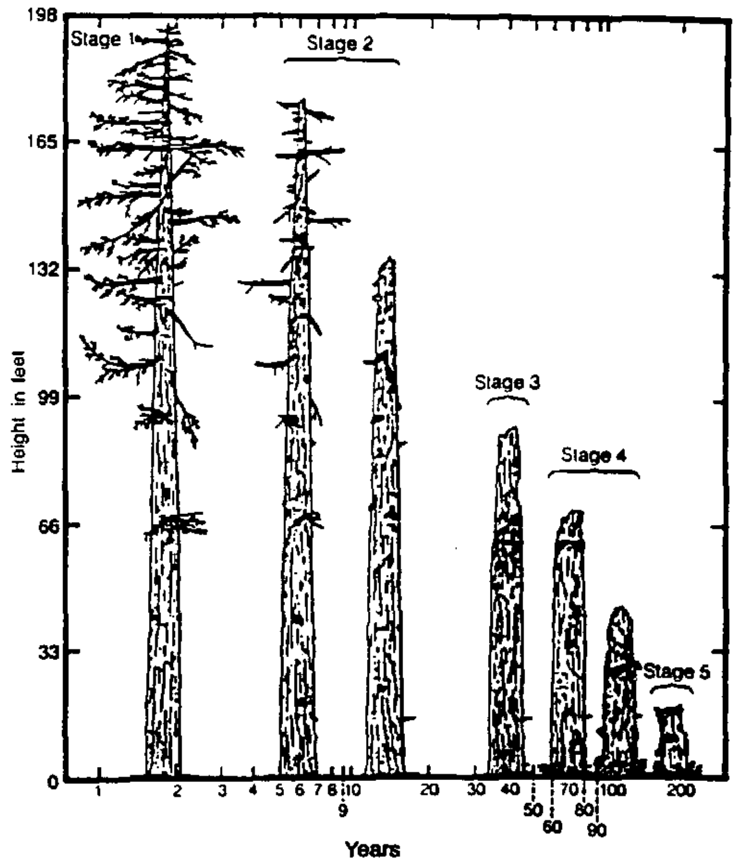


Fig 1 Illustrates the concept of wildlife tree deterioration.

Planning

When planning a timber sale activity (settings and cutting units) a target number of wildlife trees should be established. For example, two wildlife trees per acre or, "25 for cutting unit 409." This "target number" should be the number established in the management objectives for the sale area. In most cases, more candidate wildlife trees will be available than needed to meet wildlife tree objectives.

It is not a good practice to mark (e.g., metal tags, paint), prior to the sale, and/or designate specific wildlife trees in the timber sale contract unless the tree or trees have a specific habitat requirement, such as an eagle nest tree. Normally, wildlife tree identification occurs in GATES 2 and 3 of the timber sale process 3 to 10 years prior to logging activity. Additional deterioration and damage may occur prior to logging, making a selected marked tree unsuited due to additional added risk and hazard. During logging, landing locations may change requiring a "designated" wildlife tree to be removed. Only the timber sale officer (TSO) may approve removal of "designated" trees.

Wildlife Tree (Snag) Specifications for Woodsworker Safety

The following guidelines for identifying potential standing dead or standing live-defective (cull) trees for wildlife habitat are intended to provide selection criteria that are compatible with industrial safety codes. The criteria are applicable to both East and West Side operations.

The following species are listed in order of increasing hazard from a logging safety standpoint:

1. Douglas-fir (least hazardous)
2. Ponderosa pine
3. Lodgepole pine
4. Live firs and hemlock
5. Larch
6. Cedar
7. Hardwoods and other species (most hazardous)

Cedar usually remains standing longer than Douglas-fir and other tree species in unmanaged stands. In harvest units, dead cedar often become danger trees because of decay in the trunk and roots.

Dead trees with a DBH of 12 inches or less tend to be more hazardous than larger trees. Root masses on small trees are usually not well developed and deteriorate more rapidly causing the stem to become unstable. Trees with diameters greater than 12 inches are preferred. Dead trees with broken tops and less than 60 feet tall are most desirable from a safety viewpoint.

Trees which lean into the work area should not be selected. Large trees which stand more nearly straight, or lean away from the work area, are more desirable from a worker's safety viewpoint.

Other factors to consider when selecting wildlife trees are soil depth, quality of remaining root structure, and slope of the terrain. These factors must be evaluated on a case-by-case basis.

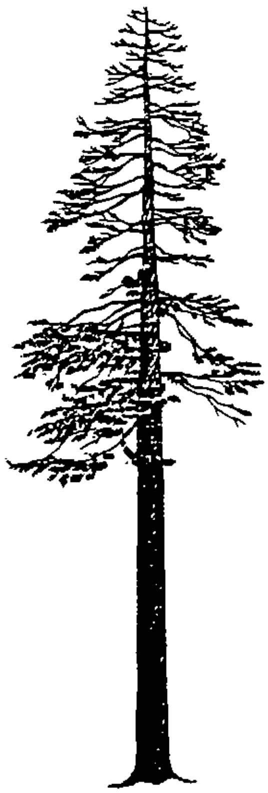


Fig. 2 Snag Type 1

Dead Tree Types That Are Compatible with Logging Operations

Standing dead or live-defective trees that are most preferred from a logging safety standpoint:

Type 1: Trees that have recently died and have sound root systems. Needles are still attached to the tree (Figure 2). Trees with no lean or lean away from the work area. Trees with tops broken out or are suitable for topping are also preferred.

Type 2: Live cull or defective trees that are windfirm and have ⅓ to ½ of the top broken out. (Figure 3.)

Fig. 3 Snag Type 2

Type 3: Live-defective trees that are safe for topping to reduce susceptibility to blowdown after harvest. (Figure 4.)

Fig. 4 Snag Type 3

Type 4: Dead trees that are over 12 inches DBH with bark still tight (Figure 5), preferable with tops broken out and with no lean or lean away from work area.

Fig. 5 Snag Type 4

Type 5: Dead trees with tops broken out with loss of bark evident. (Figure 6.) Selected wildlife tree should stand straight or lean away from work area and be less than 60 feet in height.

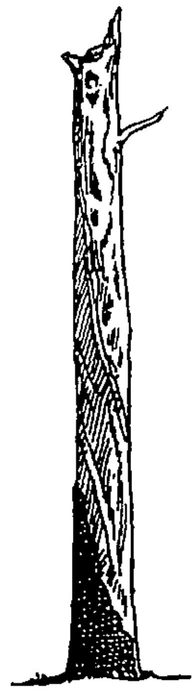


Fig. 6 Snag Type 5

The quality and useability of wildlife trees is as important as providing an adequate number.

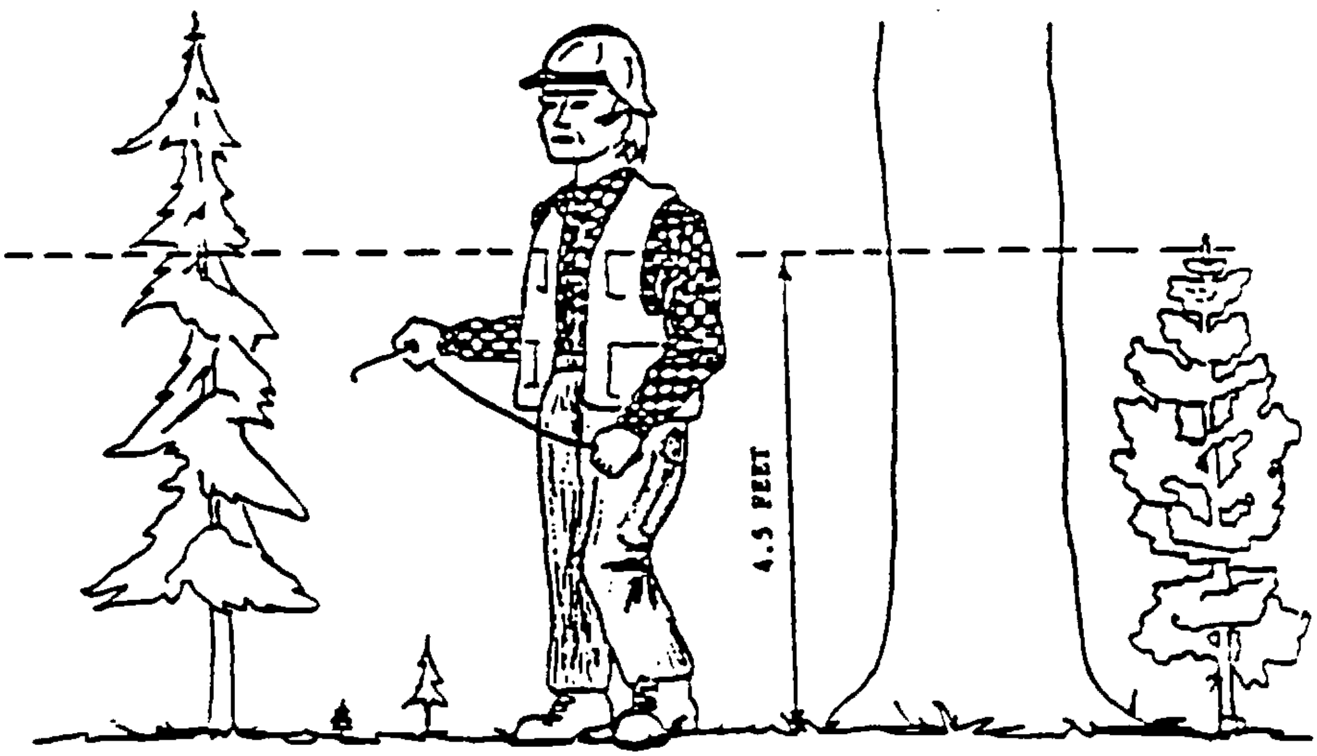
The following are options to consider in identifying quality wildlife trees:

1. Leave all hard snags, damaged and dying trees, and live defective trees during logging operations, except those considered safety hazards. Hard snags or live defective cull trees should be left for recruitment of future soft snags.
2. If a trade off must be made, retain hard snags in favor of soft snags, large diameter (over 15" DBH) in favor of small diameter, tall wildlife trees (up to 60 ft.) in favor of short wildlife trees, and dead trees with greater bark cover in favor of those with little bark cover.
3. Place emphasis on larger diameter trees because these remain standing longer, retain bark longer, and support a larger variety of wildlife.
4. In intensively managed forests, maintain large snags or cull trees (15-24 inch DBH) at various stages of deterioration.
5. Retain live trees infected with heart rot and/or broken tops.
6. Emphasize snag retention downslope from roads to reduce loss from firewood cutting. Leave live trees, broken tops, and trees with scars to provide future wildlife trees.

APPENDIX J

MEASURMENT OF DBH

Example of DBH For Trees of Various Sizes



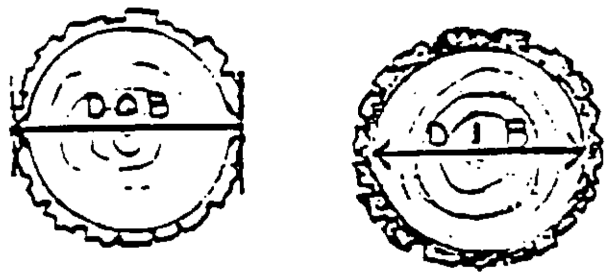
DBH is used to classify trees into the following standard size classes:

Seedling - A tree is considered a seedling if it is less than 1.0 inch at DBH (001) and not larger than 2.9 inches at DBH. A seedling is usually considered a viable tree if it is 6 inches or .5 feet high. A tree less than this height should be recorded as 000.

Sapling - DBH 3.0" - 4.9".

Poletimber and Sawtimber - DBH 5.0"+ for all species.

For the purpose of stand exams, the expression "diameter" means the distance across an X-section of a tree. It can be measured either DOB (diameter outside bark) or DIB (diameter inside bark).



Obviously, DIB must be measured by cutting the tree down or by use of an instrument such as a bark thickness gauge.

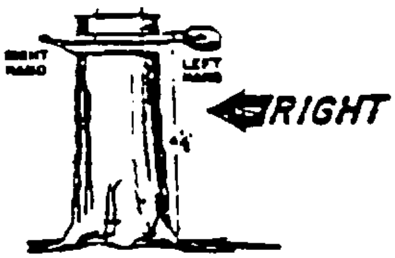
DOB can be measured with non-damaging instruments such as a diameter tape, a relaskop, or a denrometer.

No diameter measurement is of any value unless:

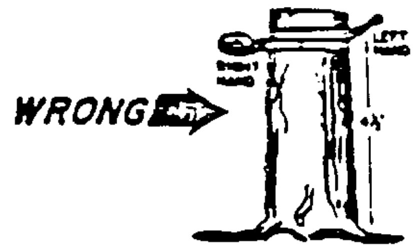
1. It is known <u>where</u> the measurement was taken, i.e., at 1 foot stump; DBH (4.5 feet above ground level); 16 feet above 1 foot stump, etc, DOB, or DIB.

2. It is measured accurately to a known specified standard.

USE OF A DIAMETER TAPE

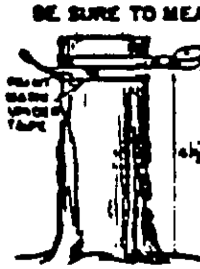


LEFT HANDED—Right hand crossed under.

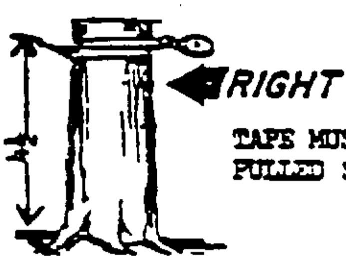


RIGHT HANDED—Left hand crossed over.

BE SURE TO MEASURE AT THE MARK

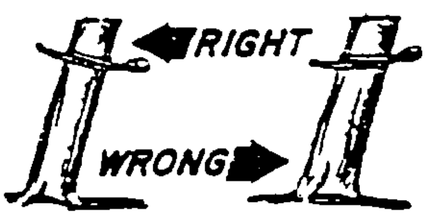


THE TAPE MUST BE READ AT THE EXACT POINT MARKED.

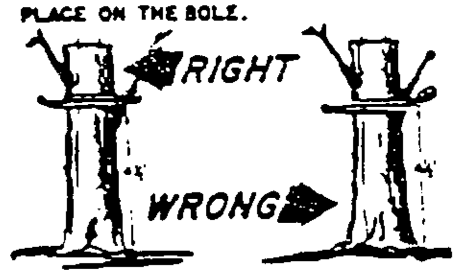


TAPE MUST BE PULLED STRAIGHT

THE TAPE MUST BE AT RIGHT ANGLES TO THE LEAN OF THE TREE.



DON'T PLACE TAPE AT AN ABNORMAL PLACE ON THE BOLE.



Why "Diameter at Breast Height"?

There are a number of practical and expeditious reasons why diameter is measured at breast height (4.5 feet above ground on the high or uphill side of the tree).

- A person of average height can comfortably measure the tree in a normal standing position without having to stoop over or pack along a stepladder.

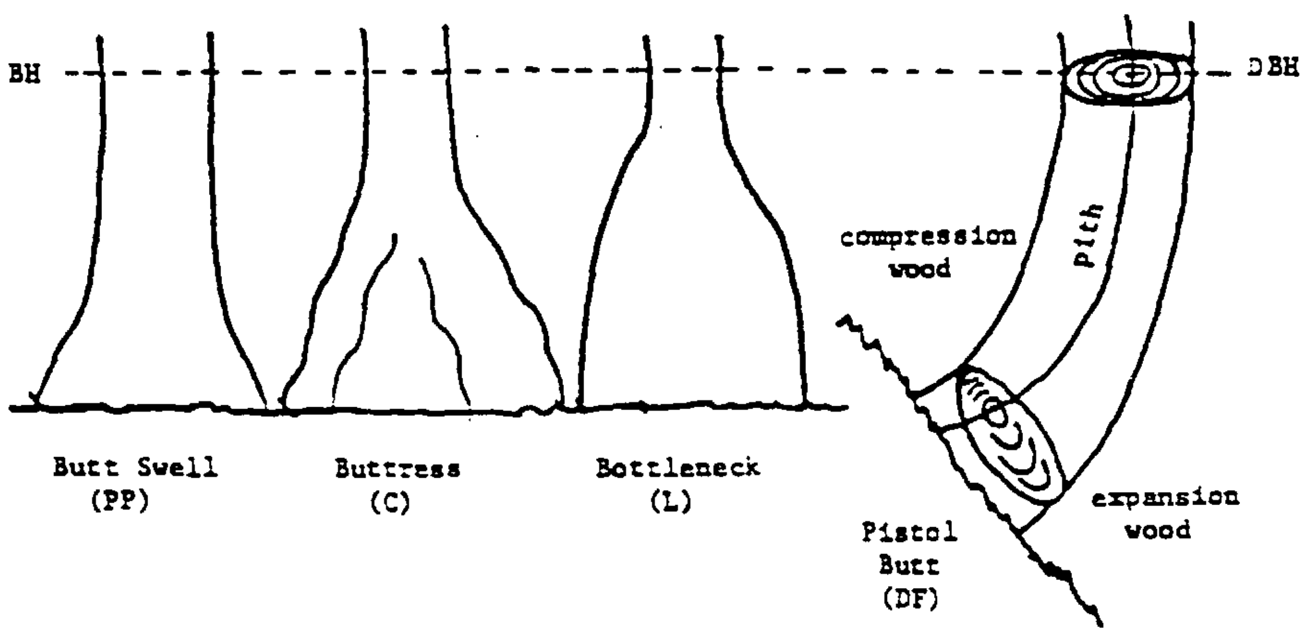
- The tree bole is often quite asymmetrical at ground level, stump height, and until it reaches breast height. By 4.5 feet, the bole is usually quite symmetrical. The pith is more likely to be located in the center at breast height, rather than off-center as is often the case at stump, particularly in "pistol-butt" trees.

- Rot at stump height (from fire damage, root injuries, etc., which permit pathogens to enter) very often does not extend to breast height. Therefore, it is often possible in such trees to obtain age at breast height when it cannot be obtained at stump height.

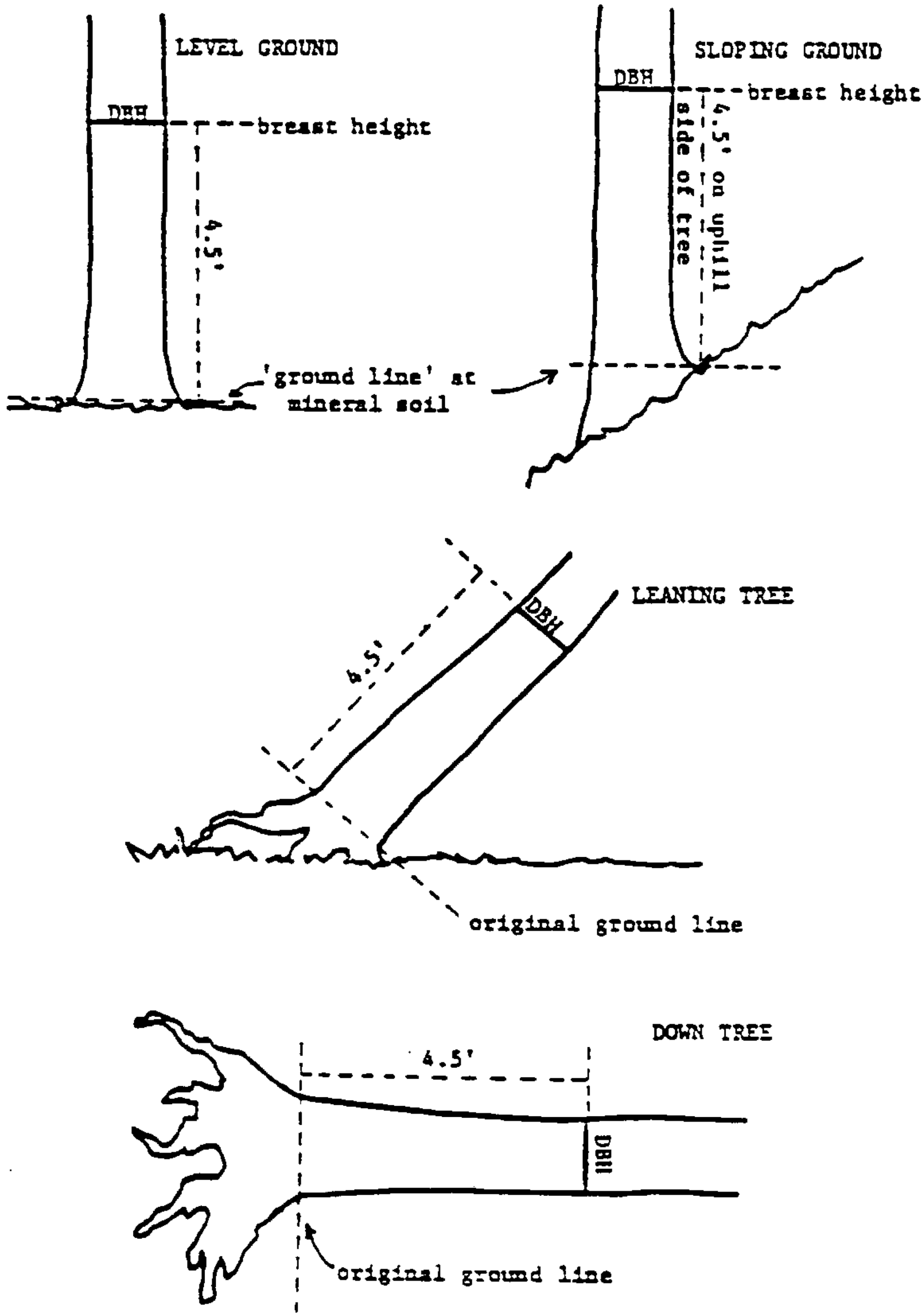
- These considerations support the reasoning for obtaining age and growth by increment boring at breast height. It would be difficult, or at least inconvenient, to get an increment boring at stump height.

- When diameter, growth, and age are all measured at the same place (breast height), a correlation between these factors can be statistically established.

Asymmetrical Conditions at Stump Height which are not usually present at Breast Height:



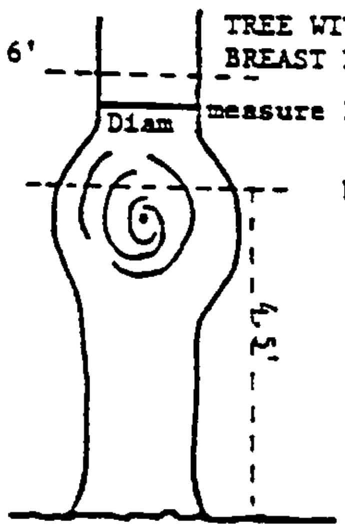
DBH of trees with Normal or Average Boles at 4.5 feet above ground:



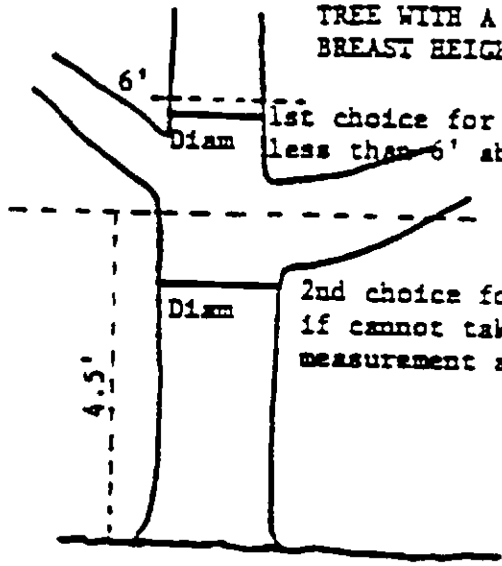
Diameter of Trees with Bole Abnormalities at Breast Height (4.5 feet above ground).

Measure diameter as close as possbile to the standard 4.5 feet above ground. For practical reasons, at a height no higher than 6 feet above ground; and preferably, no lower than 3 feet above ground. Try to get the best possible diameter for the tree.

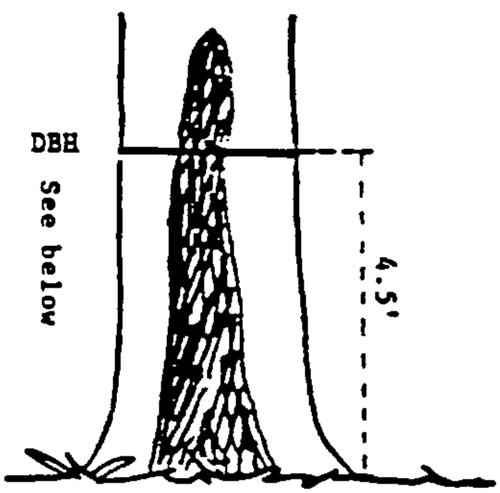
TREE WITH A SWELL AT BREAST HEIGHT



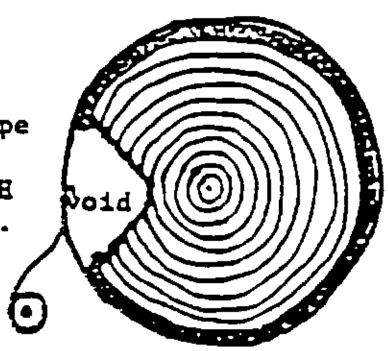
TREE WITH A BRANCH AT BREAST HEIGHT



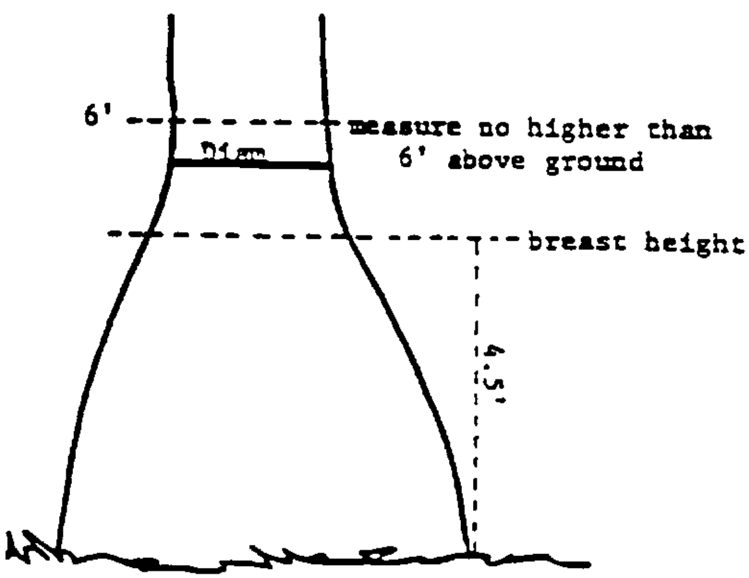
TREE WITH VOID, FIRE SCAR, RUST SCAR, ETC., AT DBH.



Round out with D-tape to where normal DBH should be.

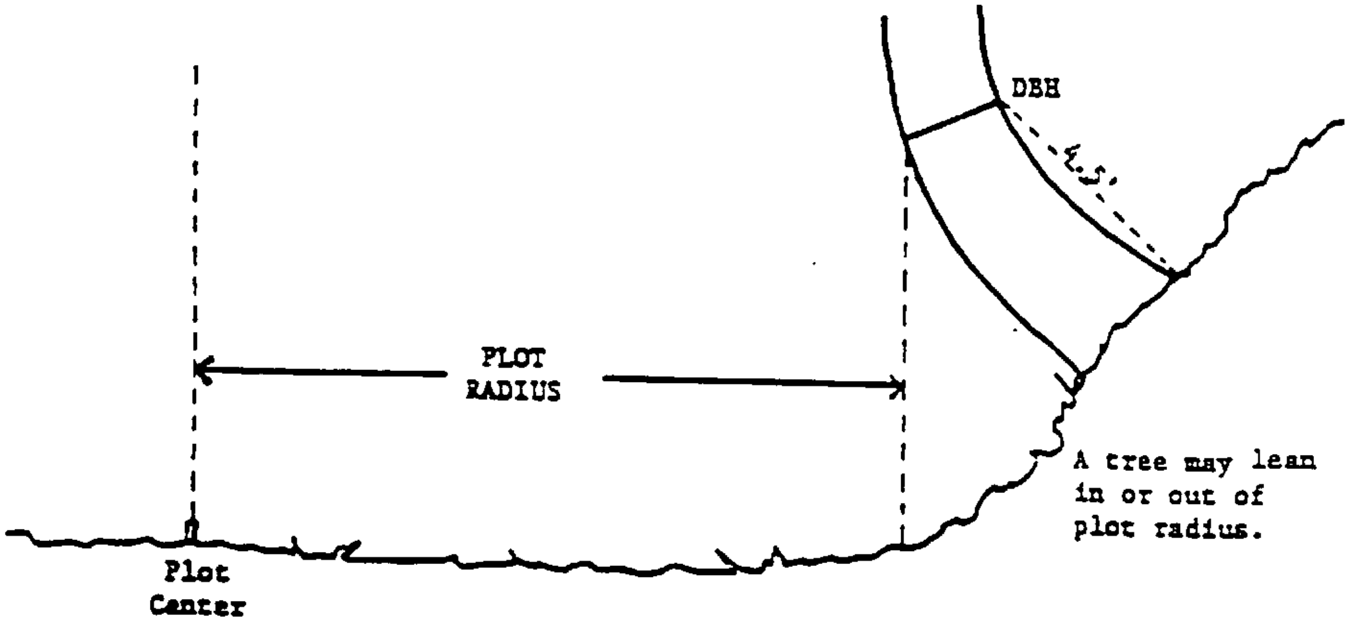


TREES WITH BUTT SWELL, BUTTRESS, BOTTLENECK, ETC., - MEASURE WHERE BOLE ASSUMES NORMAL TAPER

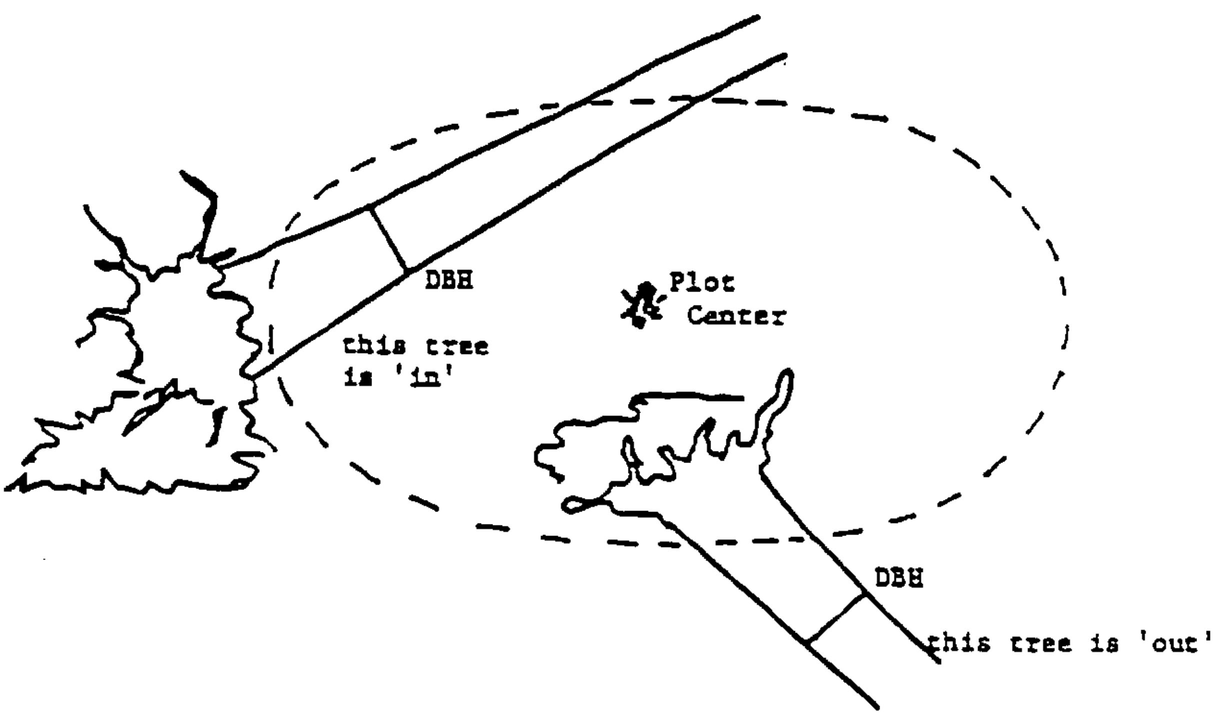


NOTE 'ABNORMAL DBH' IN "REMARKS" COLUMN

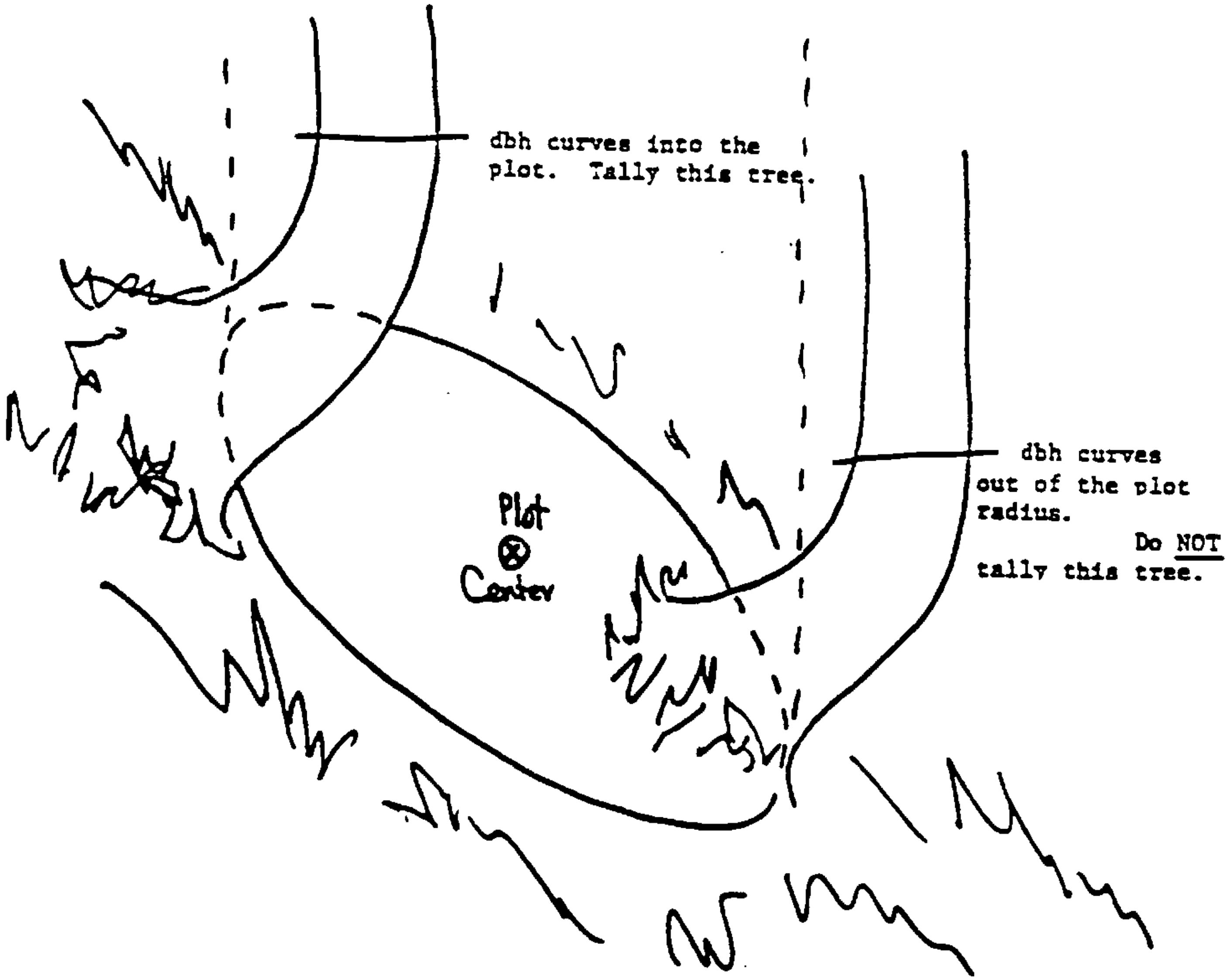
Measuring DBH in Various Situations:



Down Trees are 'in' or 'out' of plot radius based upon where the DBH now lies, not upon where the tree once stood.



Measuring DBH in Various Situations. - continued



On this steep hillside plot, one of these 'pistol-butt' trees curves into the plot, and the other one curves out of the plot.

FORKED TREES

By definition, a tree is typically a large woody perennial with a single well-defined stem (bole). Trees with forks in the stem of species which normally have a single stem are referred to as "forked trees" in Region 6.

The difference between a fork and a branch:

- A branch assumes lateral growth.

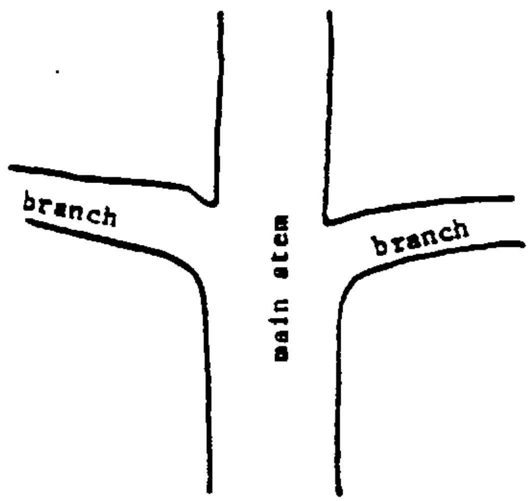
- A fork assumes vertical growth.

Forks are extensions from the main stem which, in time, assume a main stem growth pattern (vertical) and often become merchantable stem or bole wood products.

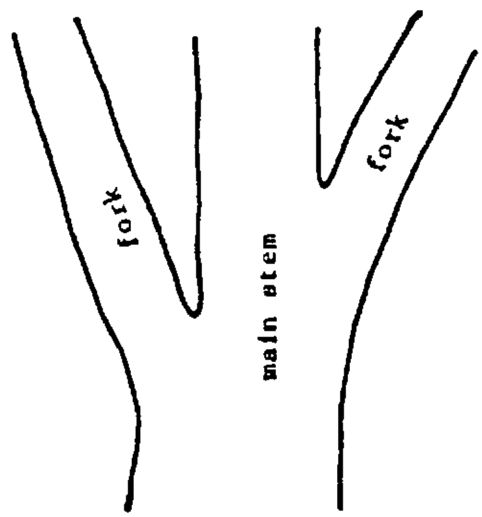
Forks are tallied because they have the potential to become products. Branches do not normally have the potential to become "products."

TALLYING FORKED TREES

Is it a fork or a branch?



Branches assume 'lateral' growth



Forks assume 'vertical' growth

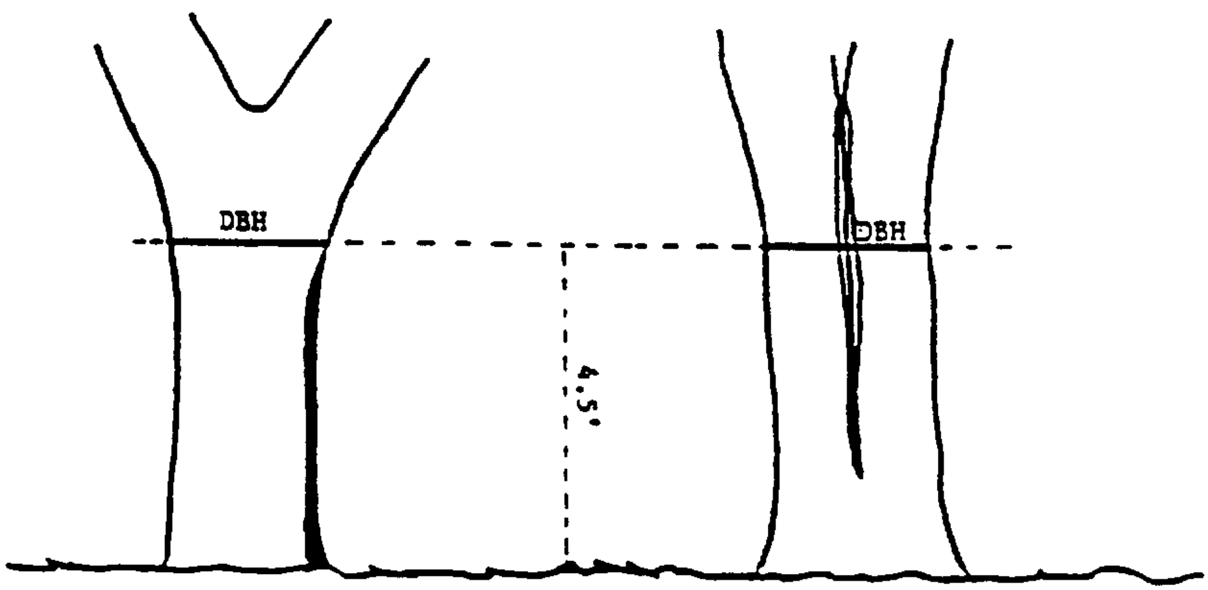
For trees of commercial species which normally have a single well-defined stem: When the top is damaged, the lateral branches often compete for top dominance. When this happens, the branch growth becomes vertical. One or more leaders may result. In time, one or more of these branches may become forks. During the transition phase, it could be difficult to classify this as branch or fork growth.

Tally Rules for Forked Trees, continued.

Forked Trees in Stand Population Statistics

Forked trees should be regarded as a separate population. They should not be used as Site Trees or Growth Sample Trees unless they are charateristic of the general stand population or unless the forking is a natural genetic function of a species to be featured in management. Height should be recorded for each tree because heights computed from prognosis would not be realistic for these trees or forks.

A. For trees which fork above 4.5 feet above ground.



This tree forks above 4.5 feet.

This tree forks below 4.5, but the forks cannot be measured individually.

1. Measure DBH at 4.5 feet or as close as practical.

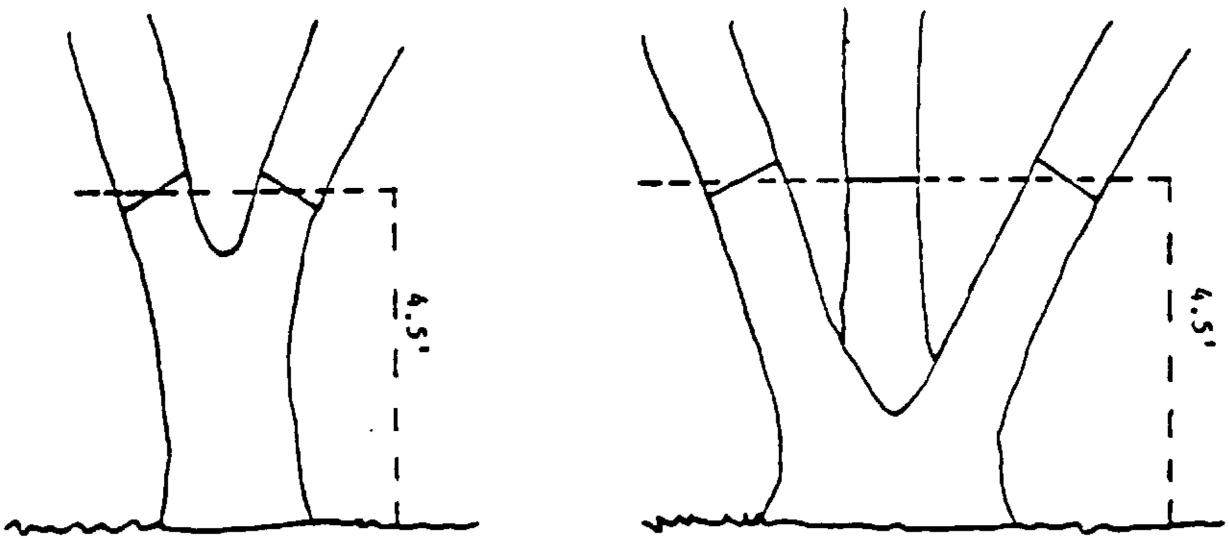
2. Record it as one tree. It may be a GST or a Tree Class 1 but not a Site Tree, unless this is a tree typical of those to be featured in management for this stand.

3. Record height of the tallest fork.

4. Record forked tree Damage Code 98.

Tally Rules for Forked Trees, continued.

3. For trees which fork below 4.5 feet above ground.



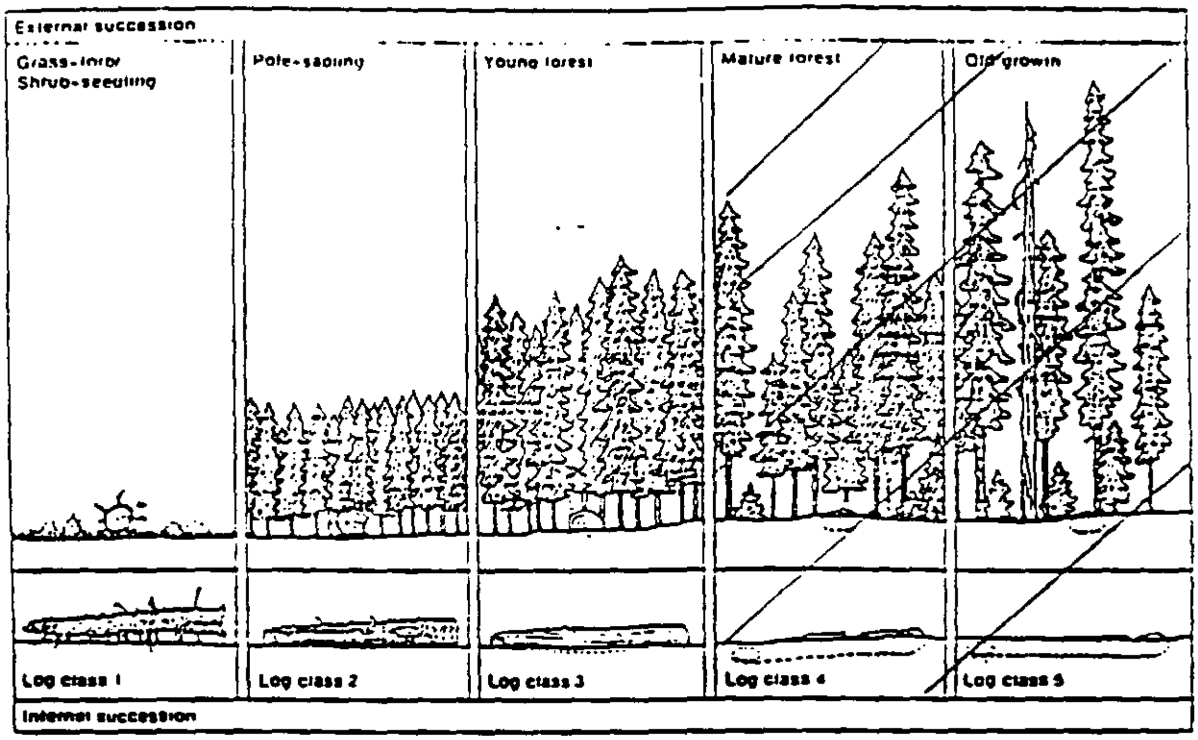
1 Determine where DBH will be measured for each fork. Fork diameters should be measured as close as practical to 4.5 feet above ground.

2. Determine whether the fork is 'in' or 'out' of the plot radius.

3. Tally the 'in' plot forks. Record each fork as an individual tree. It may be a GST or a Tree Class 1, but not a Site Tree unless this is a tree typical of those to be featured in management for this stand.

4. Record height for each fork.

Appendix L



Logs progress through two simultaneous successional processes--internal and external (adapted from Maser et al., 1979)

use only class 1-3

Log characteristics	Log decomposition class				
	1	2	3	4	5
Bark	intact	intact	trace	absent	absent
Twigs < 3 cm (1.18 in)	present	absent	absent	absent	absent
Texture	intact	intact to partly soft	hard, large pieces	small, soft, blocky pieces	soft and powdery
Shape	round	round	round	round to oval	oval
Color of wood	original color	original color	original color to faded	light brown to faded brown or yellowish	faded to light yellow or gray
Portion of log on ground	log elevated on support points	log elevated on support points but sagging slightly	log is sagging near ground	all of log on ground	all of log on ground

Five-Class System of Log Decomposition Based Upon Work Done on Douglas Fir (adapted from Maser et al., 1979)