WESTERN SOUTH DAKOTA FOREST SURVEY FIELD PROCEDURES

1983

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
U.S. Department of Agriculture Forest Service
Ogden, Utah 84401

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CONTENTS

INTRODUCTION

This manual outlines the procedures to be used by field crews working on cooperative forest resources inventories. This procedure has been developed cooperatively to meet the needs of Resources Evaluation, USDA Forest Service; the USDI Bureau of Land Management; the USDI Bureau of Indian Affairs; and several State forestry organizations. Similar procedures are used by National Forest Systems, thus essentially all unreserved forest lands may be covered by a common data base for complementary analyses of the forest resource situation and for management planning of forest resources.

The reference number associated with each tree item listed in the Table of Contents will assist you in locating in the manual and on the Timber Field Location Record the measurement procedure and place to record the measurement, respectively.

In the course of establishing and measuring field locations, there will be frequent opportunities for contacts with personnel from other State and Federal agencies and others interested in the work being done. Crew members are expected to act courteously and diplomatically in all their contacts with the public and other agencies. It is particularly important that crews obtain permission to enter or pass through private land whenever possible to do so. Be careful not to cause any property damage and to close all gates.

SECTION A. DETERMINING AND RECORDING FIELD SAMPLE LOCATION

Recorded items in this section provide information on the field sample location. This information will be used primarily to re-establish the location on future remeasurements. Therefore, information must be recorded in legible and understandable terms.

Planning Travel A.1

Planning Travel: As an aid in planning travel and in finding the field sample, crews will be supplied with highway maps, USGS 7.5' topographic maps, and aerial photographs with sample locations marked (indicated by a circled pinhole). The Field Supervisor will select the field sample to be measured prior to the day's work and the Crew Leader will determine the best route of travel using the maps and aerial photos. As a safety precaution, the Crew Leader will then leave a description of this route with the Field Supervisor, or wherever the Supervisor designates.

Establishment of Photo Base Line and Scale A.2

Establishment of Photo Base Line and Scale: Each field location will be accurately established and referenced on the ground so that it can be relocated and remeasured for subsequent inventories. Therefore, the responsibility of the field crew is to locate, on the ground, the exact point pinpricked on the photo.

The first step in locating the field location is to establish a photo base line and scale. Two methods available for doing this are the "map/photo" and the "ground/photo" techniques. The map/photo technique is generally used in the office and the ground/photo technique is a field procedure for establishing a base line. Both methods are described in the Appendix of this manual.

Reference Point (RP) A.3

Reference Point (RP): Select a landmark readily identifiable on both the ground and the photograph and as close to the sample location as possible, but not within the sampling area. Select landmarks which can be readily identified such as sharp bends in roads, streams, or drainage ditches; fence corners; prominent trees; or rocks. The RP should, if possible, be a tree not likely to die, or landmark not likely to be removed, within the next 10-15 years.

Pinprick the RP on the aerial photograph on which the sample location is pinpricked. Circle and label the pinprick RP on the back of the photograph.

In the field, mark the RP with aluminum tags when appropriate (no mark is needed if the RP is permanent and readily identifiable, such as the corner of a building or a road intersection). For example, if a tree is selected as the RP, nail aluminum tags on two sides of the tree 6 feet above ground level, and with 1 inch of nail exposed (to allow for tree growth between inventories). One tag will face the general route of

approach to the RP. A third tag, located below stump height (1 foot) will face in the direction of the field sample. On this tag scribe Field Location Number (Item 10).

Do not nail an RP tag to a private building or other private improvements. If the RP is in a place where there is a high probability that a tag at 6 feet above the ground will be vandalized, then attach the tag at ground level.

(a) Reference Point Description: Record a brief but precise description of the RP on the Field Location Record Sheet. If the RP is a tree, record its species code and diameter at breast height (DBH) to the last 0.1 inch. (See items 61 and 62 for species codes and DBH measurement procedures.)

(b) Route to RP and Remarks: Record a concise description of the route to the RP on the Field Location Record Sheet starting from an easily identifiable point (e.g., center of a town, intersection of roads, trails, drainages, etc.). Include the distances traveled between critical points along the route and the locations of locked gates or other access problems.

Course to Field Location A.4

Course to Field Location: With the RP located and marked and a baseline established, determine and record the azimuth and distance from the RP to the field location using the following procedure:

(a) On the back of the photo carefully draw a line connecting the RP and the field sample point on the photo.

(b) Using one of the following two methods, intersect the RP-field sample line with the baseline:

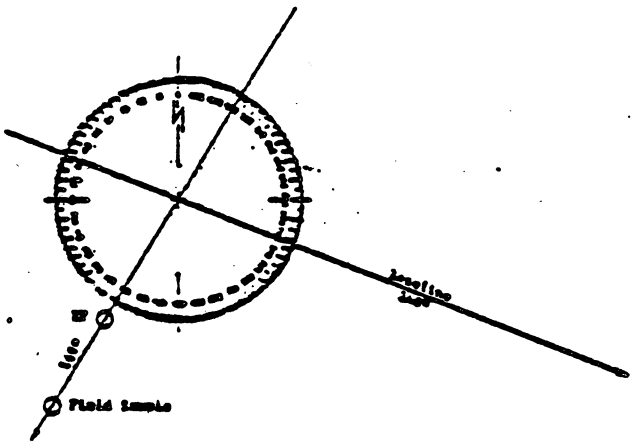
(1) Simple Baseline Method - Extend the RP-field sample line so that it intersects the baseline (Figure A-1.1).

(2) Baseline-Secondary Baseline Method -- If the baseline and the RP-field sample line do not intersect on the photograph, draw a line perpendicular to the baseline and the RP-field sample line. Use this new line as a secondary baseline (Figure A-1.2).

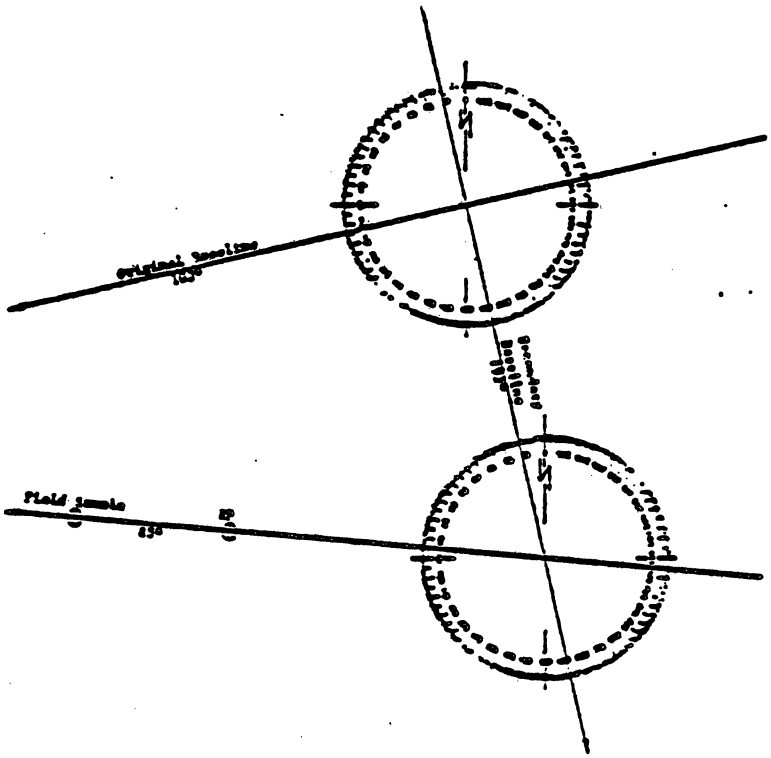
NOTE: Remember to place arrowheads on these lines to aid in measuring azimuths.

(c) To measure the azimuths of these lines, orient the photo scale-protractor inverted (i.e., upside down, since the photo work is carried out on the back of the photo) over the line intersections, and measure the azimuths in relation to the azimuth of the original baseline (Figure A-1).

(d) To determine the distance from the RP to the field location, select the scale on the photo scale-protractor that is closest to the actual photo scale and measure the distance between the RP and field sample pinholes to the nearest 12.5 feet.



A-1.1



A-1.2

Figure A-1. Measuring azimuth from RP to Field Location using two methods: A-1.1) the simple baseline method, and A-1.2) the baseline - secondary baseline method.

(e) Record the azimuth in degrees and the horizontal distance in feet from the RP to the field location on the back of the photo and on the Timber Inventory Location Record.

Travel to Field Location A.5

Travel to Field Location: Using compass and tape, run a traverse from the RP to the field sample along the azimuth and distance recorded. Distance correction for slope will be necessary when slope exceeds 10 percent (see Table A-1). Record the azimuth, horizontal distance, and slope distance on the upper right-hand side of the Field Location Record Sheet.

Sample Location A.6

Sample Location: Any physical features that will assist in accurately relocating the initial point should be drawn onto the location layout. This includes changes in vegetation type, old range or forest roads, forest/nonforest boundaries, streams, drainages, fence lines, etc. Be sure to indicate substitute points (see Substitute Points, Section B) when using a point cluster layout.

Photos A.7

Photos: Record the aerial photography code and photo numbers found on Table A-2. Place an asterisk (*) next to the primary photo (photo with the sample location pinpricked on it).

Legal Description A.8

Legal Description: Record the township, range, and section in which the field sample is located. This information is obtained from the USGS quad maps or the county transportaion maps.

FIELD CREW A.9

Field Crew: Enter the last names of the tallyperson and cruiser. If larger than a two-person crew, include names of other personnel.

Editing A.10

Editing:

(a) Field Edit: After measuring the field sample, but before leaving the area, the tallyperson will make sure all required data are recorded correctly. The tallyperson will then initial and date the Timber Inventory Location Record in the space provided.

(b) Office Edit: The Field Supervisor or other qualified personnel will review the plot data for accuracy, completeness, and legibility. They have the option of returning the data to the tallyperson for correction. The office editor will initial and date the Location Record in the space provided.

Table A-1. Slope Correction Table

Slope (%)	Correction Factor	Horizontal Distance (Feet) 50	100*	150
		Slope Distance (Feet)		
0-9	1.00	50		150
10-17	1.01	50.5		151.5
18-22	1.02	51		153
23-26	1.03	51.5		154.5
27-30	1.04	52		156
31-33	1.05	52.5		157.5
34-36	1.06	53		159
37-39	1.07	53.5		160.5
40-42	1.08	54		162
43-44	1.09	54.5		163.5
45-47	1.10	55		165
48-49	1.11	55.5		166.5
50-51	1.12	56		168
52-53	1.13	56.5		169.5
54-55	1.14	57		171
56-57	1.15	57.5		172.5
58-59	1.16	58		174
60-61	1.17	58.5		175.5
62-63	1.18	59		177
64-65	1.19	59.5		178.5
66-67	1.20	60		180
68-69	1.21	60.5		181.5
70	1.22	61		183
71-72	1.23	61.5		184.5
73-74	1.24	62		186
75	1.25	62.5		187.5
76-77	1.26	63		189
78-79	1.27	63.5		190.5
80	1.28	64		192
81-82	1.29	64.5		193.5
83	1.30	65		195
84-85	1.31	65.5		196.5
86	1.32	66		198
87-88	1.33	66.5		199.5
89	1.34	67		201
90-91	1.35	67.5		202.5
92	1.36	68		204
93-94	1.37	68.5		205.5
95	1.38	69		207
96-97	1.39	69.5		208.5
98	1.40	70		210
99-100	1.41	70.5		211.5
101	1.42	71		213

*Slope distance for 100 feet horizontal distance = Correction Factor X 100.

SECTION B. ESTABLISHMENT OF FIELD LOCATION

Establishing Center of New Field Location B.1

Establishing Center of New Field Location: If the field location is being established for the first time, place a plastic, metal, or treated-wood stake at the end of the computed course. By using the aerial photos and stereoscope, check to make sure that the photograph location agrees with ground location of the field location.

There are several situations where a field location cannot or should not be established. These situations, and the action to follow, are listed below:

(a) Owner Access: When denied access or when owners direct the crew to leave private property, the Crew Leader should:

(1) Politely attempt to identify the owner or other person acting for the owner, and write the information in "General Statement."
(2) Promptly leave the property, after explaining the purpose of the crew, if possible.
(3) Complete as many items as possible (items 1-12, 14-18, 55, 59, 77) on Field Location Record, and write ACCESS DENIED across the Field Location Record Sheet in tree tally section. Also, record any additional leader items available; i.e., forest type, etc.
(4) Inform Field Supervisor.

(b) Inaccessible Forest Land: When the crew cannot reach and/or measure the field location because of physical access or other conditions, take the following action:

(1) Record items 1-12, 14-18, 55, 59, 77, and those found in Section A of field manual (description of RP, course to location, etc.). Record any additional leader items available; i.e., forest type, etc.

(2) Write INACCESSIBLE across Field Location Record Sheet in tree tally section.

(c) Outside Sample Area: When the initial point of a field location falls on land not part of the Sample Area, the location will not be established. When the initial point falls on land not part of the Sample Area, a location is not taken. See Appendix 1 for areas included in Sample Area.

(1) If in doubt, and if no potential safety hazard or other problem exists, measure the location and inform the Field Supervisor.
(2) If a location is not taken, complete items 1-12, 14-18, 55, 59, 77, and write OUTSIDE SAMPLE AREA across Field Location Record Sheet in tree tally section.

Location Correction: When the ground location is clearly not the point pinpricked on the photograph, the field crew should determine the correct location and place a second stake at the correct location. Note the azimuth and distance from the initial stake to the second stake and record these items on the back of the aerial photo and on the Timber Inventory Location Record under Course to Field Location (Section A.4). Then remove the first stake. This second stake becomes the location of Point 1 of the sample location.

Ground Land Use B.3

Ground Land Use: Before establishing the sample location on the ground, it is necessary to classify the ground land use. This classification is based on the land use of the condition surrounding Point 1 of the location. Using the definitions which follow, the field crew must decide if the plot is timberland, woodland, nonforest land, developed forest land, or water.

In this and the following sections dealing with the field location, it should be remembered that the field location center (as defined by the pinprick on the photo) determines the ground land use classification provided the area surrounding the pinprick is at least 1 acre in size and 120 feet[1] wide. Forest boundaries are measured on the ground at the point where a vertical line is extended down from the outside edge of the forest crown since the accurate location of tree boles cannot be seen by the photo interpreter. This is not to be confused with the line of shadows cast from the edge of the crowns. Often, when uneven boundaries exist, the tallyperson must use an imaginary line to distinguish forest from nonforest.

There are 21 ground land use categories. These categories are arranged within the following hierarchal system:

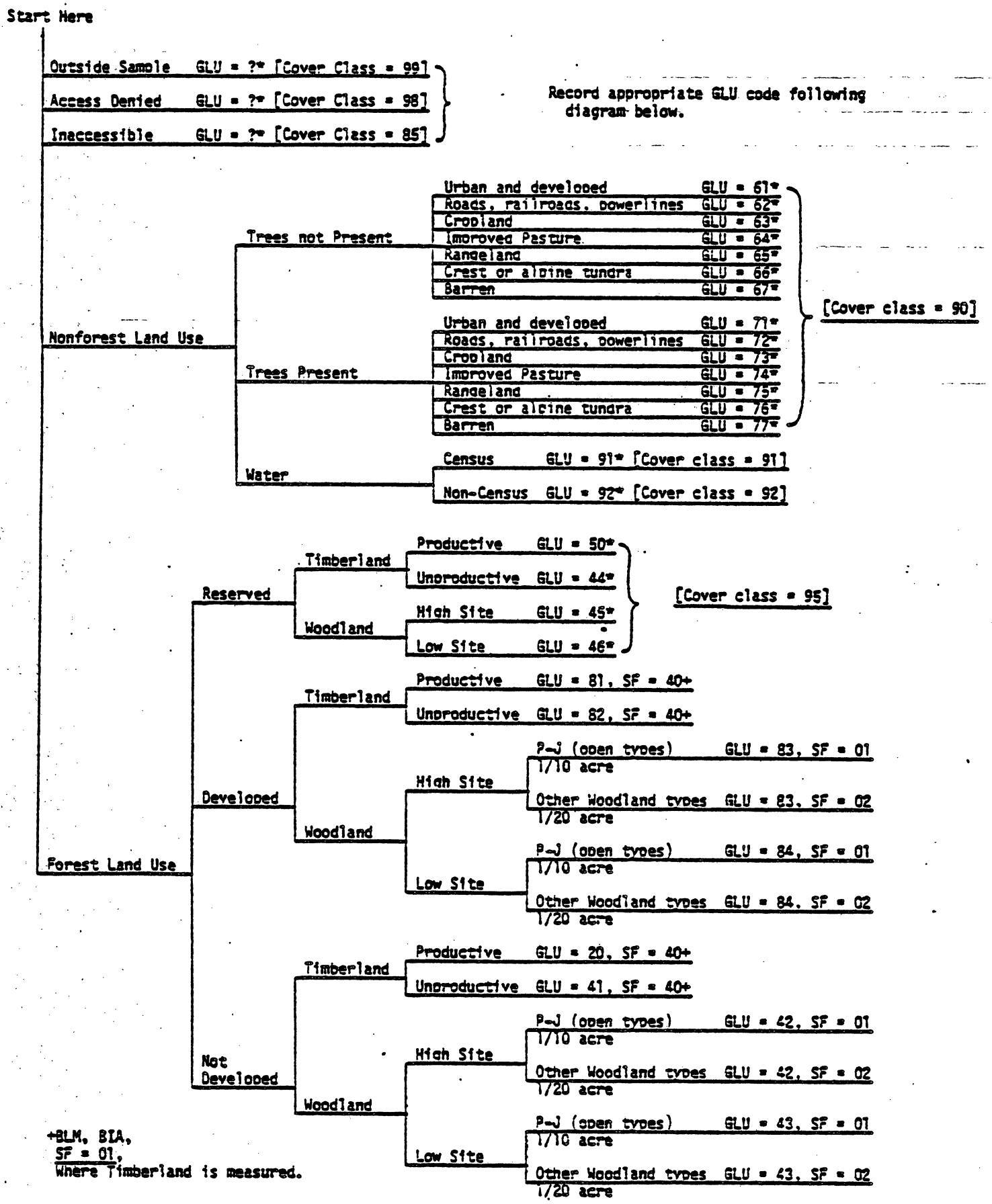
- Forest Land Use
  - Timberland:
    - Productive
    - Unproductive
  - Woodland:
    - High site
    - Low site
- Nonforest Land Use

The ground land use categories are listed on page 22.

[1]120 feet is approximately the radius of a 1-acre circle.

DECISION DIAGRAM

Move down the left side and to the right as you answer YES to "IS THE POINT OR LOCATION _____?" At the end will be a Ground Land Use (GLU, Item #16) code and, in some cases, a Sample Factor (Item #13) code.



+BLM, BIA, SF = 01, Where Timberland is measured.

*Field locations within this Ground Land Use classification will not be established or measured. A Field Location Record Sheet must be completed, however, with the following items: 1-12, 14-18, 55, 59, 77.

The field location will be established and measurements made for those locations classified as nonreserved timberland, nonreserved woodland, and four of the nonforest use categories: developed timberland-productive, developed timberland-unproductive, developed woodland-high site, and developed woodlandlow site. Locations classified as Developed will be measured using the appropriate procedures for Timberland or Woodland.

Forest Land Use B.4

Forest Land Use: This category includes productive and unproductive timberland and woodland. Forest Land must be at least 10 percent stocked (minimum of 5 percent crown cover) with timber or other tree species[2] of any size, or formerly having had such tree cover, and not currently developed for nonforest use. If Forest Land has become nonstocked and there is something happening on the land to prevent it from restocking, then the land has become something other than Forest Land. Evidence of adequate stocking in the past may be the presence of stumps, downed tree stems, snags, etc., in the area of the field sample.

The minimum area for classification of Forest Land is 1 acre. Roadside, streamside, and shelterbelt strips of trees must be at least 120 feet wide to qualify as Forest Land. Unimproved roads, trails, streams, and clearings in forest areas will be classed as Forest Land if they are less than 120 feet wide.

Forest Land does not include land currently developed for nonforest uses such as urban, residential, or resort areas within city limits; cropland (including orchards), improved roads, railroad, powerline and pipeline rights-of-way, improved pasture lands, rangeland, and alpine or barren areas.

Productive Timberland B.5

Productive Timberland: This is Forest Land producing or capable of producing crops of timber species, and which is not reserved (i.e., withdrawn from timber utilization by statute or administrative regulation). This class includes areas suitable for management to grow crops of industrial wood (i.e., forest land generally of a site quality capable of growing timber species and producing greater than 20 cubic feet/acre/year). Currently inaccessible and inoperable areas are included. Nonstocked areas that have the potential to be $\geq$10 percent stocked (5 percent crown cover) and otherwise meet the requirements are considered to be productive timberland (e.g., recently harvested or burned areas). In areas with mixtures of timber and other tree species, the land is classified as Timberland if timber species have 5 percent or more crown cover.

If Point 1 of the field location falls on nonreserved land that qualifies as productive timberland, establish the 5-point cluster and collect the necessary data. NOTE: If the field sample falls in an area that is presently being logged, establish and measure the plot only after logging is completed in the area.

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[2]Timber species: Includes all species of softwoods except pinyon, juniper, and yew. Hardwoods included in this category are aspen and cottonwood species.

Other tree species: Includes all species of hardwoods except aspen and cottonwoods (e.g., mountain mahogany, oaks, maples, etc.). Softwoods included in this category are pinyon, juniper, and yew species.

Unproductive Timberland B.6

Unproductive Timberland: This is Forest Land growing timber species, but incapable of producing 20 cubic feet per acre per year of timber species due to adverse site conditions. Adverse site conditions include sterile soils, severe climatic conditions, poor drainage, high elevation, steepness, and/or rockiness. This land is not reserved. In areas with mixtures of timber species and other tree species, the land is classified as Timberland if timber species have 5 percent or more crown cover.

If Point 1 of the field location falls on nonreserved land that qualifies as unproductive timberland, establish the 5-point cluster and collect the necessary data. NOTE: If the field sample area is currently being logged, establish and measure the plot only after logging is completed.

High-Site Woodland B.7

High-Site Woodland: This is Forest Land with 5 percent or more crown cover but less than 5 percent crown cover in timber species and which meets the following definition: Forest land capable of producing crops of wood material from other tree species.

These listed stand characteristics are generally indicative of a "high" site; however, the occurrence or lack of any one of these characteristics does not necessarily determine the site category -- they are only guides, and a judgment will have to be made as to the effect other factors may have on productivity:

(a) stocking appears adequate;
(b) many height classes present, seedlings and saplings present;
(c) majority of trees are vigorous with full crowns;
(d) seed trees present (cone-bearing);
(e) trees show little or no unusual stunting;
(f) soils are not extremely rocky;
(g) slopes are not excessive (greater than 30 percent); (h) exposures are to the north or east and are protected (i.e., not on ridge tops, peaks, etc.).

If Point 1 of the field sample falls on nonreserved land that qualifies as high-site woodland, establish the 1/10- or 1/20- and 1/100-acre plots. NOTE: If the field sample is in an area that is currently being logged, establish and measure the plot only after logging is completed.

Low-Site Woodland B.8

Low-Site Woodland: This is Forest Land with 5 percent or more crown cover but less than 5 percent crown cover in timber species and which meets the following definition: Woodland generally not capable of producing crops of wood material.

Listed below are characteristics of low-site woodlands:

(a) stocking is usually low (sparse);
(b) stand is composed of only dominants and codominants. Intermediate size classes are not present;
(c) stand is composed of overmature or decadent trees. Seedlings, saplings, and young trees are not present or are in very small numbers;
(d) no seed trees are present;
(e) trees are stunted;
(f) site occurs on one of the following:

(1) Steep, rocky terrain characterized by the presence of cliffs, ledges, rock columns, and large boulders. Any trees present usually must gain a foothold and grow on what little soil accumulates in cracks or on flat areas.
(2) High, narrow ridge tops subject to constant high winds. Generally, these areas support stunted, gnarled timber, usually of large girth but of short height. Age normally is quite high and growth has slowed to a negligible progression.
(3) Narrow to moderately wide chutes subject to frequent snowslides. The site may be capable of supporting, or may be supporting, potential commercial timber; but the periodic snowslides prohibit trees from growing to maturity by breaking their main stems, damaging lower trunks by dashing rocks and logs against them, burying smaller trees under debris, and entirely uprooting larger trees.
(4) Areas of steep to flat topography covered by large areas of shale, fist-sized rocks, or larger rocks. Commercial trees may be present -- having become established during a period when a thin layer of soil existed before the rocks slid down to cover the site.

If Point 1 of the field sample falls on nonreserved land that qualifies as low-site woodland, establish the 1/10- or 1/20- and 1/100-acre plots and record the necessary data. NOTE: If the field sample is in an area that is currently being logged, establish and measure the plot only after logging is completed.

If Point 1 of the field sample is located on reserved Forest Land, do not establish the location but record only Items 1-12, 14-18, 55, 59, 77, and those in Section A.

Nonforest Land B.9

Nonforest Land: This is land that has never supported forests and lands formerly or presently forested where use for timber management is precluded by development for other uses. (NOTE: Includes areas used for crops, improved pasture, urban areas, city parks, improved roads of any width, a railroad, powerline, pipeline clearings of any width, rangeland, alpine and barren areas. If intermingled in forest areas, umimproved roads and nonforest strips must be at least 120 feet wide and 1 acre in area to qualify as Nonforest Land.)

If Point 1 of the field sample is located on Nonforest Land, do not establish the location but record only Items 1-12, 14-18, 55, 59, 77, and those in Section A.

Water B.10

Water:

(a) Census Water -- Rivers, streams, sloughs, estuaries, and canals, more than 1/8 mile (660 feet) in width and more than 40 acres in size, and lakes, reservoirs and ponds more than 40 acres in size. Only those portions of rivers and streams meeting the definition criteria (1/8 mile wide and more than 40 acres) are considered census water.

These portions of braided streams meeting the definition criteria (1/8 mile and 660 feet) which are more than 50% water at normal high water level are considered census water.

Ephemeral (intermittant) streams are considered land.

(b) Noncensus Water -- Those portions of rivers, streams, sloughs, estuaries, and canals that are from 120 to 660 feet in width and 1-40 acres in size, and lakes, reservoirs, and ponds 1-40 acres in size. Those portions of rivers and streams not meeting the definition criteria for census water, but at least 120 feet in width and 1 acre in size are considered noncensus water.

Those portions of braided streams not meeting the definition criteria for census water, but at least 120 feet in width and 1 acre in size which are more than 50% water at normal high water land are considered non-census water.

Ephemeral (intermittant) streams are considered land.

If Point 1 of the field sample is located in census or noncensus water, do not establish the plot but record only Items 1-12, 14-18, 55, 59, 77, and those in Section A.

Developed Timberland and Developed Woodland: This is Timberland or Woodland which will probably not be managed for wood production because of development for recreational, residential, or other nonforest use. These areas are identified by the presence of campsites, homes, or a high road density. These areas are generally found in subdivisions, small tracts, or corporate ownership. Developed productive and unproductive timberland and developed high- and low-site woodland will have the same edaphic and biological conditions as productive and unproductive timberland, and high- and low-site woodland, except for development. City parks, even if forested, are considered Ground Land Use Urban and Developed.

If point 1 of the field sample is located on Developed Forest Land*, establish and measure the location as if Timberland or Woodland, but record the appropriate code for Ground Land Use.

Witnessing the Field Sample Location B.11

Witnessing the Field Sample Location: Reference Point 1 with at least two witness trees. They should preferably be:

(a) close to the stake and spaced approximately at right angles to each other. The "X" tree should be as near as possible on the extension of the azimuth followed into the location, and the "Y" tree at a right angle to this azimuth;

(b) not likely to die within 10 years;

(c) a species easily located in a stand (e.g., Engelmann spruce in a lodgepole pine stand). NOTE: Avoid aspen, if possible.

(d) At least 5.0 inches DBH (at least 2.0 inches if no trees 5.0 inches and over are available).

*If point 1 of field sample is located within city limits do not establish plot.

Record the following landmark data on the Location Record under Witness Description (Section F.4):

(a) species and DBH (to the last full 0.1 inch of the trees witnessed);

(b) azimuth (to nearest degree) from stake to center of tree at its base;

(c) slope distance (to the nearest 0.1 foot) from stake to face of the tree at its base.

Scribe an "X" above DBH on the side of the "X" tree facing the stake (point center). Scribe the Field Location (Item 10) on aluminum tags.* Then nail one tag below stump height (12.0 inches) on each witness tree so that the tags face point center. (NOTE: When driving nails into trees, leave at least 1.0 inch exposed.)

Five-Point Cluster B.12

Five-Point Cluster: After Point 1 has been established, the other four points will be located and marked with permanent stakes. Tie colored flagging to trees or brush at all five points as an aid for relocation and checking purposes.

The grid pattern of sample points is designed to obtain a distribution of independent points in a forest condition. Use spacing and orientation as follows: (NOTE: This layout will only be used for Timberland areas; use only Point 1 or the initial point for Woodland areas.)

Azimuth (°)	and	Distance (in feet)	from	Point	to	Point
60		100		1		2
180		100		2		3
300		100		3		1
300		100		1		4
180		100		4		5

*Marking procedure may vary, depending upon land ownership. See supplemental instructions.

The above spacing and orientation results in two equilateral triangles with 100-foot sides (Figure B-1). Distance correction for slope is necessary when slope exceeds 10 percent. If an area is extremely brushy or steep, then points 2 to 5 should all be located directly from Point 1 for easy relocation and remeasurement.

NOTE: If Point 1 or any other of the five points at a sample location falls within a tree trunk, shift the point location back along the approach line a distance of 2 feet from the edge of the tree trunk and mark with a stake. Measure distance to the next point from where the point should have been, although tree measurements are made from the stake.

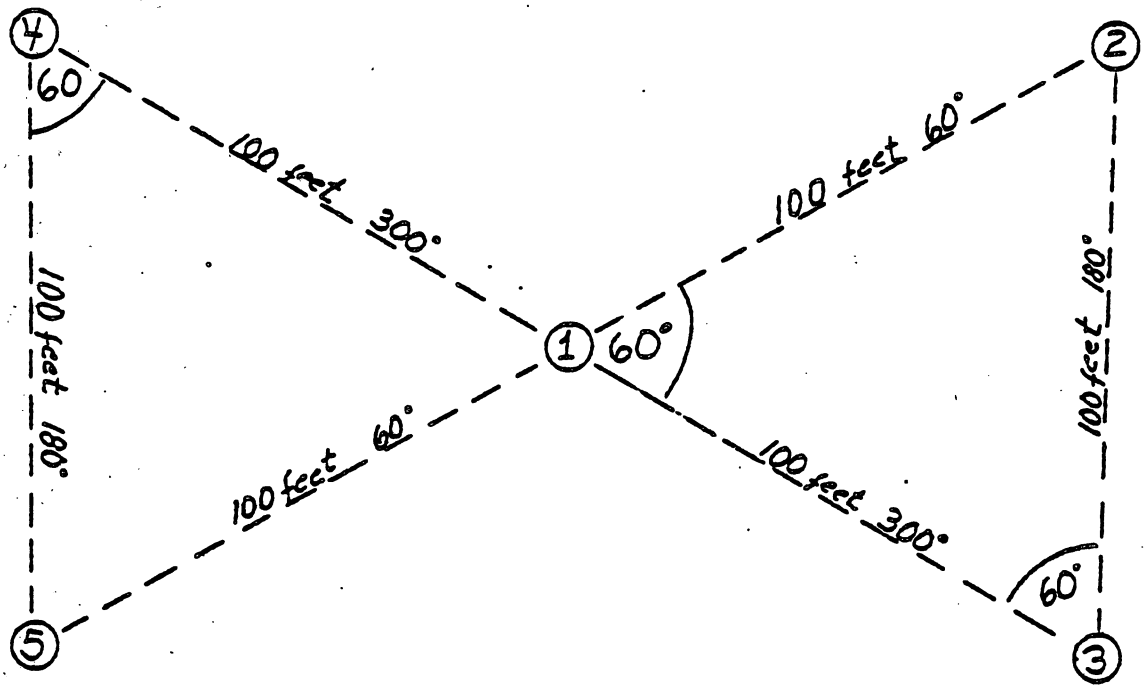


Figure B-1. Five-Point or "Bow-Tie" Cluster Layout.

One goal of the five-point or "Bow-Tie" cluster design is to sample within a homogenous vegetative and site condition. No substitutions will be made for areas of inclusions that are less than 1 acre in size.

It will be necessary to substitute points in any of the following situations:

(a) When Point 1 falls in one homogenous condition (vegetative type, size class, or site) larger than 1 acre and any of the other four points fall in a distinctly different vegetative type at least 1 acre in size and 120 feet wide, locate substitute points in the same vegetative type as Point 1 and mark with stakes. (NOTE: Transition areas with a mix of species from two vegetative types should not be considered as distinctly different vegetative types.)

(b) When Point 1 falls on Productive Timberland, and any of the other four points fall on Unproductive Timberland, Woodland, or Nonforest Land at least 1 acre in size and 120 feet wide, locate substitute points on the Productive Timberland and mark with a stake. Points falling on Unproductive Timberland, Woodland, or Nonforest Land smaller than 1 acre and less than 120 feet wide, will be considered Productive Timberland and no substitute points will be required. This reasoning also holds true for the reverse of the above situation.

(c) Locate substitute points when any of the Points 2-5 fall on improved roads or railroad, powerline, or pipeline rights-of-way regardless of width. Such nonforest clearings are not to be inventoried but should be sketched on the cluster layout diagram on the plot sheet.

Locate all five points first; then determine which must be substituted. If there is any doubt as to whether a point should be substituted, substitute it and explain your reasoning.

The following procedures will be used for point substitution:

(a) If possible, use Locations A-E, with A being the first or highest priority substitution location and E being the last or lowest priority for a substitution. Use a prime superscript to indicate that the point is a substitute. For example, if A is used as a substitute for Point 5, A is labeled both on the plot diagram and on the data record as 5'. The lowest numbered point needing substitution is placed in the highest priority location which is the same vegetative type as Point 1 (Figure B-2).

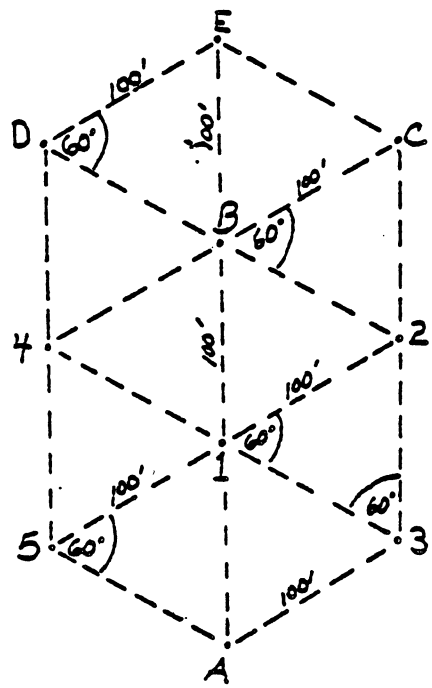


Figure B-2. Cluster Layout with Alternative Locations A-E.

(b) If none of Locations A-E can be used as substitutes:

(i) Start at 0° azimuth from the highest numbered regular point qualifying for tally.
(ii) Rotate clockwise at 60° intervals until you can locate 100 feet away the first qualifying point forming an additional equilateral triangle of points.

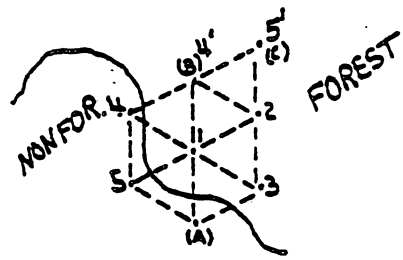
(c) When more than one substitute point is required:

(i) Follow the above procedure to locate the first substitute point.
(ii) Continue this rotation, at 60° intervals, selecting other qualifying points forming additional equilateral triangles.
(iii) If necessary, repeat this procedure at the next highest numbered regular point in turn, and then at each previously selected susbstitute point in turn.

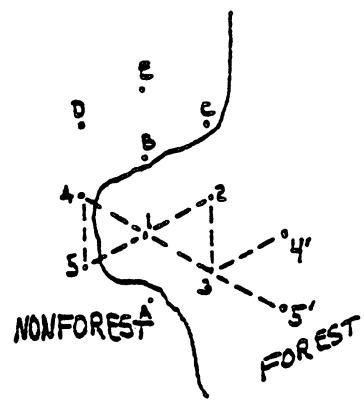
Where substitute points are selected, show their location on the Sample Record by sketching the five-point layout in the space provided. Also, show a number with a prime superscript for each substitute point.

The following two examples will show point substitution.

Example #1. Points 4 and 5 will have to be substituted as they fall in nonforest land. Therefore, B becomes point 4' and C becomes 5'. Point 4 was substituted to B because A was in nonforest and B was the highest priority location being the same vegetative type as Point 1.



Example #2. Locations A-E cannot be used for substitution because they are not the same vegetative type as Point 1. Starting at Point 3 (highest numbered point in same vegetative type as Point 1) and at 0° azimuth, rotate at 60° intervals to locate 4' and 5'.



Moving the Woodland Location: The entire Woodland location must occur within the condition being sampled. That is, if the plot boundary falls into another mapped stand or land class, then Point 1 must be moved. Move Point 1 directly away from (perpendicular to) the type or land class boundary so the plot boundary is just within the condition being sampled.

SECTION C. SAMPLE IDENTIFICATION

State 1.

State - Record the appropriate code:

Code	State	Code	State
04	Arizona	35	New Mexico
08	Colorado	46	South Dakota
16	Idaho	49	Utah
30	Montana	56	Wyoming
32	Nevada		

P.I. Map Number 2.

P.I. Map Number - Record the 4-digit map number of the USGS quadrangle on which the Field Location is found. Leave blank if not available.

P.I. Point Number 3.

P.I. Point Number (Consecutive Point Number) - Record the appropriate 4-digit code that identifies the point on the map selected for the field plot location. This number can be found on the back of the pinpricked aerial photo. If the number is not present on the photo, leave blank for the field supervisor to complete later.

Card Type 4.

Card Type - Record code 1 for the Location Record, code 2 for the Tree Record, code 3 for Multi-resource Record, code 4 for Understory Vegetation Record, and code 5 for Tree Segmentation Record.

Region 5.

Region (BLM Resource Area, BIA Area) - For private land, record code 0. For other ownerships, record the appropriate code from the code lists in Appendix 1.

Forest 6.

Forest (BLM District, BIA Agency) - For private land, record code 99. For other ownerships, record the appropriate code from the code lists in Appendix 1.

Working Circle 7.

Working Circle (BLM Planning Unit, BIA Reservation) Record the appropriate code from the code lists in Appendix 1.

Sample Area 8.

Sample Area - Record the 2-digit Working Circle code that is appropriate as shown in Appendix 1. The code designates the area and/or ownership being sampled as a unique data set.

County 9.

County - Refer to Appendix 1 and record the 3-digit code corresponding to the county in which the field sample is located.

Location Number 10.

Location Number - Record the appropriate 4-digit code from either the county map or the aerial photo on which the plot is located. Field Locations are usually numbered sequentially within a Sample Area.

Date of Survey 11.

Date of Survey - Record a 4-digit code to indicate the month and year in which the sample measurement is completed. The first two digits show the month, and the last two specify the year. Use the following codes:

Code	Month	Code	Year
01	January	80	1980
02	February	81	1981
03	March	82	1982
04	April	83	1983
05	May	84	1984
06	June	85	1985
07	July	86	1986
08	August	87	1987
09	September	88	1988
10	October	89	1989
11	November	90	1990
12	December	91	1991

For example, June 1981 would be coded 0681.

Crew Number 12.

Crew Number - Record the 2-digit code assigned to the crew that measures the field sample.

Sampling Factor 13.

Sampling Factor - Record code 40 for all field locations on which variable-radius plots are measured; for all field samples on which fixed plots of 1/10 acre are measured, code 01; for 1/20-acre plots, record 02; for 1/5-acre plots, record 05. Other sampling factors may be designated by the field supervisor.

Sample Kind 14.

Sample Kind - This item is determined by the sampling system used. Refer to the Field Location List and record the appropriate 1-digit code.

For field samples classified as Forest Land (Timberland or Woodland):

Code	Sample Kind
1	Secondary Grid A (at even 5,000 meter intervals)
2	Secondary Grid B (at offset 5,000 meter intersections)
3	Secondary Supplement (other than above) from REDAB grids
4	Locations selected from aerial photo point samples not REDAB grids
5	Locations selected from list of mapped polygons
6	Remeasured locations not on REDAB grids
7	Secondary Grid A (at even 10,000 meter intervals)
8	Secondary Grid B (at offset of 10,000 meter intervals)
9	Other

SECTION D. AREA CLASSIFICATION

Sampling Stratum 15.

Sampling Stratum: Record the appropriate 2-digit code in Columns 35 and 36 obtained from the Field Sample Location List. If these codes are not supplied on the list, leave blank.

Ground Land Use 16.

Ground Land Use: Record present land classification as determined from ground examination of the sample area. The sample area is defined as being at least 1 acre in size and wider than 120 feet at the point pinpricked on the photo. Following are the Ground Land Use Codes (see Appendix 5 for definitions). Record in Columns 37 and 38.

Code	Ground Land Use
	FOREST LAND USE
20	Timberland - productive
41	Timberland - unproductive
42	Woodland - high site
43	Woodland - low site
44*	Timberland - unproductive, reserved
45*	Woodland - high site, reserved
46*	Woodland - low site, reserved
50*	Timberland - productive, reserved
81**	Developed timberland - productive
82**	Developed timberland - unproductive
83**	Developed woodland - high site
84**	Developed woodland - low site
	NONFOREST LAND USE
Trees present: 71*	Trees not present: 61* Urban and developed
72*	62* Roads, railroads, powerlines, and other transmission lines (includes entire right-of-way)
73*	63* Cropland
74*	64* Improved pasture
75*	65* Rangeland
76*	66* Crest or alpine tundra
77*	67* Barren
	91* Census water
	92* Noncensus water

*Field locations within this Ground Land Use Classification will not be established and measured. A Field Location Record Sheet must be completed, however, for all locations in the Sample Area.

**Field locations within this Ground Land Use Classification falling within city limits will not be established and measured. A field location record sheet will be completed.

Use Trend: Record code 01 for new Field Sample Location.

Ownership: Refer to the Field Location List. If the Ownership code is not supplied on this list, leave blank.

Code	Owner Class
09	National Park Service[3]
11	National Forest
12	Bureau of Land Management
13	Indian tribal and allotted lands
14	Miscellaneous Federal[4]
15	State
16	County and municipal
20	Forest industry
40	Farmer
50	Farmer-owned, leased*
60	Other private - corporate
70	Other private individual
80	Other private corporate leased*
90	Other private individual leased*

[3]Cannot occur in net Sample Area.

*Leased: Refers to land leased to forest industry or individuals for timber utilization purposes.

[4]Bureau of Indian Affairs, Bureau of Reclamation, etc.

SECTION E. AREA DESCRIPTION

Stand Origin 19.

Stand Origin: Using the following 1-digit codes, record apparent stand origin for the field sample:

Code

1 Timberland -- natural stand with no evidence of artificial regeneration.
2 Timberland -- 41-100 percent of sample area is occupied by timber trees originating from artificial planting or seeding.
3 Timberland -- 1-40 percent of sample area is occupied by timber trees originating from artificial planting or seeding.
4 Nonstocked* forest land.
5 Woodland -- natural stand with no evidence of artificial regeneration.
6 Woodland -- regenerated after area was treated for type conversion.
7 Woodland -- encroachment on natural rangeland along forest edges.

Stand Class 20.

Stand Class: Stands are classified by the number and distribution of age classes** present. The four types of stand classes for field samples classified as timberland are:

a. Even-aged: These stands are composed of trees that do not differ in age by more than 20 years. Most tree crowns within these stands occur at approximately the same level in the canopy.
b. Two-storied: This class consists of two even-aged stands growing on the same site. The crown canopy is composed of two distinct levels. The average age of each level differs significantly from the other.
c. Uneven-aged: Three or more age classes exist in uneven-aged stands. These stands are difficult to classify because of their variability. Within the stand there may be small clumps of trees with canopies resembling even-aged stands; but, generally, the canopy consists of crowns in all positions, and there exists a wide range of tree ages in the stand.

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*Nonstocked: Forest land <10 percent stocked (<5 percent Crown Cover) with trees due to timber harvesting, forest fires, windthrow, etc.

**Age class: A timber stand classification based on grouping tree ages into classes of: (a) 10 years, for trees 1-100 years old (e.g., 1-10, 11-20, etc.); (b) 20 years, for trees 101-200 years old (e.g., 101-120, 121-140, etc.); (c) 201-300 years; and (d) 301+ years.

d. Even-aged clump: This is actually an uneven-aged stand composed of even-aged clumps of trees. The distinction between even-aged stands and even-aged clumps is made by studying the trees surrounding the field location on the aerial photo. (NOTE: Stands should be evaluated to a minimum area of 1 acre.) Determine the stand class on the photo. Check this classification on the ground. If the stand on the photo is uneven-aged and the plot falls in an even-aged clump of at least 1 acre, use Code 4 below.

Using the following 1-digit codes, record stand class for the field sample location:

Code	
1	Even-aged timberland
2	Two-storied timberland
3	Uneven-aged timberland
4	Even-aged clump timberland
5	Nonstocked timberland or woodland
6	Woodland

Seed Source 21.

Seed Source: Record prospects for natural seeding using Table E-1 (for timberland plots) and the following 1-digit codes:

Code	
1	Adequate softwoods, but inadequate hardwoods - timber species
2	Inadequate softwoods, but adequate hardwoods - timber species
3	Adequate softwoods and hardwoods timber species
4	Inadequate timber species but adequate other species
5	Inadequate all species

The following table may be used in determining if a poorly stocked opening or clearcut is likely to become adequately stocked. The columns under seed trees indicate how large a tree should be at DBH before it can be considered a predictable producer of seed. The distance is the radius of a circle that a tree of a particular species and of the minimum size will cover with an adequate seed cast.

Trees at the edge of a nonstocked clearcut will cast seed into the opening as a function of the strength of the prevailing winds and average seed weight per species. The average height of the most common species times the factor in the column on the right side of the table will give an approximation of how far into an opening an adjacent forest will cast adequate seed.

Table E-1. GUIDE FOR RATING ADEQUATE SEED SOURCE

Species of seed trees on forest type at timber edge	Seed Trees		Timber edges -- max. dist. from center of location in multiples of av. height of dominant and codominant trees
	DBH	Maximum distance from center of location	
	Inches	Feet	
White pine	16+	50	2
Cedar	16+	130	4
Ponderosa pine & Jeffrey pine	12-16	40	2
	18-24	50	2
	26+	70	2
Douglas-fir	10-14	50	2
	16+	60	2
True firs	16+	50	2
Larch	14-18	50	3
	18+	60	3
Spruce	18+	60	3
Lodgepole pine	10+	([1])	([1])
Aspen	([2])	([2])	([2])

[1]Seed source is considered adequate only if cone-bearing slash less than 5 years old is present on the ground at the center of location, or if the center of location is within 130 feet of a standing body of green timber.

[2]Seed source is adequate if the center of location is within 130 feet of a stump of a recently cut tree. Major reliance for reproduction in aspen is placed on root suckers--not seed.

Forest Type 22.

Forest Type: Record this item only for nonreserved woodland and nonreserved, nonstocked* timberland field locations. Leave blank for all other locations.

When classifying forest type in woodland, consider the species distribution of the condition** being sampled. Estimate which species has the plurality (highest amount) of basal area stocking in the condition being sampled.

To determine forest type of nonstocked forest land, estimate predominant species of the previous stand. Use evidence such as stumps, downed or residual trees, and adjacent stands on a similar aspect, slope, and soil type to make this determination.

Record Forest Type using one of the following 2-digit codes:

Code	Forest Type	Code	Forest Type
01	Douglas-fir (Interior)	54	Western larch
11	Ponderosa pine	61	Lodgepole pine
12	Jeffrey pine	77	Mtn. brush woodland-- (e.g., Mtn. Mahogany)
13	Ponderosa pine (Pacific)		
14	Sugar pine	78	Mesquite woodland
21	Western white pine	79	Misc. western softwoods
31	White fir	80	Misc. western hardwoods
32	Calif. and Shasta red fir	83	Aspen
33	Grand fir	85	Cottonwood
35	Engelmann spruce	88	Oak woodland
36	Engelmann spruce/subalpine fir	89	Riparian brush woodland-- (e.g., willow, etc.)
38	Blue spruce	90	Juniper woodland
39	White spruce	93	Pinyon/juniper woodland
41	Western redcedar	95	Bristlecone pine
45	Western juniper	96	Whitebark pine
47	Mountain hemlock	97	Chaparral woodland
48	Western hemlock	98	Limber pine

Stand-Size Class 23.

Stand-Size Class: This is a classification of forest land based on the size class of desirable and/or acceptable trees in the field sample.

Record this item only for all nonreserved woodland and nonreserved, nonstocked timberland field locations. Leave blank for all other forest land or other classifications, which will be classified by computer.

To calculate the stand-size class for woodland, ocularly estimate the size group of the plurality of basal area stocking (DRC) of trees on the plot. Record stand-size class using the following 1-digit codes:

---

*Reminder: If nonstocked timberland, find and measure six site trees near the location.

**Condition: Species distribution, tree size, and topographic site.

Code	Size Class
1	<3.0 inches DRC (seedling/sapling) - woodland
2	3.0-8.9 inches DRC (postwood) - woodland
3	9.0 inches DRC and greater - woodland
4	Nonstocked timberland or woodland

Crown Cover 24.

Crown Cover: Record the percent crown cover class that most nearly approximates the percent of the acre covered by tree crowns. Consider an acre surrounding the location that is in the same condition as Point 1. Remember that crown cover may have increased because of growth or decreased because of logging, insects, disease, or other activities. So do not rely completely on photos, especially older photos, to determine crown cover.

Code	Crown Cover (%)
1	<10
2	10-24
3	25-54
4	55-84
5	85-100

Elevation 25.

Elevation: Record elevation of Point 1 as a 3-digit code rounding to the nearest 100 feet. (Example: 7257 is coded 073. 12,134 is coded 121.)

Aspect/Slope/Curvature Class 26.

Aspect/Slope/Curvature Class: Record as a 4-digit code the aspect/slope/curvature class which best represents the area surrounding Point 1. The first digit defines aspect, the second and third describe slope, and the fourth digit indicates the curvature class (see Figure E-1).

Code	Aspect	Slope	Code	Curvature
1	N	Record actual	1	Convex
2	NE	slope percent:	2	Concave
3	E	00 to 99+.	3	Straight or flat
4	SE		4	Undulating
5	S			
6	SW			
7	W			
8	NW			
9	Level			

Example: Code 2211 = NE aspect, 21 percent slope, convex curvature.

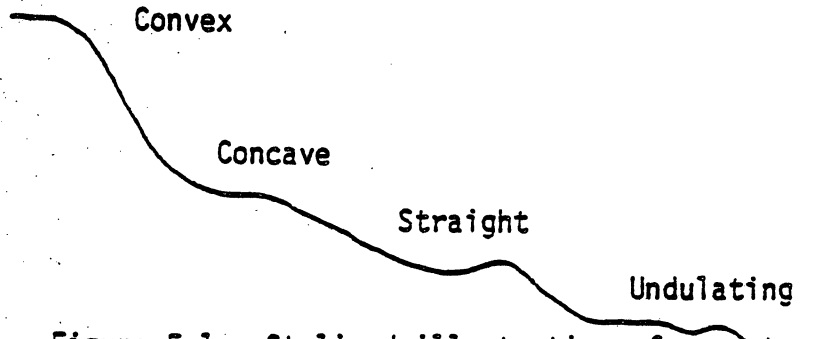

Figure E-1. Stylized illustration of curvature classes

E.3 Physiographic Class

Physiographic Class is greatly determined by landform and topographic position. Using Figure E-2, determine the physiographic class which best represents the sample area and record it as a 2-digit code.

Code	Land Form or Topographic Position
11	Mountain Ridge
12	Mountain Saddle
13	Upper Slope
14	Mid-Slope
15	Lower Slope
16	Bench (Use topo map to discern)
21	Glacial Cirque
22	Glacial Lateral Moraine
23	Glacial Terminal Moraine
31	Stream Terrace (flooded within geologic past)
32	Stream Bottom (floods frequently)
33	Alluvial Fan
34	Flat Plain
35	Bajada (lower benches that grade into valley bottoms)
36	Mesa Top
37	Side of Cliff
49	Other

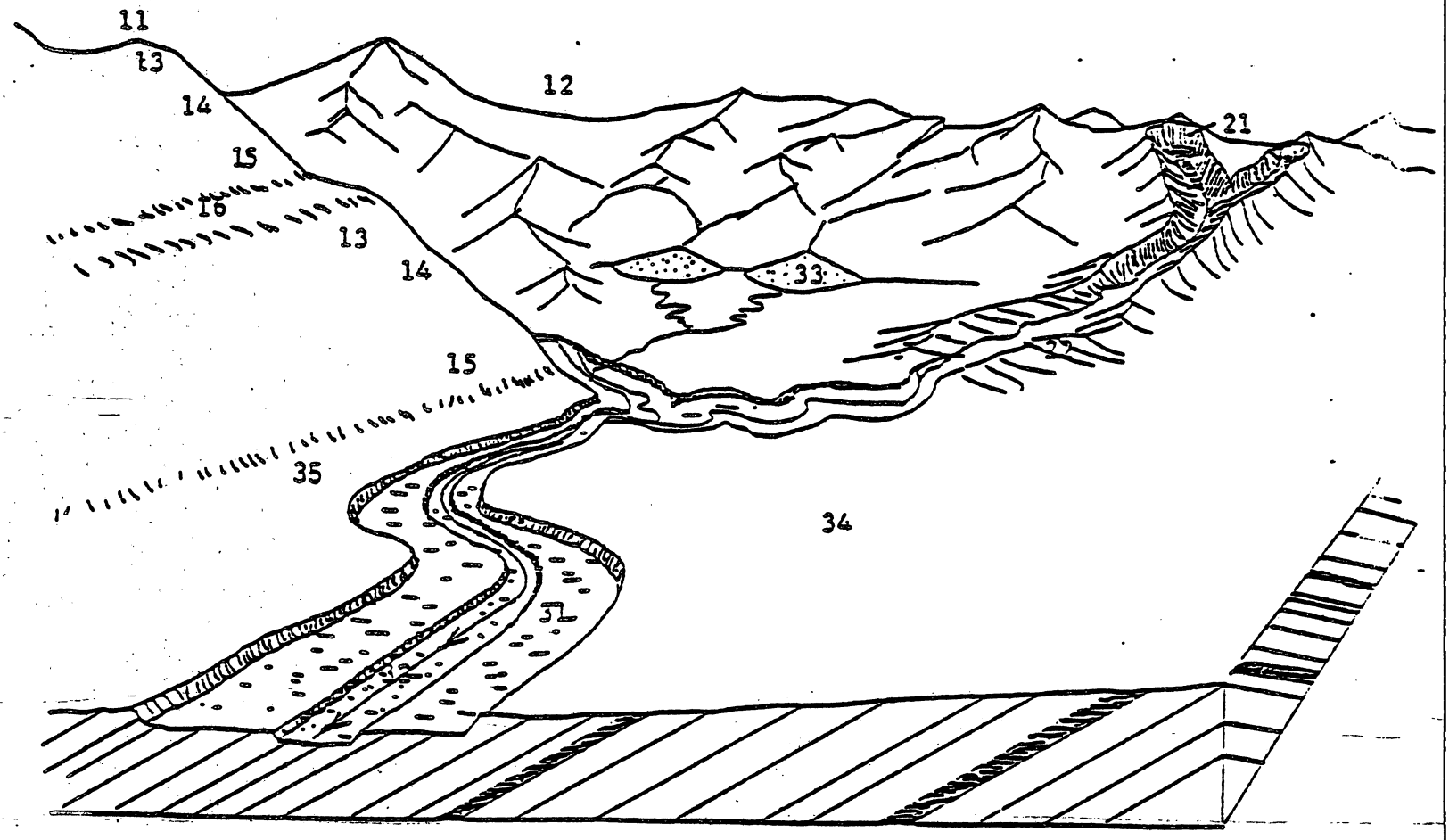

Figure E-2. Landforms and topographic positions used in determining physiographic class

Primary Plant Association 28.

Primary Plant Association. Record for those plots in the counties listed in the appendix. Record in columns 59-61. The primary plant association is that which occurs most frequently or which is the most prominent.

Secondary Plant Association 29.

Secondary Plant Association. Record for those plots in the counties as listed in the appendix. Record in columns 62-64. The secondary plant association is that which occurs next in frequency to the primary plant association. Do not record for Woodland.

Number of Points 30.

Number of Points. Record the number of points tallied for each plot. Variable/fixed should usually be 05 and fixed/fixed should be 01. When using variable/fixed-point clusters, record the actual number of points tallied for tree data. Record in columns 65 and 66.

Number of Records 31.

Number of Records. Add the total number of rows which have tree data entered, including lines for cover class but excluding remarks. Record the total number in columns 67-69.

Past Treatment 32.

Past Treatment. Record the most important man-caused or natural action which is evident on the plot. Record in columns 70-72.

Code	Treatment	Code	Treatment
001	None	640	Disease
013	Clearcut	680	Weather damage
014	Selective cut	681	Wind damage
015	Other cutting	690	Fire Evidence
153	Christmas tree selection	700	Permanent land clearing
154	Post and pole harvest	710	Road building
610	Animal damage	730	Type conversion
620	Insect damage	731	Chaining

Local Forest Type Association 33.

Local Forest Type Association.
Leave blank

Percent Ground Cover 34.

Percent Ground Cover.
Leave blank

Number of Sapling Plots 35.

Number of Sapling Plots. Record the number of sapling plots measured on the location. This should not exceed three.

Sapling Plot Size 36.

Sapling Plot Size. Record the sapling plot size used for the location.

Code	Sapling Plot Size
1	1/100 acre (11.7 ft. radius)
3	1/300 acre (6.8 ft. radius)

SECTION F. SAMPLING METHODS

After recording Items 1-18, 25-27, and items in Section A (except A.10), then establish and measure the field sample only if Ground Land Use (Item 16) is classified as nonreserved timberland or woodland (Codes 20, 41, 42, 43, 81, 82, 83, 84).

Timberland field locations will be measured using variable-radius and 6.8-foot fixed-radius (1/300 acre) plots in the bow-tie configuration. Woodland field locations will be measured using fixed-plots of 37.2-foot radius (1/10 acre) and 11.7-foot radius (1/100 acre) at Point 1 only, or 26.3-foot radius (1/20 acre) and 11.7-foot radius (1/100 acre) at Point 1 only.

The P-J, juniper, and certain specified open Woodland types will be measured using the 1/10-acre fixed plots. Other Woodland types will be measured using the 1/20-acre fixed plots.

For Field Samples Classified as Nonreserved Timberland and Developed Timberland (Ground Land Use Codes 20, 41, 81, 82): Establish and witness Point 1 according to the procedure described in Section B (5-point cluster). Two kinds of sample plots will be measured on each of the five cluster points: the variable-radius and the 6.8-foot fixed-radius plots.

Timberland

Variable-Radius Plot F.1

Variable-Radius Plot: The variable-radius plot, measured first, is used to tally all live and dead (salvable, nonsalvable, and mortality) trees of timber species 5.0 inches DBH and larger and other species 3.0 inches DRC/EDRC and larger, that fall within the limiting distance* of the basal area factor used on this inventory. This plot has no fixed size -- trees recorded and measured are determined by DBH or DRC and distance from point center.

a. Sampling Method: Standing over the point center (stake) and starting at 0° azimuth, the cruiser rotates clockwise and sights through the gauge at the trees' DBH or DRC to determine which trees 5.0 inches DBH or 3.0 inches DRC and larger are tally trees. (See Appendix for detailed procedures used in variable plot sampling.)

   For timber species, DBH is used to determine limiting distance. For other species, the DRC or the EDRC is used to determine limiting distance.

   If a tree is a "borderline" tree, or is not definitely "in" or "out," its limiting distance must be measured.

   To measure limiting distance:

   (1) measure the tree's DBH or DRC/EDRC to the last full 0.1 inch;
   (2) measure the horizontal distance (to the nearest 0.1 foot) from the face of the tree at breast height (4.5 feet) or root collar to a point directly above the plot stake;
   (3) using Table F-1, find the DBH or DRC/EDRC of the tree being checked and its associated limiting distance; and
   (4) if the tree being "checked" has a horizontal distance less than or equal to the limiting distance from Table F-1, then the tree is a tally tree and should be measured.

*Limiting Distance: See Glossary for a definition.

Table F-1.--Table of limiting distance values for variable-radius sampling. Measurements are made to face of tree.

DBH(DRC) inches	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
3	4.0	4.1	4.3	4.4	4.5	4.7	4.8	4.9	5.1	5.2
4	5.3	5.5	5.6	5.7	5.9	6.0	6.1	6.3	6.4	6.5
5	6.7	6.8	6.9	7.1	7.2	7.3	7.5	7.6	7.7	7.9
6	8.0	8.1	8.3	8.4	8.5	8.7	8.8	8.9	9.1	9.2
7	9.3	9.5	9.6	9.7	9.9	10.0	10.1	10.3	10.4	10.5
8	10.7	10.8	10.9	11.1	11.2	11.3	11.5	11.6	11.7	11.9
9	12.0	12.1	12.3	12.4	12.5	12.7	12.8	12.9	13.1	13.2
10	13.3	13.5	13.6	13.7	13.9	14.0	14.1	14.3	14.4	14.5
11	14.7	14.8	14.9	15.1	15.2	15.3	15.5	15.6	15.7	15.9
12	16.0	16.1	16.3	16.4	16.5	16.7	16.8	16.9	17.1	17.2
13	17.3	17.5	17.6	17.7	17.9	18.0	18.1	18.3	18.4	18.5
14	18.7	18.8	18.9	19.1	19.2	19.3	19.5	19.6	19.7	19.9
15	20.0	20.1	20.3	20.4	20.5	20.7	20.8	20.9	21.1	21.2
16	21.3	21.5	21.6	21.7	21.9	22.0	22.1	22.3	22.4	22.5
17	22.7	22.8	22.9	23.1	23.2	23.3	23.5	23.6	23.7	23.9
18	24.0	24.1	24.3	24.4	24.5	24.7	24.8	24.9	25.1	25.2
19	25.3	25.5	25.6	25.7	25.9	26.0	26.1	26.3	26.4	26.5
20	26.7	26.8	26.9	27.1	27.2	27.3	27.5	27.6	27.7	27.9
21	28.0	28.1	28.3	28.4	28.5	28.7	28.8	28.9	29.1	29.2
22	29.3	29.5	29.6	29.7	29.9	30.0	30.1	30.3	30.4	30.5
23	30.7	30.8	30.9	31.1	31.2	31.3	31.5	31.6	31.7	31.9
24	32.0	32.1	32.3	32.4	32.5	32.7	32.8	32.9	33.1	33.2
25	33.3	33.5	33.6	33.7	33.9	34.0	34.1	34.3	34.4	34.5
26	34.7	34.8	34.9	35.1	35.2	35.3	35.5	35.6	35.7	35.9
27	36.0	36.1	36.3	36.4	36.5	36.7	36.8	36.9	37.1	37.2
28	37.3	37.5	37.6	37.7	37.9	38.0	38.1	38.3	38.4	38.5
29	38.7	38.8	38.9	39.1	39.2	39.3	39.5	39.6	39.7	39.9
30	40.0	40.1	40.3	40.4	40.5	40.7	40.8	40.9	41.1	41.2
31	41.3	41.5	41.6	41.7	41.9	42.0	42.1	42.3	42.4	42.5
32	42.7	42.8	42.9	43.1	43.2	43.3	43.5	43.6	43.7	43.9
33	44.0	44.1	44.3	44.4	44.5	44.7	44.8	44.9	45.1	45.2
34	45.3	45.5	45.6	45.7	45.9	46.0	46.1	46.3	46.4	46.5
35	46.7	46.8	46.9	47.1	47.2	47.3	47.5	47.6	47.7	47.9
36	48.0	48.1	48.3	48.4	48.5	48.7	48.8	48.9	49.1	49.2
37	49.3	49.5	49.6	49.7	49.9	50.0	50.1	50.3	50.4	50.5
38	50.7	50.8	50.9	51.1	51.2	51.3	51.5	51.6	51.7	51.9
39	52.0	52.1	52.3	52.4	52.5	52.7	52.8	52.9	53.1	53.2
40	53.3	53.5	53.6	53.7	53.9	54.0	54.1	54.3	54.4	54.5
41	54.7	54.8	54.9	55.1	55.2	55.3	55.5	55.6	55.7	55.9
42	56.0	56.1	56.3	56.4	56.5	56.7	56.8	56.9	57.1	57.2
43	57.3	57.5	57.6	57.7	57.9	58.0	58.1	58.3	58.4	58.5
44	58.7	58.8	58.9	59.1	59.2	59.3	59.5	59.6	59.7	59.9
45	60.0	60.1	60.3	60.4	60.5	60.7	60.8	60.9	61.1	61.2
46	61.3	61.5	61.6	61.7	61.9	62.0	62.1	62.3	62.4	62.5
47	62.7	62.8	62.9	63.1	63.2	63.3	63.5	63.6	63.7	63.9
48	64.0	64.1	64.3	64.4	64.5	64.7	64.8	64.9	65.1	65.2
49	65.3	65.5	65.6	65.7	65.9	66.0	66.1	66.3	66.4	66.5
50	66.7	66.8	66.9	67.1	67.2	67.3	67.5	67.6	67.7	67.9

Prepared by subtracting ½ the DBH in feet from the limiting distance.
Limiting distance = DBH x 1.375 (for 40 BAF)

(5) for multiple-stemmed trees of other species:
(a) determine the equivalent diameter at DRC (using stems 3.0 inches DRC and larger).
(b) multiply the EDRC by 1.375. This product is the limiting distance to the geographic center of the tree.

NOTE: Large trees that are tallied on one point and also fall within the limiting distance on subsequent points will be recorded again. However, the tree number will be in sequence for the new point and have a new azimuth and distance.

b. Types of Trees Tallied: Items to record on the variable plot are indexed within timber species and other species according to the type of tally tree: live, salvable dead, nonsalvable dead, or mortality.

(1) Timber Species -- Timberland Locations
(a) Live trees -- For all live tally trees 5.0 inches DBH and larger, record the following items:

ITEM	ITEM NO.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Site Tree*	60
Species	61
DBH	62
Height	63
Radial Growth*	64
Age*	65
Crown Form	66
Relative Crown Canopy Position	67
Crown Ratio-Uncompacted	68
Crown Ratio-Compacted	69
Crown Class	70
Surface Defect	71
Internal Vol. Loss-CF	72
Total Vol. Loss-CF	73
Damage	76
Tree Class	77
First I&D Incidence	78
Second I&D Incidence	79
Mistletoe-6 Class	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	84

*These items are not recorded for all live poletimber and sawtimber tally trees. Refer to the specific item indicated for detailed instructions.

(b) Dead Trees -- All standing and fallen dead trees 5.0 inches DBH and larger will be recorded if their DBH is within the limiting distance for the 40 BAF (Basal Area Factor) angle gauge.

Standing dead trees are determined to be tally or nontally trees using the same method as for live trees. Down (fallen) dead trees are tally or nontally based on where their DBH would have been if the tree were still standing. Therefore, you must mentally upright the tree into its original position to measure the limiting distance. Measure limiting distance from the stake to a point at breast height that is slightly inside the stump or ground cavity to allow for taper. (See Figure F-1.)

On all dead trees tallied on the variable plot, place two ax blazes below stump height and facing the center stake.

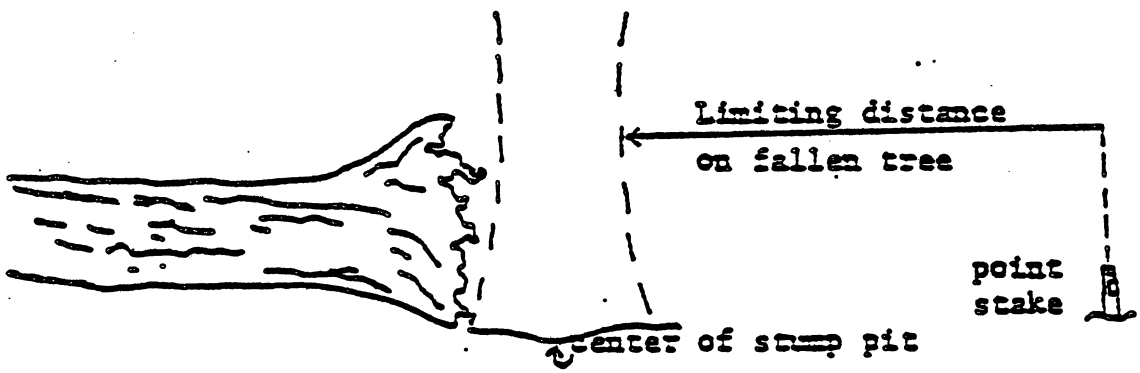

Figure F-1. Measuring limiting distance on a down dead tree

Dead trees are classified into three groups: salvable dead, nonsalvable dead, and mortality.

Salvable Dead: These are standing and down dead trees 5.0 inches DBH and larger whose volumes (measured to a 4.0-inch DOB top) are less than 50 percent rotten or missing, on a cubic-foot basis.

For salvable dead trees, record the items listed for nonsalvable dead trees.

Nonsalvable Dead: These are standing and down dead trees 5.0 inches DBH and larger whose volumes (measured to a 4.0-inch DOB top) are greater than 50 percent rotten or missing, on a cubic-foot basis. Since the primary purpose of these records is for utilization, these logs and trees must be sufficiently intact so that it would be possible to remove them from the woods.

For salvable and nonsalvable dead trees, record the following items:

Timberland

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance[1]	58
Tree History = 04 or 06	59
Species	61
DBH	62
Height	63
Internal Vol. Loss-CF	72
Total Vol. Loss-CF	73
Condition of Dead	76
First I&D Incidence*	78
Second I&D Incidence*	79

Mortality Trees: These are standing and down trees 5.0 inches DBH and larger that have died within the past 5 years. In addition, a mortality tree must have been at least 33 percent sound (i.e., it could not have been a cull tree) at time of death.

A tree estimated to have had greater than 67 percent cubic-foot cull at its time of death will not be recorded as a mortality tree.

Use Table F-2 as a guide for estimating time since mortality.

For mortality trees, record the following items:

Item	Item No.	
Point Number	55	
Tree Number	56	
Azimuth	57	
Distance	58	
Tree History = 05	59	
Species	61	
DBH	62	
Height	63	
Internal Vol. Loss-CF	72	Project back
Total Vol. Loss-CF	73	to time of death
Cause of Death	76	
Tree Class	77	

*Recorded only for trees where probable cause of death is discernible; otherwise leave blank.

[1]Distance and azimuth on down dead trees is taken to DBH.

Double Recording Mortality Trees: If a dead tree qualifies as both a mortality and a salvable or nonsalvable dead tree, complete separate entries for each. That is, record the salvable or nonsalvable dead first, then the mortality. NOTE: The entries will be the same for each item recorded except for Tree History, Condition of Dead/Cause of Death, and, possibly, Internal and Total Volume Loss (since these are projected back to time of death for mortality trees and recorded at present for salvable and nonsalvable dead trees). Two records will be counted.

(2) Other Species - Timberland Locations

(a) Live Trees -- For live trees of other species 3.0 inches DRC/EDRC and larger, record the following items:

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Species	61
DBH*	62
Height	63
Crown Form	66
Crown Ratio - Uncompacted	68
Crown Ratio - Compacted	69
Crown Class	70
Internal Vol. Loss-CF	72
Total Vol. Loss-CF	73
Damage	76
Tree Class	77
Mistletoe Class**	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	84
Number of Stems	85
Posts-Line	86
Posts-Corner	87
Christmas Tree Grade	88
DRC/Equivalent Diameter	89

(b) Salvable Dead Trees - These are dead trees of other species 3.0 inches DRC/EDRC and larger whose volumes are less than 50 percent rotten or missing on a cubic-foot basis.

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*See DBH, Other Species - pg. 58
**Recorded only for pinyon or juniper of other tree species.

For salvable dead trees of other species, record the following items:

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 04	59
Species	61
DBH (if applicable)	62
Height	63
Internal Vol. Loss-CF	72
Total Vol. Loss-CF	73
Condition of Dead	76
Number of Stems	85
Posts-Line	86
Posts-Corner	87
DRC/Equivalent Diameter	89

(c) Mortality Trees -- These are trees of other species 3.0 inches DRC/EDRC and larger that have died within the past 5 years. In addition, a mortality tree could not have been a cull tree (see Tree Class, Item 77) at its time of death.

For mortality trees of other species, record the same item as for salvable dead trees, except Tree History is coded 05, but do not record Condition of Dead. Record Cause of Death. Project Internal and Total Volume Losses (CF) back to Time of Death.

6.8-Foot Fixed-Radius Plot F.2

Fixed-Radius Plot (6.8-foot): After all trees of timber species 5.0 inches DBH and greater (3.0 inches DRC for other species) are measured on the variable-radius plot, a sample is taken on a fixed-radius plot. This sample collects data on live trees of timber species less than 5.0 inches DBH and other tree species less than 3.0 inches DRC.

a. Sampling Method: The fixed plot is a circle with radius of 6.8 feet (1/300 acre). Trees of timber species less than 5.0 inches DBH and other species without one or more stems 3.0 inches or larger DRC (saplings and established seedlings) can be tallied if the horizontal distance (measured at the diameter point) from the stake to the center of the tree stem is 6.8 feet or less.

Table F-2.--Guide For Estimating Time Since Mortality

Died within past 5 years	Species	Died more than 5 years ago
Some foliage left, 75+% twigs & 30+% branches left; bark intact	White pine	No foliage; 75% or less twigs left; many big limbs gone; much bark sloughing (except small trees)
Some foilage left; 50+% twigs left & most branches; most bark left	Ponderosa pine	No foliage; big limbs gone; much bark sloughing; 50% or less twigs or branches left
Some foliage left; 30+% twigs & 50+% branches left; little bark sloughing	Spruce	No foliage; 30% or less twigs & 50% or less branches left; big limbs gone; bark sloughing
Some foliage left; 75+% twigs & branches left	Lodgepole	No foliage; 75% or less twigs & branches left; bark sloughing
Some foliage left; 50+% twigs & 75+% branches left; bark intact	Douglas-fir	No foliage; 50% or less twigs & 75% or less branches left; big limbs gone; bark sloughing
Some foliage left; 50+% twigs & 70% branches left; bark unbroken, not curled away from bole	True firs	No foliage; 50% or less twigs & 75% or less branches left; big limbs gone; bark heavily checked & curled; much sloughing
50+% bark attached in some degree	Aspen	No foliage; bark 50% or less attached
Some foliage left; 60+% twigs left; few limbs gone; bark intact	Western redcedar	No foliage; 60% or less twigs left; many limbs gone; large pieces of bark stripping

In all cases, the presence of sporophore of sapwood rotting fungi such as Polyporus volvatus, Fomes pinicola, etc., will be accepted as evidence that the tree has been dead more than 5 years.

b. Types of Trees Sampled: Live saplings and established seedlings are tallied on the fixed-radius plots.

(1) Saplings -- Saplings include live trees of timber species 1.0-4.9 inches DBH and other tree species 1.0-2.9 inches DRC. On points 1, 2, and 5, tally all saplings on the 1/300-acre plot. On points 3 and 4, if the variable plot tally is less than four live trees 5.0 inches DBH and greater and 3.0 inches DRC, then tally sufficient saplings to bring the total point tally to 4. The priority for the sapling tally on points 3 and 4 is (i) best established trees of timber species, (ii) less than best established trees of timber species, (iii) best established trees of other species, and (iiii) less than best established trees of other species.

(a) Timber Species -- For all live saplings of timber species tallied on the fixed-radius plot, record the following items.

ITEM	ITEM NO.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Site Tree*	60
Species	61
DBH	62
Height	63
Radial Growth*	64
Age*	65
Crown Form	66
Relative Crown Position	67
Crown Ratio - Uncompacted	68
Crown Ratio - Compacted	69
Crown Class	70
Damage	76
Tree Class	77
First I&D Incidence	78
Second I&D Incidence	79
Mistletoe 6-Class	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	84

*These items are not recorded for all live saplings. Refer to the specific item indicated for detailed instructions.

(b) Other Species -- For all live saplings of other tree species tallied on the 6.8 foot fixed-radius plot, record the following items:

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Species	61
Height	63
Crown Form	66
Crown Ratio - Uncompacted	68
Crown Ratio - Compacted	69
Crown Class	70
Damage	76
Tree Class	77
Mistletoe Class*	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	84
Number of Stems (code 01)	85
DRC/Equivalent Diameter	89

(2) Established Seedlings -- Live Trees of timber species less than 1.0 inch DBH or other species less than 1.0 inch DRC are seedlings. Seedlings within the fixed-radius plot will be tallied only if they are live established seedlings.

Established seedlings must be free of disease or insect infestation and must have root systems in mineral soil. On all points: If there is no live variable plot or sapling tally, record up to 4 established timber species seedlings (if available). The priority for the seedling tally is the same as for the sapling tally. If four timber species seedlings are not available, count the number of other tree species seedlings.

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*Recorded only for pinyon or juniper of other tree species.

Timberland

(a) Timber Species

Record the following items for tallied seedlings of timber species:

ITEM	ITEM NO.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Species	61
DBH = 001	62
Age*	65
Relative Crown Position	67
Damage	76
Tree Class**	77

(b) Other Species

Where necessary to record established seedlings of other species, record Point Number, Tree History (Code 07), Species, the number of established seedlings by species (record this number under DBH, Columns 27-29), and Tree Class. NOTE: If Tree Class varies for seedlings of the same species, record a separate entry for each Tree Class.

For each point, after the variable- and 6.8-foot fixed-radius plots have been measured, record as a separate entry Point Number, Tree History (Code 08), Plant Association (recorded in Species Columns 24-26 when used), and Cover Class (Item 77).

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*This item is not recorded for all established seedlings. Refer to the specific item indicated for detailed instructions.

**Seedlings will be assigned either a growing stock (desirable and acceptable classes), Code 10 or 20, or a cull (rough) class, Code 30.

For Field Samples Classified as Nonreserved Woodland or Developed Woodland (Ground Land Use Codes 42, 43, 83, 84): Establish and witness Point 1 according to the procedure described in Section B. Two sizes of fixed-radius plots are measured at Point 1, a 37.2-foot (1/10-acre*) and an 11.7-foot (1/100-acre) fixed-radius plot. Point 1 is the only point sampled on a woodland plot. The 5-point (Bow-Tie) cluster layout is not used.

1/10-Acre* Plot F.3

1/10-Acre* (37.2-Foot Radius) Fixed Plot: The 1/10-acre* plot, measured first, is used to tally all live, salvable dead, and mortality trees of other species 3.0 inches DRC and larger that are within 37.2 feet of Point 1.

Timber species 5.0 inches and larger DBH will also be tallied if within the fixed plot radius of the stake (horizontal distance to center of tree at DBH). This includes live, salvable dead, nonsalvable dead, and mortality trees. Record the same data required when such trees are tallied on the timberland variable plot except Relative Crown Canopy Position.

a. Sampling Method: Start at 0° azimuth and move clockwise. Tally all other species 3.0 inches DRC and larger whose horizontal distance (measured at ground level) from the stake to the center of the tree stem at its base is 37.2 feet or less. For multiple stemmed trees, geographic center of the tree must be within 37.2 feet. If this tree falls "in," azimuth and distance will be taken to the tree's geographic center. Trees forking below ground level and larger than 3.0 inches DRC will be counted as one tree.

b. Types of Trees Sampled: Live, salvable dead, and mortality trees of other species are tallied on the 1/10-acre plot; also, live, salvable dead, nonsalvable dead, and mortality trees of timber species. Trees qualifying as salvable dead and mortality are recorded twice--once for each tree class.

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*A 1/20-acre plot (radius, 26.3 feet) is used for woodland plots classified as Forest Type other than pinyon and/or juniper. A 1/5acre plot may also be used in very open types, at the discretion of the field supervisor. The procedures for measuring the 1/10 or 1/5-acre plots are also applicable to the 1/20-acre plot.

Woodland

(1) Live Trees -- For live trees of other species 3.0 inches DRC and larger, record the following items:

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance or tags	58
Tree History = 01	59
Site Tree[4]	60
Species	61
DBH*	62
Height	63
Radial Growth[4]	64
Age[4]	65
Crown Form	66
Crown Ratio - Uncompacted	68
Crown Ratio - Compacted	69
Crown Class	70
Internal Vol. Loss-CF	72
Total Vol. Loss-CF	73
Damage	76
Tree Class	77
Mistletoe Class[5]	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	84
Number of Stems	85
Posts-Line	86
Posts-Corner	87
Christmas Tree Grade**	88
Tree Segmentation[6]	Appendix 4
DRC/Equivalent Diameter	89

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*See DBH, Other Species, pg. 58.
**Pinyon only.

[4]These items are recorded only for site trees. Refer to the specific item indicated for detailed instructions.

[5]Record only for pinyon and juniper other tree species.

[6]Tree Segmentation: In addition to recording the items listed, the tree segmentation procedure (See Appendix) will be completed for at least two trees of each other tree species 3.0+ inches DRC tallied on the plot. Select the first tree tallied under 10.0 inches DRC, and the first tree over 10.0+ inches DRC, tallied for each other tree species present. Segment the first tree larger than 18 inches DRC for each species, even if this requires more than two trees be segmented.

(2) Salvable Dead Trees -- These are dead trees of other species 3.0 inches DRC and larger and commercial species 5.0 inches DBH and larger whose volumes are less than 50 percent rotten or missing, on a cubic-foot basis.

For salvable dead trees of other species, record the following items:

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 04	59
Species	61
DBH	62
Height	63
Internal Volume Loss-CF	72
Total Volume Loss-CF	73
Condition of Dead	76
Number of Stems	85
Posts-Line	86
Posts-Corner	87
DRC/Equivalent Diameter	89

(3) Nonsalvable Dead Trees -- These are dead trees not qualifying as salvable dead because they are 50 percent or more rotten or missing, on a cubic foot basis. However, these trees must have stems or logs sufficiently intact to be transported for utilization, such as for shipping. Record the same items as for Salvable Dead. Use tree history code 06.

(4) Mortality Trees -- These are trees 3.0 inches DRC (5.0 inches DBH) and larger that have died within the past 5 years. In addition, a mortality tree could not have been a cull tree (see Tree Class, Item 77) at its time of death.

For mortality trees of other species, record the same items as for salvable dead trees above, except Tree History is coded 05, but do not record Condition of Dead. Record Cause of Death. Project volume loss back to time of death. Do not use present volume loss!! Also record Tree Class (Item 77) projected back to time of death. If both a salvable or nonsalvable dead and a mortality tree, record first as salvable/nonsalvable, then as a mortality tree. Use the same tree number for both records.

1/100-Acre Plot F.4

1/100-Acre (11.7-Foot Radius) Fixed-Plot: After measuring trees on the 1/10-acre* plot, measure all live trees of other species less than 3.0 inches DRC and commercial species less than 5.0 inches DBH that are within 11.7 feet of Point 1. For multiple-stemmed trees of other species, whether forking above or below ground, the geographic center of the tree must be 11.7 feet or closer to Point 1.

*Or 1/20-acre plot.

a. Sampling Method: Start at 0° azimuth and move clockwise, tallying all trees of other species less than 3.0 inches DRC and commercial species less than 5.0 inches DBH. In order for a tree to be tallied on the 1/100-acre plot, the horizontal distance (measured at ground level) from the stake to the center of the tree stem at its base must be 11.7 feet or less. NOTE: For multiple-stemmed trees of other species, measure this horizontal distance to the tree's geographic center.

Woodland

b. Types of Trees Sampled: Measure only live trees of other species less than 3.0 inches DRC and commercial species less than 5.0 inches DBH on the 1/100-acre plot.

(1) Saplings -- These are live trees of other species 1.0-2.9 inches DRC and commercial species 1.0-4.9 inches DBH.

Woodland

(a) Other Species -- For live saplings tallied on the 1/100-acre plot, record the following:

Item	Item No.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Site Tree*	60
Species	61
DBH	62
Height	63
Radial Growth*	64
Age*	65
Crown Form	66
Crown Ratio - Uncompacted	68
Crown Ratio - Compacted	69
Crown Class	70
Damage	76
Tree Class	77
Mistletoe Class	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	83
Number of Stems (code 01)	85
Christmas Tree Grade**	88
DRC/Equivalent Diameter	89

*These items are recorded only for site trees. Refer to the specific item indicated for detailed instructions.

**Pinyon only.

(b) Timber Species -- For live saplings tallied on the 1/100-acre plot, record the following:

ITEM	ITEM NO.
Point Number	55
Tree Number	56
Azimuth	57
Distance	58
Tree History = 01	59
Site Tree*	60
Species	61
DBH	62
Height	63
Radial Growth*	64
Age*	65
Crown Form	66
Crown Ratio-Uncompacted	68
Crown Ratio-Compacted	69
Crown Class	70
Damage	76
Tree Class	77
First I&D incidence	78
Second I&D incidence	79
Mistletoe 6-class	80
Percent Tree Crown Cover	82
Maximum Crown Width	83
Minimum Crown Width	84

(2) Established Seedlings -- These are live trees of other species less than 1.0 inch DRC and timber species less than 1.0 inch DBH. Established seedlings must be free of insect or disease infestation, and must have root systems in mineral soil.
Seedlings are counted on the 1/100-acre plot for all woodland locations except pinyon and/or juniper types.

For pinyon and/or juniper types or any Woodland type where 1/10-acre plots are used, count SEEDLINGS on the entire 1/10-acre plot. In the few cases where a large number of seedlings are present, count seedlings on the 1/100-acre plot and multiply the counts by 10 before recording.

For all established seedlings within the plot, record Point Number, Tree History (Code 07), Species, the number of established seedlings by species (record this number under DBH, Columns 27-29), and Tree Class. NOTE: If Tree Class varies for seedlings of the same species, record a separate entry for each Tree Class.

After measuring the 1/10-, 1/20-, or 1/5- and the 1/100-acre plots, record as a separate entry Point Number, Tree History (Code 08), and Cover Class (Item 77).

*These items are recorded only for site trees. Refer to the specific item indicated for detailed instructions.

SECTION G. TREE IDENTIFICATION

Point Number 55.

Point Number: Point Numbers refer to a specific place on the field sample layout and not order of tally (see Figure B-1 for point layout). For example, it is permitted to tally Point 3 first and all tree data associated with it will be coded as occurring on Point 3. Each tree data entry must have the appropriate Point Number recorded.

Nontallied site trees will be assigned to the point closest to them. That point will be used for azimuth and distance reference measurements. Only one point will be recorded for Woodland areas and that will be Point 1.

Tree Number 56.

Tree Number: Trees are numbered on each point beginning with Number 1.[7] Trees are tallied first by beginning at 0° azimuth and rotating clockwise. The first "in" tree is coded 01, second "in" tree is 02, and so on until a full circle is made.

When sampling the 1/100- or 1/300-acre fixed-radius plot, Tree Numbers begin where the 1/10-, 1/20-, 1/5 or variable plot numbers left off. For example, if the last numbered tree on the variable-radius plot was 07, then the first tree on the fixed plot is 08. The 1/100- or 1/300-fixed-radius plot tree numbering begins at 0° azimuth and continues clockwise.

Nontallied site trees receive a Tree Number Code of 00.

Tree Numbers on each point of the 5-point cluster begin with the number 01. Also, if the tree is both a mortality and a salvable or nonsalvable dead tree, it has two entries, but the same Tree Number for both (see Mortality Trees, Section F.).

Azimuth 57.

Azimuth: For each tree tallied, an azimuth will be taken from point center (stake) to DBH or DRC at the center of the tree, and recorded as a 3-digit code. For other tree species, record azimuth to the geographic center of multiple-stemmed species at DRC. NOTE: This item is not recorded when trees are tagged with numbered tags (some Federal lands).

Distance 58.

Distance: For each tree tallied, record slope distance from point center (stake) to the face of the tree at ground level. Record this distance to the nearest foot as a 2-digit code. Record distance to the geographic center of multiple-stemmed other species forking at or below DRC. NOTE: This item is not recorded when trees are tagged with numbered tags (some Federal lands). Record distances greater than 99 feet as 99.

Tree History 59.

Tree History: Record Tree History using one of the following 2-digit codes:

[7]When trees are tagged with numbered tags, the first tag number in a sequence will be used, and the trees will be tagged with increasing numbers as they are tallied. Only the last two digits on tags will be recorded.

Code	Tree History
00	Nontallied site trees
01	Live tally trees
04	Salvable dead trees: a. ≥5.0 inches DBH (3.0+ inches DRC for other species) b. Standing or down c. Cubic-foot volume is <50 percent rotten or missing
05	Mortality trees: a. ≥5.0 inches DBH (3.0+ inches DRC for other species) b. Standing or down c. Less than 5 years dead d. Not a rough or rotten (cull) tree at time of death (i.e., <67 percent cubic-foot defect at time of death)
06	Nonsalvable dead trees: a. <5.0 inches DBH (3.0+ inches DRC for other species) b. Standing or down c. Cubic-foot volume is ≥50 percent rotten or missing d. Firm enough to hold together if handled
07	Woodland seedling count a. <1.0 inch DRC
08	This code indicates (a) last entry for that point and (b) that a sapling fixed plot was measured. Cover class and plant association will also be recorded.
09	This code indicates (a) last entry for that point and (b) that a sapling fixed plot was not measured. Cover class and plant association will also be recorded.

Site Tree 60

Site Tree: Tree height at a given age is used as a site indicator because it is the tree variable least affected by competition and other biological factors. Thus, it provides a better indicator of the inherent productivity of the soil and the site in general. This item is divided into two separate subsections: Site tree selection and measurement for (a) field samples classified as Timberland and (b) for samples classified as Woodland.

For Field Samples Classified as Timberland: Trees selected as indicators of site productivity should have been relatively free growing (i.e., not suppressed, but dominant or codominant; see Crown Class, Item 70) within the stand all of their lives.

In mixed-species stands, select at least two trees of each legitimate timber species representing 20 percent or more of trees tallied on the variable plot. For trees representing less than 20 percent of the tally, select at least one site tree.

NOTE: Do not use Other species if the area is classified as Timberland.

The following species should not be used as site trees if others can be found:

Arizona cypress	Bristlecon pine	Chihuahua pine
Subalpine larch	Limber pine	All other tree
Whitebark pine	Mexican white pine	species

If the stand is a mix of conifer/aspen, measure conifers for site trees.

Site trees are recorded as either suitable or unsuitable according to the following criteria:

(a) Suitable site trees are:

(i) desirable or acceptable trees (Tree Class = 10 or 20);
(ii) dominant or codominant throughout their lives, (NOTE: Open grown trees may be used if no suitable dominant or codominant trees are present. Lodgepole pine, aspen, grand and white firs cannot be codominant.)
(iii) 4.0 inches DBH or larger;
(iv) under rotation age*, but at least 30 years, breast height age (preferably as close to age 50 as possible). Cottonwood and aspen should have a breast height age of at least 30 years.
(v) Trees with compacted crown ratios greater than 30 percent (greater than 20 percent for ponderosa pine, Jeffrey pine, and aspen);
(vi) vigorous.

(b) Unsuitable trees which can still give some indication of the site are:

(i) relicts;
(ii) <4.0 inches DBH;
(iii) trees with "intermediate" crown class (codominant lodgepole pine, aspen, grand and white firs);
(iv) trees over rotation age;
(v) rough trees.
(vi) trees with damage codes of recent occurrence.

Some trees CANNOT be used as site trees. Any tree which is so rotten as to prevent counting its rings cannot be used as a site tree. Any broken top or deformed-top tree or any tree which is so weakened by disease or injury as to severely limit its growth cannot be used as a site tree. These examples are not only unsuitable but also totally unacceptable.

Selecting Site Trees: Every effort should be made to measure on or near each field sample at least six of the best-growing trees as site indicator trees.

Look for trees meeting the criteria for suitable site trees on or off the field sample. It is more important that trees are suitable than that they are tallied trees; therefore, if no suitable site trees are tallied, then it will be necessary to measure nontallied site trees.

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*Rotation age for aspen is 80 years and 120 years for all other timber species.

In most cases, site trees can be selected from among the tallied trees. They should be selected throughout the sample as much as possible.

If at least six suitable site trees are not available from the field sample, then enough to total six may be selected from trees occupying a site similar in aspect, slope position, slope percent, soil type, and within the same vegetative condition (species, size) as Point 1.

Nonstocked Timberland - select and measure six site trees near the location!!

If it is not possible to measure six suitable site trees on or near the field sample, unsuitable site trees will have to be used. For example, only two suitable site trees are available on and near a location. There are also three ponderosa pine relicts (acceptable) and three sound cull trees (Tree Class Rough). Site trees selected and measured would be the two suitable site trees, the three relicts, and the best cull tree, totaling six. For not tallied site trees, Tree Number and Tree History are recorded using code 00.

Record site trees using the following 1-digit codes:

Code	Site Tree
1	Tallied on a variable or fixed plot, suitable
2	Not tallied on a variable or fixed plot, suitable
3	Tallied on a variable or fixed plot, unsuitable
4	Not tallied on a variable or fixed plot, unsuitable

For field samples classified as Timberland, tallied site trees will have all usual fields plus site tree, age, and radial growth recorded. Nontallied site trees require only the following items completed:

Item	Item No.	Item	Item No.
Point Number	55	DBH	62
Tree Number	56	Height	63
Azimuth	57	Radial Growth	64
Distance	58	Age	65
Tree History	59	Crown Class	70
Site Tree	60	Damage	76
Species	61	Tree Class*	77

Woodland

For Field Samples Classified As Woodland: Select the three best trees available. (Generally, the most vigorous trees with good form should be used. Try to use the largest trees meeting these specifications, but sample from several diameter classes when possible.) These trees should be species of which the Forest Type (Item 22) is composed. For example, if a field sample is classified as Oak Woodland (Code 88), then the site trees should be oak species. For pinyon-juniper stands, always select at least two pinyon site trees, when available, on or near the location.

*Tree class should be 10 or 20.

If timber species also are present, collect site tree data for one tree of each timber species in addition to the other tree species selected.

NOTE: Site trees will also be measured for Radial Growth (Item 64) and Age (Item 65). However, do not try to bore mountain mahogany, and use an increment hammer only on juniper.

Trees selected as indicators of site productivity should be of unusually good form, and preferably have single stems, full crowns, and uniform taper.

Site trees are recorded as either suitable or unsuitable according to the following criteria:

(a) Suitable site trees are:

(i) desirable or acceptable trees (Tree Class = 10 or 20);
(ii) dominant or codominant throughout their lives, (NOTE: Open grown trees may be used if no suitable dominant or codominant trees are present.)
(iii) 3.0 inches DRC or larger;
(iv) single-stemmed, timber species; multistemmed, other species
(v) vigorous.

(b) Unsuitable site trees are:

(i) relicts;
(ii) trees with "intermediate" crown class;
(iii) <3.0 inches DRC;
(iv) multi-stemmed (bore the largest stem for age measurement);
(v) rough trees.

Some trees CANNOT be used as site trees. Any tree which is so rotten as to prevent counting its rings cannot be used as a site tree. Any broken top or deformed-top tree or any tree which is so weakened by disease or injury as to severely limit its growth cannot be used as a site tree. These examples are not only unsuitable but also totally unacceptable. Juniper and mountain mahogany species cannot be used as site trees unless age can be determined by cutting down the trees, since cores cannot be taken.

Selecting Site Trees: Every effort should be made to measure on or near each field sample at least three of the best growing trees of species within the woodland type.

Look for trees meeting the criteria for suitable site trees on or off the field sample. In most cases, site trees can be selected from among the tallied trees.

NOTE: If at least three suitable site trees are not available on the field sample, then enough to total three may be selected from trees occupying a site similar in aspect, slope position, and slope percent, and on the same soil type as Point 1. For not tallied site trees, Tree Number and Tree History are recorded using Code 00.

If it is not possible to measure three suitable site trees on or near the field sample, then measure unsuitable site trees. If unsuitable site trees are not present on the field sample, then select trees off the field sample using the procedure outlined above.

Record site trees using the following 1-digit codes:

Code	Site Tree
1	Tallied on a fixed plot, suitable
2	Not tallied on a fixed plot, suitable
3	Tallied on a fixed plot, unsuitable
4	Not tallied on a fixed plot, unsuitable

On Woodland field samples for tallied site trees, record all items normally recorded plus site tree, radial growth, and age. For non-tallied site trees, record only the following items:

Item	Item No.	Item	Item No.
Point Number	55	Radial Growth	64
Tree Number	56	Age	65
Azimuth	57	Crown Class	70
Distance	58	Damage	76
Tree History	59	Tree Class	77
Site Tree	60	Maximum Crown Width	83
Species	61	Minimum Crown Width	84
DBH	62	Number of Stems	85
Height	63	DRC/Equivalent Diameter	89

Woodland site trees may be used for segmentation data if selected following the usual criteria.

Species: Record species for all live and dead trees tallied using the following 3-digit codes:

Code	Common name	Scientific name
015	White fir	Abies concolor
017	Grand fir	Abies grandis
018	Corkbark fir	Abies lasiocarpa var. arizonica
019	Subalpine fir	Abies lasiocarpa
020	California red fir	Abies magnifica
023	Pacific yew	Taxus brevifolia
051	Arizona cypress	Cupressus arizonica
060	Common juniper	Juniperus communis
062	California juniper	Juniperus californica
063	Alligator juniper	Juniperus deppeana
064	Western juniper	Juniperus occidentalis
065	Utah juniper	Juniperus osteosperma
066	Rocky Mountain juniper	Juniperus scopulorum
069	One-seed juniper	Juniperus monosperma
072	Subalpine larch	Larix lyallii
073	Western larch	Larix occidentalis
081	Incense cedar	Libocedrus decurrens
093	Engelmann spruce	Picea engelmannii
094	White spruce	Picea glauca
096	Blue spruce	Picea pungens
101	Whitebark pine	Pinus albicaulis
102	Bristlecone pine	Pinus aristata
104	Foxtail pine	Pinus balfouriana
106	Common pinyon	Pinus edulis
108	Lodgepole pine	Pinus contorta
112	Appache pine	Pinus engelmannii
113	Limber pine	Pinus flexilis
114	Southwestern white pine	Pinus strobiformis
116	Jeffrey pine	Pinus jeffreyi
117	Sugar pine	Pinus lambertiana
118	Chihuahua pine	Pinus leiophylla
119	Western white pine	Pinus monticola
122	Ponderosa pine	Pinus ponderosa
133	Singleleaf pinyon	Pinus monophylla
134	Mexican pinyon	Pinus cembroides
135	Arizona pine	Pinus ponderosa var. arizonica
136	Blackjack pine[1]	Pinus ponderosa
137	Yellow pine[1]	Pinus ponderosa
202	Douglas-fir	Pseudotsuga menziesii
242	Western redcedar	Thuja plicata
263	Western hemlock	Tsuga heterophylla
264	Mountain hemlock	Tsuga mertensiana

[1]NFS Region 3 (Arizona and New Mexico) classifies Ponderosa pine into Blackjack pine (young growth) Code 136 and Yellow pine (old growth) Code 137.

Code	Common name	Scientific name
300	Acacia	Acacia sp.
310	Rocky Mountain maple	Acer glabrum
312	Bigtooth maple	Acer grandidentatum
313	Boxelder	Acer negundo
350	Alder (sitka and thinleaf)	Alnus sinuata, tenuifolia, etc.
351	Red and Arizona alder	Alnus rubra, oblongifolia only
352	White alder	Alnus rhombifolia
360	Madrone	Arbutus sp.
370	Birch (water and bog)	Betula sp.
375	Paper birch	Betula papyrifera
460	Hackberry	Celtis sp.
470	Redbud	Cercis sp.
475	Curlleaf mountain mahogany	Cercocarpus ledifolius
476	Alderleaf mountain mahogany	Cercocarpus montanus
477	Hairy mountain mahogany	Cercocarpus breviflorus
478	Birchleaf mountain mahogany	Cercocarpus betuloides
479	Littleaf mountain mahogany	Cercocarpus intricatus
490	Dogwood	Cornus sp.
492	Pacific and red-osier dogwood	Cornus nuttallii, stolonifera
500	Hawthorn (black and Columbia River)	Crataegus sp.
540	Ash (Rocky Mountain)	Fraxinus sp.
600	Walnut	Juglans sp.
680	Mulberry	Morus sp.
730	Sycamore	Platanus sp.
740	Cottonwood and poplar	Populus sp.
741	Blasam poplar	Populus balsamifera
745	Plains cottonwood	Populus deltoides
746	Quaking aspen	Populus termuloides
747	Black cottonwood	Populus trichocarpa
748	Fremont poplar	Populus fremontii
749	Narrowleaf cottonwood	Populus angustifolia
755	Mesquite	Prosopis sp.
760	Cherry-Peach-Plum Bitter cherry Common chokecherry	Prunus sp.
800	Oak--deciduous	Quercus sp.
803	Arizona white oak	Quercus arizonica
810	Emery oak	Quercus emoryi
814	Gambel oak	Quercus gambelii
826	Chinkapin oak	Quercus muehlenbergii
829	Mexican blue oak	Quercus oblongifolia
850	Oak--evergreen	Quercus sp.
902	New Mexico locust	Robinia neomexicana
920	Willow	Salix sp.
945	Tamerisk	Tamarix sp.
990	Miscellaneous hardwoods	--

NOTE: Timber species: All conifers, except pinyon, juniper, or yew species, and cottonwood, poplar, or aspen hardwood species.

Other species: All hardwoods, except aspen, cottonwood, and poplar; also pinyon, juniper, and yew conifer species.

DBH 62.

Diameter at Breast Height (DBH); Timber Species. Diameter, for live trees 1.0 inch and greater and dead trees 5.0-inches and greater, is measured at a point 4.5 feet above ground level on a tree's uphill side. Record diameter as a 3-digit code to last whole tenth inch. For trees less than 1.0-inch in diameter, record DBH as code 001. (See Appendix 3.1 for correct procedures in using a diameter tape, and Appendix 3.5 for correct rounding procedures.)

The following are examples on proper coding for DBH:

a. a 9.18-inch DBH tree is coded 091,
b. a 38.23-inch DBH tree is coded 382,
c. a 0.91-inch DBH tree is coded 001.

Normally formed trees, except aspen, will be marked with a nail at 4.5 feet on the uphill side. This will be done for all tallied trees 5.0-inches DBH or larger, and radial growth saplings 3.0- to 4.9-inches DBH. Aspen will be marked with a finely scribed line at DBH. Place the nail first, then measure DBH directly above the nail. It is important that the tree be nailed at the point of measurement.

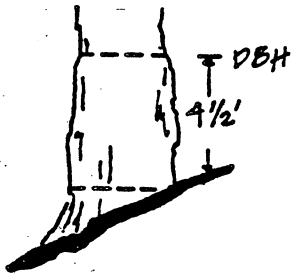
If the plot is located on privately owned land, permission must be obtained from the owner to nail or scribe trees.

In case of bole irregularities at DBH (e.g., swelling, bumps, branches), diameters are measured directly at a spot where there is normal stem form. If allowable, place a nail at point of measurement. If not, measure the diameter on the tree's uphill side and the distance from ground to point of diameter measurement and enter this distance in "remarks."

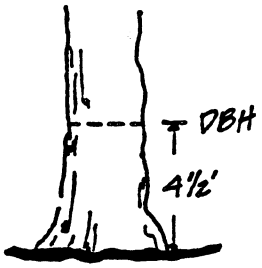
Measuring DBH on irregular trees (Figure H-1):

a. Swell-butted trees should be measured 1.5 feet above the end of the swell or bottleneck if the bottleneck is more than 3 feet high.
b. If the tree forks at or above 4.5 feet (i.e., open crotch of the fork is at or above 4.5 feet), consider the tree as one and measure the diameter below the swell as near to 4.5 feet above uphill ground level as possible. Trees of this type will be treated as single trees.

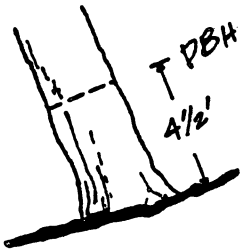
   If the stem forks below 4.5 feet, consider the tree as two trees. Each fork will be considered a tally tree if, on the variable radius plot, the tree is considered as an "in" tree at the point where DBH is to be measured. Measure the diameter of each fork that is an "in" tree at a point as near 3.5 feet above the crotch as can be conveniently reached from the ground.
c. Leaning trees will be considered tally trees if they are within the limiting distance at DBH. Measure DBH 4.5 feet from ground level along the lean on uphill side.



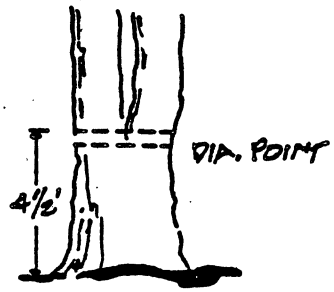
1. Tree on slope



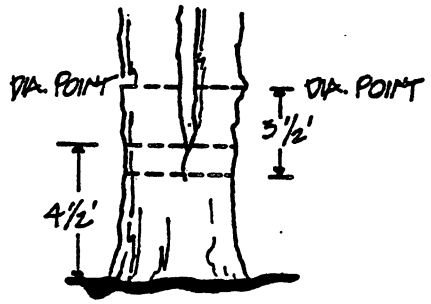
2. Tree on level ground



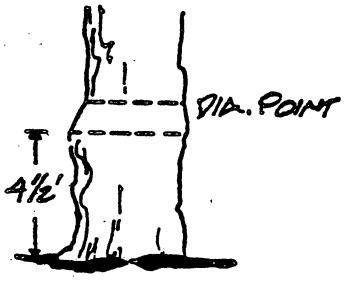
3. Leaning tree



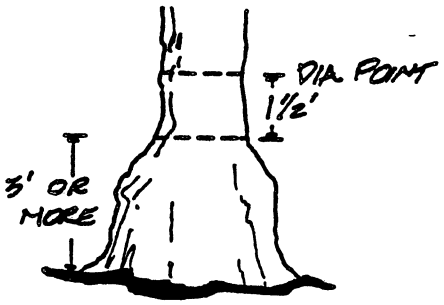
4. Tree forking at or above 4½ feet



5. Tree forking below 4½ feet

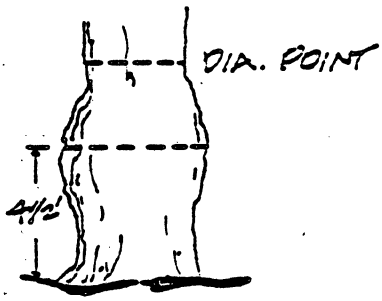


6. Tree deformed at 4½ feet

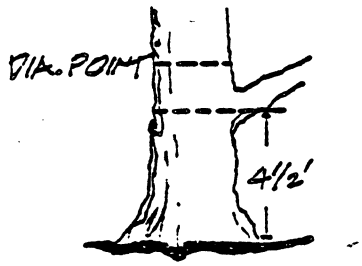


7. Bottleneck tree

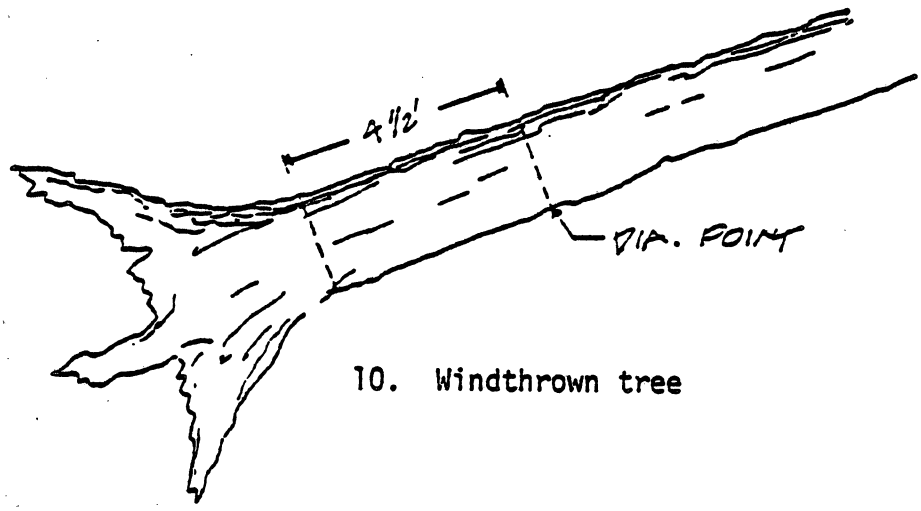
Figure H-1.--Points of diameter measurements on timber species.



8. Tree with swell at 4 1/2 feet

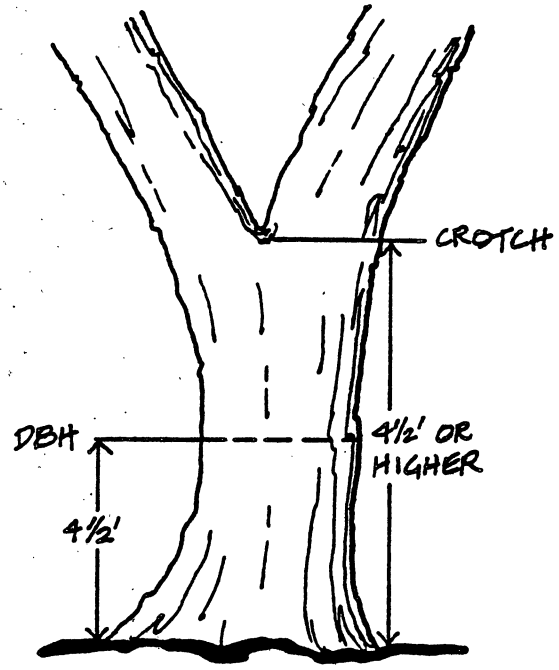


9. Tree with branch at 4 1/2 feet

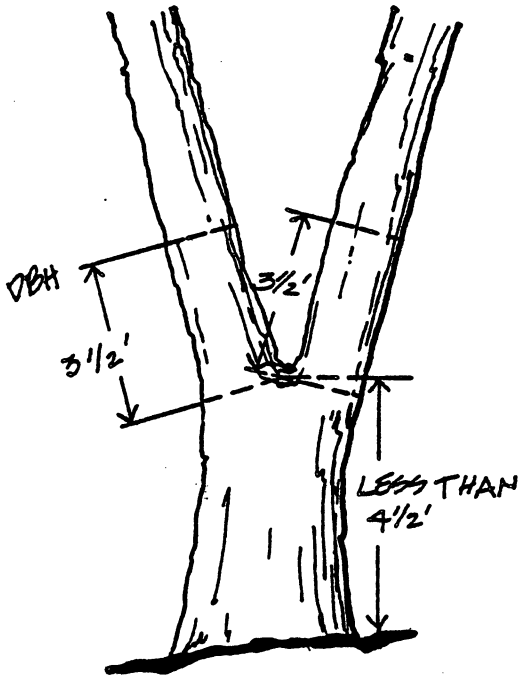


10. Windthrown tree

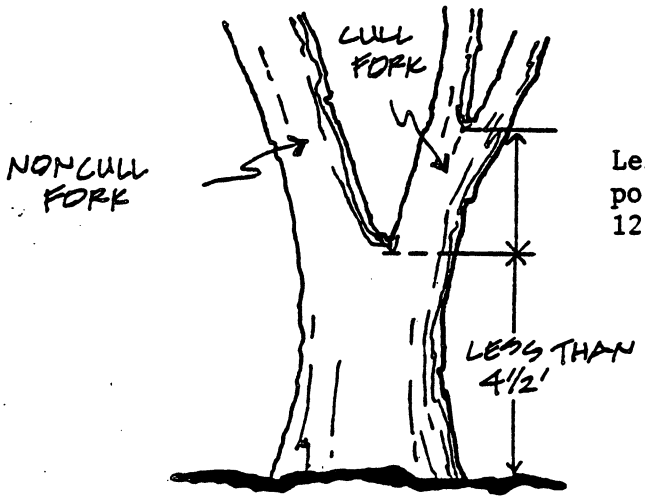
Figure H-1. Points of diameter measurements on timber species.



11. Forked at 4½ feet or higher. Record as one tree and consider only the main fork.



12. Forked below 4½ feet. Record each fork which is "in" as a separate tree.



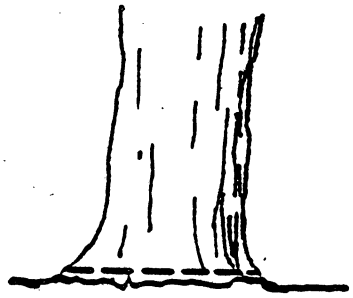
13. Rough tree because of forking. Any fork which is recorded as a separate tree and which forks again within less than 8 feet for all hardwoods and softwood poletimber or 12 feet for softwood sawtimber will be a rough tree.

Less than 8 feet for softwood poletimber and all hardwoods; 12 feet for softwood sawtimber.

Figure H-1.--Points of diameter measurement on timber species.

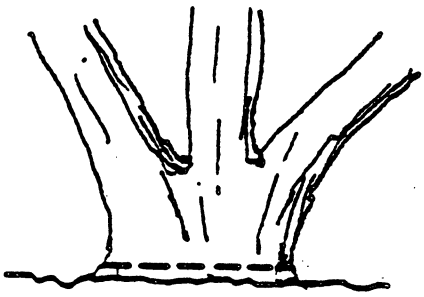
Diameter at Breast Height (DBH): Other Species

Record DBH for other tree species only when a tree 3.0 inches DRC or over has a single stem at the DBH point. When a tree has more than one stem at DBH, leave the DBH column blank (insert a dash). DBH for other tree species with single stems is measured in the same manner as for timber species with single stems; i.e., last whole tenth inch.

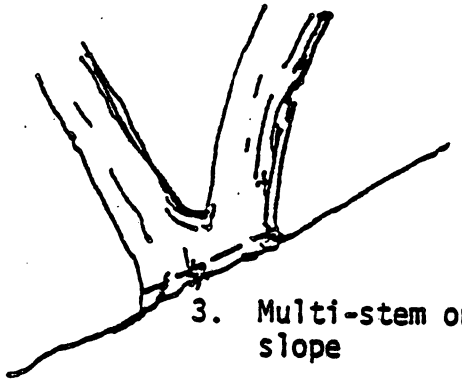


1. Single stem on level ground

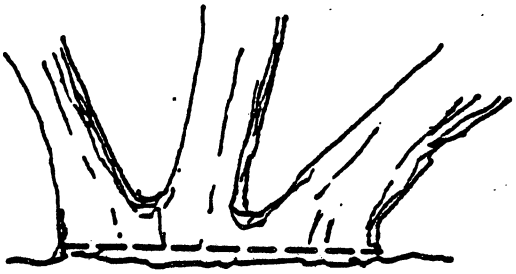
Measure above butt swell.



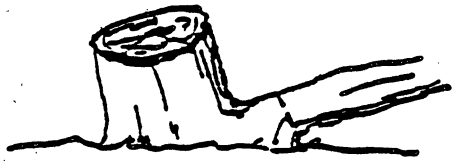
2. Multi-stem on level ground



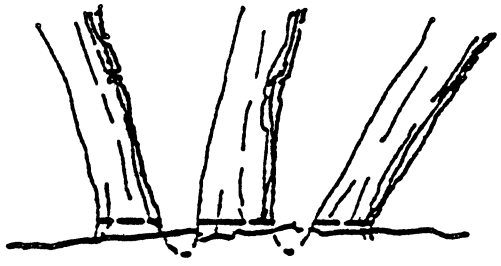
3. Multi-stem on slope



4. Multi-stem forking above ground level



5. Multi-stem with a stem removed.



6. Multi-stem forking at or below ground level. Always tally as one tree and find equivalent diameter.

Figure H-2. Points of diameter measurement on other species. Measure just above ground level.

Tree Height: Total tree height for all species is recorded to the nearest foot for all live and dead tallied trees 1.0 inch in diameter or larger.

For trees with broken or missing tops, project the height to the height of a normal tree of comparable diameter and form.

Radial Growth 64

10-year Radial Growth, Timber Species: Measure the past 10 years of radial growth from an increment core bored immediately below the point of DBH measurement and at right angles to the bole. Count 10 rings in from the outer end of the wood core and mark the point. Measure the length of the core from the outer edge of the last complete summer wood ring to the outer edge of summer wood ring 10 years ago, using a ruler graduated to 1/20 inch as a 2-digit code. Example: 6/20 Code 06, 21/20 Code 21.

Bore on side facing plot center when convenient; otherwise on uphill side.

For other species, obtain the core sample as close to the root collar as possible. Radial growth will be obtained on other tree species only from those chosen as site trees and only on Woodland Plots. (See Site Tree Code, Item 60, for woodland species to determine which trees to use.) If multiple-stemmed, use largest stem for radial growth sampling. Use an average of two or more cores for other species, whenever possible.

Timber species radial growth trees will be obtained by:

a. Place all tally trees into a diameter class, even though actual diameter is recorded, beginning with a 4.0-inch class.

DBH	Diameter Class
3.0 - 4.9	4
5.0 - 6.9	6
7.0 - 8.9	8
9.0 - 10.9	10
.	.
.	.
.	.
21.0 - 22.9	22
.	.
.	.
.	.
33.0 - 34.9	34

b. On each point tallied, obtain 10-year radial growth for the first tree tallied by species by 2-inch diameter class; that is a tree class 10 or 20. For example, if on a particular point, three Douglas-firs are tallied with the following diameters: 21.2 inches, 21.7 inches, and 22.3 inches, the first tree (21.2 inches) is sampled for radial growth for the 22-inch class and Douglas-fir species.

If the only tree encountered on a location in a particular species and 2.0-inch class has an abnormal DBH, measure radial growth at a point on the tree above or below the abnormality and enter the words "abnormal DBH" in "Remarks." The 10-year radial growth column is also left blank for all rough and rotten trees and all dead trees.

Tree Age 65

Tree Age for other tree species will be obtained at root collar for three trees reflecting the average or above average size of the stand which should be among the most vigorous trees in the stand. Try to obtain single-stemmed trees if possible. If multiple-stemmed trees have to be used, pick the largest stem for total age.

On timberland plots, do not age other tree species.

NOTE: Do not try to bore juniper or mountain mahogany species. If oaks are difficult to bore, do not continue, since the increment borers are easily broken. An increment hammer can be used on some species such as juniper, to measure growth, and to extrapolate for age where possible. In these cases, leave Age blank for age of site trees. When on public land, and where trees can be cut down conveniently off the location, tree age may be determined in this manner.

For timber species, obtain tree age for the first two radial growth trees for each species and diameter class for the entire 5-point cluster. For example, on Point 1, two Douglas-firs (21.7 inches and 22.3 inches) are tallied, and on Point 2, two more (21.5 inches and 22.1 inches) Douglas-firs are recorded. For radial growth, the 21.7 inches DF on Point 1 and the 21.5 inches on Point 2 are used. The same two trees will be used for total tree age. Important: If a desirable or acceptable timber species is tallied total age must be determined and recorded for at least one tree for each species and diameter class. If rot is present in a growing stock tree that prevents counting of all the age rings, total age will be extrapolated.

In addition, age will be collected for the first two desirable or acceptable seedlings and the first two desirable or acceptable saplings in the 2 inches DBH class for each species.

Ages recorded for timber tree species greater than 2.9 inches DBH will be breast height ages. This is the age obtained by counting growth rings from an increment core taken at breast height. This is not total tree age. Tree age will be coded as:

a) Tree age--69, code 069
b) Tree age--184, code 184,
c) All trees over 300 years old will receive a code of 300

For seedlings (trees less than 1.0 inches DBH) and saplings which are from 1.0 to 2.9 inches DBH, a total tree age will be determined by one of the following procedures:

a) Tree age for softwood seedlings and 2-inch class softwood saplings will be estimated by counting the whorls of branches. If an accurate tree age cannot be achieved by counting whorls, the tree may be bored with an increment borer, as close to the base of the tree as possible and a ring count made to determine age.

b) For aspen and cottonwood that are less than 3.0 inches DBH, determine tree age by counting the intervals between scars left on the stem by the terminal bud.

   The terminal bud scars are those which completely encircle the stem of the tree. They are formed when the tree starts growing upward in the spring. The scar is left on the stem where the terminal bud lay dormant during the winter.

c. Occasionally, a tree under 3.0 inches DBH will be so old that the bark has roughened, obscuring the terminal bud scars. These trees should be bored with an increment borer as close to the base of the tree as possible and a ring count made to determine age.

The following is a reference table for tree age:

Sawtimber and poletimber trees		Breast Height Age First two radial growth trees
Saplings	3.0 - 4.9 inches DBH	Breast Height Age First two radial growth trees
Saplings	1.0 - 2.9 inches DBH	Total Age First two desirable and/or acceptable trees
Seedlings	≤1.0 inches DBH	Total Age First two desirable and/or acceptable trees
Site Index Trees		Breast Height Age

SECTION I. TREE CLASSIFICATION

Items in this section provide the basis for systematically categorizing live trees into classes reflecting their vigor and suitability for wood products. These tree classes relate growth to area condition, and in so doing, represent harvesting and management opportunities.

Crown Ratio, Crown Class, Surface Defect, Internal Defect, Total Volume Loss, and Damage provide a procedure for classifying live timber species into two classes of growing stock, desirable and acceptable; and two classes of cull, rough and rotten. Crown form, crown ratio, crown class, internal defect, total volume loss, and damage are indicators of tree class for other species.

Crown Form 66

Crown Form: For all live tally trees 1.0 DBH or DRC and larger, crown form will consist of a 2-digit code, where the first digit will be foliage density value. These codes are:

CODE

1/2/3/4 ----- Sparse foliage density.--Few branches on tree and numerous gaps in branches allowing light to penetrate through the crown. Areas allowing light to penetrate are large and more namerous than areas with foliage.

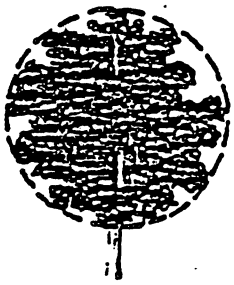
5/6/7/8 ---- Medium foliage density.--In this situation, light penetrates through the crown but the areas of no foliar cover are small and less numerous than those with foliar cover.

9 ---- Dense foliage density.--Foliage density is almost solid allowing very little in the way of penetrating light.

The second digit of the Crown Form Code for each live tree tallied of timber or other tree species indicates one of the following forms the tree crown most closely approximates. Following are forms and codes.

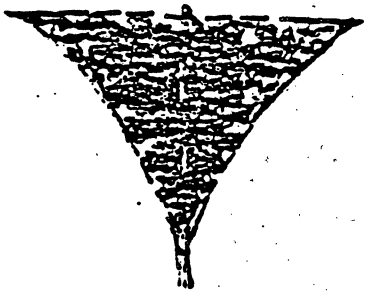
Example: A tree of other species may have medium foliage density with a parabola crown form.. This would be coded as 54.

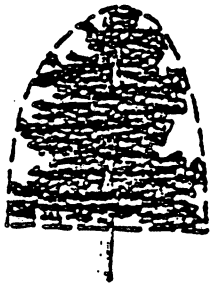
Circle = 1



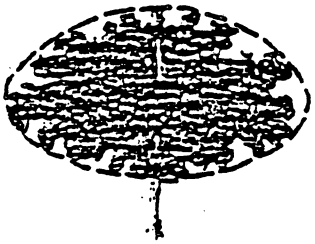
Triangle = 2

Neolloid = 3





Parabola = 4



Horizontal ellipse = 5

Vertical ellipse = 6

Rectangle = 7

Relative Crown Canopy Position 67.

Relative Crown Canopy Position: Coded only for timber species on Timberland. Leave blank for all trees on nonstocked timberland and all woodland locations. Relative Crown Canopy Position (RCP) is determined by comparing the crown position of the tree being measured to the crowns of the surrounding trees on the point.

Because Stand Class is a factor in determining the correct RCP Codes, the entire stand must first be classified as even-aged, two-storied, uneven-aged, or even-aged clump (see Stand Class, Item 20). To accurately calculate Stand Class, a sufficient number of trees must first be bored to measure their ages (unless the stand is obviously uneven-aged). RCP for the first few cluster points tallied will have to be recorded later on, after Stand Class is determined.

Using the following 2-digit codes, record RCP:

Stand Class	Relative Crown Canopy Position	Code
Even-aged (1) or Even-aged clump (4)	a. Tree within main canopy	21
	b. Tree is a relict (veteran), seedling, sapling, or other not in the main canopy	22
Two-storied (2)	a. Tree within upper story	31
	b. Tree within lower story	32
	c. Tree is a relict, seedling, sapling, or other not in a or b above (i.e., not a component of upper or lower story)	33
Uneven-aged (3)	a. Tree within an uneven-aged stand	41

Example: If a stand is classified as even-aged, then all trees on the plot must have an RCP Code of either 21 or 22. This system is also applied to the other stand classes listed. If none of the tallied trees are coded as part of the main canopy, i.e. Code 21, 31, or 32, when a stand has been classified even-aged, two-storied, or even-aged clump, then reclassify the stand uneven-aged and recode all trees 41.

Crown Ratio 68 and 69.

Crown Ratio: Crown ratio is related to vigor and growth of a tree. It is that portion of the tree bole supporting green, live, healthy foliage and is expressed as a percent of total tree height to the nearest 10 percent. Record compacted and uncompacted crown ratio as 1-digit code for all live trees 1.0 inch DBH or DRC and larger.

Crown Ratio may be ocularly estimated, or calculated from two other measurements, total tree height and height to the lowest green limb.

Uncompacted Crown Ratio 68.

Uncompacted Crown Ratio: To determine Uncompacted Crown Ratio, estimate the percent of total tree height supporting live crown, making no adjustment for openings or lopsided crown (see Figure I-1).

Record crown ratio using the following 1-digit codes:

Code	Live Crown (Percent of total tree height)
1	1 - 10
2	11 - 20
3	21 - 30
4	31 - 40
5	41 - 50
6	51 - 60
7	61 - 70
8	71 - 80
9	81 - 100

$$\text{Calculated UCR} = \frac{\text{Total Height - height to the lowest green limb}}{\text{Total Height}}$$

Compacted Crown Ratio 69.

Compacted Crown Ratio: To determine Compacted Crown Ratio, ocularly transfer lower branches to fill in large holes in the upper portion until a full, even crown is visualized. Do not compact branches to form an unnaturally dense crown (see Figure I-1). Use the same coding system as for Uncompacted Crown Ratio.

Crown Class 70.

Crown Class: Crown class is a categorization of trees based on dominance in relation to adjacent trees in the stand. This dominance is indicated by crown development and amount of light received from above and the sides.

Five crown class categories are generally recognized:

Open grown: Trees with crowns which have received full light from above and all sides throughout the life of the tree.

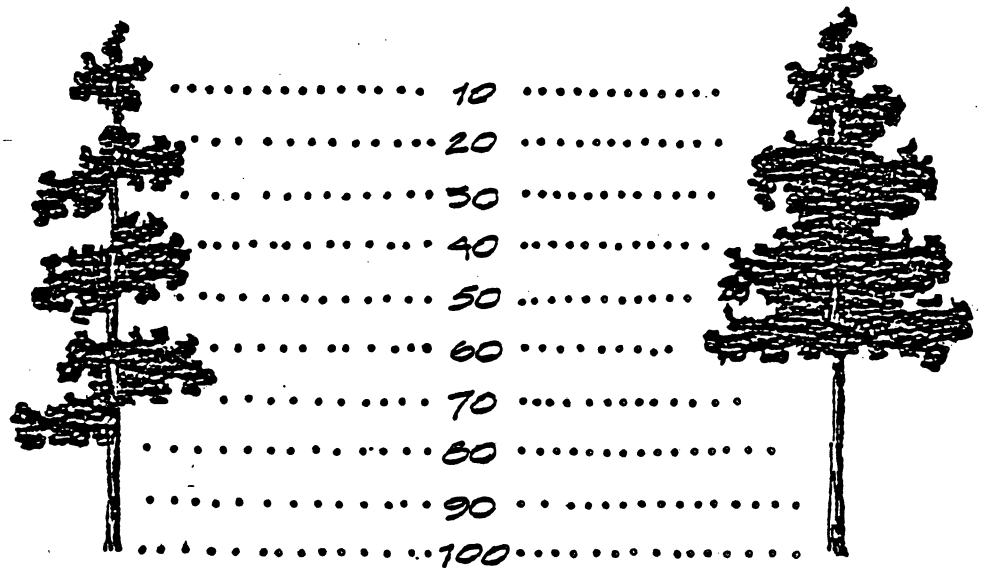


Figure I-1.--Comparison of Uncompacted to Compacted Crown Ratio

Dominant: Trees with crowns extending above the general level of the canopy and receiving full light from above and partly from the side. These trees are larger than the average trees in the stand, and have well-developed crowns which may be somewhat crowded on the sides.

Codominant: Trees with crowns forming the general level of the canopy and receiving full light from above, but comparatively little from the sides. (In stagnated stands, this class includes trees with small-sized crowns crowded on the sides.)

Intermediate: Trees shorter than those in the two preceding classes, and whose crowns are either below or extending into the canopy formed by codominant and dominant trees. Their crowns receive little direct light from above and none from the sides, are usually small, and are considerably crowded on the sides.

Overtopped: Trees with crowns entirely below the general canopy level and receiving no direct light from above or the sides.

Application of Crown Class in Uneven-Aged and Two-Storied Stands:

Differentiation of trees into crown classes is essentially designed for even-aged stands and small even-aged clumps which form uneven-aged stands. However, in uneven-aged and two-storied stands, crown class is applicable but more complex to determine.

In uneven-aged stands of tolerant species, where trees are not in small even-aged clumps, trees of intermediate crown position, with medium-sized crowns, will be considered comparable to codominants of even-aged stands and coded as such.

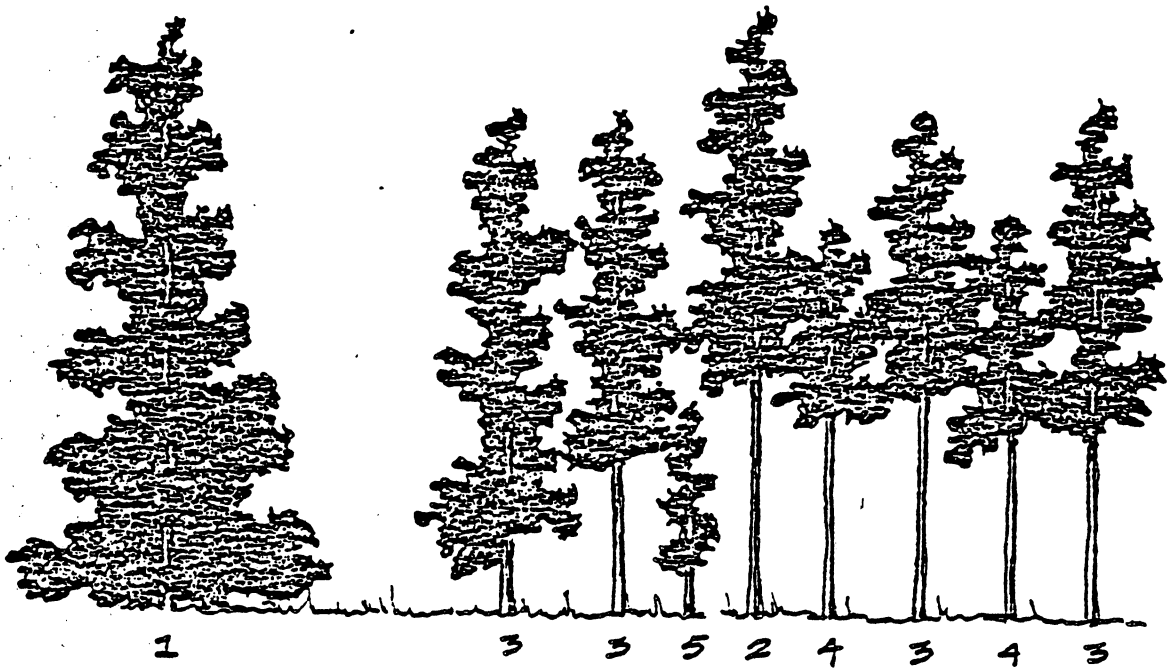
In multiple-aged or even-aged stands with understory trees of younger age classes or smaller heights, direct application of crown class definitions is often difficult. Classification into intermediate and suppressed crown classes is intended to include primarily those trees seriously affected by direct competition with adjacent trees.

Generally in two-story or multi-story stands, crown class for each tree must be judged in the context of its immediate environment (that is, those trees affecting it or being affected by it in terms of crown competition). For example, a dominant tree usually stands head and shoulders above all other trees in the vicinity. However, there may be a young vigorous tree nearby, but not overtopped by a large dominant tree. The smaller tree may be considerably shorter than the dominant tree, but still receives full light from above and partly from the side. Within its immediate environment, it is dominant and should be recorded as such. This situation commonly occurs in multi-storied and two-storied stands with tolerant trees in the understory. In such stands, only understory trees immediately adjacent to overstory trees will be assigned subordinate crown classes. In cases where the overstory consists of scattered residuals standing above large numbers of younger trees, a considerable portion of the understory trees will be classified as dominant and codominant.

Using the following 1-digit code, record crown class for all live trees 1.0 inch DBH or DRC and larger.

Code	
1	Open grown
2	Dominant
3	Codominant
4	Intermediate
5	Overtopped

NOTE: In thinnings or partial cuts less than 1 year old, residual tree crown classes will be the same as preharvest crown classes (see Figure I-2).



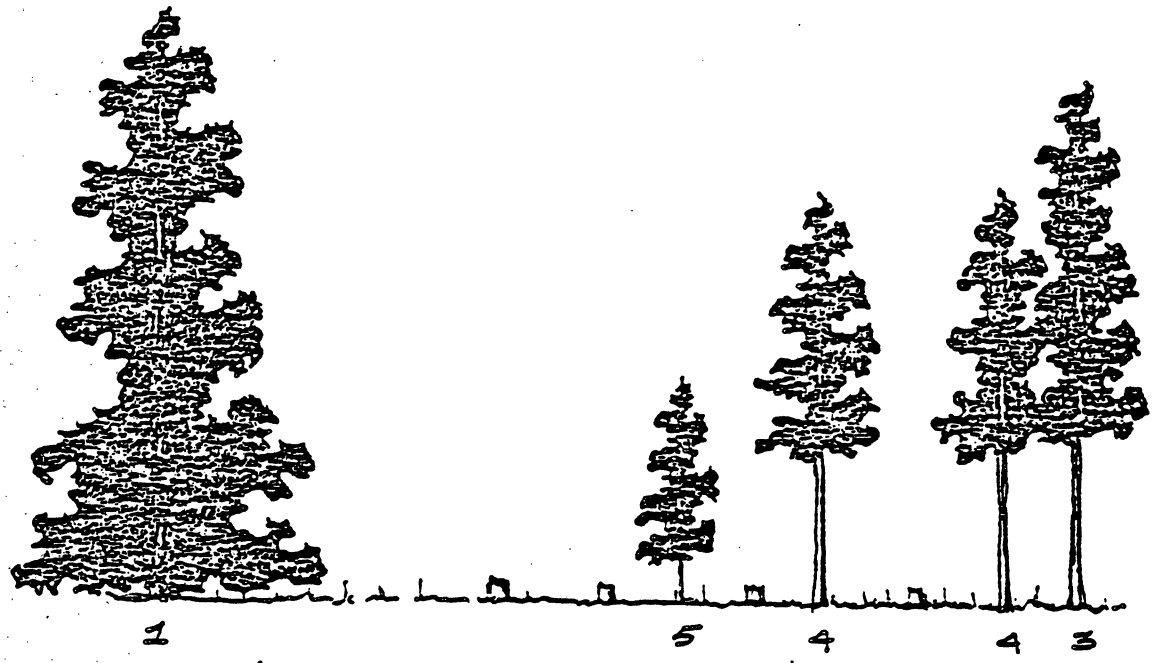


Figure I-2. Pre- and post-harvest crown class values

Surface Defect 71.

Surface Defect: Surface defect indicates lumber and veneer quality of all live, timber species poletimber and sawtimber trees, and is a factor in determining whether trees are either desirable or acceptable (Tree Class = 10 or 20).

(a) Softwood Surface Defect: Surface defect for softwoods is based on limb or knot size, which is measured or estimated at a point immediately outside the limb or knot collar and rounded to the nearest whole inch (Figure J-1). NOTE: For ponderosa and western white pine, estimate surface defect using the procedure outlined on the following page for hardwoods.

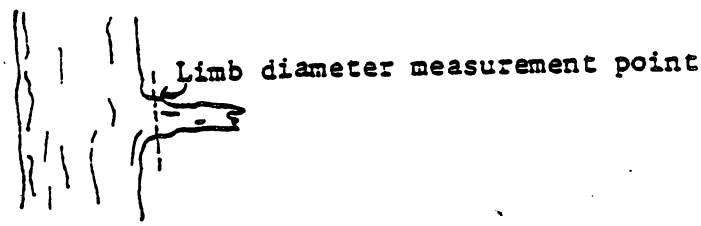


Figure J1. Measurement of limb or knot diameter.

Softwood bole sections to be observed for estimating surface defect are dependent upon DBH as follows:

DBH (inches)	Section Observed (above a 1-foot stump)
5.0 - 8.9	the first 8.0 feet
9.0+	the first 16.0 feet

Using 2-digit codes, record softwood surface defect. The first digit describes size of the largest live limb and the second digit codes size of the largest dead limb or knot.

Code	Diameter of Largest Limb or Knot (inches)
1	<1.0
2	1.0 - 1.9
3	2.0 - 2.9
4	3.0 - 3.9
5	4.0 - 4.9
6	5.0 - 5.9
7	6.0 - 6.9
8	7.0 - 7.9
9	8+

NOTE: if there are no live limbs, dead limbs, or knots in the bole section observed, record 11 (Code 1 also indicates no limbs or knots).

(b) Hardwood Surface Defect: Surface defect in hardwoods is based on the summed length of a tree's clear panels facing toward point center.

A clear panel is a section of the tree surface one-fourth the circumference of the tree, at least 2 feet long, and free of defects. Defects include limbs, knots, bumps, bark distortions which indicate overgrown knots or holes, and adventitious twigs. Ignore shallow defects that are expected to be removed by slabbing for lumber and rounding for veneer in the mill (See Figure J-2). For trees 15.0 inches DBH and larger, ignore adventitious twigs.

Hardwood bole sections to be observed for estimating surface defect are dependent upon DBH as follows:

DBH (inches)	Section Observed (above a 1-foot stump)
5.0 - 6.9	the first 8.0 feet
7.0 - 10.9	the first 12.0 feet
11.0+	the first 16.0 feet

Using the following 2-digit codes, record the summed clear panel lengths to the last whole foot:

Code	Summed Clear Panel Length (feet)
10	No clear panel of at least 2 feet
20	2 - 3
30	4 - 5
40	6 - 7
50	8 - 9
60	10 - 11
70	12 - 13
80	14 - 15
90	16

NOTE: Use the above procedure for estimating surface defect on western white pine and ponderosa pine as well as commercial hardwoods.

Volume Loss 72-75

Volume Loss: Volume loss or "cull" estimates are used to classify pole-timber (PT) and sawtimber (ST) trees of timber species as either growing stock or cull. Cubic-foot volume loss estimates are used to determine net volume and tree class for other tree species. These estimates are dependent upon the type and amount of defect present in the tree.

For all live, salvable dead, and nonsalvable dead tree entries, volume loss estimates will reflect the tree's present condition. For all mortality, volume loss estimates will reflect the tree's condition at time of death.

When searching for evidence of defect, examine all sides of the tree. Some visible indicators of defect are conks or fruiting bodies of fungi, swollen knots, severe crook and sweep, fire and lightning scars, frost and wind cracks, and forks. If a tree is suspected of containing rot, bore into the tree and examine the core for punky wood. (NOTE: To avoid permanently embedding the increment borer, bore only far enough to detect punky wood.) In addition, the sound of a tree when struck by an ax may indicate the presence of rot.

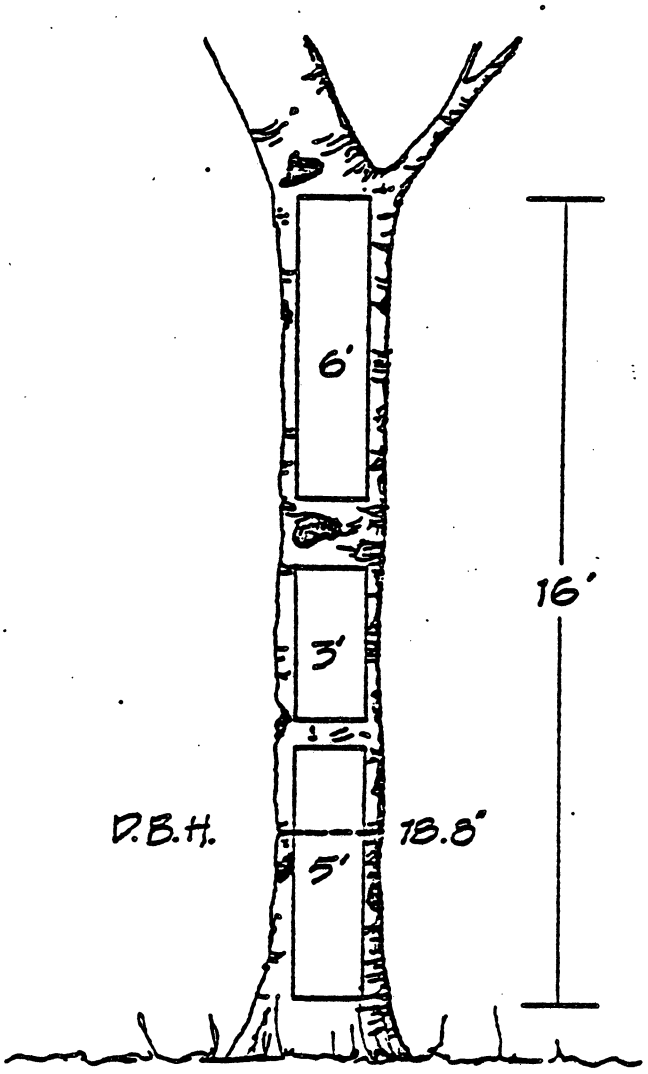


Figure J-2. Example of summing clear panels in a hardwood to determine surface defect. This method is also used for western white pine and ponderosa pine.

As an aid in estimating volume loss, timber species will be divided into 16-foot logs, and each log further divided into 4-foot sections. Tables J-1 and J-2 indicate the percent of tree volume by 4-foot sections and 16-foot logs in cubic and board feet, respectively.

Cubic-Foot Volume Loss: Considers only those defects which reduce the usable solid wood content of a tree's merchantable bole[7]. Cubic-foot cull includes: (a) the volume of rotten or missing wood in the merchantable bole, and (b) the volume of wood in the merchantable bole that is lost or not available for cubic-foot utilization (e.g., chipping) because of form defect or dead material. If a timber species ST or PT tree does not contain at least one 8-foot bolt of usable wood because of rotten or missing sections, then the tree is culled due to internal volume loss.

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[7]Top diameter for cubic volume determination is 4 inches for timber species.

Table J-1.- Percentage of cubic-foot volume (1-foot stump to 4-inch top DOB) by 4-foot sections

Logs per tree	4-foot sections																														Top to 4" DOB
	Log No. 1					Log No. 2					Log No. 3					Log No. 4					Log No. 5					Log No. 6					Log No. 7	8	9	
	1	2	3	4		5	6	7	8		9	10	11	12		13	14	15	16		17	18	19	20		21	22	23	24					
1	31	25	21	18	95																												5
2	20	18	15	12	65	10	9	7	5	31																							4
3	15	13	11	10	49	8	8	7	7	30	5	5	4	4	18																		3
4	13	11	9	7	40	7	7	6	6	26	5	5	5	4	19	4	3	3	2	12													3
5	10	9	8	7	34	6	6	6	5	23	5	5	4	4	18	4	4	3	3	14	3	2	2	2	9								2
6	9	8	7	6	30	5	5	5	5	20	5	4	4	4	17	4	3	3	3	13	3	3	3	2	11	2	2	2	1	7			2
7	8	7	6	5	26	5	5	5	5	20	5	4	4	4	17	4	3	3	3	13	3	3	3	2	11	2	2	2	1	7	4		2
8	7	6	5	5	23	5	5	5	5	20	5	4	4	4	17	4	3	3	3	13	3	3	3	2	11	2	2	2	1	7	4	4	1
9	6	5	5	5	21	5	5	5	5	20	5	4	4	4	17	4	3	3	3	13	3	3	3	2	11	2	2	2	1	7	4	3	2	1

Internal Volume Loss (Cubic-Foot) 72.

Internal Volume Loss (Cubic-Foot): This is a percentage of the unusable cubic-foot volume due to rotten and/or missing wood in the merchantable bole of all live and dead trees 5.0 inches DBH for timber species or 3.0 inches DRC for other species and larger. NOTE: Internal volume loss for mortality tree entries will be projected back to the tree's time of death.

Use Tables J-4 through J-11 to estimate cubic-foot cull for timber species ST (use Table J-3 for PT), and only for the tree species and defect indicators listed in the tables. For timber species and indicators not shown, use Table J-1 to estimate the unusable volume by 4-foot sections within each 16-foot log. This estimate, when applied to the percent of total volume represented by the section, results in percent of volume loss for that section. If more than one 4-foot section has defect, the percents of volume loss will be summed to yield the tree's total percent defect. (See Figures J-4 and J-5 for examples of how to estimate internal defect.)

For all PT with internal defect indicators other than that listed in aspen in Table J-3, use the above procedure as described for ST, estimating Volume Loss by 4-foot sections.

For other tree species, compare the total amount of internal volume loss to the total cubic volume of the tree. The total volume includes all stems and branches above a 6-inch stump to a 1.5 inch top.

Rot or Circular Internal Defect: The field person should be alert to such defect indicators as:

(1) Cankers or fruiting bodies
(2) Swollen or punky knots (sunken knots on spruce)
(3) Dull, hollow sound of bole when struck with an ax
(4) Large dead limbs, particularly those with frayed ends
(5) Sawdust around the base of the tree

Regard with suspicion all trees exhibiting any of these characteristics. Bore all such suspected trees with the increment borer. As a general rule, the presence of yellow, yellowish-brown, or light brown rot on the increment core may indicate the presence of butt or stump rot. Such rot does not normally extend more than 10 or 12 feet above the stump.

Table J-3.--Defect deduction (cubic-foot) by DBH class and external indicator

ASPEN

DBH class	Fungi	Deduction
5.0" & larger	Fomes igniarius	100% of section extending 3 feet above and 5 feet below single conk; if more than one conk, 6 feet above and below highest and lowest conks

Common names for the fungi listed in tables J-3 to J-11 are:

Fungi	Common name
Fomes pini	Red ring rot; hoof-shaped conk
Fomes laricis	Brown trunk rot; "quinine" conk
Fomes pinicola	Brown cubical rot; red belt fungus
Fomes igniarius	White trunk rot; hoofshaped conk
Echinodontium tinctorium	Brown stringy rot; Indian paint fungus
Polyporus schweinitzii	Redbrown butt rot; velvet top fungus
Polyporus circinatus	Red root and butt rot; false velvet top fungus
Poria asiatica	Brown cubical butt rot and brown cubical pocket trunk rot
Poria weirii	Yellow ring rot; flat, crusty conk

Table J-4.--Average cubic-foot defect percent by DBH class and external indicator

DOUGLAS-FIR

DBH class	Lower bole[1]					Upper bole[1]		
	Fomes pini[2]	Fomes laricis	Polyporus schweinitzii[3]	Open wound in heartwood[4]	Other	Fomes pini[2]	Fomes laricis	Broken top[5] or old spike top
10-20	50	Cull	Cull	50	Indications of butt rot, cull bottom half of first log.	35	Cull	15
22-30	40	entire	bottom	35		27	entire	36
32-40	38	tree	half of	27		24	tree	49
42-50	36		first log	27		22		55
52-60	33			28		21		60
62+	27			30		19		63

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]This conk usually occurs on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, frost cracks, or bole cankers from dwarf mistletoe.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest & Range Experiment Station, 1959.

Table J-5.--Average cubic foot defect percent by DBH class and external indicator

WESTERN HEMLOCK

DBH class	Lower bole[1]						Upper bole[1]				
	Echinodontium tinctorium	Fomes pini[2]	Polyporus schweinitzii or P. circinatus[3]	Fomes pinicola	Open wound in heartwood[4]	Other	Echinodontium tinctorium	Fomes pini[2]	Fomes pinicola	Broken top[5] or old spike top	Dwarf mistletoe
10-20	80	50	Cull	Cull	65	Indications	75	35	Cull	15	Infection in bole--cull swollen area unless open canker, then cull 6 feet above and 8 feet below swelling
22-30	72	40	bottom half	6 feet above	47	of butt rot	60	27	6 feet above	10	
32-40	66	38	of first	and 8 feet	46	cull	45	24	and	7	
42-50	64	36	log	below each	46	bottom half	36	22	8 feet below	6	
52-60	63	33		conk or group	45	of	33	21	each conk or	5	
62+	62	27		of conks	44	first log	31	19	group of conks	5	

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]These conks usually occur on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, or frost cracks.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Table J-6.--Average cubic-foot defect percent by DBH class and external indicator

TRUE FIRS

DBH class	Lower bole[1]					Upper bole[1]		
	Echinodontium tinctorium	Fomes pini[2]	Polyporus schweinitzii[3]	Open wound in heartwood[4]	Other	Echinodontium tinctorium	Fomes pini[2]	Broken top[5] or old spike top
10-20	80	Cull	Cull	65	Indications	75	Cull 3 feet above and 5 feet below each conk or swollen knot	15
22-30	72	3 feet above	bottom half	47	of butt rot	60		10
32-40	66	and	of first	46	cull	45		7
42-50	64	5 feet below	log	46	bottom half	36		6
52-60	63	each conk or		45	of first	33		5
62+	62	swollen knot		44	log	31		5

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]This conk usually occurs on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, frost cracks, or bole cankers from dwarf mistletoe.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Table J-7.--Average cubic-foot defect percent by DBH class and external indicator

LODGEPOLE PINE

DBH class	Lower bole[1]					Upper bole[1]			
	Fomes pini[2]	Fomes laricis	Polyporus circinatus[3]	Open wound in heartwood[4]	Other	Fomes pini[2]	Fomes laricis	Broken top and some spike tops[5]	Rust cankers
All classes	Mature tree Conk or swollen knot-- Cull entire tree. Immature tree Cull 3' up and 5' down from each conk or swollen knot.	Cull entire tree.	Cull bottom half of first log.	Mature tree Cull from ground to 6' above wound. Immature tree Cull portion of bole on which wound occurs.	Evidence of butt rot-- cull bottom half of first log.	Same as lower bole	Cull entire tree	Pitchy (yellowish) spike tops are sound. Other spike tops and broken tops cull: Mature tree 1 log below Immature tree 1/2 log below.	Cull visible defect only.

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]This conk usually occurs on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, frost cracks, or bole cankers from dwarf mistletoe.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Table J-8.--Average cubic-foot defect percent by DBH class and external indicator

WESTERN WHITE AND PONDEROSA PINES

DBH class	Lower bole[1]					Upper bole[1]		
	Fomes pini[2]	Polyporus[3]		Open wound in heartwood[4]	Other	Fomes pini[2]	Fomes laricis	Broken top[5] or old spike top
		Schweinitzii	Circinatus					
10-30	Cull 2 ft. above and 4 ft. below.	Cull bottom half of first log.	Conks on ground; cull bottom half of first log.	Cull from ground to 8 ft. above top of wound.	Indications of butt rot; cull bottom half of first log.	Cull same as for lower bole.	A conk anywhere on tree; cull entire tree.	Cull 8 ft. below break or dead bole adjoining break.
32-50	Cull 3 ft. above and 5 ft. below.							
52+	Cull 4 ft. above and 6 ft. below.							

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in upper bole (or lower bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]These conks usually occur on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, frost cracks, or bole cankers from dwarf mistletoe.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Table J-9.--Average cubic-foot defect percent by DBH class and external indicator

WESTERN LARCH

DBH class	Lower bole[1]					Upper bole[1]			
	Fomes pini[2]	Fomes laricis	Polyporus schweinitzii[3]	Open wound in heartwood[4]	Other	Fomes pini[2]	Fomes larcis	Broken top[5]	Dwarf-mistletoe
10-40 42+	Cull 4 ft. above and 6 ft. below each conk or swollen knot.	Cull 1 log above and below conk. Cull entire tree.	Cull bottom half of first log.	Cull from ground to 1 log above top of wound.	Indication of butt rot; cull bottom half of first log.	Same as lower bole.	Same as lower bole.	Cull 1 log below break. Cull 2 logs below break.	Infection in bole: cull swollen area, unless open canker, then cull 6 ft. above and 8 ft. below swelling.

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]This conk usually occurs on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, or frost cracks.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Table J-10.--Average cubic-foot defect percent by DBH class and external indicator

WESTERN REDCEDAR

DBH class	Lower bole[1]						Upper bole[1]		
	Fomes pini[2]	Paria weirii or P. asiatica	Polyporus schweinitzii[3]	Open wound in heartwood[4]		Sucker branch	Fomes pini[2]	Broken top[5]	Sucker branch
				Large hollow butt	Other				
10-30	Cull entire tree	Conks in root crotches near ground--Cull bottom half of first log	Cull bottom half of first log	Cull bottom half of first log	Cull bottom half of first log	Large bayonet-type branch--cull entire tree	Cull entire tree	Cull half of top log Cull top log Cull two top logs	Large bayonet-type branch Cull same as for broken top
32-50				Cull first log					
52+				Cull first two logs					

[1]Lower bole includes first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

[3]This conk usually occurs on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, and frost cracks.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Table J-11.--Average cubic-foot defect by DBH class and external indicator

ENGELMANN SPRUCE

DBH class	Lower bole[1]					Upper bole[1]			
	Conks[2]		Open wounds[4]		Rust brooms	F. pini[2] F. laricis F. pinicola	Echinodontium tinctorium	Broken top[5] or old spike top	Other
	On bole	On butt or ground[3]	Basal	Frost cracks					
All classes	F. pini F. laricis F. pinicola E. tinctorium Cull entire tree	Mature tree Cull first log Immature tree Cull bottom half of first log	Cull 10%	Cull 10%	Dead rust brooms near bole--Cull 19%	Cull entire Tree	Cull entire tree	Broken top--Cull 26% Dead or spike top--Cull 16%	Open trunk wounds--Cull 8% Frost crack--Cull 16% Dead rust broom--Cull 19%

[1]Lower bole inclues first two 16-foot logs; upper bole is above first two logs. Cull in lower bole should be added to cull in upper bole for total cull. Two indicators in lower bole (or upper bole) are not additive.

[2]Fomes pini conks include swollen or punk knots.

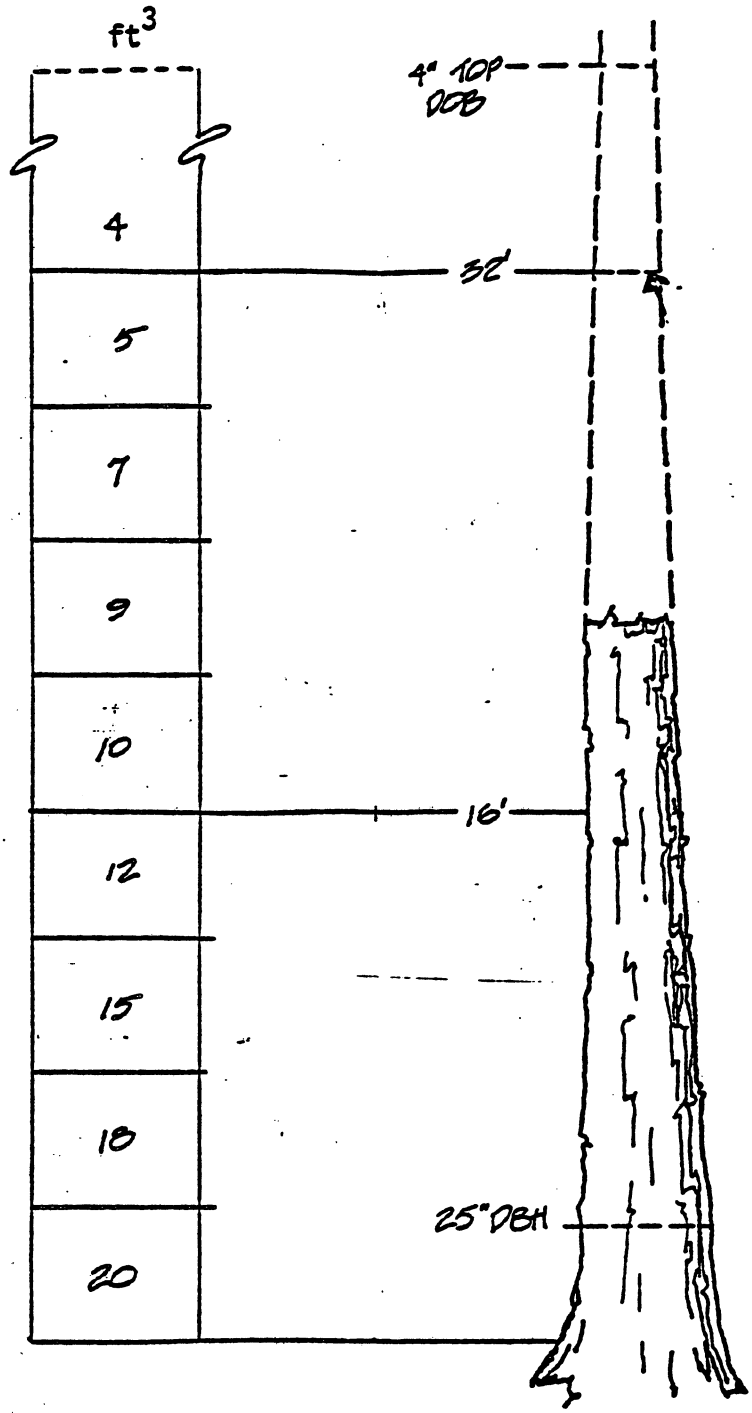
[3]Conks of polyporus schweinitzii and P. circinatus usually occur on exposed or shallow roots, or on ground near base of tree.

[4]Open bole wounds that extend into heartwood, such as cat-faces, lightning wounds, and frost cracks.

[5]Top must be broken below merchantable top.

From unpublished data, Intermountain Forest and Range Experiment Station, 1959.

Percent volume by
4-foot section



Volume loss(%)
Broken top:

ft^3=2/3(9)+7+5+4 = 22%

At point of break:

ft^3 = assume no volume loss since break is recent (no rotten wood)

Internal Volume Loss:

ft^3 = 22% (code 3)

Other Volume Loss:

ft^3 = 0%

Total Volume Loss:

ft^3=22+0 = 22% (code 3)

Figure J-4. A 2-log sawtimber conifer with a broken top which is regarded as missing wood.

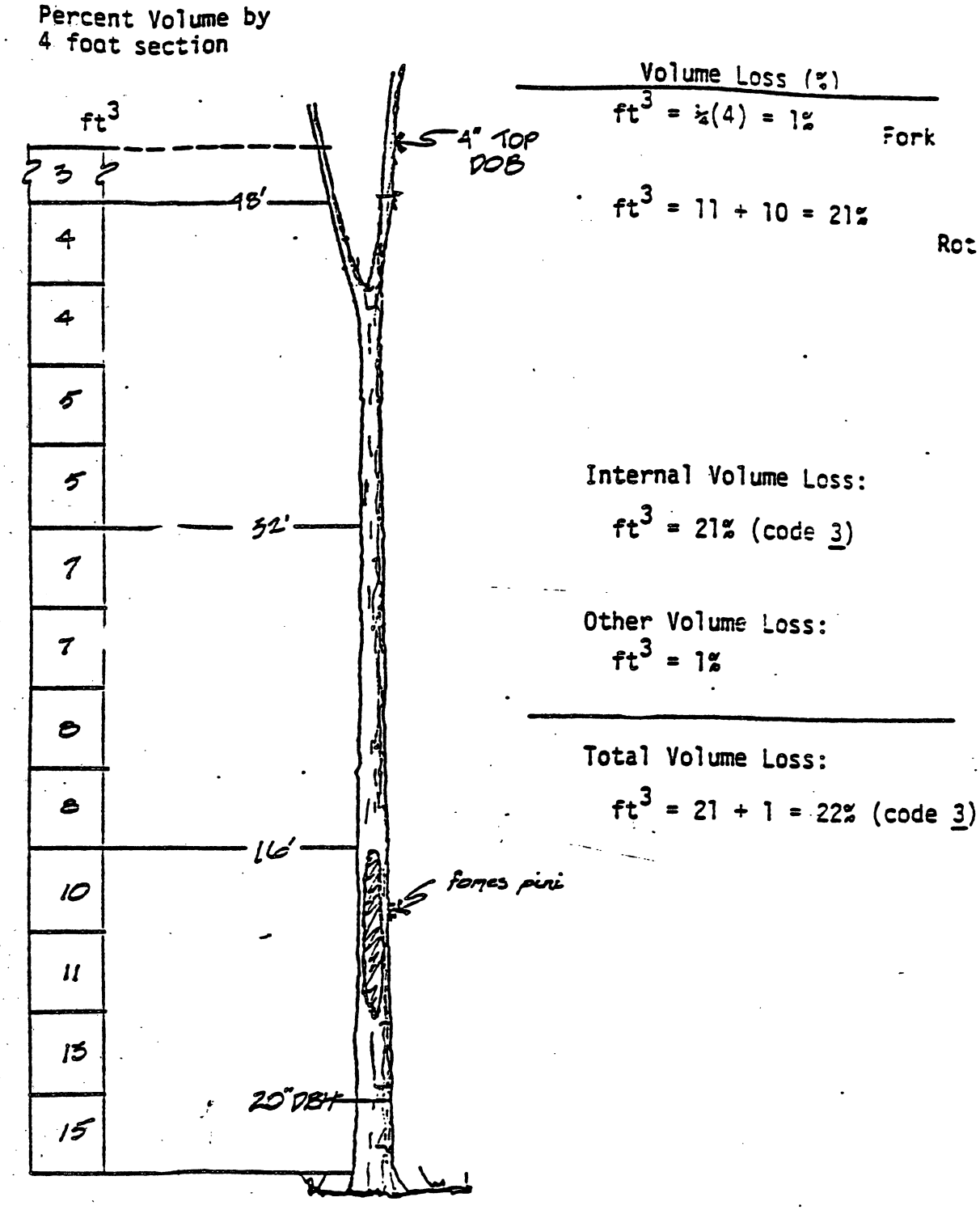


Figure J-5. Defect deductions for an immature lodgepole pine with a Fomes pini conk and a fork.

The procedure for estimating cubic-foot volume loss from circular internal defect is:

(1) Determine from Tables J-13 and J-14 the amount of deduction in percent volume for the defective portion of the tree, and
(2) apply this deduction in percent volume to the proper section(s) of the tree using Table J-1.

Missing Bole Sections: For trees with missing tops, cull out the entire merchantable volume of these sections even though the section may be lying on the ground and still usable. For bole sections missing wood from such causes as fire scars or beavers, estimate the volume loss caused by the missing wood. Use Table J-1 to estimate the percent cull volume by 4-foot sections. See Figure J-4 for an example of how to determine the cull volume of a tree with a missing top.

Record internal cubic-foot volume loss in one of the following 10 percent classes using a 1-digit code:

Code	Volume Loss (Percent)
1	1 - 10
2	11 - 20
3	21 - 30
4	31 - 40
5	41 - 50
6	51 - 60
7	61 - 67
8*	68+
9	None

Total Volume Loss (Cubic-Foot) 73.

Total Volume Loss (Cubic Foot): Total Volume Loss = Internal Volume Loss + "Other" Volume Loss.

Total volume loss is the sum of volume loss due to rotten and/or missing wood plus "other" volume loss due to severe crook, forks, excessive limbiness, and extreme form reduction (taper). Dead portions of the total tree cubic volume are also considered "other" volume loss.

Expressed as a percent of tree volume, total volume loss is measured for all live and dead trees 5.0 inches DBH or 3.0 inches DRC and larger. Record this total percentage using the same coding system as for Cubic Foot Volume (Item 72).

NOTE: Total cubic-foot volume loss for mortality tree entries will be projected back to the tree's time of death.

For timber species, dead portions are considered "other" volume loss if in the merchantable bole. For other tree species, dead stems and branches are considered "other" volume loss if they meet minimum size requirements.

*A Code 8 will cull the tree.

Table J-12.--Defect percentage for circular interior defect (For use where diameter of defect column can be determined)

DIB of 4-foot section (inches)	Diameter of defect column -- inches											
	2	4	6	8	10	12	14	16	18	20	22	24
	Percent defect (Cubic-foot basis)											
6	100											
8	100	100										
10	10	25	100	100								
12	5	20	35	100	100							
14	5	15	25	40	100	100						
16	5	10	20	30	45	100						
18	5	10	15	25	35	50	100					
20	5	5	15	20	30	40	100	100				
22	5	5	10	15	25	35	45	100	100			
24		5	10	15	20	30	40	50	100	100		
26		5	5	10	20	25	35	45	100	100	100	
28		5	5	10	15	20	30	35	45	100	100	
30		5	5	10	15	20	25	30	40	50	100	
32			5	10	10	15	20	30	35	45	50	
34			5	5	10	15	20	25	30	40	45	100
36			5	5	10	15	15	20	30	35	40	50

Table J-13.--Defect deduction for circular interior defect
(For use where diameter of defect column cannot be determined, but external indicator present)

Fungi	Trees attacked	Indicators present	Deduction Cu. ft.
Fomes pini (Red ring rot)	WWP, PP, DF, LP, ES, GF, WF, WH, SAF	Hoofshaped conks, swollen knots, "punk" knots, (Sunken knots in ES.)	100% of section extending 25' above and below single conk or knot or compact cluster of conks or knots. If conks or knots are distributed up and down trunk, cull entire tree.
Fomes pinicola (Brown crumbly rot)	DF, GF, L, WH, WF, SAF	"Red belt" conks	100% of section extending 8' above and below conk.
Fomes laricis (Brown trunk rot)	L, PP, DF, ES, LP	"Quinine" conks	Cull entire tree.
Fomes igniarius (White trunk rot)	Aspen	Hard, thick, woody conks	100% of section extending 3' above and 5' below single conk; if more than one conk, 6' above and below highest and lowest conks.
Echinodontium tinctorium (Brown stringy rot)	GF, WF, SAF, WH	Conks, rust red punk knots, rust red color in old branch stubs	Conk on butt log, cull first two logs; if conks are distributed up and down the trunk, cull the entire tree.
Stereum sanguinolentum	SAF	Thin leathery crustlike conks on dead trees and limbs.	Cull entire tree. NOTE: Conks seldom appear on living trees. If present on dead trees in stand, be suspicious of live trees.
Polyporus amarus (Pecky cedar rot)	Incense cedar	Conks, shot-hole cups	Cull entire stem from stump to 20' above conk or cup.

Revised April 1957

Since cubic-foot cull measures volume loss of solid wood, "other" volume loss is difficult to apply. In this case, "other" volume loss deals only with form defects which make sections of solid wood unusable for "total wood utilization" purposes (e.g., groundwood or pulpwood), or which prevent a tree of timber species from containing at least one 8-foot bolt of usable wood. These form defects include severe crook, forks, excessive limbiness, jump-butt stumps, and extreme form reduction.

NOTE: "Other" cubic-foot volume loss due to these defects is uncommon because most bole sections of sound wood can be chipped for total utilization purposes. However, many stems or branches may be dead, and dead stems or branches meeting minimum size requirements are "other" cubic foot volume loss.

For determining percent of "other" volume loss, follow the procedures outlined for internal volume loss, Item 72, utilizing Table J-1 and estimating the percent of volume loss due to form defect in each 4-foot bole section. See Figure J-5 for examples of "other" volume loss deductions.

NOTE: If a timber species ST or PT tree does not contain at least one 8-foot bolt of usable wood because of severe crook, forks, excessive limbiness, or extreme form reduction, then the tree is culled due to "other" volume loss and a code of 8 is recorded under Total Volume Loss-Cubic-Foot.

To calculate total cubic-foot volume loss, add the percent of internal cubic-foot volume loss to the estimated percent of "other" cubic-foot volume loss. Record this total percentage using the coding system for Internal Cubic-Foot Volume Loss in Item 72.

Damage 76.

Damage: Record damage for all live trees. Only serious damage or pathogen activity will be recorded; absence of damage or pathogen activity will be coded 01. When a tree is damaged by more than one serious agent, code the most severe one. Guides in this section will be used to ascertain serious damage.

In under-rotation age trees, any code other than 01 in damage will prevent a tree from being desirable (Section L). In over-rotation age trees, certain codes will downgrade tree class because presence of a pathogen or damaging agent reduces the tree's chance to survive 10 years. Damage must not be coded carelessly! Indiscriminate coding of minor damaging agents will cause good trees to be downgraded, and overlooking important damaging agents will result in a too high tree class. A general rule is to code damage only when something is wrong with the tree which:

(1) Will prevent it from living to maturity, or surviving 10 more years, if already mature;
(2) Will prevent it from producing marketable products (straight logs of minimum or greater dimensions); or
(3) Will reduce, or has seriously reduced, quality of the tree's products (such as may result from lightning strike, excessive lean, etc.).

In all cases, damaging agents coded must be considered separately from the causes of board-foot or cubic-foot cull. If the agent causing cull is serious in terms of damage (e.g., conks on bole cause cull and are serious to tree's chance of survival), then it should be coded as damage. However, a small fire scar which results in some cull would not be as important as a heavy mistletoe infestation. Consequently, mistletoe should be coded in damage.

Damage is a 2-digit code (see Table K-1) and will be entered in Columns 51 and 52.

The following describes codes to be used for damage:

Code 01 -- No Serious Damage: No serious damage is evident in the tally tree. Some minor damage may be evident but is not reducing tree quality or will prevent it from living to maturity.

Codes 10, 11, 12 -- Insect Damage: Only serious insect damage will be coded. Nearly any tree in the woods will have insects on it at one time or another, but this presence does not necessarily indicate serious tree damage. Use Table K-2 for rating insect damage. Code 10 will be used if the insect cannot be identified. If insect damage is coded, an appopriate code must be entered in First I&D Incidence, Item 78.

Table - K-1 DAMAGE CODES

	Code	Damage
No serious damage	01	No serious damage
Insect	10	Unidentified insect
	11	Bark beetles
	12	Defoliators
Disease	20	Unidentified disease
	21	Rusts
	22	Rots
	23	Blights
	24	Mistletoe (complete Item 80)
Fire	30	Fire
Animal	40	Unidentified animal
	41	Domestic animal
	42	Porcupine girdling
	43	Wildlife browse (other than porcupine)
	44	Other wildlife damage (trampling, etc.)
Atmosphere	50	Unidentified weather
	51	Wind
	52	Lightning
	53	Snow
	54	Air pollution
	55	Chemical
	56	Flooding
	57	Drought
Other	60	Suppression
	70	Unidentifiable/unknown
	71	Leaning 15° from vertical
	72	Forked/multiple stem below merchantable top, seedlings/saplings with multiple stems
	73	Broken top
	74	Dead top
	75	Wolf tree
	76	Unhealthy foliage
	77	Excessive taper
	78	Forked/multiple stem above merchantable top
	79	Heartwood scar on bole
Human	80	Logging or human damage

Codes 20, 21, 22, 23, 24, -- Disease Damage: Only serious disease damage will be coded. Use Code 20 for unidentified disease damage. If disease damage is coded, an appropriate code must be entered in First I&D Incidence, Item 78.

Code 21 -- Rusts:

White Pine Blister Rust.--This disease attacks all northwest five-needle pines; i.e., white pine, whitebark pine, sugar pine, and limber pine. Code this item only when disease evidence is found by using the following criteria:

Discolored areas of bark, the outer edges of discolorations yellowing to orange; or shallow blisters on the bark, which may exude a sticky substance or masses of yellow aeciospores; or branches accompanied by scaly lesions and black pycnial scars; copious resin exudation from ruptured bark in area of infection.

Other Rust.--Code only those cankers which deform the bole, or cause open wounds, or threaten to girdle the tree. Lodgepole pine is often infested with *Peridermium harknessii* "hip" cankers which sometimes kill the tree.

Code 22 -- Rots: Record this damage code especially when conks are present. These are fruiting bodies of wood rotting fungi. Any conk is serious on bole or limb of tree. Conks on ground near base of tree indicate root rots. Sapwood rotting fungi on aspen should be recorded if decay is causing a serious reduction of tree vigor.

Code 23 -- Blight: Usually not found in western tree species. Symptons are sudden drying and browning of whole leaves, shoots, or branches.

Code 24 -- Mistletoe: Any occurrence of mistletoe is serious damage and should be recorded.

Table K-2.--Guide for Rating Insect Damage for Coding Damage/Cause of Death Column

Kind of insect and host	Insect Damage probably not serious (do not code)	Insect damage serious (code)
Bark beetles in Douglas-fir Code 11	Small amount of clear or white pitch on bole of tree.	Current damage Needles turning yellow or red over most of tree (tree is dying). Boring dust in bark crevices is conspicuous. Old damage Black pitch streaks in bark over much of bole.
Bark beetles in pines (ponderosa, Jeffrey, lodge-pole, sugar, western white) Code 11	Copious pitching: pitch tubes large and consisting of yellowish to clear masses of pitch.	Needles turning yellow to red over most of tree. Small red pitch tubes (less than 1/4-inch in diameter) common. Reddish boring dust in bark flakes and crevices, or around base of tree.
Ips beetles in ponderosa pine and sugar pine Code 11	In over-rotation age trees, the top few feet of crowns fading or dead.	Tops killed in seedlings, saplings, or under-rotation age poletimber and sawtimber trees. (In some cases, especially dense stands of saplings, ips beetles may kill every tree in a small area.)
Defoliators All tree species Code 12	Less than 50 percent of entire tree de-foliated (defoliation in lower 2/3 of crown). Less than 75 percent of the top 10 feet defoliated.	Trees over 75 percent defoliated in top 10 feet, or over 50 percent defoliated over entire tree.
	Ordinarily, the mere presence of defoliators, even in large numbers may not be serious, since healthy trees usually recover after heavy defoliation.	

Code 30 -- Fire Damage: In coding fire damage, ignore basal scars unless they have killed the cambium on half or more of the bole circumference. Cull, due to large fire scars, may be sufficient to reduce tree class, even when fire damage alone has not seriously affected the tree's survival chances. In such cases, it will be board-foot or cubic-foot cull which reduces tree class, not damage.

Conversely, a scar which has killed cambium on half or more of the bole circumference, even though it has not caused sufficient cull to reduce tree class, has seriously affected survival chance and will be coded in damage and reduce tree class.

In cases where foliage has been killed by fire, do not code fire damage unless the fire-killed foliage reaches into upper one-third of crown. Ground fires may kill foliage on lower branches without seriously damaging tree.

Codes 40, 41, 42, 43, 44, -- Animal Damage: These codes will be used to code any damage by either wild or domestic animals. Use Code 40 if you cannot distinguish between domestic or wild animal damage.

Code 41 -- Domestic Animal Damage: This code will be used for any damage (trampling, browsing, etc.) that can be attributed to domestic animals (cows, horses, chickens, etc.).

Code 42-- Porcupine Damage: This code is for any porcupine damage in which one-half or more of the bole diameter has been girdled.

Code 43 -- Other Wildlife Browse: Use this code for serious damage done by wildlife species other than porcupine. Deer, mice, moles, and so forth may cause serious damage.

Code 44 -- Other Wildlife Damage: For damage other than browse, use this code. It covers such things as trampling, big game rubbing velvet off their antlers, and other forms of damage caused by beavers.

Codes 50, 51, 52, 53, 54, 55, 56, 57 -- Weather Damage: Record the appropriate code for weather-related damage. Code 50 will be used if serious damage can be attributed to a weather problem but the specific type cannot be identified.

Code 51 -- Wind Damage: Serious damage may result from wind if many branches are broken off, the stem is broken, or the whole tree has been uprooted.

Code 52 -- Lightning Damage: Lightning damages appear as long splits or cracks down the bole or top sections broken out.

Code 53 -- Snow Damage: Snow damage will result from avalanches or weight of snow breaking numerous limbs or the bole.

Code 54 -- Air Pollution Damage: Air pollution results in damage to large number of trees in the same location. Normally these areas will be in a down-wind location from large industrial sites.

Code 55 -- Chemical Damage: Chemical damage results from the use of salts on roadways, drift from herbicide usage, or spillage from large amounts of fertilizer or other chemicals. Use this code cautiously as it is difficult to determine.

Code 56 -- Flooding Damage: Flooding damage will occur near new reservoir sites, streams, or rivers.

Code 57 -- Drought Damage: Be extremely cautious when using this code as a drought damage is very difficult to observe. Recent climatic information will be necessary.

Code 60 -- Suppression: Suppressed trees are characterized by short internodes, gnarled stems, flat crowns, or sparse foliage.

Codes 70, 71, 72, 73, 74, 75, 76, 77, 78, 79 -- Miscellaneous Damage: Use these codes for the following miscellaneous damage. Code 70 will only be used if there is serious damage but cannot be identified (describe damage in Remarks).

Code 71 -- Excessive Lean: All trees leaning more than 15° from vertical, unless there is more serious damage which can be coded.

Code 72 -- Multiple Stem, Below Merchantable Top, Seedlings/Saplings: Use this code to indicate major forks or multiple stems below merchantable top and for multiple stems on seedlings and saplings.

Code 73 -- Broken Top, and Code 74 -- Dead Top: Use these codes for any under-rotation age tree with a broken/dead top. Do not use for over-rotation age trees unless more than 10 feet of the top is dead or broken out.

Code 75 -- Wolf Tree: A squatty tree usually larger in diameter than the average in the stand, with many large and dead limbs and often an "apple tree" form.

Code 76 -- Unhealthy Foliage: If the tree has unhealthy foliage but the causal agent cannot be identified (e.g., diseases, insects, drought), then use Code 76.

Code 77 -- Excessive Taper: Use this code for trees which have abnormal DBH-height ratios.

Code 78 -- Forked or Multiple Stem Above Merchantable Height: Code all major forks or multiple stems above merchantable height in under-rotation age trees. For over-rotation age trees, do not code forks or multiple stems above merchantable height.

Code 79 -- Heartwood Scar on Bole: Use this code for any scar that appears on the bole which has penetrated the heartwood. If the actual causal agent can be determined, use the appropriate code.

Code 80 -- Logging or Human Damage: Use this code to indicate that tree damage was the result of a logging operation or due to humans.

Cause of Death 76.

Cause of Death: For mortality trees (Tree History = 05), cause of death will be determined and coded as follows:

Code	Cause of Death
10	Insects
20	Disease
30	Fire
40	Animal
50	Weather
60	Suppression
70	Unknown and other mortality
80	Logging and related activity

If there is only one cause of death, use 0 for second of 2-digit code. For example, if insects alone cause death, Code 10. However, if there are two or more causes, determine the two most important and use the first digit as the primary cause and second digit as the secondary. For example, if both fire and animals caused death with fire the primary reason, code as 34. Record in Columns 51 and 52.

Condition of Dead 76.

Condition of Dead: For all salvable and nonsalvable timber species, record whether the tree is standing or down. For other species, only code for salvable dead.

Code	Condition of Dead
01	Standing
02	Down

Record in Columns 51 and 52.

SECTION L. TREE AND COVER CLASS

Tree Class 77.

Tree Class: All trees tallied, except salvable and nonsalvable dead, will receive a tree class code. Two different methods will be used, one for timber species and the other for other species. Record tree class in Columns 53 and 54.

Tree class will be determined for all live trees and estimated for mortality trees at their time of death.

A. Tree Class for Timber Species

Tree class categorizes trees as either growing-stock (desirable or acceptable) or cull (rough or rotten). It is computed as a function of compacted crown ratio, crown class, surface defect, internal and total volume loss (cubic-feet), and damage.

Growing-stock trees are species which now, or prospectively, contain at least one merchantable 12-foot saw log for softwoods or 8-foot merchantable saw log for hardwoods.

Cull trees are those which do not now, or prospectively, contain at least one merchantable 12-foot saw log for softwoods or 8-foot saw log for hardwoods because they are defective.

Tables L-1 and L-2 illustrate the basis by which the field person will classify 5.0 inches DBH and larger trees of timber species into tree classes.

Seedling and sapling trees of timber species are ocularly classified into one of the following classes, considering potential to produce cubic foot material at poletimber size:

Code	Description
10	Seedling or sapling with no form defects or missing parts, and no evidence of insects or disease.
20	Sapling with some form defects or minor evidence of insects or disease, which are not expected to preclude the tree growing into a growing-stock poletimber tree.
30	Seedling or sapling with damage, form defects, or missing parts which would preclude the tree from qualifying as a growing-stock poletimber tree.
40	Sapling with evidence of rot which would preclude its growing into growing-stock poletimber tree.

NOTE: Seedlings with any evidence of insects or disease are not expected to survive, and are not tallied.

Table L-1.ALLOWABLE CODES FOR DESIRABLE TREES

Desirable Tree (10 Class) - Allowable Codes

Surface Defect --	DBH (inches)	Maximum Limb or Knot Size	Code
Softwoods:	5.0 8.9	1 inch live or dead	11
	9.0 14.9	2 inches live or dead	11, 12, 21, 22
	15.0+	3 inches live, 2 inches dead	11, 12, 21, 22, 31, 32

	Log Length (feet)	DBH (inches)	Minimum Cumulative Clear Panel Length (Feet)	Code
Hardwoods:	8	5.0 6.9	4	30, 40, 50
	12	7.0 10.9	6	40, 50, 60, 70
	16	11.0 14.9	8	50, 60, 70, 80, 90
	16	15.0+	10	60, 70, 80, 90

Internal Volume Loss (Cubic-foot)--	Maximum Allowable Percent	Code
Poletimber	0	9
Sawtimber, rotation age or less	10	9, 1,
Sawtimber, over rotation age	20	9, 1, 2

Total Volume Loss--	Maximum Allowable Percent	Code
Poletimber	0	9
Sawtimber, rotation age or less	10	9, 1
Sawtimber, over rotation age	20	9, 1, 2

Crown Ratio (Compacted)--	Minimum Allowable Percent	Code
For all trees, except:	31	4
Ponderosa pine, Jeffrey pine, aspen	21	3

Crown Class--	Code
Open grown, dominant, codominant	1, 2, 3

Damage--	Code
No serious damage	01

Table L - 2--Allowable Codes for Tree Class 10, 20, 30, 40 (Timber species)

Item	Desirable Tree Group 10	Acceptable Tree Group 20	Rough Tree 30	Rotten Tree 40
Internal Defect	9 Poletimber 9 or 1 Sawtimber	Any noncull tree not meeting all desirable code limitations	Code 8[1]	Code 8[2]
Total Volume Loss	9 or 1 Poletimber 9 or 1 Sawtimber		Code 8[1]	Code 8[2]
Crown Ratio	3 or larger PP,JP,&Aspen 4 or larger, all others		---	---
Crown Class	1, 2, or 3		---	---
Damage/Cause of Death	01			
Surface Defect	See page 105			

[1]Rough tree if loss in internal defect column is less than half of total volume loss.

[2]Rotten tree if loss in internal defect column is half or more of total volume loss.

Acceptable Tree -- Code 20 (Timber species)

This is a growing-stock tree that does not qualify as a desirable tree.

Rough Tree (Sound Cull) -- Code 30 (Timber species)

If a live ST or PT of timber species has more than 67 percent of its volume (cubic-foot) culled, and more than half of this cull is due to extreme form or sound defects, then the tree is a rough cull.

If a tree does not contain 8 feet of merchantable wood because of form defects and/or dead wood, then cubic-foot volume is culled due to form.

Live saplings and seedlings of timber species which are unlikely to become growing-stock PT because of serious defects such as severe crook, animal, fire, or weather damage, suppression, etc., are considered rough trees.

Excessive forking may also cause a tree to be classified as a rough tree. See the diagram on page 57.

Rotten Tree (Rotten Cull) -- Code 40 (Timber species)

Total volume of these trees (cubic-foot) are culled mainly because of rotten or missing bole sections.

If a live ST or PT of timber species has more than 67 percent of its volume (cubic- foot) culled, and more than half of this cull is due to rotten or missing bole sections, then the tree is a rotten cull.

If a tree does not contain 8 feet of merchantable wood because of rotten or missing bole sections,
then cubic-foot volume is culled due to internal defects.

Seedling with rot or severe insect infestations are not tallied, since they are not expected to survive.

B. Tree Class for Other Tree Species

For other tree species, this is a rating of tree form, dominance, and vigor/soundness.

Code	Tree Class
10	Desirable --Usually single-stemmed (except juniper), full crown, uniform taper. Dominant, codominant, or open grown. Juniper or oak stems form or will form posts. For pinyon, most trees under 12 feet tall would be premium or standart grade Christmas trees. No evidence of rot or damage.
20	Acceptable--Any crown class. Does not meet specifications for a desirable tree but is not a rough or rotten tree.
30	Rough -- May have dead limbs, spike top, and some rot. If pinyon falls in this category, it is automatically a cull Christmas tree. More than 67 percent of total volume loss due to defect with more than half of defect due to dead material. Total volume loss must be code 8. Internal volume loss must be code 9 or 1-3.
40	Rotten -- Punky center and/or missing top. More than 67 percent of total volume loss due to defect with more than half of defect due to rot or missing parts. Total volume loss must be code 8. Internal volume loss must be 4-8.

Cover Class 77

Cover Class: For all geographic areas in the Rocky Mountain West, if four or more trees are tallied on a point the point is considered fully stocked (on timberland locations, there must be a tally of four or more timber species for the point to be fully stocked). However, if less than four trees are tallied, the area must be assigned to one of the other cover class codes. If cover condition can be treated through management prescription and stocking increased to full stocking, then the point cannot be considered nonstockable and a nonstocked code must be used !51 (cannot be used for woodland), 52, 53, 54, 55, 60, 701.

For cover class determination, other than fully stocked, a circular plot with a maximum fixed radius of 26.33 feet (1/20 acre) should be used to sample the entire nonstocked area on each variable radius point. For fixed radius plots (1/10, 1/20, or 1/5 acre) use the fixed plot area.

The following site conditions tend to indicate a nonstockable condition on a point throughout the entire Rocky Mountain and Intermountain area:

(a) 51 percent or more covered by exposed bedrock
(b) 51 percent or more covered by boulders 10 inches in diameter and larger
(c) 51 percent of point covered by roads, trails, and streams
(d) 51 percent or more covered by water
(e) Impaired soil drainage as indicated by the presence of bogs, seeps, potholes, and wet meadows
(f) Plants indicating moisture stress

The following factors tend to indicate stockability on Timberland even in the presence of nonstockable indicators:

(a) Dead trees 20 inches DBH and larger, regardless of time of death, if the microsite the dead tree occupies is not already occupied by an established live tree
(b) Stumps 6 inches in diameter and larger, regardless of time of cutting, if the microsite the stump occupies is not already occupied by an established live tree

After all trees on the variable/fixed plots on timberland and the fixed plots on woodland have been tallied, record point number (only 1 for woodland), tree history of 08 or 09, the plant association (record in species columns), and cover class (record in columns 53 and 54).

The following are cover class codes:

Code

41 Fully Stocked -- Points stocked with at least four live trees of timber species combining both the variable and fixed plots. This code is only for timberland. Do not consider other species.

42 Fully Stocked -- GLU Woodland only. Point has mixture of timber and other tree species. A total of four live trees are tallied on the 1/10-acre or 1/20-acre and the 1/100-acre fixed plots.

43 Fully Stocked -- GLU Woodland only. Point contains at least four live trees of other species only on the 1/10-acre or 1/20-acre and the 1/100-acre fixed plots.

Code

51 Inhibiting High Brush -- 51 percent or more of the nonstocked area is covered by brush which, when fully grown, overtops a person. Also, it may include other tree species. Do not use this code on woodland areas.

52 Inhibiting Low Brush -- 51 percent or more of the nonstocked area is covered by brush which ordinarily does not grow as high as a person. Such brush includes sagebrush, rabbitbrush, huckleberry, snowberry, and most ribes of such density as to inhibit natural regeneration.

53 Inhibiting Grass -- 51 percent or more of the nonstocked area is covered by grassy sod of such density as to inhibit natural regeneration.

54 Inhibiting Duff -- 51 percent or more of the nonstocked area is covered by duff of such depth as to inhibit natural regeneration.

55 Inhibiting Slash and Debris -- 51 percent or more of the non stocked area is covered by logging slash and debris sufficient to inhibit natural regeneration.

60 Nonstocked Not Overtopped -- 51 percent or more of the nonstocked area is clear to permit establishment and development of one or more seedlings and is not overtopped by overhanging crowns of trees.

70 Nonstocked Overtopped -- 51 percent or more of the nonstocked area is clear to permit the establishment of one or more seed lings but is sufficiently overtopped by overhanging tree crowns to prevent development of seedlings.

80 Nonstockable -- 51 percent or more of the nonstocked area is covered by rock, water, etc. Supplemental instructions for local conditions will be provided for stocking capability.

85 Inaccessible

90 Nonforest

91 Census Water

92 Noncensus Water

95 Reserved Forest Land

97 Sample Missed

98 Access Denied

99 Outside Sample Area

SECTION M. INSECT AND DISEASE INCIDENCE

Primary and secondary insect and disease incidence will be used as a supplement to the previously recorded damage codes. These codes, however, will not be utilized in determining tree class. Their major use is to obtain more data on insect and disease problems found in timber species. Almost all trees have some insects or diseases associated with them, but they may not be serious enough to code in Damage (Item 76). For this part it is important to know, regardless of how inconsequential, the diseases or insects infesting a tree. It is not necessary to enter these codes in any particular order.

First I&D Incidence 78.

First I&D Incidence: The first insect and disease incidence will be entered as a 2-digit code (See Table M-1) in Columns 55 and 56.

Second I&D Incidence 79.

Second I&D Incidence: The second insect and disease incidence will be entered as a 2-digit code (see Table M-1) in columns 57 and 58. For the second I&D incidence, a code of 10 can be used if no other infestation than the first I&D can be observed.

Table M-1.--INSECT AND DISEASE INCIDENCE CODES

	Code
HEALTHY TREE No insects, disease or damage; can be used for Second I&D if only one incidence can be observed.	10
INSECTS (examples: bark beetles, spruce bud worm)	20
DISEASES	
Stem (examples: galls rusts, needle cast)	30
Heart (examples: cankers, Indian Paint Brush)	40
Root (examples: fomes annosus root rot)	50

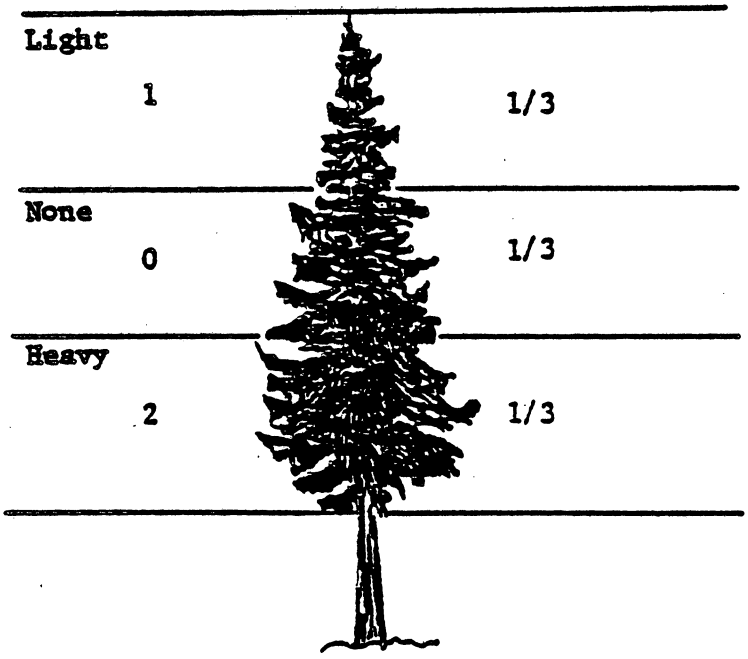
Mistletoe-6 Class 80.

Mistletoe-6 Class: All timber softwood tree species and pinyon and juniper other tree species will be rated as to mistletoe infection using the following procedures:

(a) Divide live crown into thirds; (b) Rate each third separately as to:

Code	Amount of Infection
0	No visible infection
1	Light infection (half or less of total branches in a third infected)
2	Heavy infection (half or more of total branches in a third infected)

(c) Add ratings of thirds to obtain final tree rating and enter that code in Column 59.



Total Infection Code = 1 + 0 + 2 = 3

Figure N-1.--Mistletoe-6 rating for an example tree

Blank 81.

Percent Tree Crown Cover 82.

Percent Tree Crown Cover: For all trees 1.0 inch DBH or DRC and larger record the percent of the tree crown, taken as the vertical projection of an ellipse formed with the maximum and minimum crown measurements which is the dominating crown cover for that area of the sample location. This is the percent of the ellipse which is present, dominates any other tree crowns or ground cover. Record to the nearest 5 percent in columns 62-63. See figure C-3.

Maximum Crown Width 83.

Maximum Crown Width: For all tree species 1.0 inch DBH and larger or 1.0 inch DRC and larger, record the maximum crown width through the tree center to the nearest foot (Figure N-4). This is a 2-digit code recorded in Columns 64 and 65. Measurements can be made using a tape or poles. Measure through the geographic center of the tree for multi-stemmed trees.

Minimum Crown Width 84.

Minimum Crown Width: For all tree species 1.0 inch DBH or DRC and larger, record the minimum crown width through the tree center to the nearest foot (Figure N-4). This is a 2-digit code recorded in Columns 66 and 67.

Number of Stems 85.

Number of Stems: This is a 2-digit code and will be recorded for other tree species, and only for trees with at least one stem 3.0 inches or larger. The number of stems is a simple count of stems 3.0 inches or larger within the first foot above DRC. Consider only stems 3.0 inches or larger in the count. In comparison to branches, stems generally are oriented upward, and contribute to the structural support of the main tree crown.

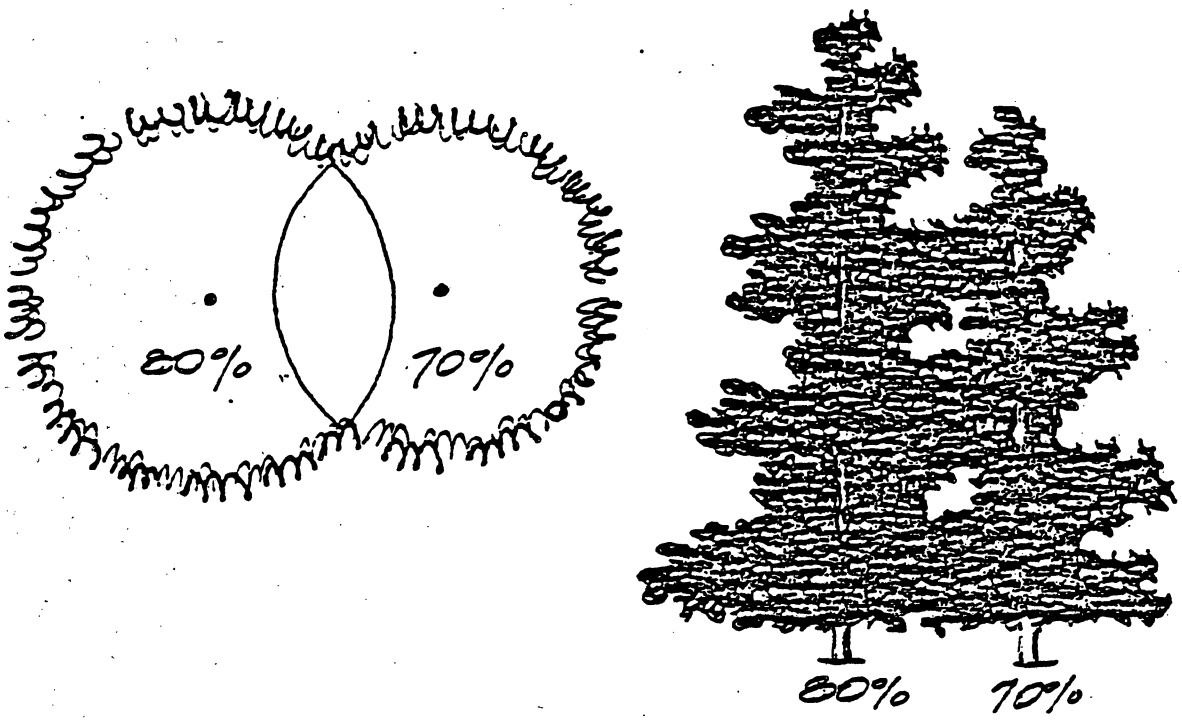


Figure C-3.

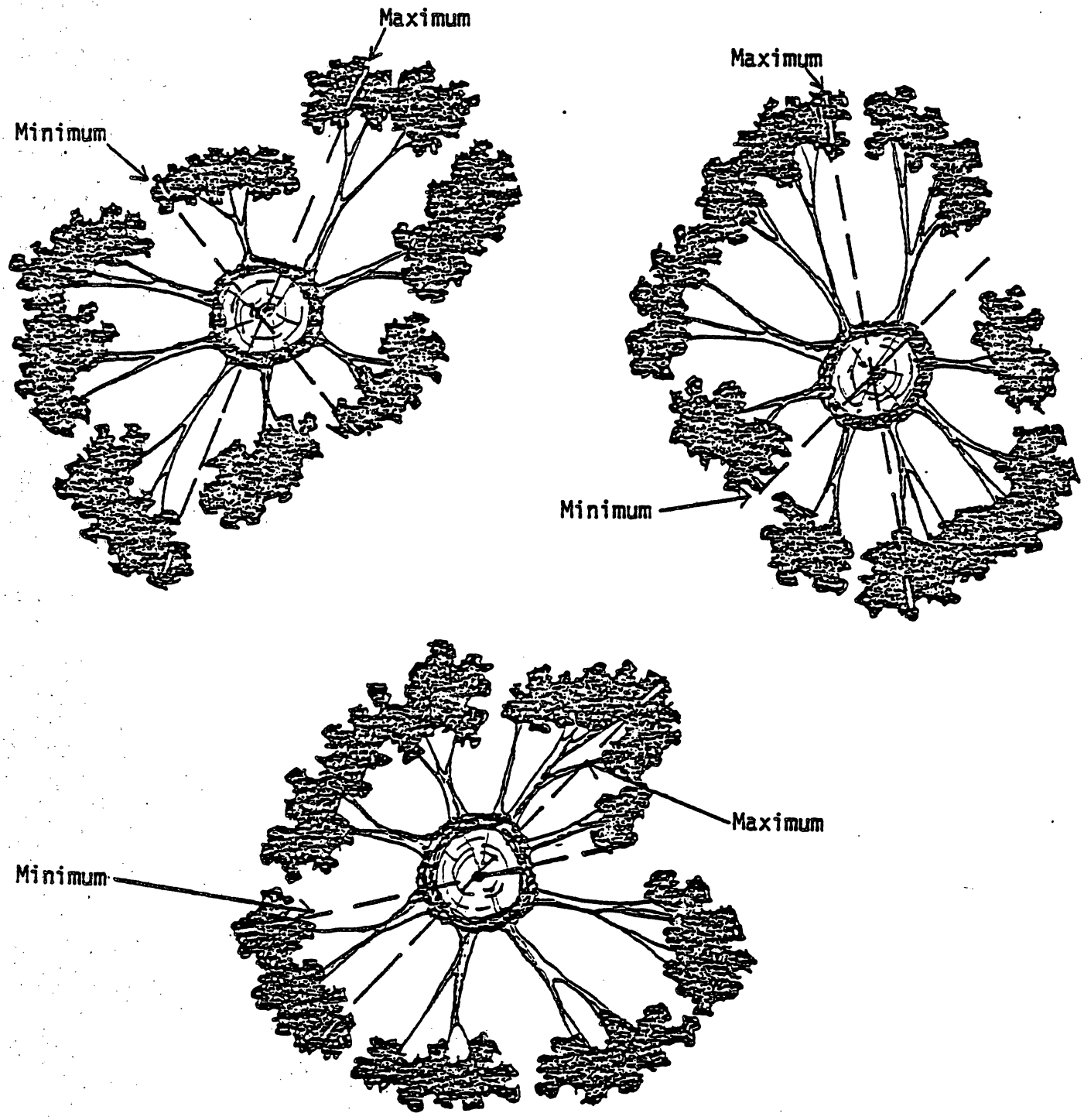


Figure N-4. Maximum and minimum crown width measurements

Posts - Line 86.

Posts - Line: For juniper, oak, and other suitable[9] other tree species, the number of Line Posts per tally tree will be determined. The following criteria will be used as minimum size for Line Posts:

(a) 5.0 - 7.0-inches diameter at butt end,
(b) 7.0 feet minimum length,
(c) 2.5 inches minimum diameter at small end.

Record number of Line Posts in Column 70.

Posts - Corner 87.

Posts Corner: For juniper, oak, and other suitable[9] other tree species, the number of Corner Posts per tally tree will be determined. The following criteria will be used as minimum size for Corner Posts:

(a) 7.0 - 9.0-inches diameter at butt end,
(b) 8.0 feet minimum length,
(c) 2.5 inches minimum diameter at small end.

Record number of Corner Posts in Column 71.

NOTE: Butt segments larger than 9.0 inches will be ignored. However, if a post occurs above a large butt segment, and meets specifications, it will be counted. Any large branches which meet the specifications will also be counted.

Christmas Tree Grade 88.

Christmas Tree Grade: The following 1-digit code will be recorded for Pinyon sp. only.[10] Leave blank if tree size or species is not suitable for Christmas trees.

Code	Grade	
1	Premium --	Excellent conical form with no gaps in branches; straight
2	Standard --	Good conical form with small gaps in branches; trees are bent or slightly malformed
3	Utility --	Conical in form with branches missing; trees are bent or malformed
4	Cull --	Poor conical form; large gaps in branches; may have more than one stem, any tree over 12-foot height.

See Figure N5. Record in Column 72.

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[9]Juniper and oak species only, unless otherwise instructed.

[10]Other species, such as juniper may be given Christmas tree grade, at the option of the field supervisor. Grade additional species only if specifically instructed.

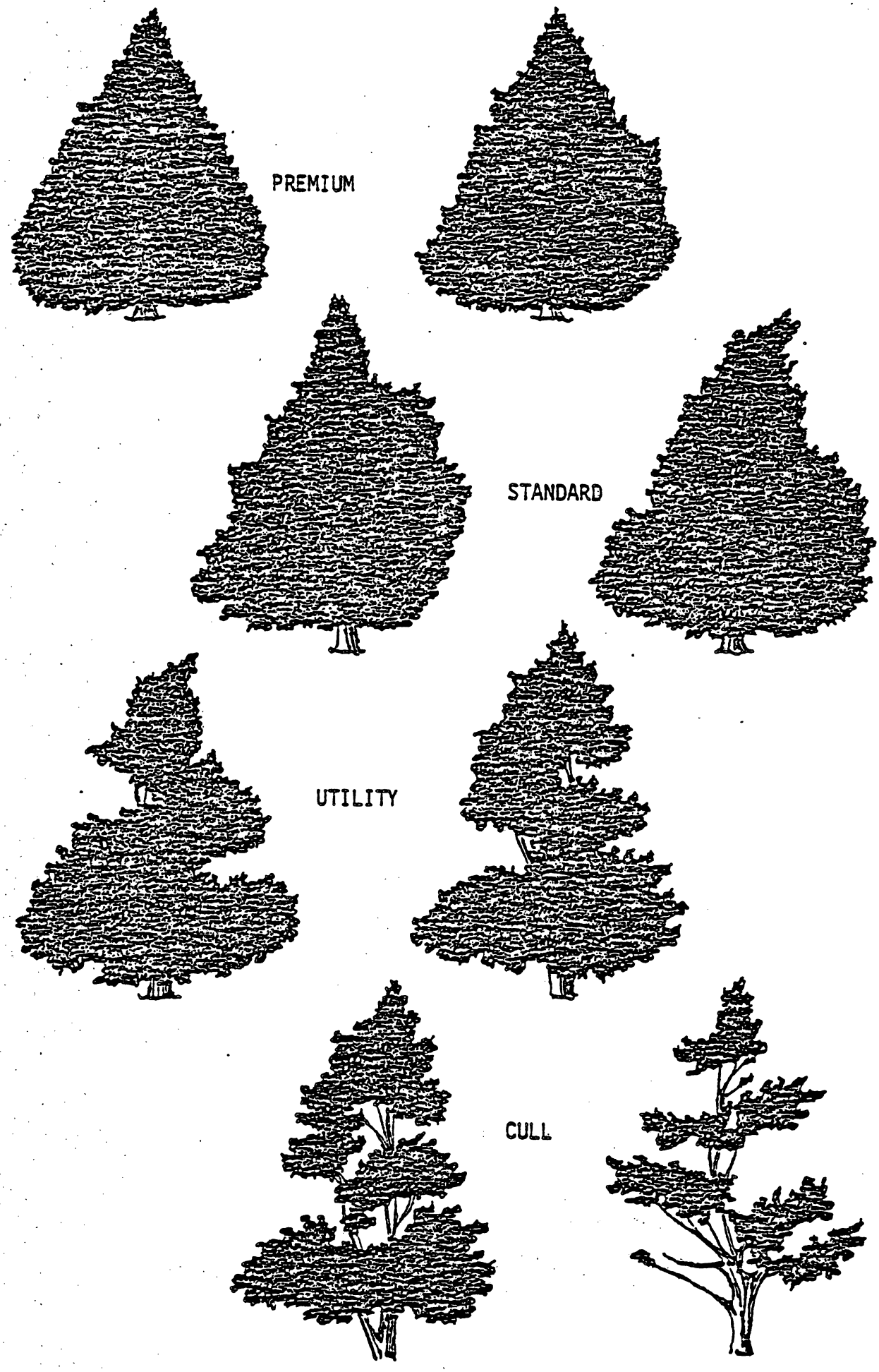

Figure N-5. Christmas tree grades for pinyon sp.

Other Tree Species DRC/EDRC: Diameter at root collar (DRC) or equivalent diameter at root collar (EDRC) is recorded for all trees of other species. Unlike timber species, Other tree species may fork at any point and still be considered a single tree.

Diameter at Root Collar (DRC): Diameter is measured at the root collar or the natural ground line, whichever is higher on other tree species. Remove duff, etc., but not mineral soil. Remove windblown sand to the natural ground line. All woodland trees will be nailed at the point of measurement. When several stems are clumped together, one nail on the largest stem is sufficient.

NOTE: Only other tree species are measured at root collar. Trees of other species with stems clumped together and appearing to be from the same origin and with a unified crown are treated as one tree. These trees commonly have multiple stems.

For other tree species with multiple stems at the DRC point, trees with one or more stems 3.0 inches and larger DRC, and two or more stems with 1/ qualifying segments, an equivalent diameter will be recorded.

When a single DRC measurement does not reasonably represent the sum of several main stems originating near DRC, the qualifying stems should be measured individually and the equivalent diameter should be computed.

Some other tree species, particularly juniper and oak, are extremely variable in form. Try to measure the DRC of stems so the measurement is consistent with the stem(s) above, when trees are extremely deformed at the base.

a. Trees of Other Species with Single Stems:

(1) [illegible] Variable Timberland PLOT -- Trees 3.0 inches and larger will be tallied. Record DRC to the last whole tenth inch in the DRC/EDRC column.

(2) 1/100-acre Woodland Plot or 1/300acre Timberland Plot. Saplings (1.0-2.9 inches DRC) -- For trees 1.0-2.9 inches largest stem DRC tallied, record the DRC to the last whole inch in the DRC/EDRC column.

(3) 1/100-acre Woodland Plot or 1/300-acre Timberland Plot, Seedlings (<1.0 inches DRC) -- On the 1/100-acre woodland plot, count the seedlings and record in the DRC column, and record Tree History code 07.

On the 1/300-acre Timberland plots, count other tree species in the same manner, but only if four trees of commercial species are not available.

b. Trees of Other Species with Multiple Stems:

(1) [illegible] or Variable Timberland Plot -- For trees tallied with at least one stem 3.0 inches DRC or larger and at least two stems with qualifying segments, record the equivalent diameter (from the sum of the BA for all stems of the tree with qualifying segments--ignore smaller--stems and the use of Table H-1) in item 89, DRC/EDRC.

1/ Qualifying segment - stem that is at least 1 ft. long and at least 1 1/2 inches in diameter at the small end.

6.8

(2) 1/100-acre Woodland Plot or 1/300-acre Timberland Plot, Saplings (1.0-2.9 inches DRC) -- For trees tallied with the largest stem 1.0-2.9 inches DRC, record the largest diameter -- ignore smaller stems. Equivalent diameters are calculated only for trees having at least one stem 3.0 inches or larger.

(3) 1/100-acre Woodland Plot or 1/300-acre Timberland Plot, Seedlings (<1.0 inches DRC) -- On the 1/100 acre Woodland Plot, count the seedlings and record the count in the DRC column, and record the Tree History code 07. If it is necessary to tally other tree species seedlings on the 1/300-acre Timberland Plot, then record the diameter as 001 for each tree tallied. NOTE: Count seedlings on the entire 1/10-acre plot for pinyon and/or juniper types.

(4) Use of Table H-1 for Equivalent Diameter Determination -- To determine the Equivalent Diameter for trees with multiple stems at DRC:

(a) Measure the appropriate stems individually to the last whole tenth inch at base, and use the following formula:

Equivalent Diameter = square root of sum of squared stem diameters

$$EDRC = \sqrt{\sum_{i}^{n} (DRC_i)^2}$$

A qualifying segment is any stem or branch section at least 1.0 feet long and 2.0 inches midpoint diameter, with a minimum small end diameter of 1.5 inches.

(b) If a calculator is not available, use Table H-1 to determine the basal area for each stem measured.
(c) Sum the basal areas
(d) From Table H-1, find the nearest basal area value to the summed BA's, then read the diameter value corresponding to the summed BA's. This value, rounded to the last whole tenth inch, is entered in the other Species Equivalent Diameter column, item 89. To calculate values beyond the limits of this table, use the formula.

NOTE: Whenever DRC/EDRC is impossible or extremely difficult to measure with a diameter tape, because of thorns or extreme limbiness on some species, the stem(s) may be measured to the last whole inch with the measurement poles. In this case always record the midpoint of the 1-inch class, or use it in EDRC computations. For example, a stem measuring anywhere between 6 and 7 inches would be recorded as 6.5 inches (065). Record EDRC at the midpoint of the 1-inch class also.

Table H-1.--Square-Foot Values for Certain Diameters
(To be used in determining Diameter at Root Collar
for other species that have multiple stems)

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1	.0055	.0066	.0079	.0092	.0107	.0123	.0140	.0158	.0177	.019
2	.0218	.0241	.0264	.0289	.0314	.0341	.0369	.0398	.0428	.045
3	.0491	.0524	.0559	.0594	.0631	.0668	.0707	.0747	.0788	.083
4	.0873	.0917	.0962	.1008	.1056	.1104	.1154	.1205	.1257	.131
5	.1364	.1419	.1475	.1532	.1590	.1650	.1710	.1772	.1835	.189
6	.1963	.2029	.2097	.2165	.2234	.2304	.2376	.2448	.2522	.259
7	.2673	.2749	.2827	.2907	.2987	.3068	.3150	.3234	.3318	.340
8	.3491	.3578	.3667	.3757	.3848	.3941	.4034	.4128	.4224	.432
9	.4418	.4517	.4616	.4717	.4819	.4922	.5027	.5132	.5238	.534
10	.5454	.5564	.5675	.5786	.5899	.6013	.6128	.6244	.6362	.648
11	.6600	.6720	.6842	.6964	.7088	.7213	.7339	.7466	.7594	.772
12	.7854	.7985	.8118	.8252	.8386	.8522	.8659	.8797	.8936	.907
13	.9218	.9360	.9503	.9648	.9793	.9940	1.0088	1.0237	1.0387	1.053
14	1.0690	1.0843	1.0998	1.1153	1.1310	1.1467	1.1626	1.1786	1.1947	1.210
15	1.2272	1.2436	1.2601	1.2768	1.2935	1.3104	1.3273	1.3444	1.3616	1.378
16	1.3963	1.4138	1.4314	1.4491	1.4669	1.4849	1.5029	1.5211	1.5394	1.557
17	1.5763	1.5948	1.6136	1.6324	1.6513	1.6703	1.6895	1.7087	1.7281	1.747
18	1.7671	1.7868	1.8066	1.8265	1.8466	1.8667	1.8869	1.9073	1.9277	1.948
19	1.9689	1.9897	2.0106	2.0316	2.0527	2.0739	2.0953	2.1167	2.1382	2.159
20	2.1817	2.2035	2.2255	2.2476	2.2698	2.2921	2.3145	2.3371	2.3597	2.382
21	2.4053	2.4282	2.4513	2.4745	2.4978	2.5212	2.5447	2.5683	2.5920	2.615
22	2.6398	2.6639	2.6880	2.7123	2.7367	2.7612	2.7858	2.8105	2.8353	2.860
23	2.8852	2.9104	2.9356	2.9610	2.9865	3.0121	3.0377	3.0635	3.0895	3.115
24	3.1416	3.1678	3.1942	3.2206	3.2472	3.2739	3.3006	3.3275	3.3545	3.381
25	3.4088	3.4362	3.4636	3.4911	3.5188	3.5466	3.5744	3.6024	3.6305	3.658

Example: On the 1/100-acre plot, a juniper is tallied with four stems from forks below ground level. The Diameter at Root Collar (DRC) for these four stems is determined in the following manner:

a. Measure individual DRC for four stems and use table to get basal area:

Stem No. 1 -	2.6"	.0369 basal area
Stem No. 2 -	4.3	.1008 basal area
Stem No. 3 -	6.1"	.2029 basal area
Stem No. 4 -	7.9"	.3404 basal area

b. Sum the basal area: .0369 + .1008 + .2029 + .3404 = .6810

c. Go back into table and obtain the deameter which corresponds to a basal area of .6810. This value is closest to .6842 which is the basal area for 11.2 inches. 111 is entered in the EDRC column for this tree.

REMARKS

The line immediately beneath a tree record can be used to record any comments about a tree. Anything out of the ordinary can and should be noted. Typical comments might note diameter measurement at a location other than DBH, a tree which appears desirable but is too rotten to age, or a tree of extraordinarily good or poor growth.