

APPENDICIES

Appendix E: Existing Vegetation Composition Types

Appendix G: Potential Vegetation Codes

Appendix H: List of Species

Appendix J: Fixed Radius Plot

Appendix K: Variable Radius Plot

Appendix L: Measuring Diameter

Appendix M: Point of Measurement for DBH and DRC

Appendix N: Radial Growth and Height Growth

Appendix O: Measuring Age

Appendix P: Measuring Height

Appendix Q: Measuring Crowns

Appendix R: Damage Categories, Agents, Severity Ratings, and Tree Parts

Appendix S: Down Woody Material

Appendix E: Existing Vegetation Composition Types

SAF - Forest cover types of the Society of American Foresters

SRM - Rangeland cover types of Society of Range Management

Code	Description
SAF000	Non Forest Types
SAF206	Engelmann spruce - subalpine fir
SAF208	Whitebark pine
SAF210	Interior Douglas-fir
SAF212	Western larch
SAF213	Grand fir
SAF217	Aspen - Western forests - Middle elevation - Interior
SAF218	Lodgepole pine
SAF219	Limber pine
SAF237	Interior ponderosa pine
SRM104	Antelope bitterbrush-bluebunch wheatgrass
SRM109	Ponderosa pine-shrubland
SRM110	Ponderosa Pine-grassland
SRM209	Montane shrubland
SRM217	Wetlands
SRM302	Bluebunch wheatgrass-Sandberg bluegrass
SRM304	Idaho fescue-bluebunch wheatgrass
SRM305	Idaho fescue-Richardson needlegrass
SRM306	Idaho fescue-slender wheatgrass
SRM307	Idaho fescue-threadleaf sedge
SRM308	Idaho fescue-tufted hairgrass
SRM313	Tufted hairgrass- sedge
SRM314	Big sagebrush-bluebunch wheatgrass
SRM315	Big sagebrush-Idaho fescue
SRM401	Basin big sagebrush
SRM402	Mountain big sagebrush
SRM408	Other sagebrush types
SRM409	Tall forb
SRM410	Alpine rangeland
SRM411	Aspen woodland
SRM421	Chokecherry-serviceberry-rose
SRM422	Riparian

Appendix G: Potential Vegetation Codes

<u>CODE</u>	<u>SYMBOL</u>	<u>CONIFER HABITAT TYPE AND PHASE</u>
41000	PIFL/	PINUS FLEXILIS SERIES
41050	PIFL/FEID	Limber pine/Idaho fescue
41060	PIFL/CELE	Limber pine/Curlleaf mt. mahogany
41070	PIFL/JUCO	Limber pine/Common juniper
41080	PIFL/HEKI	Limber pine/Spike fescue
41100	PIPO/	PINUS PONDEROSA SERIES
41120	PIPO/STOC	Ponderosa pine/Western needlegrass
41130	PIPO/AGSP	Ponderosa pine/Bluebunch wheatgrass
41140	PIPO/FEID	Ponderosa pine/Idaho fescue
41160	PIPO/PUTR	Ponderosa pine/Bitterbrush
41161	PIPO/PUTR/AGSP	Bluebunch wheatgrass phase
41162	PIPO/PUTR/FEID	Idaho fescue phase
41170	PIPO/SYAL	Ponderosa pine/Common snowberry
41190	PIPO/PHMA	Ponderosa pine/Ninebark
41195	PIPO/SYOR	Ponderosa pine/Mountain snowberry
41200	PSME/	PSEUDOTSUGA MENZIESII SERIES
41210	PSME/AGSP	Douglas-fir/Bluebunch wheatgrass
41220	PSME/FEID	Douglas-fir/Idaho fescue
41221	PSME/FEID/FEID	Idaho fescue phase
41222	PSME/FEID/PIPO	Ponderosa pine phase
41250	PSME/VACA	Douglas-fir/Dwarf huckleberry
41260	PSME/PHMA	Douglas-fir/Ninebark
41262	PSME/PHMA/CARU	Pinegrass phase
41264	PSME/PHMA/PIPO	Ponderosa pine phase
41265	PSME/PHMA/PSME	Douglas-fir phase
41280	PSME/VAGL	Douglas-fir/Blue huckleberry
41290	PSME/LIBO	Douglas-fir/Twinflower
41310	PSME/SYAL	Douglas-fir/Common snowberry
41313	PSME/SYAL/SYAL	Common snowberry phase
41315	PSME/SYAL/PIPO	Ponderosa pine phase
41320	PSME/CARU	Douglas-fir/Pinegrass
41323	PSME/CARU/CARU	Pinegrass phase
41324	PSME/CARU/PIPO	Ponderosa pine phase
41325	PSME/CARU/FEID	Idaho fescue phase
41330	PSME/CAGE	Douglas-fir/Elk sedge
41331	PSME/CAGE/CAGE	Elk sedge phase
41332	PSME/CAGE/SYOR	Common snowberry phase
41334	PSME/CAGE/PIPO	Ponderosa pine phase
41340	PSME/SPBE	Douglas-fir/White spirea
41341	PSME/SPBE/SPBE	White spirea phase
41343	PSME/SPBE/CARU	Pinegrass phase
41344	PSME/SPBE/PIPO	Ponderosa pine phase
41360	PSME/JUCO	Douglas-fir/Common juniper
41370	PSME/ARCO	Douglas-fir/Heartleaf arnica

41371	PSME/ARCO/ARCO	Heartleaf arnica phase
41372	PSME/ARCO/ASMI	Weedy milkvetch phase
41375	PSME/OSCH	Douglas-fir/Mountain sweetroot
41380	PSME/SYOR	Douglas-fir/Mountain snowberry
41385	PSME/CELE	Douglas-fir/Curlleaf mt. mahogany
41390	PSME/ACGL	Douglas-fir/Mountain maple
41392	PSME/ACGL/SYOR	Mountain snowberry phase
41393	PSME/ACGL/ACGL	Mountain maple phase
41395	PSME/BERE	Douglas-fir/Oregon grape
41396	PSME/BERE/BERE	Oregon grape phase
41397	PSME/BERE/SYOR	Mountain snowberry phase
41398	PSME/BERE/CAGE	Elk sedge phase
41400	PIEN/	PICEA ENGELMANNII SERIES
41410	PIEN/EQAR	Engelmann spruce/Common horsetail
41440	PIEN/GATR	Engelmann spruce/Sweetscented bedstraw
41490	PIEN/CADI	Engelmann spruce/Soft leaved sedge
41493	PIEN/HYRE	Engelmann spruce/Hypnum
41500	ABGR/	ABIES GRANDIS SERIES
41505	ABGR/SPBE	Grand fir/White spirea
41510	ABGR/XETE	Grand fir/Beargrass
41511	ABGR/COOC	Grand fir/Goldthread
41515	ABGR/VAGL	Grand fir/Blue huckleberry
41520	ABGR/CLUN	Grand fir/Queencup beadlily
41525	ABGR/ACGL	Grand fir/Mountain maple
41526	ABGR/ACGL/ACGL	Mountain maple phase
41527	ABGR/ACGL/PHMA	Ninebark phase
41580	ABGR/VACA	Grand fir/Dwarf huckleberry
41585	ABGR/CARU	Grand fir/Pinegrass
41590	ABGR/LIBO	Grand fir/Twinflower
41591	ABGR/LIBO/LIBO	Twinflower phase
41592	ABGR/LIBO/XETE	Beargrass phase
41593	ABGR/LIBO/VAGL	Blue huckleberry phase
41600	ABLA/	ABIES LASIOCARPA SERIES
41605	ABLA/CABI	Subalpine fir/Marsh marigold
41620	ABLA/CLUN	Subalpine fir/Queencup beadlily
41621	ABLA/CLUN/CLUN	Queencup beadlily phase
41625	ABLA/CLUN/MEFE	Menziesia phase
41635	ABLA/STAM	Subalpine fir/Twisted stalk
41636	ABLA/STAM/STAM	Twisted stalk phase
41637	ABLA/STAM/LICA	Canby's ligusticum phase
41638	ABLA/COOC	Subalpine fir/Goldthread
41640	ABLA/VACA	Subalpine fir/Dwarf huckleberry
41645	ABLA/ACGL	Subalpine fir/Mountain maple
41650	ABLA/CACA	Subalpine fir/Bluejoint reedgrass
41651	ABLA/CACA/CACA	Bluejoint reedgrass phase
41652	ABLA/CACA/LICA	Canby's ligusticum phase
41654	ABLA/CACA/VACA	Dwarf huckleberry phase
41655	ABLA/CACA/LEGL	Labrador tea phase

41660	ABLA/LIBO	Subalpine fir/Twinflower
41661	ABLA/LIBO/LIBO	Twinflower phase
41662	ABLA/LIBO/XETE	Beargrass phase
41663	ABLA/LIBO/VASC	Grouse whortleberry phas
41670	ABLA/MEFE	Subalpine fir/Menziesia
41671	ABLA/MEFE/Mefe	Menziesia phase
41672	ABLA/MEFE/LUHI	Smooth woodrush phase
41690	ABLA/XETE	Subalpine fir/Beargrass
41691	ABLA/XETE/Vagl	Blue huckleberry phase
41692	ABLA/XETE/VASC	Grouse whortleberry phase
41694	ABLA/XETE/LUHI	Smooth woodrush phase
41705	ABLA/SPBE	Subalpine fir/White spirea
41720	ABLA/VAGL	Subalpine fir/Blue huckleberry
41721	ABLA/VAGL/Vasc	Grouse whortleberry phase
41723	ABLA/VAGL/Vagl	Blue huckleberry phase
41730	ABLA/VASC	Subalpine fir/Grouse whortleberry
41731	ABLA/VASC/Caru	Pinegrass phase
41732	ABLA/VASC/Vasc	Grouse whortleberry phase
41734	ABLA/VASC/PIAL	Whitebark pine phase
41740	ABLA/ALSI	Subalpine fir/Sitka alder
41745	ABLA/JUCO	Subalpine fir/Common juniper
41750	ABLA/CARU	Subalpine fir/Pinegrass
41780	ABLA/ARCO	Subalpine fir/Heartleaf arnica
41790	ABLA/CAGE	Subalpine fir/Elk sedge
41791	ABLA/CAGE/CAGE	Elk sedge phase
41793	ABLA/CAGE/ARTR	Big sagebrush phase
41810	ABLA/RIMO	Subalpine fir/Mountain gooseberry
41830	ABLA/LUHI	Subalpine fir/Smooth woodrush
41831	ABLA/LUHI/VASC	Grouse whortleberry phase
41833	ABLA/LUHI/LUHI	Smooth woodrush phase
41850	PIAL-ABLA	Whitebark pine - Subalpine fir
41870	PIAL/	PINUS ALBICAULIS SERIES
41870	PIAL hts	Whitebark pine types
41900	PICO/	PINUS CONTORTA SERIES
41905	PICO/FEID	Lodgepole pine/Idaho fescue
41920	PICO/VACA	Lodgepole pine/Dwarf huckleberry
41940	PICO/VASC	Lodgepole pine/Grouse whortleberry
41955	PICO/CAGE	Lodgepole pine/Elk sedge

Appendix H: List of Species

(TES = Threatened, endangered, sensitive; IND = indicator species for habitat type; CT = species listed in constancy table for central idaho)

Symbol	Common Name	Status
Tree		
ABGR	Grand fir	IND
ABLA	Subalpine fir	IND
LAOC	Western larch	CT
PIAL	Whitebark pine	IND
PICO	Lodgepole pine	IND
PIEN	Engelmann spruce	IND
PIFL2	Limber pine	IND
PIPO	Ponderosa pine	IND
POPUL	Cottonwood	
POTR5	Quaking aspen	IND
PSME	Douglas-fir	IND
TABR2	Pacific yew	
Shrub		
ACGL	Rocky Mountain maple	IND
ALSI3	Sitka alder	IND
AMAL2	Saskatoon serviceberry	CT
ARTRV	Mountain big sagebrush	IND
ARUV	Kinnikinnick, bearberry	IND
CELE3	curl-leaf mountain mahogany	IND
CESA	redstem ceanothus	
CEVE	Snowbrush ceanothus	CT
CHUM	Pipissewa (princes pine)	CT
CHNA	rubber rabbitbrush	
CHVI8	yellow rabbitbrush	
COSES	redosier dogwood	
GAHU	alpine spicywintergreen	CT
HODI	oceanspray	IND
JUCO6	common juniper	IND
LEGL	western Labrador tea	IND
LIBO3	twinflower	IND
LOCA6	sweetberry honeysuckle	CT
LOUT2	Utah honeysuckle	CT
MARE11	Oregon grape	IND
MEFE	Rusty menziesia	IND
PAMY	Oregon boxleaf	CT
PHMA5	mallow ninebark	IND
PREM	bitter cherry	CT
PRVI	chokecherry	IND
PUTR2	antelope bitterbrush	
RIBES	Currant and gooseberry	
RICE	wax currant	IND
RILA	prickly currant	CT
RIVI3	sticky current	CT
ROGY	Dwarf rose	CT
RONUH	Bristly Nootka rose	CT
ROWO	Wood's rose	CT
RUBA	Barton's raspberry	TES
RUPA	thimbleberry	CT
SACE3	blue elderberry	
SALIX	Willow	CT
SARAM4	Black elderberry	
SASC	Scouler's willow	

List of Species (cont.)

SETR	Arrowleaf ragwort (groundsel)	IND
SHCA	Russet buffaloberry	CT
SOSC2	mountain ash	CT
SPBE2	white spiraea	IND
SPPY	pyramid spiraea	IND
SYAL	Common Snowberry	IND
SYOR2	mountain snowberry	IND
VACA13	dwarf bilberry (dwarf huckleberry)	IND
VAGL	blue huckleberry	IND
VAME*	Thinleaf huckleberry	IND
VASC	Grouse whortleberry	IND
Subshrub		
ASVEN	White clouds milkvetch	TES
CLCO2	rock clematis	IND
DOID	Idaho dwarf primrose	TES
PECO10	Compact penstemon	TES

* For habitat typing in Central Idaho, VAME is considered the ecological equivalent to VAGL

Symbol	Common Name	Status
Forb		
ACMI2	Common Yarrow	CT
ACCO4	Columbian monkshood	CT
ACRU2	red baneberry	IND
ADBI	American trailplant	IND
AGLA9	Mill Creek agoseris	TES
ALMA6	Swamp onion	TES
ALSI*	Simil onion	* not local, see ALSI3
ALTOP	Sevendevils onion	TES
ALVI2	Sugarstick	TES
AMAL	Prostrate pigweed	
ANCO	flat-top pussytoes	CT
ANRA	Raceme pussytoes	CT
ARAC2	prickly sandwort	CT
ARCO*	sagebrush rockcress	*not local, see ARCO9
ARCO9	heartleaf arnica	IND
ARLA8	broadleaf arnica	CT
ASAM4	Custer milkvetch	TES
ASAN7	Goose Creek milkvetch	TES
ASAQ2	Lemhi milkvetch	TES
ASMI9	timber milkvetch	IND
ASPA16	Payson's milkvetch	TES
BASA3	arrowleaf balsamroot	CT
CABI2	twinflower marsh marigold	IND
CACH19	Christ's Indian paintbrush	TES
CACO36	Coville's Indian paintbrush	CT
CAMI12	giant red Indian paintbrush	CT
CHANA2	fireweed	CT
CHDO	Douglas' dustymaiden	CT
CLUN2	brides bonnet (queencup beadlily)	IND
CODEC	Alpine collomia	TES
COOC	Idaho goldthread	IND
CRAC2	tapertip hawksbeard	CT
CYFR2	brittle bladderfern	CT
DITR2	roughfruit fairybells	IND
DOJE	Seirra shoting star	CT
DRTR3	Stanley Creek draba	TES
EQAR	field horsetail	IND
ERCAW2	Welsh's buckwheat	TES

List of Species (cont.)

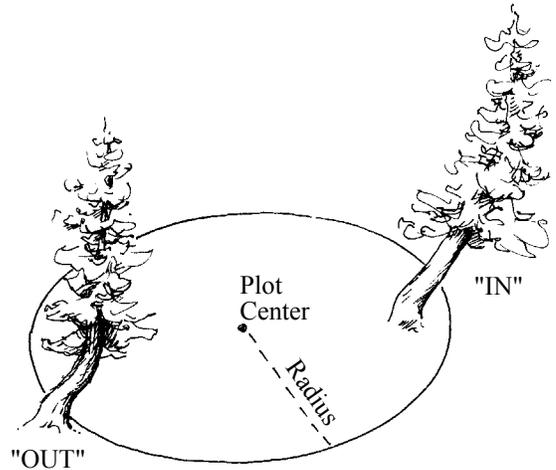
Symbol	Common Name	Status
Forb (cont)		
ERDE11	Great Basin Desert buckwheat	TES
EUCO36	showy aster	CT
EUEN	Engelmann's aster	CT
FRVE	Woodland strawberry	CT
FRVI	Virginia strawberry	CT
HAPEP	Perplexed halimolobos	TES
GATR3	fragrant bedstraw	IND
GEUM	old man's whiskers	CT
GEVI2	sticky purple geranium	CT
GOOB2	western rattlesnake plantain	CT
HAL2	white hawkweed	CT
HIGR	slender hawkweed	CT
LANE3	sierra pea	IND
LEPA8	Payson's bladderpod	TES
LEPA17	Idaho pepperweed	TES
LIBO*	Bolander's lily	*not local, see LIBO3
LICA2	Canby's licorice-root	IND
LITE2	Idaho licorice root	CT
LODI	fernleaf biscuitroot	CT
LUAR3	silvery lupine	CT
LUPO2	bigleaf lupine	CT
MARAR	feathery false lily of the valley	CT
MAST4	starry false lily of the valley	CT
MICL3	North Idaho monkeyflower	TES
MIMA2	MacFarlane's four o'clock	TES
MIPE	five stamen miterwort	CT
MIST3	small flower miterwort	CT
MOMA3	large leaf sandwort	CT
ORSE	sidebells wintergreen	CT
OSHC	mountain sweetroot	IND
OSDE	bluntsed sweetroot	CT
OXBES	Salmon River locoweed	TES
PAPSP2	false groundsel	CT
PAST13	Rocky mountain groundsel	CT
PEBR	Bracted lousewort	CT
PEID	Idaho beardtongue	TES
PELE8	Lemhi penstemon	TES
PEWI	Wilcox's penstemon	IND
PHDIL2	Idaho twinpod	TES
PHHA	silverleaf phacelia	CT
PODI2	varileaf cinquefoil	CT
POFL3	high mountain cinquefoil	CT
POGR9	slender cinquefoil	CT
PRAL6	Bluedome primrose	TES
PTAQ	Western brackenfern	CT
PYAS	liverleaf wintergreen	CT
SABRT	Tobias' saxifrage	TES
SAOD2	brook saxifrage	CT
SETR	arrowleaf groundsel	IND
SOMU	Rocky mountain goldenrod	CT
SPDI6	Diluvim ladies'-tresses	TES
STAM*	American chickweed	*not local, see STAM2
STAM2	twisted stalk	IND
THIDA	Idaho pennycress	TES
THOC	Western meadow-rue	CT
THRE2	wavyleaf thelypody	TES
TRCA	Carolina bugbane (false bugbane)	IND

List of Species (cont.)

Symbol	Common Name	Status
Forb (cont)		
TROV2	Pacific trillium	CT
VASC2	Scouler's valerian	CT
VEVI	green false hellebore	CT
VIAD	hookedspur violet	CT
VINU2	Nuttall's violet	CT
VIOR	darkwoods violet	CT
VIPU4	goosefoot violet	CT
XETE	Common beargrass	IND
Graminoid		
AGSP(PSSPS)	(bluebunch) wheatgrass	IND
BRVU	Columbian brome	CT
CACA4	bluejoint	IND
CADI6	softleave sedge	IND
CAGE*	White Mountain sedge	* not local, see CAGE2
CAGE2	elk sedge (Geyer's sedge)	IND
CARO5	Ross' sedge	CT
CARU	Pinegrass	IND
CATW	Tweedy's reedgrass	TES
ELGL	blue wildrye	CT
FEID	Idaho fescue	IND
HEKI	spike fescue	CT
JUCO*	Roundfruit rush	*not local. see JUCO6
JUPA	Parry's rush	CT
KOMA	Prairie Junegrass	CT
LUHI4	smooth woodrush	IND
MEBU	oniongrass	IND
POABM	Marsh's bluegrass	TES
PONE2	wheeler bluegrass	CT
STOC2	western needlegrass	CT
Lichen		
XAID	Idaho xanthoparmelia lichen	TES

Appendix J: Fixed Radius Plot

A fixed radius plot is used to sample trees that are less than the specified breakpoint diameter. These sample trees are determined to be "in or out" at ground line. If the measured distance from plot center to the central axis of the tree at ground line is equal to or less than the fixed plot radius the tree is tallied as a sample tree. If this distance is greater than the fixed plot radius, the tree is not tallied.



On level ground, the fixed plot radius is determined by holding the measuring tape or pole in a horizontal position from plot center to the central axis of the sample tree. On slopes greater than 9 percent, if a measuring tape or pole can not be held horizontally from plot center to the central axis of the sample tree, the fixed plot radius is corrected for the slope percent.

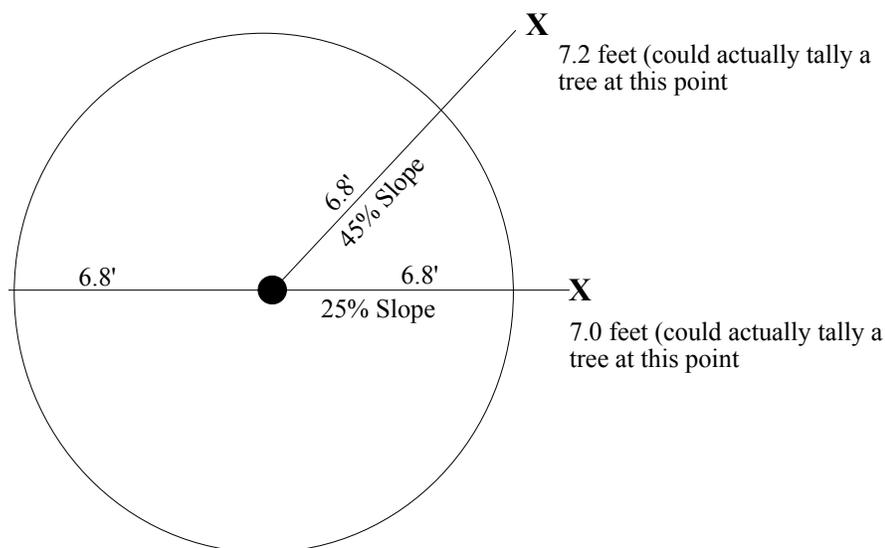
Determine the slope limiting distance to borderline trees by using the "Slope Correction Table" (The slope being corrected is the slope from plot center to the tree, not the overall plot slope.). Measure the distance parallel to the ground line to the borderline tree. This method always results in an oval plot on the slope. Following is a list of fixed plot sizes and the specific radius for each:

<u>Plot Size</u>	<u>Plot Radius</u>	<u>Plot Size</u>	<u>Plot Radius</u>	<u>Plot Size</u>	<u>Plot Radius</u>
1/1000	3.7 feet	1/250	7.4 feet	1/5	52.7 feet
1/500	5.3 feet	1/150	9.6 feet	1/4	58.9 feet
1/400	5.9 feet	1/100	11.8 feet	1/3	67.6 feet
1/300	6.8 feet	1/50	16.7 feet	1/2	83.3 feet
1/250	7.4 feet	1/20	26.3 feet	1	117.1 feet
1/200	8.3 feet	1/10	37.2 feet		

To determine the slope limiting distance, multiply the plot radius for the appropriate plot size by the appropriate slope correction factor.

Example 1: 1/300 acre fixed plot with a borderline tree on a 45 percent slope. A 1/300 acre plot equals a 6.8 foot radius and the slope correction factor for a 45 percent slope is 1.10. $6.8 \times 1.10 = 7.48$; thus, a tree on a 1/300 acre fixed plot at a 45 percent slope can be 7.5 feet from plot center.

Example 2: The same plot has another borderline tree on a 25 percent slope. The slope correction factor for a 25 percent slope is 1.03. $6.8 \times 1.03 = 7.0$; thus, a tree on a 1/300 acre fixed plot at a 25 percent slope can be 7.0 feet from plot center.



Slope Correction Table

Percent of Slope	Degree of Slope	Correction Factor	Percent of Slope	Degree of Slope	Correction Factor	Percent of Slope	Degree of Slope	Correction Factor
0 to 9	0 to 6	1.00	78 to 79	38	1.27	117	49	1.54
10 to 17	7 to 10	1.01	80	39	1.28	118-119	50	1.55
18 to 22	11 to 12	1.02	81 to 82	39	1.29	120	50	1.56
23 to 26	13 to 14	1.03	83	40	1.30	121	50	1.57
27 to 30	15 to 17	1.04	84 to 85	40	1.31	122	51	1.58
31 to 33	18	1.05	86	41	1.32	123-124	51	1.59
34 to 36	19 to 20	1.06	87 to 88	41	1.33	125	51	1.60
37 to 39	21	1.07	89	42	1.34	126	52	1.61
40 to 42	22	1.08	90 to 91	42	1.35	127-128	52	1.62
43 to 44	23	1.09	92	43	1.36	129	52	1.63
45 to 47	24	1.10	93 to 94	43	1.37	130	52	1.64
48 to 49	25 to 26	1.11	95	44	1.38	131	53	1.65
50 to 51	27	1.12	96 to 97	44	1.39	132-133	53	1.66
52 to 53	28	1.13	98	44	1.40	134	53	1.67
54 to 55	29	1.14	99 to 100	45	1.41	135	53	1.68
56 to 57	29	1.15	101	45	1.42	136	54	1.69
58 to 59	30	1.16	102	46	1.43	137-138	54	1.70
60 to 61	31	1.17	103-104	46	1.44	139	54	1.71
62 to 63	32	1.18	105	46	1.45	140	54	1.72
64 to 65	33	1.19	106-107	47	1.46	141	55	1.73
66 to 67	34	1.20	108	47	1.47	142-143	55	1.74
68 to 69	34	1.21	109	47	1.48	144	55	1.75
70	35	1.22	110-111	48	1.49	145	55	1.76
71 to 72	36	1.23	112	48	1.50	146	56	1.77
73 to 74	37	1.24	113	48	1.51	147	56	1.78
75	37	1.25	114-115	49	1.52	148-149	56	1.79
76 to 77	38	1.26	116	49	1.53	150	56	1.80

Appendix K: Variable Radius Plot

Introduction

For information on the theory and mathematics of variable plot cruising; and formulas for determining the plot radius factor for any given BAF, the reader is referred to Log Scaling and Timber Cruising, 1973, J. R. Dilworth. OSU Book Stores, Inc., Corvallis, Oregon.

The experienced field person using a wedge prism, angle gauge, or relaskop can quickly tell in most cases which trees are "in" or "out" on the variable plot. However, there are certain trees that are questionable (borderline) for tally because they are located at the outer limits of the variable plot radius. This narrative deals with the procedures needed to ascertain if these borderline trees should be tallied: the mechanics of using plot radius tables in the field, the associated measurements, and corrections of variable plot radii for slope.

Measurement of Borderline Trees to Determine "In or Out" Status

In variable plot sampling, the plot radius varies according to the DBH or DRC of each tree (Figure K-1). Therefore, to determine whether a tree is to be sampled requires measurement of its DBH or DRC and its distance from plot center. Tables K-1 through K-5 display limiting distances (the maximum horizontal distance from plot center to the face of the tree at breast height for a tree to be considered "in") for various tree diameters and commonly used basal area factors (BAF).

Once the DBH or DRC of the borderline tree is taken, the limiting distance is found by entering the table appropriate for the specified BAF. This limiting distance is then compared to the horizontal distance between plot center and the nearest **face of the tree** at breast height. If the measured horizontal distance from plot center is *less than or equal to* the limiting distance from the table, the tree in question is "in" and is tallied as a sample tree. However, if the measured horizontal distance from plot center is greater than the limiting distance, then the tree in question is "out" and is not tallied.

1. Measure the diameter to the tenth of an inch (example 20.9").
2. Measure the percent slope from the face of the tree at DBH or DRC to plot center (example 42%).
3. If the slope is less than ten percent, look up limiting distance in Tables K-1 through K-5 (example: limiting distance =27.9) or use the BAF correction factors listed below.

BAF	10	15	20	25	30	35	40	50	60
Plot Radius Factor**	2.708	2.203	1.902	1.697	1.546	1.428	1.333	1.188	1.081

There are other BAFs that are available on the Relaskop which may be used if the contract or supervisor allows. The examiner should be aware that the line widths for these BAFs are approximate, and that limiting distances should be measured to verify tree tally.

BAF	14	18	23	28	34	46	54	62	71
Plot Radius Factor**	2.282	2.008	1.772	1.602	1.450	1.240	1.142	1.063	0.990

(**This is a **corrected** PRF, corrected for determining the limiting distance to the **face of the tree**. A standard PRF is used to determine limiting distance to the center of a tree, and is computed by $PRF = 8.696/SQR(BAF)$. A corrected PRF subtracts $1/24$ (.041666) from the standard PRF value)

Example for a 40 BAF: Plot Radius Factor * (DBH or DRC) = Limiting Distance
 $1.333 * 20.9 \text{ inches} = 27.9$

4. If the slope is greater than ten percent, determine the slope correction factor. The slope correction factor can be calculated by using the formula below or by referring to table L-1 (PAGE L-5) (example slope correction factor for 42% = 1.08)

Slope Correction Factor = $SQR(1 + (\text{slope percent}/100)^2)$

$$1.08 = SQR(1 + (42/100)^2)$$

5. Multiply the slope correction factor by the limiting distance identified in (3) above to obtain the slope corrected distance.

Example: $1.08 * 27.9 = 30.1$

6. Measure the distance from the stake to the face of the tree at DBH or DRC (face nearest plot center). Both the slope measurement and distance measurement must be taken at the same point on the stake, either to the top of the stake or where the stake intersects the forest floor. Since the measure distance (29.0 feet) is less than the limiting distance (30.1 feet), the tree is "in".

Correction of Measured Distance for Slope Using Combined Slope and Plot Radius Factors

Table K-5 displays a list of Combined Slope and Plot Radius Factor Measurements (CSPR). This table includes correction factors to be used in determining limiting distances (the maximum horizontal distance from plot center to the face of the standing tree at breast height for a tree to be considered "in") for slopes 0 to 150 and commonly used basal area factors (BAF). This value is multiplied by the diameter to obtain the limiting distance. If the measured slope distance is less than or equal to the limiting distance, the tree is tallied as "in" on the sample points.

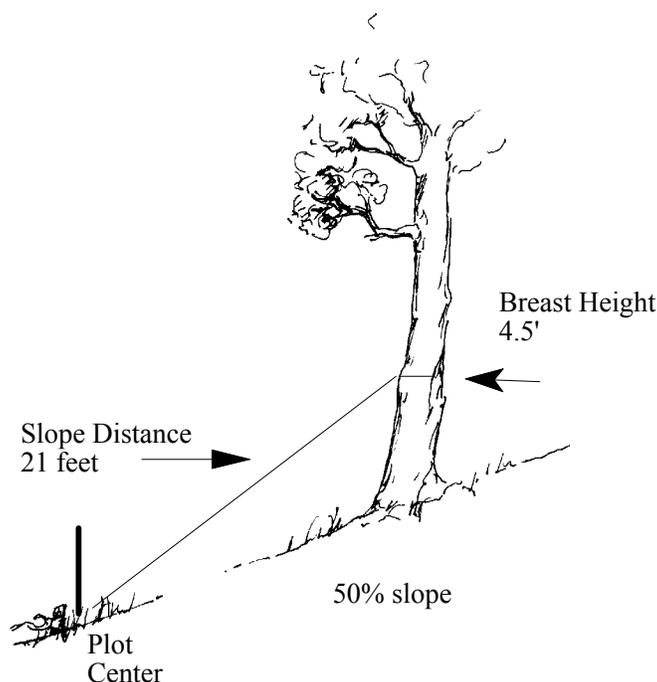


Figure K-2. Determining limiting distance on a slope.

Example: BAF 40, tree DBH is 15.0", slope distance is measured at 21.0 feet. The slope measurement is 50%. Referring to Table L-5 the Combined Factor is 1.490. The limiting distance is calculated as:

$$\text{DBH} * \text{CSPR} = \text{Limiting Distance or } 15.0 * 1.490 = 22.35$$

Since 21.0 is less than or equal to the limiting distance of 22.35 feet, the tree is "in" and is tallied as a sample tree.

Measuring "In" or "out" Down Trees

Down trees are "in or out" of the variable plot radius based on where the DBH or DRC now lies, not on where the tree once stood. The distance measurement is taken from plot center to the nearest face of the tree at breast height.

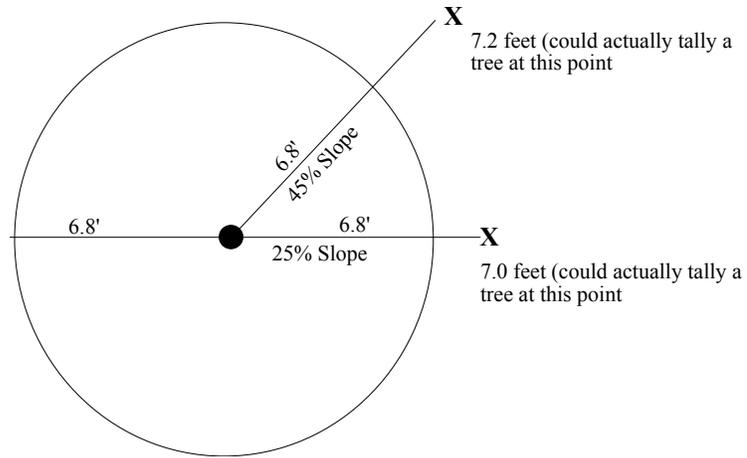


Figure K-3. Downed trees. Locate breast height at 4.5 feet above the root collar, as tree lies on the ground. If this point lies on or inside the plot boundary, count the tree in.

Table K-1: BAF 10 Plot Radii in Feet and Tenths of Feet from Plot Center to Face of Tree at DBH for 0% Slope

Inches	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	13.5	13.8	14.1	14.4	14.6	14.9	15.2	15.4	15.7	16.0
6	16.2	16.5	16.8	17.1	17.3	17.6	17.9	18.1	18.4	18.7
7	19.0	19.2	19.5	19.8	20.0	20.3	20.6	20.9	21.1	21.4
8	21.7	21.9	22.2	22.5	22.7	23.0	23.3	23.6	23.8	24.1
9	24.4	24.6	24.9	25.2	25.5	25.7	26.0	26.3	26.5	26.8
10	27.1	27.4	27.6	27.9	28.2	28.4	28.7	29.0	29.2	29.5
11	29.8	30.1	30.3	30.6	30.9	31.1	31.4	31.7	32.0	32.2
12	32.5	32.8	33.0	33.3	33.6	33.9	34.1	34.4	34.7	34.9
13	35.2	35.5	35.7	36.0	36.3	36.6	36.8	37.1	37.4	37.6
14	37.9	38.2	38.5	38.7	39.0	39.3	39.5	39.8	40.1	40.3
15	40.6	40.9	41.2	41.4	41.7	42.0	42.2	42.5	42.8	43.1
16	43.3	43.6	43.9	44.1	44.4	44.7	45.0	45.2	45.5	45.8
17	46.0	46.3	46.6	46.8	47.1	47.4	47.7	47.9	48.2	48.5
18	48.7	49.0	49.3	49.6	49.8	50.1	50.4	50.6	50.9	51.2
19	51.5	51.7	52.0	52.3	52.5	52.8	53.1	53.3	53.6	53.9
20	54.2	54.4	54.7	55.0	55.2	55.5	55.8	56.1	56.3	56.6
21	56.9	57.1	57.4	57.7	58.0	58.2	58.5	58.8	59.0	59.3
22	59.6	59.8	60.1	60.4	60.7	60.9	61.2	61.5	61.7	62.0
23	62.3	62.6	62.8	63.1	63.4	63.6	63.9	64.2	64.5	64.7
24	65.0	65.3	65.5	65.8	66.1	66.3	66.6	66.9	67.2	67.4
25	67.7	68.0	68.2	68.5	68.8	69.1	69.3	69.6	69.9	70.1
26	70.4	70.7	70.9	71.2	71.5	71.8	72.0	72.3	72.6	72.8
27	73.1	73.4	73.7	73.9	74.2	74.5	74.7	75.0	75.3	75.6
28	75.8	76.1	76.4	76.6	76.9	77.2	77.4	77.7	78.0	78.3
29	78.5	78.8	79.1	79.3	79.6	79.9	80.2	80.4	80.7	81.0
30	81.2	81.5	81.8	82.1	82.3	82.6	82.9	83.1	83.4	83.7
31	83.9	84.2	84.5	84.8	85.0	85.3	85.6	85.8	86.1	86.4
32	86.7	86.9	87.2	87.5	87.7	88.0	88.3	88.6	88.8	89.1
33	89.4	89.6	89.9	90.2	90.4	90.7	91.0	91.3	91.5	91.8
34	92.1	92.3	92.6	92.9	93.2	93.4	93.7	94.0	94.2	94.5
35	94.8	95.1	95.3	95.6	95.9	96.1	96.4	96.7	96.9	97.2
36	97.5	97.8	98.0	98.3	98.6	98.8	99.1	99.4	99.7	99.9
37	100.2	100.5	100.7	101.0	101.3	101.6	101.8	102.1	102.4	102.6
38	102.9	103.2	103.4	103.7	104.0	104.3	104.5	104.8	105.1	105.3
39	105.6	105.9	106.2	106.4	106.7	107.0	107.2	107.5	107.8	108.0
40	108.3	108.6	108.9	109.1	109.4	109.7	109.9	110.2	110.5	110.8
41	111.0	111.3	111.6	111.8	112.1	112.4	112.7	112.9	113.2	113.5
42	113.7	114.0	114.3	114.5	114.8	115.1	115.4	115.6	115.9	116.2
43	116.4	116.7	117.0	117.3	117.5	117.8	118.1	118.3	118.6	118.9
44	119.2	119.4	119.7	120.0	120.2	120.5	120.8	121.0	121.3	121.6
45	121.9	122.1	122.4	122.7	122.9	123.2	123.5	123.8	124.0	124.3
46	124.6	124.8	125.1	125.4	125.7	125.9	126.2	126.5	126.7	127.0
47	127.3	127.5	127.8	128.1	128.4	128.6	128.9	129.2	129.4	129.7
48	130.0	130.3	130.5	130.8	131.1	131.3	131.6	131.9	132.2	132.4
49	132.7	133.0	133.2	133.5	133.8	134.0	134.3	134.6	134.9	135.1
50	135.4	135.7	135.9	136.2	136.5	136.8	137.0	137.3	137.6	137.8

Prepared by multiplying the BAF 10 Plot Radius Factor 2.708 * DBH.

For example, if DBH = 14.3 inches, then 14.3 * 2.708 = 38.7

Table K-2: BAF 20 Plot Radii in Feet and Tenths of Feet from Plot Center to Face of Tree at DBH for 0% Slope

inches	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	9.5	9.7	9.9	10.1	10.3	10.5	10.7	10.8	11.0	11.2
6	11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.7	12.9	13.1
7	13.3	13.5	13.7	13.9	14.1	14.3	14.5	14.6	14.8	15.0
8	15.2	15.4	15.6	15.8	16.0	16.2	16.4	16.5	16.7	16.9
9	17.1	17.3	17.5	17.7	17.9	18.1	18.3	18.4	18.6	18.8
10	19.0	19.2	19.4	19.6	19.8	20.0	20.2	20.4	20.5	20.7
11	20.9	21.1	21.3	21.5	21.7	21.9	22.1	22.3	22.4	22.6
12	22.8	23.0	23.2	23.4	23.6	23.8	24.0	24.2	24.3	24.5
13	24.7	24.9	25.1	25.3	25.5	25.7	25.9	26.1	26.2	26.4
14	26.6	26.8	27.0	27.2	27.4	27.6	27.8	28.0	28.1	28.3
15	28.5	28.7	28.9	29.1	29.3	29.5	29.7	29.9	30.1	30.2
16	30.4	30.6	30.8	31.0	31.2	31.4	31.6	31.8	32.0	32.1
17	32.3	32.5	32.7	32.9	33.1	33.3	33.5	33.7	33.9	34.0
18	34.2	34.4	34.6	34.8	35.0	35.2	35.4	35.6	35.8	35.9
19	36.1	36.3	36.5	36.7	36.9	37.1	37.3	37.5	37.7	37.8
20	38.0	38.2	38.4	38.6	38.8	39.0	39.2	39.4	39.6	39.8
21	39.9	40.1	40.3	40.5	40.7	40.9	41.1	41.3	41.5	41.7
22	41.8	42.0	42.2	42.4	42.6	42.8	43.0	43.2	43.4	43.6
23	43.7	43.9	44.1	44.3	44.5	44.7	44.9	45.1	45.3	45.5
24	45.6	45.8	46.0	46.2	46.4	46.6	46.8	47.0	47.2	47.4
25	47.6	47.7	47.9	48.1	48.3	48.5	48.7	48.9	49.1	49.3
26	49.5	49.6	49.8	50.0	50.2	50.4	50.6	50.8	51.0	51.2
27	51.4	51.5	51.7	51.9	52.1	52.3	52.5	52.7	52.9	53.1
28	53.3	53.4	53.6	53.8	54.0	54.2	54.4	54.6	54.8	55.0
29	55.2	55.3	55.5	55.7	55.9	56.1	56.3	56.5	56.7	56.9
30	57.1	57.3	57.4	57.6	57.8	58.0	58.2	58.4	58.6	58.8
31	59.0	59.2	59.3	59.5	59.7	59.9	60.1	60.3	60.5	60.7
32	60.9	61.1	61.2	61.4	61.6	61.8	62.0	62.2	62.4	62.6
33	62.8	63.0	63.1	63.3	63.5	63.7	63.9	64.1	64.3	64.5
34	64.7	64.9	65.0	65.2	65.4	65.6	65.8	66.0	66.2	66.4
35	66.6	66.8	67.0	67.1	67.3	67.5	67.7	67.9	68.1	68.3
36	68.5	68.7	68.9	69.0	69.2	69.4	69.6	69.8	70.0	70.2
37	70.4	70.6	70.8	70.9	71.1	71.3	71.5	71.7	71.9	72.1
38	72.3	72.5	72.7	72.8	73.0	73.2	73.4	73.6	73.8	74.0
39	74.2	74.4	74.6	74.7	74.9	75.1	75.3	75.5	75.7	75.9
40	76.1	76.3	76.5	76.7	76.8	77.0	77.2	77.4	77.6	77.8
41	78.0	78.2	78.4	78.6	78.7	78.9	79.1	79.3	79.5	79.7
42	79.9	80.1	80.3	80.5	80.6	80.8	81.0	81.2	81.4	81.6
43	81.8	82.0	82.2	82.4	82.5	82.7	82.9	83.1	83.3	83.5
44	83.7	83.9	84.1	84.3	84.4	84.6	84.8	85.0	85.2	85.4
45	85.6	85.8	86.0	86.2	86.4	86.5	86.7	86.9	87.1	87.3
46	87.5	87.7	87.9	88.1	88.3	88.4	88.6	88.8	89.0	89.2
47	89.4	89.6	89.8	90.0	90.2	90.3	90.5	90.7	90.9	91.1
48	91.3	91.5	91.7	91.9	92.1	92.2	92.4	92.6	92.8	93.0
49	93.2	93.4	93.6	93.8	94.0	94.1	94.3	94.5	94.7	94.9
50	95.1	95.3	95.5	95.7	95.9	96.1	96.2	96.4	96.6	96.8

Prepared by multiplying the BAF 20 Plot Radius Factor 1.902 * DBH.
 For example, if DBH = 14.3 inches, then 14.3 * 1.902 = 27.2

Table K-3: BAF 30 Plot Radii in Feet and Tenths of Feet from Plot Center to Face of Tree at DBH for 0% Slope

inches	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	7.7	7.9	8.0	8.2	8.3	8.5	8.7	8.8	9.0	9.1
6	9.3	9.4	9.6	9.7	9.9	10.0	10.2	10.4	10.5	10.7
7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	12.1	12.2
8	12.4	12.5	12.7	12.8	13.0	13.1	13.3	13.5	13.6	13.8
9	13.9	14.1	14.2	14.4	14.5	14.7	14.8	15.0	15.2	15.3
10	15.5	15.6	15.8	15.9	16.1	16.2	16.4	16.5	16.7	16.9
11	17.0	17.2	17.3	17.5	17.6	17.8	17.9	18.1	18.2	18.4
12	18.6	18.7	18.9	19.0	19.2	19.3	19.5	19.6	19.8	19.9
13	20.1	20.3	20.4	20.6	20.7	20.9	21.0	21.2	21.3	21.5
14	21.6	21.8	22.0	22.1	22.3	22.4	22.6	22.7	22.9	23.0
15	23.2	23.3	23.5	23.7	23.8	24.0	24.1	24.3	24.4	24.6
16	24.7	24.9	25.0	25.2	25.4	25.5	25.7	25.8	26.0	26.1
17	26.3	26.4	26.6	26.7	26.9	27.1	27.2	27.4	27.5	27.7
18	27.8	28.0	28.1	28.3	28.4	28.6	28.8	28.9	29.1	29.2
19	29.4	29.5	29.7	29.8	30.0	30.1	30.3	30.5	30.6	30.8
20	30.9	31.1	31.2	31.4	31.5	31.7	31.8	32.0	32.2	32.3
21	32.5	32.6	32.8	32.9	33.1	33.2	33.4	33.5	33.7	33.9
22	34.0	34.2	34.3	34.5	34.6	34.8	34.9	35.1	35.2	35.4
23	35.6	35.7	35.9	36.0	36.2	36.3	36.5	36.6	36.8	36.9
24	37.1	37.3	37.4	37.6	37.7	37.9	38.0	38.2	38.3	38.5
25	38.7	38.8	39.0	39.1	39.3	39.4	39.6	39.7	39.9	40.0
26	40.2	40.4	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6
27	41.7	41.9	42.1	42.2	42.4	42.5	42.7	42.8	43.0	43.1
28	43.3	43.4	43.6	43.8	43.9	44.1	44.2	44.4	44.5	44.7
29	44.8	45.0	45.1	45.3	45.5	45.6	45.8	45.9	46.1	46.2
30	46.4	46.5	46.7	46.8	47.0	47.2	47.3	47.5	47.6	47.8
31	47.9	48.1	48.2	48.4	48.5	48.7	48.9	49.0	49.2	49.3
32	49.5	49.6	49.8	49.9	50.1	50.2	50.4	50.6	50.7	50.9
33	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.3	52.4
34	52.6	52.7	52.9	53.0	53.2	53.3	53.5	53.6	53.8	54.0
35	54.1	54.3	54.4	54.6	54.7	54.9	55.0	55.2	55.3	55.5
36	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	57.0
37	57.2	57.4	57.5	57.7	57.8	58.0	58.1	58.3	58.4	58.6
38	58.7	58.9	59.1	59.2	59.4	59.5	59.7	59.8	60.0	60.1
39	60.3	60.4	60.6	60.8	60.9	61.1	61.2	61.4	61.5	61.7
40	61.8	62.0	62.1	62.3	62.5	62.6	62.8	62.9	63.1	63.2
41	63.4	63.5	63.7	63.8	64.0	64.2	64.3	64.5	64.6	64.8
42	64.9	65.1	65.2	65.4	65.6	65.7	65.9	66.0	66.2	66.3
43	66.5	66.6	66.8	66.9	67.1	67.3	67.4	67.6	67.7	67.9
44	68.0	68.2	68.3	68.5	68.6	68.8	69.0	69.1	69.3	69.4
45	69.6	69.7	69.9	70.0	70.2	70.3	70.5	70.7	70.8	71.0
46	71.1	71.3	71.4	71.6	71.7	71.9	72.0	72.2	72.4	72.5
47	72.7	72.8	73.0	73.1	73.3	73.4	73.6	73.7	73.9	74.1
48	74.2	74.4	74.5	74.7	74.8	75.0	75.1	75.3	75.4	75.6
49	75.8	75.9	76.1	76.2	76.4	76.5	76.7	76.8	77.0	77.1
50	77.3	77.5	77.6	77.8	77.9	78.1	78.2	78.4	78.5	78.7

Prepared by multiplying the BAF 30 Plot Radius Factor 1.546 * DBH.
 For example, if DBH = 14.3 inches, then 14.3 * 1.546 = 22.1

Table K-4: BAF 40 Plot Radii in Feet and Tenths of Feet from Plot Center to Face of Tree at DBH for 0% Slope

Inches	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
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	48.2	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	52.2	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	56.2	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	60.2	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	64.2	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	66.6	67.0	67.2	67.3	67.4	67.6	67.7	67.8

Prepared by multiplying the BAF 40 Plot Radius Factor 1.333 * DBH.
 For Example if DBH = 14.3 inches, then 14.3 * 1.333 = 19.1 feet.

Table K-5: BAF 60 Plot Radii in Feet and Tenths of Feet from Plot Center to Face of Tree at DBH for 0% Slope

Inches	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	5.4	5.5	5.6	5.7	5.8	5.9	6.1	6.2	6.3	6.4
6	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.4	7.5
7	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5
8	8.6	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6
9	9.7	9.8	9.9	10.1	10.2	10.3	10.4	10.5	10.6	10.7
10	10.8	10.9	11.0	11.1	11.2	11.4	11.5	11.6	11.7	11.8
11	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.8	12.9
12	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
13	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	15.0
14	15.1	15.2	15.4	15.5	15.6	15.7	15.8	15.9	16.0	16.1
15	16.2	16.3	16.4	16.5	16.6	16.8	16.9	17.0	17.1	17.2
16	17.3	17.4	17.5	17.6	17.7	17.8	17.9	18.1	18.2	18.3
17	18.4	18.5	18.6	18.7	18.8	18.9	19.0	19.1	19.2	19.3
18	19.5	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4
19	20.5	20.6	20.8	20.9	21.0	21.1	21.2	21.3	21.4	21.5
20	21.6	21.7	21.8	21.9	22.1	22.2	22.3	22.4	22.5	22.6
21	22.7	22.8	22.9	23.0	23.1	23.2	23.3	23.5	23.6	23.7
22	23.8	23.9	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.8
23	24.9	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8
24	25.9	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9
25	27.0	27.1	27.2	27.3	27.5	27.6	27.7	27.8	27.9	28.0
26	28.1	28.2	28.3	28.4	28.5	28.6	28.8	28.9	29.0	29.1
27	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.1	30.2
28	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2
29	31.3	31.5	31.6	31.7	31.8	31.9	32.0	32.1	32.2	32.3
30	32.4	32.5	32.6	32.8	32.9	33.0	33.1	33.2	33.3	33.4
31	33.5	33.6	33.7	33.8	33.9	34.1	34.2	34.3	34.4	34.5
32	34.6	34.7	34.8	34.9	35.0	35.1	35.2	35.3	35.5	35.6
33	35.7	35.8	35.9	36.0	36.1	36.2	36.3	36.4	36.5	36.6
34	36.8	36.9	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7
35	37.8	37.9	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8
36	38.9	39.0	39.1	39.2	39.3	39.5	39.6	39.7	39.8	39.9
37	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.8	40.9	41.0
38	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	41.9	42.1
39	42.2	42.3	42.4	42.5	42.6	42.7	42.8	42.9	43.0	43.1
40	43.2	43.3	43.5	43.6	43.7	43.8	43.9	44.0	44.1	44.2
41	44.3	44.4	44.5	44.6	44.8	44.9	45.0	45.1	45.2	45.3
42	45.4	45.5	45.6	45.7	45.8	45.9	46.1	46.2	46.3	46.4
43	46.5	46.6	46.7	46.8	46.9	47.0	47.1	47.2	47.3	47.5
44	47.6	47.7	47.8	47.9	48.0	48.1	48.2	48.3	48.4	48.5
45	48.6	48.8	48.9	49.0	49.1	49.2	49.3	49.4	49.5	49.6
46	49.7	49.8	49.9	50.1	50.2	50.3	50.4	50.5	50.6	50.7
47	50.8	50.9	51.0	51.1	51.2	51.3	51.5	51.6	51.7	51.8
48	51.9	52.0	52.1	52.2	52.3	52.4	52.5	52.6	52.8	52.9
49	53.0	53.1	53.2	53.3	53.4	53.5	53.6	53.7	53.8	53.9
50	54.1	54.2	54.3	54.4	54.5	54.6	54.7	54.8	54.9	55.0

Prepared by multiplying the BAF 60 Plot Radius Factor 1.081 * DBH.

For Example, if DBH = 14.3 inches, then 14.3 * 1.081 = 15.5 feet

Table K-6: Limiting Distance to Face of Tree for Various Basal Area Factors

This table provides an expanded list of slope correction factors to the face of the tree for use with various basal area factors. To use the table, measure the slope and the distance from plot center to the face of the tree at DBH. To obtain the corrected limiting distance to a tree multiply the trees DBH by the "combined factor" shown under the appropriate BAF heading.

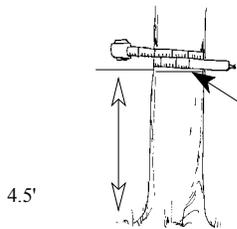
Slope %	Slope Correction Factor	----- "Combined Factor"-----					
		<u>5 BAF</u>	<u>10 BAF</u>	<u>15 BAF</u>	<u>20 BAF</u>	<u>30 BAF</u>	<u>40 BAF</u>
1	1.00000	3.847	2.708	2.203	1.902	1.546	1.333
2	1.00020	3.848	2.709	2.203	1.902	1.546	1.333
3	1.00045	3.849	2.709	2.204	1.903	1.547	1.334
4	1.00080	3.850	2.710	2.205	1.904	1.547	1.334
5	1.00125	3.852	2.711	2.206	1.904	1.548	1.335
6	1.00180	3.854	2.713	2.207	1.905	1.549	1.335
7	1.00245	3.856	2.715	2.208	1.907	1.550	1.336
8	1.00319	3.859	2.717	2.210	1.908	1.551	1.337
9	1.00404	3.863	2.719	2.212	1.910	1.552	1.338
10	1.00499	3.866	2.722	2.214	1.911	1.554	1.340
11	1.00603	3.870	2.724	2.216	1.912	1.555	1.341
12	1.00717	3.875	2.727	2.219	1.916	1.557	1.343
13	1.00841	3.879	2.731	2.222	1.918	1.559	1.344
14	1.00975	3.884	2.734	2.224	1.921	1.567	1.346
15	1.01119	3.890	2.738	2.228	1.923	1.563	1.348
16	1.01272	3.896	2.742	2.231	1.926	1.566	1.350
17	1.01435	3.902	2.747	2.235	1.921	1.568	1.352
18	1.01607	3.909	2.752	2.238	1.933	1.571	1.354
19	1.01789	3.916	2.756	2.245	1.936	1.574	1.357
20	1.01980	3.923	2.762	2.245	1.940	1.577	1.359
21	1.02181	3.931	2.767	2.251	1.943	1.580	1.362
22	1.02391	3.939	2.773	2.256	1.947	1.583	1.365
23	1.02611	3.947	2.779	2.261	1.952	1.586	1.368
24	1.02840	3.956	2.785	2.266	1.956	1.590	1.371
25	1.03078	3.965	2.791	2.271	1.967	1.594	1.374
26	1.03325	3.975	2.798	2.276	1.965	1.597	1.377
27	1.03581	3.985	2.805	2.282	1.970	1.601	1.381
28	1.03846	3.995	2.812	2.288	1.975	1.605	1.384
29	1.04120	4.005	2.820	2.294	1.980	1.610	1.388
30	1.04403	4.016	2.827	2.300	1.986	1.614	1.392
31	1.04695	4.028	2.835	2.306	1.991	1.619	1.396
32	1.04995	4.039	2.843	2.313	1.997	1.623	1.400
33	1.05304	4.051	2.852	2.320	2.003	1.628	1.404
34	1.05622	4.063	2.960	2.327	2.009	1.633	1.408
35	1.05948	4.076	2.869	2.334	2.015	1.638	1.412
36	1.06283	4.089	2.878	2.341	2.022	1.643	1.417
37	1.06626	4.102	2.887	2.349	2.028	1.648	4.421
38	1.06977	4.115	2.897	2.357	2.035	1.654	1.426
39	1.07336	4.129	2.907	2.365	2.042	1.659	1.431
40	1.07703	4.143	2.917	2.373	2.049	1.665	1.436
41	1.08079	4.158	2.927	2.381	2.056	1.671	1.441
42	1.08462	4.173	2.937	2.389	2.063	1.677	1.446
43	1.08853	4.188	2.948	2.398	2.070	1.683	1.451
44	1.09252	4.203	2.959	2.407	2.078	1.689	1.456
45	1.09659	4.219	2.970	2.416	2.086	1.695	1.462
46	1.10073	4.235	2.981	2.425	2.094	1.702	1.467
47	1.10494	4.251	2.992	2.434	2.102	1.708	1.473
48	1.10923	4.267	3.004	2.444	2.110	1.715	1.479
49	1.11360	4.284	3.016	2.453	2.118	1.723	1.484
50	1.11803	4.301	3.028	2.463	2.126	1.728	1.490

Slope %	Slope Correction		----- "Combined Factor"-----					
	Factor	5 BAF	10 BAF	15 BAF	20 BAF	30 BAF	40 BAF	BAF
51	1.12254	4.318	3.040	2.473	2.135	1.735	1.496	
52	1.12712	4.336	3.052	2.483	2.144	1.743	1.502	
53	1.13177	4.354	3.065	2.493	2.153	1.750	1.509	
54	1.13649	4.372	3.078	2.504	2.162	1.757	1.515	
55	1.14127	4.390	3.091	2.514	2.171	1.764	1.521	
56	1.14612	4.409	3.104	2.525	2.180	1.772	1.528	
57	1.15104	4.428	3.117	2.536	2.189	1.780	1.534	
58	1.15603	4.447	3.131	2.547	2.199	1.788	1.541	
59	1.16108	4.467	3.144	2.558	2.208	1.795	1.548	
60	1.16619	4.486	3.158	2.569	2.218	1.803	1.555	
61	1.17137	4.506	3.172	2.581	2.228	1.811	1.561	
62	1.17661	4.526	3.186	2.592	2.238	1.819	1.568	
63	1.18191	4.547	3.201	2.604	2.248	1.827	1.575	
64	1.18727	4.567	3.215	2.616	2.258	1.836	1.583	
65	1.19269	4.588	3.230	2.627	2.268	1.844	1.590	
66	1.19817	4.609	3.245	2.640	2.279	1.852	1.597	
67	1.20370	4.631	3.260	2.652	2.289	1.861	1.605	
68	1.20930	4.652	3.275	2.664	2.300	1.870	1.612	
69	1.21949	4.691	3.302	2.687	2.319	1.885	1.626	
70	1.22066	4.696	3.306	2.689	2.322	1.887	1.627	
71	1.22642	4.718	3.321	2.702	2.333	1.896	1.635	
72	1.23223	4.740	3.337	2.715	2.344	1.905	1.643	
73	1.23810	4.763	3.353	2.728	2.355	1.914	1.650	
74	1.24403	4.786	3.369	2.741	2.366	1.923	1.658	
75	1.25000	4.809	3.385	2.754	2.378	1.933	1.666	
76	1.25603	4.832	3.401	2.767	2.389	1.942	1.674	
77	1.26210	4.855	3.418	2.780	2.401	1.951	1.682	
78	1.26823	4.879	3.434	2.794	2.412	1.961	1.691	
79	1.27440	4.903	3.451	2.808	2.424	1.970	1.699	
80	1.28062	4.927	3.468	2.821	2.436	1.980	1.707	
81	1.28690	4.951	3.485	2.835	2.448	1.990	1.715	
82	1.29321	4.975	3.502	2.849	2.460	1.999	1.724	
83	1.29958	4.999	3.519	2.863	2.472	2.009	1.732	
84	1.30599	5.024	3.537	2.877	2.484	2.019	1.741	
85	1.31244	5.049	3.554	2.891	2.496	2.029	1.749	
86	1.31894	5.074	3.572	2.906	2.509	2.039	1.758	
87	1.32548	5.099	3.589	2.920	2.521	2.049	1.767	
88	1.33207	5.124	3.607	2.935	2.534	2.059	1.776	
89	1.33870	5.150	3.625	2.949	2.546	2.070	1.784	
90	1.34536	5.176	3.643	2.964	2.559	2.080	1.793	
91	1.35207	5.201	3.661	2.979	2.572	2.090	1.802	
92	1.35882	5.227	3.680	2.993	2.584	2.101	1.811	
93	1.36561	5.254	3.698	3.008	2.597	2.111	1.820	
94	1.37244	5.280	3.717	3.023	2.610	2.122	1.829	
95	1.37931	5.306	3.735	3.039	2.623	2.132	1.839	
96	1.38622	5.333	3.754	3.054	2.637	2.143	1.848	
97	1.39316	5.359	3.773	3.069	2.650	2.154	1.857	
98	1.40014	5.386	3.792	3.085	2.663	2.165	1.866	
99	1.40716	5.413	3.811	3.100	2.676	2.175	1.876	
100	1.41421	5.440	3.830	3.116	2.690	2.186	1.885	
102	1.42843	5.495	3.868	3.147	2.717	2.208	1.904	
103	1.43558	5.523	3.888	3.163	2.730	2.219	1.914	
104	1.44278	5.550	3.907	3.178	2.744	2.231	1.923	
105	1.45000	5.578	3.927	3.194	2.758	2.242	1.933	
106	1.45726	5.606	3.946	3.210	2.772	2.253	1.943	

% Slope	Slope	----- "Combined Factor"-----					
	Correction Factor	<u>5 BAF</u>	<u>10 BAF</u>	<u>15 BAF</u>	<u>20 BAF</u>	<u>30 BAF</u>	<u>40 BAF</u>
107	1.46455	5.634	3.966	3.226	2.786	2.264	1.952
108	1.47187	5.662	3.986	3.243	2.799	2.276	1.962
109	1.47922	5.691	4.006	3.259	2.813	2.287	1.972
110	1.48661	5.719	4.026	3.275	2.828	2.298	1.982
111	1.49402	5.747	4.046	3.291	2.842	2.310	1.992
112	1.50147	5.776	4.066	3.308	2.856	2.321	2.001
113	1.50894	5.805	4.086	3.324	2.870	2.333	2.011
114	1.51644	5.834	4.107	3.341	2.884	2.344	2.021
115	1.52498	5.863	4.127	3.357	2.899	2.356	2.031
116	1.53154	5.892	4.147	3.374	2.913	2.368	2.042
117	1.53912	5.921	4.168	3.391	2.927	2.379	2.052
118	1.54674	5.950	4.189	3.407	2.942	2.391	2.062
119	1.55438	5.980	4.209	3.424	2.956	2.403	2.072
120	1.56205	6.000	4.230	3.441	2.971	2.415	2.082
121	1.56975	6.039	4.251	3.458	2.985	2.427	2.092
122	1.57747	6.069	4.272	3.475	3.000	2.439	2.103
123	1.58521	6.098	4.293	3.492	3.015	2.451	2.113
124	1.59298	6.128	4.314	3.509	3.030	2.463	2.123
125	1.60078	6.158	4.335	3.527	3.045	2.475	2.134
126	1.60860	6.188	4.356	3.544	3.060	2.487	2.144
127	1.61645	6.218	4.377	3.561	3.074	2.499	2.155
128	1.62432	6.249	4.399	3.578	3.089	2.511	2.165
129	1.63221	6.279	4.420	3.595	3.104	2.523	2.176
130	1.64012	6.310	4.441	3.613	3.120	2.536	2.186
131	1.64806	6.340	4.463	3.631	3.135	2.546	2.197
132	1.65602	4.370	4.485	3.648	3.150	2.560	2.207
133	1.66400	6.401	4.506	3.666	3.165	2.573	2.218
134	1.67200	6.432	4.528	3.683	3.180	2.585	2.229
135	1.68003	6.463	4.550	3.701	3.195	2.597	2.239
136	1.68808	6.494	4.571	3.719	3.211	2.261	2.250
137	1.69614	6.525	4.593	3.737	3.226	2.622	2.261
138	1.70423	6.556	4.615	3.754	3.241	2.635	2.272
139	1.71234	6.587	4.637	3.772	3.257	2.647	2.283
140	1.72047	6.619	4.659	3.790	3.272	2.660	2.293
141	1.72861	6.650	4.681	3.808	3.288	2.672	2.304
142	1.73678	6.681	4.703	3.826	3.303	2.685	2.315
143	1.74497	6.713	4.725	3.844	3.319	2.698	2.326
144	1.75317	6.744	4.748	3.862	3.335	2.710	2.337
145	1.76139	6.776	4.770	3.880	3.350	2.723	2.348
146	1.76963	6.808	4.792	3.898	3.366	2.736	2.359
147	1.77789	6.840	4.815	3.917	3.382	2.749	2.370
148	1.78617	6.871	4.837	3.935	3.397	2.761	2.381

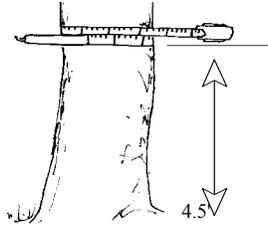
Appendix L: Measuring Diameter

Correct Method



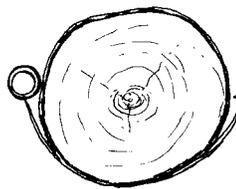
End of tape (with the "0" mark or hook) crossed under.

Optional Method if left handed

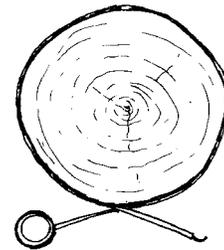


End of tape crossed under (Be careful -- reading will be made from upside down d-tape marks).

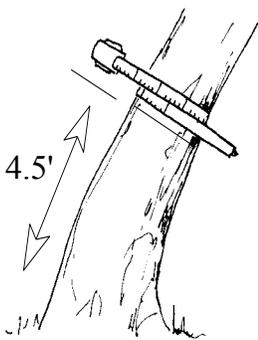
Press the tape firmly against the tree. Do not pull it out at a tangent to the tree at the point of measurement



Correct

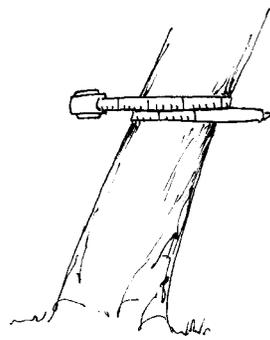


Incorrect

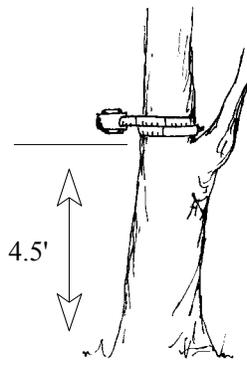


Correct

Tape must be at right angles to lean of tree.

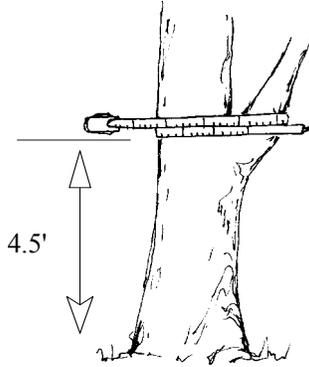


Incorrect



Correct

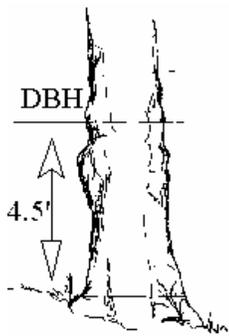
Do not place tape at abnormal location on bole of tree.



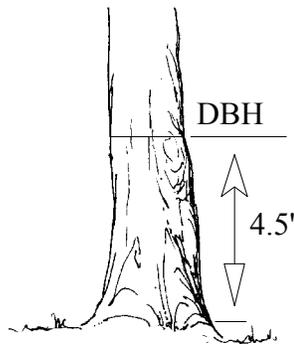
Incorrect

Appendix M: Point of Measurement for DBH and DRC

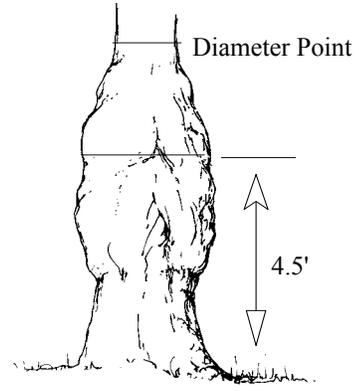
Point of Measurement for DBH



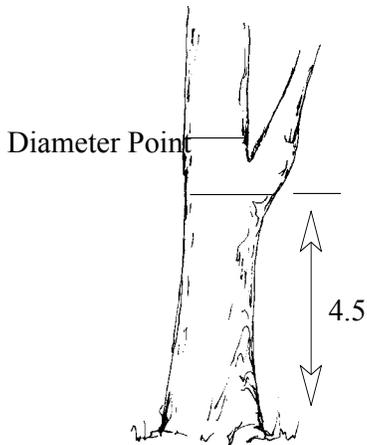
Tree on slope



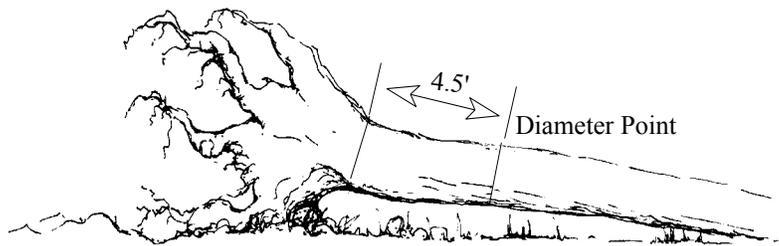
Tree on level ground



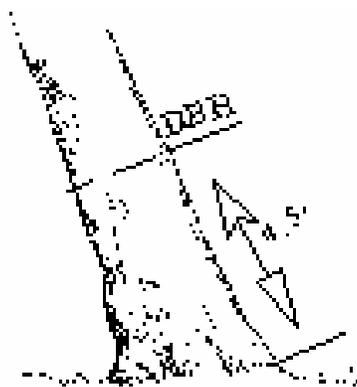
Tree deformed at DBH



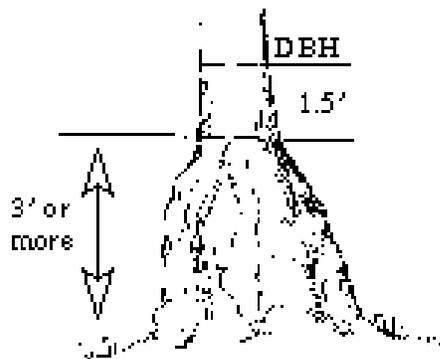
Tree with branch at 4.5 feet



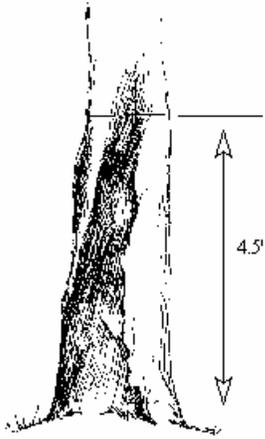
Windthrown tree



Leaning Tree



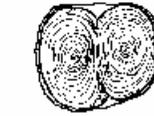
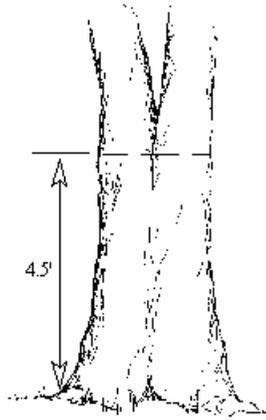
Bottleneck Tree



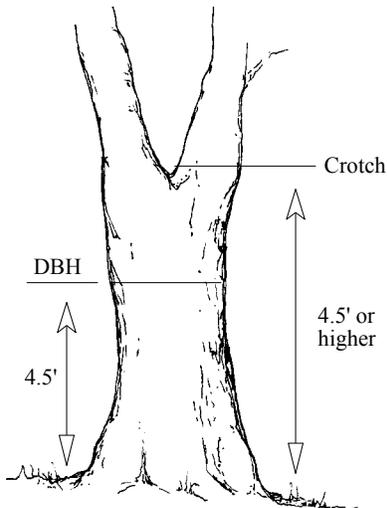
Tree with a catface



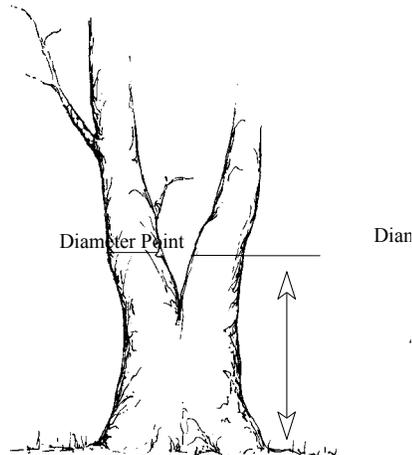
Adjust diameter tape to a normally rounded position to allow for the missing catface portion



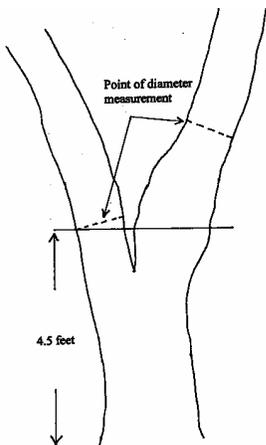
Measure diameter around entire tree.



Tree forked at 4.5 feet or higher. Record as one tree and consider only the main fork

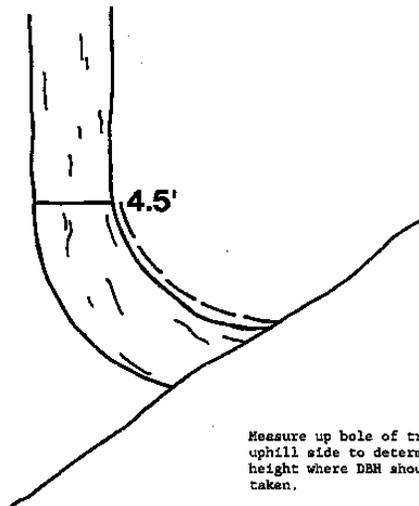


Tree forked below 4.5 feet. Record each fork that is "in" as a separate tree. Measure diameter at 4.5 feet.



Measuring abnormal diameters on forked trees.

Diameter on abnormal fork.



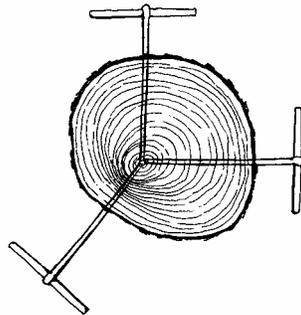
Measure up bole of tree on uphill side to determine height where DBH should be taken.

Diameter on pistol butt tree.

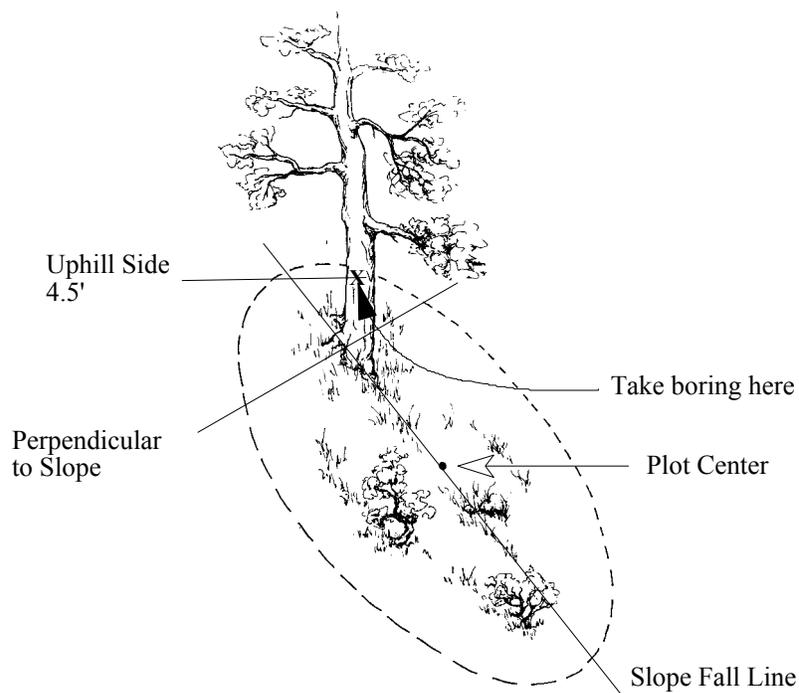
Appendix N: Radial Growth and Height Growth

Radial Growth

The rule "make an increment boring at breast height facing plot center" is intended to reduce bias in selecting the radial growth sampling cores, because there can be considerable growth difference between the various areas of the same breast height X-section. Slope, aspect, influence from neighboring trees, etc., can affect the width of the growth rings in any given core area. Theoretically, this is not so important for age, assuming the number of rings rather than ring width is what is important. However, in certain trees, especially the aged, some growth planes may become inactive, and this can cause a difference in age count between cores in the same X-section.

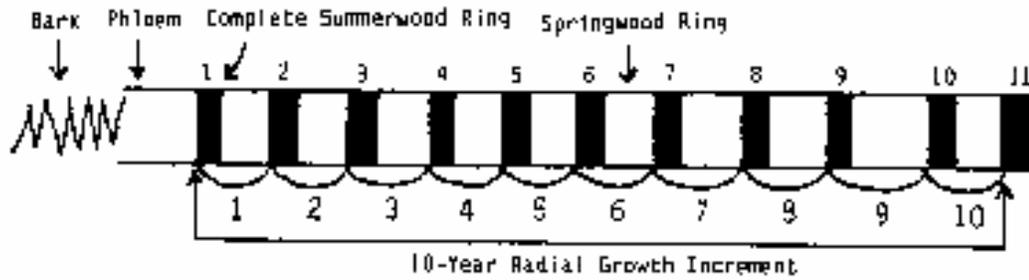


It may be difficult or impossible to obtain an increment boring at breast height on very steep slopes when the plot center is downhill from the tree. In this circumstance, obtain the core at breast height on a side of the tree perpendicular to the slope fall line.

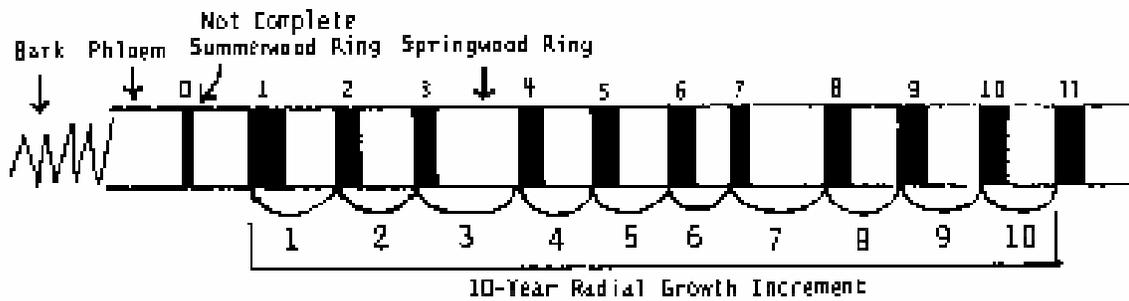


The radial increment growth period is usually 10 years. The measurement is taken from the outside edge of the most current, complete summerwood (denser, dark-colored) ring to the outside edge of the eleventh

summerwood ring, so that 10 complete annual increments are included. The last summerwood growth ring is considered complete by September 1 each year.



Example of a 10-year radial growth increment with the first summerwood ring being a complete growth ring.

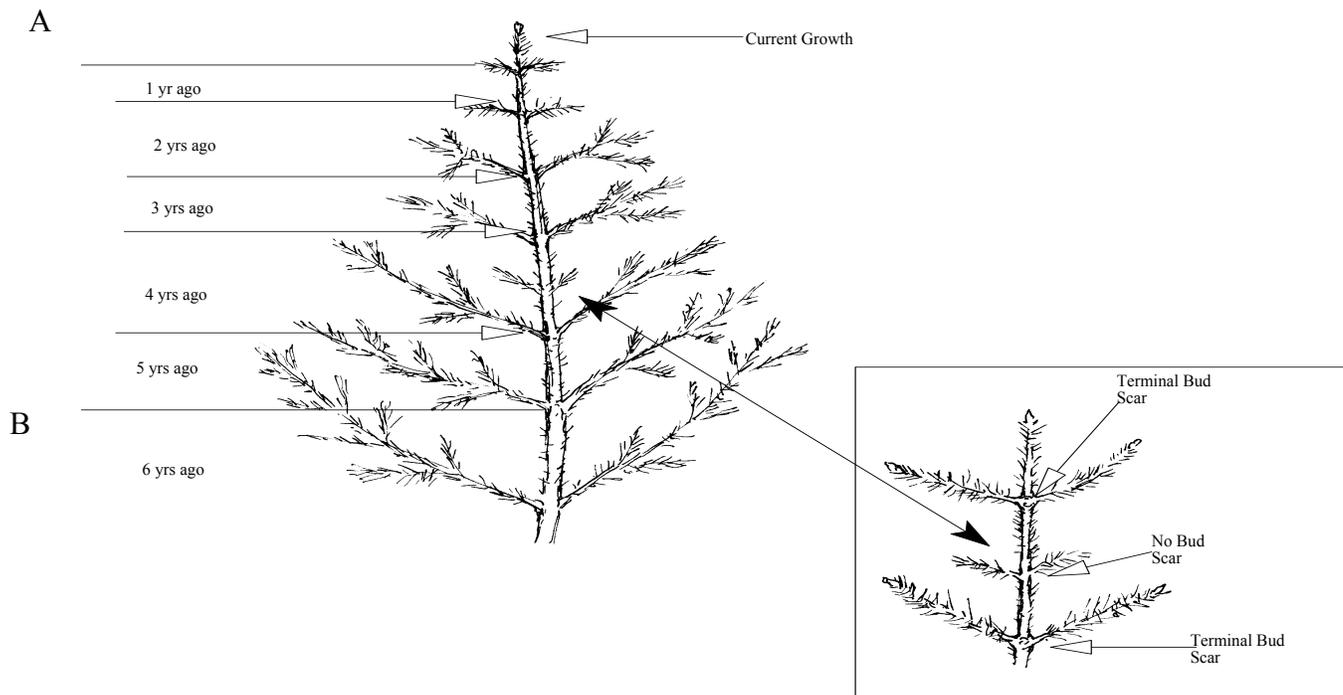


Example of a 10-year radial growth increment with the first summerwood ring not a complete growth ring.

Note that the rulers above are 20th scale rulers.

Height Growth

Five-year height growth is measured on trees less than 3.0 inches DBH. It is measured to the nearest 1/10 foot and recorded in feet and tenths of feet. The measurement is taken on the most recent five complete height segments. The current terminal leader is excluded unless budset has occurred. Height increments are recognized by the presence of budscale scars on the nodes (except western redcedar) or by dissecting the leader and counting annual rings with a hand lens.



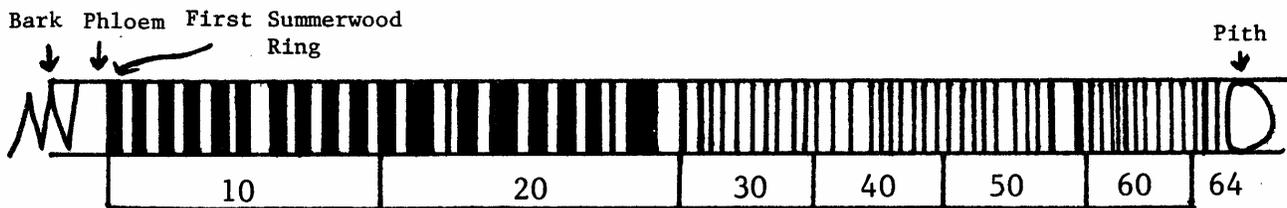
Between lines A and B is the 5-year Height Increment.

Appendix O: Measuring Age

Age Measurements for Trees > 3 Inches DBH

For sample trees 3.0 inches DBH and larger, age is determined from an increment boring made at breast height. The increment boring should be made at breast height facing plot center, to reduce bias. Usually the boring for measuring radial growth is also used for age measurement.

Age is counted from the most current summerwood ring to the pith of the tree. Record the age counted, do not add an estimate of the number of years to grow to breast height.



The ring count is 64 years. Record 64 for Tree Age.

When determining the age of a tree that has a radius greater than the length of the increment borer, use the following procedure. Bore into the tree as far as possible, extract core and count the rings. Measure the diameter of the tree and divide by two, then subtract the bark thickness. This gives the radius of the wood part of the tree. Measure the length of the core and subtract from the radius of the wood to determine how much longer the core would have to be to reach the pith. Count the number of rings in the innermost inch and extrapolate to the center.

Example: Determine the age of a 40-inch DBH tree having a bark thickness of 2.0 inches when a core 16 inches long has 200 rings and the innermost inch has five rings.

Age Measurements for Large Trees

- | | |
|--------------------------------------|----------------------------------|
| 1. DBH / 2 | $40.0 / 2 = 20.0$ |
| 2. Bark thickness | 2 inches |
| 3. Difference | $20.0 - 2 = 18$ (radius of wood) |
| 4. Core length | 16 inches |
| 5. Radius of wood - core length | $8 - 16 = 2$ |
| 6. Number of rings (inner-most inch) | 5 |
| 7. Product (5 x 2) | $5 \times 2 = 10$ |
| 8. Number of rings on core + 10 (7) | $200 + 10 = 210$ Tree age |

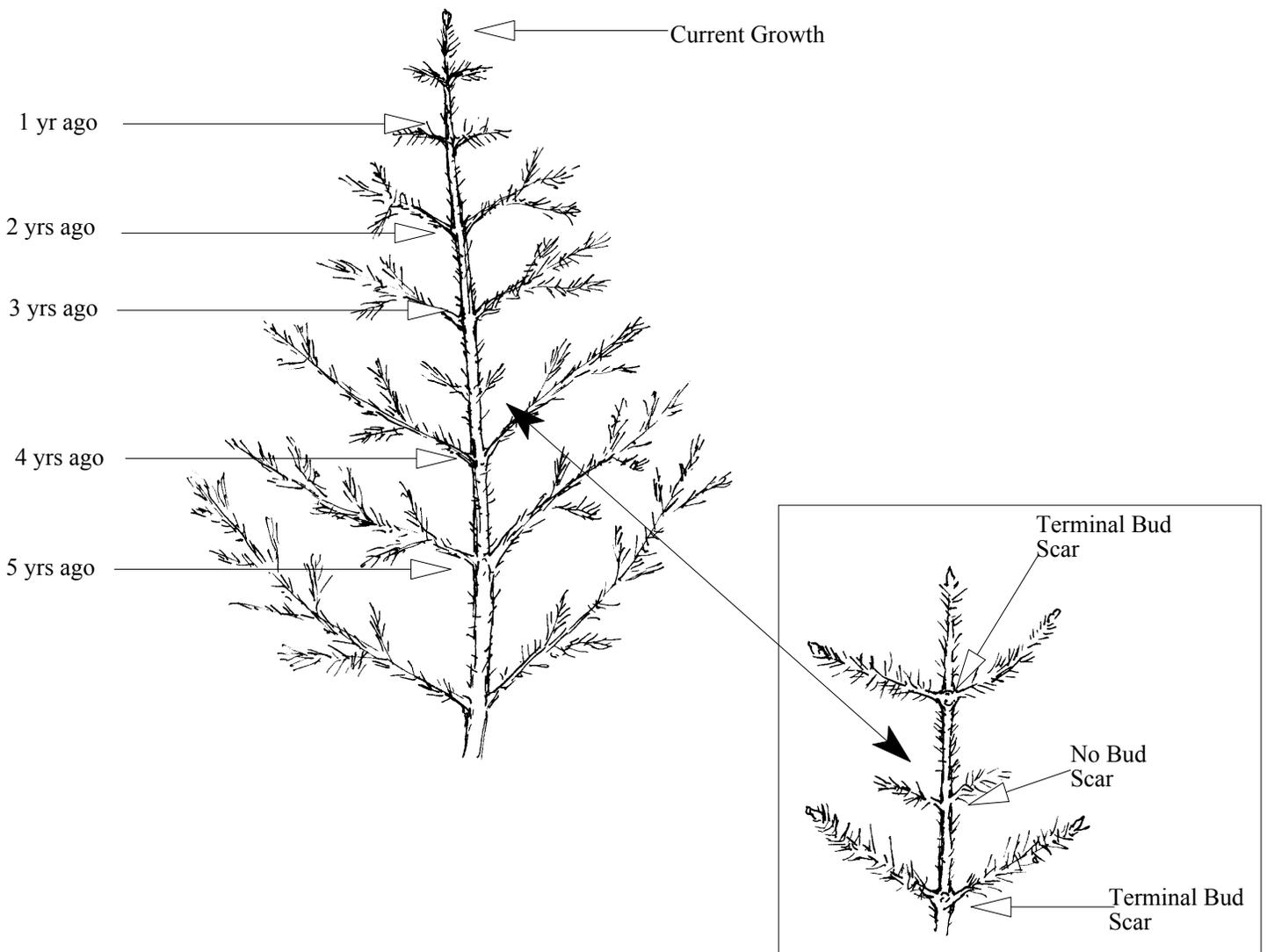
- | |
|--|
| (1) $40.0/2 = 20.0$ inches (radius of bark and wood) |
| (3) $20.0 - 2.0 = 18.0$ inches (radius of wood) |
| (5) $18.0 - 16.0 = 2.0$ inches (short of hitting center) |
| (7) $5 \times 2 = 10$ rings |
| (9) $200 + 10 = 210$ years old |

Age Measurements for Trees < 3 Inches DBH

For sample trees less than 3.0 inches DBH, total tree age may be determined by counting branch whorls which represent annual height increments, by severing the tree at the root collar and counting annual rings, or by taking an increment boring at the root collar.

Counting Branch Whorls

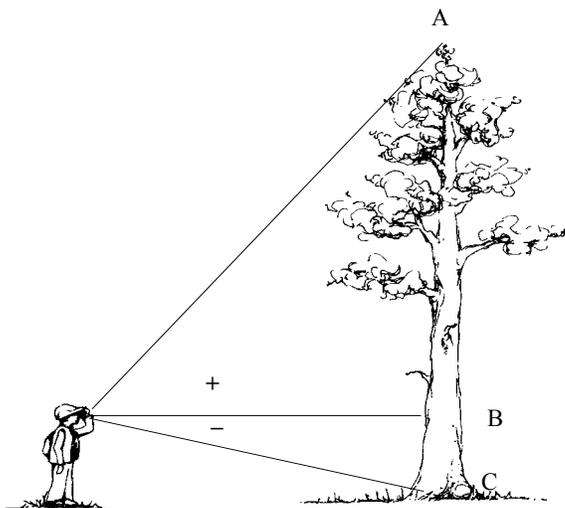
Counting branch whorls to determine tree age should only be done on western white pine or other species where the distinction between annual branch whorls and false branch whorls can be clearly recognized. False branch whorls can sometimes be recognized by having shorter branches and will never have budscale scars at the node. The presence of budscale scars guarantees that the branch whorl represents an annual growth increment, but as a tree ages, budscale scars become masked by bark development. Western red cedar does not have budscale scars and false whorls are common, so counting branch whorls is never appropriate for cedar. The total age is recorded in Tree age.



Appendix P: Measuring Height

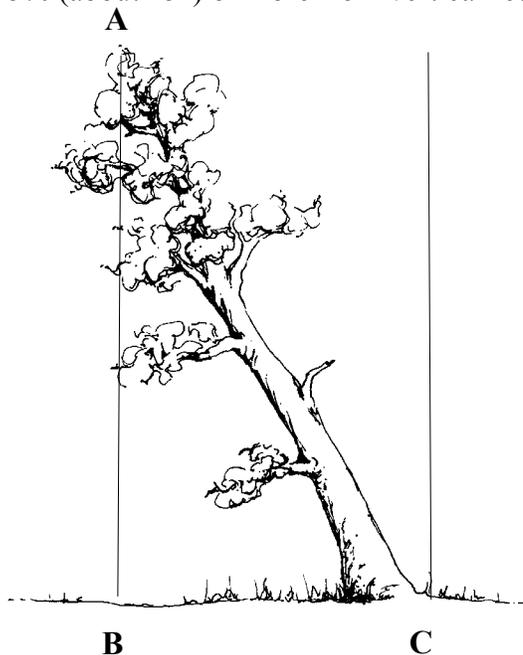
Total Tree Height

Measure from the base of the tree on the high ground side to the tip of the tree leader. Measure height from a point uphill or on the same contour line as the tree. Record total tree height to the nearest foot.



Leaning Trees

Trees leaning 25% (about 15°) or more from vertical require the following special height measuring technique.



Locate point on ground directly under tip of leaning tree. Measure height A B. Measure horizontal distance B C. Determine actual tree height (AC) using either the Pythagorean theory for right triangles where:

$$\text{Tree Height} = \sqrt{AB^2 + BC^2}$$

Example: Measured height (AB) = 120'
 Horizontal distance (BC) = 40'

$$\text{Corrected tree height} = \sqrt{120^2 + 40^2} = 126.49$$

or use the following table.

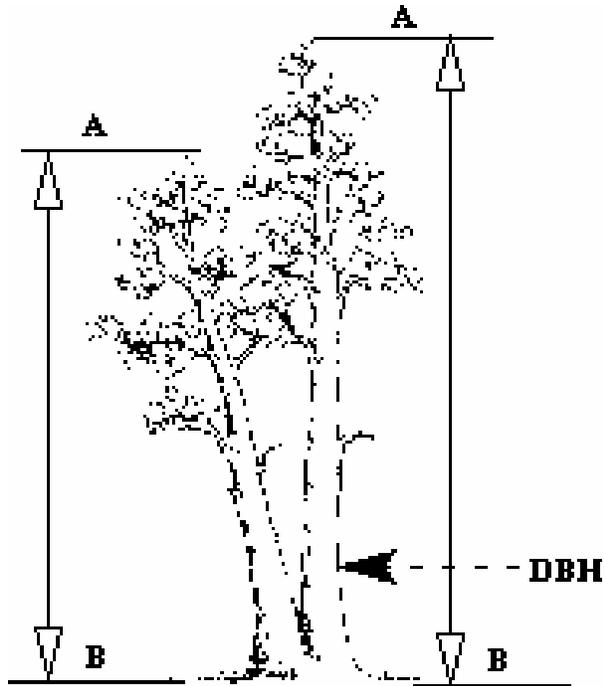
Horizontal Distance - tip to center of bole at ground (B C)

MS HT	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
40	40	41	43	45												
50	50	51	52	54	56											
60	60	61	62	63	65	67										
70		71	72	73	74	76	78									
80		81	81	82	84	86	87	89								
90		91	91	92	94	95	97	98	101							
100		101	101	102	103	104	106	108	110	112						
110			111	112	113	114	116	117	119	121	123					
120			121	122	123	124	125	126	128	130	132	134				
130			131	131	132	133	135	136	138	139	141	143	145			
140			141	141	142	143	144	146	147	149	150	152	154	157		
150			151	151	152	153	154	155	157	158	160	162	164	166	168	
160			161	161	162	163	164	165	166	168	169	171	173	175	177	179
170	171	171	172	173	174	175	176	177	179	180	182	184	186	188	190	
180	181	181	182	183	183	184	176	187	188	190	191	193	195	197	199	201
190		191	192	192	193	194	195	196	198	200	201	203	204	206	208	210
200		201	202	202	203	204	205	206	208	209	211	212	214	215	217	219

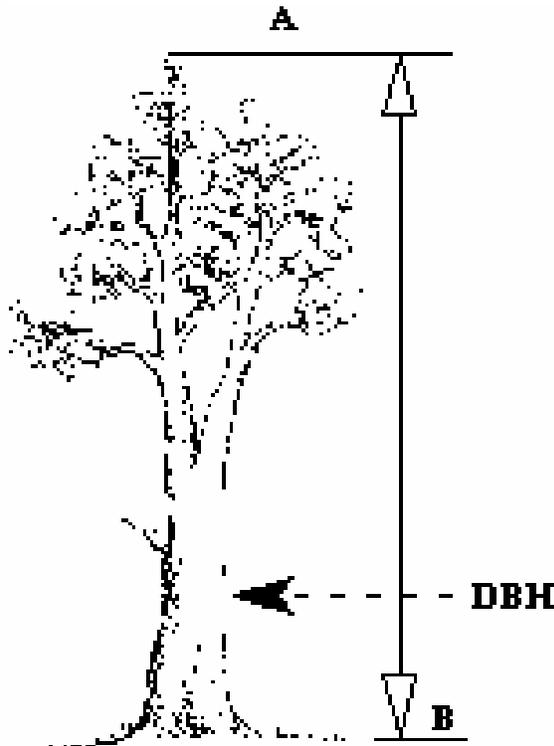
MS HT = (A B) Measured Height

Forked Trees

If tree forks below DBH, treat as two trees and measure height of each stem from base of tree to tip of tree.

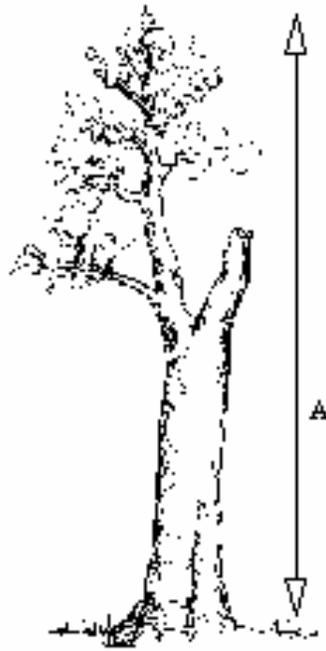


If the fork crotch occurs at or above 4.5 feet on high ground side, the tree is treated as a single tree. Measure height of the tallest fork.



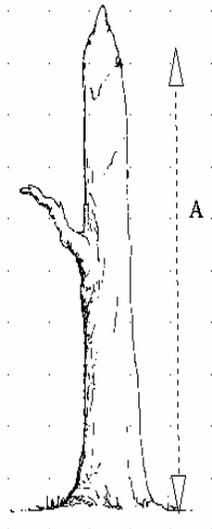
Forked Tree with a Broken Top

Trees forked below DBH are treated as two separate trees. Trees forked above DBH are recorded as a single tree. The height of the tallest fork is measured and recorded in the "Total Height" field. Also record a tree damage of "broken top" (99-1).



Trees with a Broken or Missing Top

Measure height of stub and record in the "Total Height" field. Also record a tree damage of "broken top" (99-1). If the tree is forked, measure the height of the stub of the dominant fork



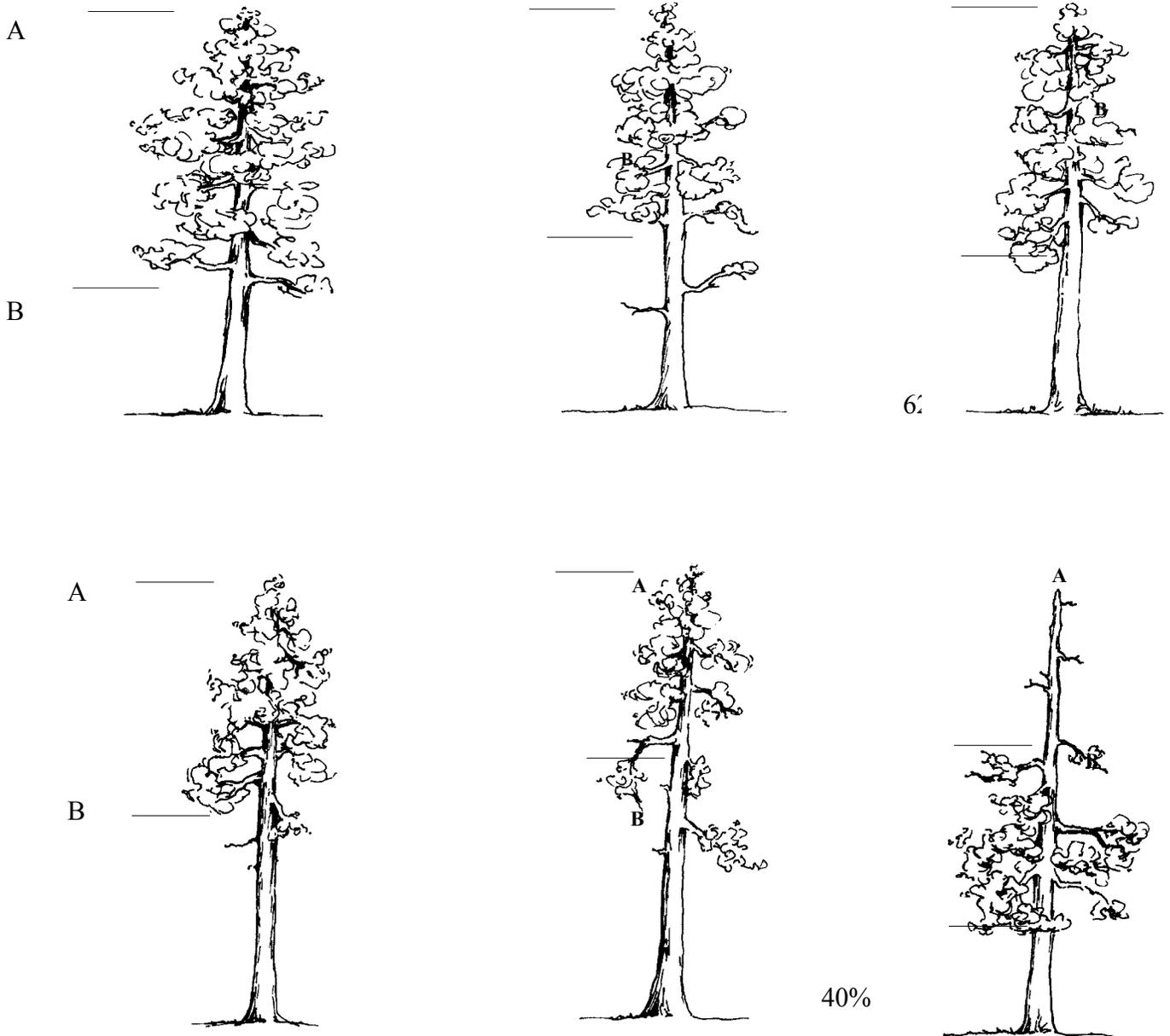
Appendix Q: Measuring Crowns

Height to Live Crown



Measure the height from the base of the tree on the uphill side (B) to the base (A) of the live crown. Base of the live crown is the lowest branch whorl with live branches in at least two quadrants exclusive of epicormic branching and of whorls not continuous with the main crown.

Crown Ratio



Crown ratio is the portion of the tree bole supporting live, healthy foliage and is expressed as a percent of the actual tree height. The distance between A and B is the existing crown length.

Appendix L: Damage Categories, Agents, Severity Ratings, and Tree Parts

Damage Categories

Code	Description
00	None(default)
10	General insects
11	Bark beetles
12	Defoliators
13	Chewing insects
14	Sucking insects
15	Boring insects
16	Seed/cone/flower/fruit insects
17	Gallmaker insects
18	Insect predators
19	General diseases
20	Biotic damage
21	Root/butt diseases
22	Stem decays/cankers
23	Parasitic/epiphytic plants
24	Decline complexes/dieback/wilts
25	Foliage diseases
26	Stem rusts
27	Broom rusts
30	Fire
41	Wild animals
42	Domestic animals
50	Abiotic damage
60	Competition
70	Human activities
71	Harvest
80	Multi-damage (insect/disease)
90	Unknown
99	Physical effects

Damage Agents

11		000	Bark Beetles
	I	002	Western pine beetle
	I	006	Mountain pine beetle
	I	007	Douglas-fir beetle
	I	009	Spruce beetle
	I	012	Red turpentine beetle
	I	015	Western balsam bark beetle
	I	029	Pine engraver
	I	030	Ips engraver beetles
	I	050	Fir engraver
SEVERITY RATING 1 = Unsuccessful bole attack: pitchout and beetle brood absent 2 = Strip attacks: galleries and brood present 3 = Successful bole attack: galleries and brood present 4 = Topkill 5 = Successful attack last year 6 = Older dead			
Category	Import	Agent	Common Name
12		000	Defoliators
	P	003	Looper
	I	005	Sawfly
	I	038	Spruce budworm
	P	039	Sugar pine tortrix
	I	040	Western spruce budworm
	I	047	Larch casebearer
	I	050	Ponderosa needleminer
	I	094	Western tent caterpillar
	I	104	Lodgepole sawfly
	I	116	Pine butterfly
	I	123	Douglas-fir tussock moth
	I	160	Pine needle sheathminer
SEVERITY RATING 0 = No severity rating recorded 1 = Light defoliation (1-25%), no topkill 2 = Light defoliation (1-25%), topkill <=10% 3 = Light defoliation (1-25%), topkill >10% 4 = Moderate defoliation (26-75%), no topkill 5 = Moderate defoliation (26-75%), topkill <=10% 6 = Moderate defoliation (26-75%), topkill >10% 7 = Heavy defoliation (76-100%), no topkill 8 = Heavy defoliation (76-100%), topkill <=10% 9 = Heavy defoliation (76-100%), topkill >10%			
21		000	Root
	I	001	Armillaria root disease
	I	004	Brown crumbly rot
	I	010	Annosus root disease
	I	015	Schweinitzii butt rot
SEVERITY RATING for trees 1 = Tree within 30 feet of tree with deteriorating crown, tree with diagnostic symptoms or signs, or tree killed by root disease 2 = Pathogen (sign) or diagnostic symptom detected - no crown deterioration 3 = Crown deterioration detected - no diagnostic symptoms or signs 4 = Both crown deterioration and diagnostic signs symptoms detected 5 = Bleeding present on bole 6 = Bleeding present on bole and adjacent mortality present 7 = Laboratory confirmed Sudden Oak Death			
Importance (col 2) Key: I=most important, P=present, N=nursery pest			

Damage Agents (cont.)

Category	Import	Agent	Common Name
22		000	Stem Decays
	I	001	Heart rot
	I	002	Stem rot
	I	003	Sap rot
	I	006	Black knot of cherry
	I	024	Gray-Brown sap rot
	I	026	Cytospora canker of fir
	I	028	Rust-red stringy rot
	I	047	Red ring rot
	I	059	Red belt fungus
	I	063	Coniophora puteana
SEVERITY RATING			
0 = 0-4% rotten 5 = 46%-55%			
1 = 5-15% rotten 6 = 56%-65%			
2 = 16-25% rotten 7 = 66%-75%			
3 = 26-35% rotten 8 = 76%-85%			
4 = 36%-45% 9 = 86-100% rotten			
23		000	Parasitic
	I	006	Lodgepole pine dwarf mistletoe
	I	008	Western dwarf mistletoe
	I	009	Limber pine dwarf mistletoe
	I	011	Douglas-fir dwarf mistletoe
	I	013	Larch dwarf mistletoe
	I	021	Red fir dwarf mistletoe
SEVERITY RATING			
1 = Hawksworth tree DMR rating 1			
2 = Hawksworth tree DMR rating 2			
3 = Hawksworth tree DMR rating 3			
4 = Hawksworth tree DMR rating 4			
5 = Hawksworth tree DMR rating 5			
6 = Hawksworth tree DMR rating 6			
25		000	Foliage Diseases
	I	001	Blight
	I	002	Broom rust
	I	009	True fir needlecast
	P	011	Cercospora blight of juniper
	P	015	Pine needle rust
	I	022	Elythroderma disease
	P	041	Brown felt blight of pines
	P	042	Snow blight
SEVERITY RATING			
1 = minor: present, but less than half the foliage affected			
2 = severe: present and greater than half the foliage affected			

Damage Agents (cont.)

Category	Import	Agent	Common Name
26		000	Stem Rusts
	I	001	White pine blister rust
	I	002	Western gall rust
	I	003	Stalactiform blister rust
	I	004	Comandra blister rust
SEVERITY RATING			
1 = Branch infections located greater than 2 feet from tree bole.			
2 = Branch infections located between 6 inches and 2 feet from tree bole.			
3 = Bole infections or branch infections located within 6 inches of bole.			
4 = Topkill.			
27		000	Broom Rusts
	I	001	Spruce broom rust
	I	004	Fir broom rust
SEVERITY RATING			
1 = minor: present, but less than 10 brooms/tree			
2 = severe: bole infection or greater than 10 brooms/tree			
30		000	Fire
		031	Wildfire
		032	Human caused fire
		033	Crown fire damage
		034	Ground fire damage
SEVERITY RATING			
301 = minor: < 20% crown affected			
302 = severe: >20% crown affected or any damage to the bole			
41		000	Wild Animals
	I	001	Bear
	I	002	Beaver
	I	003	Big game
	I	004	Mice or voles
	I	005	Pocket gophers
	I	006	Porcupines
	I	007	Rabbits or hares
	I	008	Sapsucker
	I	009	Squirrels
	I	010	Woodpeckers
	I	011	Moose
SEVERITY RATING			
1 = minor: <20% of crown affected, bole damage is < 50% circumference			
2 = severe: >20% of crown affected, bole damage is >50% circum, upper 1/3 crown killed			
Category	Import	Agent	Common Name
42		000	Domestic Animals
	I	001	Cattle
	I	002	Goats
	I	003	Horses
	I	004	Sheep
SEVERITY RATING			
1 = minor: <20% of crown affected, bole damage is < 50% circumference			
2 = severe: >20% of crown affected, bole damage is >50% circum, upper 1/3 crown killed			

Damage Agents (cont.)

50		000	Abiotic Damage
	I	003	Drought
	I	004	Flooding/high water
	I	005	Frost
	I	006	Hail
	I	007	Heat
	I	008	Lightning
	I	009	Nutrient imbalances
	I	011	Snow/ice
	I	013	Wind/tornado
	I	014	Winter injury
	I	015	Avalanche
	I	016	Mud/land slide
	I	017	Volcano
	I	018	Other geologic event
	I	019	Mechanical (non-human caused)
SEVERITY RATING			
1 = minor: <20% of crown affected, bole damage is < 50% circumference			
2 = severe: >20% of crown affected, bole damage is >50% circum, upper 1/3 crown killed			
60		000	Competition
SEVERITY RATING			
1 = minor: tree slightly deformed and has some live, terminal growth			
2 = severe: tree extremely deformed or has no live terminal, growth severely reduced relative to neighbors			
70		000	Human Activities
	I	001	Herbicides
	I	002	Human caused fire
	I	003	Imbedded objects
	I	004	Improper planting technique
	I	005	Land clearing
	I	006	Land use conversion
	I	008	Mechanical
	I	009	Pesticides
	I	010	Roads
	I	011	Soil compaction
	I	012	Suppression
	I	013	Vehicle damage
Category	Import	Agent	Common Name
SEVERITY RATING			
1 = minor, present, but does not cause reduction in growth potential, or increased risk of mortality			
2 = severe, present, and causes reduction in growth potential, or increased risk of mortality			
71		000	Harvest
SEVERITY RATING			
1 = minor, present, but does not cause reduction in growth potential, or increased risk of mortality, bole damage is less than 1/2 of the bole circumference			
2 = severe, present, and causes reduction in growth potential, or increased risk of mortality; bole damage is 1/2 or more of the bole circumference			

Damage Agents (cont.)

80		000	Multi-Damage (Insect/Disease)
	I	001	Aspen defoliation (12037, 12096, 25036, 25037)
	I	002	Subalpine fir mortality (11015 and 21001)
SEVERITY RATING			
1 = minor			
2 = severe			
90		000	Unknown
SEVERITY RATING			
0 = 0 – 9% affected			
1 = 10 – 19% affected			
2 = 20 – 29% affected			
3 = 30 – 39% affected			
4 = 40 - 49% affected			
5 = 50 - 59% affected			
6 = 60 - 69% affected			
7 = 70 - 79% affected			
8 = 80 - 89% affected			
9 = 90 - 100% affected			

99	000	Physical Effects	How to code Severity (actual %)
	001	Broken top	% of missing height
	002	Dead top	% of dead height
	003	Limby (large limbs top to bottom)	% of height with many limbs/knots
	004	Forked top	% of height above fork
	005	Forked below merch top	% of height affected
	006	Crook or sweep	% of height affected
	007	Checks, bole cracks	% of height affected
	008	Foliage discoloration	% of foliage discolored
	009	Mortality	100
	011	Poor planting stock	100
	012	Poor growth	1 = Minor (reduced growth) 2 = Severe (affecting survival)
	013	Total board foot volume loss	% loss
	014	Total cubic foot volume loss	% loss
	015	Bark removal	% of bole circumference missing
	016	Foliage loss	1 = Minor (reduced growth) 2 = Severe (affecting survival)
	017	Sunscauld	1 = Minor (reduced growth) 2 = Severe (affecting survival)
	018	uproot	100
	019	scorched foliage	% foliage scorched
	020	scorched bark	% of bark scorched
	021	dieback (stocking only)	1=minor 2=severe
	022	poor crown form	1=minor 2=severe
	023	Severe forking	% of height affected
	026	Open wound	% of bole affected
	033	Damaged shoots, buds, or foliage	1=minor 2=severe
	034	Excessively deformed sapling	
	037	Leaning tree >15% / self supporting	% lean from verticle

These severities do not need to be preceded by the category code of 99. Only the actual percentage needs to be recorded

Importance (col 2) Key: I=most important, P=present, N=nursery pest

Tree Parts

Code	Description
UN	Unspecified
TO	Top
FO	Foliar (Crown)
LI	Limb
BO	Bole, other than Top or Base
BA	Base
RO	Roots
WT	Whole Tree
TT	Top Third of Crown
MT	Middle Third of Crown
BT	Bottom Third of Crown
TA	Above merch top
TB	Below merch top

Appendix S: Down Woody Material

There are two recommended methods to inventory dead, down woody debris. One is the Planar Intercept Method referenced in the “Handbook for Inventorying Down, Woody Material” by James K. Brown (1974). The second method is known as the Photo Series for Quantifying Forest Residues. The difference between the two methods is that the Planar Intercept uses data measurements that are accurate to a specific statistical reliability. The Photo series is an estimating technique. The actual data contained in the Photo series tables were obtained by sampling the photo plots using the Planar Intercept method. The other difference is the time, expense, and level of training needed to collect the data.

Photo Series Method

This method involves making visual comparisons between the on-site fuel condition and the conditions depicted on the photos. The Photo Series is intended to allow fast, easy and inexpensive quantifications of forest residues. Before using a particular Photo Series, become thoroughly familiar with the photo series book. To best understand how the photo series works, conduct several samples utilizing James K. Brown’s Handbook for Inventorying Downed Woody Material. Actual hands on sampling using the Brown method provides the ability to fine-tune ocular estimates. The photo series relies heavily on one’s ability to visually compare the actual on the ground conditions against representative photos and its characteristics.

Enter the weight (tons/acre) and volume (MBF/acre) by size class by selecting the representative photo based on the instructions found within the photo series. Compare photos to best match the ground conditions being evaluated. Only the dead and downed woody material (twigs, stems, branches, and bolewood) from trees and shrubs is evaluated. Do not allow the live species in the sample are to skew the visual estimate. Since the photo series requires an interpolation of photos to actual conditions, it is helpful to begin by estimating mid size fuels first before moving to the finer fuels.

Brown Protocol Method

Sampling Procedures

For average amounts of downed debris, about 5 to 6 minutes per sample point is required for the measurements. More time is usually spent in traveling and locating sample points than in making the measurements. If only downed woody material is inventoried, a two-person crew can complete 20 to 40 plots a day, depending on how much debris is present.

The Sampling Planes

The inventory is based on the planar intersect technique^{1, 2}, which has the same theoretical basis as the line intersect technique³. The planar intersect technique involves counting intersections of woody pieces with vertical sampling planes that resemble guillotines dropped through the downed debris.

1 Brown, James K. 1974. Handbook for inventorying downed woody material. USDA For. Serv. Gen. Tech. Rep. INT-16, 24 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

2 Brown, James K., and Peter J. Roussopoulos. 1974. Eliminating biases in the planar intersect method for estimating volumes of small fuels. For. Sci. 20(4): 350-356.

3 Van Wagner, C. E. 1968. The line intersect method in forest fuel sampling. For. Sci. 14(1): 20-26.

Sampling Plane Height

The sampling plane height (vertical height) is undefined so that all intersections of dead down material are tallied regardless of their height above the ground. Tree boles are considered down if they lean greater than 45 degrees from the perpendicular. Sampling plane lengths vary by size and amount of downed woody material.

Sampling Plane Length

Length of sampling plane can be varied by users to obtain desired sampling precision. Generally, as fewer sample points are taken, sampling plane lengths should be longer to achieve desired sampling precision.

Sampling plane lengths are horizontal lengths. Slope distance will need to be adjusted to a horizontal distance. If a sampling plane extends beyond the border of the stand, truncate the plane at the stand boundary and project the remaining length along the reverse azimuth from the point center.

The table that follows suggests sampling plane lengths and number of sample points needed to obtain specified percent errors (standard error of estimate divided by the mean, expressed as percentage). These recommendations are based on average distributions of naturally fallen downed woody material sampled in the northern Rocky Mountains⁴. The sampling plane lengths can be expected to vary from one-half of the table values for heavy fuels that are uniformly distributed to twice the table values for light and unevenly distributed fuels. For heavy slash, the sampling plane lengths recommended for naturally fallen fuels could be cut in half.

A standard error of estimate within 20 percent of the mean is often considered adequate for fuel appraisal. A smaller percent error may be desirable for planning utilization of downed woody material. Percent errors greater than 35 percent afford poor reliability. If sampling cannot provide at least this level of reliability, it may not be worthwhile.

Fuel Estimate

Decide whether an estimate of fuels is needed for an individual stand or for several stands together. If fuel quantities are believed to be similar in several stands, then a single estimate is appropriate for appraising fuels in these stands. This is often the case for several adjacent stands in a timber sale area. If fuel estimates are desired for individual stands, then choose a sampling plane length appropriate for the number of sample points planned for the stand. The same sampling plane length should be used throughout each stand or group of stands for which fuel estimates are sought.

4 Brown, James K., Rick D. Oberheu, and Cameron M. Johnston. 1982 Handbook for Inventorying surface fuels and biomass in the Interior West. USDA For. Serv. Gen. Tech. Rep. Int-129, 48 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Length of Sampling Plane for Percent Errors and Number of Sample Points

Field	Diameter	Percent Error	-----Number Sample Points-----								
			5	6	7	8	10	15	20	30	
			----- Sampling Plane Lengths in Feet -----								
2 and 3	0-1 inches	15	34	28	24	21	17	11	8	6	
	20	19	16	14	12	10	6	8	4		
	25	12	10	9	8	6	4	3	2		
	30	8	7	6	5	4	3	2	2	2	
	35	6	5	5	4	3	2	2	2	1	
4	1-3 inches	15	85	70	60	55	45	30	22	14	
	20	50	40	35	30	24	16	12	8		
	25	30	25	22	20	16	10	8	5		
	30	22	18	15	14	11	7	5	4		
	35	16	13	11	10	8	5	4	3		
8	3+ inches	15		380	315	270	235	190	125	95	65
	20		210	175	150	130	105	70	50	35	
	25		140	115	100	90	70	50	35	25	
	30		100	80	70	60	50	35	25	15	
	35	70	60	50	45	35	25	18	12		

Record each Sampling Plane Length once per sample stand, on the Sample Design form. For example, if number of sample points is 20 and desired percent of error is 20%, then record:

05 in field 02
 12 in field 02
 050 in Down Woody field 02

In medium fuel situations, these sampling planes should provide percent errors of about 20 percent with 20 sample points and 30 percent with 10 sample points. Unless users specify sampling plane lengths on the field record, the following lengths should be used and are assumed (defaults) in the computer programs:

<u>Fuel Diameter</u>	<u>Sampling Plane Length</u>
3+ inches	27 feet
1-3 inches	7 feet
0-1 inches	7 feet

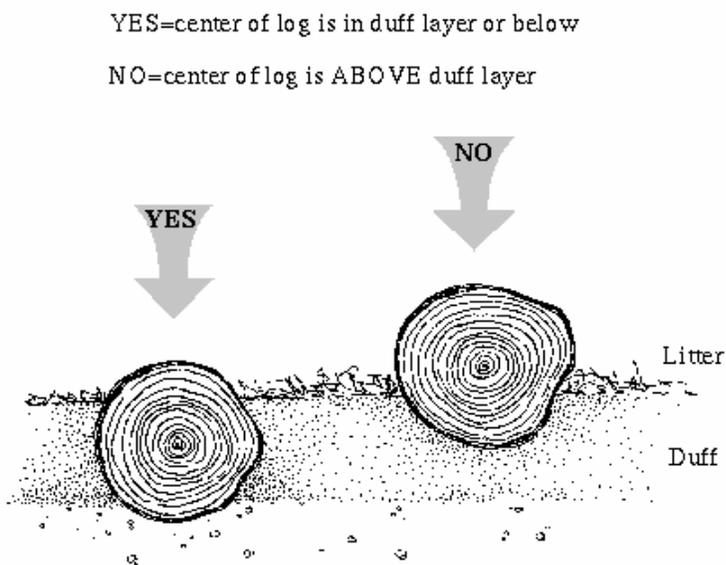
Tally Rules for the Downed Fuel Inventory

1. Particles qualifying for tally include downed, dead woody material (twigs, stems, branches, and bolewood) from trees and shrubs. Dead branches attached to boles of standing trees are omitted because they are not downed vegetation. Consider a particle "downed" if it has fallen to the ground or is severed from its original source of growth. Cones, bark flakes, needles, leaves, grass, and forbs are not counted. Dead woody stems and branches still attached to standing brush and trees are not counted.
2. Twigs or branches lying in the litter layer and above are counted. However, they are not counted when the intersection between the central axis of the particle and the sampling plane lies in the duff (forest floor below the litter).

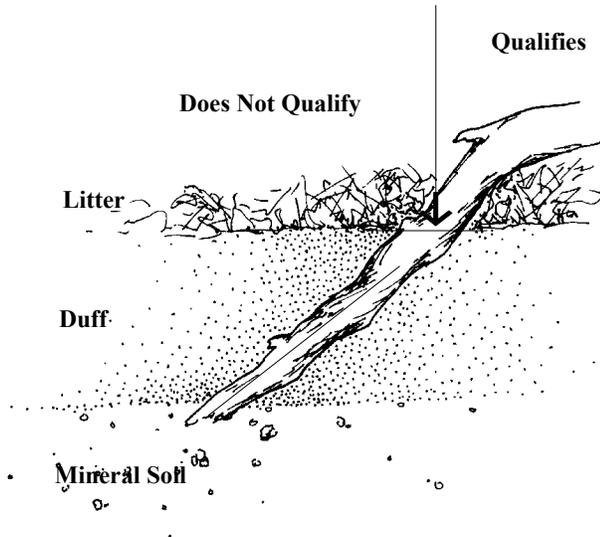
3. If the sampling plane intersects the end of a piece, tally only if the central axis is crossed. If the plane exactly intersects the central axis, tally every other such piece.
4. Don't tally any particle having a central axis that coincides perfectly with the sampling plane.
5. If the sampling plane intersects a curved piece more than once, tally each intersection.
6. Tally wood slivers and chunks left after logging. Visually mold these pieces into cylinders TO determine size class or recording diameters.
7. Tally uprooted stumps and roots not encased in dirt. For tallying, consider uprooted stumps as tree boles or individual roots, depending on where the sampling planes intersect the stumps. Do not tally undisturbed stumps.
8. Tally all intersections of dead tree boles that lean greater than 45 degrees from the perpendicular regardless of the height of these intersections. Do not tally intersections of any standing dead trees that do not lean greater than 45 degrees from the perpendicular even if the point of intersection is within 6 feet of the ground.

Explanatory Figures

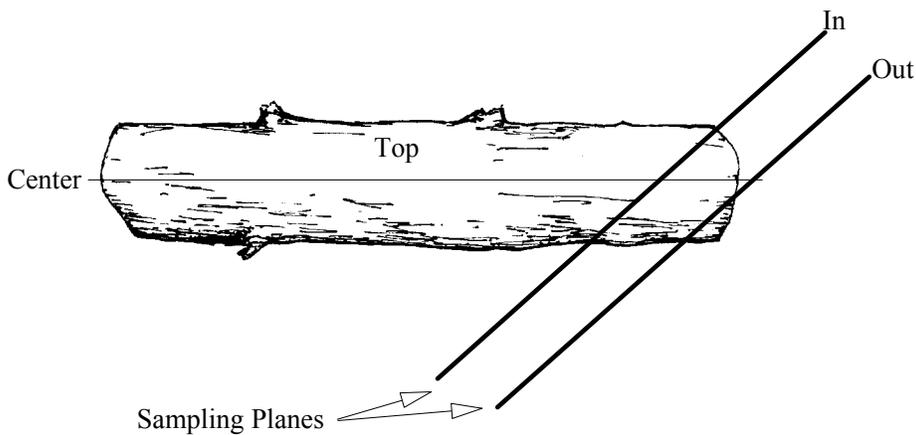
1. When stumps, logs, and trees occur at the point of duff measurement, offset 1 foot perpendicular to the right of the sampling plane. Measure through rotten logs whose central axis is in the duff layer.



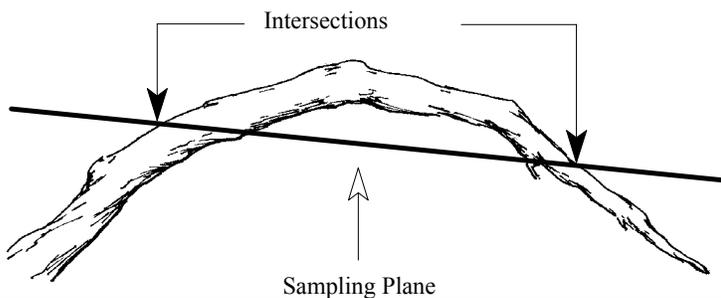
- Twigs or branches lying in the litter layer and above are counted. However, they are not counted when the intersection between the central axis of the particle and the sampling plane lies in the duff (forest floor below the litter).



- If the sampling plane intersects the end of a piece, tally only if the central axis is crossed. If the plane exactly intersects the central axis, tally every other such piece.

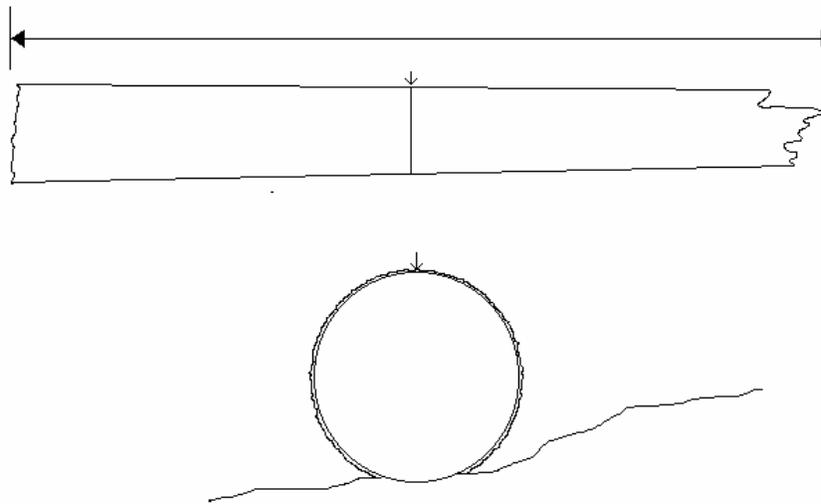


- If the sampling plane intersects a curved piece more than one, tally each intersection.

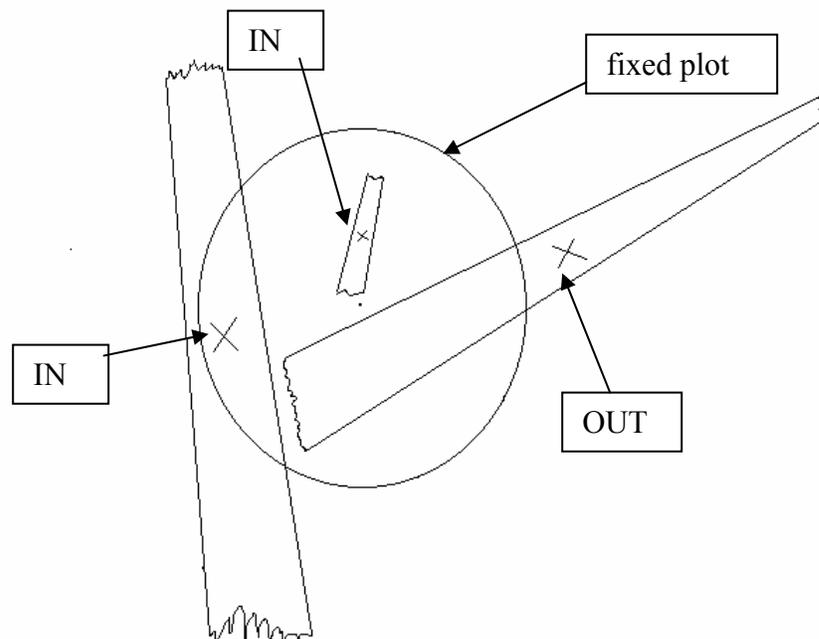


Determining Tally Pieces on a Fixed Area Plot

If collecting down woody information on a fixed area plot, the piece is tallied if the point on the upper most surface of the cylinder, mid-length of the piece, is within the fixed area plot. To determine the midpoint of a piece, measure the length, in feet, and divide by 2.

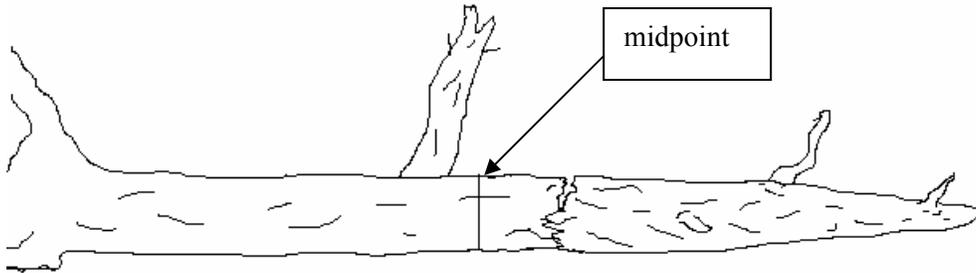


Midpoint is the uppermost point at the mid-length of the piece.



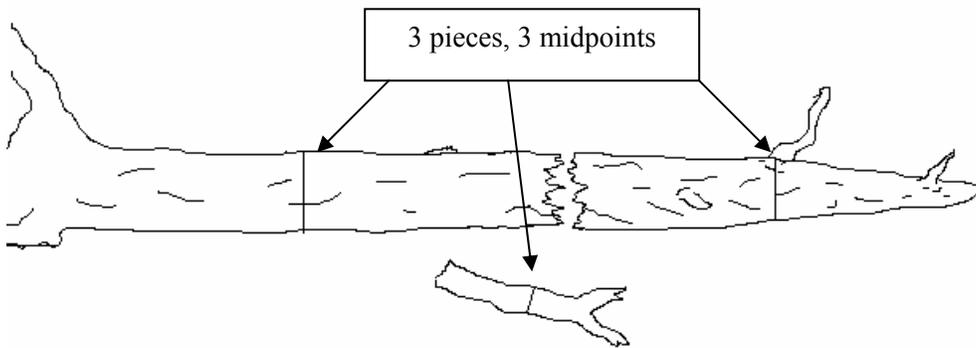
Position of midpoint of piece on the plot determines tally.

A down log may be broken into more than one piece. If a log is cracked, broken, or partially cut, but the two parts are still physically touching, then the log shall be considered one piece.

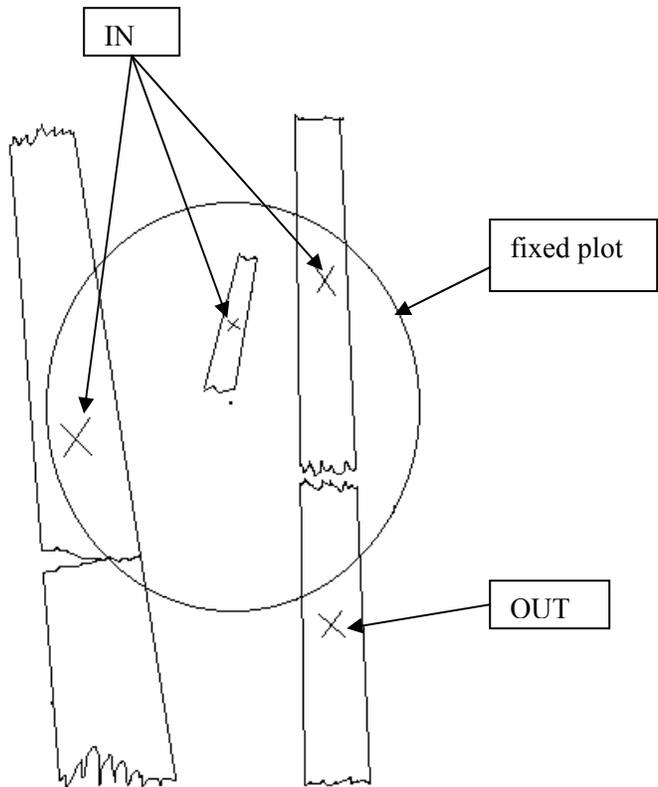


Midpoint on a one-piece log.

If, however, the two or more parts are not physically touching, then they will be considered separate pieces, each having their own midpoint. This may affect whether all parts of the down log are within the fixed radius plot.



Broken pieces not touching are measured separately.



Broken pieces have separate midpoints, which can affect which pieces are tallied.