

## **APPENDIX 3**

### **TREE LEVEL DATA**

## SOUTHERN U.S. TREE SPECIES CODES

The following list includes tree species tallied in the southern FIA region. (w) designates woodland species where DRC is measured instead of DBH. All codes that are not shaded are on the FIA national species list. Shaded codes 100, 690, 912, and 998 are southern regional codes – followed by (regional). The other shaded codes are tropical tree species that are collected in Florida only – followed by (FL).

<b>Code</b>	<b>Common Name</b>	<b>Genus</b>	<b>Specific epithet</b>
010	fir spp.	Abies	spp.
012	balsam fir	Abies	balsamea
016	Fraser fir	Abies	fraseri
043	Atlantic white-cedar	Chamaecyparis	thyoides
051	Arizona cypress	Cupressus	arizonica
057	redcedar / juniper	Juniperus	spp.
059	redberry juniper (w)	Juniperus	erythrocarpa
061	Ashe juniper	Juniperus	ashei
063	alligator juniper (w)	Juniperus	deppeana
066	Rocky Mnt. juniper (w)	Juniperus	scopulorum
067	southern redcedar	Juniperus	silicicola
068	eastern redcedar	Juniperus	virginiana
069	oneseed juniper (w)	Juniperus	monosperma
090	spruce spp.	Picea	spp.
091	Norway spruce	Picea	abies
094	white spruce	Picea	glauca
095	black spruce	Picea	mariana
096	blue spruce	Picea	pungens
097	red spruce	Picea	rubens
100	pine spp. (regional)	Pinus	spp.
106	common pinyon (w)	Pinus	edulis
107	sand pine	Pinus	clausa
110	shortleaf pine	Pinus	echinata
111	slash pine	Pinus	elliottii
113	limber pine	Pinus	flexilis
115	spruce pine	Pinus	glabra
121	longleaf pine	Pinus	palustris
122	ponderosa pine	Pinus	ponderosa
123	Table Mountain pine	Pinus	pungens
125	red pine	Pinus	resinosa
126	pitch pine	Pinus	rigida
128	pond pine	Pinus	serotina
129	eastern white pine	Pinus	strobus
130	Scotch pine	Pinus	sylvestris
131	loblolly pine	Pinus	taeda
132	Virginia pine	Pinus	virginiana
136	Austrian pine	Pinus	nigra
140	Mexican pinyon pine	Pinus	cemroides
150	Caribbean pine (FL)	Pinus	caribaea
221	baldcypress	Taxodium	distichum
222	pondcypress	Taxodium	distichum var.nutans
234	Florida yew (FL)	Taxus	floridana
241	northern white-cedar	Thuja	occidentalis
252	Florida torreyia	Torreya	taxifolia

<b>Code</b>	<b>Common Name</b>	<b>Genus</b>	<b>Specific epithet</b>
260	hemlock spp.	Tsuga	spp.
261	eastern hemlock	Tsuga	canadensis
262	Carolina hemlock	Tsuga	caroliniana
270	Australian pine	Causarina	spp.
299	unknown dead conifer	UNKNOWN	UNKNOWN
310	maple spp.	Acer	spp.
311	Florida maple	Acer	barbatum
313	boxelder	Acer	negundo
314	black maple	Acer	nigrum
315	striped maple	Acer	pensylvanicum
316	red maple	Acer	rubrum
317	silver maple	Acer	saccharinum
318	sugar maple	Acer	saccharum
319	mountain maple	Acer	spicatum
320	Norway maple	Acer	platinoides
323	chalk maple	Acer	leucoderme
330	buckeye, horsechestnut spp.	Aesculus	spp.
331	Ohio buckeye	Aesculus	glabra
332	yellow buckeye	Aesculus	octandra
334	Texas buckeye	Aesculus	glabra var. arguta
341	ailanthus	Ailanthus	altissima
345	mimosa, silktree	Albizzia	julibrissou
351	red alder	Alnus	rubra
355	European Alder	Alnus	glutinosa
356	serviceberry spp.	Amelanchier	spp.
367	pawpaw	Asimina	triloba
370	birch spp.	Betula	spp.
371	yellow birch	Betula	alleghaniensis
372	sweet birch	Betula	lenta
373	river birch	Betula	nigra
374	water birch	Betula	occidentalis
379	gray birch	Betula	populifolia
381	chittamwood,gum bumelia	Bumelia	lanuginosa
391	American hornbeam, musclewood	Carpinus	caroliniana
400	hickory spp.	Carya	spp.
401	water hickory	Carya	aquatica
402	bitternut hickory	Carya	cordiformis
403	pignut hickory	Carya	glabra
404	pecan	Carya	illinoensis
405	shellbark hickory	Carya	laciniosa
406	nutmeg hickory	Carya	myristiciformis
407	shagbark hickory	Carya	ovata
408	black hickory	Carya	texana
409	mockernut hickory	Carya	tomentosa
410	sand hickory	Carya	pallida
421	American chestnut	Castanea	dentata
422	Allegheny chinkapin	Castanea	pumila
423	Ozark chinkapin	Castanea	ozarkensis
450	catalpa spp.	Catalpa	spp.
451	southern catalpa	Catalpa	bignonioides
452	northern catalpa	Catalpa	speciosa

<b>Code</b>	<b>Common Name</b>	<b>Genus</b>	<b>Specific epithet</b>
460	hackberry spp.	Celtis	spp.
461	sugarberry	Celtis	laevigata
462	hackberry	Celtis	occidentalis
463	netleaf hackberry	Celtis	reticulata
471	eastern redbud	Cercis	canadensis
481	yellowwood	Cladrastis	kentukea
491	flowering dogwood	Cornus	florida
500	hawthorn	Crataegus	spp.
501	cockspur hawthorn	Crataegus	crus-galli
502	downy hawthorn	Crataegus	mollis
510	eucalyptus	Eucalyptus	spp.
521	common persimmon	Diospyros	virginiana
531	American beech	Fagus	grandifolia
540	ash spp.	Fraxinus	spp.
541	white ash	Fraxinus	americana
543	black ash	Fraxinus	nigra
544	green ash	Fraxinus	pennsylvanica
545	pumpkin ash	Fraxinus	profunda
546	blue ash	Fraxinus	quadrangulata
547	velvet ash	Fraxinus	velutina
548	Carolina ash	Fraxinus	caroliniana
551	waterlocust	Gleditsia	aquatica
552	honeylocust	Gleditsia	triacanthos
555	loblolly-bay	Gordonia	lasianthus
571	Kentucky coffeetree	Gymnocladus	dioicus
580	silverbell	Halesia	spp.
591	American holly	Ilex	opaca
600	walnut spp.	Juglans	spp.
601	butternut	Juglans	cinerea
602	black walnut	Juglans	nigra
605	Texas walnut	Juglans	microcarpa
611	sweetgum	Liquidambar	styraciflua
621	yellow-poplar	Liriodendron	tuliperfia
641	Osage-orange	Maclura	pomifera
650	magnolia spp.	Magnolia	spp.
651	cucumbertree	Magnolia	acuminata
652	southern magnolia	Magnolia	grandiflora
653	sweetbay	Magnolia	virginiana
654	bigleaf magnolia	Magnolia	macrophylla
655	mountain magnolia	Magnolia	fraseri
660	apple spp.	Malus	spp.
680	mulberry spp.	Morus	spp.
681	white mulberry	Morus	alba
682	red mulberry	Morus	rubra
690	gum, tupelo (regional)	Nyssa	spp.
691	water tupelo	Nyssa	aquatica
692	Ogeechee tupelo	Nyssa	ogeche
693	blackgum	Nyssa	sylvatica
694	swamp tupelo	Nyssa	sylvatica var. biflora
701	eastern hophornbeam	Ostrya	virginiana
711	sourwood	Oxydendrum	arboreum
712	paulownia, empress-tree	Poulownia	tomentosa
721	redbay	Persea	borbonia

<b>Code</b>	<b>Common Name</b>	<b>Genus</b>	<b>Specific epithet</b>
722	water-elm, planertree	Planera	aquatica
731	sycamore	Platanus	occidentallis
740	cottonwood, poplar spp.	Populus	spp.
741	balsam poplar	Populus	balsamifera
742	eastern cottonwood	Populus	deltoides
743	bigtooth aspen	Populus	grandidentata
744	swamp cottonwood	Populus	heterophylla
746	quaking aspen	Populus	tremuloides
748	Rio Grande cottonwood, Fremont poplar	Populus	deltoides ssp. wislizeni
749	narrowleaf poplar	Populus	angustifolia
752	silver poplar	Populus	alba
755	mesquite spp.	Prosopis	spp.
756	western honey mesquite	Prosopis	glandulosa var. torreyana
757	velvet mesquite	Prosopis	velutina
758	screwbean mesquite	Prosopis	pubescens
760	cherry and plum spp.	Prunus	spp.
761	pin cherry (fire cherry)	Prunus	pensylvanica
762	black cherry	Prunus	serotina
763	chokecherry	Prunus	virginiana
766	wild plum	Prunus	americana
800	oak -- deciduous	Quercus	spp.
802	white oak	Quercus	alba
803	Arizona white oak (w) and gray oak (w)	Quercus Quercus	arizonica grisea
804	swamp white oak	Quercus	bicolor
806	scarlet oak	Quercus	coccinea
808	Durand oak	Quercus	durandii
809	northern pin oak	Quercus	ellipsoidalis
810	Emery oak (w)	Quercus	emoryi
812	southern red oak	Quercus	falcata var.falcata
813	cherrybark oak	Quercus	falcata var.pagodifolia
814	Gambel oak (w)	Quercus	gambelii
816	bear oak, scrub oak	Quercus	ilicifolia
817	shingle oak	Quercus	imbricaria
819	turkey oak	Quercus	laevis
820	laurel oak	Quercus	laurifolia
822	overcup oak	Quercus	lyrata
823	bur oak	Quercus	macrocarpa
824	blackjack oak	Quercus	marilandica
825	swamp chestnut oak	Quercus	michauxii
826	chinkapin oak	Quercus	muehlenbergii
827	water oak	Quercus	nigra
828	Nuttall oak	Quercus	nuttallii
830	pin oak	Quercus	palustris
831	willow oak	Quercus	phellos
832	chestnut oak	Quercus	prinus
833	northern red oak	Quercus	rubra
834	Shumard oak	Quercus	shumardii
835	post oak	Quercus	stellata
836	Delta post oak	Quercus	stellata var. mississippiensis
837	black oak	Quercus	velutina
838	live oak	Quercus	virginiana

<b>Code</b>	<b>Common Name</b>	<b>Genus</b>	<b>Specific epithet</b>
840	dwarf post oak	Quercus	stellata var. margaretta
841	dwarf live oak	Quercus	minima
842	bluejack oak	Quercus	incana
843	silverleaf oak (w)	Quercus	hypoleucoides
844	Oglethorpe oak	Quercus	oglethorpensis
845	Dwarf chinkapin oak	Quercus	prinoides
850	oak – evergreen (w)	Quercus	spp.
852	torchwood (FL)	Amyris	elemifera
853	pond apple (FL)	Annona	glabra
854	gumbo limbo (FL)	Bursera	simaruba
855	camphor tree (FL)	Cinnamomum	camphora
856	fiddlewood (FL)	Citharexylum	fruticosum
857	citrus spp. (FL)	Citrus	spp.
863	pigeon plum (tietongue)(FL)	Coccoloba	diversifolia
864	soldierwood (FL)	Colubrina	elliptica
865	geiger tree (FL)	Cordia	sebestena
866	carrotwood (FL)	Cupaniopsis	anacardioides
873	red stopper (FL)	Eugenia	rhombea
874	inkwood (butterbough) (FL)	Exothea	paniculata
876	strangler fig (FL)	Ficus	aurea
877	shortleaf fig (wild banyantree) (FL)	Ficus	citrofolia
882	blolly (beef tree) (FL)	Guapira	discolor
883	manchineel (FL)	Hippomane	mancinella
884	false tamarind (FL)	Lysiloma	latisiliquum
885	mango (FL)	Mangifera	indica
886	poisonwood (FL)	Metopium	toxiferum
887	fishpoison tree (FL)	Piscidia	piscipula
888	schefflera (octopus tree) (FL)	Schefflera	actinophylla
890	false mastic (FL)	Sideroxylon	foetidissimum
891	white bully (willow bustic) (FL)	Sideroxylon	salicifolium
895	paradise tree (FL)	Simarouba	glauca
896	java plum (FL)	Syzygium	cumini
897	tamarind (FL)	Tamarindus	indica
898	other tropical (FL)		
901	black locust	Robinia	pseudoacacia
902	New Mexico locust	Robinia	neomexicana
906	paurotis palm (FL)	Acoelorrhaphe	wrightii
907	silver palm (FL)	Coccothrinax	argentata
908	coconut palm (FL)	Cocos	nucifera
909	royal palm (FL)	Roystonea	spp.
911	other sabal spp.	Sabal	spp.
912	sabal palmetto (regional)	Sabal	palmetto
913	key thatch palm (FL)	Thrinax	morrisii
914	Florida thatch palm (FL)	Thrinax	radiata
915	other palms (FL)	Family Arecaceae	when not listed above
919	western soapberry	Sapindus	drummondii
920	willow	Salix	spp.
921	peachleaf willow	Salix	amygdaloides
922	black willow	Salix	nigra
927	white willow	Salix	alba

<b>Code</b>	<b>Common Name</b>	<b>Genus</b>	<b>Specific epithet</b>
931	sassafras	Sassafras	albidum
935	American mountain-ash	Sorbus	americana
936	European mountain-ash	Sorbus	aucuparia
940	Mahogany (FL)	Swietenia	mahagoni
950	basswood spp.	Tilia	spp.
951	American basswood	Tilia	americana
952	white basswood	Tilia	heterophylla
953	Carolina basswood	Tilia	americana var. caroliniana
970	elm spp.	Ulmus	spp.
971	winged elm	Ulmus	alata
972	American elm	Ulmus	americana
973	cedar elm	Ulmus	crassifolia
974	Siberian elm	Ulmus	pumila
975	slippery elm	Ulmus	rubra
976	September elm	Ulmus	serotina
977	rock elm	Ulmus	thomasii
986	black mangrove (FL)	Avicennia	germinans
987	buttonwood mangrove (FL)	Conocarpus	erectus
988	white mangrove (FL)	Laguncularia	racemosa
989	red mangrove	Rhizophora	mangle
992	melaleuca	Melaleuca	quinquenervia
993	chinaberry	Melia	azedarach
994	Chinese tallowtree	Sapium	sebiferum
995	tung-oil-tree	Aleurites	fordii
996	smoketree	Cotinus	obovatus
997	Russian olive	Elaeagnus	angustifolia
998	miscellaneous species (regional)	take a sample and consult supervisor	
999	unknown dead hardwood	UNKNOWN	UNKNOWN

## DIAMETER PROCEDURES

### ITEM 5092 DIAMETER AT BREAST HEIGHT (DBH) (CORE 5.09.2)

Unless one of the special situations described below is encountered, measure DBH at 4.5 ft above the ground line on the uphill side of the tree. Round each measurement down to the last 0.1 inch. For example, a reading of 3.68 inches is recorded as 3.6 inches.

When Collected: Trees on the 24.0 ft radius subplot, record for live and standing dead trees 5.0 inches in diameter or larger.

Trees on the 6.8 ft radius microplot, record for live trees between 1.0 inch and 4.9 inches in diameter.

Field width: 3 digits (xx.y)

Values: 001 to 999

Special DBH situations:

1. **Forked tree:** In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 1.0 ft, between 1.0 and 4.5 ft, or above 4.5 ft.

- **Trees forked below 1.0 ft.** Trees forked in this region are treated as distinctly separate trees (Figure 10). Distances and azimuths are measured individually to the center of each stem where it splits from the stump (Figure 13 A-C). DBH is measured for each stem at 4.5 ft above the ground. When stems originate from pith intersections below 1 ft, it is possible for some stems to be within the limiting distance of the microplot or subplot, and others to be beyond the limiting distance. If stems originating from forks that occur below 1.0 ft fork again between 1.0 and 4.5 ft (Figure 13-E), the rules in the next paragraph apply.

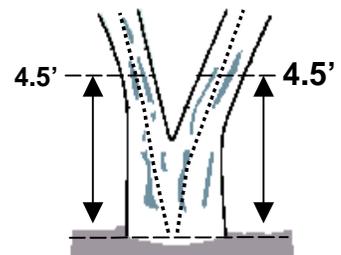


Figure 10. Forked below 1.0 ft.

- **Trees forked between 1.0 ft and 4.5 ft.** Trees forked in this region are also counted as separate trees (Figure 11), but only one distance and azimuth (to the central stump) is used for all (Figure 13 D-F). Although a single azimuth and distance applies to all, multiple stems should be recorded as they occur in clockwise order (from front to back when one stem is directly in front of another). The DBH of each fork is measured at a

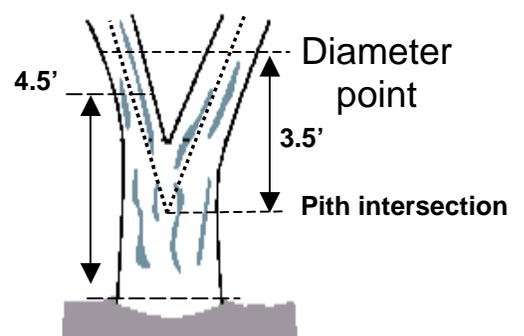


Figure 11. Forked between 1.0-4.5 ft.

point 3.5 ft above the pith intersection. When forks originate from pith intersections between 1.0 and 4.5 ft, the limiting distance is the same for all forks--they are either all on, or all off the plot.

Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 3.5 ft above the common pith intersection (Figure 13 F).

Once a stem is tallied as a fork that originated from a pith intersection between 1.0 and 4.5 ft, do not recognize any additional forks that may occur on that stem. Measure the diameter of such stems at the base of the second fork as shown in Figure 13-E (i.e., do not move the point of diameter the entire 3.5 ft above the first fork).

- Trees forked at or above 4.5 ft. Trees forked in this region count as one single tree (Figure 12). If a fork occurs at or immediately above 4.5 ft, measure diameter below the fork just beneath any swelling that would inflate DBH.

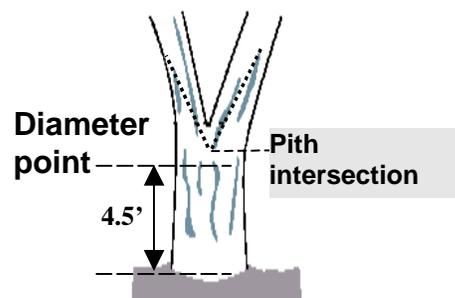
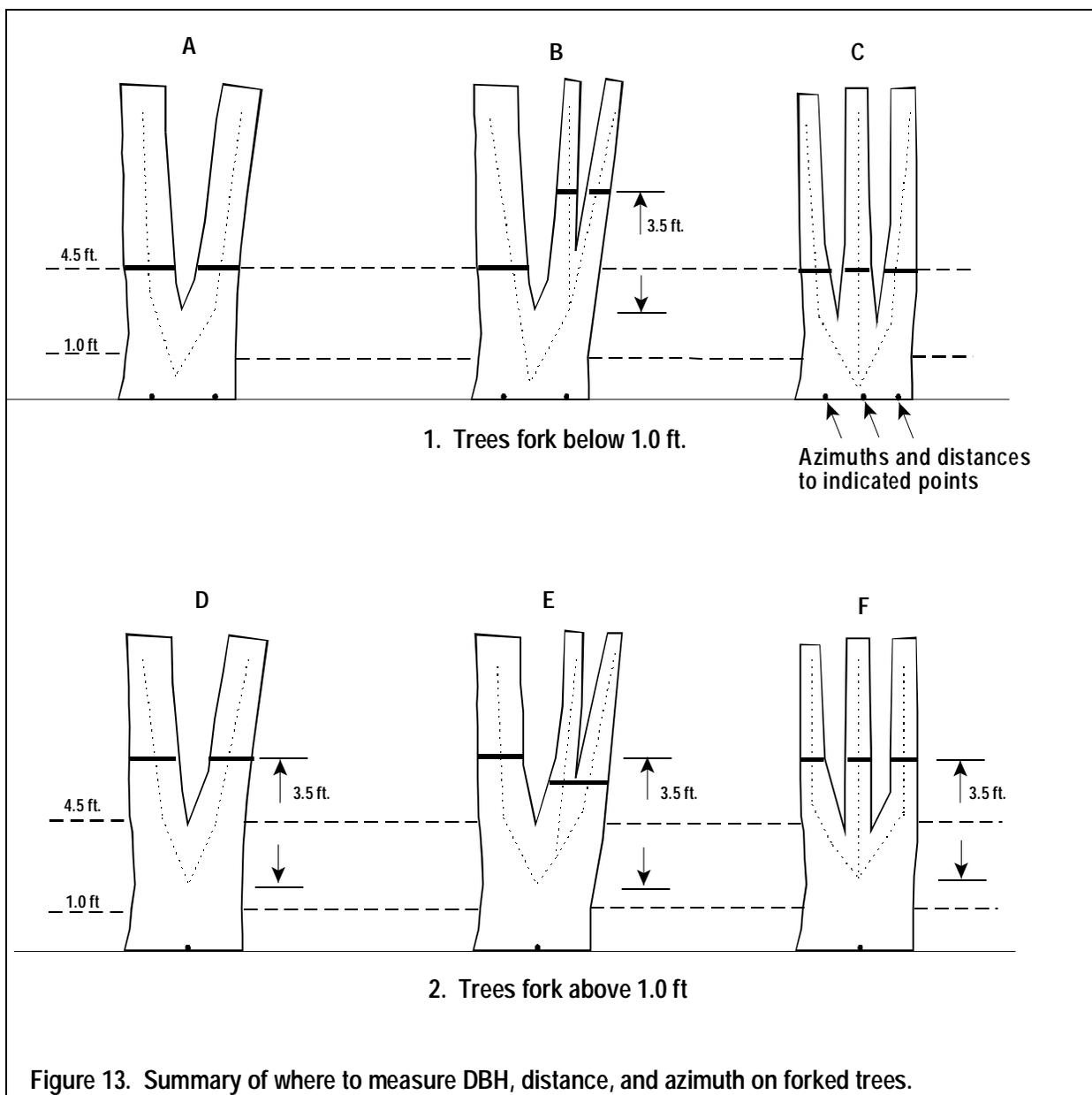
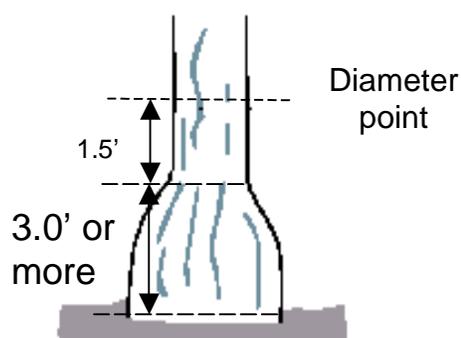


Figure 12. One tree

2. Stump Sprouts. Stump sprouts originate between ground level and 4.5 ft on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole. Stump sprouts originating below 1.0 ft are measured at 4.5 ft from ground line. Stump sprouts originating between 1.0 ft and 4.5 ft are measured at 3.5 ft above their point of occurrence. As with forks, rules for measuring distance and azimuth depend on whether the sprouts originate above or below 1.0 ft. For multi-stemmed woodland species, treat all new sprouts as part of the same new tree.



3. Tree with butt-swell or bottleneck:  
 Measure these trees 1.5 ft above the end of the swell or bottleneck if the swell or bottleneck extends 3.0 ft or more above the ground (Figure 10).



4. Tree with irregularities at DBH: On trees with swellings (Figure 13), bumps, depressions, branches (Figure 14), etc. at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.

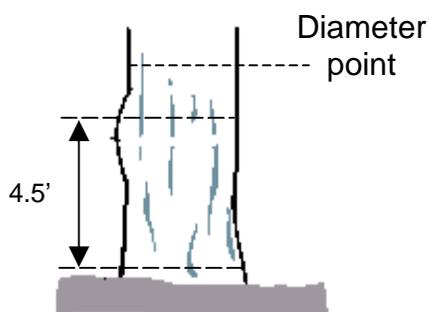


Figure 15. Tree with swelling

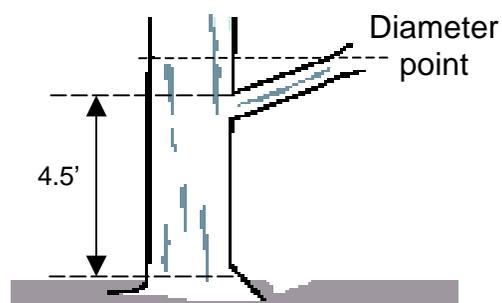


Figure 16. Tree with branch

5. Tree on slope: Measure diameter at 4.5 ft from the ground along the bole on the uphill side of the tree (Figure 15).

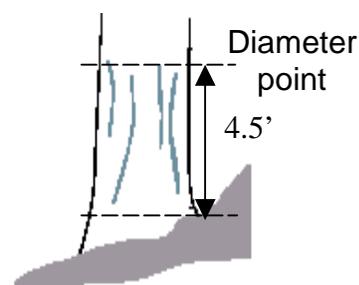


Figure 17. Tree on a slope

6. Leaning tree: Measure diameter at 4.5 ft from the ground along the bole. The 4.5 ft distance is measured along the underside face of the bole (Figure 16).

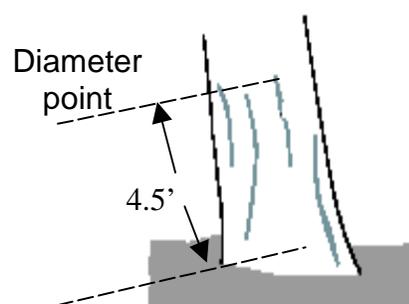


Figure 18. Leaning tree

7. Turpentine tree: On trees with turpentine face extending above 4.5 ft, estimate the diameter at 10.0 ft above the ground and multiply by 1.1 to estimate DBH outside bark.
8. Independent trees that grow together: Continue to treat them as two trees.

9. Missing wood or bark. Do not reconstruct the DBH of a tree that is missing wood or bark at the point of measurement. Record the diameter, to the nearest 0.1, of the wood and bark that is still attached to the tree (Figure 19). If a tree has a localized abnormality (gouge, depression, etc.) at the point of DBH, apply the procedure described for trees with irregularities at DBH (Figure 14).

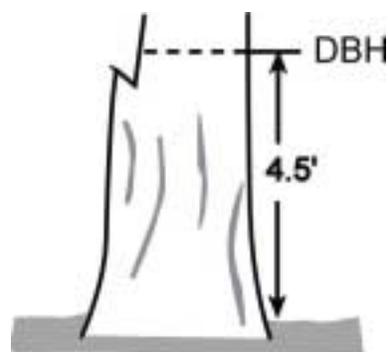


Figure 19. Tree with broken stem

10. Live windthrown tree: Measure from the top of the root collar along the length to 4.5 ft (Figure 18).

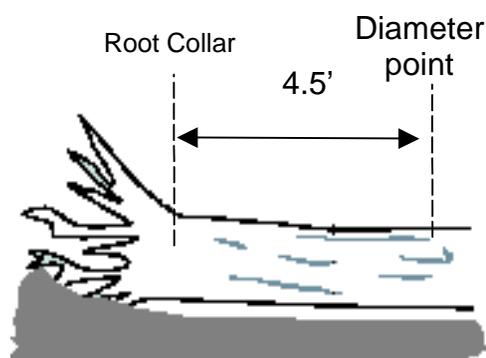
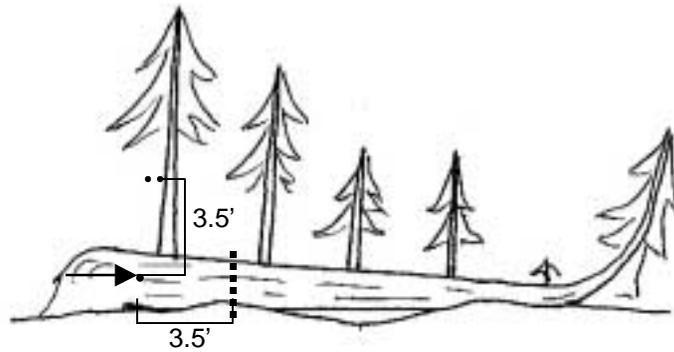


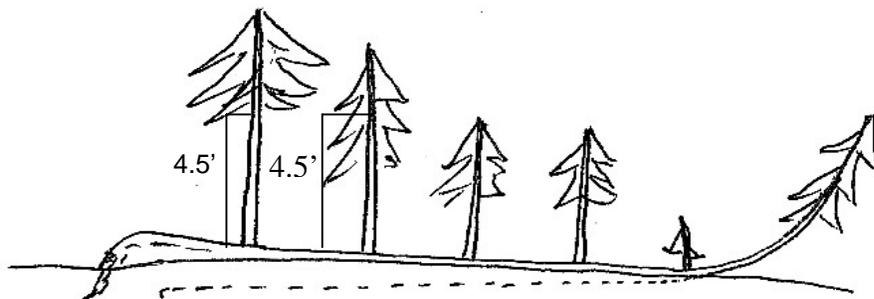
Figure 20. Tree on ground.

11. Down live tree with tree-form branches growing vertical from main bole. When a down live tree, touching the ground, has vertical ( $<45^\circ$  from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main bole (averaged along the first log of the tree) is above or below the duff layer.
- If the pith of the main bole is above the duff layer, use the same forking rules specified for a forked tree, and take all measurements accordingly (Figure 21).
    - If the pith intersection of the main down bole and vertical tree-like branch occurs below 4.5' from the stump along the main bole, treat that branch as a separate tree, and measure DBH 3.5' above the pith intersection for both the main bole and the tree-like branch.



**Figure 21. Down tree above duff**

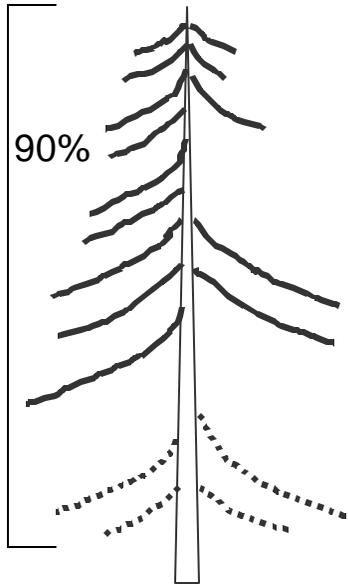
- If the intersection between the main down bole and the tree-like branch occurs beyond the 4.5' point from the stump along the main bole, treat that branch as part of the main down bole.
- If the pith of main tree bole is below the duff layer, ignore the main bole, and treat each tree-like branch as a separate tree; take DBH and length measurements from the ground, not necessarily from the top of the down bole (Figure 22). However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer.



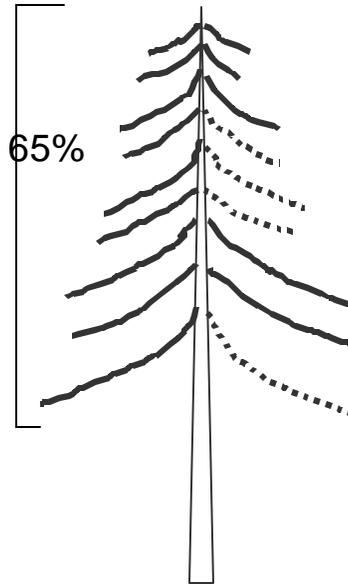
**Figure 22. Down tree below duff**

Open-crown conifer (e.g., ponderosa pine) –

Uncompacted:

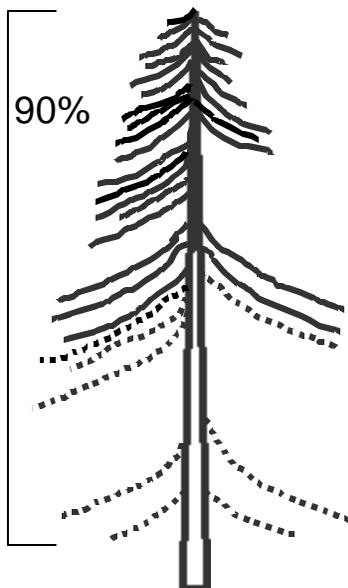


Compacted:

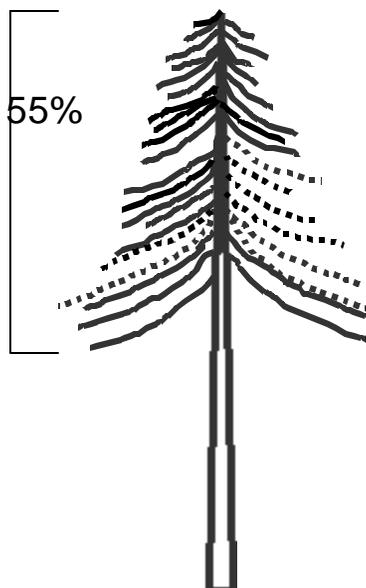


Dense-crown conifer (e.g., subalpine fir) –

Uncompacted:



Compacted:



**Figure 27. Examples of COMPACTED CROWN RATIO of conifers.**

## CUBIC FOOT CULL PROCEDURES

### ITEM 5110 PERCENT ROTTEN/MISSING CULL (CORE 5.11)

Record the percent rotten or missing cubic-foot cull for all live tally trees  $\geq$  5.0 in DBH.

When Collected: All live tally trees  $\geq$  5.0 in DBH

Field width: 2 digits

Values: 00 to 99

Record the percentage of rotten and missing cubic-foot volume, to the nearest 1 percent. When estimating volume loss (tree cull), only consider the cull on the merchantable bole/portion of the tree, from a 1-ft stump to a 4-inch top. Do not include any cull estimate above actual length.

Rotten and missing volume loss is often difficult to estimate. Refer to supplemental disease and insect pests field guides and local defect guidelines as an aid in identifying damaging agents and their impact on volume loss. Use your best judgment and be alert to such defect indicators as the following:

- Cankers or fruiting bodies.
- Swollen or punky knots.
- Dull, hollow sound of bole (use regional standards).
- Large dead limbs, especially those with frayed ends.
- Sawdust around the base of the tree.

Also cull portions of the tree that contain embedded metal objects (e.g., fencing, nails) and sections between metal objects that are less than 4 feet in length.

<b>Cubic-Foot Volume of Short Logs</b>										
D.I.B. midpoint	Length of log or section (feet)									
	1	2	3	4	6	8	10	12	14	16
4	0.1	0.2	0.3	0.3	0.5	--	--	--	--	--
5	0.1	0.3	0.4	0.5	0.8	1.1	1.4	1.6	1.9	2.2
6	0.2	0.4	0.6	0.8	1.2	1.6	2.0	2.4	2.7	3.1
7	0.3	0.5	0.8	1.1	1.6	2.1	2.7	3.2	3.7	4.3
8	0.3	0.7	1.0	1.4	2.1	2.8	3.5	4.2	4.9	5.6
9	0.4	0.9	1.3	1.8	2.7	3.5	4.4	5.3	6.2	7.1
10	0.5	1.1	1.6	2.2	3.3	4.4	5.5	6.5	7.6	8.7
12	0.8	1.6	2.4	3.1	4.7	6.3	7.9	9.4	11.0	13.0
14	1.1	2.1	3.2	4.3	6.4	8.6	11.0	13.0	15.0	17.0
16	1.4	2.8	4.2	5.6	8.4	11.0	14.0	17.0	20.0	22.0
18	1.8	3.5	5.3	7.1	11.0	14.0	18.0	21.0	25.0	28.0
20	2.2	4.4	6.5	8.7	13.0	18.0	22.0	26.0	30.0	35.0
22	2.6	5.3	7.9	11.0	16.0	21.0	26.0	32.0	37.0	42.0
24	3.1	6.3	9.4	13.0	19.0	25.0	31.0	38.0	44.0	50.0
26	3.7	7.4	11.0	15.0	22.0	30.0	37.0	44.0	52.0	59.0
28	4.3	8.6	13.0	17.0	26.0	34.0	43.0	51.0	60.0	68.0
30	4.9	9.8	15.0	20.0	30.0	39.0	49.0	59.0	69.0	78.0
32	5.6	11.0	17.0	22.0	34.0	45.0	56.0	67.0	78.0	89.0
34	6.3	13.0	19.0	25.0	38.0	50.0	63.0	76.0	88.0	101.0
36	7.1	14.0	21.0	28.0	42.0	56.0	71.0	85.0	99.0	113.0
38	7.9	16.0	24.0	32.0	47.0	63.0	79.0	94.0	110.0	126.0
40	8.7	18.0	26.0	35.0	52.0	70.0	87.0	105.0	122.0	140.0

## BOARD FOOT CULL PROCEDURES

### ITEM R504 PERCENT BOARD FOOT CULL

Record the percentage of rotten and missing board-foot volume, to the nearest 1 percent. When estimating board-foot cull, only consider the cull in the sawlog portion of the tree, from a 1-ft stump to a 7-inch top for pines, from a 1-ft stump to 9-inch top on hardwoods. Do not include any cull estimate above actual length. Board foot cull cannot be coded greater than 67 percent. If the actual amount of board foot cull is greater than 67 percent, then TREE CLASS ≠2, and board foot cull is not required.

When collected: live trees with DBH ≥ 9.0 in, SPECIES < 300, and TREE CLASS = 2; live trees with DBH ≥ 11.0 in and TREE CLASS = 2

Field width: 2 digits

Values: 00-67

Board-foot cull is the volume within the entire sawlog portion of all live trees that cannot be recovered for use as lumber because of rot, sweep or crook, or other defect. Cull volume includes the entire volume of sections that do not meet minimum log grade requirements. This includes all sections less than 8 feet in length and the cull volume within sawlogs. Board foot cull is assigned for those trees receiving a tree grade, according to the section length (in feet), from a 1-foot stump to a 7-inch top in softwood or 9 inch top in hardwood.

#### Sweep and Crook

Estimate the length, small-end DIB, and sweep or crook departure of the affected section. If the length is 6 feet or less, treat as crook. To determine board-foot deduction, see the tables for sweep and crook in the appendix. If sweep or crook is so excessive that the section is cull, record the entire volume of the section as cull. This is the area within the heavy black lines of the sweep/crook tables.

#### Other Board-Foot Cull

Determine the length and the small-end DIB of the section containing decay, missing wood, fork, etc. Estimate the percentage of the section that is unusable for lumber, ties, or timber, ignoring cull defect that could normally be removed in slabbing. Apply this percentage to the total volume contained in the section, as shown in the board foot cull table.

#### Sawlog Stoppers

Measure the main stem to the point above which no sawlog can be produced to meet log grade standards (size and soundness) and to a minimum top of 7.0 inches DOB for softwoods and 9.0 inches DOB for hardwoods.

The sawlog cannot extend above a point where taper becomes excessive as evidenced by:

- (1) A fork with less than 8 foot sawlog above it (12 feet if this is the only log in the tree)

- (2) A limb with a base diameter equal to one half or more of the stem diameter below the limb, or a group of smaller limbs 2.0 inches or larger within a 1 foot section with equivalent diameter which collectively influence taper to the same degree.

Sawlog length should not extend above a sawlog section that does not meet minimum grade specifications and which has less than 8 feet of sawlog length above it (12 feet if this is the only log in the tree).

<b>Board-Foot Volume of Short Logs</b>										
DIB small end	Length of log or section (feet)									
	1	2	3	4	6	8	10	12	14	16
6	1	2	2	3	5	8	10	13	16	19
7	1	3	4	5	8	12	15	19	24	28
8	2	4	6	8	12	17	22	27	33	39
9	3	5	8	10	16	22	29	36	43	51
10	3	7	10	13	21	29	37	46	55	65
11	4	9	13	17	26	36	46	57	68	80
12	5	10	16	21	32	44	57	69	83	97
13	6	13	19	25	39	53	68	83	99	115
14	8	15	23	30	46	63	80	98	117	136
16	10	20	31	41	62	84	108	131	158	181
18	13	26	40	53	81	109	139	169	200	232
20	17	33	50	67	102	137	174	212	251	290
22	21	41	62	82	125	169	214	259	306	354
24	25	50	74	99	151	203	257	311	368	424
26	29	59	88	118	179	241	304	368	435	501
28	35	69	104	138	210	281	356	430	507	584
30	40	80	120	160	243	325	411	497	585	674
32	46	92	137	183	278	373	470	568	669	770
34	52	104	156	208	316	423	534	644	758	872
36	59	117	176	235	356	477	601	725	853	981
38	66	132	197	263	398	533	672	811	954	1096
40	73	146	220	293	443	593	747	902	1060	1218

Crook Deduction in Board Feet															
Crook departure (inches)	Crook length (feet)	Scaling diameter of section with crook (inches)													
		6	7	8	9	10	12	14	16	18	20	22	24	26	28
1	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	2	0	0	0	1	1	1	1	1	1	2	2	2	2	2
	3	1	1	1	1	1	1	2	2	2	2	3	3	3	4
	4	1	1	1	1	1	2	2	3	3	3	4	4	4	5
	5	1	1	1	1	2	2	3	3	4	4	5	5	6	6
	6	1	1	2	2	2	3	3	4	5	5	6	6	7	8
2	1	0	0	0	1	1	1	1	1	1	2	2	2	2	3
	2	1	1	1	1	1	2	2	2	3	3	4	4	4	5
	3	1	1	2	2	2	3	3	4	4	4	6	6	7	7
	4	1	1	2	2	3	3	4	5	6	7	8	8	9	10
	5	1	2	2	3	3	4	5	6	8	8	10	10	11	13
	6	2	2	3	4	4	5	7	8	9	10	13	13	14	15
3	1	0	0	1	1	1	1	2	2	2	3	3	3	3	4
	2	1	1	2	2	2	2	3	4	4	5	5	6	7	7
	3	1	2	2	3	3	4	5	6	7	8	8	9	10	11
	4	2	2	3	3	4	5	6	8	9	10	10	12	13	15
	5	2	3	4	4	5	6	8	10	11	13	13	16	17	19
	6	2	3	4	5	6	8	10	12	14	15	15	19	20	23
4	1	1	1	1	1	1	2	2	2	3	3	3	4	4	5
	2	1	2	2	2	3	3	4	5	6	7	7	8	9	10
	3	1	2	3	3	4	5	7	8	9	10	10	12	13	15
	4	2	3	4	3	5	7	9	10	12	13	13	17	18	20
	5	2	3	5	6	7	9	11	13	15	17	17	21	22	25
	6	3	5	6	7	8	11	13	15	18	20	20	25	27	30
5	1	-	-	1	2	2	2	3	3	4	4	4	5	6	6
	2	-	-	2	3	4	4	5	6	7	8	8	10	11	12
	3	-	-	4	4	5	7	8	10	11	12	12	16	17	19
	4	-	-	5	6	6	9	11	13	15	17	17	21	22	25
	5	-	-	6	7	8	11	13	16	19	21	21	26	28	31
	6	-	-	8	9	10	13	16	19	23	26	26	32	34	36
6	1	-	-	-	2	2	2	3	4	4	5	5	6	7	8
	2	-	-	-	3	4	5	6	7	9	10	10	13	13	15
	3	-	-	-	4	6	8	10	12	13	15	15	19	20	22
	4	-	-	-	7	8	10	13	15	18	20	20	25	27	30
	5	-	-	-	9	10	13	16	19	23	25	25	32	34	38
	6	-	-	-	11	13	16	20	23	27	31	31	38	41	45
8	1	-	-	-	-	-	3	5	5	6	7	7	8	9	10
	2	-	-	-	-	-	7	9	10	12	13	13	17	18	20
	3	-	-	-	-	-	10	13	16	18	20	20	25	27	30
	4	-	-	-	-	-	14	17	20	24	27	27	33	36	40
	5	-	-	-	-	-	17	22	26	30	34	34	42	45	50
	6	-	-	-	-	-	21	26	31	36	41	41	51	54	60
10	1	-	-	-	-	-	-	-	6	7	8	8	10	11	12
	2	-	-	-	-	-	-	-	12	14	16	16	21	23	25
	3	-	-	-	-	-	-	-	19	22	25	25	31	34	37
	4	-	-	-	-	-	-	-	26	29	34	34	41	45	49
	5	-	-	-	-	-	-	-	32	37	42	42	52	57	62
	6	-	-	-	-	-	-	-	39	45	51	51	63	69	75

In dashed (--) spaces, excessive sweep culls the entire section. Boxed spaces are sound for softwoods, but cull for hardwoods

Sweep Deduction in Board Feet															
Sweep departure (inches)	Sweep length (feet)	Scaling diameter of section with sweep (inches)													
		6	7	8	9	10	12	14	16	18	20	22	24	26	28
2	6	1	1	2	2	3	3	4	5	6	6	7	8	9	9
	8	1	1	2	2	3	4	5	5	6	7	8	8	9	10
	10	1	1	2	2	3	4	4	5	6	7	7	8	9	10
	12	1	1	2	2	2	3	4	4	5	6	6	6	7	8
	14	1	1	1	1	1	2	2	2	3	3	3	4	4	5
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	6	2	3	3	5	5	6	7	9	10	11	13	14	15	17
	8	2	3	4	6	6	7	9	10	12	14	15	17	19	20
	10	2	4	5	6	6	8	10	12	13	15	17	19	20	22
	12	3	4	5	7	7	9	11	12	14	16	18	19	21	23
	14	3	4	5	7	7	9	10	12	14	16	17	19	21	23
	16	3	4	5	6	6	8	10	11	13	14	16	18	19	21
4	6	3	4	5	6	7	8	11	13	15	17	18	20	22	24
	8	4	5	6	7	9	11	14	16	18	21	23	25	28	30
	10	5	6	8	9	10	13	16	19	21	24	27	29	32	35
	12	5	7	8	10	12	14	18	20	23	26	29	32	35	38
	14	6	8	9	11	12	16	19	22	25	28	31	35	38	41
	16	6	8	10	11	13	16	19	23	26	29	32	35	39	42
5	6	-	5	6	8	9	11	14	16	19	22	24	27	29	32
	8	5	7	8	10	12	15	18	21	24	27	31	34	37	40
	10	6	8	10	12	14	18	21	25	29	33	36	40	44	48
	12	8	10	12	12	16	20	25	29	33	37	41	45	50	54
	14	9	11	13	16	18	22	27	32	36	41	45	50	54	59
	16	10	12	15	17	20	24	29	34	39	44	48	53	58	63
6	6	-	-	8	9	11	14	17	20	24	27	30	33	36	39
	8	-	-	11	12	14	18	22	26	30	34	38	42	46	50
	10	-	10	13	15	18	23	27	32	36	41	46	51	56	60
	12	-	12	15	18	21	26	32	37	42	48	53	58	64	69
	14	11	15	18	20	23	29	36	41	47	53	59	65	71	77
	16	13	16	20	23	26	32	39	45	52	58	64	71	77	83
7	6	-	-	-	11	13	16	21	24	28	32	36	39	43	47
	8	-	-	-	15	17	22	27	31	36	41	46	51	56	60
	10	-	-	-	19	21	27	33	39	44	50	56	62	67	73
	12	-	-	-	22	25	32	39	45	52	58	65	71	78	84
	14	-	-	-	25	29	36	44	51	58	66	73	81	88	95
	16	-	-	24	28	33	40	49	57	64	72	80	88	96	104
8	6	-	-	-	-	-	19	24	28	33	37	41	46	50	54
	8	-	-	-	-	-	25	31	37	42	48	54	59	65	70
	10	-	-	-	-	25	32	39	46	52	59	66	72	79	86
	12	-	-	-	-	30	37	46	53	61	69	76	84	92	100
	14	-	-	-	-	34	43	52	61	69	78	87	96	105	113
	16	-	-	-	34	39	48	58	68	77	87	97	106	116	125
9	6	-	-	-	-	-	-	27	32	37	42	47	52	57	62
	8	-	-	-	-	-	29	36	42	48	55	61	68	74	80
	10	-	-	-	-	-	37	44	52	60	67	75	83	91	99
	12	-	-	-	-	-	43	52	61	70	80	88	97	106	115
	14	-	-	-	-	-	50	61	71	81	91	101	111	121	131
	16	-	-	-	-	-	57	68	79	90	102	113	124	135	146

In dashed (--) spaces, excessive sweep culls the entire section. Boxed spaces are sound for softwoods, but cull for hardwoods

## TREE GRADE PROCEDURES

### HARDWOOD TREE GRADES

<b>HARDWOOD TREE GRADES</b>			
<b>GRADING FACTORS</b>	<b>GRADE 1</b>	<b>GRADE 2</b>	<b>GRADE 3</b>
Length of grading zone (ft)	Butt 16	Butt 16	Butt 16
Length of grading section <sup>a</sup> (ft)	Best 12	Best 12	Best 12
Minimum DBH (in)	16 <sup>b</sup>	13	11
Minimum DIB at the top of the grading section (in)	13 <sup>b</sup> 16 20	11 <sup>c</sup> 12	8
Clear cuttings on 3rd best face <sup>d</sup> minimum length (ft)	7 5 3	3 3	2
number on face (max)	2	2 3	unlimited
yield in face length (min)*	5/6	4/6	3/6
Cull deduction, including crook and sweep but excluding shake, maximum w/in grading section (%)	9	9 <sup>e</sup>	50

<sup>a</sup> Whenever a 14- or 16-ft section of the butt log is better than the best 12-ft section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors, such as diameter and cull deduction.

<sup>b</sup> In basswood and ash, DIB at the top of the grading section may be 12-in and DBH may be 15-in.

<sup>c</sup> Grade 2 trees can be 10-in DIB at the top of the grading section if otherwise meeting surface requirements for small grade 1's.

<sup>d</sup> A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.

<sup>e</sup> 15% crook and sweep, or 40% total cull deduction are permitted in grade 2 if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40%.

<b>*Minimum Yield in Face Length</b>			
Face Length	Grade 1 Min. Yield	Grade 2 Min. Yield	Grade 3 Min. Yield
12-ft	10-ft	8-ft	6-ft
14-ft	11.7-ft	9.3-ft	7-ft
16-ft	13.3-ft	10.7-ft	8-ft

<b>HARDWOOD TIE AND TIMBER GRADE 4</b>	
<b>GRADING FACTORS</b>	<b>SPECIFICATIONS</b>
Length of grading zone (ft)	Butt 16
Scaling diameter (in)	8-in DIB and larger
Length, w/o trim (ft)	12-ft and longer
Clear cuttings	No requirements (not graded on cutting basis)
Maximum sweep allowance	One-fourth DIB of small end for half logs, and one-half DIB for logs 16-ft long
Sound surface defects -	
Single knots	Any number, if none has an average collar <sup>a</sup> diameter that is more than one-third of the log diameter at the point of occurrence.
Whorled knots	Any number, provided the sum of the collar diameters does not exceed one-third the log diameter at the point of occurrence.
Knots	Any number not exceeding knot specifications, if they do not extend more than 3-in into the contained tie or timber.
Unsound surface defects <sup>b</sup>	Any number and size, if they do not extend into contained tie or timber. If they extend into contained tie or timber, they shall not exceed size, number, and depth of limits for sound defects.

<sup>a</sup> Knot collar is the average of the vertical and horizontal diameters of the limb, or knot swelling, as measured flush with the surface of the log.

<sup>b</sup> Interior defects are not visible in standing trees. They are considered in grading cut logs. No interior defects are permitted except one shake not more than one-third the width of the contained tie or timber, and one split not more than 5-in long.

### **HARDWOOD TREE GRADE 5**

Record TREE GRADE 5 for hardwood species that do not meet the length of grading zone requirement for TREE GRADE 1-4, but do have either an upper 12-foot log or 2 non-contiguous 8-foot logs, and the total board foot cull deduction is less than 67%.

These logs must still meet the size, soundness and surface yield requirements for a grade 1-4 log. The only difference is that the length of the grading zone extends beyond the butt 16-foot log.

Since these logs are in the upper portion of the tree, determining the surface yield is impractical. When determining if TREE GRADE = 5, simply make sure the log appears to meet the size and soundness requirements of a TREE GRADE 4 (no internal rot). If it is clear the upper log does have internal rot, then it must be examined further to determine if it can at least meet the size, soundness and surface yield requirements of a TREE GRADE 3 (the log must be at least 8 inches DIB, with no more than 50% board foot cull in the section, at least 3/6 of the section length clear of defects, and at least 2 feet between defects.)

Log abnormalities that are defects in factory logs include the following:

Adventitious bud clusters	Limb
Bulge, butt or stem	Knots
High bumps	Knot overgrowths
Burl	Low bumps
Butt scar	Overgrowths following insect damage or bird peck*
Canker	Seams, if not superficial
Conk	Wounds extending into the bole
Flutes, if not superficial	
Holes extending into the bole	
Embedded metal (fence)	

Bird pecks: There must be four bird pecks within a square foot to affect the tree grade. First, determine the tree grade without the bird pecks. If the tree grade is determined to be 1 or 2, then down grade the tree by one grade. If the tree graded out to be a 3 or 4 without the bird pecks, then ignore them as defects and record the initial tree grade.

Abnormalities not ordinarily limiting cuttings are butt swell, flanges and surface rise.

### SOUTHERN PINE TREE GRADES

SOUTHERN PINE TREE GRADES			
All pines except eastern white pine. Includes red cedar and cypress.			
FACE LENGTH	GRADE 1	GRADE 2	GRADE 3
Butt 16-ft*	3 or 4 clear faces	1 or 2 clear faces	No clear faces

After the tentative grade is established, the tree will be **reduced one grade** for each of the following:

- Sweep** - Degrade any tentative Grade 1 or 2 tree one grade if sweep in the lower 12-ft of the grading section amounts to 3 or more inches and equals or exceeds one-fourth the DBH.
- Heart rot** - Degrade any tentative Grade 1 or 2 tree one grade if conks, punk knots, or other evidence of advanced heart rot is found anywhere on the tree stem.
- Note** - No tree can be degraded below Grade 3, provided the total scaling deductions for sweep and/or rot do not exceed two-thirds the gross scale of the tree. Trees with total scaling deductions in excess of two-thirds are classified as cull (Tree Class 3 or 4).

A face is one-fourth the circumference of the 16-ft grading section and extends the full length of the grading section. Clear faces are those free from knots measuring more than 1/2-inch in diameter, overgrown knots of any size, and holes more than 1/4-inch in diameter. Faces may be rotated, if necessary to obtain the maximum number of clear faces on the grading section.

\*Note: Only grade the length of the log up to a 7-inch top DOB. The 7-inch top DOB must be between 12-16 feet off of the 1ft stump to be coded TREE CLASS 2.

### SOUTHERN PINE TREE GRADE 5

Record TREE GRADE 5 for southern pine species that do not have a 12-foot log in the butt 16-foot grading section due primarily to poor form, but do have either an upper 12-foot log or 2 non-contiguous 8-foot logs, and the total board foot cull deduction is less than 67%.

**EASTERN WHITE PINE TREE GRADES**

<b>EASTERN WHITE PINE TREE GRADES</b>				
<b>GRADING FACTORS</b>	<b>GRADE 1</b>	<b>GRADE 2</b>	<b>GRADE 3</b>	<b>GRADE 4</b>
Minimum DBH (in)	9	9	9	9
Maximum weevil injury in butt 16-ft section (number)	None	None	2 Injuries	No limit
Minimum face requirements on butt 16-ft section	Two full length or four 50% length good faces <sup>1</sup> . (In addition, knots on balance of faces shall not exceed size limitations for Grade 2 sections.)	NO GOOD FACES REQUIRED. Maximum diameter of knots on 3 best faces: <b>SOUND RED KNOTS</b> not to exceed 1/6 of scaling diameter or 3-in maximum <sup>2</sup> . <b>DEAD OR BLACK KNOTS</b> , including overgrown knots, not to exceed 1/12 scaling diameter and 1-1/2-in maximum.	NO GOOD FACES REQUIRED. Maximum diameter of knots on 3 best faces: <b>SOUND RED KNOTS</b> not to exceed 1/3 of scaling diameter of 5-in maximum <sup>2</sup> . <b>DEAD OR BLACK KNOTS</b> , including overgrown knots, not to exceed 1/6 scaling diameter and 2-1/2-in maximum.	Includes all trees not qualifying for Grade 3 or better and judged to have at least 1/3 of their gross volume in sound wood suitable for manufacture into standard lumber.
Maximum sweep or crook in butt 16-ft section (%)	20	30	40	No limit
Maximum total scaling deduction in 16-ft section (%)	50	50	50	No limit

After the tentative grade of the section is established from face examination, the section will be **reduced one grade** whenever the following defects are evident<sup>3</sup>:

**CONKS, PUNK KNOTS AND PINE BORER DAMAGE ON THE SURFACE OF THE SECTION**  
 Degrade one grade if present on one face.  
 Degrade two grades if present on two faces.  
 Degrade three grades if present on three to four faces.

If the final grade of the grading section is 1, 2 or 3, examine the tree for weevil injuries in the merchantable stem **above** 16-ft. If the total apparent weevil damage exceeds 3, degrade the tree grade one below the section grade<sup>3</sup>. Otherwise the tree grade is the same as the final section grade.

<sup>1</sup> Trees under 16-in DBH require four full length good faces.

<sup>2</sup> Scaling diameter is estimated at the top of the 16-ft grading section.

<sup>3</sup> No tree will be designated below Grade 4 unless net tree scale is less than one-third of gross tree scale.

<b>White Pine Collar Diameter Limits for Red &amp; Black Knots</b>			
<b>Scaling Diameter (DIB in)</b>	<b>Black Knots 1/12</b>	<b>Black &amp; Red Knots 1/6</b>	<b>Red Knots 1/3</b>
7	7/12"	1-1/6"	2-1/3"
8	2/3"	1-1/3"	2-2/3"
9	3/4"	1-1/2"	3"
10	5/6"	1-2/3"	3-1/3"
11	11/12"	1-5/6"	3-2/3"
12	1"	2"	4"
13	1-1/12"	2-1/6"	4-1/3"
14	1-1/6"	2-1/3"	4-2/3"
15	1-1/4"	<b>2-1/2" Black Max</b>	<b>5" Max</b>
16	1-1/3"	2-2/3"	<b>5" Max</b>
17	1-5/12"	2-5/6"	<b>5" Max</b>
18	<b>1-1/2" Max</b>	<b>3" Red Max</b>	<b>5" Max</b>

### **EASTERN WHITE PINE TREE GRADE 5**

Record TREE GRADE 5 for eastern white pine trees that do not have a 12-foot log in the butt 16-foot grading section due primarily to poor form, but do have either an upper 12-foot log or 2 non-contiguous 8-foot logs, and the total board foot cull deduction is less than 67%.

### **SPRUCE, FIR, WHITE-CEDAR, TAMARACK AND HEMLOCK**

<b>SPRUCE, FIR, WHITE-CEDAR, TAMARACK AND HEMLOCK</b>				
<b>Minimum Merchantability Specifications for Grade 1</b>				
<b>DIB (small end of log)</b>	<b>Length (2-ft multiples w/o trim)</b>	<b>Total Deduction</b>	<b>Sweep Permitted</b>	<b>Other Requirements*</b>
6" - 12"	12' - 16'	50%	25%	Not more than one sound knot or branch greater than 2" in diameter.
13" +	12' - 16'	50%	25%	Not more than one sound knot or branch greater than 3" in diameter.

If the tree does not meet the specifications for a grade 1, but does have a 12-foot log in the butt 16-foot section, then record TREE GRADE = 4.

### **SPRUCE, FIR, WHITE-CEDAR, TAMARACK AND HEMLOCK TREE GRADE 5**

Record TREE GRADE 5 for trees that do not have a 12-foot log in the butt 16-foot grading section due primarily to poor form, but do have either an upper 12-foot log or 2 non-contiguous 8-foot logs, and the total board foot cull deduction is less than 67%.



## TREE DAMAGE PROCEDURES

### OVERVIEW

Record up to two different damages per tree. Damage is characterized according to three attributes: location of damage, type of damage, and severity of damage. Damages must meet severity thresholds in order to be recorded.

The tree is observed from all sides starting at the roots. Damage signs and symptoms are prioritized and recorded based on location in the following order: roots, roots and lower bole, lower bole, lower and upper bole, upper bole, crownstem, and branches (DAMAGE LOCATION 1-9). No damage is recorded as location code 0.

Within any given location, the hierarchy of damage follows the numeric order of DAMAGE TYPE possible for that location. The numeric order denotes decreasing significance as the code number goes up, i.e., DAMAGE TYPE 01 is more significant than DAMAGE TYPE 25. A maximum of two damages are recorded for each tree. If a tree has more than two damages that meet the threshold levels, the first two that are observed starting at the roots are recorded.

### PROCEDURES TO RECORD MULTIPLE DAMAGES AT THE SAME LOCATION

When multiple damages occur in the same place, the most damaging is recorded. For example, if a canker, DAMAGE TYPE 01, meets the threshold and has a conk growing in it, record only the canker. Another example: if an open wound meets threshold and also has resinosis, record only the open wound.

### PROCEDURES TO RECORD MULTIPLE OCCURRENCES OF THE SAME DAMAGE

Damage codes 01 (canker), 03 (open wounds), and 04 (resinosis/gummosis) must meet a threshold of 20 percent of the circumference at the point of occurrence, within any 3-ft section. Multiple cankers or open wounds which are directly above one another pose no more threat to long term tree survival than would a single damage incidence of the same width. However, should multiple damages be located horizontally within any 3-ft section, the translocation of water and nutrients would be significantly affected. The widths of each individual damage are added and compared as a percent, to the total circumference at the midpoint of the 3-ft section (Figure 24).

### PROCEDURES TO MEASURE CIRCUMFERENCE AFFECTED

A practical approach is to observe every face of the "stump", bole, or crownstem. About 40% of the circumference of a face can be observed at any one time. The damage is measured horizontally between the margins. If the cumulative area affected within a 3-ft section exceeds 1/2 of any face, then the 20% minimum threshold has been met. The percent of the circumference affected by damage is then estimated in 10% classes. If in doubt, measure the damage and circumference at the widest point of occurrence on the bole with a linear tape, and determine the percent affected.

**ITEMS 5181, 5184      DAMAGE LOCATION 1, 2 (CORE 5.18.1, 5.18.4)**

Record the location on the tree where DAMAGE TYPE is found (Figure 23). If the same damage continues into two or more locations, record the appropriate code listed below, or if the combination of locations does not exist (damage extends from crownstem to roots), record the lowest location that best describes the damage (see Figure 24). Multiple damages may occur in the same location, but record the higher priority damage (lower code number) first. If the damages are coincident (a conk within a canker), record only the higher priority damage.

The “base of the live crown” is defined as the horizontal line which would touch the lowest part of the foliage, excluding branches towards the base of the tree which are less than 1.0 inch, or more than 5 ft from the rest of the crown.

| When Collected: **P3 PLOTS ONLY:** All live tally trees  $\geq 5.0$  in DBH

Field width: 1 digit

Values:

- 0 No damage
- 1 Roots (exposed) and stump (12 inches in height from ground level)
- 2 Roots, stump, and lower bole
- 3 Lower bole (lower half of the trunk between the stump and base of the live crown)
- 4 Lower and upper bole
- 5 Upper bole (upper half of the trunk between stump and base of the live crown)
- 6 Crownstem (main stem within the live crown area, above the base of the live crown)
- 7 Branches (>1 in at the point of attachment to the main crown stem within the live crown area)
- 8 Buds and shoots (the most recent year's growth)
- 9 Foliage

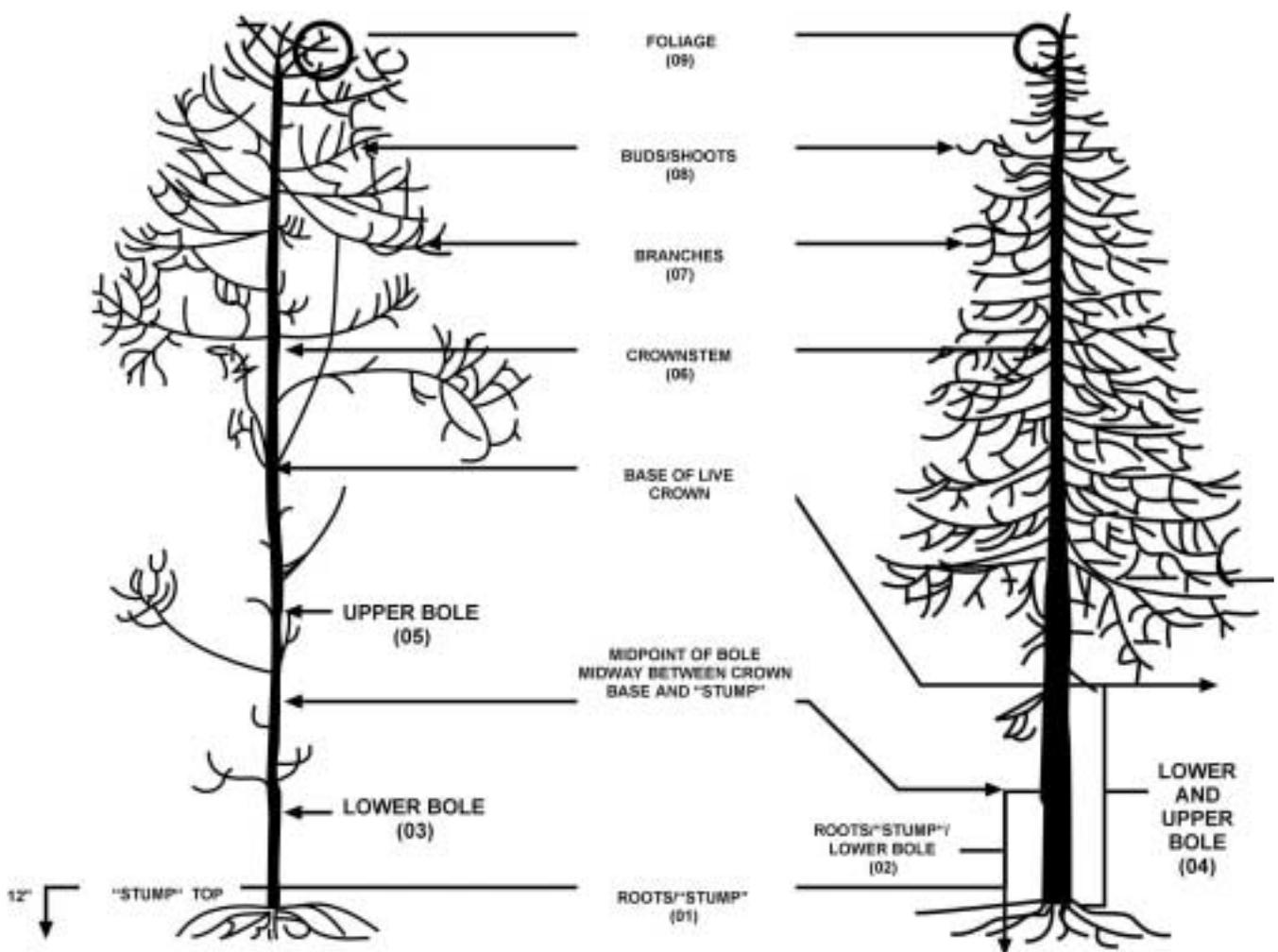


Figure 23. Location codes for damage.

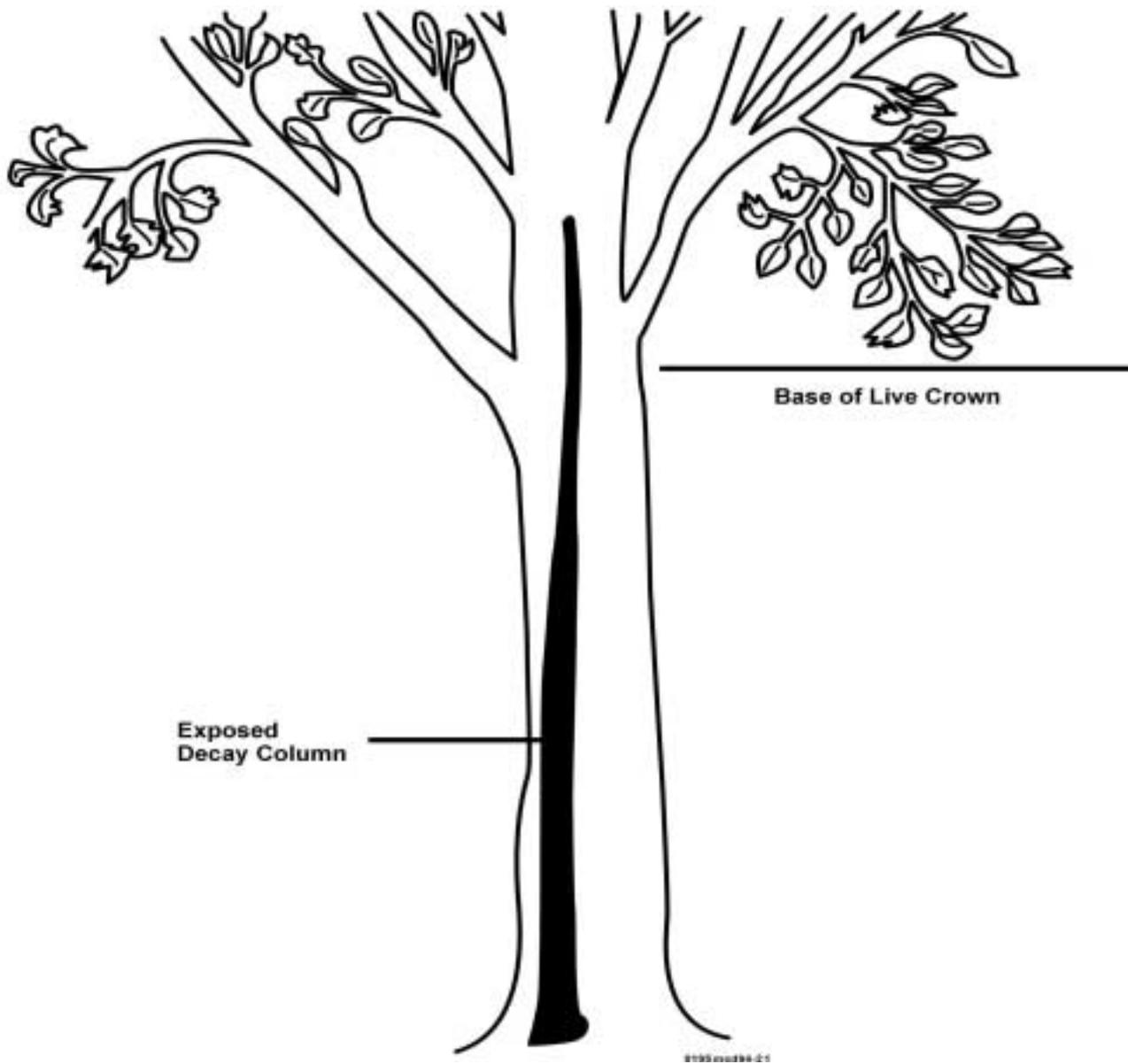


Figure 24. The damage runs from stump to crownstem. Code here should be 02 (roots and "stump" and lower bole) which represents the lowest locations of this multi-location damage.

**ITEMS 5182, 5185      DAMAGE TYPE 1, 2 (CORE 5.18.2, 5.18.5)**

Record the first damage type observed that meets the damage threshold definition in the lowest location. Damage categories are recorded based on the numeric order that denotes decreasing significance from damage 01-31.

When Collected: **P3 PLOTS ONLY:** All tally trees where DAMAGE LOCATION 1 > 0

Field width: 2 digits

Values:

- 1 Canker, gall: Cankers may be caused by various agents but are most often caused by fungi. The bark and cambium are killed, and this is followed by death of the underlying wood, although the causal agent may or may not penetrate the wood. This results in areas of dead tissue that become deeper and wider, or galling (including galls caused by rusts), on roots, bole, or branches. Due to the difficulty in distinguishing some abnormal swellings (e.g., burls) from classic galls and cankers, all are recorded as damage 01. A canker may be:

**Annual** (enlarges only once and does so within an interval briefer than the growth cycle of the tree, usually less than one year),

**Diffuse** (enlarges without characteristic shape or noticeable callus formation at margins), or

**Perennial** (enlarges during more than one year - often has a target appearance).

- 2 Conks, fruiting bodies, and signs of advanced decay: Fruiting bodies on the main bole, crownstem, and at the point of the branch attachment are signs of decay. "Punky wood" is a sign of decay and is evidenced by soft, often moist, and degraded tissue.

Cavities into the main bole that are oriented in such a way that they act as catchment basins for water are signs of decay. Bird cavities are signs of decay.

Rotten branches or branches with conks **are not indicators of decay unless** the threshold is met (>20% of branches are affected).

Rotting stumps associated with coppice regeneration (e.g., northern pin oak, maple) are excluded from coding.

- 3 Open wounds: An opening or series of openings where bark has been removed or the inner wood has been exposed and no signs of advanced decay are present. Improper pruning wounds that cut into the wood of the main stem are coded as open wounds, if they meet the threshold; those which leave the main stemwood intact are excluded.
- 4 Resinosis or gummosis: The origin of areas of resin or gum (sap) exudation on branches and trunks.

- 5 Cracks and seams: Cracks in trees are separations along the radial plane. When they break out to the surface they often are called frost cracks. These cracks are not caused by frost or freezing temperature, though frost can be a major factor in their continued development. Cracks are most often caused by basal wounds or sprout stubs, and expand when temperatures drop rapidly. Seams develop as the tree attempts to seal the crack, although trees have no mechanism to compartmentalize this injury.

Lightning strikes are recorded as cracks when they do not meet the threshold for open wounds.

- 11 Broken bole or roots (less than 3 ft from bole): Broken roots within 3 ft from bole either from excavation or rootsprung for any reason. For example, those which have been excavated in a road cut or by animals.

Stem broken in the bole area (below the base of the live crown) and tree is still alive.

- 12 Brooms on roots or bole: Clustering of foliage about a common point on the trunk. Examples include ash yellows witches' brooms on white and green ash and eastern and western conifers infected with dwarf mistletoes.

- 13 Broken or dead roots (beyond 3 ft): Roots beyond 3 ft from bole that are broken or dead.

- 20 Vines in the crown: Kudzu, grapevine, ivy, dodder, etc. smothers tree crowns. Vines are rated as a percentage of tree crown affected.

- 21 Loss of apical dominance, dead terminal: Mortality of the terminal of the crownstem caused by frost, insect, pathogen, or other causes.

- 22 Broken or dead: Branches that are broken or dead. Branches with no twigs are ignored and not coded as dead. Dead or broken branches attached to the bole or crownstem outside the live crown area are not coded. 20% of the main, first order portion of a branch must be broken for a branch to be coded as such.

- 23 Excessive branching or brooms within the live crown area: Brooms are a dense clustering of twigs or branches arising from a common point that occur within the live crown area. Includes abnormal clustering of vegetative structures and organs. This includes witches' brooms caused by ash yellows on green and white ash and those caused by dwarf mistletoes.

**On deciduous trees, only record codes 24 and 25 from June-August.**

- 24 Damaged buds, foliage or shoots: Insect feeding, shredded or distorted foliage, buds or shoots >50% affected, on at least 30% of foliage, buds or shoots. Also includes herbicide or frost-damaged foliage, buds or shoots.
- 25 Discoloration of foliage: At least 30% of the foliage is more than 50% affected. Affected foliage must be more of some color other than green. If the observer is unsure if the color is green, it is considered green and not discolored.
- 31 Other: Use when no other explanation is appropriate. Specify in comments section of PDR for "tree notes." Code 31 is used to maintain consistency with the Phase 3 crown damage protocols.

**LEGAL COMBINATIONS OF DAMAGE TYPE BY DAMAGE LOCATION:**

For each of the following location codes, possible damage codes and damage definitions are presented.

Location 1: Roots and stump

- 01 Canker, gall -- exceeds 20% of circumference of stump
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% of circumference of stump
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference of stump
- 05 Cracks and seams -- any occurrence
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole -- any occurrence.
- 13 Broken or dead roots -- exceeds 20% of roots, beyond 3 ft from bole, broken or dead
- 31 Other

Location 2: Roots, stump, and lower bole

- 01 Canker, gall -- exceeds 20% of circumference of stump
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% at the point of occurrence, or for the portion in root zone, 20% of the circumference of stump
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% at the point of occurrence, or for the portion in root zone, 20% of circumference of stump.
- 05 Cracks and seams - any occurrence
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole - -any occurrence.
- 13 Broken or dead roots -- exceeds 20% of roots, beyond 3 ft from bole, broken or dead
- 31 Other

## Location 3: Lower bole

- 01 Canker, gall -- exceeds 20% of circumference at the point of occurrence
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% of circumference at the point of occurrence
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence
- 05 Cracks and seams -- any occurrence
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole -- any occurrence
- 31 Other

Location 4: Lower and upper bole -- same as lower bole.

Location 5: Upper bole - same as lower bole.

## Location 6: Crownstem

- 01 Canker, gall -- exceeds 20% of circumference of crownstem at the point of occurrence
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds - exceeds 20% of circumference at the point of occurrence -- any occurrence
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence
- 05 Cracks and seams -- all woody locations -- any occurrence.
- 21 Loss of apical dominance, dead terminal -- any occurrence
- 31 Other

## Location 7: Branches &gt;1 in at the point of attachment to the main or crown stem

- 01 Canker, gall -- exceeds 20% of circumference on at least 20% of branches
- 02 Conks, fruiting bodies and signs of advanced decay -- more than 20% of branches affected
- 03 Open wounds -- exceeds 20% of circumference at the point of occurrence on at least 20% of branches
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence on at least 20% of branches
- 05 Cracks and seams -- all occurrences, and on at least 20% of branches
- 20 Vines in the crown -- more than 20% of live crown affected
- 22 Broken or dead -- more than 20% of branches affected within the live crown area
- 23 Excessive branching or brooms -- more than 20% of branches affected
- 31 Other

Location 8: Buds and shoots

- 24 Damaged buds, shoots or foliage - more than 30% of buds and shoots damaged more than 50%.
- 31 Other

Location 9: Foliage

- 24 Damaged buds, shoots or foliage - more than 30% of foliage damaged more than 50%.
- 25 Discoloration of foliage - more than 30% of foliage discolored more than 50%.
- 31 Other

**ITEMS 5183, 5186 DAMAGE SEVERITY 1, 2 (CORE 5.18.3, 5.18.6)**

Record a code to indicate the amount of affected area (above threshold) in DAMAGE LOCATION 1 recorded for TREE DAMAGE 1. Severity codes vary depending on the type of damage recorded.

When Collected: **P3 PLOTS ONLY:** All tally trees where DAMAGE LOCATION 1 > 0

Field width: 2 digits

Values: The codes and procedures for SEVERITY 1 values are defined for each DAMAGE TYPE 1.

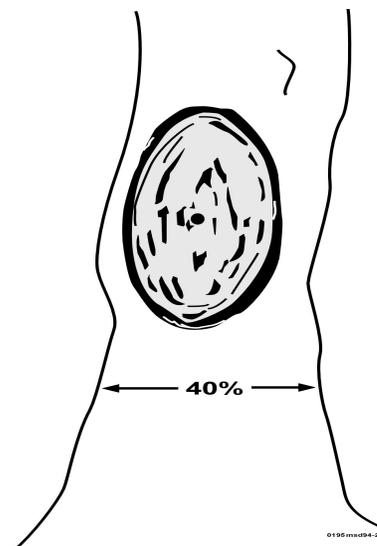
DAMAGE TYPE Code 01 -- Canker, gall

Measure the affected area from the margins (outer edges) of the canker or gall within any 3-ft vertical section in which at least 20% of circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes. See Figure 25.

Severity classes for code 01 (percent of circumference affected):

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
2	20-29	6	60-69
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99

**Figure 25. A canker which exceeds threshold. Since 40% of circumference is visible from any side, and since over half the visible side is taken up by the canker, it obviously exceeds the 20% minimum circumference threshold.**



**DAMAGE TYPE Code 02 -- Conks, fruiting bodies, and signs of advanced decay**

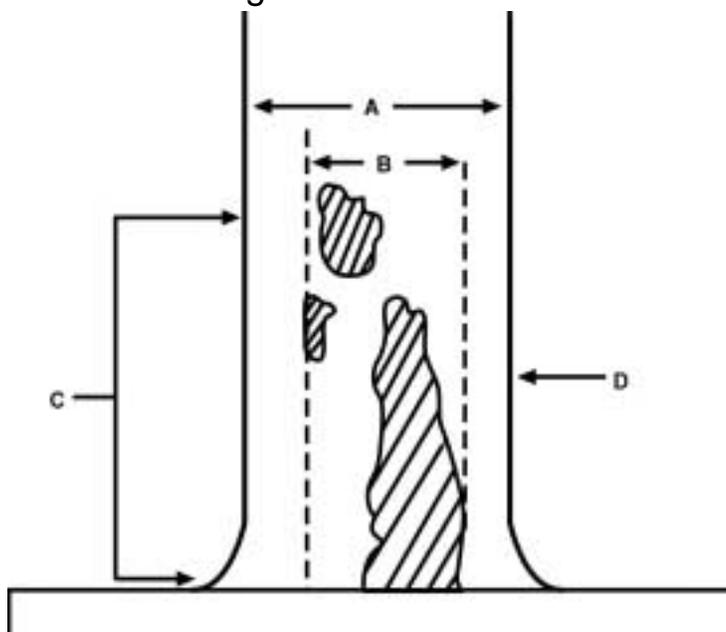
Severity classes for code 02: **None**. Enter code 0 regardless of severity, except for roots > 3 ft from the bole, or number of branches affected - 20%

**DAMAGE TYPE Code 03 -- Open wounds**

The damaged area is measured at the widest point between the margins of the exposed wood within any 3-ft vertical section in which at least 20% of the circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes. See Figure 26.

Severity Classes for code 03 (percent of circumference affected):

<u>Code</u>	<u>Classes</u>
2	20-29
3	30-39
4	40-49
5	50-59
6	60-69
7	70-79
8	80-89
9	90-99



**Figure 26. Multiple damage in "stump" and lower bole. A=approximately 40% of tree circumference; B=portion of tree circumference affected by damage; C=vertical distance within one meter; D=midpoint of occurrence at which circumference is measured.**

**DAMAGE TYPE Code 04 -- Resinosis or gummosis**

Resinosis or gummosis is measured at the widest point of the origin of the flow width in which at least 20% of the circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes.

Severity classes for code 04 (percent of circumference affected):

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
2	20-29	6	60-69
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99

## DAMAGE TYPE Code 05 -- Cracks and seams

## Severity class for code 05

Seam must be > 5 feet long. Record severity code 0 for the lowest location in which the crack occurs. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes.

## DAMAGE TYPE Code 11 -- Broken bole or roots less than 3 ft from bole

Severity classes for code 11: None. Enter code 0 regardless of severity.

## DAMAGE TYPE Code 12 -- Brooms on roots or bole

Severity classes for code 12: None. Enter code 0 regardless of severity.

## DAMAGE TYPE Code 13 -- Broken or dead roots

At least 20% of roots beyond 3 ft from bole that are broken or dead.

Severity classes for code 13 (percent of roots affected):

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
2	20-29	6	60-69
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99

## DAMAGE TYPE Code 20 -- Vines in crown

Severity classes for code 20 (percent of live crown affected):

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
2	20-29	6	60-69
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99

## DAMAGE TYPE Code 21 -- Loss of apical dominance, dead terminal

Any occurrence (> 1%) is recorded in 10% classes as a percent of the crownstem affected. Use trees of the same species and general DBH/DRC class in the area or look for the detached portion of the crownstem on the ground to aid in estimating percent affected. If a lateral branch has assumed the leader and is above where the previous terminal was, then no damage is recorded.

Severity classes for code 21:

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
0	01-09	5	50-59
1	10-19	6	60-69
2	20-29	7	70-79
3	30-39	8	80-89
4	40-49	9	90-99

DAMAGE TYPE Code 22 -- Broken or dead branches ( > 1in above the swelling at the point of attachment to the main or crown stem within the live crown area)

At least 20% of branches are broken or dead.

Severity classes for code 22 (percent of branches affected):

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
2	20-29	6	60-69
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99

DAMAGE TYPE Code 23 -- Excessive branching or brooms

At least 20% of crownstem or branches affected with excessive branching or brooms.

Severity classes for code 23 (percent of area affected):

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
2	20-29	6	60-69
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99

DAMAGE TYPE Code 24 - Damaged buds, shoots or foliage

At least 30% of the buds, shoots or foliage (i.e., chewed or distorted) are more than 50% affected.

Severity classes for code 24:

<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99
6	60-69		

## DAMAGE TYPE Code 25 - Discoloration of Foliage

At least 30% of the foliage is more than 50% affected.

Severity classes for code 25 (percent affected):

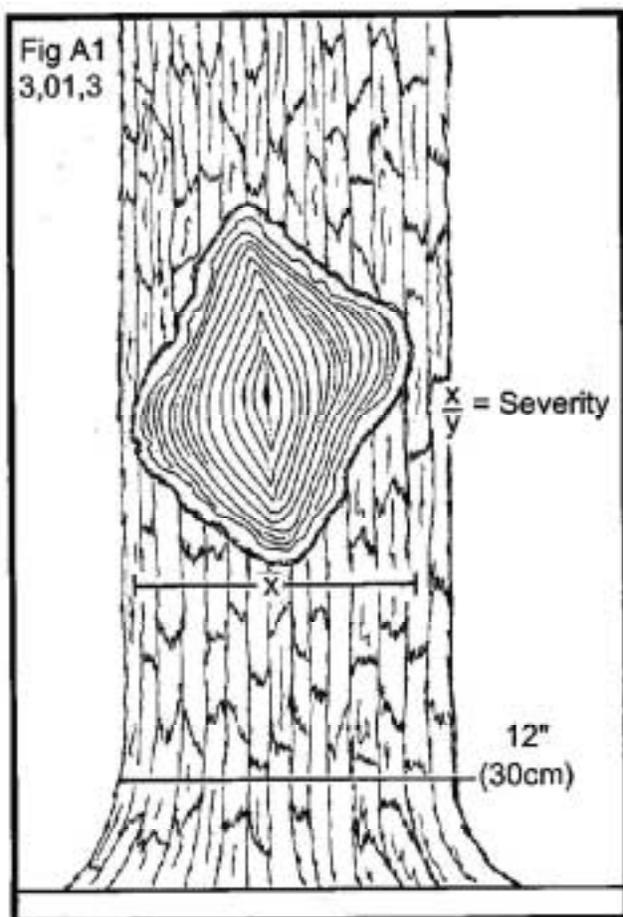
<u>Code</u>	<u>Classes</u>	<u>Code</u>	<u>Classes</u>
3	30-39	7	70-79
4	40-49	8	80-89
5	50-59	9	90-99
6	60-69		

## DAMAGE TYPE Code 31 -- Other

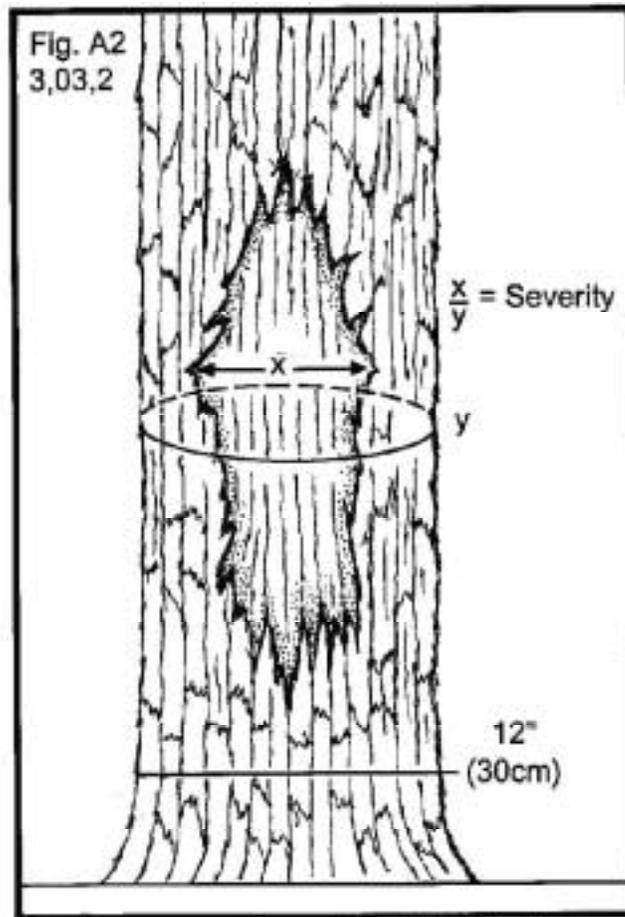
Severity classes for code 31:

None. Enter code 0 regardless of severity. Describe condition in tree notes.

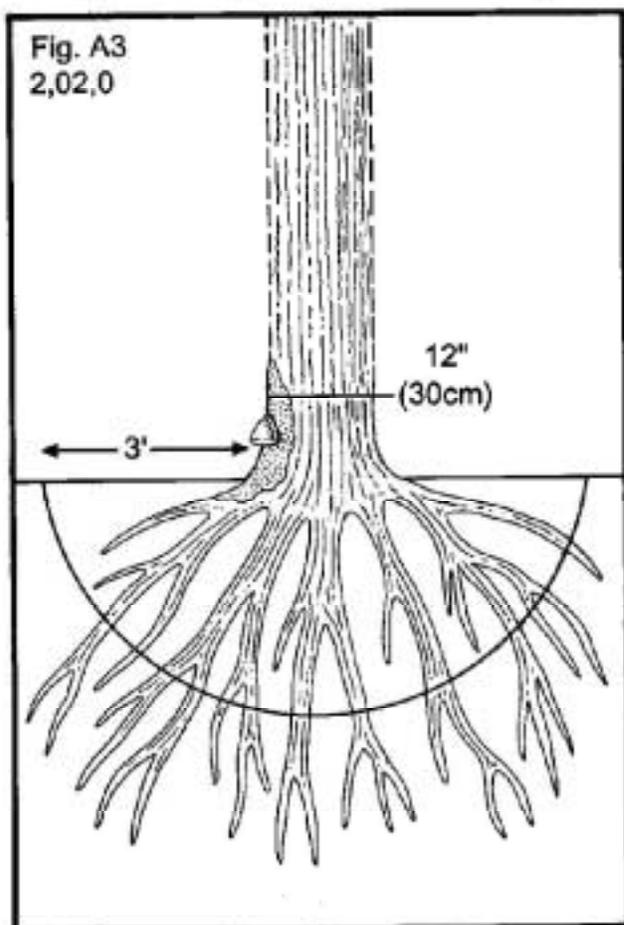
Examples are shown in Figures 33-39.



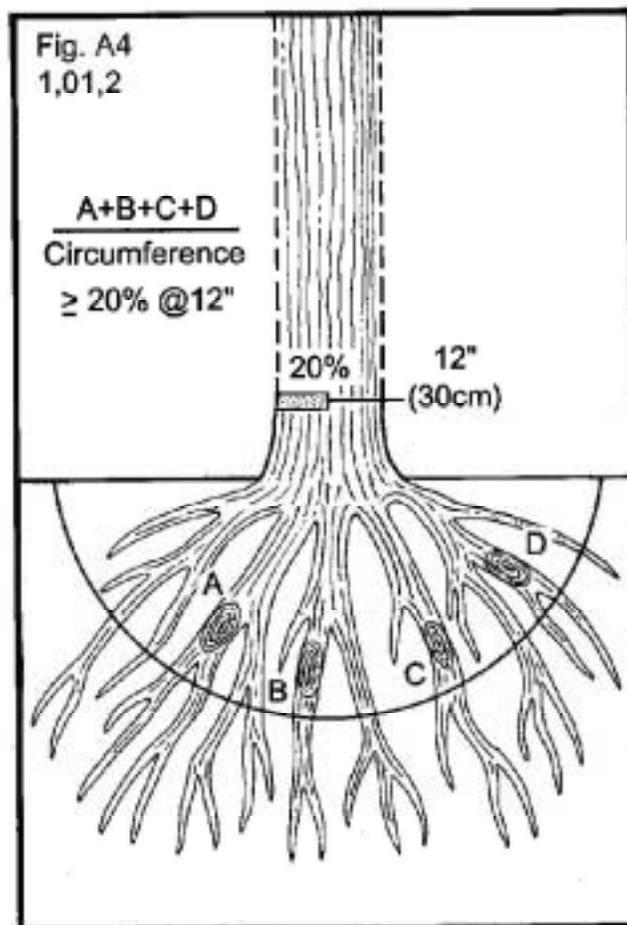
01 - Canker measured as widest distance between the outside of canker swelling (refer to Fig. 2 for y measurement)



03 - Open wound measured at widest point inside of wound margins

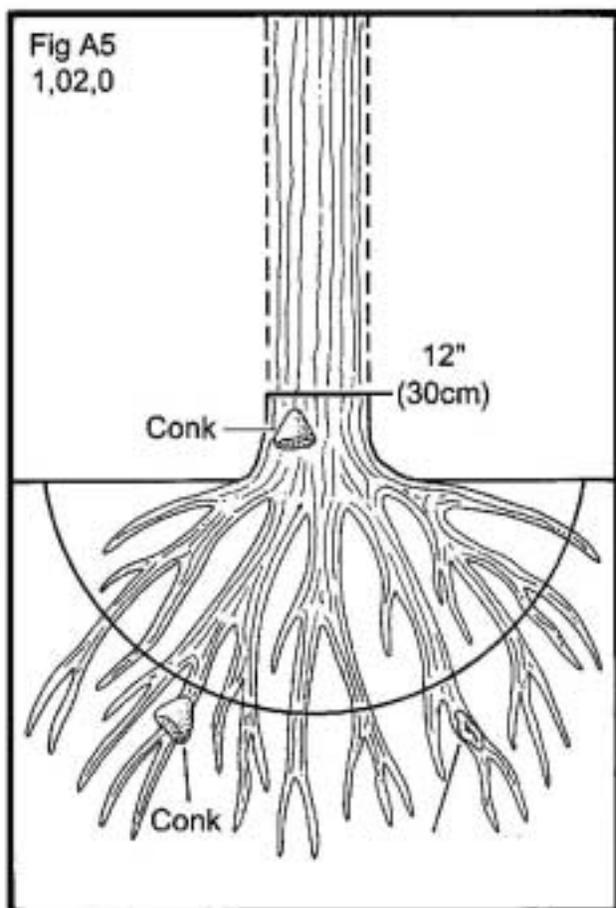


02 - Decay indicator on roots and lower bole

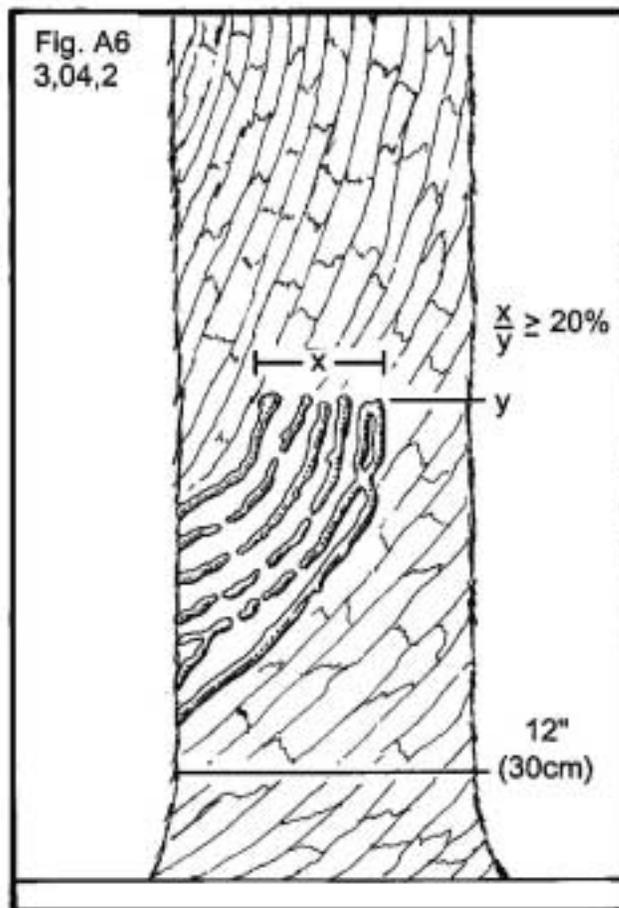


01 - Canker / gall on roots (within 3' of bole)

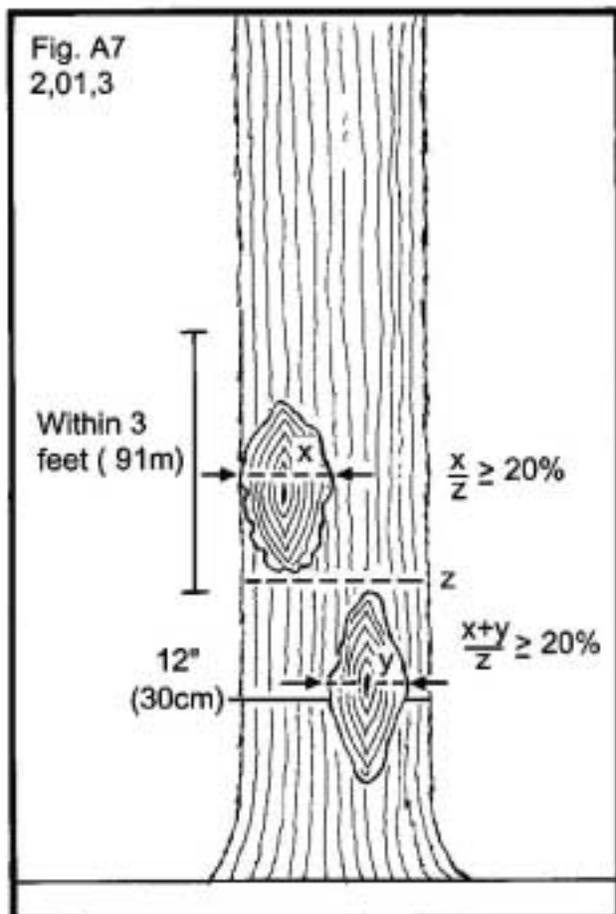
Figure 33. Examples of damage coding.



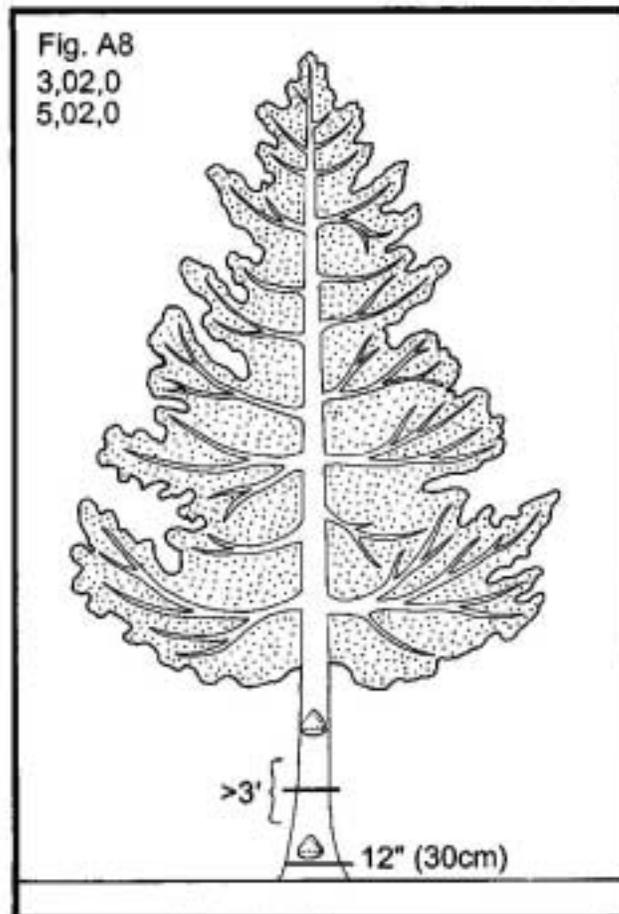
02 - Indicator of decay within 3' of bole. Beyond 3" of bole, indicators must affect  $\geq 20\%$  of roots (see fig. 12)



04 - Origin of resinosis in lower bole

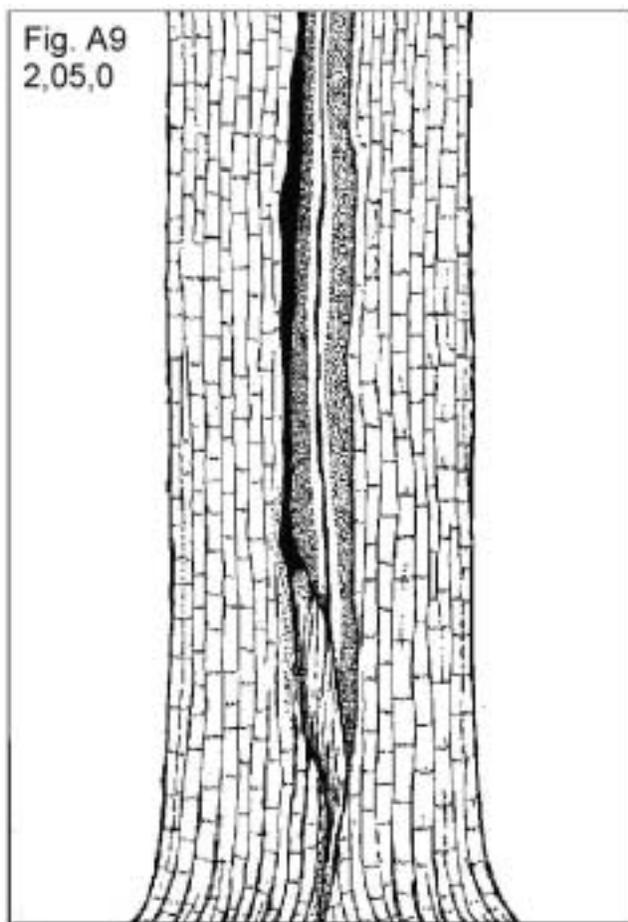


01 - Additive cankers within 3' in roots and lower bole

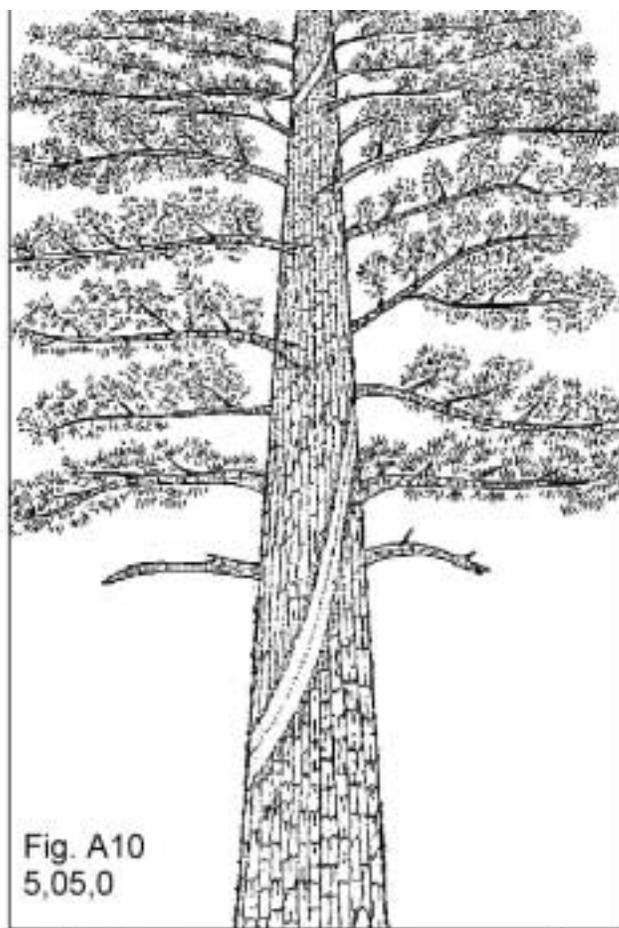


02 - Conks separated by >3'; 2 damages

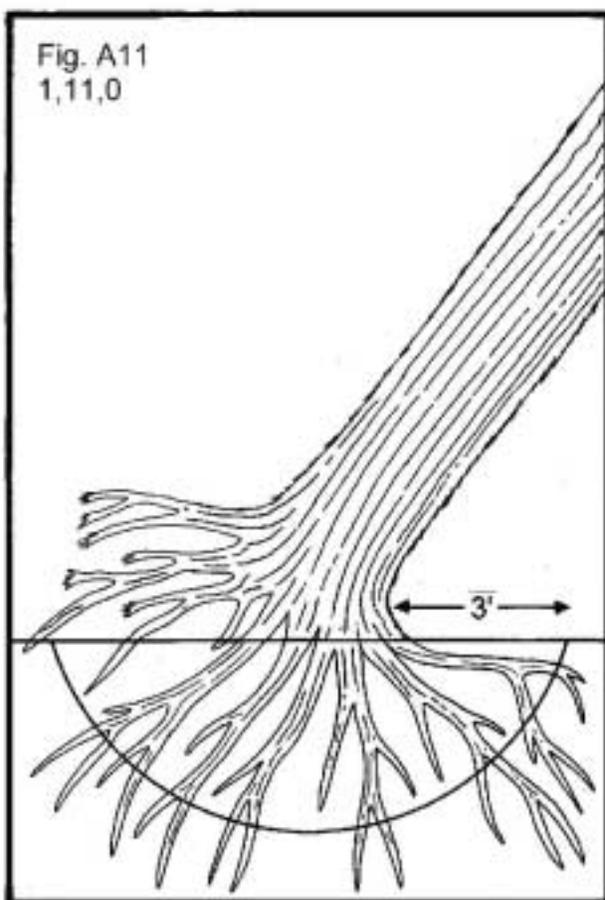
Figure 34. Examples of damage coding.



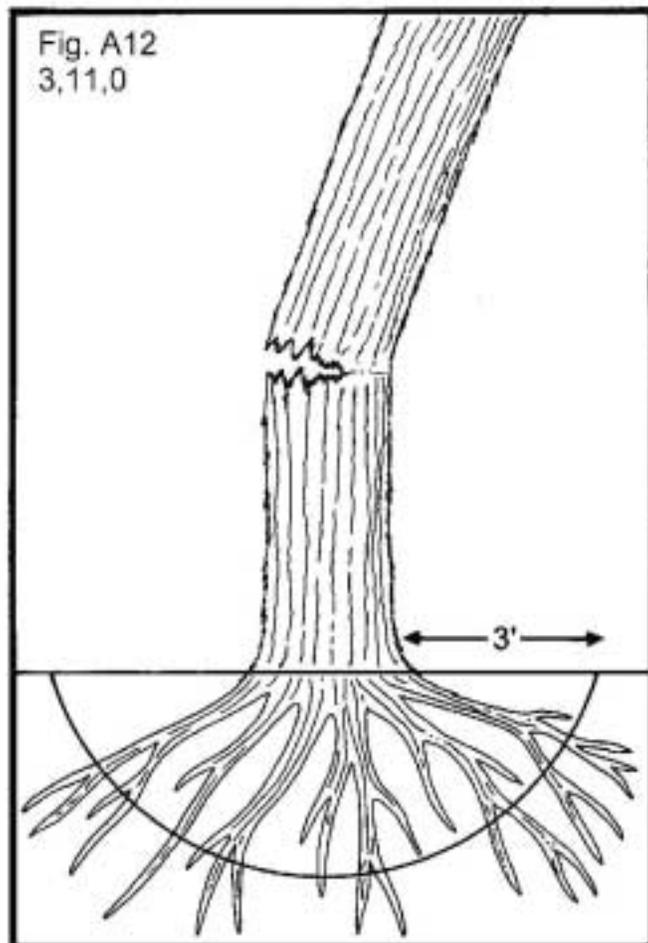
05- Cracks and seams



05 - Lightning strike

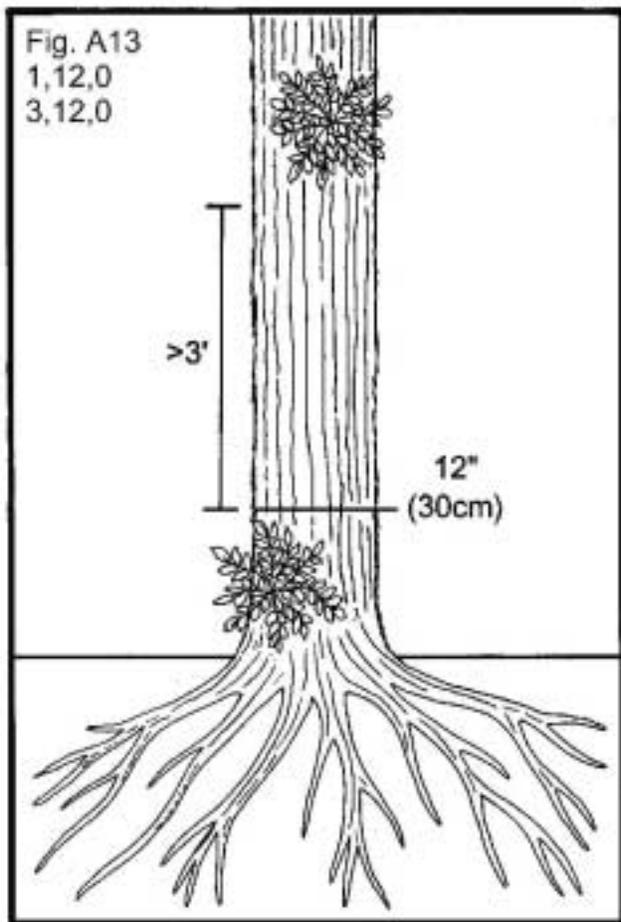


11 - Broken bole or roots <3' from bole, broken roots must be visible

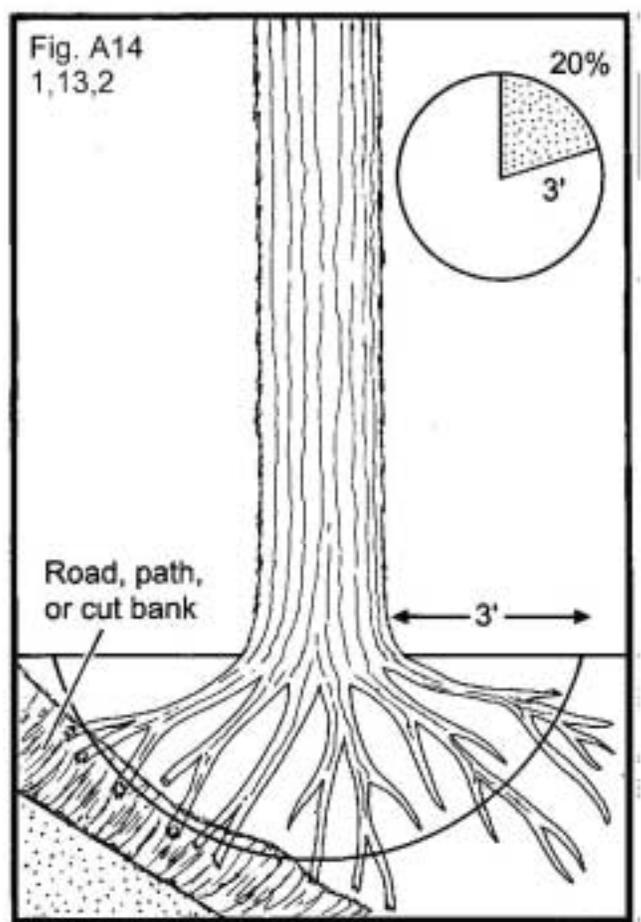


11 - Broken bole or roots <3' from bole

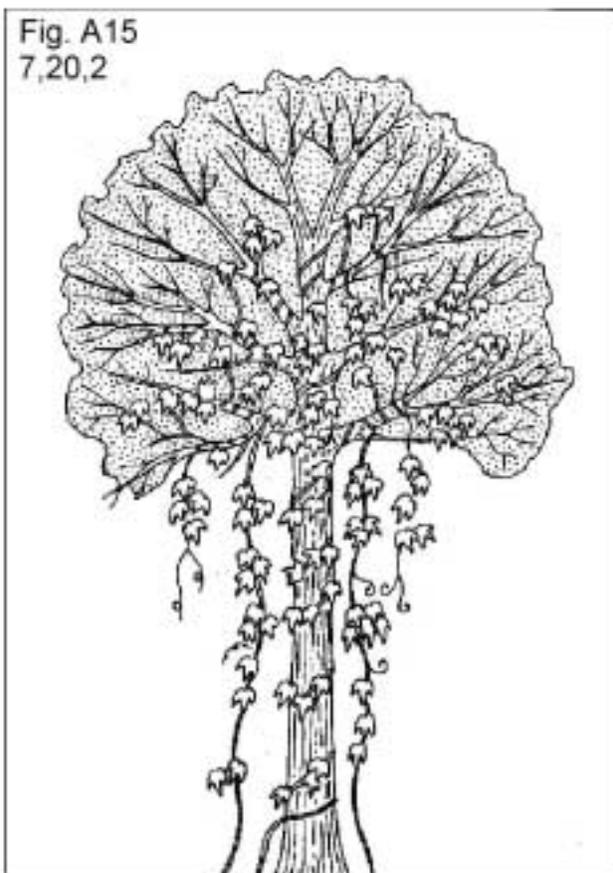
Figure 35. Examples of damage coding.



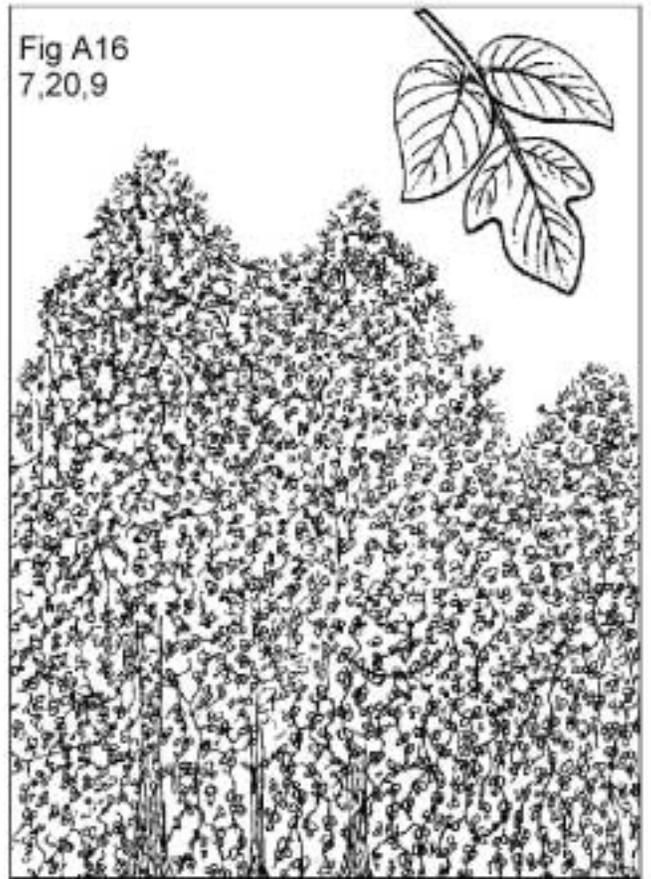
12 - Brooms on roots or bole



13 - Broken or dead roots >3' from bole

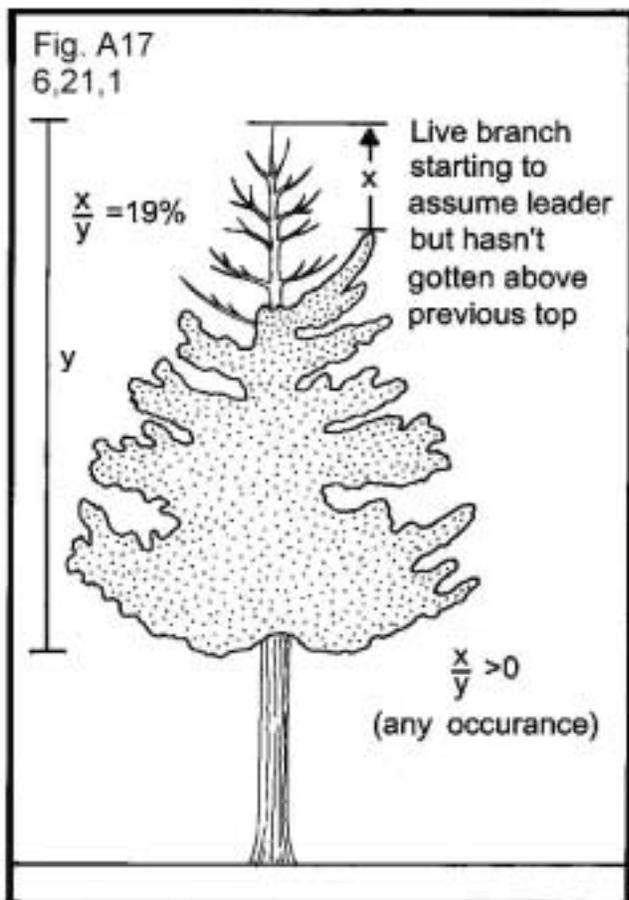


20 - Vines in crown

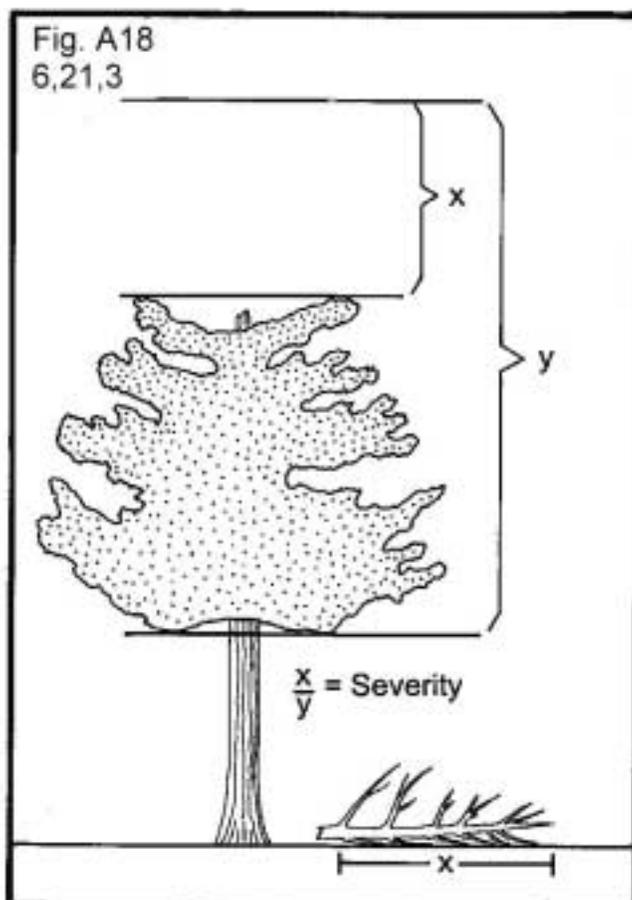


20 - Vines in crown

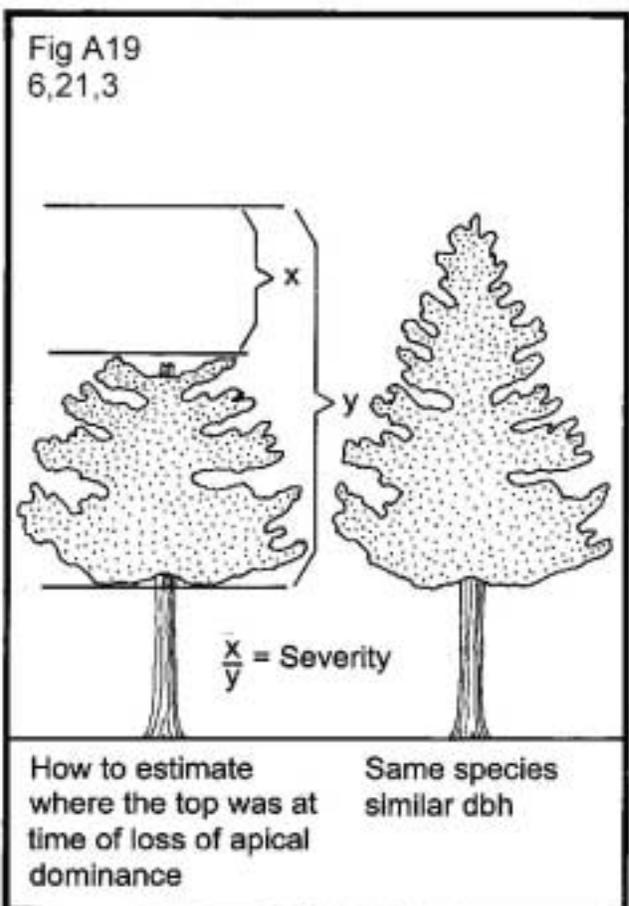
Figure 36. Examples of damage coding.



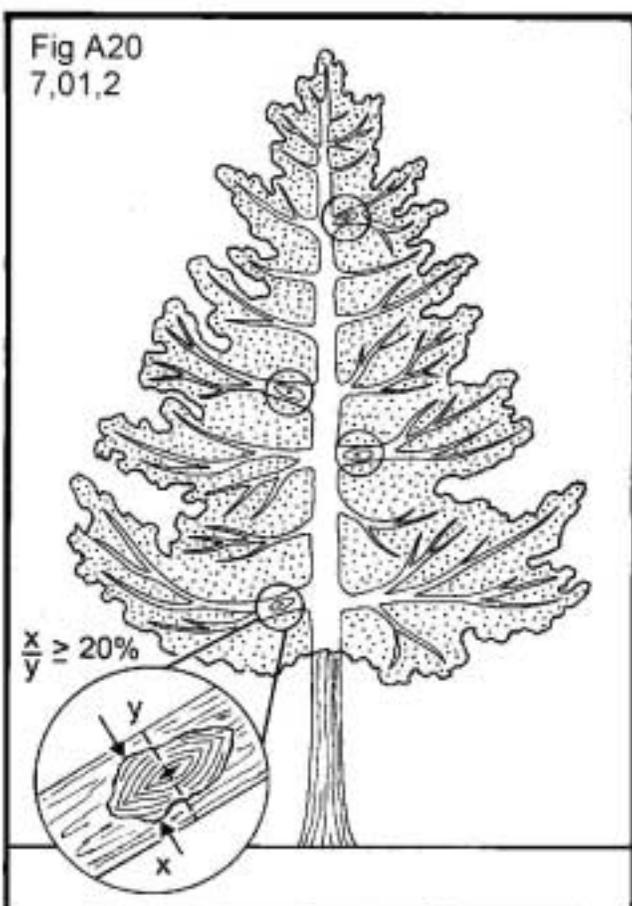
21 - Loss of apical dominance



21 - Loss of apical dominance, look for old top to estimate the top of x and y



21 - Loss of apical dominance, look for same species of similar dbh

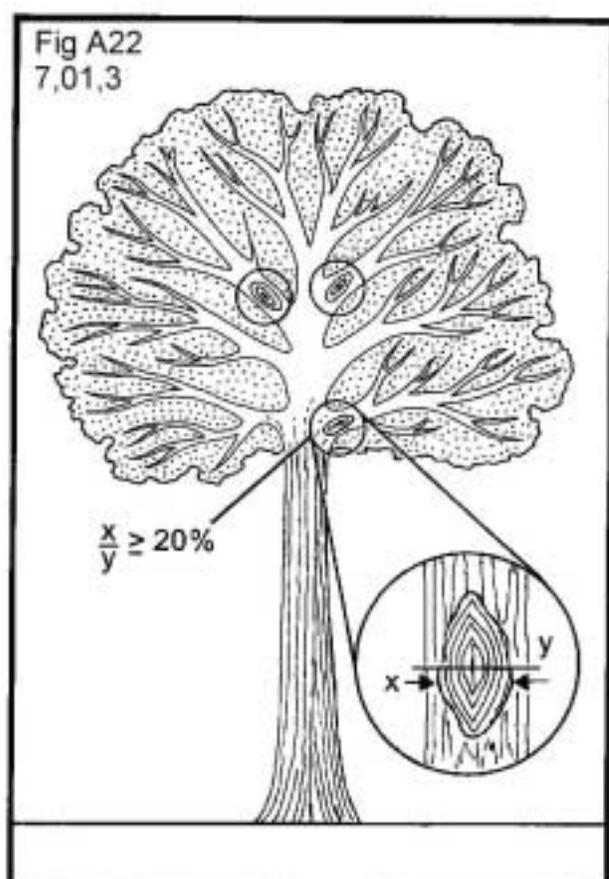


01 - Cankers above the threshold on  $\geq 20\%$  of branches

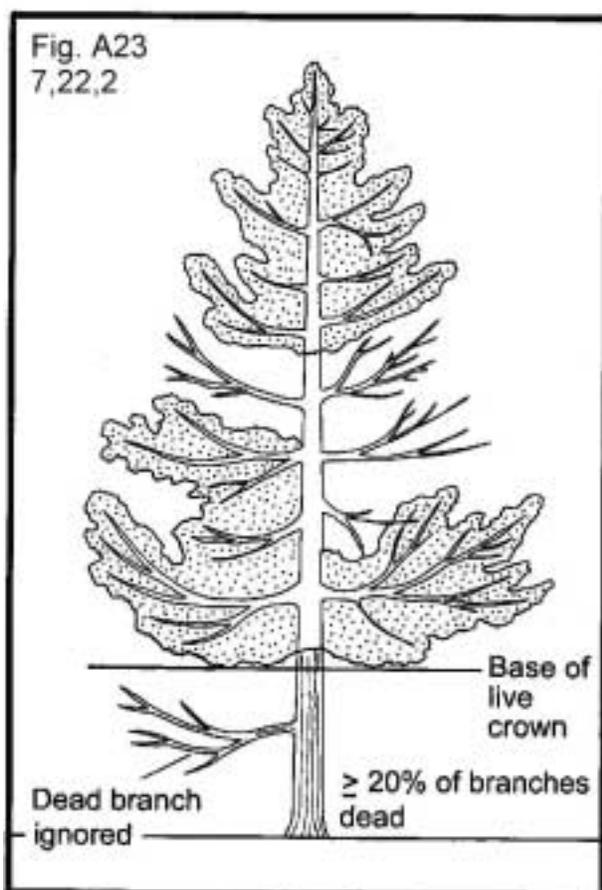
Figure 37. Examples of damage coding.



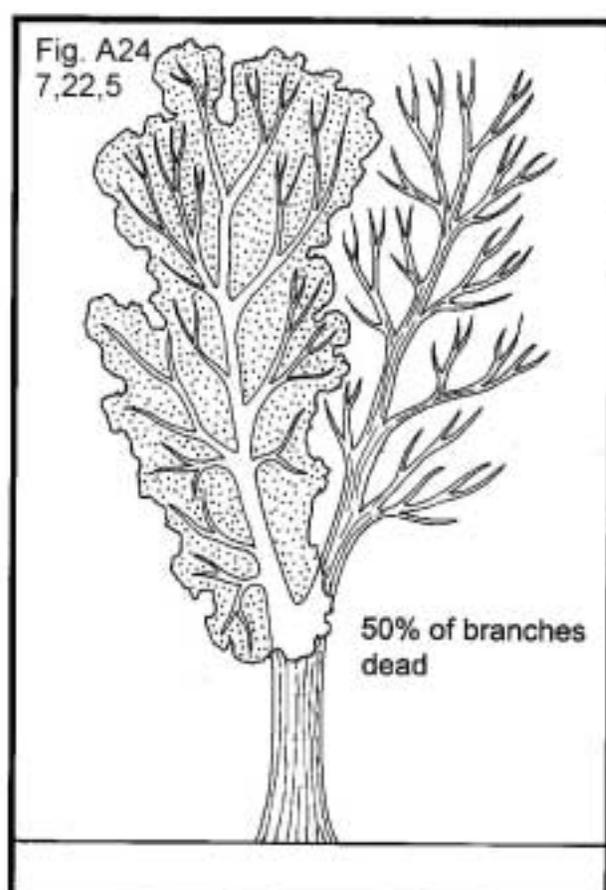
02 - Conks on  $\geq 20\%$  of branches



01 - Cankers above threshold on  $\geq 20\%$  of branches

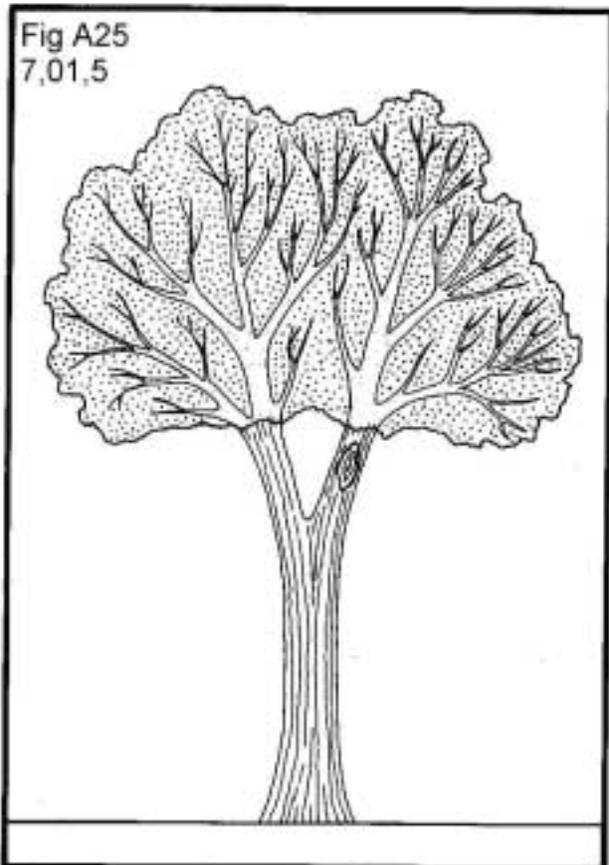


22 - Dead branches within the live crown area. If branches cannot easily be counted, estimate % area of live crown affected

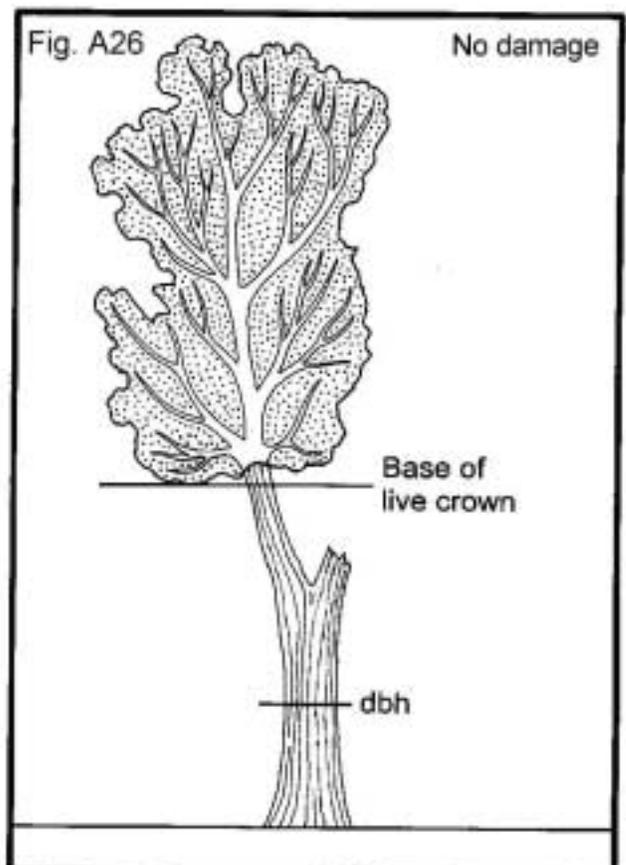


22 - Dead branches; only 2 branches present within live crown area, fines present and  $\geq 20\%$  of branch dead

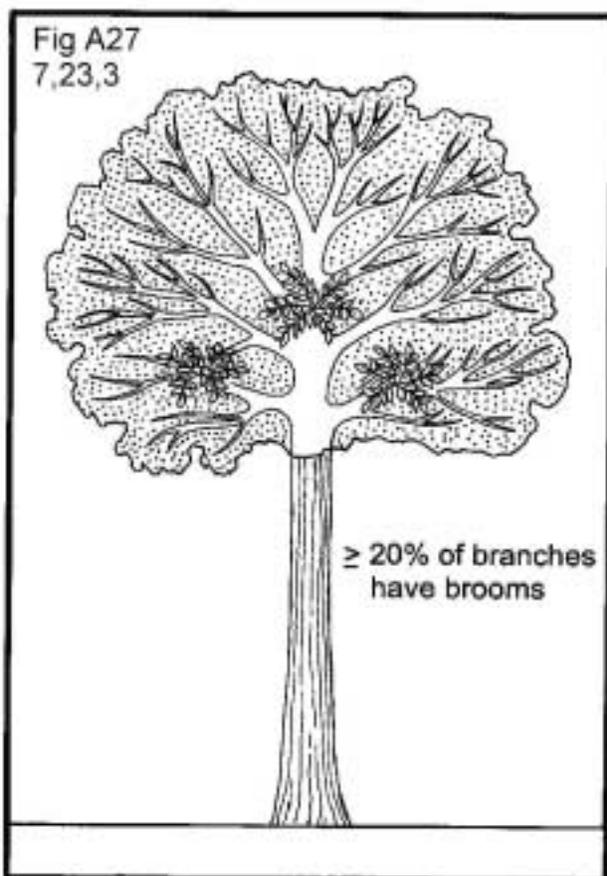
Figure 38. Examples of damage coding.



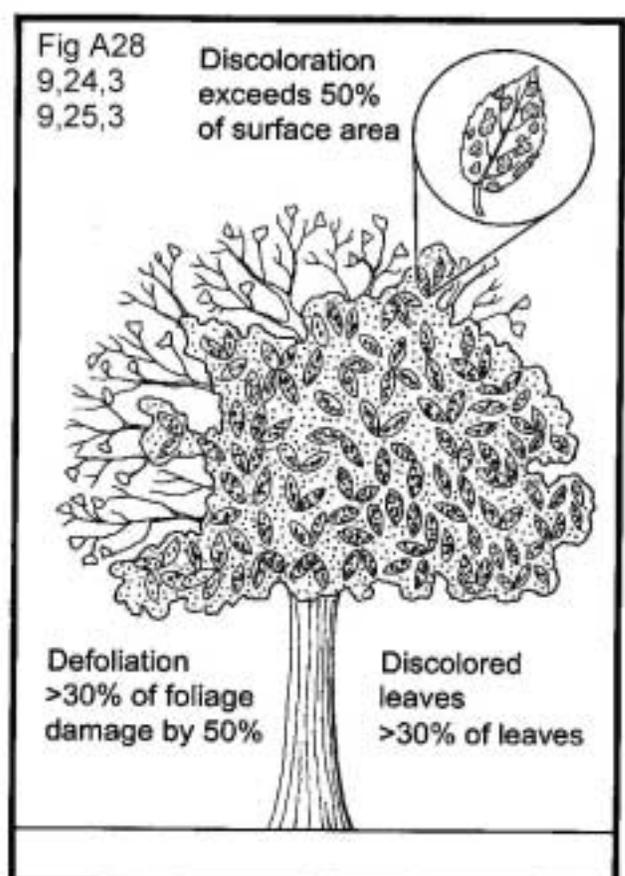
01 - Canker; no crown stem and only 2 branches present



No damage - base of live crown is above old fork, stub is a snag branch



23 - Excessive branching or brooms in crown



24 - Defoliation, 25 - Discoloration

Figure 39. Examples of damage coding.