

A HANDBOOK OF "DEFECT  
ESTIMATORS  
FOR STANDING TIMBER"

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Adapted for  
electronic media  
by the Forest  
Management  
Service Center,  
Fort Collins,  
Colorado

This guide has descriptions and illustrations to help you identify problems and estimate useful wood volume in trees with one or more defects. Problems listed are those of forests in Utah, Idaho (south of the Salmon River), & eastern Oregon.

We assume that you have a hatchet-like tool available while examining tree

problems. You also need an increment borer to find problems in trees that have no indicators of defect.

Technical & scientific terms are defined in a [Glossary \(9.0\)](#), the [Index \(10.0\)](#) helps you find specific information, and a [Summary \(11.0\)](#) allows you quick reference to specific defects.

Before you use the key you'll need to know which tree species is present (Table I.).

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#### Table I. LIST OF TREE SPECIES

Concolor fir (*Abies concolor*)

Douglas fir (*Pseudotsuga mensezii*)

Engelman spruce (*Picea engelmanni*)

Grand fir (*Abies grandis*)

Limber pine (*Pinus flexilis*)

Lodgepole pine (*Pinus contorta*)

Mountain hemlock (*Tsuga mertensiana*)

Subalpine fir (*Abies lasiocarpa*)

Western larch (*Larix occidentalis*)

Western white pine (*Pinus monticola*)

Whitebark pine (*Pinus albicaulis*)

Black cottonwood (*Populus  
trichocarpa*)

Quaking aspen (*Populus  
tremuloides*)



## PROMINENT FEATURES & KEYS TO PROBLEMS USING COMMON SYMPTOMS

When you use this key, prominent characteristics lead you to a brief problem name and then the number in parenthesis refers to a description in the text.

As you diagnose, don't ignore the indicators on neighbors - cut stumps, roots, logs, broken trees, etc.

### *PROMINENT FEATURES on STEMS:*

A. SWELLINGS - BULGES, MOUNDS, LUMPS, BUMPS, or KNOBS

Aa. lumps or mounds - under the bark of grand fir: [Fir Engraver \(6.5\)](#)- in large cankers which have swollen margins, lodgepole pine: [Gall Rust \(3.1\)](#)

Ab. swollen knots, (be sure these are knots & not just swellings), with fungus inside = **punk knots**  
- on grand fir - red inside: [Redpaint \(1.6\)](#)

- on larch, pines or douglas fir, rusty brown inside: [Ring Rot \(1.1\)](#)

- on hardwoods, dark brown inside:  
[White Trunk Rot \(1.8\)](#), [Mottled Trunk Rot \(1.9\)](#)

Ac. knobs, **galls**, burls - on ponderosa pine, lodgepole pine - round gall/s or knobs on stem, may accompany stem canker (hip canker): [Gall Rust \(3.1\)](#)

Ad. **hip-like swellings** - esp. on lodgepole pine: [Gall Rust \(3.1\)](#)

Ae. **butt swell** - look for carpenter ants or root disease;  
if other indicators are absent, ignore the swell.

B. **SUNKEN**, INDENTED or DEPRESSED

Ba. **long depression** - on lodgepole pine, ponderosa pine - wood dark underneath: [Atropellis Canker \(3.5\)](#)

Bb. **open depression** with swollen ('lipped') margins - on douglas fir: [Dasycypha Canker \(3.3\)](#)

C. **WOUNDS**, SCARS or CANKERS

Ca. **mechanical wounds** - ripped, without branches or stubs in the wound area [\(4.0\)](#)

**Cb. cankers -**

Cb1. **sunken**, with bark on, dark wood under the canker - on pine: [Atropellis Canker \(3.5\)](#)

Cb2. **open**, with or without bark, wood beneath is resin-soaked but not dark - on pines, douglas fir: [Dasycypha Canker \(3.3\)](#)

Cb3. **dead areas** with many tiny, black bodies embedded in the bark - on cottonwood, aspen, true firs: [Cytospora Canker \(3.4\)](#)

**Note:** in firs, lightly skin the outer bark to see the black bodies

Cb4. cankers with **cracked bark** - on white pine, whitebark pine, limber pine - bark remains on the canker which has orange sacs around it in spring: [Blister Rust \(3.2\)](#)

Cb5. very **long catface** (a canker with concentric rings of callus around the dead area), often w/ chewed bark at the edges - on lodgepole pine, rarely ponderosa pine: [Stalactiform Rust \(3.2\)](#)

Cb6. **long canker** with bark on - on ponderosa or lodgepole pine: [Comandra Rust \(3.7\)](#)

Cc. **catfaces** (a canker with concentric rings of callus around the dead area).

See [Cb1](#), [Cb2](#), [Cb3](#), [Cb5](#).

Cd. **scars** - injuries with a single encircling or covering callus, healing successfully: no measurable defect

Cd1. **scolytus lumps** - lumps w/a few cracks on grand fir: [Fir Engraver \(6.5\)](#)

Cd2. **lightning scars** - very long splintery column along the trunk, any tree ([3.9](#))

Cd3. **fire scars** - openings, esp. at tree bases w/some charring - look for decay in any opening

Cd4. a **hole** in the bark **healing** successfully, no catfacing. Surface defect only unless decay or borers are indicated on the open face.

#### D. CRACKS or SPLITS

Da. long crack often with swelling at the edges (lips) & bleeding - esp. on grand fir, concolor fir, spruce - [frost cracks \(3.8\)](#)

Db. long, splintery crack the length of the tree, any tree - [lightning scar \(3.9\)](#)

## E. HOLES

Ea. in bark -

Ea1. tiny, round, even - insect **bore holes** - look for galleries & see **J.**

Ea2. small, irregular, roughly arranged in lines: **sapsucker pits (5.4)**

Ea3. small, irregular, rough at random: **woodpecker pits (5.3)**

Eb. in stem

large - see cavities below & **Timber Worms (2.0)** & **Woodpeckers (5.3)**

F. CAVITIES - large holes into the wood - almost rectangular: **Woodpecker holes (5.3)**

G. wood CHIPS - on the ground below a tree - look for 'cavities' above: **Woodpeckers (5.3)**

H. FUNGUS parts -

Ha. fungus, **conks**, mushrooms, toadstools -

Ha1. **small brown** conks, rusty inside - on many spp., esp. white pine, larch: **Ring Rot (1.1)**

Ha2. **large, dark** conks beneath branch stubs, red inside - on grand fir, concolor fir, subalpine fir, hemlock: **Redpaint (1.6)**

- Ha3. large, dirty-white conks - on douglas fir, larch: [Quinine Conk \(1.13\)](#)
- Ha4. many, small, round, white conks, scattered - on many tree spp.: [Pouch Fungus \(1.14\)](#)
- Ha5. large, dark brown conks on the ground - esp. near douglas fir: [Velvet Top \(1.11\)](#)
- Ha6. large, dark, cracked conks mostly at knots - on aspen, cottonwood: [False Tinder Conk \(1.8\)](#)
- Ha7. large, grey, smooth conks - on aspen, cottonwood: [Tinder Conk \(1.9\)](#)
- Hb. fungus sheets or felts
- Hb1. under bark, without veins or fan-like structure - on many spp., esp. grand fir, subalpine fir, pines: [Slimey Root Rot \(1.7\)](#)
- Hb2. under bark, with veins or a fan-like structure - on all species, esp. pines, douglas fir, firs: [Armillaria Root Rot \(1.5\)](#)
- Hb3. thin sheets in the bark - on many species, esp pines, true firs: [Annosus Root Rot \(1.0\)](#)

- I. MISTLETOE plants - usually associated with brooms - on many species (8.1)
- J. BORING DUST, frass and/or bore holes with insect galleries (multiple etchings) under the bark or in the wood
- Ja. red - on douglas fir - main gallery long, vertical: Douglas Fir Beetle (6.8)
- Jb. red - on Douglas fir - main gallery short, vertical, crooked: Douglas Fir Pole Beetle (6.9)
- Jc. red with conspicuous, white pitch tubes on bark - under bark, main gallery long, vertical - esp. on lodgepole pine, ponderosa pine: Mountain Pine Beetle (6.1)
- Jd. red with white pitch tubes on bark - under bark, main gallery short, irregularly vertical - on lodgepole pine: Lodgepole Pine Beetle (6.3)
- Je. white - on true fir - main gallery horizontal: Fir Engraver (6.5)
- Jf. white - on subalpine fir - gallery radiate: Balsam Bark Beetle (6.6)
- Jg. red with some inconspicuous, white pitch tubes - winding and crossing galleries - on pine: Western Pine Beetle (6.2)

- Jh. red, at tree base only and with red pitch tubes - wide galleries irregular:  
[Red Turpentine Beetle \(6.10\)](#)
- Ji. white, no pitch tubes - central gallery with radiate arms - on pine:  
[Pine Engraver \(6.4\)](#)
- Jj. white - vertical gallery, short with pitchy frass in the base - on spruce:  
[Spruce Beetle \(6.7\)](#)
- Jk. white, at the tree base, not in bark crevices - on many tree spp. - live ants usually are visible: [Carpenter Ants \(2.7\)](#)

K. PITCH, resin, ooze, slime

Ka. flow look for fungus under the bark or on the bark or for beetle galleries

Kb. lumps, nodules, masses

- with a central hole - see 'pitch tubes' below ([Kc.](#)) & ([Kb1.](#))

- red: [Pitch Tube Moth \(6.11\)](#)

Kb1. - red pitch tubes at tree base:

[Red Turpentine Beetle \(6.10\)](#)

Kb2. - red pitch masses with an insect chamber in each mass - on pines, true firs: [Pitch Tube Moth \(6.11\)](#)



Kc. **tubes** - globs of pitch each with a central hole

Kc1. **white**, numerous - on lodgepole or ponderosa pines: [Mountain Pine Beetle \(6.1\)](#)

Kc2. **white**, occasional - on lower bole of pines: [Western Pine Beetle \(6.2\)](#)

Kc3. **red** on tree base only: [Red Turpentine Beetle \(6.10\)](#)

## L. BROKEN TREE TOP

La. without decay - cull only the broken area + 2 ft. below.

Lb. **with decay** in the heartwood:

Lb1. **yellow** and **stringy** with red streaks - on true fir or hemlock: [Redpaint \(1.6\)](#)

Lb2. with tiny **white pockets** (spots); & **zone lines** in the decay - brown fungus in knots - esp. on douglas fir, pines: [Red Ring Rot \(1.1\)](#)

**no zone lines** and no brown fungus - on pines: [Red Ray Rot \(1.2\)](#)

Lb3. **brown**, **cubical** with thick, white fungus felts esp. on larch, douglas fir: [Dark Brown Heartrot \(1.13\)](#), [Dark Brown Rot \(1.14\)](#)

Lb4. **various shades of brown cubical with a very thin white covering on cubes - on high elevation species: Dusted Rot (1.15)**

Lc. in heartwood and sapwood:

Lc1. **uniform dark brown, cubical with fungus felts, any species: Crumbly Brown Rot (1.12)**

M. **BROKEN BASE** or stump:

with decay - **Ma, Mb, Mc, Md**

with stain in the wood - **Me**

with holes and tunnels - **Mf**

Ma. with **brown, cubical decay in heartwood:**

Ma1. **w/large cubes, & no fungus material - esp on douglas fir & pines: Red Butt Rot (1.11)**

Ma2. **w/ small cubes having a very thin white coating - on high elevation species, esp subalpine fir & spruce: Dusted Rot (1.15)**

Ma3. **cubical w/ heavy fungus felts which tend to follow the annual rings: Dark Brown Heartrot (1.13), Dark Brown Rot (1.14)**

Ma4. **cubical w/ fungus felts in all directions: Crumbly Brown Rot (1.12)**

- Mb. with **yellow decay** in heartwood (little difference between "yellow" & "white"):
- Mb1. **stringy**, with **red streaks** or **flecks** - on true firs or hemlock:  
[Redpaint \(1.6\)](#)
  - Mb2. **stringy**, **soft**, **watery**, with much yellow or white fungal matting in the wood: [Slimey Rot \(1.7\)](#)
- Mc. in conifers, **white**:
- Mc1. small **pockets**:
    - Mc1a. and **black spots**: [Black-Spotted Rot \(1.0\)](#)
    - Mc1b. and **zone lines** in the decay and brown fungus in knots or cracks: [Red Ring Rot \(1.1\)](#)
    - Mc1c. and no spots or zone lines, with **pockets merging**, esp pines: [Red Ray Rot \(1.2\)](#)
    - Mc1d. no spots, zone lines, etc. **pockets discrete** and giving a honeycombed appearance to cross sections on high-elevation spp.: [Honeycombed Rot \(1.3\)](#)
  - Mc2. finely **fibrous**, dry with **zone lines**: [Fibrous Rot \(1.5\)](#)
- Md. in hardwoods, **white** with many **zone lines**: [White Trunk Rot \(1.8\)](#), [Mottled White Rot \(1.9\)](#)

Me. in conifers, **black streaks** coming up from roots, esp. in plantations:

[Black-Stain \(7.1\)](#)

Mf. with borings:

Mf1. long tunnels in wood, running mostly **up and down** the tree:

[Carpenter Ants \(2.7\)](#)

Mf2. **holes** visible on exposed wood:

Mf2a. in conifers:

Mf2aA. **very large** holes with coarse cuttings within: [Timber Worms \(2.0\)](#)

Mf2aB. **oval** holes

Mf2aB1. in weak trees, wide galleries in inner bark - esp. on true firs: [Flathead Fir Borer \(2.5\)](#)

Mf2aB2. in weak pines at root crown or on large roots: [Calif. Flatheaded Borer \(2.4\)](#)

Mf2aB3. in dead or dying trees: [Blazed Tree Borer \(2.3\)](#)

Mf2aC. **round** 5-8mm holes, in fire-killed douglas fir: [Newhouse Borer \(2.1\)](#)

Mf2b. in **hardwoods**, holes **round**

Mf2bA. **small** 2-3 mm - in aspens, poplars, willows: [Poplar Borer \(2.7\)](#)

Mf2bB. large 7-9 mm - in aspens,  
poplars: [Aspen Carpenterworm](#)  
(2.6)

Mf2c. in conifers or hardwoods,  
very tiny round holes with dark  
edges: [Ambrosia Beetles](#) (6.12)

N. UPROOTED, windthrow - LEANING,  
"Widowmaker"

Na. with decay and/or fungus in roots -

Na1. outer roots fibrous decayed,  
inner firm; white fungus fans may be  
present: [Armillaria](#) (1.5)

Na2. rotted roots stringy, wet, slimy  
with yellow or white fungus in the  
decayed wood: [Slimey Root Rot](#)  
(1.7)

Na3. rotted roots brown-cubically  
decayed. Rot mostly in root centers:  
[Red-brown Root Rot](#) (1.11)

Na4. on end section rotted roots have  
a honeycombed pattern:  
[Honeycomb Root Rot](#) (1.3)

Nb. without decay or fungus in roots

Nb1. roots have swollen lenticels -  
excess moisture (water) (7.0)

Nb2. shallow roots with a pancake-  
like root mass - hardpan or high  
water table (7.0)

Nb3. roots firm but with dark streaks in the wood - [Black-Stain \(7.1\)](#)

O. bark EATEN or RIPPED by animals

Oa. bark of upper stems eaten in irregular patches. Large tooth marks present: [Porcupine \(5.1\)](#)

Ob. lower stem with long, deep scratches: [Bear \(5.5\)](#)

Oc. thin bark of lower stem irregularly scratched & ripped: [Deer, Elk \(5.5\)](#)

P. SWEEP or CROOK - defines other than a straight stem ([4.1](#))

Q. MULTIPLE TOP, double top - no defect is recognized unless stem diameter/s exceed 4 inches. The defect crooks at the junction/s.

R. SCHOOLMARM - a large double top with "outstretched arms."

S. FORK, double stem

T. STAGHEAD, dead top - defect all dead wood in the crown

## PROMINENT FEATURES ON BRANCHES

- U. **BROOMS**, witches brooms, branch-masses
- Ua. **tight with small**, often **yellow needles** - on grand fir, subalpine fir, concolor fir: [Yellow Witches Broom \(8.3\)](#)
- Ub. **tight or loose** - on douglas fir, or larch: [Mistletoe \(8.1\)](#)
- Uc. **tight or loose**, **all parts green** - on ponderosa or lodgepole pine: [Mistletoe \(8.1\)](#)
- Ud. **tight or loose**, **some parts brown**, some needles missing - on ponderosa or lodgepole pine: [Elytroderma Broom \(8.2\)](#)
- V. **DIE-BACK**, dead top. Defect dead material
- W. **MULTIPLE TOPS**. Defect only dead or crooked parts.
- X. large branch/es **BROKEN**  
decay in ....  
see under [L.](#) above

Y. branch STUBS

associated fungus is...

Y1. white: Red Ray Rot (1.2)

Y2. brown: Red Ring Rot (1.1)

Y3. dark w/teeth, red inside: Redpaint  
(1.6)

Z. discolored foliage, FLAGGED-

see under 'wounds, cankers or stem  
rusts' C. above.

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Be sure you have identified neighboring  
hints - broken trees, the roots of  
uprooted trees, decay patterns in cut  
stumps, logs on the ground.

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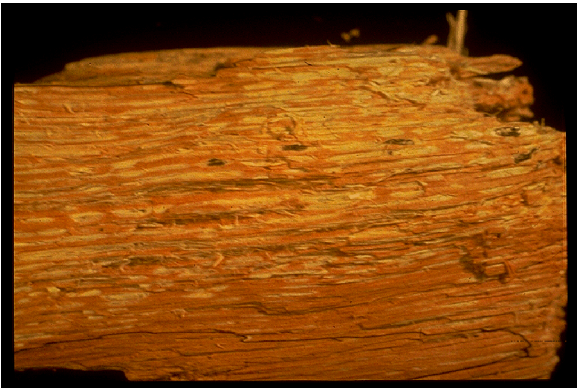
Be very careful to review the "Compare  
with:..." statements in the sections  
below.

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1.0 BLACK-SPOTTED POCKET ROT AND ROOT ROT - caused by *Heterobasidion annosum*. Affects conifers, most commonly white pine, grand fir and hemlock.

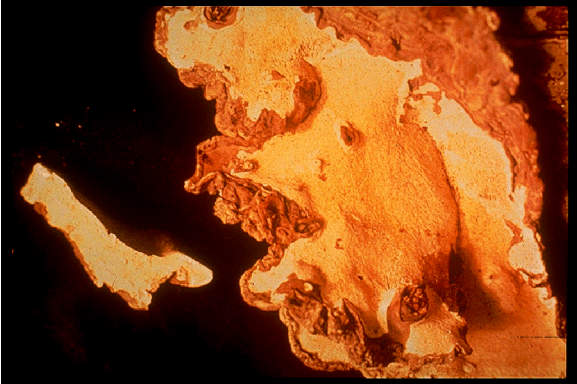
Crowns deteriorate and usually die. The heartwood is decayed and decay is associated with root decay and death. Decay is confirmed by thin, white fungus mats (mycelium) growing in the bark and a licorice-like odor to the wood. Decayed wood has white pockets with tiny black specks included. It is limited to the lower 10 ft. of trees in this region.



Later, the pockets merge to create a spongy white mass flecked with black spots. Decay varies depending on where it occurs and often no pockets

develop under wet conditions. Pockets are common in standing trees.

Conks, rare on standing trees, occur at the base under



the duff and are irregular in outline. They are usually less than 3 inches across and may shelve or be crustlike. The upper surface is dark. The lower surface and the interior are white.

Compare with: [Red Ring Rot \(1.1\)](#), [Red Ray Rot \(1.2\)](#).

**DEFECT:** conks on older trees indicate 8-10 feet of cull in the lower stem.

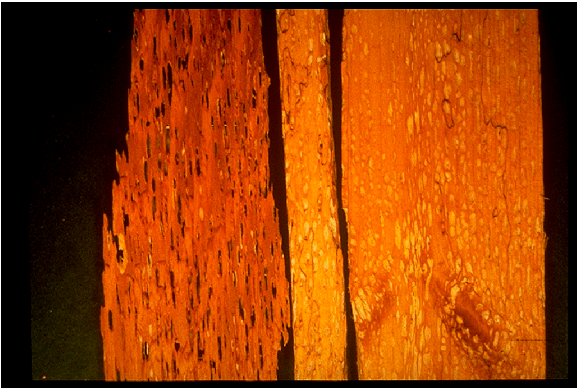
**Stand Indicators:** conks may be just beneath the duff on killed trees. Downed trees will be present and roots will display the decay.

1.1 RED RING ROT - caused by *Phellinus pini*. Affects all conifers, esp. larches and white pine.

On cross-section decay follows the annual rings as a set of concentric, but broken, rings of visible rot.



On longitudinal-section the decay has distinct white pockets and zone lines. Brown mycelium is inside knots.



Conks and "punk knots" are common and visible. Conks, at knots or branch stubs, are 1 to 12 inches across & average 3 inches. The shape varies but they shelve and have a yellow-brown lower surface and interior. The upper surface is dark brown and furrowed. Conks are hard.



Punk knots are slight swellings around old branch unions and are filled with

brown fungus which can be exposed with an axe chop.



Compare with: [Black-Spotted Pocket Rot \(1.0\)](#), [Red Ray Rot \(1.2\)](#)

**DEFECT:** many conks or swollen knots evenly distributed on the bole indicate extensive decay and usually total heartwood cull. Any conk or swollen knot on larch indicates total heartwood loss.

On other species, cull will extend 2-4 ft. up and 4-5 ft. down from a conk or punk knot. In white pine the cull will be confined to the side of the tree supporting the conk, provided no other indicators are present.

**Stand Indicators:** conks or swollen knots appear on some affected trees in a stand.

1.2 RED RAY ROT - caused by *Dichomitus squalens*. Affects conifers, esp. ponderosa pine and lodgepole pine.

On cross-section this decay, in either early or late stages, has a red, star-like or ray-like pattern.



Longitudinal sections have elongate, white pockets with blurred borders. Pockets tend to run together & eventually the wood is very soft and crumbles readily. Zone lines do not occur in this decay.





This is the major decayer of ponderosa pine slash.

Conks are rare except on slash or downed trees. They are entirely white and shelve little or none. The conks are hard and look chalk-like.

Compare with: [Red Ring Rot \(1.1\)](#)

**DEFECT:** conks indicate total cull of logs or heartwood of trees. Fallen branches with decay indicate total decay in the tree and extensive stand loss.



Stand Indicators: only the decay, and sometimes attendant conks, on fallen branches or downed trees indicate decay in standing trees.

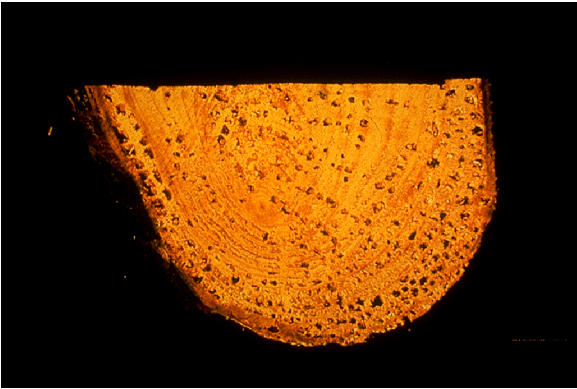


1.3 HONEYCOMB ROOT AND STEM ROT - caused by *Inonotus tomentosus*. Affects conifers at high elevations esp. true firs, spruce, and douglas fir.

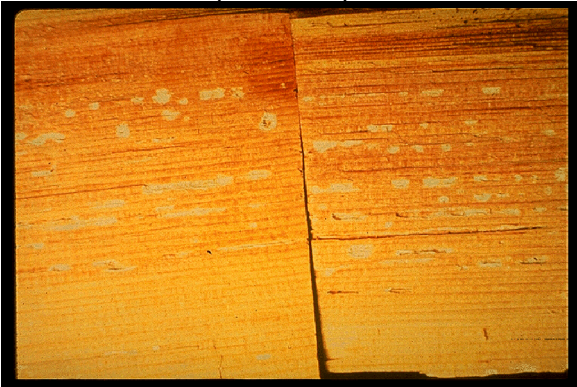
Standing trees do not have external indicators. Look for the decay in similar cut, fallen or broken trees in the stand.

Decay begins in roots and works into stems. In roots, it destroys both sapwood and heartwood. In stems, only heartwood is affected. On cross-section, the decay appears as a tiny, modest honeycombing surrounded by an irregular, light-brown to red incipient zone.





Longitudinal sections have tiny, rectangular to blunt spindle-shaped, white pockets whose edges tend to merge with surrounding wood. No zone lines or black spots are present.



Small, 2 to 3-inch, firm, yellow-brown to rusty-brown, centrally-stalked, conks grow on the soil near trees, but are undependable warnings of decay in nearby trees.



Compare with: [Red Ring Rot \(1.1\)](#)

DEFECT: decay extends, as a cone, 6-10 ft. into the butt log.

Stand Indicators: only decay in broken or uprooted trees indicates stand deterioration. Bark beetles often accompany and indicate this problem. Combined indicators in a stand imply 6-10 feet of basal cull in affected species.

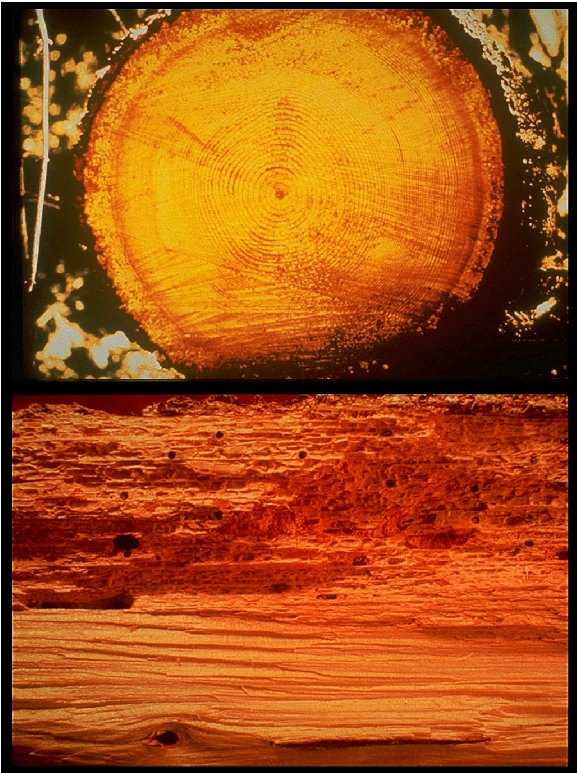
#### 1.4 PITTED SAP-ROT (CONIFERS)

- caused by *Hirschioporus abietinus*.

"Purple conk." Affects all dead conifers.

Only the sapwood decays & on cross-section appears rough where the saw passed through.

On longitudinal-section the decayed sapwood is honey-combed with tiny, rectangular, shallow, empty pockets & becomes spongy or corky.



Small, numerous conks occur on decaying logs. They have pores, are hairy gray to white, usually 1 in. (sometimes 2-in.) across & appear in groups. When actively growing, the lower surface is purple.



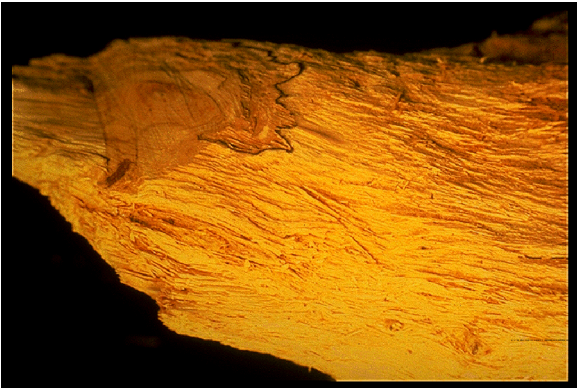
DEFECT: conks indicate total decay of the sapwood only.

1.5 FIBROUS WHITE ROOT AND STEM ROT - caused by *Armillaria mellea*.

"Honey Mushroom." Affects almost all species, but planted trees are very susceptible.

The end of decayed logs may be partly hollow with spots of fibrous decay & zone lines.

On longitudinal-section, root or stem wood is light yellow or white, finely stringy & has fine, black zone lines.



Signs:

- a. white mycelial (fungus) fans appear under the bark at tree bases.
- b. black rhizomorphs (root-like fungus) occur in or on roots.
- c. clumps of light brown or honey-colored mushrooms appear in bunches at dead tree bases or around stumps in late autumn. Each cap is 1-3 1/2 inches across with very fine brown scales on top.







Compare with: [Slimey Rot \(1.7\)](#)

DEFECT: decay extends into the base  
2-5 ft.

Stand Indicators: The fibrous decay will be in uprooted trees & mycelial fans on recently killed trees. Roots of dead or dying trees have a fibrous rot of outer wood with firm root centers meaning they do not break easily.

Other Indicators: with this & other root diseases, boring dust (frass) or pitch tubes on a tree may imply the presence of root disease.

Look for: Galleries of [bark beetles \(6.0\)](#) under the bark.

But also look for: other consorts. This often is secondary to root disease by *Phaeolus schweinitzii* or *Inonotus tomentosus* or *Leptographium* spp.



Mycelial fans alone do not mean this disease is primary in a tree. Be sure their occurrence doesn't lead you to incorrect diagnosis. If fans are present, the tree & stand must be examined for all potential causes.

### 1.6 STRINGY HEART-ROT - caused by *Echinodontium tinctorium*.

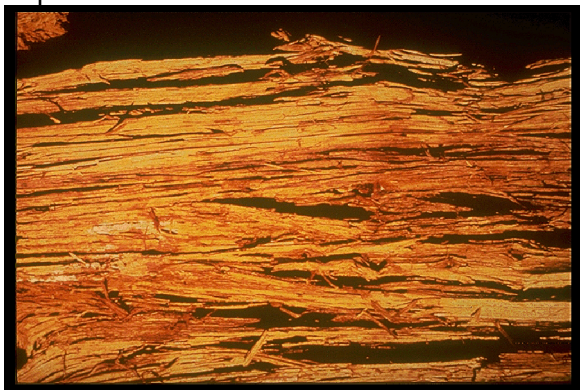
"Redpaint Fungus." Affects hemlock & grand fir commonly, other conifers sometimes.

This is the major decay of true firs in the Northwest. Only heartwood is decayed.

On cross-section, decayed heartwood is very fibrous, yellow or red-tinged & has a circular pattern. Often the trunk is partly hollow.



On longitudinal-section decayed wood is yellow to red-yellow & fibrous or stringy. Rusty-red streaks appear, chiefly near knots. Knots on rotted trees or logs have a rusty-red mass, easily exposed with a hatchet.



Signs:

- a. large, hard, woody, conks occur beneath branch stubs. These are perennial, hard, dark-colored & have a brick-red interior. The lower surface is spiny.



- b. knots are filled with the brick-red fungus (mycelium) that constitutes the interior of conks.



Compare with: [Fibrous White Rot \(1.5\)](#), [Spongy Butt Rot \(1.7\)](#)

**DEFECT:** a lone conk indicates 16 ft of heartwood loss in each direction, but this varies with species & locality & must be applied on a local basis. In some cases, we have recorded up to 50 ft of decay indicated by a single conk. Two or three scattered conks on a tree indicate total heartwood loss. Some trees bear no conks but the relative abundance of conks in the stand will indicate the total cull therein. On hemlock a conk indicates total heartwood loss.

Stand Indicators: conks occur on at least some trees in an affected stand. Broken trees are additional evidence.

1.7 SPONGY ROOT AND BUTT-ROT, Slimey rot, Feather rot - caused by *Perenniporia subacida*. "White Root Conk." Affects roots & butts of live conifers, esp. grand fir or subalpine fir, or dead conifers & hardwood trees or slash.

On cross-section the decay appears as patches or a circle & is very wet, soft & slimey with visible, yellow (fungus)



mycelial masses included. Stems & roots of dead or dying trees are decayed.

On longitudinal- section wood is a soggy (spongy) mass of yellow (or white) rot with black spots. Prominent yellow or white mycelial mats are included in the decayed wood.



On live trees conks are rare, but in an infested stand they are found on dead

material. They exist under logs or in root crotches as flat, dingy-yellow crust-like conks often forming large sheets. They have pores, are perennial & are the same color throughout.



Compare with: [Fibrous White Rot \(1.5\)](#), [Stringy Heart-Rot \(1.6\)](#).

## DEFECT:

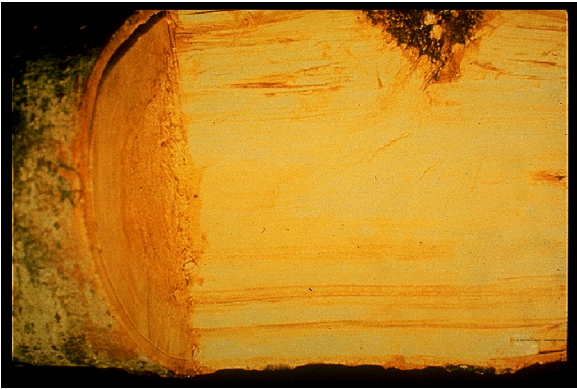
- a. decay enveloping the heartwood of a butt cut will continue into the log 16-18 ft.
- b. on live trees, conks indicate up to 16 ft. of butt cull.
- c. on dead logs, conks indicate total cull.

Stand Indicators: broken & overturned trees will show the typical decay. In true firs bark beetles commonly associate with and suggest this root rot.

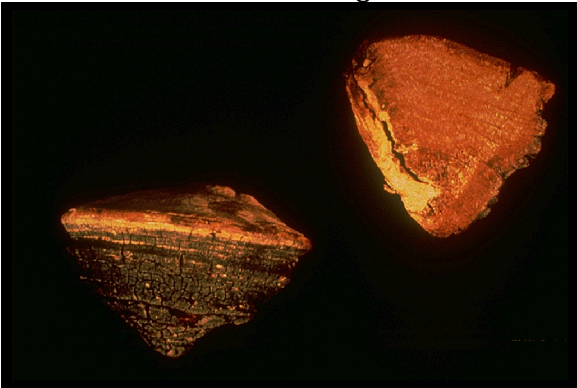
1.8 WHITE TRUNK ROT - caused by *Phellinus igniarius*. "False Tinder Conk." Affects both live and dead hardwoods, esp. aspens, poplars, & birches. A principal cause of loss in hardwoods. Mostly, heartwood is affected, but sapwood also is invaded & ultimately destroyed. In live trees this fungus causes cankers.

Decayed wood is soft, light weight, yellow or white & has many, obvious, black zone lines running throughout. Zone lines surround each decay column.





Conks, usually present, are hard, woody & generally hoof-shaped with a convex lower surface & very tiny pores. They average 4 in. wide & have a dark upper surface that becomes cracked & "cinder-like." The interior is dark brown with distinct tube layers. Older tubes are stuffed with white fungus.



**DEFECT:** a conk indicates decay extending at least 8 ft. in either direction.



Several conks indicate no usable heartwood. A canker caused by the fungus indicates total cull.

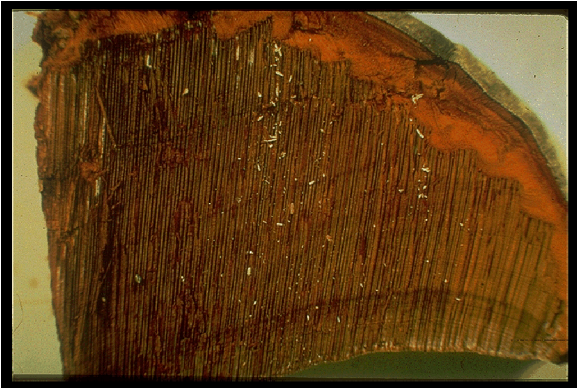
Compare with: [Mottled White Trunk Rot \(1.9\)](#).

Stand Indicators: conks are common.

1.9 MOTTLED WHITE TRUNK ROT - caused by *Fomes fomentarius* "Tinder Conk." Affects hardwoods, esp. poplars, aspens & birches. This is a decay of sapwood & heartwood of dead timber, but occasionally attacks heartwood of live trees & may attack live sapwood.

Decayed wood is yellow or white, soft, with many black zone lines; essentially the same as that caused by *Fomes igniarius* although it may have small radial cracks with yellow mycelium within.

Conks, usually present, are hard & hoof-shaped with a concave lower surface & very tiny pores. The upper surface is grey & smooth. The interior is dark brown, but the tube layers are indistinct & rarely contain white mycelium.



Compare with: [White Trunk Rot \(1.8\)](#).  
**DEFECT:** conks on live trees indicate little sound heartwood & on logs indicate no useful wood.  
Stand Indicators: conks on many trees in an infested stand.

1.10 GREY-BROWN SAP-ROT - caused by *Cryptoporus volvatus*. "Pouch Conk." Affects dead conifer sapwood; dead trees, logs & slash.

Grey areas which develop in wood beneath conks later become limited decay zones. Zones, less than 1 in. wide & 10 in. long, develop a very light brown, cubical, crumbly decay which penetrates only the sapwood.



Conks, always present, are small (< 2 in.), round & numerous on affected stems. They are, first, light yellow-brown & rubbery but soon become hard & white. The pores are covered & not visible on the outside. When a conk is split, an opening or "pouch" is revealed with the tubes inside.



Compare with: [Pitted Sap-Rot \(1.4\)](#).

**DEFECT:** is limited to minor deterioration of the sapwood & often is ignored in cruises. The conks are present for 2-3 yrs. after tree death & are good indicators of the time of death.

## 1.11 RED-BROWN ROOT & BUTT-ROT

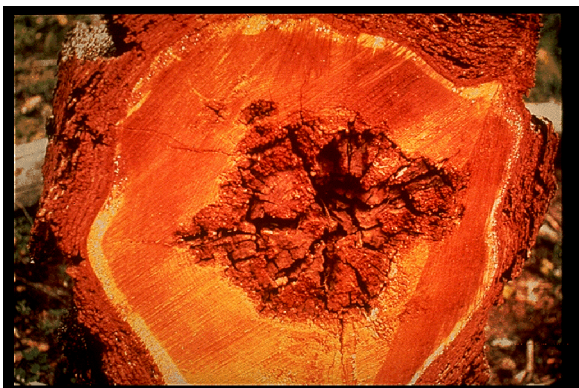
- caused by *Phaeolus schweinitzii*.

"Velvet-top Conk" or "Cowpie fungus."

Affects conifers & some hardwoods.

Common in douglas fir & pines.

On cross-section this decay is dark brown, cubical & only in heartwood of the lower stem. It may appear in patches, symbolizing entrance from individual roots.



On longitudinal-section decay appears yellow-brown to dark red-brown, crumbly, with few cubical cracks. Thin, light, white material occurs occasionally in shrinkage cracks. The decay is very brittle & crumbles to a fine powder.



Conks occur rarely on trees but rather are on the duff beneath trees if present at all. They are annual, large (6-18 in. average), generally circular, dark brown & have a central stalk supporting several caps flower-like. Individual caps are thin brackets with a dark red-brown velvety upper surface. The lower surface is the same as the upper but is green-yellow-brown when young. The pores are large & angular.





Compare with: [Crumbly Brown Cubical Rot \(1.12\)](#), [Dark Brown Cubical Heartrot \(1.13\)](#), [Dark Brown Cubical Rot \(1.14\)](#)

**DEFECT:** a conk in or near a tree or decay in the butt indicates 8-12 ft. of tapered decay in the first log. However, if carpenter ants are present, decay will extend to 32 ft. In very dry habitat types the decay often extends to 32 ft. without ants.

Increment borings reveal brown rot in the stem at DBH. Several borings may be needed, especially above large roots, to confirm this.

Stand Indicators: conks, if present, indicate of decay extent in a stand. In general: 1 -3 conks per acre, 40% of the trees are affected; 4-6 conks indicate 60%; > 6 indicates 80-100 % are affected. Since approximately 60% of a

tree's volume resides in the first 16 ft. log, this means serious volume reduction in affected stands.

The presence of broken or uprooted trees with decay is a strong indicator. Downed trees will have roots with the brown center decay & usually many nubbed roots.

## 1.12 CRUMBLY BROWN CUBICAL ROT

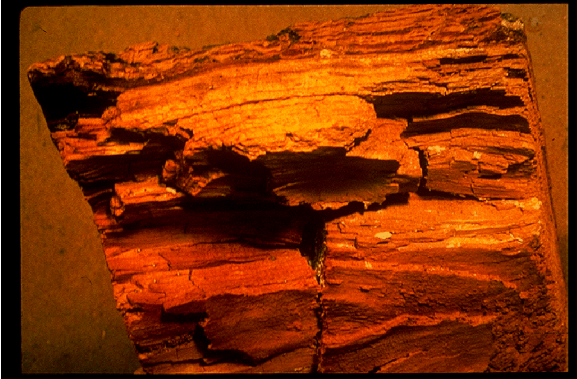
- caused by *Fomitopsis pinicola*.

"Red Belt Conk" or "Wotsat Conk."

Affects tree species throughout the world. This is the most common decay in the world.

On logs, the end-section will have brown, cubical decay with many mycelial felts & much radial cracking. Decay may be confined to heartwood but will be connected with a wound & will be invading sapwood. More often, this decays dead logs where both the heartwood & sapwood become brown-cubically decayed with many mycelial felts included.





Conks, usually present, are large and have a cork-brown, corky-textured interior. A red belt may occur along the outer edge of the upper surface not always. This is the most common conk on wood in our forests.



Compare with: [Dark Brown Cubical Heartrot \(1.13\)](#), [Dark Brown Cubical Rot \(1.14\)](#).

**DEFECT:** decay on an end-section or the presence of a conk imply total loss of the heartwood &, in dead logs, total cull of all wood.

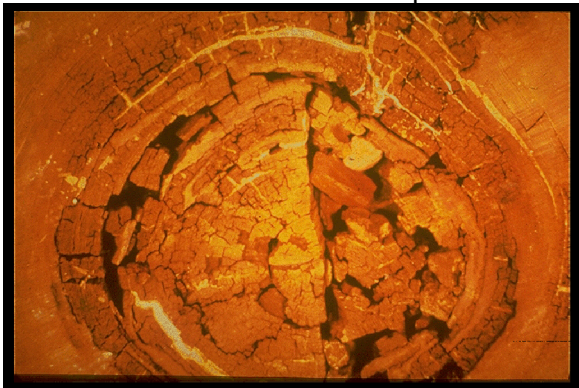
1.13 DARK BROWN CUBICAL  
HEARTROT - caused by *Fomitopsis*  
*officinalis*. "Quinine Conk."

Affects live conifers & infested logs.

On end-section the decay appears dark brown with thick, white mycelial felts following the annual rings.

Decayed wood is dark red-brown, cubically cracked & crumbly. Thick, white mycelial felts are abundant in shrinkage cracks usually following annual rings. Felts taste bitter.

Sometimes the heartwood changes color little but these felts are present.



Conks may or may not be present. They are large (6-24 in. long), pendulous or hoof-shaped, & a dirty chalky white in both color & texture. The interior & all surfaces are chalky white. All parts taste very bitter.



Compare with: [Dark Brown Cubical Rot \(1.14\)](#)

**DEFECT:** a single conk indicates loss of all heartwood in the tree, but conks are rare. If the fungus is known to be in a stand "high risk" trees will have broken tops or large broken branches. Decay on a log end extends as a column through the log.

**Stand Indicators:** conks on any tree indicate considerable stand decay and trees should be sampled by borings.

1.14 DARK BROWN CUBICAL ROT - caused by *Laetiporus sulphureus*. "Sulfur Conk" or "Chicken O' Th' Woods." Affects heartwood of live conifers & hardwoods & dead trees, logs or stumps.

The decay is identical to that caused by *F. officinalis*, but the mycelial felts are not bitter.

Conks may or may not be present & are distinctly shelving, large (10- 30 in.), & bright yellow on the lower surface & interior. The upper surface is bright orange. The conks have a sulfur odor. When conks age, they are chalky in color & texture.



Compare with: [Dark Brown Cubical Rot \(1.13\)](#)

**DEFECT:** a conk indicates total cull of most logs. On trees the decay is extensive but confined to the butt log. Decay on a log end extends as a column throughout the log.

Stand Indicators: same as for "[Quinine Conk](#)" (1.13).

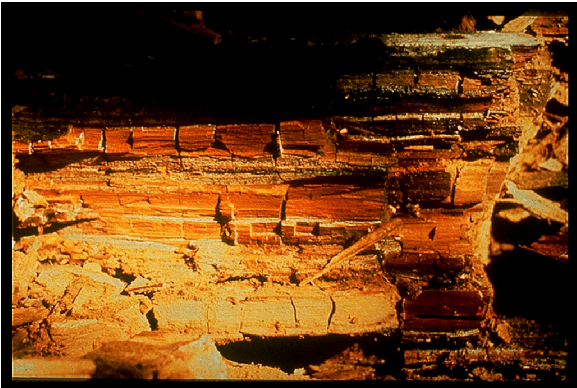
1.15 DUSTED CUBICAL ROT -caused by *Coniophora puteana*. Affects live or dead conifers & some hardwoods, esp. trees at high elevations. A major decay of high-elevation trees.

On end-section the decay appears irregular & indistinctly outlined with partly light-brown and partly dark-brown wood with large irregular cracks.

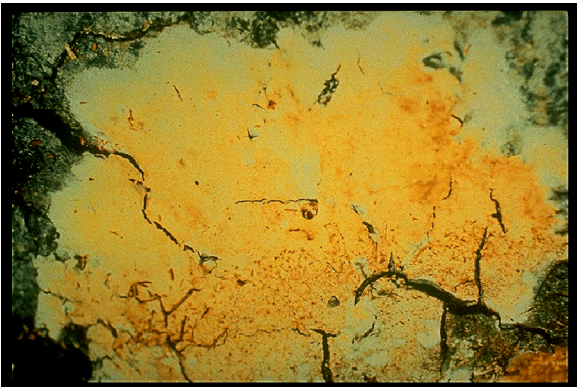


On longitudinal-section decayed wood is greatly cubed with a thin, white mycelial coating on many cube faces. The decay color varies from purple-brown to dark- or light-brown.





Conks are rare except on logs where they appear as large (6 in.- 3 ft.), thin, flat, annual, crust-like sheets. They are principally olive or very light brown in the center & white toward the margins. They are smooth with no pores, gills or teeth.



**DEFECT:** a decay circumference on a log end extends throughout a log.

Conks indicate localized decay up to 6 ft. from each conk in dead wood.

Stand Indicators: broken trees with the decay are usually present and imply a need to bore stems.



## BORERS

2.0 PONDEROUS BORER *Ergates spiculatus*. "Timber Worm." Affects standing, dead douglas fir & ponderosa pine, but also other pines, & true firs.

Extremely large (2-6 cm. across), frass packed (excelsior-like) tunnels penetrate & riddle affected wood.



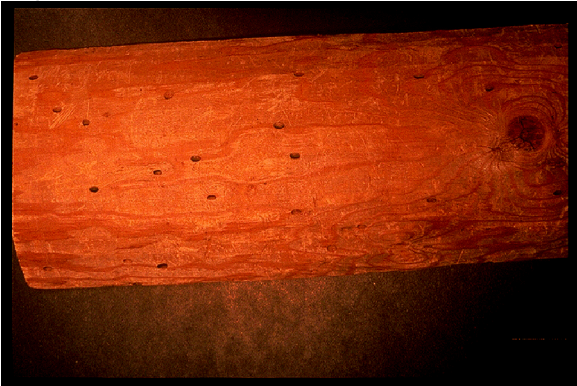
Larvae are large (60-70 mm. long) soft-bodied, dirty white and roundheaded with 4 toothlike projections just above the mandibles.

Compare with: [Woodpecker damage \(5.3\)](#).

DEFECT: is localized, often to the lower part of the first log only.

2.1 NEWHOUSE BORER *Arhopalus productus*. Affects fire-killed douglas fir trees & lumber from such trees.

Large (5-8 mm. wide) larval mines occur under the bark & into the sapwood & heartwood.



They cause major damage to the wood. Live insects remain in manufactured wood & cause damage after structures are completed. Larvae

are dirty white, soft-bodied and roundheaded.

**DEFECT:** the large, round holes in logs or in manufactured wood indicate severe damage with structural strength reduced or destroyed. All wood within 2 ft of the boreholes is cull.

All douglas fir wood should be routinely examined for holes caused by this insect especially before being used in construction.

2.2 POPLAR BORER *Saperda calcarata*. Affects live aspens, poplars & willows.

Small (2-3 mm.) holes in twigs or stems indicate the problem. The holes typically have expelled boring dust spilling from them. The insects bore



into the sapwood & heartwood & mine extensively commonly causing wind breakage.



Decay by *Pholiota adiposa* (or *P. aurivella*) often accompanies or follows this insect.

The insects commonly are absent by the time damage is noticed.

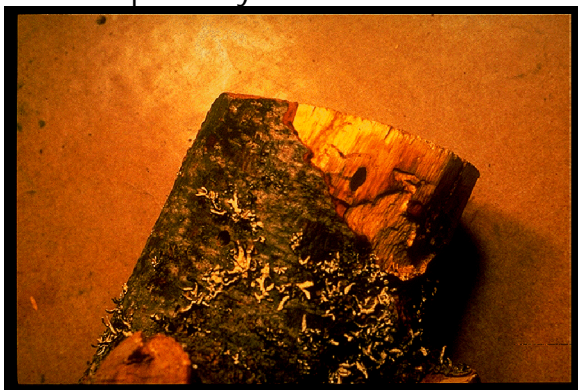
**DEFECT:** these cause serious damage to standing aspen, poplars & willows & destroy wood quality. Their frequent association with decay implies affected trees are cull.

Affected trees should be cut & burned.

### 2.3 BLAZED TREE BORER

*Serropalpus substriatus*. Affects many dead or dying conifers. Common after fire.

Oval tunnels, with very fine, dustlike frass penetrate the sapwood. Emergence holes (3-5 mm) through the bark are perfectly round.



Larvae are long (10-15 mm.), slim and white.

**DEFECT:** is limited to mines which penetrate sapwood in the locality of boreholes in unprocessed logs.

**Management:** in problem areas, process logs as quickly as possible.

2.4 CALIFORNIA FLATHEADED BORER *Melanophila californica* Affects pines, esp. ponderosa pine. Principally weak, old, unhealthy trees.

Affected trees show no crown thinning, but quickly turn yellow & brown or red. Boring dust from large (8x5 mm), oval boreholes at the root crown or on large

roots indicates insect activity. Borer galleries beneath the bark are wide (8-10mm) & frass-packed with borers present.



Compare with: [Flatheaded Fir Borer \(2.5\)](#)

Defect: mortality, but no volume loss is associated.

## 2.5 FLATHEADED FIR BORER

*Melanophila drummondii*. The borer most frequently attacking injured, weak or dying douglas fir, true firs, spruce, hemlock or western larch.

The lower Stems of affected trees will have boring dust on them. At the lower stem or on large roots, the inner bark will be bored with wide (9-12 mm), irregular galleries packed with frass.

The large flatheaded larvae often are present.



Compare with: [California Flatheaded Borer \(2.4\)](#)

DEFECT: mortality but no volume loss is associated.

## 2.6 ASPEN CARPENTERWORM

*Acosus populi*. Affects cottonwoods & poplars

Affected trees will have dying & discolored limbs & frass will be found on the bark. Large tunnels (7-9 mm) are visible under the bark & tunnels penetrate wood. Little or no cambial mining occurs. The cream-colored larvae bore trembling aspen so much that affected trees often snap off. Cream-colored larvae may be present in the tunnels.





**DEFECT:** all wood beneath the bore holes is waste but the waste does not extend laterally more than a few inches.

2.7 CARPENTER ANTS *Campanotus* spp. Affect conifer or hardwood heartwood in live trees.

Piles of boring dust collect below entrance holes at a tree base particularly at sites of old wounds. All underlying wood to the trees' center is tunnelled vertically & structural value is destroyed. The tunnels are large (up to 9 mm. across) & long (some several feet). Intervening wood may be only very thin plates.





Large (7-15 mm), black or black & red ants are present at entrance holes scurrying in & out of the tree.

**DEFECT:** frass around entrance holes with ants present indicates severe damage. Minimally, loss will extend 10 ft up the tree. If **red-brown root & butt rot (1.11)** is present 32 ft. of the basal heartwood is decayed.

These insects typically associate with decays.

### 3.0 STEM RUSTS, CANKERS AND INJURIES:

#### STEM RUSTS OF CONIFERS

"Rusts" can not live on dead trees or parts. Most are native & only a few cause serious damage. Usually they cause swellings of stems or branches.

#### CANKERS

"Cankers" are expanding patches of dead or dying bark & cambium. The patches do not heal like wounds, but expand as fungi kill the cells that ring the area. This occurs around a stem or down a branch producing zones, lines, of mortality. Thus, cankers have concentric lines or callus or "catfacing." Most also have tiny, visible pathogen parts.



Borers often infest cankered areas and introduce stain or decay fungi.

3.1 WESTERN GALL RUST - caused by *Endocronartium harknessii*. Affects most 2- and 3-needled pines. It is problematic on ponderosa pine, scots pine, and lodgepole pine. Vigorous

trees are very susceptible. This rust is capable of directly reinfesting pines.

Conspicuous, round, galls form on branches or main stems. In the spring or early summer, orange spore masses erupt from living galls and the powdery mass of spores is easily dislodged. The bark on small branches cracks so that death



of the galls & parts beyond the galls is common. Thus, flagging & twig mortality are symptoms of the disease. On large branches or main stems, galls may continue to develop for many years so that large burls form. Also, cankers may form as the older parts of large galls die.

Live galls are regularly gnawed by rodents.

On lodgepole pine "hip cankers" commonly develop.



**DEFECT:** is confined to the gall area except hip cankers may distort wood 2-3 ft in either direction from each gall.

3.2 WHITE PINE BLISTER RUST - caused by *Cronartium ribicola*. Affects 5-needled pines (white, limber, whitebark, sugar, et al).

Bark discoloration occurs on thin-barked trees. Older cankers will be heavily cracked & accompanied by resin flows. Swelling occurs above girdling cankers.

"Flags" of yellow to red-brown foliage are common, occurring when branches above cankers are killed.

During spring, blisters appear around the lesions as small (1-3 mm) yellow to

light-brown patches. These soon dry leaving dark lesions visible during all seasons. Often the blistered bark is gnawed by rodents.



On inner parts of each lesion, white, sack-like blisters also appear. They erupt exposing powdery, orange-yellow spore masses. After spores are discharged, the white sac crumbles & the bark dries & cracks. The underlying cambium soon dies. Blisters develop each year until the stem above the canker is killed.



Compare with: [Atropellis Canker \(3.5\)](#)  
DEFECT: is confined to killed tops, branches or trees or to the gall area.

3.3 DASYCYPHA CANKERS - caused by *Dasycypha* spp. Affects pines and douglas fir.

Perennial cankers first appear as somewhat flattened stem depressions. Later the margins & adjoining tissues are swollen producing a "lip" around each canker, particularly in douglas fir. Resinosis from the canker is common. Bark over young cankers is intact. Wood beneath cankers is resin soaked but not dark-stained.



Tiny (1-4 mm), light brown to pale orange or white, disc-shaped fungi appear on or at the edges of the canker. They are slightly hairy on the outside of the disc & orange on the inside.





Compare with: [Atropellis Canker \(3.5\)](#).  
**DEFECT:** is confined to the wood just beneath the canker only on the side of the trunk having the canker.

3.4 CYTOSPORA CANKERS - caused by *Valsa* spp. Affects many hardwoods, esp. poplars, willows, and cottonwoods.

Lesions form on trunks & large branches or twigs. These are dark-colored spots which enlarge on large stems but work down branches. Large cankers tend to be slightly sunken areas. In all cankers, the underlying bark is brown & a sharp line exists between this & the green of adjoining healthy bark. When a canker is indistinct, as on rough-barked trees, a thin longitudinal slice of outer bark will expose the line.



Tiny (0.5-1 mm), black, pimple-like fungus bodies are shallowly embedded in the bark over cankers.

These cankers often combine with insects. A common interaction exists between "poplar and willow borers" & *Valsa* spp..

**DEFECT:** is limited to outer wood just beneath the canker. However, decay may be associated & examination should confirm or deny its presence.

### 3.5 ATROPELLIS CANKERS OF PINES - caused by *Atropellis* spp. Affects pines only.

Cankers are perennial, oval or elongate, sunken areas often with the bark intact over a "catface." Wood beneath each canker is streaked blue-black or grey-green. Branches or main stems are affected and



often girdled causing companion flagging. Large trees rarely are killed & most damage is deformation or degrade. The wood discoloration & pitch are serious problems in paper manufacture.

Atropellis flagging commonly is misdiagnosed as blister-rust-caused.

Small (2-5) mm), black, disc-shaped fungi appear on the bark of cankered areas.

Compare with: [White Pine Blister Rust \(3.2\)](#).

DEFECT: on the side of the tree with the canker, all wood beneath each canker & for 2 inches to each side is cull. Or you may use a 15% deduction for any log with a canker.

3.6 STALACTIFORM RUST - caused by *Peridermium stalactiforme*. Affects high-elevation lodgepole pine & occasionally ponderosa pine.

On small branches or stems, slightly spindle-shaped swellings develop. These may girdle the branch or stem.

Perennial, vertically elongate cankers form on large stems but rarely girdle. These may be 30 feet long and are crusted with yellow resin. Branches or branch stubs remain within each canker face.



Orange fungus sacs form on branch swellings or at the edges of cankers. When these rupture, fringed edges form and many, white filaments show within the cavities.





Rodents gnaw the outer edges of such cankers leaving them white. Old trees, even those heavily infected, rarely are killed, but seedlings & saplings are often killed.

Compare with: [Atropellis canker \(3.5\)](#), [Wounds \(4.0\)](#). This is mistaken for

wounding, but is easily detected by branches retained in the face.

**DEFECT:** the area under a canker is heavily resin-soaked so that the length & width of the canker plus 2 inches is considered cull to the interior of the tree.

Some, e.g. log-home builders, prefer the resin-soaking.

3.7 COMANDRA BLISTER RUST -  
caused by *Cronartium comandrae*.  
Affects high-elevation, dry site  
ponderosa & lodgepole pines.  
Lodgepole pine is very susceptible.

Spindle-shaped swellings of bark occur on needle-bearing twigs or stems & often go unnoticed until white fungus sacs push through the bark and rupture exposing orange spore masses. After spores are shed, the bark cracks & cambium is killed. Eventually, girdling occurs so that flagging is frequent.





When cankers reach main stems of large trees, the bark usually is constricted instead of swollen and resinous is common. Aecia are rare on such cankers on lodgepole pine although they may be found under the bark scales of ponderosa pine. Cankers

are usually gnawed by rodents which often is the best diagnostic lead.

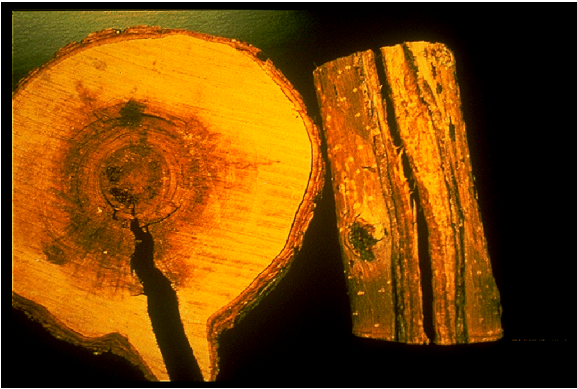
Compare with: [Stalactiform Rust \(3.6\)](#)

DEFECT: is confined to the canker area.

3.8 FROST CRACK - (a misnomer) - is caused by extreme temperature differentials - not by "frost." A rapid, severe weather change leaves the temperature of the outer part of a stem violently different than that of the interior & differential shrinkage causes the cracking.

Affects any species but especially those with high moisture contents in stem wood (e.g. grand fir).

A very elongate, vertical crack is obvious along the bole and deep into the wood. Bleeding is common along the crack & a lip of callus may develop outside of the crack which usually fails to heal. The crack does not expand to form a dead area surrounding the original fracture.



Compare with: [Lightning Damage \(3.9\)](#), [Stalactiform Rust \(3.6\)](#).

**DEFECT:**

- a. cull 2 inches to both sides of the crack to the trees' center--
- b. except that in a tree with an old, lipped crack all heartwood will be decayed or watersoaked.
- c. In grand fir with bleeding around the crack, ring shake will have ruined the heartwood.

**3.9 LIGHTNING DAMAGE** - caused by lightning. Affects all species particularly those in exposed positions.

One or several, long, narrow, ragged rips deep into the wood will extend almost the entire length of an affected tree.



No fungi or insects will be associated.

Compare with: [Frost Crack \(3.8\)](#).

**DEFECT:** a strip 3 inches to each side of the injury and 8 inches deep will be cull.

3.10 BLACK CANKER OF ASPEN -  
caused by *Cenangium singulare*.

Affects aspens.

These are dirty black, elongate  
cankers with concentric ridges of callus.  
Old bark adheres raggedly to the  
ridges. Cankers appear on trunks or  
large limbs & are often multiple on a



single tree. Small trees may be girdled. Occasionally cankers heal over. Affected trees occur in scattered groups. A few trees are killed, but most are only distorted.

**DEFECT:** is limited to the cankered area and resulting distortions, but the disease often is associated with heartrot or boring insects which cause more severe loss.

4.0 WOUNDS - cause: mechanical injury (falling trees, logging equipment, etc.). Affect all species.

Mechanical damage can be distinguished from other problems by the lack of branches within the 'wound' area & usually by shredded bark & a single callus at the edges (no catfacing).

No fungi will be present on the face, but borers & decay frequent the open wood.

Compare with: [Stem Rusts, Cankers and Injuries \(3.0\)](#)

DEFECT: is limited to the wound area unless borers or decay are there. If so see [borers \(2.0\)](#) & [decays \(1.0 - 1.15\)](#).

4.1 SWEEP or CROOK - caused by various factors. Affects all species.

Affected stems arc or curve rather than growing straight.

No insects or fungi are associated.



Defect: reduce estimated log lengths to produce as many useable sections as possible (e.g. two 8 ft logs instead of one 16 ft when centrally crooked). When severe enough that no part of a straight log will be available, cull the crooked section.



## 5.0 ANIMAL AND BIRD DAMAGE

Birds & animals cause some tree damage, but most is localized and minimal -- except in special cases like overpopulation.

Some symptoms of recognizable damage by common birds and animals follow:

### ANIMAL DAMAGE

RODENTS - cause most of the animal-damage to trees, particularly when population expansions results from predator/prey imbalances.

5.1 PORCUPINES *Erethizon dorsatum* - eat the bark off the upper stems during the winter. They leave large tooth marks & often do not completely girdle affected trees.



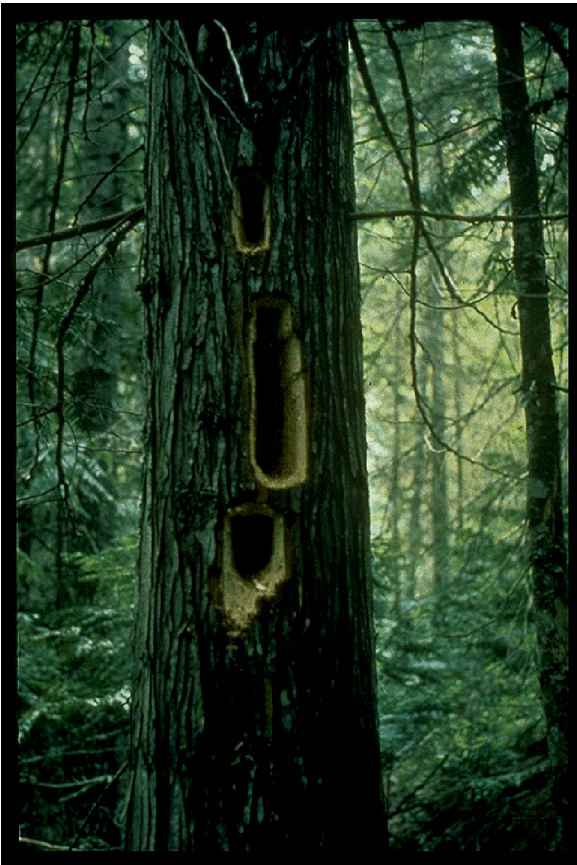
The injury is vivid because of the yellow color given by resin on the wounded area. The animals tend to revisit the same tree or location each year and because of this some suggest leaving gnawed trees rather than have damage affect new trees each year.

DEFECT: girdled tops will rot quickly & must be culled.

5.2 BEAVERS *Castor canadensis* - cut trees at their bases, leaving very large tooth marks deep in wood. These animals inhabit water, but may wander hundreds of yards from home. Their roles in stream improvement, fish management & erosion control permit them a few trees & a place in the forest.

DEFECT: is limited to the chewed area on the tree.

5.3 WOODPECKERS *Picoides spp.*, *Dryocopus pileatus* - produce large (approx. 2-3x4-8 in.) rectangular holes, several inches deep in certain trees.



Compare with: [Borers \(2.0\)](#)

**DEFECT:** the holes cause local loss to the depth of the holes but, more importantly, their presence indicates insect borers and heartwood loss in affected trees. Generally heartwood 4 ft in either direction from the woodpecker's holes is defective.

5.4 SAPSUCKERS *Sphyrapicus varius*,  
*Sphyrapicus thyroideus*. Produce  
horizontal and vertical rows of shallow  
holes in the bark of trees, esp.  
lodgepole pine and spruce.



DEFECT: while the damage is showy,  
it causes no cull.

5.5 Bears, Deer, et al *Ursus* spp.,  
*Odocoileus* spp., etc.

Long, irregular, essentially vertical  
scratches show in the outer bark and  
sometimes into the wood particularly on  
small trees.



**DEFECT:** these cause no volume loss  
unless the affected tree fails to heal, in

which case the damage will be assessed as a dry face.

## 6.0 BARK BEETLES & STEM INSECTS

When you find bark-beetle evidence be sure to look for accompanying root disease. These are interrelated and, without care, you may overlook the major problem.

6.1 MOUNTAIN PINE BEETLE - *Dendroctonus ponderosae*. Affects lodgepole pine, ponderosa pine, western white pine, whitebark pine and sometimes limber pine.

The presence of beetles is first noticed by white pitch tubes on the lower and mid stem with red boring dust in bark crevices & on the ground & roots. Trees discolor & redden rapidly. Normally, these beetles attack weak trees, but they will attack even the most healthy when epidemics affect all. Tree-killing attacks require the presence of stain fungi, particularly *Ophiostoma (Euophium) clavigerum*.

The beetle can be recognized by its very elongate central gallery (30-90 cm = 12-36 in) engraved in both the wood and bark, following the wood grain. Smaller larval galleries of various



lengths extend at right angles from the central gallery. These galleries are



packed with frass. Successful insects will have obvious staining around their galleries.



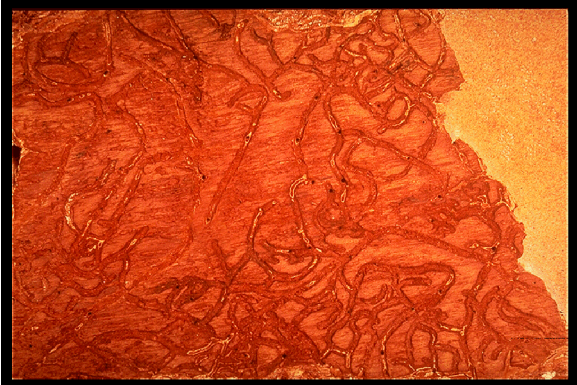
**DEFECT:** the sapwood, to a depth of 10 inches, will be heavily stained. Otherwise, no defect except tree mortality is associated.

## 6.2 WESTERN PINE BEETLE -

*Dendroctonus brevicomis*. Affects ponderosa, lodgepole, & western white pines.

Dead or dying trees have inconspicuous, white pitch tubes & red boring dust on the main stem.

Underlying galleries in the inner bark (2-3 mm wide) wind in all directions & cross & recross each other mazelike. The sapwood is mined little or none. Blue stain by *Ceratocystis minor* & others occurs in the underlying sapwood.



This insect almost always is adjunct to with root disease or other cause of severe stress & typically attacks trees jointly or successively with beetles such as *Ips* spp. & other *Dendroctonus* spp.

Compare with: [Mountain Pine Beetle \(6.1\)](#).

DEFECT: the sapwood, up to 10 inches deep will be heavily stained.

6.3 LODGEPOLE PINE BEETLE - *Dendroctonus murrayanae*. Affects weak, injured or root-diseased lodgepole pine.

Large, white pitch tubes develop at the root crown and lower bole of weak trees.

The underlying gallery is vertical, approximately 12 inches long, & has many lateral groups of galleries along both sides. Galleries scour both bark & wood & lateral are packed with frass.



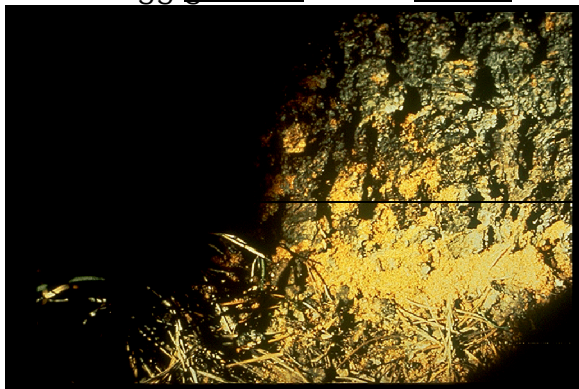
Compare with: [Mountain Pine Beetle \(6.1\)](#)

**DEFECT:** whenever this insect is present other defects are probable. At the least, the sapwood is devalued by stain.

#### 6.4 PINE AND SPRUCE ENGRAVERS - *Ips* spp. Affect pines & spruces.

Affected trees first turn grey-green, then yellow, & then light brown. Light-colored boring dust appears in bark crevices & at tree bases.

Galleries beneath the bark groove the bark & sometimes etch the outer wood. They are not packed with boring dust. Several egg galleries fork or radiate





from a central chamber. Adjoining wood is heavily stained particularly by *Ophiostoma ips*.

**DEFECT:** successful attacks will kill a tree, but also introduce blue stain that will devalue sapwood. In pines this will be up to 10 inches deep.

6.5 FIR ENGRAVER - *Scolytus ventralis*.  
Affects true firs.

Top killing or decline & death of firs will be accompanied by light-colored frass in bark crevices & on exposed root bases. Some attacks are insufficient to kill a tree & the insects are pitched out.

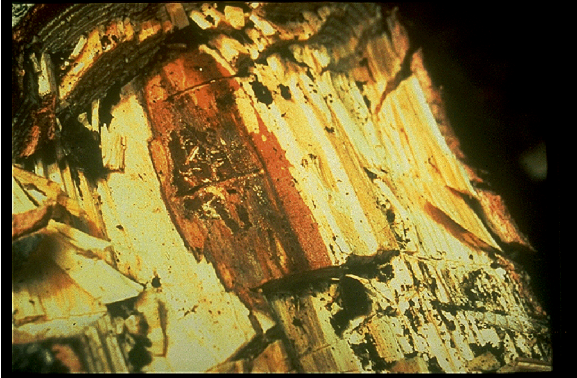




In such cases, the affected patch of cambium heals over leaving a brown pitch pocket in the wood & a swollen lump of cracked bark over it. These are visible on the stem.

Under the bark there is a horizontal main gallery (5-15 cm long) deeply

scoring the outer wood & vertical larval galleries radiating up & down.



Compare with: [Western Balsam Bark Beetle \(6.6\)](#).

**DEFECT:**

- a. lumps on the bark, are healed attack points & indicate defect at least 3 inches into the stem and 6 inches around each lump.
- b. heavily attacked trees will die.



- c. this beetle is almost always associated with root problems such as root rot.

## 6.6 WESTERN BALSAM BARK BEETLE

- *Dryocoetes confusus*. Affects subalpine fir, the principal host, but spruce & lodgepole pine occasionally are affected.

Light-colored frass on dead or declining trees indicates the beetles' presence.

Under the bark & lightly etching the wood, several egg galleries radiate from a central chamber. Stains caused by *Ophiostoma dryocoetides* & other pathogenic stains are always associated with successful galleries.



Compare with: [Fir Engraver \(6.5\)](#).  
DEFECT: is confined to the sapwood  
which will be stained.

6.7 SPRUCE BEETLE - *Dendroctonus rufipennis*. Affects spruce.

Dead & dying trees will have red-brown frass in bark crevices & at their bases.



Galleries beneath the bark have a vertical egg gallery 6-22 cm long with a pitchy frass filling the base. The lateral

larval galleries alternate in groups along the egg gallery. Mines at first are transverse but later frequently cross each other



DEFECT: tree mortality is the resulting defect but is almost always associated with root disease and the attendant cull.

## 6.8 DOUGLAS FIR BEETLE -

*Dendroctonus pseudotsugae*. Affects douglas fir (& brood only in downed larch).

Attacked trees become off-color, yellow & finally red-brown. Beetles attack weakened & particularly root-diseased trees in the lower bole, usually up to 12 ft. Other beetles will attack at levels above this either coincidentally or later.

Red or yellow boring dust catches in bark crevices or around the base of infested trees. Resin may flow from upper attacks but no pitch tubes are present.

Galleries, in the inner bark & slightly etching the wood, are elongate (12-90 cm, Avg. 30 cm) & perpendicular with alternating radiating, fan-like larval galleries. The lower part of the central gallery angles across grain for 2.5-5.0 cm. Success is associated with stain fungi showing around galleries.



Compare with: [Douglas Fir Pole Beetle \(6.9\)](#).

**DEFECT:** mortality results but is almost always associated with root disease and the attendant cull.

6.9 DOUGLAS FIR POLE BEETLE -  
*Pseudohylesinus nebulosus*. Affects  
douglas fir.

Dead & dying trees or slash & downed  
trees are attacked. Usually, this beetle  
allies with douglas-fir beetle, & follows  
its attacks, but it may work alone.

Affected trees have light-colored boring  
dust in bark crevices.

The underlying galleries consist of a  
short, longitudinal main gallery (4-7 in)  
with a crook in the middle and many  
lateral larval galleries. This beetle is a  
common associate in disease/insect  
complexes affecting douglas fir.





Compare with: [Douglas Fir Bark Beetle \(6.8\)](#)

**DEFECT:** the beetles alone cause no defect, but are associated with other severe problems particularly cull from root rot.



6.10 RED TURPENTINE BEETLE -  
*Dendroctonus valens*. Affects  
most conifers, esp. ponderosa or  
lodgepole pines.

Red pitch tubes at the base of a tree  
indicate this insect is there, but  
sometimes they are not successful.  
Check for galleries.



Galleries beneath the tubes are large, irregular & stuffed with frass. The beetles, if present, are tinged red.



Compare with: [Pitch Tube Moths \(6.11\)](#).

**DEFECT:** beetles alone cause no defect but almost always associate with some other severe condition. Search affected trees carefully.

## 6.11 PITCH TUBE MOTHS -

*Vespamima sequoiae* (Sequoia pitch moth) or *Petrova* spp. (pitch nodule moths). Affect pines & douglas fir.

Lumps of red pitch show on the bark most commonly around injuries or at the junctions of limbs & stems. These masses are not tubes but have a protective chamber within, often with the large larva (worm-like) present.



Pitch masses caused by 'sequoia pitch' moth are free of most debris. Those caused by 'pitch nodule moths' are round dirty lumps with pitch and frass mixed.

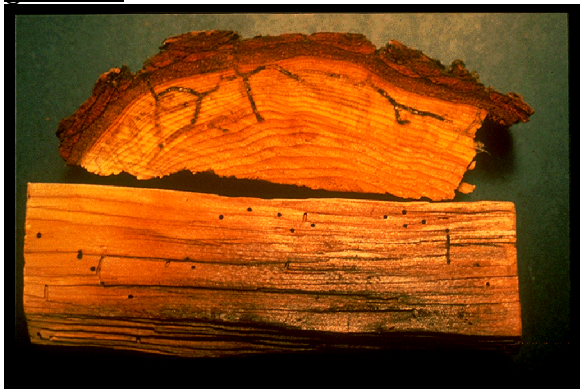
Compare with: [Red Turpentine Beetle \(6.10\)](#).

**DEFECT:** although either of these insects indicate weak trees they cause no recognizable defect by themselves. Often these are diagnosed as bark beetles.

6.12 AMBROSIA BEETLES *Platypus* spp., *Trypodendron* spp., et al. Affect weak or dead trees of all species.

Tiny holes, "pinholes," in the bark have a fine powder exuding from them. Holes penetrate into the wood and will have a dark stain immediately surrounding each hole.

Tunnels continue into the sapwood and rarely into heartwood without galleries beneath the bark.



Compare with: [Bark Beetles \(6.0\)](#).

**DEFECT:** the sapwood will be riddled with tiny holes but can be peeled for

plywood or cut into lumber with little strength loss. Generally, the sapwood will be defective.

7.0 WATER EXCESS (Soil Drench, Flooding, Modified Water Table) - cause: prolonged soil saturation with water, commonly in areas with a high water table. Affects all tree species (common in subalpine fir & lodgepole pine). Entire trees die suddenly, often so that the crowns turn red-brown. Roots are sound but have enlarged & swollen lenticels. No fungi, insects or other symptoms are present.





Compare with: [Root Diseases \(1.0\), \(1.3\), \(1.5\), \(1.7\), \(1.11\), \(7.1\)](#)

DEFECT: a tree may be killed but is not otherwise defective unless other indicators are present.

7.1 BLACK-STAIN DISEASE - caused by *Leptographium* spp. Affects planted pines and douglas fir.

Killed or dying trees have a very dark streaking of the outer and inner wood of the lower stem and roots. This resembles blue stain, but is very dark and the stain tends to follow the annual rings on cross sections.





Compare with: [Atropellis Canker \(3.5\)](#).  
DEFECT: no defect except mortality is associated. This often is associated with Armillaria fans.

## 8.0 BROOM CAUSES:

8.1 DWARF MISTLETOES - caused by *Arceuthobium* spp. Affect most conifers.

In young trees, mistletoe plants may be the only indications of infection. In older trees witches brooms develop and are common obvious symptoms. Affected branches or stems are slightly swollen at the points of infection so that spindle-shaped swellings develop. Stem cankers may occur on swollen areas. Multiple infections may starve distal parts of the host so that the leader, upper crown, or large branches die. Mistletoe plants are usually evident although some are tiny & difficult to distinguish from tree foliage.



The mistletoes are small, segmented, less than 8 inches tall (avg 1-2 inches), with leaves reduced to scales at the stem joints, & with angular (not round) stems. Small cups remain attached to the host when mistletoe plants break off.



Compare with: [Elytroderma Needle Cast and Witches Broom \(8.2\)](#), [Yellow Witches Broom \(8.3\)](#).

**DEFECT:** brooms confined to the crown imply no volume loss unless they involve the stem. Cull 1 foot in either direction from each broom involving the bole except if the upper stem is dying above the broom, in which case, cull all from the broom upward.

## 8.2 ELYTRODERMA NEEDLE CAST

AND WITCHES BROOM - caused by *Elytroderma deformans*. Severely affects ponderosa pine; lodgepole, pinyon & jack pines are infected less. During late spring or early summer, infected needles turn brown. Most affected needles are shed during the fall but some turn grey & remain attached.

The causal fungus is perennial in bark & frequently causes loose or tight witches brooms in ponderosa. In contrast to



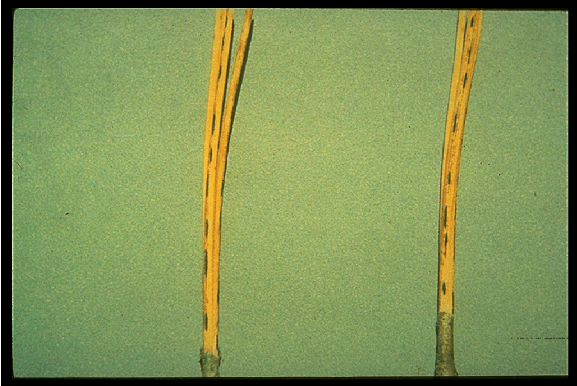
other brooms, these will have lost some needles & some retained needles will remain brown among the normal green. The brooms often catch & hold fallen



needles which have long, black, fungus bodies that identify the disease.



Some trees are so severely broomed that growth is greatly reduced. Relatively conspicuous, long, black, fungus bodies appear on all surfaces of infected needles by late summer or early fall.



Compare with - Dwarfmistletoe Brooms (8.1), Yellow Witches Broom (8.3).

**DEFECT:** no defect is applied unless tree death is imminent or unless the broom bases have entered the stem in which case the wood directly beneath each stem is cull.

### 8.3 YELLOW WITCHES BROOM -

Caused by *Melampsorella caryophyllacearum*. Affects true firs (*Abies* spp.).

Compact witches brooms develop on branches. Infected needles on these brooms are dwarfed & yellow so that brooms are conspicuous against the normal green of surrounding foliage.





These leaves drop during winter leaving brooms bare until new growth begins.

Swelling of infected stems or branches may occur.

Tiny, yellow to white, powder-filled fungus bodies develop on infected needles during the summer.



**DEFECT:** brooms in the crown cause no defect unless they occupy at least 40% of the live crown at which point growth loss & eventual death is probable. Brooms attached to the stem or residual stem swellings from brooms cause no real volume loss.

## 9.0 GLOSSARY OF TERMS

BOLE - the trunk of a tree.

BROOM - a "wadding" of branches and foliage.

BURL - same as a 'gall.'

BUTT SWELL - an unusually expanded lower stem.

CALLUS a rounded lip of healing tissue surrounding a wound or canker.

CANKER - an enlarging dead spot or area of bark. Usually sunken. May have bark retained or may be open.

HIP CANKER - a hip-like swelling surrounding a canker, esp. one caused by western gall rust.

CATFACE - an opening in the stem with concentric rings of callus.

CONIFER - a 'needled' tree which produces cones. e.g. pine.

CONK - a (reproductive) fungus structure on a log, tree, et al, e.g. pouch conk.

CULL - discardable material, e.g. decay in a stem.

DECAY - discolored, softened, deteriorated wood.

DBH - diameter breast high - a standard measure taken at 4.5 ft from the ground.

DUFF - The leaves and incompletely decayed material on the top of soil.

FRASS - tiny chips or dust-like bits of wood or bark. These are mined and expelled onto bark by insects that bore wood.

FRIABLE - easily crumbled.

GALL - a globe-like (or part of a globe) type of swelling

GALLERY - insect etchings of the inner bark and/or the outer wood of a stem. Beetles each have a characteristic gallery pattern.

HARDWOOD - a tree with broad leaves, not needles.

HEARTWOOD - the inner, non-living, wood of a tree - often darker than the outer "sapwood."

KNOTS - places where branches emerge from the stem.

PUNK KNOTS - knots with fungus material included in the wood and bark.

SWOLLEN KNOTS - knots that are abnormally mounded.

LAMINATE DECAY - decay that causes the wood to separate into plates at annual rings.

LENTICELS - small, regularly spaced rough spots on the bark that enable a tree to exchange gases.

MYCELIUM - the fine fibers of a fungus; when grouped, forming cottony masses or mats or fans, etc.

NUBBED - rounding-off & slight swelling of a root or branch at its extremity

PITCH MASSES - rough lumps of pitch without a hole through the surface.

PITCH TUBES - rough cylinders of pitch and frass produced by beetles

POROID, PORES - refers to the tiny holes in the bottom of a conk.

RESINOSUS - flow of pitch or resin

RHIZOMORPHS - root-like fungus structures - white or black usually.

SACS - a flimsy, sack-like, covering over small fungus bodies of the 'rusts.'

SAPWOOD - the living, outer wood of a tree - usually light-colored.

STAIN - a discoloration of wood, usually blue or black.

SUSCEPT - a tree susceptible to a certain problem, e.g. white pine is a suspect for blister rust.

TRUE FIRS - grand fir, concolor fir, subalpine fir

TUBES - the same as "pores" except as viewed from the side.

WIDOWMAKER - a dangerous, leaning tree or unstable limb or top.

ZONE LINES - thin, dark lines running through decayed wood.

Letters refer to the "keys"

Numbers refer to "descriptions"

<i>Acossus populi</i> . . . . .	2.6
ambrosia beetles . . . . .	Mf2c, 6.12
animal & bird damage . . . . .	5.0
annosos root rot . . . . .	Hb3, 1.0
<i>Arceuthobium</i> spp. . . . .	8.1
<i>Arhopalus productus</i> . . . . .	2.1
<i>Armillaria mellea</i> (etc.) . .	Mc2, Na1, 1.5
<i>Armillariella mellea</i> see	
<i>Armillaria mellea</i> (etc.)	
armillaria root rot . . . . .	Hb2, 1.5
aspen carpenterworm . . . . .	Mf2bB, 2.6
atropellis canker . . . . .	Ba, Cb1, 3.5
<i>Atropellis</i> spp. . . . .	3.5
bark beetles . . . . .	6.0
balsam bark beetle . . . . .	Jf, 6.6
bears . . . . .	Ob, 5.5
beaver . . . . .	5.2
birds . . . . .	Fc
black canker of aspen . . . . .	3.10
black-spotted rot . . . . .	1.1
black-stain disease . . . . .	Me, Nb3, 7.1
blazed tree borer . . . . .	Mf2aB3, 2.3
blister rust, comandra . . . . .	Cb6, 3.7
blister rust, white pine . . . . .	Cb4, 3.2
borers . . . . .	2.0
brooms . . . . .	R,8.0



brown root-center rot . . . . .	1.11
bulges . . . . .	A
bumps . . . . .	A
burls . . . . .	Ac
butt swell . . . . .	Ae
california flatheaded borer	
	Mf2aB2, 2.4
<i>Campanotus</i> sp. . . . .	2.7
cankers . . . . .	Cb, 3.0
carpenter ants . . . . .	JK, Mf1, 2.7
<i>Castor canadensis</i> . . . . .	5.2
catfaces . . . . .	Cc
cavities . . . . .	F
<i>Cenangium singulare</i> . . . . .	3.10
chicken o' th' woods . . . . .	1.14
chips (wood) . . . . .	G
comandra blister rust . . . . .	3.7
<i>Coniophora puteana</i> . . . . .	Lb4, Ma2, 1.15
conks . . . . .	Ha
cowpie fungus . . . . .	1.11
cracks . . . . .	D
<i>Cronartium comandre</i> . . . . .	3.7
<i>Cronartium harknessii</i> see	
	<i>Endocronartium harknessii</i>
<i>Cronartium ribicola</i> . . . . .	3.2
<i>Cronartium stalactiforme</i> . . . . .	3.6
crook . . . . .	P, 4.1
crumbly brown-cubical rot . . . . .	1.12
<i>Cryptoporus volvatus</i> . . . . .	1.10
cytophora canker . . . . .	Cb3, 3.4

<i>Cytospora</i> spp. see . . . . .	<i>Valsa</i> spp.
dark brown cubical heartrot . . . . .	1.13
dark brown cubical rot . . . . .	1.14
dasycypha canker . . . . .	Bb, Cb2, 3.3
<i>Dasycypha</i> spp. . . . .	3.3
deer . . . . .	Oc, 5.5
depressions . . . . .	Ba, Bb
<i>Dendroctonus brevicomis</i> . . . . .	6.2
<i>Dendroctonus monticolae</i> see	
	<i>Dendroctonus ponderosae</i>
<i>Dendroctonus murrayanae</i> . . . . .	6.3
<i>Dendroctonus ponderosae</i> . . . . .	6.1
<i>Dendroctonus pseudotsugae</i> . . . . .	6.8
<i>Dendroctonus rufipennis</i> . . . . .	6.7
<i>Dendroctonus valens</i> . . . . .	6.10
<i>Dichomitus squalens</i> . . . . .	Mc1c, Y1, 1.2
douglas fir bark beetle . . . . .	Ja, 6.8
douglas fir pole beetle . . . . .	Jb, 6.9
<i>Dryocoetes confusus</i> . . . . .	6.6
<i>Dryocopus pileatus</i> . . . . .	5.3
dusted cubical rot . . . . .	1.15
dwarf mistletoes . . . . .	Ub, 8.1
<i>Echinodontium tinctorium</i> . . . . .	Mb1, 1.6
elk . . . . .	Oc, 5.5
<i>Elytroderma deformans</i> . . . . .	8.2
elytroderma needle cast & broom	
	Ud, 8.2
<i>Endocronartium harknessii</i> . . . . .	1.15
<i>Erethizon dorsatum</i> . . . . .	5.1
<i>Ergates spiculatus</i> . . . . .	2.0

excess moisture . . . . .	Nb1, 7.0
false tinder conk . . . . .	Ab, Ha6, 1.8
feather rot . . . . .	1.7
fibrous root rot . . . . .	1.5
fir engraver . . . . .	Je, 6.5
flagging . . . . .	W, 3.1, 3.5, 3.7
flatheaded borer . . . . .	2.4, 2.5
flatheaded fir borer . . . . .	Mf2aB1, 2.5
<i>Fomes annosus</i> see	
	<i>Heterobasidion annosum</i>
<i>Fomes fomentarius</i> . . . . .	Md, 1.9
<i>Fomes igniarius</i> see	
	<i>Phellinus igniarius</i>
<i>Fomes laricis</i> see	
	<i>Fomitopsis officinalis</i>
<i>Fomes officinalis</i> see	
	<i>Fomitopsis officinalis</i>
<i>Fomes pini</i> see	
	<i>Phellinus pini</i>
<i>Fomes pinicola</i> see	
	<i>Fomitopsis pinicola</i>
<i>Fomitopsis officinalis</i>	Lb3, Ma3, 1.13
<i>Fomitopsis pinicola</i> . . . . .	Ma4, 1.12
frass . . . . .	J, Jj, 1.5, 2.0, 2.3, 2.4, 2.5, 2.6, 2.7, 6.1, 6.3, 6.5, 6.6, 6.7, 6.10, 6.11
frost cracks . . . . .	Da, 3.8
fungus felts . . . . .	Hb
fungus sheets . . . . .	Hb
galleries . . . . .	Ea1, J

galls . . . . .	Ac
Glossary of terms . . . . .	9.0
grey-brown sap-rot . . . . .	1.10
<i>Heterobasidion annosum</i>	
	Hb3, Mc1a, 1.0
high water table . . . . .	Nb2, 7.0
hip-like swellings . . . . .	Ad
<i>Hirschioporus abietinus</i> . . . . .	1.4
holes . . . . .	Ea
honeycomb rot . . . . .	Mc1d, Na4, 1.3
honeycombed root rot	
	Mc1d, Na4, 1.3
honey mushroom . . . . .	1.5
<i>Inonotus tomentosus</i>	
	Mc1d, Na4, 1.3
<i>Ips</i> spp. . . . .	6.4
knobs . . . . .	A, Ac
<i>Laetiporus sulphureus</i>	
	Lb3, Ma3, 1.12
<i>Leptographium</i> spp. . . . .	7.1
lightning damage . . . . .	Cd2, Db, 3.9
lodgepole pine beetle . . . . .	Jd, 6.3
lumps . . . . .	A, Aa
<i>Melampsorella carophyllacearum</i> . . . . .	8.3
<i>Melanophila californica</i> . . . . .	2.4
<i>Melanophila drummondii</i> . . . . .	2.5
molds . . . . .	Hd
mottled white trunk rot . . . . .	1.9
mounds . . . . .	A, Aa
mountain pine beetle . . . . .	Jc, Kc1, 6.1

mushrooms . . . . .	Ha
newhouse borer . . . . .	Mf2aC, 2.1
ooze . . . . .	K
<i>Perenniporia subacida</i> . . . . .	Mb2, 1.7
<i>Petrova</i> spp. . . . .	6.11
<i>Phaeolus schweinitzii</i> . . . . .	1.11
<i>Phellinus igniarius</i> . . . . .	Md, 1.8
<i>Phellinus pini</i> . . . . .	Ab, Ha1, Mc1b, Y2, 1.1
<i>Picoides</i> spp. . . . .	5.3
pine & spruce engraver . . . . .	Ji, 6.4
pitch . . . . .	K
pitch nodule moths . . . . .	6.11
pitch tube moths . . . . .	Kb2, 6.11
pitch, flow . . . . .	Ka
pitch, lumps . . . . .	Kb, 6.11
pitch, tubes . . . . .	Kc, 6.1, 6.2, 6.3, 6.10
pitted sap-rot . . . . .	1.4
<i>Platypus</i> spp. . . . .	6.12
<i>Polyporus abietinus</i> see	
	<i>Hirschioporus abietinus</i>
<i>Polyporus anceps</i> see	
	<i>Dichomitus squalens</i>
<i>Polyporus sulphureus</i> see	
	<i>Laetiporus sulphureus</i>
<i>Polyporus tomentosus</i> see	
	<i>Inonotus tomentosus</i>
<i>Polyporus volvatus</i> see	
	<i>Cryptoporus volvatus</i>
ponderous borer . . . . .	Mf2aA, 2.0
poplar borer . . . . .	Mf2bA, 2.7

porcupine . . . . .	5.1
<i>Poria subacida</i> see	
	<i>Perenniporia subacida</i>
pouch conk . . . . .	Ha4, 1.10
<i>Pseudohylesinus nebulosus</i> . . . . .	6.9
purple conk . . . . .	1.4
quinine conk . . . . .	Ha3, 1.13
red ray rot . . . . .	Lb2, 1.2
red ring rot . . . . .	Lb2, Mc1b, 1.1
red turpentine beetle	
	Jh, Kb1, Kc3, 6.10
red-brown root & butt rot	
	Ma1, Na3, 1.11
redbelt fungus . . . . .	Lc1, Ma3, 1.12
redpaint fungus	
	Ab, Ha2, Lb1, Mb1, Y3, 1.6
resin . . . . .	K
rodents . . . . .	Fc
<i>Saperda calcarata</i> . . . . .	2.2
sapsuckers . . . . .	EB, 5.4
scars . . . . .	Cd
scars, fire . . . . .	Cd3
scars, lightning . . . . .	Cd2, 3.9
scolytus lumps . . . . .	Aa, Cd1, 6.5
<i>Scolytus ventralis</i> . . . . .	6.5
sequoia pitch moth . . . . .	6.11
<i>Serropalpus substriatus</i> . . . . .	2.3
slime . . . . .	K
slimey rot . . . . .	Mb2, 1.7
slimey root rot . . . . .	Hb1, Mb2, Na2, 1.7

splits . . . . .	D
spongy butt-rot . . . . .	1.7
spruce beetle . . . . .	Jj, 6.7
spruce and pine engraver	
	Ji, 6.4
stalactiform rust . . . . .	Cb5, 3.6
stem rusts . . . . .	3.0
stringy heartrot . . . . .	1.6
sulfur conk . . . . .	1.14
sweep . . . . .	P, 4.1
swellings, butt . . . . .	Ae
swellings, hip-like . . . . .	Ad
swollen knots . . . . .	Ab
<i>Sphyrapticus varius</i> . . . . .	5.4
<i>Sphyrapticus thyroideus</i> . . . . .	5.4
timber worms . . . . .	Mf2aA, 2.0
tinder conk . . . . .	Ab, Ha7, 1.9
toadstools . . . . .	Ha
<i>Trypodendron</i> spp. . . . .	6.12
<i>Valsa</i> spp. . . . .	3.4
velvet top fungus . . . . .	Ha5, 1.11
<i>Verticicladiella</i> spp. see	
	<i>Leptographium</i> spp.
<i>Vespamima sequoiae</i> . . . . .	6.11
water excess . . . . .	Nb1, 7.0
webs . . . . .	Hc, Hd1
western balsam bark beetle . . . . .	6.6
western gall rust . . . . .	Aa, Ac, Ad, 3.1
western pine beetle . . . . .	Jg, Kc2, 6.2
white pine blister rust . . . . .	3.2



white trunk rot . . . . .	1.8
windthrow . . . . .	N
woodpeckers . . . . .	EC, Fa, G, 5.3
wounds . . . . .	Ca
yellow witches broom . . . . .	Ua, 8.3