

***Class I
Damaging Agents
for
Washington, Oregon, California***

Forest Inventory and Analysis
PNW Research Station
Spring 2006

Bark Beetles

Damage
Code
01



Bark Beetles

- **Fading foliage (green to yellow to red)**
- **May be in patch of dead and dying trees**
- **Top kill possible with some bark beetles or borers**
- **Pitch tubes on pines**
- **Boring frass in bark crevices**
- **Check nearby dead trees for bark beetle and borer galleries**

Hosts:

- **Most conifers**

Bark Beetles

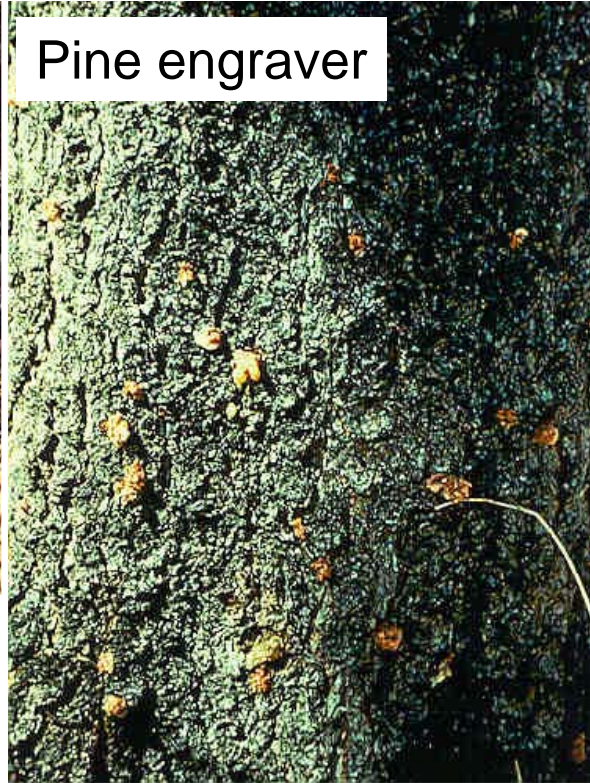
Pitch tubes

Damage
Code
01

Red turpentine beetle



Pine engraver



W. Pine beetle



Mountain pine beetle



Bark Beetles

Galleries

Damage
Code
01

Mtn pine beetle galleries



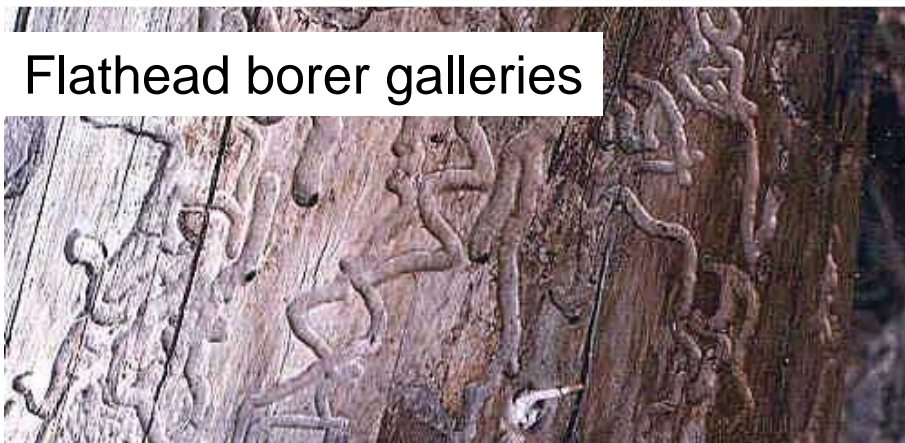
W. pine beetle galleries



Douglas-fir beetle galleries

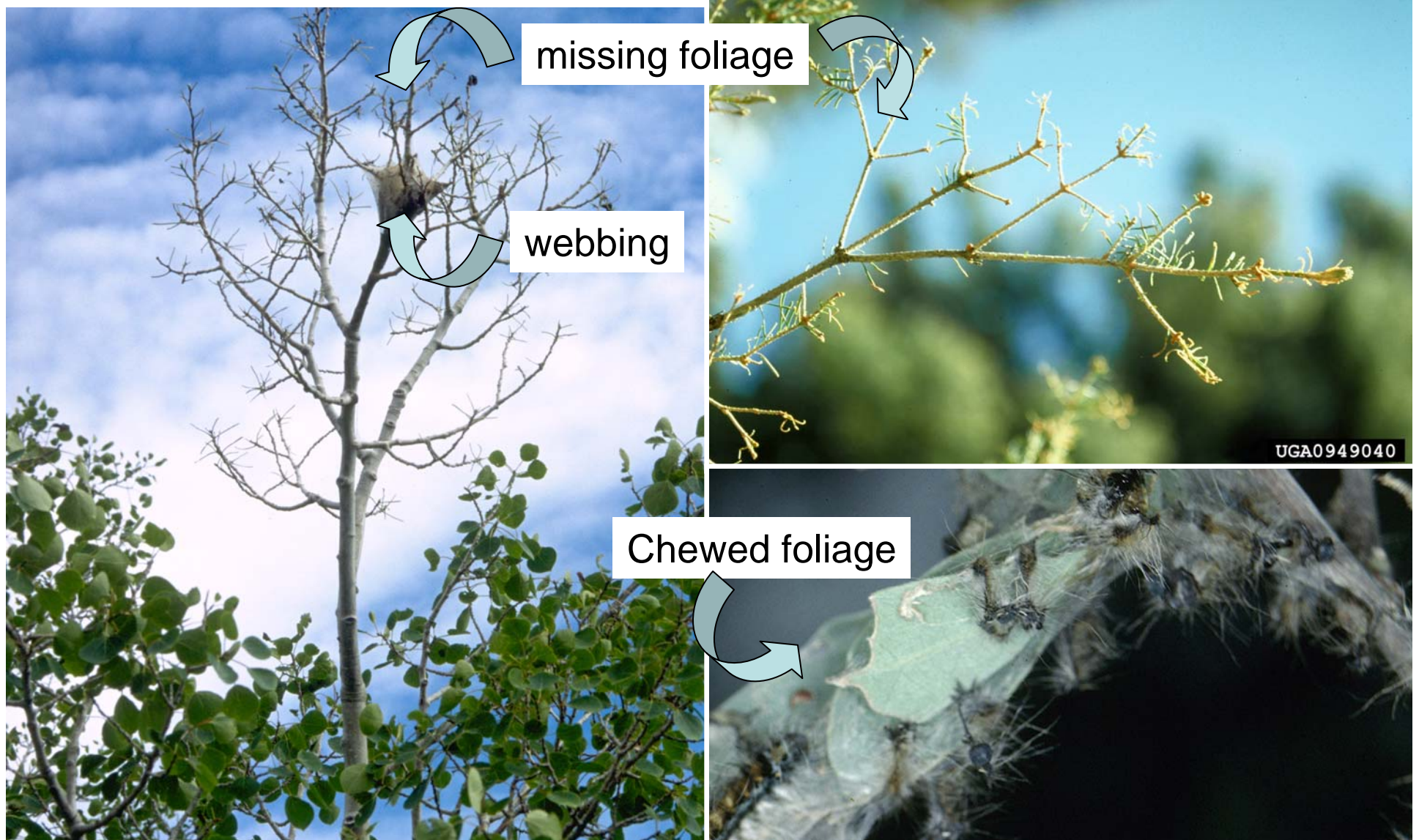


Flathead borer galleries



Damage
Code
10

Defoliators



Defoliators

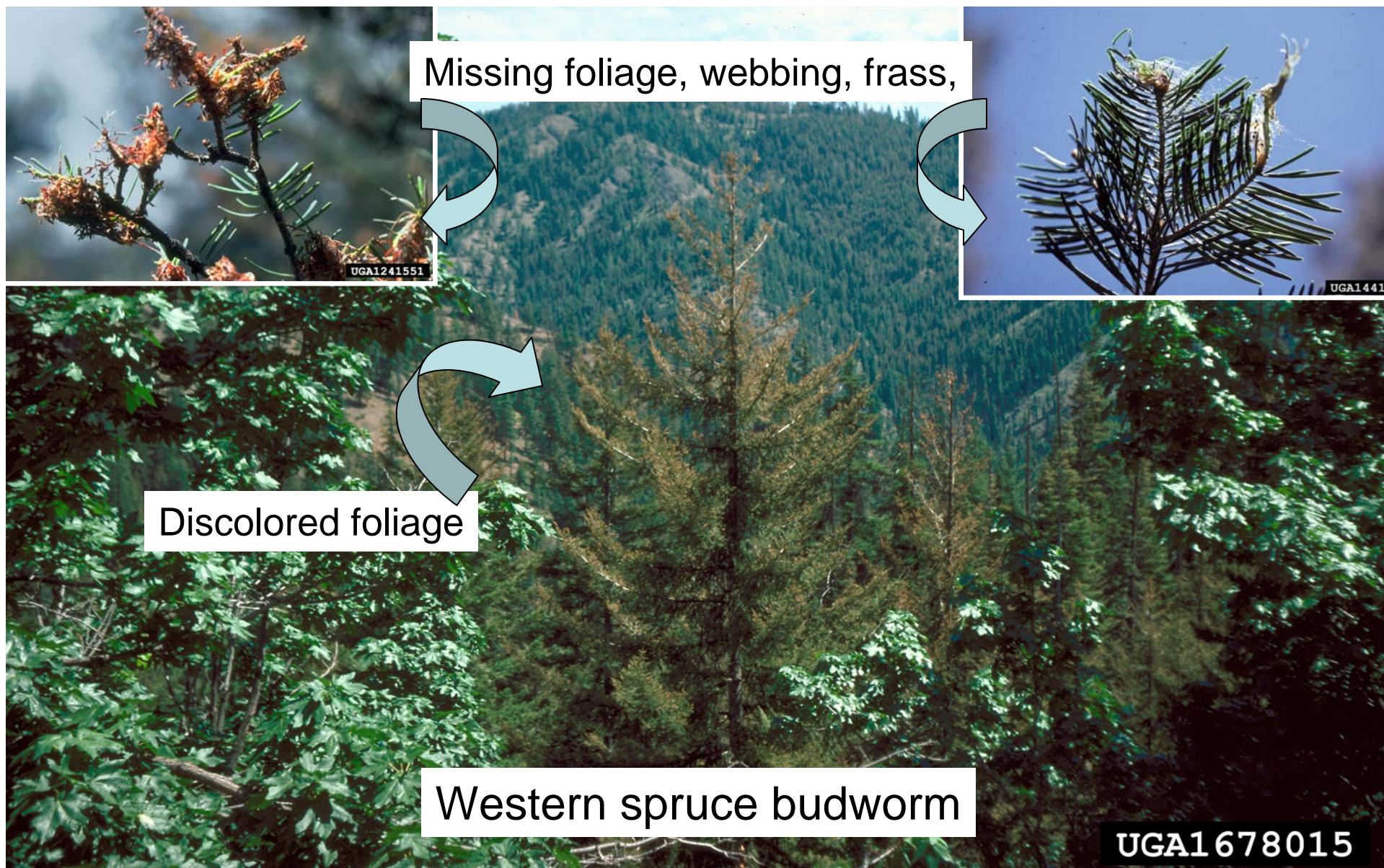
- Caused by foliage-feeding insects
- May feed on new foliage or all ages of foliage
- Signs of the insect include webbing, frass, or insect larvae, pupae or cocoons
- Foliage symptoms – discolored leaves or needles, chewed foliage, or foliage missing altogether

Hosts

- Many conifers
- Many hardwoods

Damage
Code
29

Budworm



Budworm

Spruce budworms:

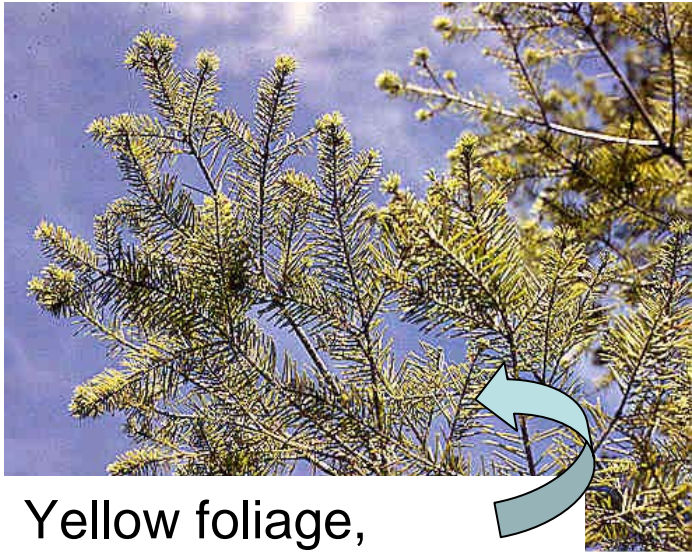
- **New foliage and buds of the host tree are preferred; upper crowns more severely defoliated than lower crowns**
- **Trees of all ages are defoliated.**
- **In the spring, small larvae mine in needles and later enter the swelling buds.**
- **As shoot growth starts, larval feeding may cause malformation.**
- **Webbed branch tips appear in July, indicating the presence of full grown larvae.**
- **After discolored foliage has fallen, bare tips indicate that budworm feeding has occurred.**
- **Hosts for spruce budworms - Douglas-fir &, true firs; occasionally, w. larch & spruces**

Other budworms have different feeding habits and hosts including:

- **Modoc Budworm – white fir**
- **Black-headed budworm - hemlocks, spruces, Douglas-fir, true firs**

Root Disease

Damage
Code
60



Yellow foliage,
reduced annual growth



Fallen trees with
missing, decayed roots

Root Disease

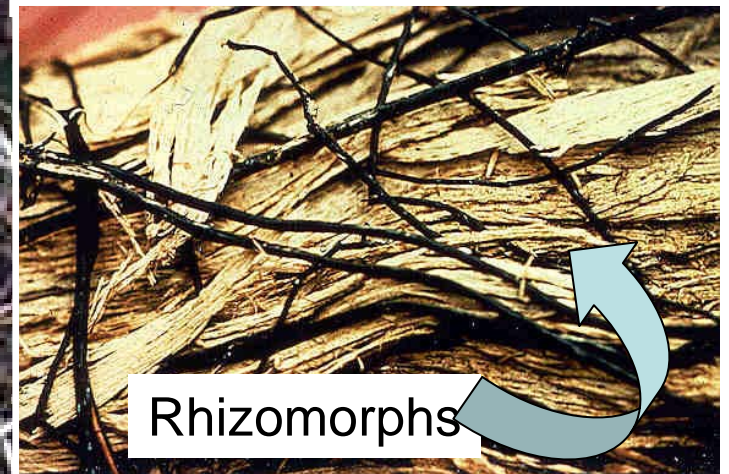
- **May occur in rings or amoeboid-shaped patches with oldest mortality in center and most recent dead or dying towards the edges**
- **Symptoms of infection include:**
 - **Yellow and/or sparse foliage; entire crown affected**
 - **Heavy (stress) cone crops**
 - **Resin flow at base of tree**
- **Signs (fruiting bodies, staining, decay) vary from agent to agent**

Hosts

- **Most conifers susceptible to one or more root disease fungi**
- **Some hardwoods susceptible to *Armillaria***

Armillaria Root Disease

Damage
Code
62



Armillaria Root Disease

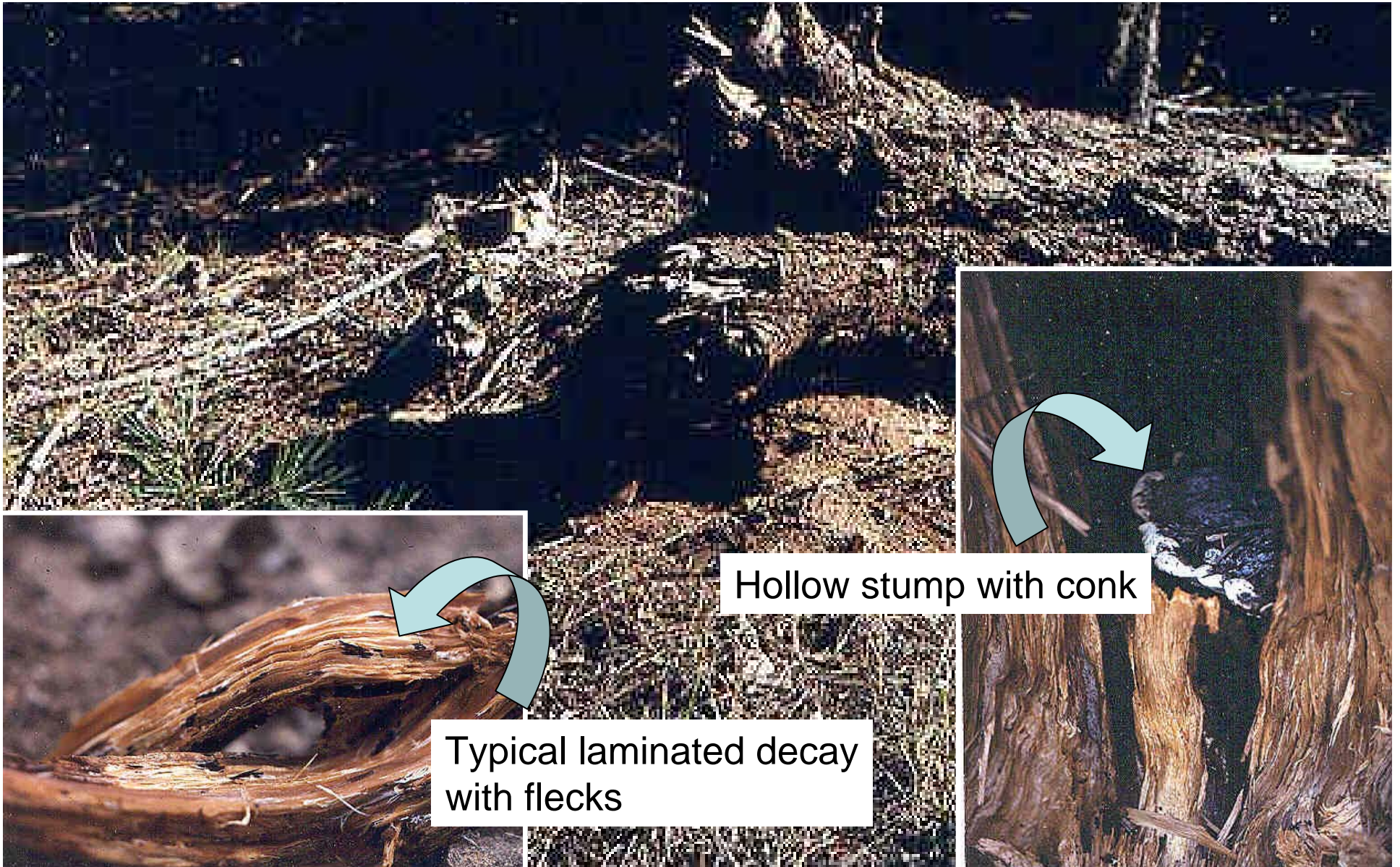
- **Symptoms include: thinning crowns, declining growth increments, foliage yellowing, heavy distress cone crops, and heavy basal resin flow.**
- **White mycelial fans under the bark of roots and lower stems is diagnostic.**
- **Advanced decay is yellow, stringy, and malodorous.**
- **Rhizomorphs (black or brown shoe string-like structures) may be found under bark**
- **Golden-colored mushrooms of the pathogen sometimes found around the bases of infected trees in fall.**
- **Distinct disease centers or scattered infected trees**

Hosts

- **Most conifers and many hardwoods, all ages**

Annosus Root Disease

Damage
Code
61



Annosus Root Disease

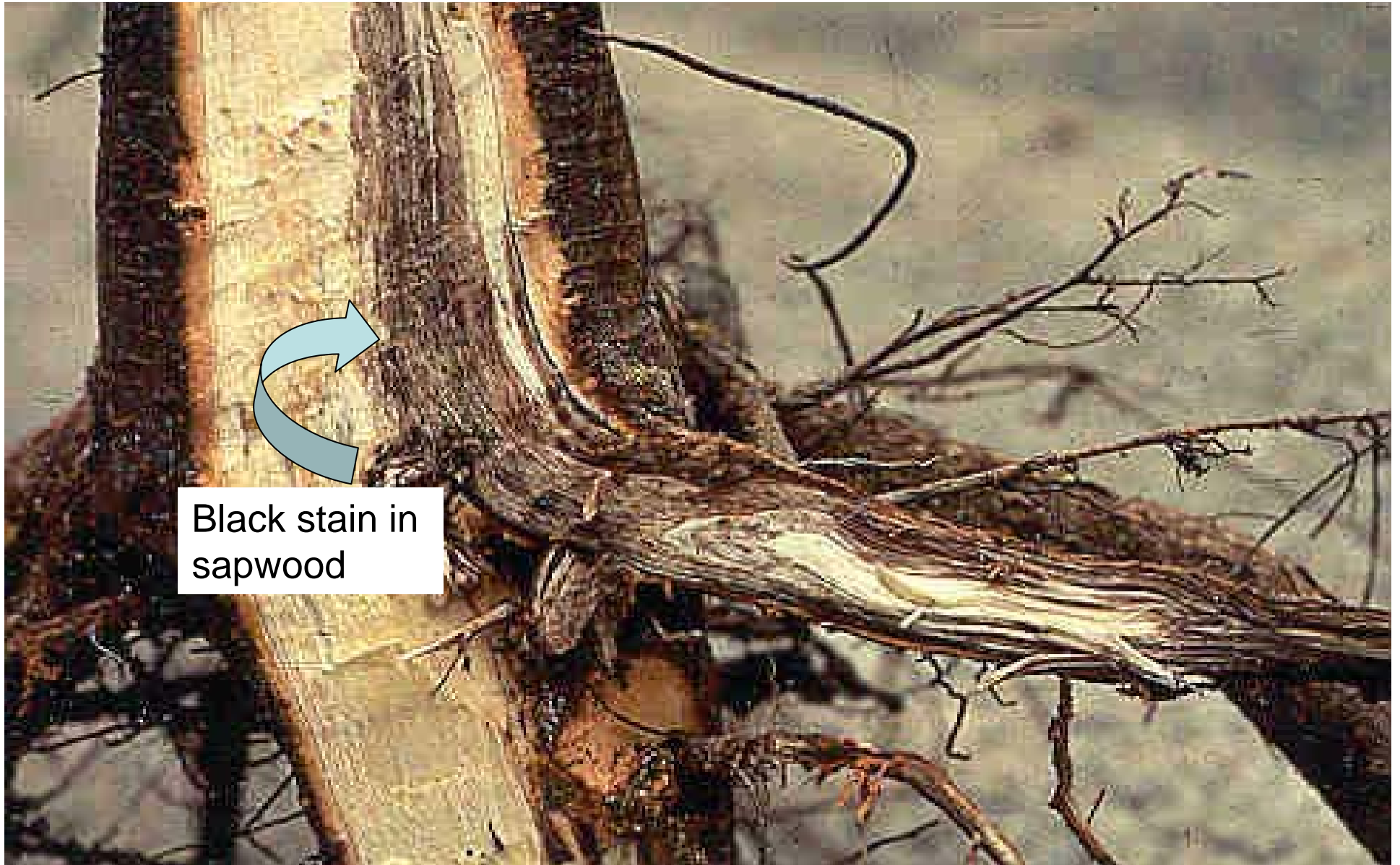
- **Annosus centers often consist of dead or dying trees or open areas around large stumps that may contain annosus fruiting bodies.**
- **Any susceptible host in close proximity to an annosus center is likely to be infected, whether or not it shows symptoms.**
- **Advanced decay is either: 1) laminated, lacking setal hyphae, often but not always with pitting on only one side of the laminae or 2) stringy and white with small black flecks.**
- **Infected trees may have small annosus pustules or conks on roots or just below the duff layer at root collars.**
- **Variable symptoms: decreased terminal growth, needle yellowing, and crown decline.**

Hosts

- **Most conifers**

Black Stain Root Disease

Damage
Code
63



Black stain in
sapwood

Black Stain Root Disease

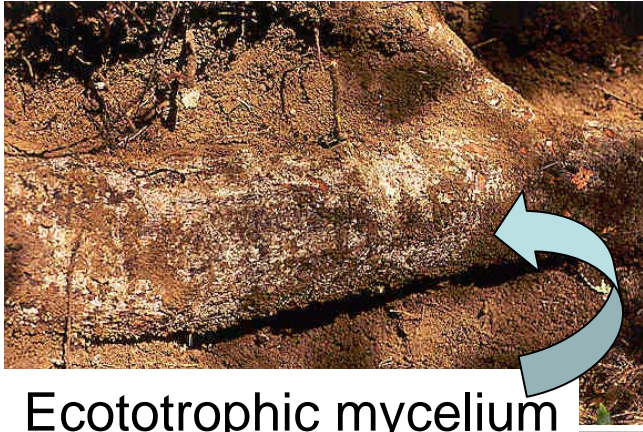
- **Symptoms include: sparse & chlorotic crowns; reduced growth; heavy stress cone crops; and basal resinosus.**
- **Dark brown to purple-black stain in the sapwood of infected roots and lower stems is diagnostic.**
- **Distinct disease centers or scattered infected trees.**

Hosts

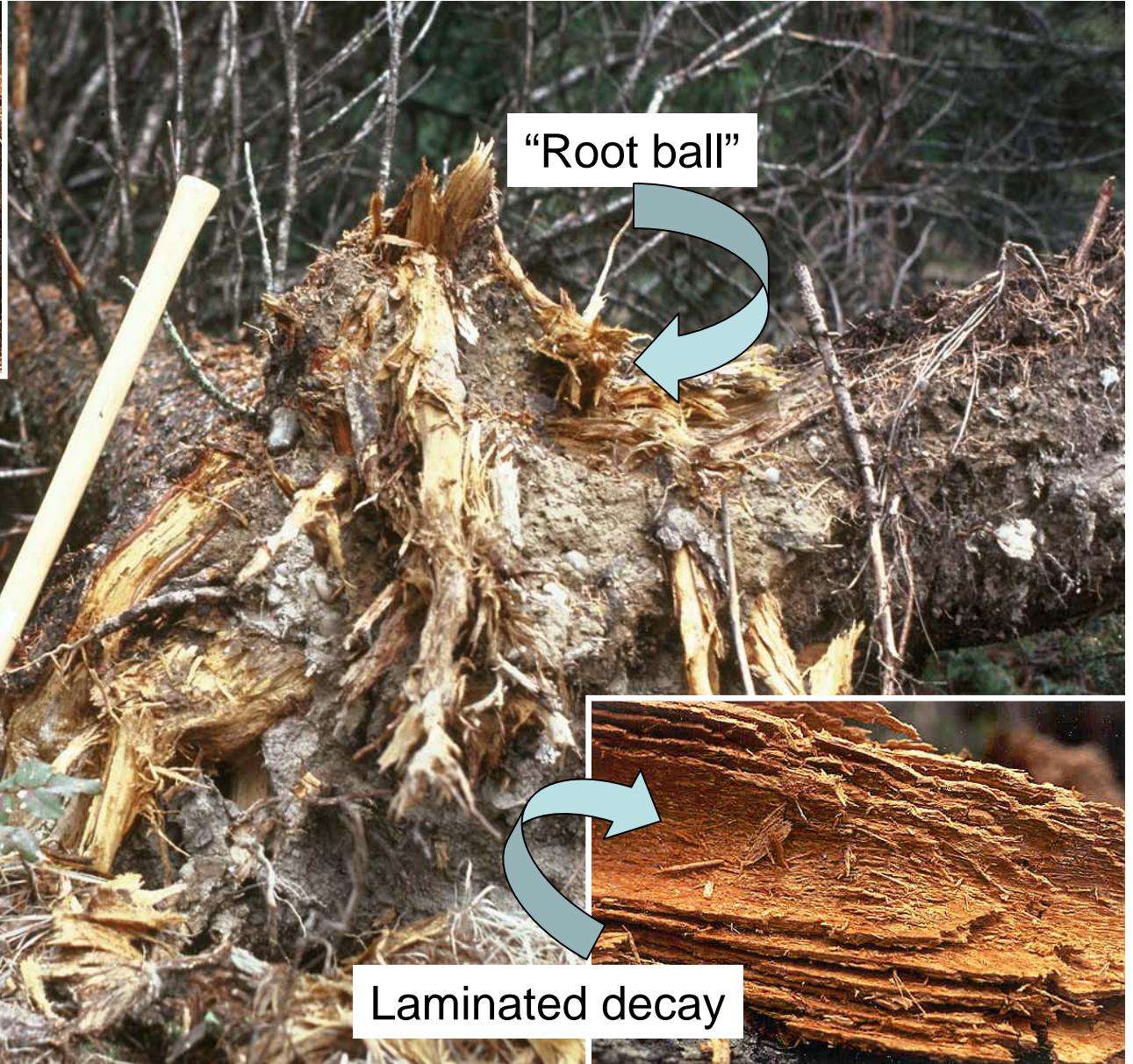
- **Douglas-fir, especially in <30 year old plantations**
- **Pines, especially ponderosa and Jeffrey**
- **Pinyon pine – in southern California**
- **Occasionally on other pines and western hemlock**

Laminated Root Disease

Damage
Code
65



Ecototrophic mycelium
on root surface



“Root ball”



Laminated decay

Laminated Root Rot

- **Symptoms include: crown thinning, increment reduction, foliage yellowing, heavy stress cone crops.**
- **Infected trees are frequently windthrown and exhibit "root balls" where most of their roots have rotted off just below the root crown.**
- **Advanced decay is laminated with pitting on both sides of the layers, and diagnostic reddish-brown to pinkish whiskery setal hyphae occurring between the laminae.**
- **White to grayish ectotrophic mycelium on the bark surface of roots of small infected hosts and in bark crevices on older, thick-barked trees.**
- **Distinct disease centers or scattered infected trees**
- **Common in OR and WA, but only IDed in 2 places in extreme northern CA**

Hosts

- **Douglas-fir, true firs, hemlocks, and spruces**
- **Pines and cedars rarely infected**
- **Hardwoods immune**

Port-Orford-Cedar Root Disease

Damage
Code
66



Port-Orford-Cedar Root Disease

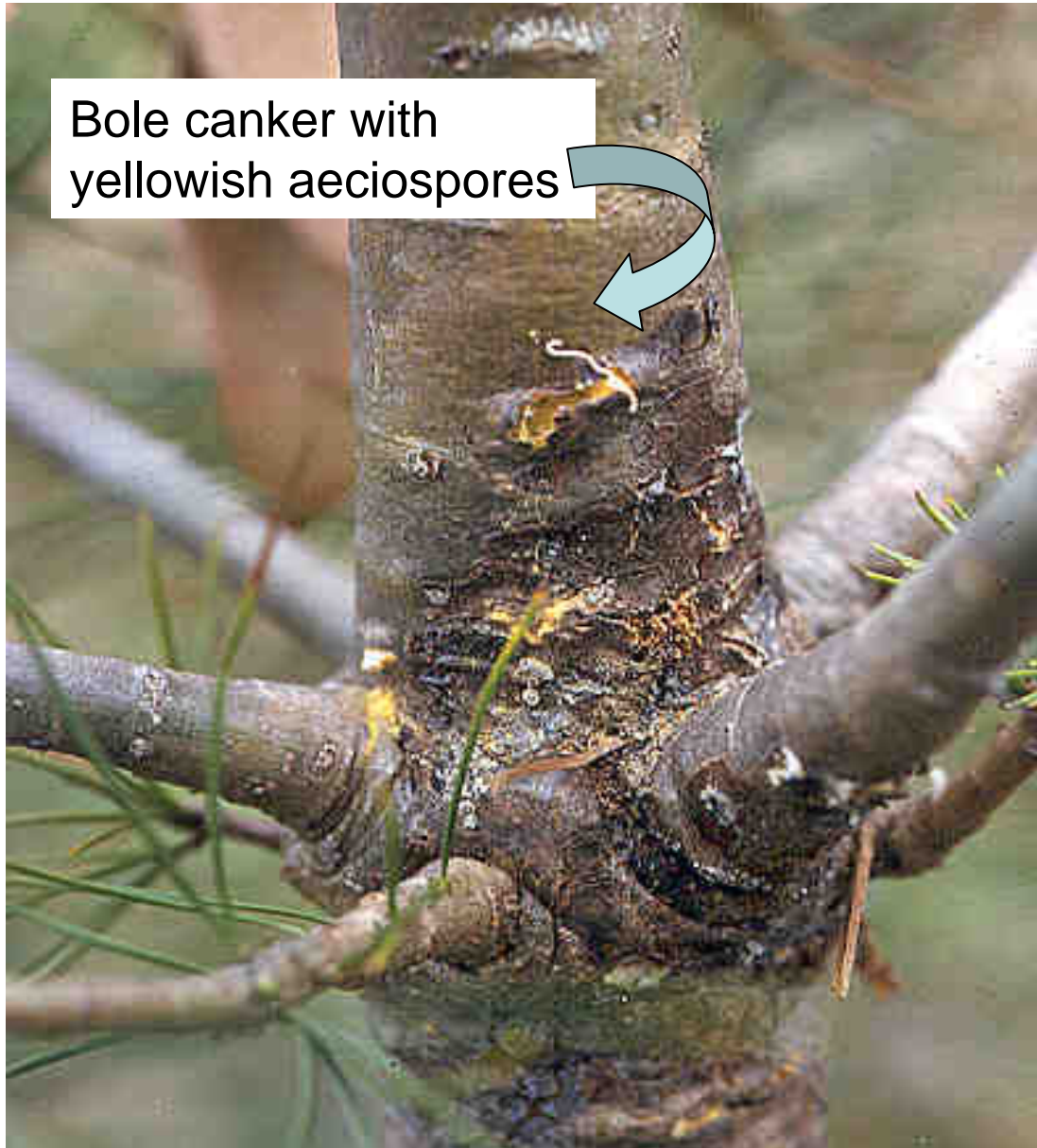
- **Rapid decline of infected trees - crowns fade from yellow to red to brown in a matter of weeks in the case of small trees and in a year to 4 years for large trees.**
- **Clear demarcation between cinnamon-brown stain and creamy white unstained sapwood in the root collars or lower stems of symptomatic but not yet-dead hosts is diagnostic.**

Hosts

- **Port-Orford-cedar**
- **Pacific yew, occasionally in association with Port-Orford-cedar**

White Pine Blister Rust

Damage
Code
36



White Pine Blister Rust

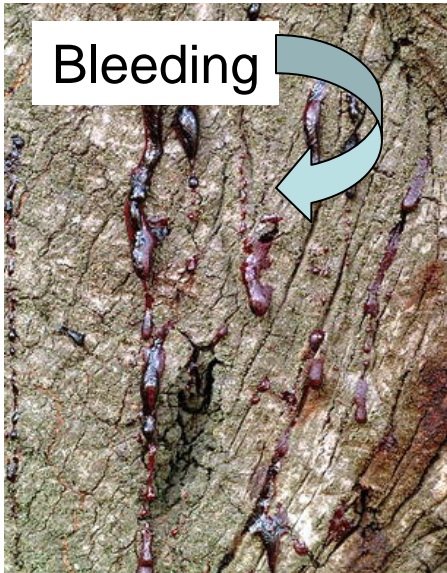
- **Symptoms include:**
 - spindle-shaped swellings on branches
 - cankers with roughened bark
 - flagging of branches and tops
 - outright mortality, especially of sapling and pole-sized trees.
- **Clear, sappy ooze (pycnia) and whitish to yellow-orange spore pustules (aecia) on the swollen portions of infected pine stems in spring and early summer.**

Hosts

- **5-needle pines, including western white pine, sugar pine, limber pine, foxtail pine, and white bark pines**

Sudden Oak Death

Damage
Code
31



Sudden Oak Death

- **Symptoms on oak species (*Quercus* spp) and tanoak (*Lithocarpus densiflorus*):**
 - **Burgundy red to tar black sap bleeding on the bark surface**
 - **Sunken or flattened areas (cankers) beneath the bleeding**
 - **Distinctive black zone lines between diseased and healthy tissue in the inner bark of the trees.**
 - **Cankers and bleeding occur above ground, usually from 1 to 15 feet above the soil line.**
 - **Bleeding is not always observed on infected tanoaks, particularly not with smaller diameter stems. In addition, the new growth of tanoaks may wilt or droop before any bleeding appears.**

SOD causes leaf spots on other hosts such as bay laurel, rhododendron, toyon, bigleaf maple, and buckeye. When SOD is coded on oak and tanoak, samples of spotted leaves from these species should be collected in the vicinity of the symptomatic oaks or tanoaks.



Pitch Canker

Damage
Code
32



Pitch Canker

- **Symptoms include:**
 - **Needle yellowing and wilting, then red discoloration, then branch dieback**
 - **Resin accumulation accompanies dieback (flows down bole or coats lower branches)**
 - **Resinous bole or branch cankers**
 - **Top or entire infected tree can be killed by bark beetles**
- **Symptoms appear at any time of year**

Hosts

- **At least 12 species of native and introduced pines including:**
 - **Bishop and Monterey (most damage)**
 - **Coulter, gray, Knobcone, ponderosa, shore, and Torrey (mostly in plantations)**
- **Douglas-fir**

Balsam Woolly Adelgid

Damage
Code
24



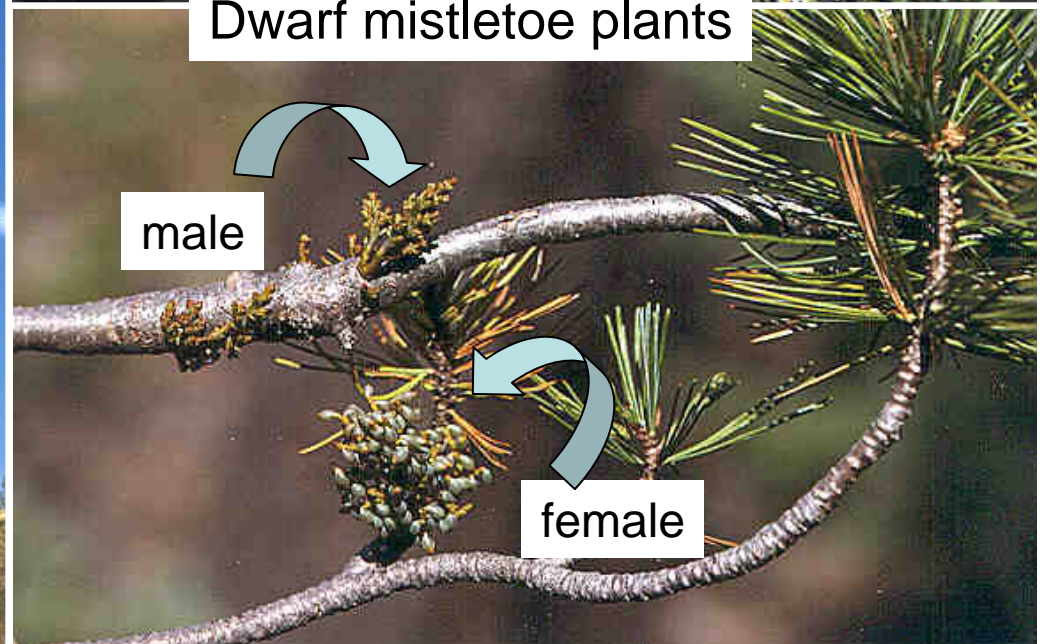
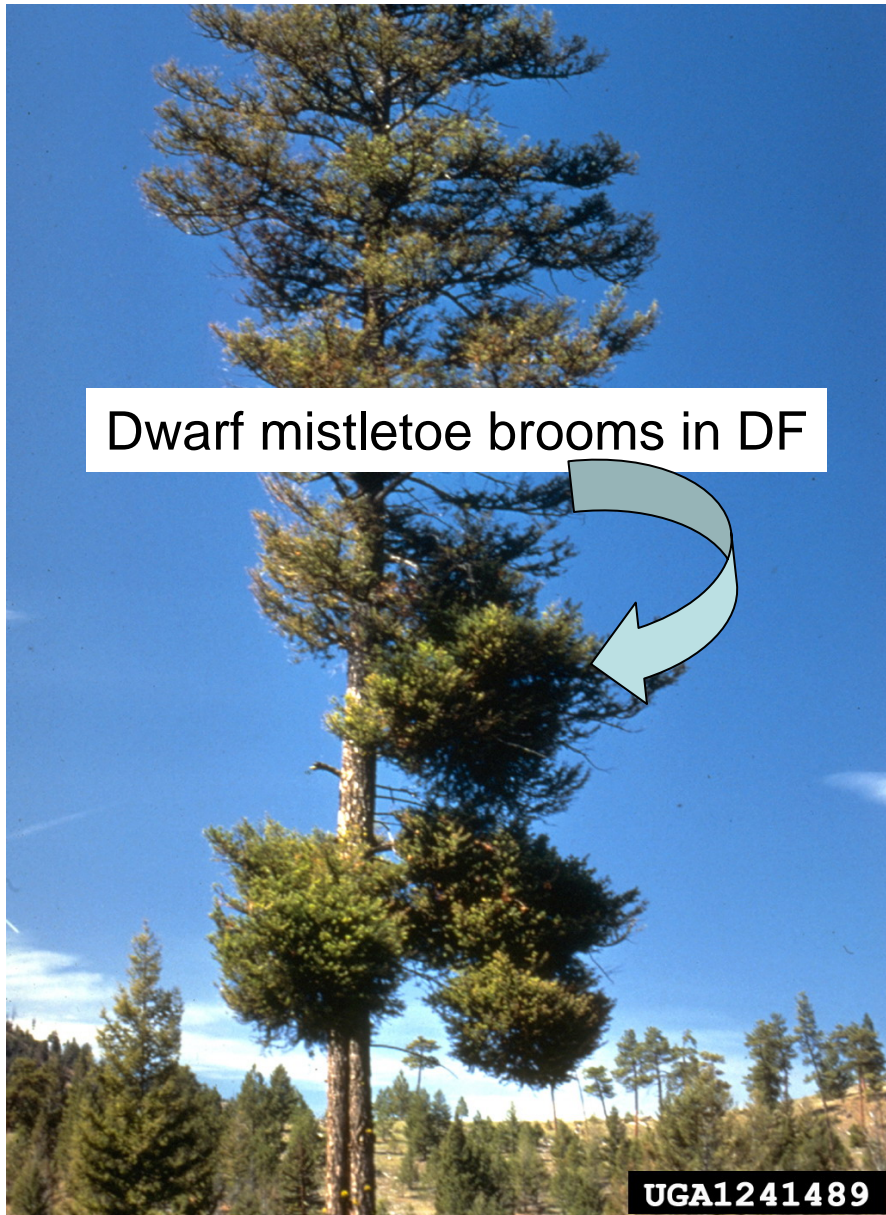
Balsam Woolly Adelgid

- **Symptoms and signs include:**
 - **"Gouting" - a stunting of terminal growth with distinct swellings around the buds and branch nodes. Growth is retarded on gouted trees, and the dead and dying upper stem is often invaded by wood-destroying fungi.**
 - **Mass infestation along the main stem. Stem-attacked trees show needle discoloration or needle loss, followed ultimately, by death.**

Hosts

- **Subalpine fir and Pacific silver fir in the mountainous areas**
- **Grand fir in the lowland valleys**

Dwarf Mistletoes



Dwarf Mistletoes

- **Symptoms include:**
 - **Witches' brooms**
 - **Branch or stem swellings**
 - **Growth loss and ultimately, mortality**
- **Signs include:**
 - **Aerial leafless shoots of mistletoe plant: shoots, flowers, fruits. Usually green, yellow, gray, or brown in color. Along branches; occasionally on bole.**
 - **Basal cups – the points of attachment of the aerial shoots (after mistletoe plant has dropped off) on host plant**
- **Positive identification of a dwarf mistletoe infection is only possible when actual evidence of mistletoe plants (i.e. aerial shoots or basal cups) is observed directly.**

Hosts

- **Most western conifer species**

True “Leafy” Mistletoes

Mistletoe
Class



True “Leafy” Mistletoes

- **No brooming**
- **Less damaging than dwarf mistletoes**
- **Bole swelling only in incense cedar**
- **Signs include:**
 - **Appear as conspicuous balls or clumps of green foliage growing in tree crowns.**
 - **Fruits (berries) about the size of peas.**
 - **Mistletoe plants may have leaves (junipers, cypress, white fir, hardwoods) or no leaves (juniper or incense cedar)**

Hosts

- **Conifers: juniper, incense cedar, cypress, white fir**
- **Hardwoods: oaks**

***Decay Agents
for
Washington, Oregon, California***

Forest Inventory and Analysis
PNW Research Station
Spring 2006

Phellinus pini

“red ring rot”

Damage
Indicator
47



Rotten Cull
Indicator

Phellinus pini
“red ring rot”

Damage
Indicator
47

Rotten Cull
Indicator

- **Perennial, woody conks**
- **Vary in size, shape, texture**
- **Lower pore surface rusty or cinnamon brown**
- **Upper surface grayish, with concentric furrows**
- **Associated with branch stubs**

Hosts

- **Douglas-fir**
- **Pines**
- **Hemlocks**
- **Spruces**
- **True firs**
- **Western redcedar**
- **Incense cedar (rare)**

Echinodontium tinctorium

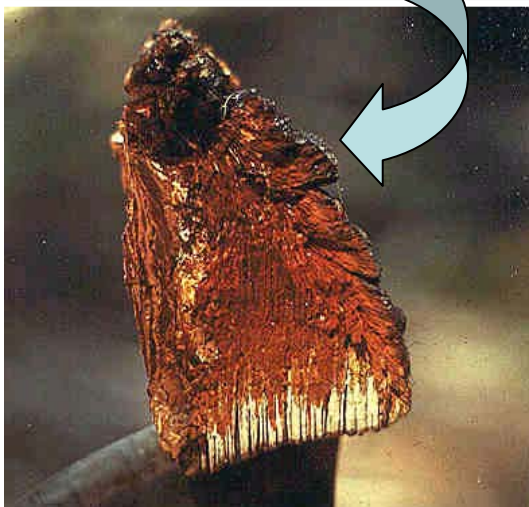
“Indian paint fungus”

Damage
Indicator
48

Rotten Cull
Indicator



X-sections



Echinodontium tinctorium
“Indian paint fungus”

Damage
Indicator
48

Rotten Cull
Indicator

- **Woody, perennial, hoof-shaped**
- **Usually on underside of branch stubs**
- **Undersurface with teeth or spines**
- **Brick-red interior**

Hosts

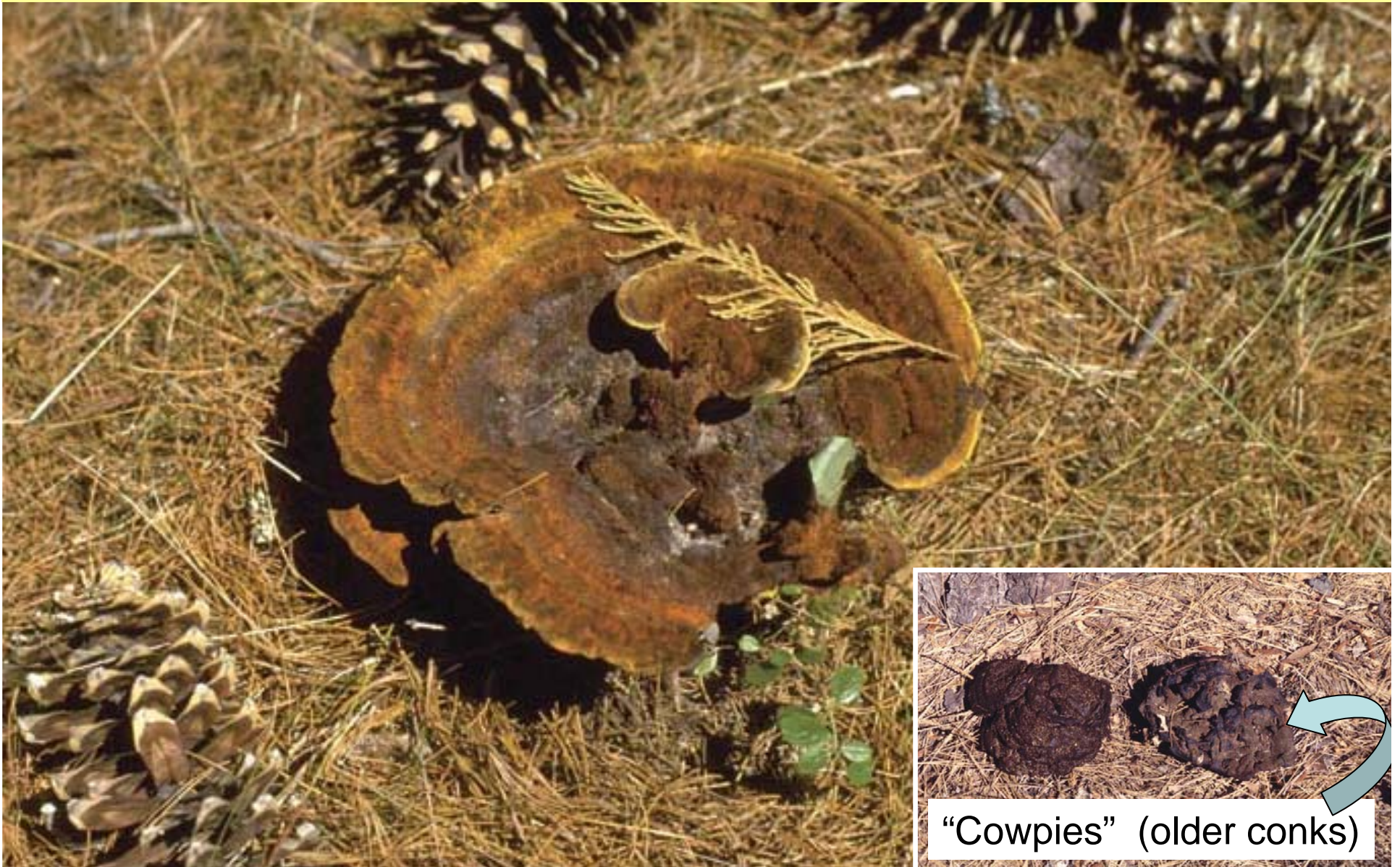
- **True firs**
- **Hemlocks**
- **Douglas-fir (rare)**
- **Spruce (rare)**

Phaeolus schweinitzii

“velvet top fungus” or “cowpie fungus”

Damage
Indicator

49



Phaeolus schweinitzii
“velvet top fungus” or “cowpie fungus”

Damage
Indicator
49

- On soil, at tree base, or on butt log
- Mushroom-like or bracket-shaped
- Annual
- Soft, velvety top, concentric lines
- Lower pore surface light brown
- Often associated with old fire scars
- Affected trees often swollen at the base (“jug-butt”)

Hosts

- Older Douglas-fir most frequently
- Spruces
- Jeffrey, ponderosa, western white, and sugar pine
- Rarely on western redcedar, hemlocks, and true firs.

Laetiporous sulphureus
“Chicken of the Woods”, “sulfur fungus”⁵²

Damage
Indicator



Laetiporous sulphureous
“Chicken of the Woods”, “sulfur fungus”

Damage
Indicator
52

- Annual, fleshy conks on lower bole
- Soft, clustered and shelf-like
- When fresh, bright yellow to brilliant orange to red-orange w/ bright sulfur-yellow pore surfaces
- When old, brittle and chalky-white to off-yellow
- Decay most often in the butts of trees

Hosts:

- Douglas-fir
- True firs
- Pines
- Hemlocks
- Spruces
- Western redcedar
- Hardwoods including oaks, maples, and willow

Fomitopsis officinalis

“quinine conk”

Rotten Cull
Indicator



Fomitopsis officinalis
“quinine conk”

Rotten Cull
Indicator

- “Old-growth” forests
- Fruiting bodies rare; sometimes huge (up to 2 feet)
- Woody, hoof-shaped, chalky
- One indicates extensive decay
- Bitter taste (“quinine conk”)

Hosts

- Douglas-fir
- Pines
- Western larch
- Spruces
- Hemlocks
- True firs (occasionally)

Oligoporus amarus

Rotten Cull
Indicator



Oligoporus amarus

Rotten Cull
Indicator

- **Moist and soft (quickly eaten by insects and rodents)**
- **Annual, summer or fall**
- **Yellow undersurface, tan top**
- **Shot-hole cups (depression left after conk is gone)**

Hosts

- **Incense-cedar**
- **Rarely true firs**

Phellinus cancriformans

“butterfly conk”

Rotten Cull
Indicator

No photo available

Rotten Cull
Indicator

Phellinus cancriformans
“butterfly conk”

- Conks similar to *P. pini* but smaller
- Produced in groups, usually on sunken areas on the host's lower bole.

Hosts

- True firs in southwest OR and northern CA