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Natural Resource Manager (NRM)



FSVeg Common Stand Exam User Guide Stem Decays and Cankers (Category 22)

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TABLE OF CONTENTS

Introduction	4
(22-001) Heart Rot.....	4
(22-002) Stem Rot	4
(22-003) Sap Rot.....	4
(22-004) Slime Flux	4
(22-005) Virus.....	5
(22-006) Black Knot of Cherry.....	5
(22-007) Atropellos Canker	6
(22-008) Siberian Elm Canker	6
(22-009) Botryosphaeria Canker	7
(22-010) Black Rot Fungus.....	7
(22-011) Caliciopsis Canker	8
(22-012) Black Canker of Aspen	8
(22-013) Sycamore Canker Stain	9
(22-023) Chestnut Blight.....	9
(22-024) Gray-Brown Saprot.....	10
(22-025) Cryptosphaeria Canker of Aspen	10
(22-026) Cytospora Canker of Fir	11
(22-027) Western Red Rot	12
(22-028) Rust Red Stringy Rot	12
(22-029) Sooty-Bark Canker	13
(22-030) Eutypella Canker	14

(22-031) Fusarium Cortical Stem Rot	14
(22-032) Pitch Canker	14
(22-033) Fusicoccum Canker	15
(22-034) Scleroderris Canker	15
(22-035) Amelanchier Rust	17
(22-036) Cedar Apple Rust	17
(22-037) Hypoxylon Canker of Oak	17
(22-038) Hypoxylon Canker of Aspen	18
(22-039) Canker Rot of Oak	19
(22-040) Sterile Conk Trunk Rot of Birch	19
(22-041) European Larch Canker	20
(22-042) Beech Bark Disease	20
(22-043) Nectria Canker	21
(22-044) Ash Heart Rot	21
(22-047) Red Ring Rot	22
(22-048) Aspen Trunk Rot	24
(22-049) Stem Decay of Black Walnut	24
(22-050) Phomopsis Canker	24
(22-051) Phomopsis Canker	25
(22-052) Leyland Cypress Canker	25
(22-053) Butternut Canker	25
(22-054) Maple Canker	26
(22-055) Thyronectria Canker	26
(22-056) Citrus Canker	26

(22-057) Cytospora Canker of Aspen.....	27
(22-058) Dothichiza Canker	27
(22-059) Red Belt Fungus	27
(22-060) Leucocytospora Canker of Spruce.....	28
(22-061) Sooty Bark Cancer	28
(22-062) Brown Heartrot	28
(22-063) Coniophora puteana	30
(22-064) Tinder Fungus	31
(22-065) Purple Conk.....	32
(22-066) Black Stain Root Disease	33
(22-067) Phellinus hartigii	34
(22-068) False Tinder Fungus	34
(22-069) Robustus Conk	35
(22-070) Yellow Cap Fungus	36
(22-071) Oyster Mushroom	36
(22-072) White Ring Rot	37
(22-073) Hemlock Canker	37
(22-074) Cedar Brown Pocket Rot.....	38
(22-075) Lachnellula Canker	38
(22-076) Strumella Canker.....	38
(22-077) Phomopsis Blight.....	39
(22-078) Fusarium Canker of Yellow Poplar	39
(22-079) Ignonotus glomeratus.....	39

INTRODUCTION

Root diseases can be difficult to detect. Diagnosis is usually done by a combination of stand-level and tree-level characteristics. Stand indicators include:

(22-001) HEART ROT

- Injury: Damage can be easily observed. Most begins at basal injuries, like those caused by fire and logging damage. Poorly healed and decayed branch stubs and other stem defects are strong indications of heart rot. Heart rot can affect all parts of the tree, but frequently occurs in the butt log, where its impact on the value of the tree is greatest.
- Description: Many fungi are responsible for heart rot. The conks they produce can identify them. Heart rots begin through wounds, if the wounds are sufficiently deep or large. Healing is slow and permits a succession of chemical changes, and bacterial and fungal colonization. If the succession is complete, decay will be initiated and will continue for many years.

(22-002) STEM ROT

- Description: Stem rot is the physical and chemical deterioration of the stem, resulting from wood rotting fungi.

(22-003) SAP ROT

- Description: Sap rot is the physical and chemical deterioration of the sapwood resulting from wood rotting fungi.

(22-004) SLIME FLUX

- Host: Oaks and other hardwoods
- Injury: Patches of wet bark having a sour smell are generally the first symptom of this disease. In addition, insects are attracted to the wet area. Often the bark in the area of the slime flux separates from the tree bole and gives a hollow sound when tapped.

Description: The prime wounding agents are insect borers, mechanical injuries, and natural cracks and splits which are rarely observed. The clear sap flowing from the wound becomes colonized with bacteria. It then darkens, and develops an unpleasant odor. The specific bacteria causing the dark color and odor are rarely identified.

Defect: Severe quality loss occurs to the affected tree.

(22-005) VIRUS

Description: A virus is a submicroscopic obligate parasite consisting of nucleic acid and protein.

(22-006) BLACK KNOT OF CHERRY

Species: *Apiosporina morbosa*

Host: Black cherry

Range: Throughout the southeast except southern Florida and southern Louisiana

Injury: Irregular swellings on stems, branches, and twigs. Often a white fungus is found growing over the swellings. Later, the swellings blacken and appear rough.

Description: Swellings are covered with an irregular, rough, fruiting layer of fungal tissue. Spore bearing fruiting bodies form within this fruiting layer. Burls or swellings up to six feet long can form.

Defect: Degrades this valuable veneer and lumber species.

Figure 1: Gall and fruiting body on cherry (photo by Robert L. Anderson)



(22-007) ATROPELLOS CANKER

<u>Species:</u>	<i>Atropellis piniphila</i>
<u>Host:</u>	Lodgepole pine, ponderosa pine, whitebark pine, jack pine, loblolly pine, Virginia pine
<u>Injury:</u>	Branch and stem cankers are produced. Wood in the canker area is resin-soaked, distorted, and has a blue-black stain of the heartwood and sapwood. The bark is usually tight over dead cambium. Damage may be severe in dense stands, particularly those growing on dry sites. Single infections in small trees or multiple infections in large stems often girdle the host. This pathogen is likely to be found in cool, moist sites. The cankers may cause vertical seams, which give stems a fluted appearance.
<u>Description:</u>	Black, disc-shaped fruiting bodies 1/16 to 3/16 inches in diameter may be visible on the canker surface. Cankers are usually many times longer than wide.
<u>Defect:</u>	On the side of the tree with the canker, all of the wood beneath each canker, and for two inches to each side, is cull. Alternatively, use a 15% deduction for any log with a canker.

Figure 2: Atropellos canker



(22-008) SIBERIAN ELM CANKER

<u>Species:</u>	<i>Botryodiplodia hypodermia</i>
<u>Host:</u>	Elms
<u>Injury:</u>	Cankers develop on twigs, branches, and trunks and may girdle them in a single season. In newly infected bark, tissue appears water soaked, soft and reddish brown to brown. Foliage may yellow, wilt, and die beyond the cankered area. On Siberian elm, cankered bark may slough off and leave obvious scars. Leaves on American elms may turn bright yellow in mid to late summer and shed prematurely. This symptom can be confused with Dutch elm disease.
<u>Description:</u>	Over winters as cankers and primarily attacks stressed trees, invading through wounds. Spores are produced in fungal fruiting structures in the cankers all season long and spread by wind and rain splash, but damage is most severe when infection occurs during the spring.

(22-009) BOTRYOSPHERA CANKER

<u>Species:</u>	<i>Botryosphaeria ribis</i>
<u>Host:</u>	Giant sequoia, incense cedar, hickory, Atlantic white cedar, American elm, persimmon, blackgum, black locust, Pacific willow, eastern redcedar, sweetgum
<u>Injury:</u>	This fungus is common on host trees grown outside of their natural range. It is particularly damaging when giant sequoia is grown in the warmer lower elevation ranges. This fungus progressively kills branches and may severely damage or kill trees. Initial symptoms are scattered dieback of twigs and branches. With time, the fungus builds up and spreads throughout the crown. Occasionally tops are killed. Recently killed branches appear as reddish brown flags. Branches dead for longer periods are gray brown and lacking much of their foliage. Infected branches often exude drops of pitch.

(22-010) BLACK ROT FUNGUS

<u>Species:</u>	<i>Botryosphaeria stevensii</i>
<u>Host:</u>	Juniper, primarily Rocky Mountain juniper
<u>Range:</u>	Reported from the Great Plains region but is probably more widely distributed in the United States
<u>Injury:</u>	Formation of distinct, sunken lesions on the bark, restrict water and nutrient movement and may ultimately lead to branch dieback and tree death. Occasionally, girdling stem cankers cause rapid death of the top third to one-half of the tree crown. More commonly, the disease causes death of branches throughout the crown and a gradual tree decline. This disease should not be confused with Kabatina or Phomopsis tip blights, which affect only foliage and succulent branch tips.
<u>Description:</u>	Develop elongated, flattened, often resinous cankers. These cankers may occur anywhere on woody stems but are commonly located near branch crotches in the interior portion of the tree crown. Cankers are often difficult to see, and it is often necessary to cut the dead branch off and carefully scrape away the outer bark to expose the chocolate brown, dead tissue in the canker. Surrounding healthy tissue will be pearl white. Small, black fruit bodies of the fungus also develop in the canker, but these may be partially hidden by thin pieces of dead bark.

(22-011) CALICIOPSIS CANKER

<u>Species:</u>	<i>Calliciopsis pinea</i>
<u>Host:</u>	Eastern white pine, pitch pine, shortleaf pine, loblolly pine, and Virginia pine in the east, Douglas-fir in the west
<u>Injury:</u>	Causes a superficial canker on the main stems of suppressed saplings and shaded branches. It will occasionally kill a suppressed sapling.
<u>Description:</u>	On eastern white pine the cankers are sharply marked depressed areas in the bark, with a reddish brown color and a smoother surface than the surrounding bark. The lesions vary from small to several inches in diameter. Black cylindrical bristles or spines about two mm high arise from stroma in the cankered bark.

(22-012) BLACK CANKER OF ASPEN

<u>Species:</u>	<i>Ceratocystis fimbriata</i>
<u>Host:</u>	Quaking aspen
<u>Range:</u>	Range of aspen in the western states
<u>Injury:</u>	Canker first appears as a circular, necrotic area on the trunk around a wound or branch stub.
<u>Description:</u>	Small cankers are oval or elliptical. Older cankers have a central area of dead wood surrounded by a series of calluses with black dead bark adhering. Calluses give the canker its diagnostic “target” shape. Black spots appear on edges of canker in spring on one-year old wood.

Figure 3: Aspen stand with trees damaged by black canker



Figure 4: Black canker with large callus folds



(22-013) SYCAMORE CANKER STAIN

<u>Species:</u>	<i>Ceratocystis fimbriata f.sp. platani</i>
<u>Host:</u>	Sycamore
<u>Injury:</u>	The first symptom is a dark-brown or black discoloration in lens-shaped or more elongated areas inline with the grain of the wood. On bark retaining the old plates and scales, the first evidence is an elongate depression with the inner bark blackened and dead. The first year the cankers are small but widen yearly, and girdle and kill the tree. Infected wood is reddish brown or bluish in color, the discoloration is deepest in the rays.

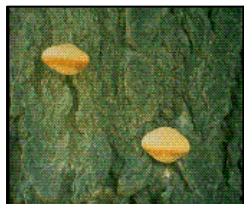
(22-023) CHESTNUT BLIGHT

<u>Species:</u>	<i>Cryphonectria parasitica</i>
<u>Host:</u>	Post oak, live oak
<u>Secondary host:</u>	Maple, hickory
<u>Range:</u>	Eastern hardwood forests
<u>Injury:</u>	Stem cankers are either swollen or sunken, and the sunken type may be grown over with bark. The bark covering swollen cankers is usually loose at the ends of the canker. Trees die back above the canker and may sprout below it. Frass and webs from secondary insects are common under loose bark.
<u>Description:</u>	The fungus forms yellowish or orange fruiting bodies about the size of a pinhead on the older portion of cankers. Spores may exude from the fruiting bodies as orange, curled horns during moist weather.

(22-024) GRAY-BROWN SAPROT

<u>Species:</u>	<i>Cryptoporus volvatus</i>
<u>Host:</u>	Grand fir, subalpine fir, Englemann spruce, lodgepole pine, limber pine, western white pine, ponderosa pine, Douglas-fir, western hemlock
<u>Injury:</u>	Primarily attacks dead conifers. It causes a rapid decay of sapwood in bark-beetle attacked trees. Rounded, white or tan conks about one inch in diameter form on the outer bark of infected trees. The conks emerge through holes in the bark produced by bark beetles within one to three years of attack.
<u>Description:</u>	Conks are leathery at first and totally sealed with an air space and a pink pore layer inside. At maturity, the conks have a hole in the underside about 1/8th to 1/4th of an inch in diameter. New conks may be produced on a dead tree each year for up to 3 years. Conks live only one summer and deteriorate on the tree within a year or two.
<u>Defect:</u>	Minimum volume loss usually results because most of the decay is removed in cutting the cant.

Figure 5: Conks on stem



(22-025) CRYPTOSPHAERIA CANKER OF ASPEN

<u>Species:</u>	<i>Cryptosphaeria populina</i>
<u>Host:</u>	Quaking aspen
<u>Injury:</u>	Cankers are long and narrow, following the grain of underlying wood and frequently associated with trunk wounds. Dead bark adheres tightly to sapwood. Two- to three-year old dead bark is black, stringy, and sooty like and contains small, scattered lenticular light-colored areas. Infected bark on the edges of the canker is light brown to orange with annual callus formation. The cankers are commonly long and narrow, spiraling around the tree like a snake, hence the common name "snake canker."

Figure 6: Snake-like pattern of infection



Figure 7: Lens-shaped, light-colored areas within infected bark tissue



(22-026) CYTOSPORA CANKER OF FIR

<u>Species:</u>	<i>Cytospora abietis</i>
<u>Host:</u>	Douglas-fir, western larch, white fir, grand fir, California red fir, subalpine fir, western hemlock, Englemann spruce, western redcedar
<u>Range:</u>	Western states
<u>Injury:</u>	Branch and stem cankers are produced. Branches and tops of trees are quickly girdled and killed. Stem cankers occasionally girdle and kill saplings, but seldom kill larger trees. Flagged branches and dead tops of seedlings and saplings are usually the most obvious symptoms. Sunken bark with dead cambium underlying is the result of the canker. Slight resin flow is often present at the canker margin and the bark within the cankered area often appears discolored. Conks are seldom observed.
<u>Description:</u>	If the edge of the canker is cut, an abrupt margin is observed between the green, live bark and the brown, dead bark. Orange tendrils of spores exude from microscopic holes in the bark at canker margins.

(22-027) WESTERN RED ROT

<u>Species:</u>	<i>Dichomitus squalens</i>
<u>Host:</u>	Ponderosa pine, lodgepole pine
<u>Injury:</u>	It is usually detected in live, standing trees by means of increment cores. Decay starts as reddish or purplish discoloration in a radiate or circular pattern. Advanced decay consists of elongate white pockets with square ends and poorly defined margins. Black flecks may be present. Decay column appears in cross section as a star-like or radiate pattern of advanced decay surrounded by purplish red incipient decay. If borings show a white pocket rot, it is probably red ring rot.
<u>Defect:</u>	Conks indicate total cull of logs or heartwood of trees. Fallen branches with decay indicate total decay in the tree and extensive stand loss.

(22-028) RUST RED STRINGY ROT

<u>Species:</u>	<i>Echinodontium tinctorium</i>
<u>Host:</u>	Grand fir, Pacific silver fir, white fir, noble fir, California red fir, subalpine fir, western hemlock, mountain hemlock, Englemann spruce, Sitka spruce, western redcedar
<u>Injury:</u>	This fungus attacks heartwood; in advanced stages, the heartwood becomes reddish-yellow to brown and stringy or fibrous. It enters the trees through dead branches. Decay may be stimulated by injury.
<u>Description:</u>	Conks are large woody conks with a black, roughly cracked upper surface; they usually originate from knotholes or branch stubs. Punk knots and conks are rusty-red in color when split open.
<u>Defect:</u>	One conk may indicate at least 16 feet of decay in each direction. Three to four punk knots or two or more conks indicate complete cull. On hemlock, a single conk indicates total heartwood loss.

Figure 8: Conk



Figure 9: Punky knot

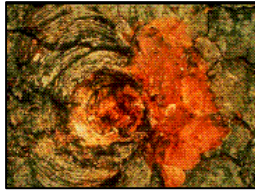


Figure 10: Decayed heartwood



Figure 11: Conk on mountain hemlock



(22-029) SOOTY-BARK CANKER

Species: *Encoela pruinosa*

Host: Quaking aspen

Injury: Outer bark sloughs off trunks in a concentric pattern from edges of cankers. Callus does not form. Exposed inner bark is a uniform sooty black and crumbles easily in the hand. The trunk shows small, black, spotted areas where the fungus held the bark to the tree. Light gray dots (fruiting bodies or apothecia) form abundantly on old, dead, inner bark.

Figure 12: Cup-shaped fruiting bodies develop in the old inner bark



(22-030) EUTYPELLA CANKER

<u>Species:</u>	<i>Eutypella parasitica</i>
<u>Host:</u>	Sugar maple, boxelder
<u>Injury:</u>	It attacks primarily saplings or small trees, and usually affects only scattered trees within a stand. The first symptom is a callus formation around an infection point, usually at a branch stub or wound. A sunken, dead area develops in the center of the callus and expands, as the fungus grows outward. Broad, slightly raised areas of callus tissue may cause a wave-like appearance on the canker face. In later years, the canker may form a hump, as the tree responds to invasion of the fungus. Dry, flinty bark normally remains attached to the face of the canker for many years. White mycelial fans can be found by cutting the callus tissue from the canker. Black fruiting bodies develop in older cankers and release spores.

(22-031) FUSARIUM CORTICAL STEM ROT

<u>Species:</u>	<i>Fusarium avenaceum</i>
<u>Host:</u>	Conifer seedlings including spruces, true firs, pines, Douglas-fir, larch
<u>Range:</u>	Widespread in North American nurseries
<u>Injury:</u>	Foliar symptoms are variable: newly infected seedlings typically have scattered chlorotic or curled needles followed by tip dieback, wilt symptoms, and stunting as the disease progresses. The seedling foliage often turns reddish brown just before the seedling dies. Diseased root systems show lack of fine root development and extensive cortical decay so that the epidermis is easily stripped away from the core tissues.
<u>Description:</u>	A diagnostic is the production of fruiting structures on the seedling stem, where yellow-orange spore masses are exuded. These spores are typically multi-cellular and sickle-shaped and can be used to positively identify the fungus.

(22-032) PITCH CANKER

<u>Species:</u>	<i>Fusarium subflutinans</i>
<u>Host:</u>	Plantations of slash pine and loblolly pine
<u>Range:</u>	Southern pine region

<u>Injury:</u>	Infected trees exhibit shoot dieback of the current year's growth, and abundant resin flow from the affected area. The wood beneath the canker is resin-soaked. The main terminal and upper laterals are most often affected.
<u>Description:</u>	Pinkish fruiting bodies containing fungus spores are produced on cankered shoots in the needle scars and on the outer surface of bark. Microscopic features of the spore-bearing structures, aid in identification.

(22-033) FUSICOCCUM CANKER

<u>Species:</u>	<i>Fusicoccum spp.</i>
<u>Host:</u>	Ash
<u>Injury:</u>	Cankers and dieback are most severe on sites where trees are growing poorly. Small branches are most affected, although the bole can be attacked. Canker development is usually arrested on trees with vigorous growth; however, cankers may girdle small limbs resulting in dieback and wind breakage.
<u>Description:</u>	Annual cankers appear pale brown when young, but eventually turn dark brown with a distinct boundary between the living and dead tissues. Old, inactive cankers appear sunken and may be surrounded by callus. Dead bark may separate from the wood and disappear from old cankers not covered by advancing callus. Symptoms alone are sometimes insufficient to identify this disease. The fungus forms white masses of conidia within minute, asexual fruiting bodies embedded in cankers of diseased branches. Conidia must be examined microscopically for identification.

(22-034) SCLERODERRIS CANKER

<u>Species:</u>	<i>Gremmeniella abietina</i>
<u>Host:</u>	Scots pine, red pine, pitch pine, white pine, ponderosa pine, Austrian pine, lodgepole pine, jack pine, white spruce, black spruce, Norway spruce

Injury:

The first symptom of infection in plantations is dieback of buds and the discoloration of needles on the previous season's growth. Needles turn orange at the base during early May, approximately 9 months after infection.

By midsummer, the needles are brown. These needles are very loose and usually drop off, leaving a bare branch tip. After infection, the fungus grows down the branch until it reaches the main stem of the tree. Young trees are girdled quickly and die within a few months. On larger trees, branch infection is usually arrested before reaching the main stem by such things as competition from saprophytic fungi, or breakage of infected branches by heavy, wet snow. Stem infections frequently form a canker. This canker may eventually be overgrown, but usually will deform the stem. Small cankers are common on branches infected with the European strain, but are rarely found on branches infected with the Lake States strain. A characteristic yellow-green stain color is commonly observed in the cambial zone of recently killed tissue.

The time that the Lake States strain first infects a plantation affects the severity of damage. A high percentage of trees may be killed in stands heavily infected during the first 5 years after planting. Infections that start in plantation trees 6 ft in height cause only minor damage. Although the lower branches of these trees are killed, the disease does not move into the tops or the trunks of the trees and normally causes little tree mortality.

The European strain is able to attack and kill branches throughout the entire tree. Infected branches have been observed 82 ft above the ground. Large trees are killed when infection rapidly builds up throughout the entire crown and kills all the branches.

Figure 13: Multiple branch tips infected



Figure 14: Dead pine



(22-035) AMELANCHIER RUST

<u>Species:</u>	<i>Gymnosporangium harknessianum</i>
<u>Host:</u>	Western juniper
<u>Injury:</u>	Its alternate host is the western serviceberry. Telia form a reddish brown gelatinous mass on the leaves.

(22-036) CEDAR APPLE RUST

<u>Species:</u>	<i>Gymnosporangium juniper-virginianae</i>
<u>Host:</u>	Eastern red cedar
<u>Injury:</u>	Brown, round galls form on the branches of redcedar, but cause no injury.
<u>Description:</u>	The fungus forms galls on the branches of eastern redcedar. In the spring, these galls produce long, orange tendrils or “horns.” Leaf spots form on the apple host in the spring. These spots produce yellow spores on the lower surface of the leaf.

(22-037) HYPOXYLON CANKER OF OAK

<u>Species:</u>	<i>Hypoxyylon atropunctatum</i>
<u>Host:</u>	Live oak
<u>Secondary host:</u>	Beech, hickory
<u>Injury:</u>	The fungus invades the cambium, and the fruiting layer exerts sufficient pressure to dislodge the bark. Careful observation is sometimes needed to see the fruiting layer, since it can resemble bark.
<u>Description:</u>	The fungus is usually visible as a definite fruiting layer that has dislodged the bark. Fruiting layers vary in color. Hundreds of small, black fruiting bodies are imbedded in this layer.

(22-038) HYPOXYLON CANKER OF ASPEN

Species: *Hypoxylon mammatum*

Host: Quaking aspen; occasionally balsam poplar

Range: Range of aspen, except in Alaska

Injury: Young cankers first appear on bark as slightly sunken, yellowish-orange areas with irregular margins. As the infection progresses, the outer bark is raised in blister like patches and sloughs off, exposing the blackened crumbling cortex. Old cankers, which may be several feet long, are rough and blackened at the center and yellowish-orange at the newly invaded margins.

Although callus may develop occasionally at the margin of a canker, the fungus usually invades new tissue so rapidly that callus has no time to form. Many trees infected on the lower bole are girdled and killed within 5 years. An infection on the upper bole may cause only part of the crown to die, after which a lower branch may become the growing tip of the tree, but the entire tree may then die from suppression. Some trees are so weakened by decay in the cankered zone that wind breaks the stems before girdling is complete.

The most reliable field symptom for identifying young cankers is the laminated or mottled black and yellowish-white cortex, which can be exposed by cutting into young cankers or cutting near the margins of older cankers. Removing the bark exposes white mycelial fans in the cambial zone.

Figure 15: Mycelial fan beneath the bark



Figure 16: Canker



(22-039) CANKER ROT OF OAK

<u>Species:</u>	<i>Inonotus hispidus</i>
<u>Host:</u>	Black ash, oak, hickory
<u>Injury:</u>	Cankers and associated localized decay vary in size, shape, and degree of callus formation. Dead branch stubs usually are located at the centers of cankers.
<u>Description:</u>	Fungal fruiting bodies may be associated with the cankers and are variable. They are usually shelf like and up to 10 inches wide. The undersurface is golden brown. The conk is annual.
<u>Defect:</u>	Decay is mostly in the upper portion of the trunk.

(22-040) STERILE CONK TRUNK ROT OF BIRCH

<u>Species:</u>	<i>Inonotus obliquus</i>
<u>Host:</u>	Yellow birch, paper birch
<u>Range:</u>	Northeastern states and Alaska

Injury: The fungus enters the tree through wounds, especially poorly healed branch stubs. Once the fungus is in the tree, decay is rapid and extensive. Viewed at the end of a cut log, decayed wood is yellow with a dark brown border.

The “cinder conk” is not a fruiting body but a wedge. The structure forces the bark apart, keeping the wound open and allowing the fungus to enter uninfected wood. Every time the tree walls off the fungus, the wedge kills additional tissue; the fungus continues to infect, and a canker forms. About 6 years after a tree has died and decay has spread throughout the wood to the bark, the fungus fruits.

Description: The short-lived fruiting bodies form under the bark and break through. They are flat, thin, and brown.

Defect: A tree with the typical “cinder conk” is usually 50 to 100 percent cull.

Figure 17: Sterile conk on paper birch



(22-041) EUROPEAN LARCH CANKER

Species: *Lachnellula wilkommii*
Host: Larch
Range: Massachusetts, Maine
Injury: Can kill both mature and immature trees.

(22-042) BEECH BARK DISEASE

Species: *Nectria coccinea*
Host: Beech

Injury: fungus “complex.” Disease results when the fungus infects the bark of the trunk through feeding wounds made by beech scale insects. The beech scale, *C. fagisuga*, usually infests trees greater than 8 inches in diameter. It is sometimes found on smaller trees. The insect secretes a white, wooly wax covering that is easily seen.

The asexual stage of the fungus produces a cushion of white spores during wet weather in the summer. These cushions resemble the wooly secretions of the insect. The small, red fruiting bodies of this stage are found in clusters. They can best be seen in the fall when they mature. Fungal invasion is apparent 3 to 5 years after the scale insect appears. Dark, dead patches are produced where other fungi enter. Infection points may be walled off with callus tissue, giving the tree a pockmarked appearance.

(22-043) NECTRIA CANKER

Species: *Nectriagalligena*

Host: Yellow birch, black walnut

Secondary host: Aspen, red oak, maple, beech, poplar, birch

Injury: Well-defined areas of bark, cambium, and underlying wood are killed by the fungus. Concentric, annual callus ridges develop around the expanding canker, and bark sloughs off the older parts of the canker. After several years, the canker resembles a target.

Description: Creamy-white fruiting structures that appear on cankers soon after infection. It can be identified by the pinheaded sized, red, lemon-shaped perithecia near canker margins after one year.

Defect: Seriously reduces the quantity and quality of wood. It causes serious volume loss.

(22-044) ASH HEART ROT

Species: *Pereniporia fraxinophila*

(22-047) RED RING ROT

<u>Species:</u>	<i>Phellinus pini</i>
<u>Host:</u>	Western larch, Douglas-fir, subalpine fir, grand fir, Englemann spruce, Sitka spruce, white spruce, black spruce, western redcedar, western hemlock, mountain hemlock, western white pine, ponderosa pine, limber pine, lodgepole pine
<u>Injury:</u>	This is the number one heartwood decay in the United States. Punk knots are often present in absence of fruiting bodies. They may be open or overgrown by sapwood and inconspicuous until chopped open. Punk knots indicate points where old conks have fallen or the beginning of a new conk.
<u>Description:</u>	The shelf-like conk is 1 to 12 inches in diameter, dark gray to black on top and cinnamon to yellowish-brown on the undersides. It usually occurs at branch stubs. Punk knots are filled with the same cinnamon to yellowish-brown punky substance composing the interior of the conk.
<u>Defect:</u>	Conks and punk knots are strong cull indicators. The presence of one of these fruiting bodies would indicate the tree is half rotten; two or more and the tree is cull. Decay extends 2 to 5 feet up and 4 to 7 feet down from individual indicators. Any conk or swollen knot on larch indicates total heartwood loss. In white pine the cull is confined to the side of the tree supporting the conk, provided no other indicators are present.

Figure 18: Cross-section

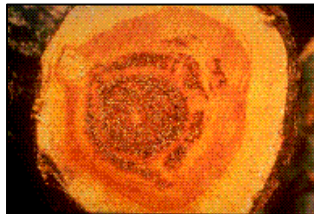


Figure 19: Conks



Figure 20: Conks



Figure 21: Punky knots



Figure 22: Punky knots



Figure 23: Rot in trees



Figure 24: Rot in trees



(22-048) ASPEN TRUNK ROT

Species: *Phellinus tremulae*

Host: Quaking aspen

Injury: White or yellowish spongy rot is generally confined to heartwood. Sapwood is decayed in advanced stages and contains concentric black zone lines.

Description: Conks are hoof-shaped and an average of four inches wide with grayish black, cracked upper surface, brown under surface with many pores, and a rusty brown interior with a layer of tubes. Conks are at angles of about 45 degrees from horizontal.

Figure 25: Aspen trunk rot



(22-049) STEM DECAY OF BLACK WALNUT

Species: *Phellinus weirianus*.

(22-050) PHOMOPSIS CANKER

Species: *Phomopsis occulta*.

Host: Blue spruce

Injury: Causes tip blight characterized by downward curling and necrosis of expanding shoots, where stem cankers and sap exudate commonly occur.

(22-051) PHOMOPSIS CANKER

<u>Species:</u>	<i>Phomopsis spp.</i>
<u>Host:</u>	Douglas-fir
<u>Injury:</u>	Yellow or light green "flags" which eventually turn brown, appear in crowns or at the tips of infected trees. These "flags" gradually work inward and down the tree. Resin often appears from cankered areas particularly on large stems. Primarily affects young trees, often killing trees less than 3 inches in diameter and causing branch flagging on older trees.

(22-052) LEYLAND CYPRESS CANKER

<u>Species:</u>	<i>Seiridium cardinal</i>
<u>Host:</u>	Monterey cypress
<u>Injury:</u>	Infected trees or branches 2 to 3 years old may be killed within a year, whereas, on larger trees, infected branches or trunks may remain alive for 5 to 10 years. Fading and death of twigs, branches and tops of trees are the most conspicuous symptoms. Resin flow usually accompanies canker development and as the killed bark dries out, a sunken area develops. Bark cracking accompanies canker development. Cypress bark beetles are often associated with, and hasten the death of, infected trees.
<u>Description:</u>	Spread is by windborne spores and by spores washed out of the fruiting bodies by rain. Most infection occurs at the bases of small branches, or in branch forks. Both wounded and unwounded tissue is a site for infection. Cankers grow more rapidly along a branch than around it, and they usually have a length-width ratio of 3:1. Dark, irregular shaped blister like fruiting bodies .3 to 1.5 mm in size are produced and break through the bark of dead tissue.

(22-053) BUTTERNUT CANKER

<u>Species:</u>	<i>Sirococcus clavigignenti-juglandacearum</i>
<u>Host:</u>	Butternut
<u>Description:</u>	The first symptom is branch dieback. Annual stem and branch cankers form, and the bark splits at the point of the canker. A black substance oozes from the canker. Epicormic branching is common, and tufts of live branches form along the bole before the tree dies. This disease is threatening the survival of the species.

(22-054) MAPLE CANKER

<u>Species:</u>	<i>Steganosporium spp.</i>
<u>Host:</u>	Maple
<u>Injury:</u>	This canker causes dieback. Large branches die back with conspicuous flagging. The black tar-like fruiting bodies are formed in cankers.

(22-055) THYRONECTRIA CANKER

<u>Species:</u>	<i>Thyronectria austro-americana</i>
<u>Host:</u>	Honey locust
<u>Injury:</u>	Causes a canker on the smaller branches, and may cause branch death. Some trees die from multiple branch infections.
<u>Description:</u>	The slightly depressed cankers range in size from a pinhead to about ½ inch in diameter, eventually enlarging or coalescing to girdle a branch. Gummy exudate occurs on many cankers. The underlying outer wood is streaked with reddish brown for several inches in each direction from a canker.

(22-056) CITRUS CANCER

<u>Species:</u>	<i>Xanthomonas citri</i>
<u>Host:</u>	Citrus
<u>Range:</u>	Pacific Islands including Guam and Hawaii
<u>Injury:</u>	This is a bacterial disease of citrus trees. Symptoms are rough, brown corky eruptions on both sides of leaves and fruit. On foliage, the lesions are surrounded by oily or yellow halos. Old lesions become brown and corky. Stems and twigs of citrus trees that grow in the wild die back because of the disease.

(22-057) CYTOSPORA CANKER OF ASPEN

<u>Species:</u>	<i>Cytospora chrysosperma</i>
<u>Host:</u>	Aspen, poplar, willow
<u>Injury:</u>	Yellow or light green "flags" which eventually turn brown, appear in crowns or at the tips of infected trees. These "flags" gradually work inward and down the tree. Resin often appears from cankered areas particularly on large stems. Usually attacks weakened trees, especially branches previously infected with dwarf mistletoe. Dead branch-tips are the most visible symptom. On large limbs and trunks, a canker is formed by circular bark killing over a period of years.

(22-058) DOTHICHIZA CANKER

<u>Species:</u>	<i>Dothichiza populae</i>
<u>Host:</u>	Poplars, eastern cottonwoods
<u>Injury:</u>	The disease is primarily one of young and newly planted trees and of trees that have been weakened by other factors. The fungus attacks the trunk, limbs, and twigs, causing the formation of cankers. These are frequently found at the base of the twigs and limbs. Cankers will girdle and kill branches, and eventually kill the tree. Below the cankered areas, water sprouts appear abundantly, but they too are eventually killed.
<u>Description:</u>	Cankers first appear as slightly sunken areas with the diseased bark a shade darker in color than healthy bark. The long axis of the elongated cankers parallels the long axis of the stem. The bark is killed to the cambium, the sapwood is invaded, and a brown discoloration results.

(22-059) RED BELT FUNGUS

<u>Species:</u>	<i>Formitopsis pinicola</i>
<u>Host:</u>	Douglas-fir, subalpine fir, grand fir, Englemann spruce, ponderosa pine, lodgepole pine, limber pine, western white pine, western hemlock
<u>Injury:</u>	This is one of the most common wood decay fungi in Northwestern United States. It usually is found on dead rotting trees and stumps. Both sapwood and heartwood of dead trees are attacked. The wood becomes yellowish to pale brown, dry and crumbly in the early stages of decay. Later the rot becomes red-brown and cubically cracked with white felts of mycelium in some cracks.

Description: Conks are variable in form and may range up to a foot or more in diameter. Hoof-shaped conks have a tan to dark brown upper surface with a red band near the margin. The lower surface is white with minute pores. Young conks start as thick mounds of white or cream colored tissue without visible pores. At all stages, conks are tough and corky.

(22-060) LEUCOCYTOSPORA CANKER OF SPRUCE

Species: *Leucocytophora kunzei*

Host: Norway spruce, blue spruce, white spruce, red spruce, Douglas-fir

Injury: Branch cankers disfigure the trees, but rarely kill them. Trunk cankers, however, sometimes girdle and kill the trees. This canker sometimes attacks young trees, but is more common in trees 15 years of age and older. Trees of low vigor, shallow roots and those growing on unfavorable sites, and those weakened by drought, mechanical injury, or insects are more susceptible. The first symptom of infection is usually the death of a lower branch and subsequent needle browning. As the disease progresses, infection spreads to higher branches. Infected areas may be covered by resin, which often drips onto lower branches. The removal of outer bark and resin from cankers reveals the brown, dead areas of inner bark and cambium.

Description: The cankers on infected are inconspicuous because the infected bark does not change color or become depressed. Tiny, black, pinhead-like fruiting bodies form in the bark where the diseased tissue adjoins healthy tissue. During rainy weather, the threadlike, yellowish spore masses ooze from the fruiting bodies.

(22-061) SOOTY BARK CANCER

Species: *Phyllosticta singular*

Host: Poplar

(22-062) BROWN HEARTROT

Species: *Fomitopsis officinalis*

Host: Western larch, ponderosa pine, lodgepole pine, western white pine, Douglas-fir, Sitka spruce, Englemann spruce, subalpine fir, grand fir, western hemlock

Injury: This is a heart rot of the stem. A single conk usually indicates complete cull. The decay is common only in a few old growth stands.

Description: Conks are large, up to two feet long, hoof-shaped or columnar. They are soft, yellow-white when young, soon becoming white and chalky throughout. The decay is brown, cubically cracked, with thick white felts in large cracks. The taste of both conks and felts is bitter and distinct for this species.

Defect: A single conk usually indicate complete cull, 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.

Figure 26: Decayed heartwood



Figure 27: Conk



Figure 28: Conk



(22-063) CONIOPHORA PUTEANA

<u>Species:</u>	<i>Coniophora puteana</i>
<u>Host:</u>	Balsam fir, subalpine fir, Englemann spruce, white spruce, black spruce, lodgepole pine, western redcedar
<u>Injury:</u>	Affects trees at high elevations. It causes a brown cubical rot. It occurs on slash and building timbers. It sometimes decays living trees.
<u>Description:</u>	The annual, crust like, fleshy fructifications are usually a little over two inches in diameter, or they may be elongated. The surface is smooth or slightly wavy and olive to brownish in color with a white margin.
<u>Defect:</u>	A decay circumference on a log end extends throughout a log. Conks indicate localized decay up to six feet from each conk in dead wood.

Figure 29: Fruiting body and advanced stage



Figure 30: Cross-section

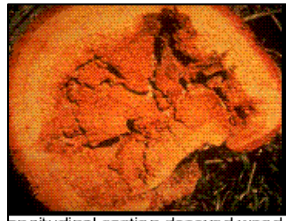


Figure 31: Cross-section



Figure 32: Cross-section



(22-064) TINDER FUNGUS

<u>Species:</u>	<i>Fomes fomentarius</i>
<u>Host:</u>	Beech, paper birch, yellow birch, California laurel, and aspen
<u>Injury:</u>	Decay usually is limited to areas killed by some other agent. The fungus causes a white rot of both sapwood and heartwood living and dead trees. The decayed wood is soft, spongy, and yellowish-white with narrow brown to black zones lines and small radial cracks.
<u>Description:</u>	The conk is hard, gray, smooth, and shaped like a horse's hoof.
<u>Defect:</u>	Presence of conk indicates little usable wood.

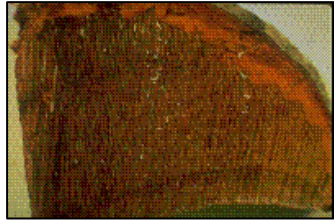
Figure 33: Conk on paper birch



Figure 34: Tinder fungus



Figure 35: Tinder fungus



(22-065) PURPLE CONK

Species: *Hirschioporus puteana*

Host: Dead conifers

Injury: This is a pitted sap rot or a white pocket rot of fir. It may attack dead sapwood in wounds of living trees. Only the sapwood decays and on cross-section appears rough where the saw passed through. On longitudinal section the decayed sapwood is honeycombed with tiny, rectangular, shallow, empty pockets and becomes spongy or corky.

Description: Small, numerous conks appear on decaying logs. They have pores, are hairy, gray to white, one to two inches across, and appear in groups. When actively growing, the lower surface is purple.

Decay: Conks indicate total decay of the sapwood only.

Figure 36: Decayed sapwood

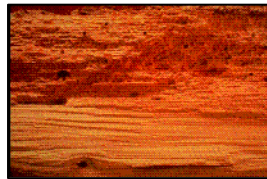
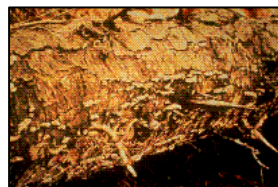


Figure 37: Conks on log



(22-066) BLACK STAIN ROOT DISEASE

<u>Species:</u>	<i>Leptographium wagnerii</i>
<u>Host:</u>	Douglas-fir, ponderosa pine, Jeffery pine, pinyon, singleleaf pinyon
<u>Injury:</u>	Infected trees exhibit symptoms of gradual decline before they die. In early stages of decline, terminal growth is reduced and older needles become chlorotic. As the disease progresses, older needles are shed prematurely, new needles are somewhat stunted and yellow, and reduced internodal growth is evident on lateral branches. In advanced stages, new growth is chlorotic, with a tufted appearance, and crowns exhibit very sparse foliage. Trees may bear “distress” cone crops. This disease affects groups of trees in distinct infection centers. Typical centers have trees in various stages of decline near the perimeter and dead trees in the interior near the origin of initial infection.

Figure 38: Cross-section through affected root



Figure 39: Dark sapwood stain



Figure 40: Faded sparse crown



(22-067) PHELLINUS HARTIGII

<u>Species:</u>	<i>Phellinus hartigii</i>
<u>Host:</u>	Western hemlock, mountain hemlock
<u>Range:</u>	Host range in Alaska
<u>Injury:</u>	The fungus causes a white rot of sapwood and heartwood of living trees. Decay of the sapwood causes a sunken canker where the side of a tree is killed.
<u>Description:</u>	Brown perennial conk usually located on the underside of limbs or branch stubs, but sometimes occurring directly on the bole. Upper surface is dark brown to black and cracked. The under surface is rusty brown to brown with very small regular pores. The tissue inside the conk is yellow to rust brown with streaks of white mycelium.
<u>Defect:</u>	Decay is usually confined to the side of the tree where infection occurred and normally extends only a few feet above and below the conk.

Figure 41: Conk on a mistletoe broom



(22-068) FALSE TINDER FUNGUS

<u>Species:</u>	<i>Phellinus igniarius</i>
<u>Host:</u>	Beech, birch, paper birch, quaking aspen

Injury:

The appearance of conks on living trees is the most reliable external indicator of decay. The white or yellowish spongy rot is generally confined to the heartwood. The early stage of decay is characterized by soft cream-colored wood, often with a distinct dark zone line separating it from the surrounding healthy wood. In later stages of decay, the wood becomes spongy or punky, yellowish in color and the decayed wood contains a number of irregular concentric black zone lines. A brown stain is usually found on the outside perimeter of the decayed wood. The rot can occur throughout the length of the tree and often, in advanced stages, sapwood tissue is invaded. Occasionally the damage is so prevalent that it masks or conceals rot caused by other fungi. Suspected entry points for the organism are dead branch stubs, cankers, and various types of injuries that extend deep into the sapwood. The shelf like or hoof-like fruiting bodies emanate from these points.

Description:

The conks are black and rough on top and may be shaped like a hoof. A cross section shows several distinct layers of dark-brown pores, some of which may be filled with white, fluffy mycelia. Conks average four inches wide.

Defect:

A conk indicates decay extending at least eight feet in both directions. Several conks indicate no usable heartwood. A canker caused by the fungus indicates total cull.

Figure 42: Conks

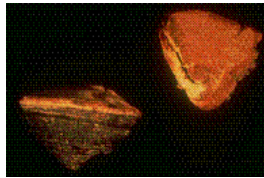


Figure 43: Conk on paper birch



(22-069) ROBUSTUS CONK

Species:

Phelinus robustus

Host:

Hardwoods

(22-070) YELLOW CAP FUNGUS

<u>Species:</u>	<i>Pholiota spp.</i>
<u>Host:</u>	Balsam fir, California red fir, white fir, birch, poplar
<u>Injury:</u>	The fungi leave a more or less fibrous or stringy residue, which may be tan, white, or brownish. As the decay progresses, effected wood is often reduced to a wet, pulpy mass. Later this wood may be destroyed, leaving a hollow in the tree. The fungus enters through fire scars or other basal wounds.
<u>Description:</u>	The conks are yellow or light tan mushrooms that appear in late summer on decaying trunks, stumps, and logs. The mushrooms appear in clusters and have caps with sticky upper surfaces, scales on both caps and stems, and gills beneath the caps.
<u>Defect:</u>	Rot extends up the trunk, sometimes to 50 or 60 feet above the ground.

Figure 44: Fungus at the base of an infected tree



(22-071) OYSTER MUSHROOM

<u>Species:</u>	<i>Pleurotus ostreatus</i>
<u>Host:</u>	Alder, aspen, cottonwood, birch
<u>Injury:</u>	It causes a white, flaky rot of the sapwood and heartwood. Infection usually occurs through open wounds.
<u>Description:</u>	The white, fleshy, shelf-like mushrooms are smooth on the upper surface with gills on the lower surface, and often arise in clusters. The gills on the lower surface characteristically extend down the along the stalk.

Figure 45: Oyster mushroom on aspen



(22-072) WHITE RING ROT

Species: *Poria albipellucida*

Host: Redwood, western red cedar

Injury: This rot increases in severity from its southern range to its northern range. The incidence of rot in redwood is correlated with the amount of western red cedar in the stand. Entrance courts for this fungus are wounds, mainly fire scars and dead or broken tops. This rot does not move into stump sprouts from rotted stumps. The rot looks like normal heartwood except for a dark brown discoloration. As the decay progresses, the heartwood becomes soft, and turns lighter brown. Wood with advanced decay is soft and cinnamon brown and often separates along the annual rings. Minute, elongated pits occur in the wood surfaces between these separations. These pitted surfaces may become somewhat hairy with whitish wood fibers as the rot continues. Wood in the final stage of decay appears as a stringy, fibrous mass.

Description: Fruiting bodies have never been found associated with decayed wood of redwood. The fungus is identified solely from laboratory cultures obtained from rotted wood. Fruiting bodies are found on western red cedar slash.

(22-073) HEMLOCK CANKER

Species: *Xenomeris abietis*

(22-074) CEDAR BROWN POCKET ROT

<u>Species:</u>	<i>Poria sericeomollis</i>
<u>Host:</u>	Western redcedar
<u>Injury:</u>	Causes heart rot of the stem. The rot occurs in irregular, large patches several inches to several feet in length throughout the stem. Each patch may become one to several inches in diameter. In the early stages of development, the decay patches are yellow to light brown and often vague, but in late stages, they become distinctly brown with cubical cracking.
<u>Description:</u>	Conks are rare. They are indistinct, thin; white pore layers produced directly on the bark of dead trees.
<u>Defect:</u>	Heart rot of stem, often producing total cull.

(22-075) LACHNELLULA CANKER

<u>Species:</u>	<i>Lachnellula flavorirens</i>
<u>Host:</u>	Western larch
<u>Injury:</u>	Usually attacks seedlings and saplings. The stem and branch cankers girdle and kill treetop, branches, or the entire tree. Sunken, discolored, sometimes resinous areas of bark on stem or branch. Cambium is killed. A distinct margin between dead and live cambium is observed by cutting away bark.
<u>Description:</u>	Small, cup-shaped fruiting bodies are occasionally found on dead bark within canker. These fruiting bodies are 1/8 inch in diameter, yellow inside and brown outside.

(22-076) STRUMELLA CANKER

<u>Species:</u>	<i>Strumella coryneoidea</i>
<u>Host:</u>	White oaks, beech, blackgum, shagbark hickory
<u>Injury:</u>	A diffuse looking canker develops on smooth barked saplings, rapidly girdle, and kill the trees. Target shaped cankers are more common and are formed by the alteration of cambium killed by the fungus around the canker perimeter and then the formation of a callus ridge by the host. Cankers can reach several feet in length.

Description: The fungus produces dark brown, cushion like structures about 1/20 to 1/10 inches in diameter, on dead bark and surrounding tissue. The fruiting body is cup shaped and grows on infected branches and stems that have fallen to the ground.

(22-077) PHOMOPSIS BLIGHT

Species: *Phomopsis juniperovora*

Host: Eastern redcedar, cypress, Atlantic white cedar

Injury: Primarily a problem in nurseries. The tips of branches are usually killed. Then they turn brown. Formation of small, black fruiting bodies at the point between living and dead tissue is common.

Description: The fungus forms small, black fruiting bodies on the needles and stems. These bodies contain small, oval spores.

(22-078) FUSARIUM CANKER OF YELLOW POPLAR

Species: *Fusarium solani*

Host: Sugar maple, sweetgum, poplar

Injury: The fungus enters the tree through broken branches; dead water sprouts, bark wounds, especially those made by ambrosia beetles. First, small vertical cracks form in the bark. These cracks become cankers up to a foot in length; separate cankers often merge. Infected tissues commonly ooze in the fall. Foliage does not appear to be damaged in the early stages of the disease, but as the cankers enlarge and kill more bark, the crown begins to thin and die back.

(22-079) IGNONOTUS GLOMERATUS

Species: *Ignonotus glomeratus*

Host: Sugar maple, red maple, beech

Injury: A black cinder-like mass of fungal material forms in the opening created by a dead branch stub. This material is sterile. It causes a canker rot on its host. Rot is usually extensive, and the decay is greater in the upper portions of the tree above the branch stubs. The yellowish brown conks form on the undersides of down trees or logs.