Common Fungi Affecting Pacific Northwest Trees

Implications for Tree Risk Assessment.

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Implications for Tree Risk Assessment.

Arborists and foresters conducting tree risk assessments need to:

a) know what to look for, and

b) know what they are looking at.

Fungi affecting trees show considerable variability in form and their ability to cause decay. Part of that variability is driven by the species of tree and fungus, the age and vigour of the tree, the extent of the fungal attack and associated decay, and the ability of the tree to compartmentalise the invading pathogens. Understanding the CODIT process is integral to understanding where decay may be within the tree.

The following table of fungi affecting trees in the Pacific Northwest area has been compiled from numerous sources of literature, including books, articles, and web sites, as well as extensive experience. It is intended as a general guide so that users can better identify and understand the implications of these various fungi.

The contents must be used with caution. Each tree, and its interaction with any one fungal pathogen will be different from the next one. In many cases it is not enough to assume that merely seeing the presence of a fruiting body automatically means the tree has extensive decay; although that is the case with some fungi. The extent of decay can vary tremendously. The literature available can only ever provide general guidance about what to expect.

It is up to the individual arborist or forester to investigate each circumstance carefully. That may mean conducting detailed and advanced investigations of the tree to map out possible decay. Using the results, a determination can then be made about the likelihood of failure within a defined timeframe, along with possible mitigation options.

The list below is not comprehensive. Rather, it provides a starting point for some of the most commonly seen fungi. There are many other fungi that may be important. If in doubt, collect the fruiting body and take well lit and properly focused images and send them in to a laboratory for identification. State extension services, forestry and/or natural resorce management departments, or forestry schools all provide advice and identification services.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Armillaria solidipes* (formerly *Armillaria ostoyae* and before that *A mellea*)										
Typical Host tree in the Pacific Northwest Region	Conifers and hardwoods										
Form of fruiting body	Perennial		Annual	✔	Polypore		Gilled	✔			
Type of decay	White rot		Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot	✔	Butt rot	✔	Sap rot		Heart rot				

Comments:
Armillaria is parasitic and saprobic on wood and roots. It causes decay in roots, but only minor decay in the butt log. However, it kills a wide range of tree species. In coastal areas, trees over 15 to 20 years old are less susceptible and although infected may stay alive. East of the Cascades all ages of trees are susceptible and mortality can be significant in forest areas. The disease is spore borne and enters through wounds, but the most common mode of spread is by rhizomorphs in the soil. Infected trees will spread the disease by root grafting.

Diseased trees show the typical root disease symptoms of reduced leader growth, with discoloured and sparse foliage, and a heavy cone crop. On the more resinous conifers such as Douglas-fir and lodgepole pine, there may be a resinous exudate coming out of the bark close to the base of the tree. This is more common on moist sites than on dry sites. Underneath the bark there may be typical white fans of mycelium, and / or the classic dark brown to black flattened rhizomorphs resembling shoe strings.

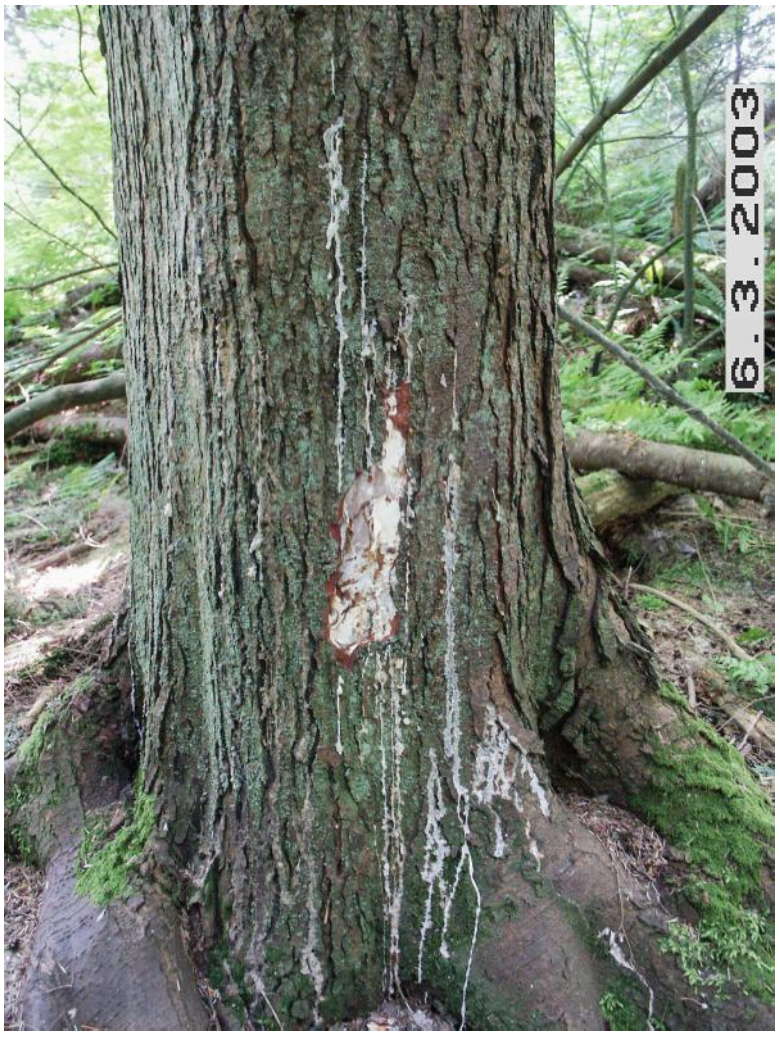
The fruiting bodies appear as clumps of gilled, cream to brown mushrooms 5 - 10 cm wide, in late summer through to mid-autumn. Located at the base of living, infected, and killed trees, as well as colonised stumps, the mushrooms have a well defined ring underneath the cap at the top of the stem.

Risk assessment and management implications
Armillaria may be found in conjunction with other pathogens. If fruiting bodies are seen get them correctly identified. In urban areas they can be confused with Coprinus (Inky cap) mushrooms. If the fungus is confirmed, check root conditions.

Armillaria solidipes mushrooms. Note mycelial fan under the bark and resinosus on trunk.

Armillaria solidipes

Rhizomorphs and mycelial fans on Douglas-fir.



Resinosus and mycelial fan under bark. Western hemlock.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Fomes fomentarius*										
Typical Host tree in the Pacific Northwest Region	Hardwoods										
Form of fruiting body	Perennial	✔	Annual		Polypore		Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot		Butt rot		Sap rot	✔	Heart rot	✔			

Comments:
Spread by spores landing on dead wood areas and branch stubs. Pronounced hoof-shape conk, woody, leathery conk silvery grey / brown on the upper surface, the lower surface is concave, light brown, poroid. The age of the conk can be estimated by counting the layers on the main conk. Decays sapwood and heartwood.

Risk assessment and management implications

The conk indicates extensive columns of decay which may equate to a high likelihood of failure. However, if the target zone can be managed, and people kept away, the decay provides excellent opportunities for smaller nesting birds and critical wildlife habitat.

Fomes fomentarius on Red alder and Birch.

Common Fungi Affecting Pacific Northwest Trees

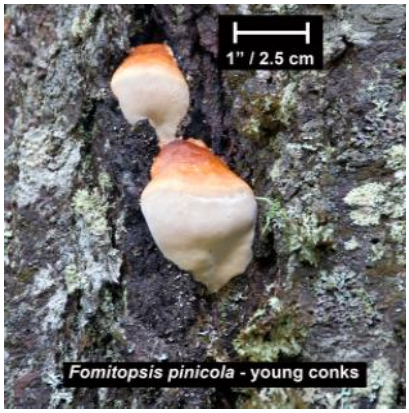
Latin name	*Fomitopsis pinicola*										
Typical Host tree in the Pacific Northwest Region	Conifers and deciduous (less common)										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot		Brown rot	✔	Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot		Butt rot		Sap rot		Heart rot	✔			

Comments:

Common on old growth conifers, it can also be seen on hardwoods. It is parasitic on live trees, saprobic on dead wood, and may be seen as a secondary pathogen where other causes have created dead wood areas within the tree. Typically located on the trunk. The fungus is a heartrot and its presence implies a column of decay above and below the conk. It is very common dead and downed logs. Common name is red belt fungus.

The conk is a hard leathery conk similar in appearance to a *Ganoderma applanatum* bracket. The top area is reddish brown, and shiny. The edge is yellow or white, with the underside all white. Unlike *Ganoderma applanatum* the underside does not bruise or retain a scatch line. It can also be seen as a surface form spread over wound areas. It may be possible to count the annual layers of growth to get an approximate age of the conk.

Risk assessment and management implications
Infected trees may have extensive columns of decay, especially in old growth trees. Stem breakage is common. If the site allows for it, infected trees can make excellent wildlife snags.



Common Fungi Affecting Pacific Northwest Trees

Latin name	*Ganoderma applanatum*										
Typical Host tree in the Pacific Northwest Region	Deciduous and coniferous trees.										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot		Butt rot	✔	Sap rot	✔	Heart rot	✔			

Comments:

Leathery to woody conk, flat, plate-like bracket, upper surface light brown, ridged. Lower surface is white when fresh and active, brown when old. Conk may persist for many years. The bracket form is always horizontal in layout. Downed trees with horizontal brackets suggest the brackets developed after failure. If the brackets are vertical then they were present prior to failure. Infected trees may show reduced growth rates and smaller than usual leaf size. Early stages may be seen as a white polypore with no defined upper and lower surface. Early decay stage bleaches the wood, circled by a dark brown stain. Advanced decay turns the wood white, mottled, and spongy.

Expect to see decay above and below the conk. If multiple conks are present expect extensive decay. New infections spread by spores. When actively reproducing there may be an area of fine brown powder (the spores) below and near to the conk. *Ganoderma* brackets may sometimes look similar to *Fomitopsis pinicola* conks. The simple test is to scratch the underside area. *Ganoderma applanatum* conks will retain an etched line. *Fomitopsis* conks do not show any discoloration when scratched.

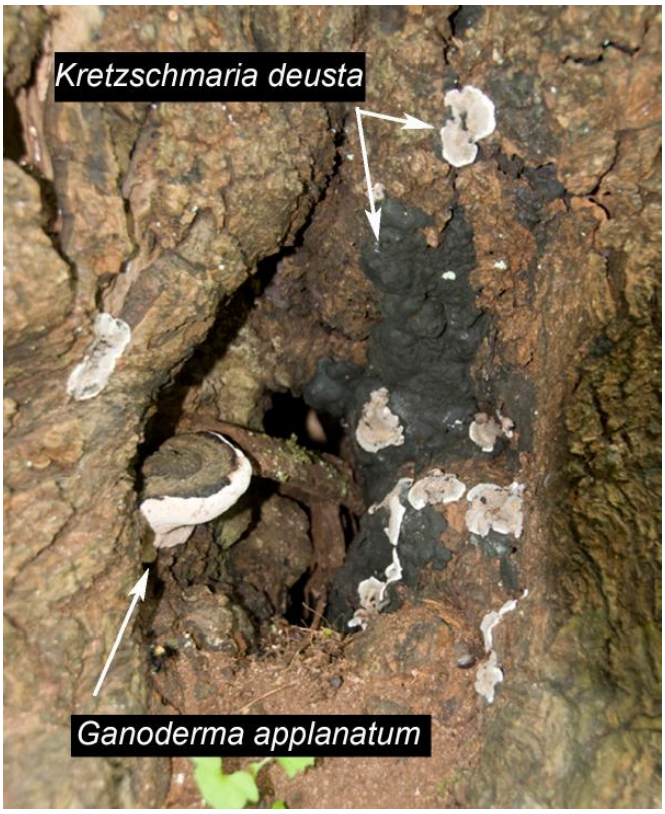
Ganoderma decays dead wood but can enter live trees through wound areas, and may cause extensive decay. There is no control for *Ganoderma applanatum.* Infected trees may decline slowly, and if in good health, some species may be able to wall off and contain the decay pockets for many years. Oaks generally appear to be better able to compartmentalise an infection than the maples. On western hemlock decay is likely to be present for about 3 metres above and below a fruiting body.

Risk assessment and management implications

Examine age, overall health, and growth rate of tree and conk. It may be necessary to perform a Level 3 Advanced Risk Assessment to map the extent of the decay using sonic tomography and resistance drilling. The presence of multiple conks may be enough justification for removal of the tree.

Ganoderma applanatum

Ganoderma applanatum on Douglas-fir. Multiple conks suggests extensive internal decay of trunk.



Ganoderma applanatum on Bigleaf maple in conjunction with *Kretzschmaria deusta*. Expect to see extensive internal decay.

Ganoderma applanatum on Purple leaf plum that is over 100 years old. This is an old conk that is no longer active. Tests suggested that the decay is reasonably well contained at the site of the conk.

Ganoderma applanatum on Horse chestnut. This is a young, active conk in its first year of growth.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Heterobasidion occidentale* (formerly *H annosum*)										
Typical Host tree in the Pacific Northwest Region	Found on a wide range of conifers and deciduous trees										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood	✔	Dead wood		Both						
Typical location of decay	Root rot	✔	Butt rot	✔	Sap rot		Heart rot				

Comments:
Considered to be the most economically damaging pathogen of trees in North America, Heterobasidion root rot is distributed by windborne spores over long distances (many miles / km). It can also spread by root grafting. The fruiting body is leathery, and appears on the underside of roots, the root flare, or downed logs. It is typically dark brown on the upper side and white underneath, although it may also be seen as a white mass covering root or trunk areas.

Early stages of infection cause a staining of the wood. Advanced decay produces a white stringy, spongy wood and eventually a hollow tree with few if any structuarlly sound roots. Trees can be infected for many years before any above ground symptoms develop, by which time there will be extensive root decay in the roots and root collar area. The decay will be faster in the stem than the roots. The roots may also graft and gain support from adjacent healthy trees. Trees in decline typically show sparse chlorotic foliage and reduced needle or leaf growth. Failure at the base of the tree, or by windthrow are typical.

Risk assessment and management implications
Infected trees will have extensive root rot and possibly butt rot as well. If trees are removed the cut stump can be treated with a borax solution, which changes the wood chemistry and prevents new infection. If the stump is already infected borax makes no difference.

Heterobasidion occidentale conks on the underside of a downed log

Heterobasidion occidentale

Heterobasidion occidentale conks on western hemlock

Advanced decay leaving white stringy, spongy wood.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Inonotus dryadeus*										
Typical Host tree in the Pacific Northwest Region	Oaks, Bigleaf maple										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood	✔	Dead wood		Both						
Typical location of decay	Root rot	✔	Butt rot	✔	Sap rot		Heart rot				

Comments:

Considered to be an aggressive pathogen, the above ground fruiting bodies only occur once decay is extensive. On oaks, the conks are typically seen at the base of the trunk or just below the root flare at or just below the soil surface. Conks are fleshy, with a velvety upper surface, varying from creamy, to yellow, often with pronounced brown orange ooze forming droplest over the surface. Size can be up to a foot (30 cm) across. Conks may overwinter and can last several years.

If testing for decay, focus on the lower root crown and structural roots. There may be no evidence of decay at the base of the trunk, but extensive decay in the structural roots nearby. If a root excavation is undertaken expect to find the decay on the underside of roots.

Risk assessment and management implications

The presence of conks is considered a clear indicator of extensive decay in the structural roots. Most of the literature suggests removal of infected trees. If retention is desirable, undertake an extensive root investigation and test thoroughly before deciding to retain the tree.

Inonotus dryadeus on Garry Oak

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Kretzschmaria deusta*										
Typical Host tree in the Pacific Northwest Region	Deciduous trees, especially bigleaf maple										
Form of fruiting body	Perennial	✔	Annual		Polypore		Gilled				
Type of decay	White rot		Brown rot		Soft rot	✔					
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot	✔	Butt rot	✔	Sap rot	✔	Heart rot				

Comments:
Inconspicuous fruiting bodies may be hidden by bark, or be below the soil line. Young fruiting bodies appear as a white to grey patch, while the older fruiting bodies are seen as crusty black nodules or patches resembling charcoal, that crumble when touched. Infection occurs by spores colonising wounds resulting from mechanical injury, fire, and in some species, by root contact. Decay occurs as a centralised column in roots and trunks. In its early stages the physiological function of the roots is not affected and no external signs will be visible. Because the pathogen destroys cellulose preferentially, seemingly healthy trees can fail with a brittle fracture pattern in structural roots or at the base of the trunk.

Risk assessment and management implications
Infected trees should be inspected very carefully. Note that sonic tomography may not detect decayed areas due to the way in which the decay works at a cellular level.

Fruiting bodies of *Kretzschmaria deusta*

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Laricifomes officinalis* (*Fomitopsis officinalis*)										
Typical Host tree in the Pacific Northwest Region	western larch, amabilis and grand fir,Engelmann and Sitka spruce, lodegpole, ponderosa, western white pine, Douglas-fir, western hemlock.										
Form of fruiting body	Perennial	✔	Annual		Polypore		Gilled				
Type of decay	White rot		Brown rot	✔	Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot		Butt rot		Sap rot		Heart rot	✔			

Comments:
Found in old growth forests. Common name is agarikon or quinine conk, it is considered to be one of, if not the longest living fungus in the world. It has widespread medicinal properties recognised over many centuries. The conks are often very old, and can be large hoof shaped to long pendulous structures up to two feet long. The upper surface is ribbed, white when fresh changing to dark grey or light brown in older conks, it may have a chalky powder when touched. The lower surface is white when fresh and poroid. The decay is brown, cubical with fleshy white mycelial felts in the cracked wood.

Risk assessment and management implications

The presence of the conk indicates very extensive decay and a high likelihood of failure. Trees with a high use target zone may need to be removed, or the target zone closed off. If the site permits, retain the trees as significant wildlife tree habitat.

Agarikon. *Laricifomes officinalis.*

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Laetiporus conifericola* - conifers / *Laetiporous gilbertsonii* - hardwoods											
Typical Host tree in the Pacific Northwest Region	*L conifericola* is seen on western hemlock, Engelmann, white and Sitka spruce,true firs, larch, spruce, ponderosa and western white pine, Douglas-fir, and western redcedar. *L gilbertsonii* is found on maples, oaks, cherry, horse chestnut, willow.											
Form of fruiting body	Perennial		Annual	✔	Polypore		Gilled					
Type of decay	White rot		Brown rot	✔	Soft rot							
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.												
Typically attacks:	Live wood		Dead wood		Both							
Typical location of decay	Root rot		Butt rot		Sap rot		Heart rot	✔				

Comments:
A fleshy, leathery conk, seen as one or more layered bracket-like structures, usually on the main stem. Size can reach almost three feet (1 metre) across. The upper surface is orange yellow, with white to pink edges. The lower surface is yellow. Older conks turn white, become brittle, and smell strongly of sulphur. The conks seldom develop on live conifers, but are seen on live deciduous trees. The incipient stage of decay is a a light brown stain. Advanced stage of decay forms a classic brown cubical rot with white sheets of mycelium in the shrinkage cracks of the decayed wood. Entry is through wounds and dead branch stubs.

The conks typically appear only after the fungus is well established and decay is advanced. Heartrot is common in the butt log part of the tree stem, but can be found higher up in branches, as well as in larger roots.

The conk is considered edible when young, hence its name 'chicken of the woods.'

Risk assessment and management implications

Presence of the conks indicates extensive decay. Investigate above, below, and beyond conks to map extent of decay column.

Sulphur fungus *Laetiporous gilbertsonii.*

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Neofusicoccum arbuti*										
Typical Host tree in the Pacific Northwest Region	*Arbutus menziesii*										
Form of fruiting body	Perennial		Annual		Polypore		Gilled				
Type of decay	White rot		Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood	✔	Dead wood		Both						
Typical location of decay	Root rot		Butt rot		Sap rot		Heart rot				

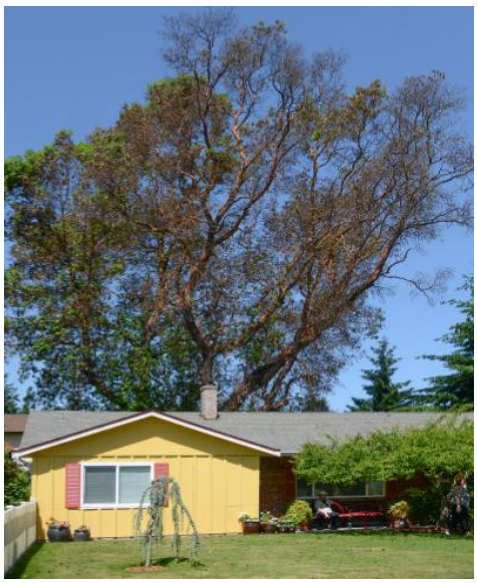
Comments:

The disease is widespread in the Pacific Northwest region where it primarily affects Arbutus. Elsewhere it has a wide range of host plants. It invades through heat-injured bark due to strong sunlight, or wounds resulting from pruning or other mechanical disruptions of the bark. In the early stages of infection look for areas of foliage and shoots dying back. These spread to become localised areas of crown dieback that spread outwards to cause entire sections of the crown to die. In its advanced stages the canker will be seen as as extensive areas of blackened necrotic tissue, or individual cankers. These can be rough and raised up, or sunken with a pronounced ridge of active callus around the margins. Dead branches and twigs can persist on the tree for several years after death, but do eventually fall off. Arbutus is susceptible to other diseases which may be acting in conjunction with the canker. Root rot caused by *Phytophthora cactorum* can cause whole tree failure.

The disease may be endemic in some areas and only develops when the tree is stressed by drought, or watgerlogged soils.

Risk assessment and management implications

Where target values are high consider pruning out dead wood, with cuts about 12 inches (30 cm) below the infected area.



Crown dieback on mature arbutus.

Cankers on arbutus stems.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Phaeolus schweinitizii*										
Typical Host tree in the Pacific Northwest Region	Subalpine and amabilis fir, western larch, tamarack, Sitka and white spruce, lodge-pole, ponderosa, and western white pine, Douglas-fir, western redcedar (rare), western hemlock, Garry oak.										
Form of fruiting body	Perennial		Annual	✔	Polypore	✔	Gilled				
Type of decay	White rot		Brown rot	✔	Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot	✔	Butt rot	✔	Sap rot		Heart rot				

Comments:

The early stage fruiting body is leathery with a light brown, yellowish appearance. On the ground the conk has a small stem. On the trunk it is a shelf-like structure. Later on, the conks turn dark brown and become brittle. The top has concentric rings and is velvety in texture, hence its common name 'velvet top fungus.' Conks can persist in dead wood for many years.

Conks on the ground, several feet from the base, or at the base of the trunk indicate root rot rather than butt rot. Conks higher up the trunk indicate extensive butt rot. The disease is parasitic on live wood and saprobic on dead wood. It produces a pronounced column of decay. There are few early indicators of infection, although thinning crowns, poor shoot elongation, and some crown dieback may occur. Spreads by windborne spores. Root to root infection can occur but is rare. Infects trees through wounds, fire scars or armillaria lesions, but can also enter from the soil through root tips. Primarily found on mature trees.

Common in Douglas-fir more than 75 years old, decay will typically be in the first 10 ft (3m) of the butt log. Decay can spread rapidly causing loss of heartwood, loss of strength and a high susceptibility to stem breakage in windy conditions. On old growth trees the likelihood of trunk failure will be high, especially in windy conditions. The stress of the disease may render the tree susceptible to Douglas-fir bark beetle and armillaria as secondary problems.

Risk assessment and management implications

If there are valuable targets or, the target zone is frequently occupied, it may be prudent to remove the tree. If the site conditions allow it, consider converting tall trees into wildlife snags as the heartwood decay provides excellent nesting habitat.

Phaeolus schweinitzii

Young conk at base of Douglas-fir tree.

Old conk on stump.

Butt rot on Douglas-fir.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Phellinus hartigii*										
Typical Host tree in the Pacific Northwest Region	western and mountain hemlock, Sitka spruce, amabilis and subalpine fir, Douglas-fir. Yew in Oregon.										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot		Butt rot	✔	Sap rot	✔	Heart rot	✔			

Comments:
A greyish brown hoof-shaped conk on trunks, yellow brown and resupinate on the underside of branches and branch stubs. Conk shape can be very variable. Poroid surface. Often seen in association with wounds, dead branches, and mistletoe infections. Decay may be localised by the original infection point, but spreads approximately 3 feet (1 metre) above and below the conk. Decay is sometimes seen as an area of saprot moving inwards.

Considered to be an aggressive pathogen, infected trees are prone to trunks snapping.

Risk assessment and management implications

Presence of the fruiting body is a strong indicator of extensive internal decay and strength loss in the adjacent wood.

Phellinus hartigii on western hemlock

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Phellinus sulphurascens* (formerly *Phellinus weirii*)										
Typical Host tree in the Pacific Northwest Region	Douglas-fir, grand, amabilis, subalpine fir, Sitka and Engelmann spruce, western larch, western hemlock, lodgepole, ponderosa, western white pine. Western redcedar is considered to be resistant (but not immune). Deciduous trees are immune.										
Form of fruiting body	Perennial		Annual	✔	Polypore	✔	Gilled				
Type of decay	White rot		Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood	✔	Dead wood		Both						
Typical location of decay	Root rot	✔	Butt rot	✔	Sap rot		Heart rot				

Comments:
A root rot that extends up into the lower butt log of infected trees. Early signs of infection include reduced height and crown growth. By the time the crown foliage is sparse and yellowing the entire root system is extensively decayed. A heavy stress-induced cone crop may alse be noted. The bark at the base of the trunk may be darkened, and have a water stained appearance shortly before the tree dies. In forested areas infected trees may be found as a disease centre with a large group of infected trees, or they may be individuals scattered throughout the area.

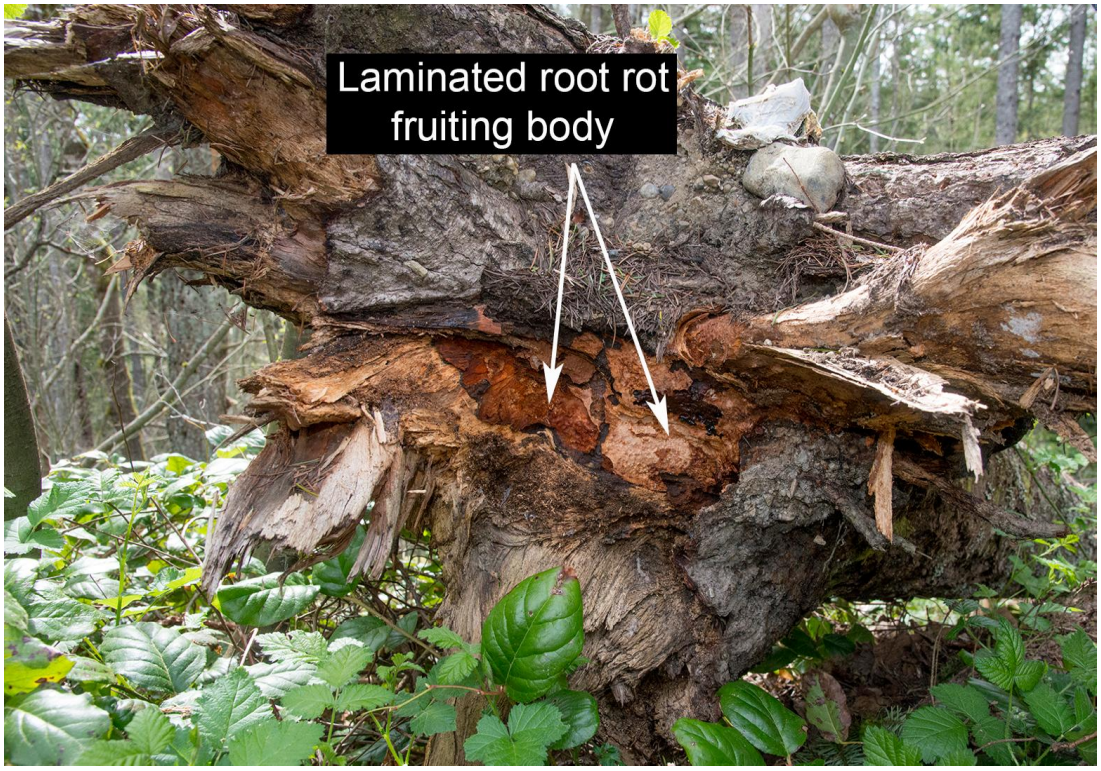
The fruiting body, which may last several years, is a buff colour when young, turning dark brown with age. It is not often seen as it grows on the underside of roots and decayed wood. There may be white to light brown ectotrophic mycelium on or in the bark close to the root collar. This may be found in conjunction with a brown crust-like mycelial growth at the root collar or on the roots, that resembles blistering paint. In its advanced stage, the wood causes annual rings to separate leaving sheets of soft wood. The disease spreads by root contact and can remain viable in stumps and roots for several decades. A simple test is to peel away a small piece of bark on a root and look for the telltale red or red/brown setal hyphae resembling fine hair or fur right under the bark. The pathogen decays the roots first of all so the presence of decay in the butt log implies that few roots remain.

On redcedar, the conk is perennial and mainly causes butt rot. Cedars are seldom killed by the disease, but extensive butt rot may lead to stem breakage.

Risk assessment and management implications
Trees infected with the Douglas-fir form will have few if any viable structural roots, and are very susceptible to windthrow. Some literature suggests any trees within 50 feet of an infected tree may be compromised. Management can include removal of infected trees, thin out trees around infected pockets of disease, remove stumps and turn them over to expose roots, replant with different species such as redcedar, western white pine or hardwoods.

Typical windthrown tree, with all of the structural roots decayed.

Phellinus sulphurascens



The fungal fruiting body on the underside of a windthrown stump.

Stand of Douglas-fir showing typical disease centre of trees infected with laminated root rot.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Phellinus tremulae.*										
Typical Host tree in the Pacific Northwest Region	Aspen trees.										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both						
Typical location of decay	Root rot		Butt rot		Sap rot		Heart rot	✔			

Comments:

Hard, woody, hoof-shaped conk located at branch stubs. Can also occur as a punk or blind knot form. The top surface is typically black, sometimes with a cracked surface appearance, the underside is light gray, white or light yellow. Causes extensive heart rot, and infected trees with advanced decay are prone to stem failure in wind. Decay can continue once the tree has fallen down, but ceases if the wood is milled. Younger trees are less susceptible, but older trees may have extensive heartrot columns. Spreads via spores on wounds and branch stubs.

Risk assessment and management implications

The presence of a conk indicates a high failure potential. In areas with a mix of age classess, consider removing the older trees and allowing the younger ones to develop. If the land use allows it, retain taller stumps as wildlife habitat.

Phellinus tremulae on aspen.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Pleurotus ostreatus*										
Typical Host tree in the Pacific Northwest Region	Hardwoods, limited on conifers										
Form of fruiting body	Perennial		Annual	✔	Polypore		Gilled	✔			
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood	✔	Both						
Typical location of decay	Root rot		Butt rot		Sap rot	✔	Heart rot	✔			

Comments:

Commonly found on dead wood and seldom on live wood. It may be found on trees dying from other causes. The extent of decay associated with the mushroom clusters can be very variable. It may be a localised pocket of decay, or an more extensive column.

Risk assessment and management implications

The fruiting bodies indicate dead wood. If the rest of the tree is live, examine area affected and determine extent of decay if it affects the structural integrity of the tree or component parts.

P ostreatus on Maple.

P ostreatus on Mountain ash.

P ostreatus on dead red alder. Black arrows are *Fomes fomentarius*.

Common Fungi Affecting Pacific Northwest Trees

Latin name	*Porodaedalea pini* (formerly *Phellinus pini*)										
Typical Host tree in the Pacific Northwest Region	Amabilis, grand, subalpine fir, western larch, Engelmann and Sitka spruce, jack, lodgepole, ponderosa and western white pine, Douglas-fir, western redcedar, yellow cedar, western and mountain hemlock, juniper, and yew.										
Form of fruiting body	Perennial	✔	Annual		Polypore	✔	Gilled				
Type of decay	White rot	✔	Brown rot		Soft rot						
White rot - preferential loss of lignin, some break down lignin & cellulose. Brown rot - preferential loss of cellulose. Soft rot - breaks down cellulose.											
Typically attacks:	Live wood		Dead wood		Both	✔					
Typical location of decay	Root rot		Butt rot	✔	Sap rot	✔	Heart rot	✔			

Comments:
Woody conk, light to dark brown, plate to hoof-shaped bracket around 3" (7.5 cm), but can be spread over the underside of branches. Upper surface is red / brown to black, zoned with a well defined margin. Lower surface is a lighter yellow / brown colour and poroid with irregular pores. Isolated conks are often seen on trunks with limited decay pockets beyond, but this is very species specific. In Engelmann spruce, lodgepole pine, and subalpine fir, expect to find extensive decay columns. The presence of multiple conks suggests a more extensive column of decay and should be investigated in more detail. Conks have been known to occur on large structural roots. An alternate form is the punk knot, which is a swollen or sunken resinous knot that has not fully calloused over. The pathogen is parasitic on live conifers and saprobic on dead wood.

Decay is initiated by spores entering through branch stubs. Decay can move from heartwood into sapwood and may kill the tree. The incipient stage of decay is a red stain in the heartwood, often forming a well defined ring, hence the common name of "red ring rot." Advanced decay forms spindle-shaped area of white running parallel to the wood grain commonly termed "white pocket rot, white pitted rot, or white speck rot." Darker zone lines may be present. The early incipient stage does not seriously reduce wood strength. It is considered to be one of the most destructive heartwood decays in North American conifers.

Risk assessment and management implications

Examine the tree carefully to determine the number and location of the conks. In the early stages of infection expect to see pockets of decay behind each conk. In its advanced stage, there may be more extensive columns of decay and significant loss of wood strength. Trees with extensive heart rot are considered to have a high likelihood of failure. This pathogen is most common on older trees.

Large old growth trees infected with Porodaedalea pini provide an excellent source of habitat as wildlife trees, and if possible, based on analysis of the target zone and landscape uses, they should be retained in that capacity.

Porodaedalea pini

Porodaedalea pini on Douglas-fir

Porodaedalea pini on Sitka spruce