Trees play an important aesthetic and biological role in our environment. Trees such as Douglas-fir can suffer from a wide variety of native and introduced pests. This guide is intended to help non-specialists recognize common ailments of Interior Douglas-fir and diagnose the likely cause. Using this guide, you may be able to determine an appropriate treatment for your tree or better describe the problem to a tree care professional.
Insects and disease can afflict all portions of the interior Douglas-fir: needles, bark, wood, and roots.

Where’s the Problem?

Foliage or branches affected:
- Foliage discoloured or absent. Frass or webbing present...see defoliating insects
- Branches swollen with prolific production of shoots and foliage...see dwarf mistletoes
- Foliage discoloured or mottled. Small bumps or blisters on leaf surface...see foliar problems
- Foliage covered with small, cottony tufts...see foliar problems/adelgids

Whole tree affected (declining):
- Mature tree
  - Crown discoloured bright yellow, red, or brown...see bark beetles
- Tree any age
  - Gradual thinning of crown and yellowing foliage...see root diseases

Main stem:
- Conks (bracket fungi) visible on stem...see wood decay fungi

Insects that feed on needles are called defoliators. Caterpillars, the pre-adult form of butterflies and moths, are common defoliators.

Dwarf mistletoes produce conspicuous swellings of branches and growth of aerial shoots.

Symptoms of foliar problems are chlorosis or discoloration, bleaching, shrivelling, twisting, or dropping of needles.

Bark beetles are some of the most damaging forest insect pests. They attack trees by boring into the inner bark and laying eggs.

Root diseases are caused by a group of fungi. Over several years, infected trees will weaken as the root system deteriorates.

Wood decay fungi survive on the woody tissue of trees and cause decay in the heartwood and sapwood.

Abiotic problems are caused by the elements and may damage or kill trees.
Defoliating insects

Defoliators are insects that feed on the needles or leaves of trees. Caterpillars, the pre-adult or larval form of butterflies and moths, are common foliage-eating pests of conifers, including Douglas-fir. Symptoms of damage include discoloration or loss of foliage (in general, from the top of the tree downward and from branch tips inward); chewed needles on the tree or ground; silken webbing; frass (insect droppings) accumulations under the tree; and abundant caterpillars, pupae, pupal cases, or adult moths.

Spruce budworm

Spruce budworm is a serious pest of Douglas-fir forests in the interior of British Columbia. The full-grown larvae have hairless, reddish to olive-brown bodies and each body segment has four distinct light-coloured spots. Young larvae mine needles and buds, and feed on new foliage. Mature larvae may feed on older foliage.

The rusty tussock moth caterpillar looks very similar to the Douglas-fir tussock moth caterpillar; however, the nodes from which the tufts arise are orange instead of red. The four brushes on its back are golden. This caterpillar also feeds on many other tree species including deciduous trees.

Dwarf mistletoe

Dwarf mistletoes are plants that parasitize a living host tree, robbing it of nutrients and water. This pest infects trees of any age but is quite host-specific, preferring only a few species. Douglas-fir dwarf mistletoe primarily affects Interior Douglas-fir.

Dwarf mistletoe spreads via seeds that are ejected from their pods in the fall. These seeds land on adjacent Douglas-fir foliage and germinate, penetrating through the bark. After 2–3 years, the branch swells around the point of infection, and aerial shoots containing flowers are produced.

While mainly an aesthetic problem, if enough dwarf mistletoe brooms occur on a tree they will drain sufficient nutrients to reduce tree vigour and growth, leaving the tree susceptible to attack by other pests. Large overhead brooms may also break off in high winds, posing a safety hazard.
Foliar problems

Foliar diseases are most noticeable the year after infection occurs, particularly if the previous spring was wet with mild temperatures. A foliar disease, such as Douglas-fir needle blight, produces small, dark spots on one-year-old needles. These are clearly visible in the spring, just before the affected needles drop. Most foliar diseases do not warrant treatment, as they will persist only for a year or two. Trees will suffer only if they lose foliage over several consecutive years or if new foliage is repeatedly infected. In these cases, you may consider applying a fungicide to reduce the frequency or severity of infection.

The Cooley spruce gall adelgid, an aphid-like insect, alternates between two hosts, Douglas-fir and spruce. It is named for the cone-like galls or swellings it causes on the branches of spruce trees. This insect is extremely small — the adults are approximately 0.1 cm long. Adults, which are completely covered with a white, waxy “wool”, appear as white tufts on the underside of needles, on new shoots, and on developing cones.

Attacked needles may be yellow or mottled and twisted, and may drop prematurely. Light infestations are common, yet not seriously damaging. Damage is usually less conspicuous on older trees. Small trees stressed by environmental conditions are often more heavily infested.

Bark beetles

Bark beetles generally attack large, mature trees. The Douglas-fir beetle prefers felled trees, slash, stumps, and windfall as well as trees that have been damaged or stressed by factors such as the urban environment, defoliators, or root disease.

Adult Douglas-fir beetles are small, 4–7 mm, cylindrical, and usually brown or black. They bore into the bark of trees and lay eggs in galleries tunnelled under the bark. Larvae hatching from the eggs feed on the inner bark. Adults may also introduce a fungus, which, along with larval feeding, usually kills the tree.

The foliage of an attacked tree usually changes from green to pale yellow-green to red by the spring of the year following the initial attack, before dropping.
Root diseases

Root diseases are a group of fungi that attack healthy tree roots, interrupting the flow of water or nutrients to the crown, causing a decline in tree vigour. Usually, young trees die more quickly than older ones. Living infected trees may blow over because their root systems are structurally weakened. Root diseases spread primarily by contact between infected roots and neighbouring uninfected roots. Depending on the root disease, the roots of dead trees and stumps may remain infectious for many years.

Infected trees may show one or more of these symptoms: yellowing or thinning foliage; gradual shortening of leader growth (“rounding” of the crown); or a heavy crop of small cones. Infected trees that are wind-thrown usually have small root balls with few remaining fine roots. Additional signs and symptoms are specific to the root disease.

**Armillaria root disease**, caused by *Armillaria ostoyae*, may produce minor to copious resin flow (pitching) at the base of an infected tree. Whitish, fan-like fungal mycelia will be found between the bark and wood. Honey-coloured mushrooms may appear at the base of infected trees in the fall. Extended decay produces a stringy type of white rot. This disease is common in the interior.

**Prolonged decay by laminated root rot**, caused by *Phellinus weirii*, creates small pits in the wood. Eventually this decaying wood separates into sheets along the annual growth rings. Red-brown mats of hair-like fungal mycelia may be found between sheets of decayed wood. This fungus rarely produces fruiting bodies.

**Blackstain root disease**, caused by *Leptographium wageneri*, is a vascular wilt. This means it causes little degradation of the roots, but instead kills by interrupting the flow of water within the tree. The fungus produces a brown to black stain, which can be identified by cutting into the last few years of wood growth. This fungus is transferred to host trees mainly by root beetles, less often directly from root to root. It does not produce a visible fruiting body.
Wood decay fungi

A group of fungi called bracket (or conk) fungi cause decay of tree wood. These fungi survive by breaking down the components of wood tissue and absorbing the resulting nutrients. Decay fungi may enter trees through wounds, broken or dead branches, or roots.

Decays are generally split into two groups: brown rots and white rots. Brown rots darkly stain the wood, which eventually degrades into a brittle, cube-like structure. White rots cause lighter staining and the wood becomes pitted or mottled, eventually degrading into a stringy structure or separating along annual rings into sheets.

Decay fungi normally progress slowly. The presence of conks usually indicates that wood decay is well advanced—the tree is probably structurally unsound and subject to breakage.

If a conk is not present, a suspect tree may be drilled to see if the stem wood is still sound. These drill holes can be capped with putty or silicone to prevent insects or fungal spores from entering.

An example of a common wood decay fungus is *Fomitopsis pinicola*. It produces a brown crumbly rot that is not usually evident until the tree falls. The only external indicator is the fruiting body.

Insects such as wood borers, carpenter ants, and dampwood termites are often associated with decaying wood.

Abiotic problems

Douglas-fir, depending on seasonal weather patterns, can suffer from sunscald, drought, or frost. Drought is difficult to recognize because the effects may not appear until the following year—far too late for corrective action.

Drought-stressed trees will usually drop all or a portion of their foliage the spring following a dry summer, often with little colour change. Mortality of the top of the tree or the whole tree can occur. This will be more common in areas where Douglas-fir is a marginal species. Juvenile trees and those growing on rocky or porous soils will suffer the most.

Tree foliage and bark protected from the direct rays of the sun may become damaged by sunscald if exposed abruptly. Foliage may become scorched and drop prematurely but will usually recover. Bark, usually on the southwest side of the main stem, may be damaged after thinning or pruning if the heat of direct sun damages or kills the cambium underneath. Damaged areas will usually appear copper to bright red, marking the extent of the damage. This colour fades gradually and will be distinguished by the flattened appearance of the stem as the tree.
grows around the wound. In some cases the bark may fall off altogether. Most times the tree will recover.

**Frost damage** typically occurs in the spring when low temperatures freeze the sensitive tissues of newly flushed buds. Late-season frosts more uniformly affect the entire tree, causing needles and small twigs to die. Unless frost damage is severe, older trees should survive but may become deformed if the leader is killed repeatedly. Frost may kill young trees outright.

**How Can I Control These Pests?**

These general guidelines will show you how to control pest infestations. Consult a specialist before using any insecticide.

Douglas-fir trees, though fairly tolerant to **defoliating insects**, may be killed if attacked year after year. In these cases, apply an approved insecticide, especially to preserve special or high-value trees.

**Dwarf mistletoe** brooms and branch infections should be pruned. This will reduce stress on the tree and reduce future infections.

Damage caused by **adelgids** will rarely need to be treated because it is usually not significant except on seedlings or small saplings. Insecticides registered and recommended for aphids are usually effective if applied when the adelgid is first noticed.

Trees attacked by **Douglas-fir beetles** rarely survive. Cut down infested trees as soon as possible and burn the bark to kill any living beetles and to prevent the spread of these insects to nearby susceptible trees.

**Carpenter ants** may be a nuisance as well as cause serious structural damage to wood construction. Because dead and down trees, waste wood, and firewood are likely to harbour ant colonies, clear these materials away from buildings.

When **bracket fungi**, or **conks**, appear on the tree, it usually indicates well-advanced decay. The wood will have deteriorated to the point where the tree may be structurally unsound, allowing the stem to break. Remove such trees, as they can pose a safety hazard.

Few options are available to treat trees afflicted with **root disease**. Remove any infected dead or obviously weakened trees from the area, as they will pose a hazard to humans and property. Ideally, also remove infected stumps because they can harbour the fungi for many years and will spread the disease to newly planted Douglas-fir or other susceptible neighbours. If stump removal is not possible, use the following table to restrict your choice of future plantings near infected stumps.

<table>
<thead>
<tr>
<th>If tree dies from:</th>
<th>Do not replace with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armillaria ostoyae</td>
<td>Douglas-fir, true firs, spruce, cedar, hemlock, pine</td>
</tr>
<tr>
<td>Phellinus weirii</td>
<td>Douglas-fir, true firs, hemlock</td>
</tr>
<tr>
<td>Leptographium</td>
<td>No restriction</td>
</tr>
</tbody>
</table>
For further information, please contact:

Ministry of Forests
Forest Health

Nelson Forest Region,
518 Lake Street,
Nelson, B.C. V1L 4C6
(250) 354-6200

Kamloops Forest Region,
515 Columbia Street,
Kamloops, B.C. V2C 2T7
(250) 828-4131

Cariboo Forest Region
200-640 Borland Street
Williams Lake, B.C. V2G 4T1
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Or via Enquiry BC:
• In Vancouver – 660-2421
• In Victoria – 387-6121
• Elsewhere in B.C. – 1-800-663-7867

Internet contact:

Ministry of Forests – www.for.gov.bc.ca
Canadian Forest Service –
www.pfc.cfs.nrcan.gc.ca
Insect Diagnostics –
www.forestry.ubc.ca/fetch21/FRST308/labindex.html
Brochure URL Address –
www.for.gov.bc.ca/hfd/pubs/docs/sil/sil471.htm

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