

ASSESSING POST-FIRE SURVIVABILITY OF TREES

Extensive research on the fate of fire damaged trees provides guidance for assessing survival based on post-fire observations of crown scorch, bark char, and root damage. Vulnerability to fire damage depends on tree species and size. Larger trees with thicker bark and larger amounts of foliage can generally withstand more damage than smaller trees.

Thick-barked species including Douglas-fir, ponderosa pine, western larch, and incense cedar are resistant to fire damage. High levels of crown injury are typically required to kill thick-bark trees. Thin barked species such as western hemlock, western redcedar, spruce, and lodgepole pine are easily killed by fire, even with little crown damage.

It may take several years for trees to die from fire-related injury. Trees that survive direct injuries from fire often have increased vulnerability to secondary factors including insects and drought stress.

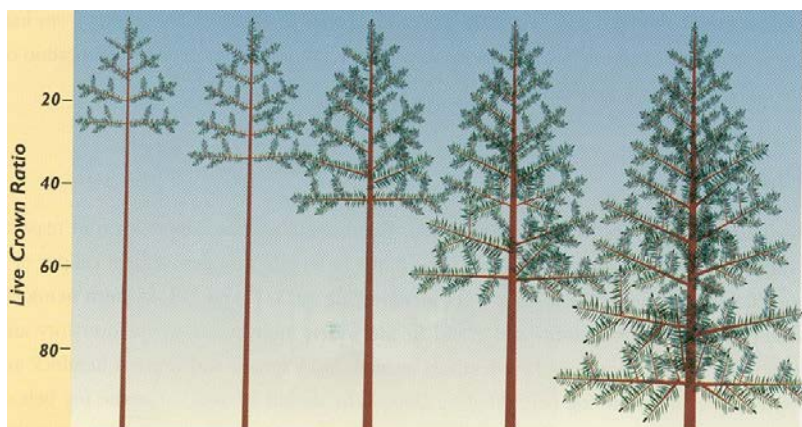
A general assessment to categorize damage across the range from light to heavy can help simplify the assessment. It is easy to judge the fate of trees on either the heavy or light end of the fire severity spectrum. The cases in the moderate damage category are less predictable.

Fire injury categories

| | Heavy – Severe | Moderate – Significant | Light – Minor |
|-------------------------|---|--|---|
| | Trees very likely to die | Trees may die, less predictable, more careful assessment, or “time will tell” | Trees not likely to die |
| Crown | Little or no live crown remaining | Varying levels of crown scorch | Most of the crown intact |
| Bole | Deep char | Varying levels of bole char | Very little bole char |
| Base, Root crown | Deep basal char; all 4 quarters - total circumference | Varying levels of basal char; 2-4 quarters | Very little basal char, 1 quarter or less |

For in-depth guidance on assessing fire damaged conifers, refer to *Post Fire Assessment of Tree Status and Marking Guidelines for Conifers in Oregon and Washington*, Hood et al 2020.

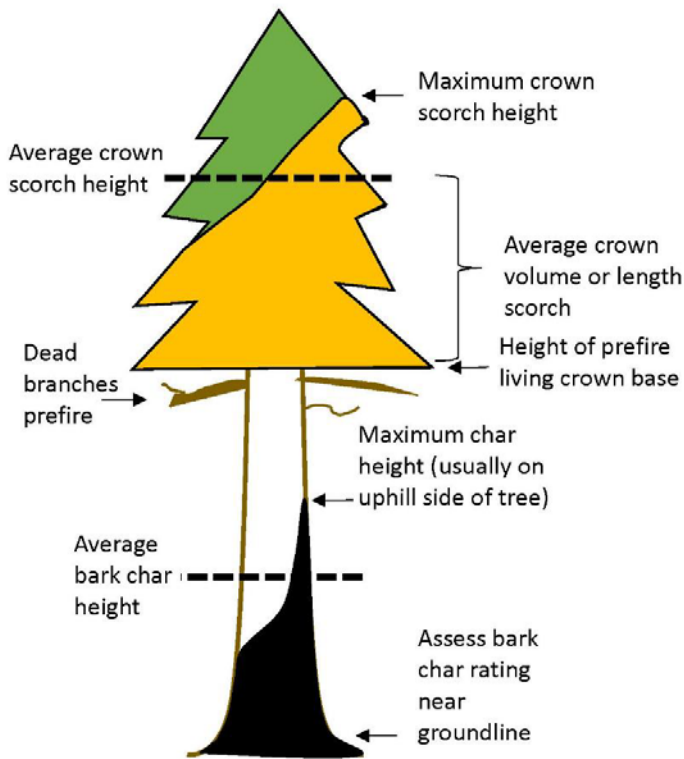
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Live crown ratio

Regardless of fire injury, the vigor and survivability of trees is related to the amount of live crown or crown ratio, expressed as a percentage of the total tree height. When considering survivability of trees, especially if they are to be left more exposed after removing their neighbors, it is best to have at least a 35% crown ratio.

Figure 1: Live crown ration - a simple index of tree vigor.



Crown injury rating

When assessing fire damage, injury to the live crown is the first and most important consideration.

Crown scorch

An estimate of how much of pre-fire crown was killed. It is expressed as a percentage of pre-fire live crown that is damaged.

Assessing damage based on bark char

This involves examination of the bole, base, & roots. Bark char on thin-bark species is a reliable indicator of cambium death, but is not as reliable on species with thick bark. Cambium is the living tissue under the bark.

Figure 2: Example of how to assess crown scorch and bark char.

Guide for assessing damage based on bark char

| Heavy - Severe | Moderate - Significant | Light - Minor |
|---|--|---|
| Bark burned into, not necessarily to the wood; species bark characteristics are lost; bark smoothed, all ridges are gone. | Bark is uniformly black except some inner fissures; species bark characteristics still discernable . | Bark is not completely blackened; species bark characteristics obvious; edges of bark plates charred. |
| Considerable or deep duff and woody debris consumption around base. | Some organic matter consumed in the burned area. | Little duff or organic matter consumed. |
| Many roots exposed and charred due to combustion of organic matter. | Some roots may be exposed and charred. | Roots not exposed or charred. |

Tolerance for risk - Decisions about whether or not to remove injured trees depend upon your tolerance for risk. You may have a low tolerance for risk where it is important to avoid leaving trees that may die (for example where damaged trees could threaten safety or property). You may have a higher tolerance for risk of tree death in forest settings where your goal is to save any trees that may live.

Longer-term outlook - Damaged trees that do survive may recover their strength and have a long life ahead. But fire scars may allow wood decay to enter the main stem and increase risk of breakage over time. Trees must regain vigor enough to grow new wood around fire scars and keep up with wood rot. Also, fire scarred trees with partial decay make good wildlife trees.

See the Tree Assessment Criteria below for major conifer species in Oregon and Washington. For further assistance with assessment of fire injury on your trees, contact your local offices for OSU Extension and Oregon Department of Forestry.

Tree Assessment Criteria - The tree is likely to die (>50% chance) if damage exceeds the criteria for either crown scorch or bark char. From: *Post Fire Assessment of Tree Status and Marking Guidelines for Conifers in Oregon and Washington*, Hood et al 2020.

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd814664.pdf

| Species | Criteria | Diameter Class | | |
|----------------------------|--------------|--|---|--------------------|
| | | 5 – 11.9” | 12 – 20.9” | 21”+ |
| ABAM: Pacific silver fir | Crown scorch | > 30% volume | | > 40% volume |
| | Bark char | ≥ 50% any char | | |
| ABCO: white fir or hybrids | Crown scorch | ≥ 70% volume | | |
| | Bark char | ≥ 75% deep char | | |
| ABGR: grand fir | Crown scorch | ≥ 60% volume | | |
| | Bark char | ≥ 50% any char | ≥ 75% moderate or deep char | |
| ABLA: subalpine fir | Crown scorch | > 30% volume | | > 40% volume |
| | Bark char | > 50% any char | | |
| ABMA: red fir | Crown scorch | ≥ 70% volume | | |
| | Bark char | > 75% deep char | | |
| CADE: Incense cedar | Crown scorch | ≥ 85% volume | | |
| | Bark char | > 75% deep char | | |
| LAOC: Western larch | Crown scorch | If needles on: ≥ 80% crown length If needles off: average char height over entire tree length > 70% | | |
| | Bark char | > 75% deep char | Bole char not a predictive injury indicator | |
| PIEN: Engelmann spruce | Crown scorch | ≥ 75% volume | | |
| | Bark char | > 75% any char | | |
| PISI: Sitka spruce | Crown scorch | ≥ 75% volume | | |
| | Bark char | > 75% any char | | |
| PICO: Lodgepole pine | Crown scorch | ≥ 40% volume | | |
| | Bark char | ≥ 75% any char | | |
| PIAL: Whitebark pine | Crown scorch | ≥ 40% volume | | |
| | Bark char | ≥ 75% any char | | |
| PILA: Sugar pine | Crown scorch | ≥ 70% volume | | |
| | Bark char | > 90% moderate or deep char | | |
| PIMO: Western white pine | Crown scorch | > 30% volume | | |
| | Bark char | ≥ 90% any char | | |
| PIPO: Ponderosa pine | Crown scorch | Pre-bud break (volume): • ≥ 85% needles scorched if < 10% blackened needles OR • > 40% needles scorched if > 10% blackened needles Post-bud break (volume): > 70% crown volume killed (no new growth) | | |
| | Bark char | > 90% deep char | | |
| PSME: Douglas-fir | Crown scorch | > 65% crown volume | | |
| | Bark char | > 50% deep char | > 75% deep char | |
| THPL: Western red cedar | Crown scorch | > 20% crown volume | > 40% crown volume | > 60% crown volume |
| | Bark char | > 50% any char | | > 75% any char |
| TSHE: Western hemlock | Crown scorch | ≥ 20% crown volume | | |
| | Bark char | ≥ 90% any char | | |
| TSME: Mountain hemlock | Crown scorch | ≥ 20% crown volume | | |
| | Bark char | ≥ 90% any char | | |

Note: If a species is host to bark beetles or wood borers and there is boring dust and attack signs that are not RTB around > 50% of the bole circumference, the tree will die regardless of fire injury.

RTB = Red turpentine beetle, a large bark beetle attacking the base of pine species.