Assessing Tree Injury and Insect Activity after Wildfire

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Damage Assessment

- Which trees are unlikely to survive?
- What will happen to the injured or killed trees?

Recommended Actions

- Improve tree vigor and forest health

Major factors influencing fire injury:

Season of wildfire

Before Aug 1← more sensitive ← After Aug 1

Pre-fir tree vigor and site quality

Poor health on poor sites← more sensitive← Good health on good sites

Lots of woody debris near← more sensitive← Little or no debris near

Sensitivity to fire injury varies by tree species and size and vigor

Thin bark ← more sensitive ←Thick bark

young trees, grand fir, Douglas-fir, ponderosa pine

Small buds ← more sensitive ← Large buds

Douglas-fir ponderosa pine

Poor health ← more sensitive ← Good health

Small % live crown

Small recent diameter growth

Dwarf mistletoe infected

How were the trees injured?

Foliage consumption

Needle set

Crown scorch volume

Stem char

Foliage consumption

Needle set

Crown scorch volume

Estimate what percent of the volume of the previously living crown is now scorched.

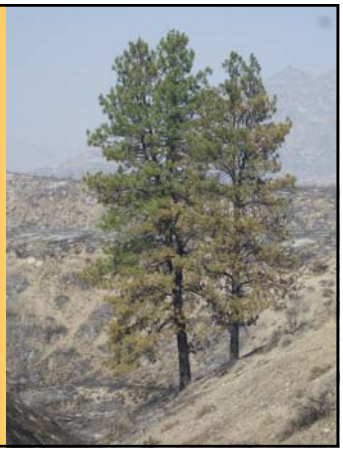
Crown scorch

Top half is ok so 50% is fine.

Bottom half has about 35% damaged and 15% ok.

So tree is about 35% scorched and 65% ok.

Crown scorch volume



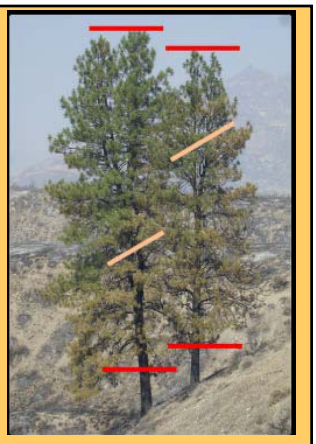
Crown scorch

Left tree:

Top 60-70% is ok so 30-40% is scorched.

Right tree:

About 20-25% fine and 75-80% scorched.



Crown scorch

Table 2: Probability of fire-induced mortality for ponderosa pine.

	CROWN SCORCH VOLUME (PERCENT)									
DBH	10	20	30	40	50	60	70	80	90	100
5	49%	53%	60%	68%	78%	86%	93%	97%	99%	99%
6	42%	46%	53%	62%	72%	83%	90%	95%	98%	99%
7	36%	40%	46%	55%	67%	78%	88%	94%	98%	99%
8	30%	34%	40%	49%	61%	74%	85%	93%	97%	99%
9	25%	28%	34%	43%	55%	69%	82%	91%	96%	99%
10	21%	24%	29%	37%	49%	64%	78%	89%	95%	98%
12	15%	17%	21%	28%	39%	53%	69%	84%	93%	97%
14	11%	12%	10%	21%	30%	43%	61%	77%	90%	96%
16	8%	9%	7%	16%	23%	35%	52%	71%	86%	94%
18	6%	7%	6%	12%	18%	29%	45%	65%	82%	93%
20	5%	5%	4%	10%	15%	24%	39%	59%	78%	91%
22	4%	4%	4%	8%	13%	21%	34%	54%	74%	89%
24	3%	4%	3%	7%	11%	18%	31%	50%	71%	87%
26	3%	3%	3%	6%	10%	16%	28%	47%	69%	86%
28	3%	3%	3%	6%	9%	15%	27%	45%	67%	85%
30	3%	3%	3%	6%	9%	15%	26%	44%	67%	85%

Sources/Notes: Table developed by David C. Powell, Forest Silviculturist, Umatilla National Forest, Pendleton, OR. These values are probabilities, expressed as a percent, of ponderosa pines of various diameters being killed by fire. They are based on an equation from Reinhardt and Ryan (1989) and a bark thickness factor from Keane et al. (1989). See Steele et al. (1996) for a description of the calculation methodology. White values on a blue background denote combinations of crown scorch and DBH with a mortality probability ≥ 50%.

Crown scorch

Table 4: Probability of fire-induced mortality for Douglas-fir.

	CROWN SCORCH VOLUME (PERCENT)									
DBH	10	20	30	40	50	60	70	80		
5	52%	56%	62%	70%	79%	87%	93%	97%	99%	100%
6	45%	49%	56%	65%	75%	84%	91%	96%	98%	99%
7	39%	43%	49%	59%	70%	81%	89%	95%	98%	99%
8	33%	37%	43%	53%	64%	76%	87%	94%	97%	99%
9	28%	32%	38%	47%	59%	72%	84%	92%	97%	99%
10	24%	27%	33%	41%	53%	67%	80%	90%	96%	98%
12	17%	20%	24%	32%	43%	58%	73%	86%	94%	98%
14	12%	14%	18%	24%	34%	48%	65%	81%	91%	97%
16	9%	11%	13%	18%	27%	40%	57%	75%	88%	95%
18	7%	8%	10%	14%	21%	33%	50%	69%	84%	94%
20	5%	6%	8%	11%	17%	27%	43%	63%	81%	92%
22	4%	5%	7%	9%	14%	23%	38%	57%	77%	90%
24	4%	4%	6%	8%	12%	20%	34%	53%	74%	89%
26	3%	4%	5%	7%	11%	18%	30%	49%	71%	87%
28	3%	3%	4%	6%	10%	16%	28%	47%	69%	86%
30	3%	3%	4%	6%	9%	16%	27%	45%	67%	85%

Sources/Notes: Table developed by David C. Powell, Forest Silviculturist, Umatilla National Forest, Pendleton, OR. These values are probabilities, expressed as a percent, of Douglas-firs of various diameters being killed by fire. They are based on an equation from Reinhardt and Ryan (1989) and a bark thickness factor from Keane et al. (1989). See Steele et al. (1996) for a description of the calculation methodology. White values on a blue background denote combinations of crown scorch and DBH with a mortality probability ≥ 50%.

Did the buds survive?

Stem char

Photo: Chris Schnepf, University of Idaho

What's happening? Wood Decay starts

- Caused by chemical processes of bacteria and fungi
- Bark removal allows bacteria and fungi to enter trees
- Decay rates depend on tree species, exposure, piece size, moisture and temperature

Sometimes wood decay is enhanced by insect activity

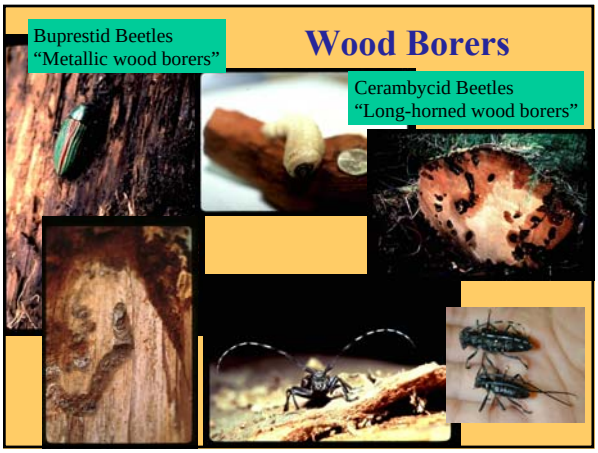
Tunnels

Blue stain

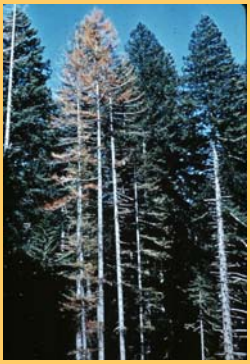
Wood Borers

Buprestid Beetles
"Metallic wood borers"

Cerambycid Beetles
"Long-horned wood borers"



Bark Beetles



- Attack trees weakened by competition, defoliation, drought, root disease, or fire injury
- Death occurs rapidly
- Damage may not show up until tree dries out one year later

Bark Beetles

Feed on phloem, so …

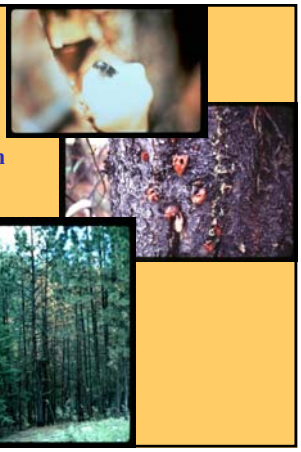
- Are generally tree host and size specific
- Have evolved effective means of locating and mass-attacking susceptible trees

Bark Beetles

Example: Douglas-fir beetle

Pine Bark Beetles

- Generally, attack trees in mid to late summer
- Focus their initial attack on weak or injured trees
- Can then switch a coordinated attack to nearby vigorous trees

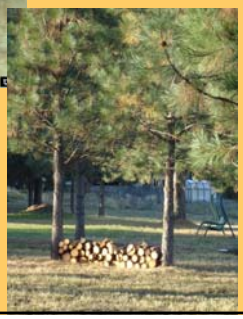


Ips Beetles

- Prefer fresh slash to live trees
- Populations build up in fresh (January to June) pine slash
- In late summer, high populations kill small diameter trees and tops of larger trees

Good

Bad



What's left?

- How much of the stand is trees that are likely to survive?
- How had the trees been growing (diameter) before the fire?
- How much of the live crown remains? (>30%)

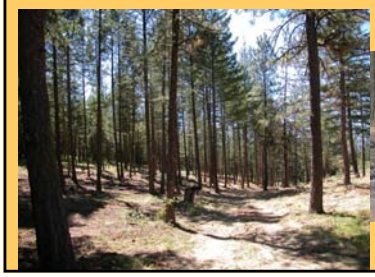
- **What else can I correct during this entry?**
  - **Diversify species mix?**
  - **Thin crowded areas?**
  - **Improve forest health?**

Western spruce budworm

- Hosts: Douglas-fir and grand fir
- Eats just the new foliage each year.
- Becomes serious after many years of activity
- Caterpillars move between layers of crowns

Recommendations:

Mimic the structure that natural fire would have produced: more pine, less fir; less canopy layering; less crowding; leave the healthiest trees.



Conclusions:

- **Prioritize salvage for high value products.**
- **Pine staining and wood boring insect activity start right away.**
- **It's unlikely insects will kill additional, uninjured trees.**
- **It's likely more of the injured trees will be killed by bark beetles next year.**
- **Manage to optimize tree vigor and reduce susceptibility to budworm.**