Bark Beetles, Fire and Fuels
Management Treatments

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Two Issues

• Effects of fuels management treatments, primarily prescribed fire and chipping, on subsequent amounts of bark beetle-caused tree mortality

• Effects of bark beetle outbreaks on forest fuels and potential fire behavior
What do we know?

• Sublethal heating of critical plant tissue can stress trees, which then are more susceptible to bark beetle attack (e.g., Flanagan 1996; Bradley and Tueller 2001; Ganz et al. 2003; Sullivan et al. 2003; Wallin et al. 2003; Elkin and Reid 2004; Hood et al. 2007; Fettig et al. 2008, 2009).

• Fire intensity and bark beetle colonization rates are positively correlated for many species.

• Bark beetles are attracted to trees with only moderate amounts of crown scorch (e.g., Furniss 1965; Flanagan 1996; Weatherby et al. 1994; Wallin et al. 2003).

• Probability of bark beetle attack may differ between early and late season burns (Schwilk et al. 2006).
A NATIONWIDE STUDY OF THE ECONOMIC AND ECOLOGICAL CONSEQUENCES OF FIRE AND FIRE SURROGATE TREATMENTS IN FORESTS AT RISK FROM SEVERE WILDFIRE

FFS is the largest study of its kind. Much information can be obtained at http://frames.nbii.gov/ffs as well as special issues in ECAPS, FORECO and FS.
All 12 sites have common treatments, replication (3x), plot sizes (>10 ha), and core variables:

Treatments:
- prescribed fire
- thinning or other mechanical treatment
- thinning (or other mechanical) and prescribed fire
versus,
no management?
Each treatment is designed to achieve stand conditions such that if impacted by a head fire under 80% weather conditions, at least 80% of the overstory BA would survive.

Treatments guided by desired future conditions at the local level.
Southern Cascades, CA
• Mixed-conifer forest
• Fire return interval: 10-15 yrs
• Represents 2.7 million ha
• About 61% public ownership
Significantly higher rates of bark beetle-caused tree mortality occurred on B (9.2%) than C (3.2%), T (<1%) or T + B (3.3%) cumulatively during the four year period.

Mean percentage (±SEM) of trees killed by bark beetles

Sample period 1 (2-yr) Sample period 2 (4-yr)

A. All treatments

B. Prescribed burned (B and T + B)

Concern that beetle populations can "buildup" in recently stressed trees (2-yr) and then may attack and kill large numbers of adjacent trees that might otherwise have survived (4-yr).

Overall, mortality was almost evenly distributed between surveys, with 53.8% (979 trees) recorded during the first (2-yr) sampling period.
ENTERING
BLACKS MOUNTAIN
EXPERIMENTAL FOREST
OPERATED BY
PACIFIC SOUTHWEST FOREST AND RANGE
EXPERIMENT STATION
AND LASSEN NATIONAL FOREST
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Approximately 85.6% (2,339 trees) of all bark beetle-caused tree mortality occurred on burned split plots.

We did observe that 6% of ponderosa pines >23.5 in. dbh died as a result of WPB attack on one experimental unit.
Management Implications

- In both studies, we concluded that near-term levels of bark beetle-caused tree mortality likely would not interfere with management objectives considering that almost half was represented by FE infesting white fir.
Mortality shift – five years after treatment
What about other fuel management treatments, such as chipping of sub- and unmerchantible trees?
“Chipping in spring is a dangerous thing.”

No significant differences in tree mortality rates during the first two years. However, we continued to monitor these plots on an annual basis.

Higher levels of bark beetle-caused tree mortality occurring in CS over the 4 year period.

Management Implications

• Managers should conduct chipping during periods of relative bark beetle inactivity.

• Reasonable effort should be made to limit large quantities of chips from directly contacting residual trees.

• Treatments that promote the desiccation of slash and low decay of monoterpenes prior to chipping should be considered.
Bark beetles in Southern California reached epidemic proportions five years ago…provided fuel for the catastrophic wildfires of 2003.”

- In general, do bark beetle outbreaks increase the amount of fuel available?

- No, bark beetle outbreaks change the composition, size, distribution, and arrangement of forest fuels. However, they do not change the total amount of fuel available - despite what you may read in the literature, popular press or the Federal Register.
What do we know?

- Outbreaks may influence the initiation, intensity, and spread of wildfires, but few scientifically-and statistically-valid studies have been published.

- The relationship between bark beetle-caused tree mortality and subsequent fire behavior is, at best, very complicated. Some authors suggest it is cover type, or even site, specific.

- It is generally held that beetle-affected lodgepole pine forests have a higher probability of burning (Turner et al. 1999, Lynch 2006a), while infested high elevation spruce-fir forests do not (Baker and Veblen 1990, Bebi et al. 2003).
What do we know?

• Lynch (2006b) reported that the Yellowstone fires of the late 1980s were preceded by two MPB outbreaks (1972-75; 1980-83). Only the former is believed to have affected fire behavior.

• Others have suggested beetle outbreaks can actually reduce fire “hazard” (Romme et al. 2006).
Representative plots from current research investigating fuel accumulations in Douglas-fir beetle-affected stands in northern Utah indicate total loadings of 1, 10, and 100 hour fuel classes range from 4.4 to 5.6 tons/acre (Page and Jenkins 2007).

No Mortality
1 hour = 1.6 tons/acre
10 hour = 1.8 tons/acre
100 hour = 1.3 tons/acre
Litter = 2.8 tons/acre
Average live shrub cover = 18%

* 1, 10, 100, and litter are only represented because of their importance to fire spread.
Douglas-fir Beetle Mortality-Caused Fuel Accumulation

**Current Mortality ~ 85% of trees**
- 1 hour = 1.6 tons/acre (0)
- 10 hour = 1.8 tons/acre (0)
- 100 hour = 1.0 tons/acre (0)
- Litter = 4.5 tons/acre (++)
- Average live shrub cover = 52% (++)

**Older Mortality (>5 yrs) ~ 100% of trees**
- 1 hour = 1.2 tons/acre (-)
- 10 hour = 2.4 tons/acre (++)
- 100 hour = 2.0 tons/acre (++)
- Litter = 1.9 tons/acre (---)
- Average live shrub cover = 27% (---)
Douglas-fir Beetle Mortality-Caused Fuel Accumulation

1. Little change in 1 hour fuels across uninfested, currently infested and post-outbreak stands.

2. 10 and 100 hour fuels increase in post-outbreak stands compared to uninfested stands.

3. Litter accumulations peaked in currently infested stands, but returned to background (uninfested) levels in post-outbreak stands.
Great References
