Sudden Oak Death and Fire

Lenya Quinn-Davidson
UC Cooperative Extension, Humboldt
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What do we know about fire & SOD?

- SOD has been in CA less than 20 years
- Fire/SOD is a new area of research
- Limited spatially and temporally
  - Long-term fuels implications?
  - How will things play out in wildfire scenarios?

From Meentemeyer et al. 2004
Fire & SOD in California

- Fire/SOD research focused on wildfire-prone ecosystems and landscapes, and on most susceptible tree species
  - Douglas-fir-tanoak
  - Redwood-tanoak
  - Mixed evergreen
Today’s Presentation

Foliar moisture and crown fire

Surface fuels and fire behavior

SOD-related mortality & fire severity  P. ramorum survival after wildfire
• Fuel Type
  – Live fuels vs. dead fuels
• Fuel/Foliar Moisture
• Fuel Structure
  – Surface fuels
  – Ladder fuels
  – Aerial/canopy fuels
• Fuel Size & Loading
Foliar moisture and crown fire

How does sudden oak death affect foliar moisture content (FMC) and crown fire potential in tanoak?

Phases of Sudden Oak Death Infection in Tanoak

- **Uninfected**
- **Phase 1** Initial infection
- **Phase 2** Mortality
- **Phase 3** Post leaf fall
- **Phase 4** Stem failure

**Time**

Kuljian and Varner 2010
Methods

• Tracked FMC of 25 tanoaks every month for one year
• Collected from 8 uninfected trees, 10 SOD-infected trees, and 7 standing dead trees (SOD killed with leaves still attached)
• Used FMC values to model crown fire ignition
Foliar moisture and crown fire

Found major differences in FMC between phases of infection

Kuljian and Varner 2010
Other findings

- Cured canopy fuels increase risk of crown fire ignition
- FMC of standing dead trees same if not lower than surface litter
- RAWS 10 hr fuel moisture shows potential as predictor of FMC on standing dead trees

Kuljjan and Varner 2010
How does sudden oak death change surface fuel loading and potential fire behavior in Douglas-fir-tanoak forests?

Valachovic et al. 2011
Surface fuels and fire behavior

- What is the long-term fuels forecast for these forests?
- How will fuelbed changes affect firefighter responses?

Valachovic et al. 2011
The goal: to compare surface fuels in SOD-infested and uninfested forests over different time horizons in 3 north coast counties that have SOD.

Complication: SOD has been present in the 3 counties for different amounts of time.

Solution: use herbicide-treated tanoak stands as a surrogate for the effects of SOD.

Valachovic et al. 2011
Surface fuels and fire behavior

Surrogate Approach

Herbicide treated or SOD infested?

Valachovic et al. 2011
Surface fuels and fire behavior

Methods

• Collected fuels and stand data in SOD-infested, herbicided, and uninfested (control) stands
• Compared custom fuel models to standard fuel models
  – Can standard models adequately predict fire behavior in infested areas?
• Performed fire suppression operations safety analysis
  – Will the disease affect firefighter responses in infested areas?

Valachovic et al. 2011
Surface fuels and fire behavior

Similar to mid-stage herbicide treatments

Valachovic et al. 2011
Surface fuels and fire behavior

Fuel Models & Fire Behavior

• Standard fuel model (SB2) fit the control plots
• Standard models did not accurately predict SOD-infested or herbicide-treated plots
• Made sense to look at plots based on fuel structure
  – Fuels on surface or in canopy (aerial)?
SOD-related surface fuel accumulations take place over an extended period of time (at least 8-12 years post-infection for significant accumulation)

Valachovic et al. 2011
Surface fuels and fire behavior

Conclusions

Tanoak fuels may take a long time to break down (large log piles still present and sound in some plots 12 years after herbicide treatment)

Valachovic et al. 2011
Surface fuels and fire behavior

Conclusions

SOD-related fuel accumulations may have important implications for fire suppression. Firefighters should be aware of whether or not stands are infested, and how fuels are structured (surface or aerial).

Photo courtesy of Kerri Frangioso, UC Davis
The effects of herbicide treatment may approximate the most extreme effects of SOD. However, SOD is chronic, long-term, and unpredictable. Herbicide treatment is a one-time pulse of material.
How do these concepts play out in a wildfire setting?

The 2008 wildfires in Big Sur provided a rare opportunity to test assumptions about SOD-related tree mortality and fire severity.

A pre-existing plot network provided detailed pre-wildfire measurements of standing dead woody stems and downed woody debris.

Metz et al. 2011
Testing a widespread assumption

SOD-related mortality & fire severity

Hypothesis

Burn Severity

SOD Impacts

2006

2008

Metz et al. 2011
SOD-related mortality & fire severity

Pre-fire fuels elevated with SOD

**Standing Dead Trees**

- **Basal Area (m²/plot)**
  - SOD absent
  - SOD present

**Downed Logs**

- **Volume (m³/plot)**
  - SOD absent
  - SOD present

Metz et al. 2011
SOD-related mortality & fire severity

Burn severity and SOD impacts

Metz et al. 2011
SOD-related mortality & fire severity

- Found relationships between severity and different stages of disease
  - In plots with recent mortality, where dead trees still had leaves attached, severity was high
  - In plots with older mortality (with lots of downed wood), fire severity was high in the soil

Metz et al. 2011
Conclusions

• Links between SOD and fire severity are not straightforward

• Fire severity dependent on many factors, including topography, weather, fuels, and stand health
  – Stage of disease influences fuel structure, fuel moisture, and fuel loading

Metz et al. 2011
How does wildfire affect survival of *P. ramorum*?
Methods

• Used same plot network as Metz et al. (2011) to look at post-wildfire survival of *P. ramorum*

• Surveyed pathogen survival in 63 plots in Big Sur known to be infested with the pathogen
  – Included 45 plots that had burned in 2008, and 18 outside of fire perimeter
  – Plots surveyed in 2009 and 2010

• Looked at importance of burn severity, pre-fire host density, and pre-fire disease prevalence in pathogen persistence
Results

- One year following wildfire, *P. ramorum* was:
  - 72 times more likely to be found in unburned plots
  - 10 times more likely in redwood-tanoak plots
  - More likely in plots with more symptomatic bay trees before 2008

Beh 2011
$P. \text{ ramorum}$ survival following wildfire

Results

- Two years following wildfire, $P. \text{ ramorum}$ was:
  - More likely to be recovered in burned plots with lower severity
  - More likely in redwood-tanoak plots and plots with more pre-fire symptomatic bay trees, as in 2009
- Pathogen remains in burned areas

Beh 2011
P. ramorum survival following wildfire

Summary

• The 2008 wildfires in Big Sur suppressed *P. ramorum*, but did not eradicate it
  – Similar to results in OR using controlled burns
• Wildfire decreased host materials for the pathogen, but patchy fire severity created refugia
  • Surviving bay trees provide inoculum source capable of infecting new post-wildfire vegetation
  • Sprouts very vulnerable

Beh 2011
Management Implications

• There are a number of serious fire-related concerns associated with SOD
  – Decreased fuel/foliar moisture
  – Increased surface fuels and standing dead trees
  – Increased fire severity, from substrate to canopy
  – Important changes to fire suppression tactics

• However, fire behavior is complicated
  – Dependent on weather, topography, fuel availability, stage of disease, species composition
  – Important to understand how SOD can influence fire behavior, and incorporate these considerations into fuels planning and other fire mitigation efforts
For more information


THANK YOU!
SOD, Fuels, & Fire Behavior

Understanding Fuels

- Fuel Type
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Beh 2011
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*Beh 2011*