Sudden Oak Death- Caused Changes to Surface Fuels Loadings and Potential Fire Behavior in Douglas-fir-Tanoak forests

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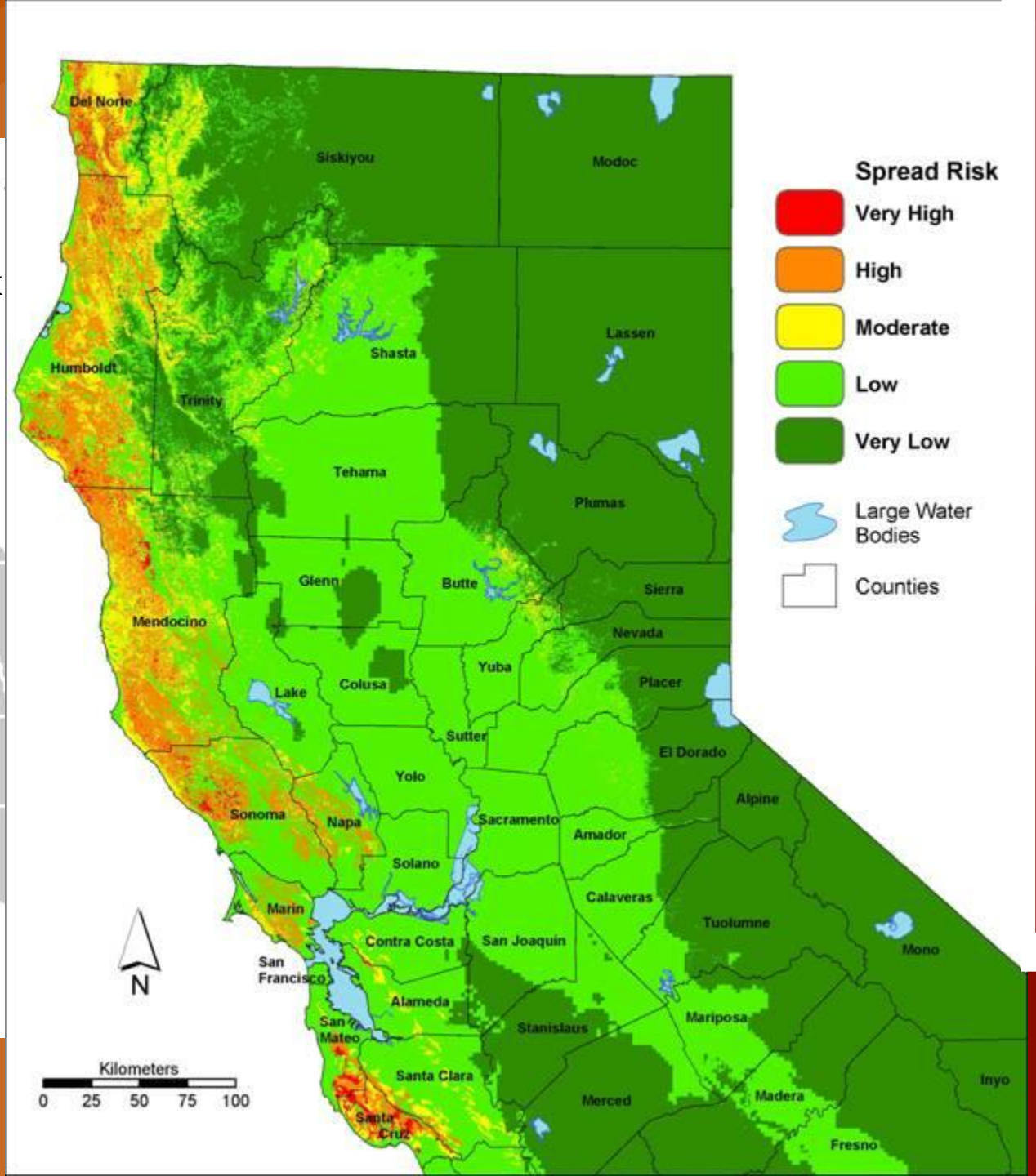
There is a strong public perception that *P. ramorum* killed trees significantly contribute to fuel loadings and increase potential fire behavior.

Risk models

Tanoak



Meentemeyer et al., 2004

Surface versus Aerial Fuels

Surface fuels are dead fuels found in the duff, litter, sticks, branches, fallen trees, stumps.

They contribute to fire behavior by:

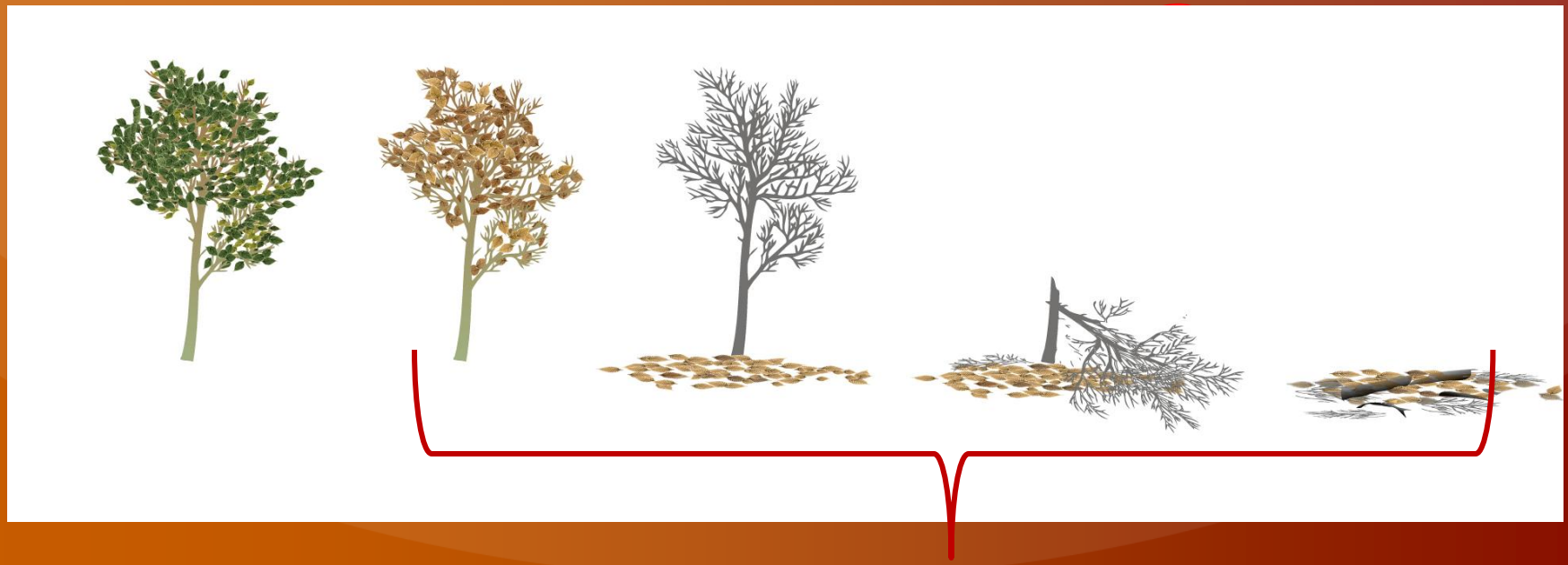
- carrying the fire
- affecting flame lengths
- influencing intensity
- affecting duration of burn

Aerial fuels are located in the forest canopy. They are shorter lived than surface fuels. They affect behavior by:

- contributing to spotting
- ember production
- torching
- crown fires
- sheltering the stand from wind

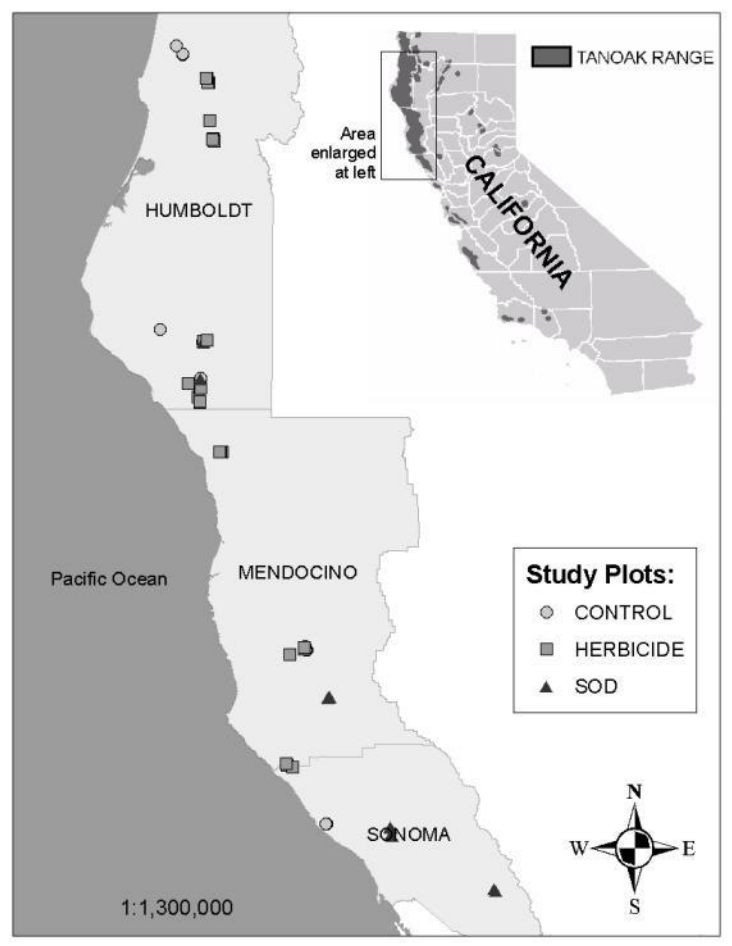
Study Objectives

- How long do surface fuels persist in Douglas-fir/ tanoak forests?
- What is the long-term fuels forecast for these forests?



How long does this process take?

Our study



- The goal: to compare surface fuels in SOD-infested with uninfested forests over different time horizons in 3 north coast counties with SOD
- Complication: SOD has been present in the various counties for varying lengths of time
- Solution: use herbicide-treated tanoak stands as a surrogate for the effects of SOD

Locations

Stage	Sonoma	Mendocino	S. Humboldt	N. Humboldt
Sudden Oak Death				
2-5 years	×	×	×	
5-8 years	×			
8-12 years	×			
Herbicide Treatment				
2-5 years	×	×	×	×
5-8 years	×	×	×	×
8-12 years	×	×	×	×
Control	×	×	×	×

5 replicates each

Methods

Douglas-fir type stands, south facing aspect

- No riparian vegetation
- 1/10 acre (0.04 ha) circular plots were randomly established in each stand condition
- All trees inventoried by species, diameter, height
- 3 Brown's surface fuel (1974) transects per plot

Surface Fuel Variables

1hr (<1/4 inch)

10 hr (1/4 – 1 inch)

100 hr (1-3 inch)

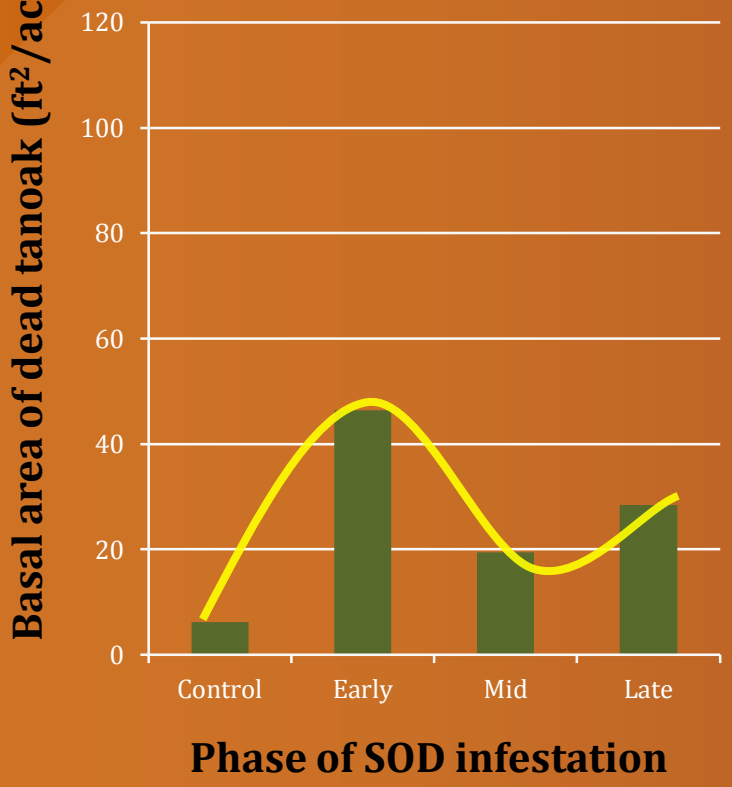
1000 hr (CWD)

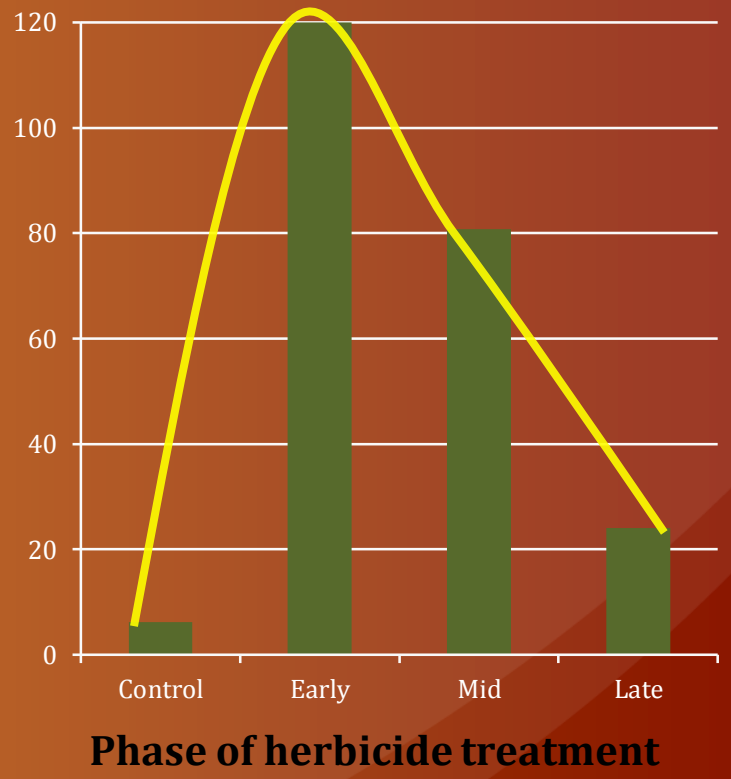
Duff and litter depth

Fuelbed depth

Results

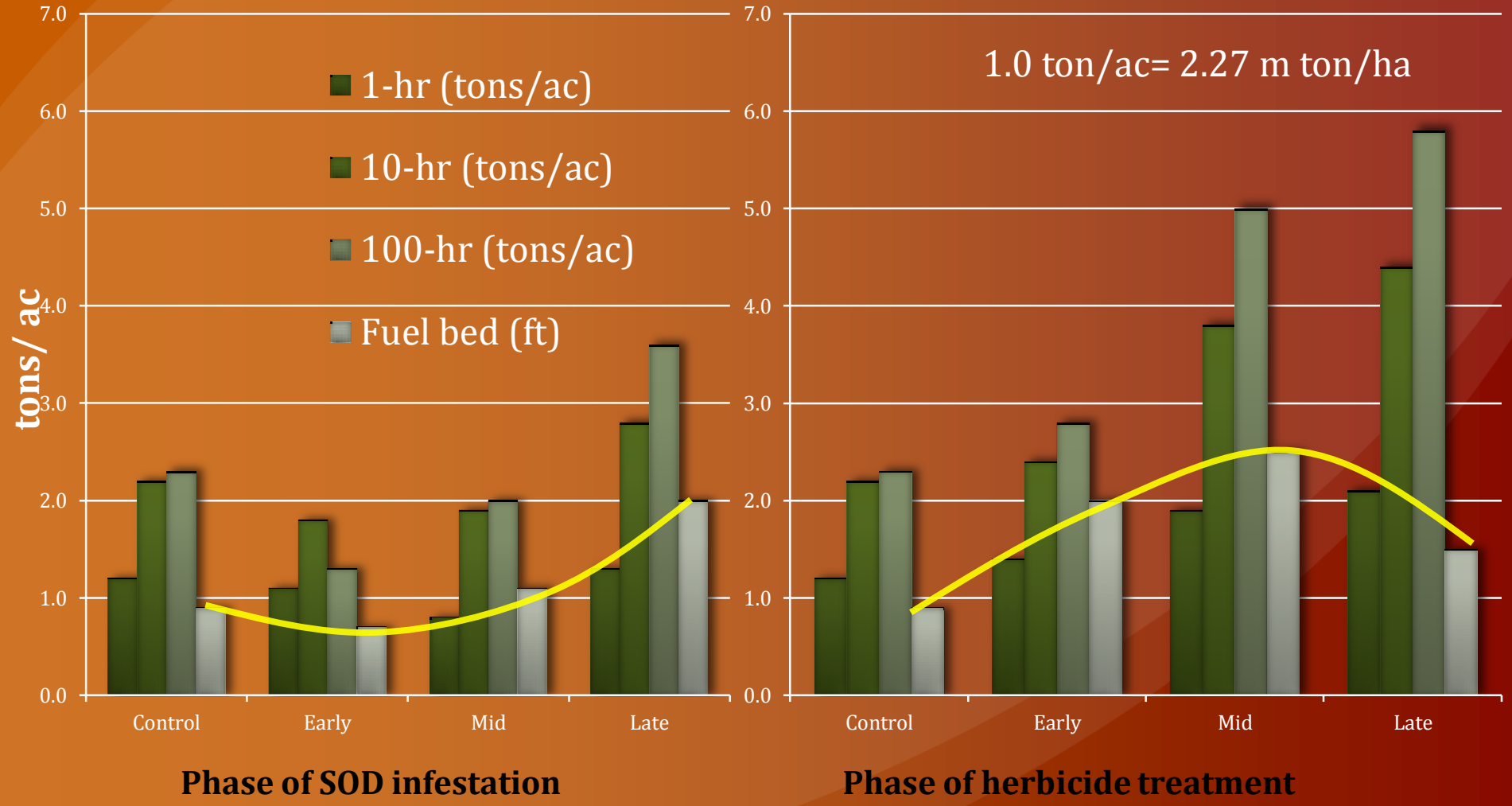
Basal area of **dead tanoak** increased sharply with ***P. ramorum*** infection but decreased in the mid-stage. Notice continuing wave of infection by late stage. Basal area of dead tanoak increased sharply with **herbicide** treatment and then declined as trees failed.





1.0 $ft^2/ac = 0.23 m^2/ha$

Surface fuels and fuelbed depths decreased at first, then increased slowly over time in stands infected by ***P. ramorum.*** Surface fuels increased over time in all **herbicide** treatments. Fuelbed depth decreased in late stage as fine fuels broke down.



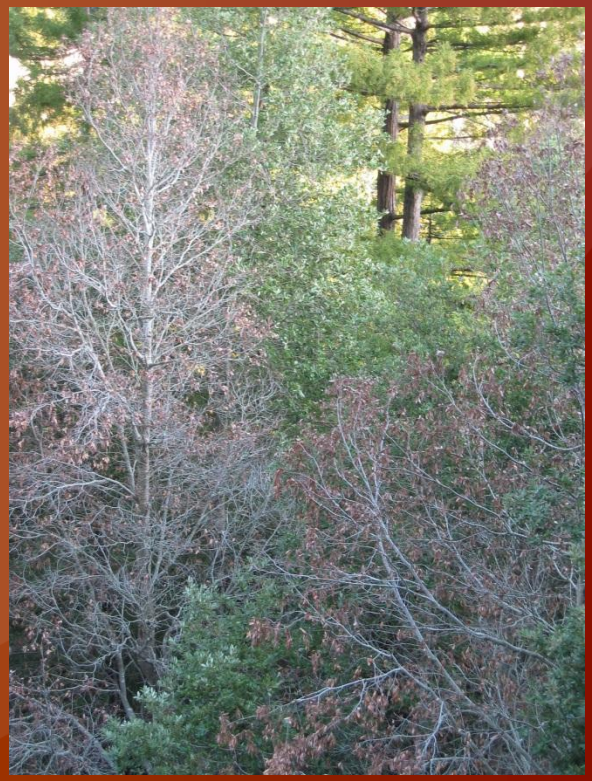
Example Plots

A: Control (N. Humboldt)
B: SOD 2-5 years (Mendocino)
C: SOD 5-8 years (Sonoma)
D: SOD 8-12 years (Sonoma)
E: Herbicide 2-5 years (Humboldt)
F: Herbicide 5-8 years (N. Humboldt)
G. Herbicide 8-12 years (Mendocino)

Stage versus Phase

Stage

- Early(2-5 years)
- Mid (5-8 years)
- Late (8+ years)



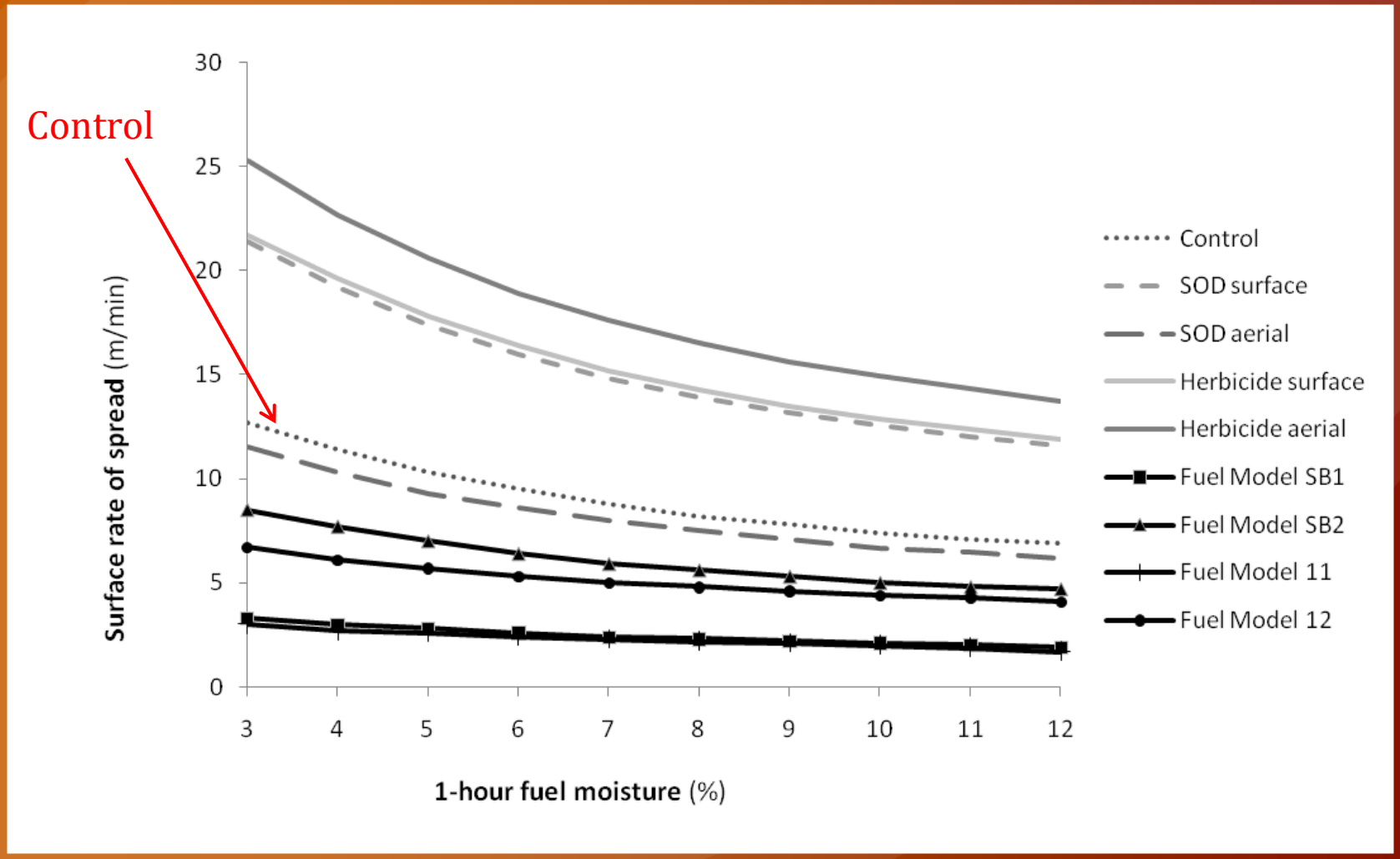
Phase

- Aerial (majority of fuels in crown)
- Surface (majority of fuels on the ground)

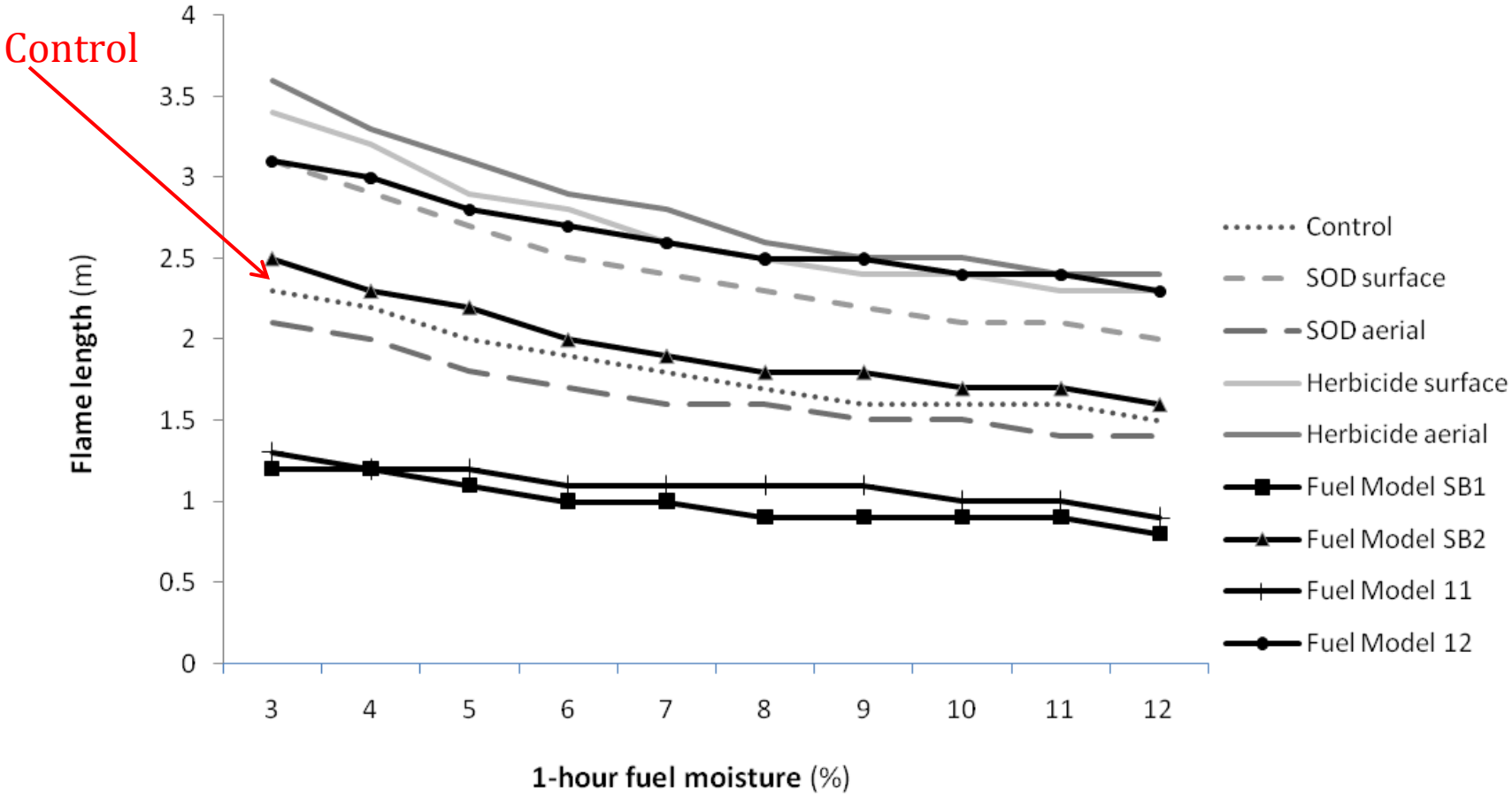
Fire Behavior Analysis

- The amount of surface fuels observed in the four regions for each condition constituted a “custom fuel model” for that condition
- We entered these fuel models into BehavePlus 5.0.1 to simulate predicted fire behavior
  - STEP 1: Wind (3mph), topographic conditions (Slope held constant at 45 %); a range of 1-hour dead fuel moistures; **how do custom fuels models compare to standard fuel models?**
  - STEP 2:Wind speeds were varied for a suppression safety analysis; **what resources are needed to attack a fire in these fuel conditions under a variety of wind speeds?**

Predicted Rate of Spread by Fuels Category ("Aerial"/"Surface")



Predicted Flame Lengths by Fuels Category ("Aerial"/"Surface")



Safety Analysis for Fuels Categories

Condition	Litter + FWD (tons/ac)	Fuel Bed Depth (ft)	Rate of Spread (ft/min) Mid Flame Wind Speed (mi/hr) 0	1	2	3	4	5
AERIAL SOD	5.7	0.7	7.7	8.8	11.4	15.2	19.9	25.5
CONTROL	7.3	0.9	8.5	9.8	12.7	16.8	22	28.2
SURFACE SOD	7.7	1.5	14.1	16.3	21.2	28.2	37.1	47.6
AERIAL HERB	9.2	1.8	16.7	19.3	25.1	33.5	43.9	56.4
SURFACE HERB	13.1	2.2	14.6	17	22.1	29.3	38.3	49

Condition	Litter + FWD (tons/ac)	Fuel Bed Depth (ft)	Flame Length (ft) Mid Flame Wind Speed (mi/hr) 0	1	2	3	4	5
AERIAL SOD	5.7	0.7	3.3	3.5	3.9	4.5	5	5.7
CONTROL	7.3	0.9	3.6	3.8	4.3	4.9	5.5	6.2
SURFACE SOD	7.7	1.5	4.7	5	5.6	6.4	7.3	8.2
AERIAL HERB	9.2	1.8	5.4	5.8	6.6	7.5	8.5	9.5
SURFACE HERB	13.1	2.2	5.2	5.6	6.3	7.2	8.1	9.1

Interpretation: Two type one handcrews required for grey conditions, indirect attack only for black conditions (flame lengths > 8 feet)

Conclusions

The dynamics of surface fuel accumulations after SOD are long-term (at least 8-12 years post-infection for significant accumulation), but the fuels do pile up and will probably cause changes in surface fire behavior.

There is a shorter-term risk from dead leaves remaining in killed trees for 1-3 years with critically low foliar moisture content (Kuljian and Varner 2010).

Tanoak fuels take longer to break down than often thought (large log piles still present and sound in some plots 12 years after treatment); could affect fire severity.

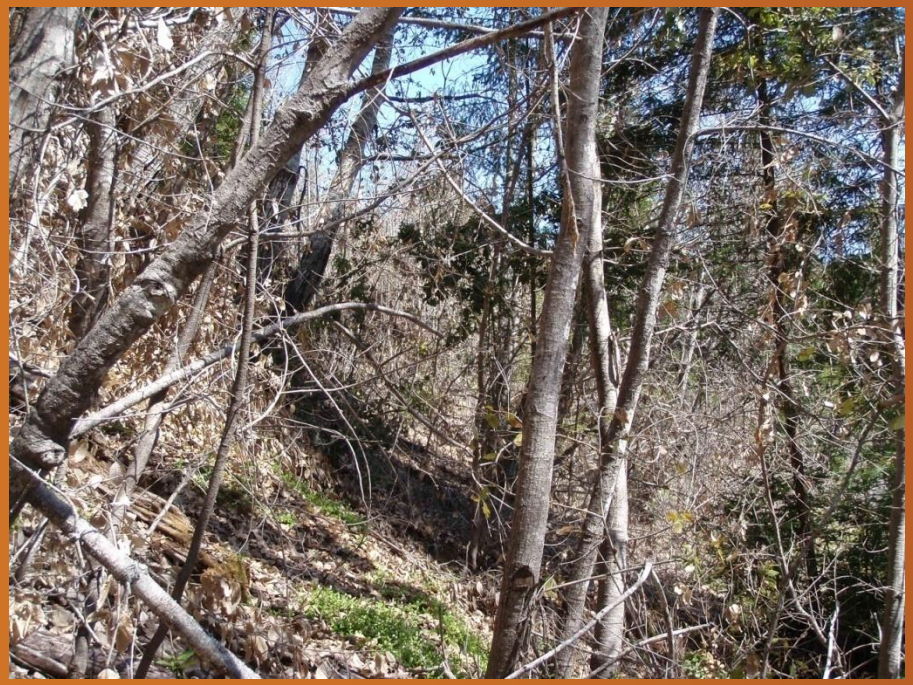
Photo courtesy Kerri Frangioso, UC Davis

Both predicted fire behavior and predicted fire effects should be considered on the landscape for planning purposes. Even if fire severity ends up being low, ramped-up fire behavior will inspire a different choice of tactics for suppression, and this choice will have consequences.

Herbicide treated

P. ramorum infested

The effects of herbicide treatment may approximate the most extreme effects of SOD. However, SOD is chronic, long-term, and unpredictable, while herbicide treatment is a one-time pulse of material that shows up in targeted, discrete areas that are accessible for fire suppression.



Aerial

Surface

The “aerial”/“surface” fuel distinction provides a relatively reliable, quick, and easy way to assess possible hazards and determine appropriate firefighter response from surface fuels on either SOD or herbicide-treated plots.

Full paper available at:

Valachovic et al

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