

Collateral Damage

Fire and *P. ramorum*
interact to increase mortality
in coast redwood



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Invasions and disturbance

- Invading species can alter disturbance regimes

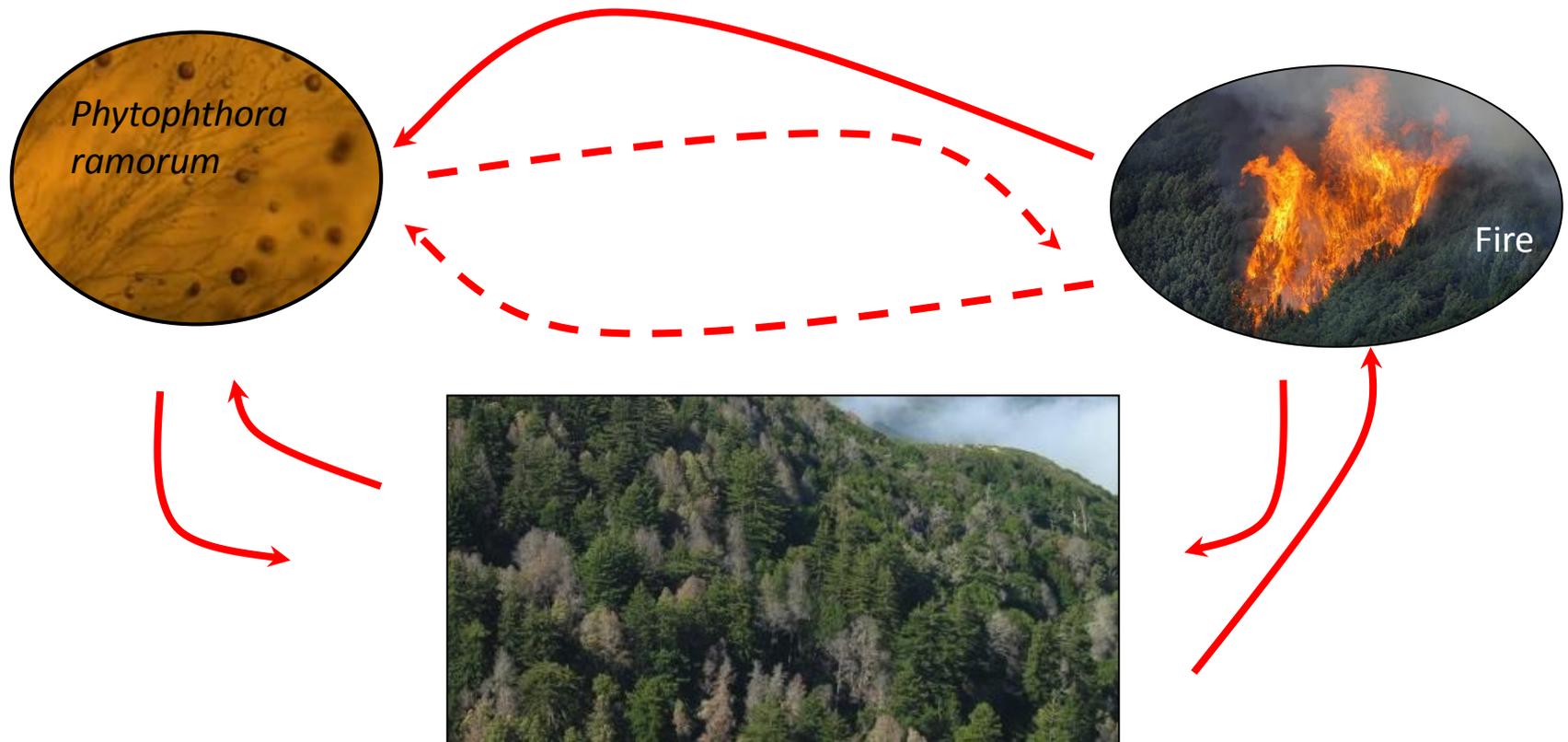
Invasions and disturbance

- Invading species can alter disturbance regimes
 - e.g. Cheat grass invasion
 - Positive feedback with fire frequency and invasion spread

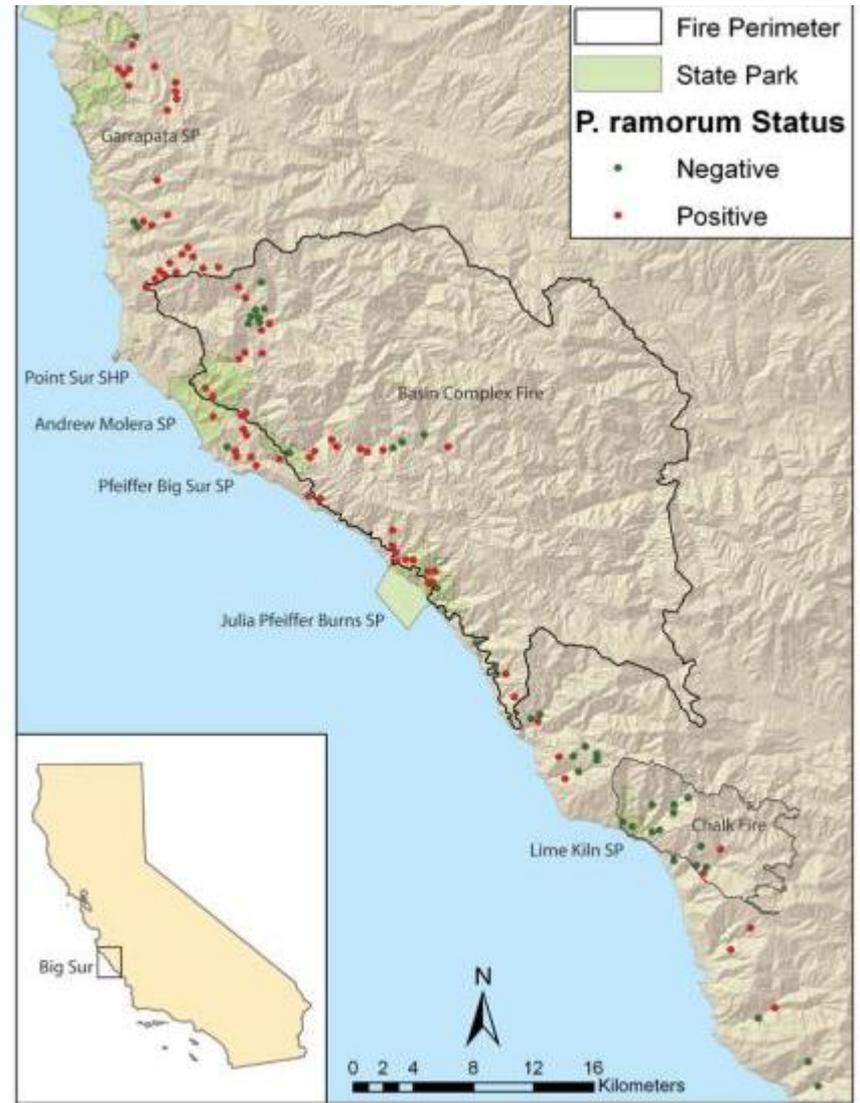
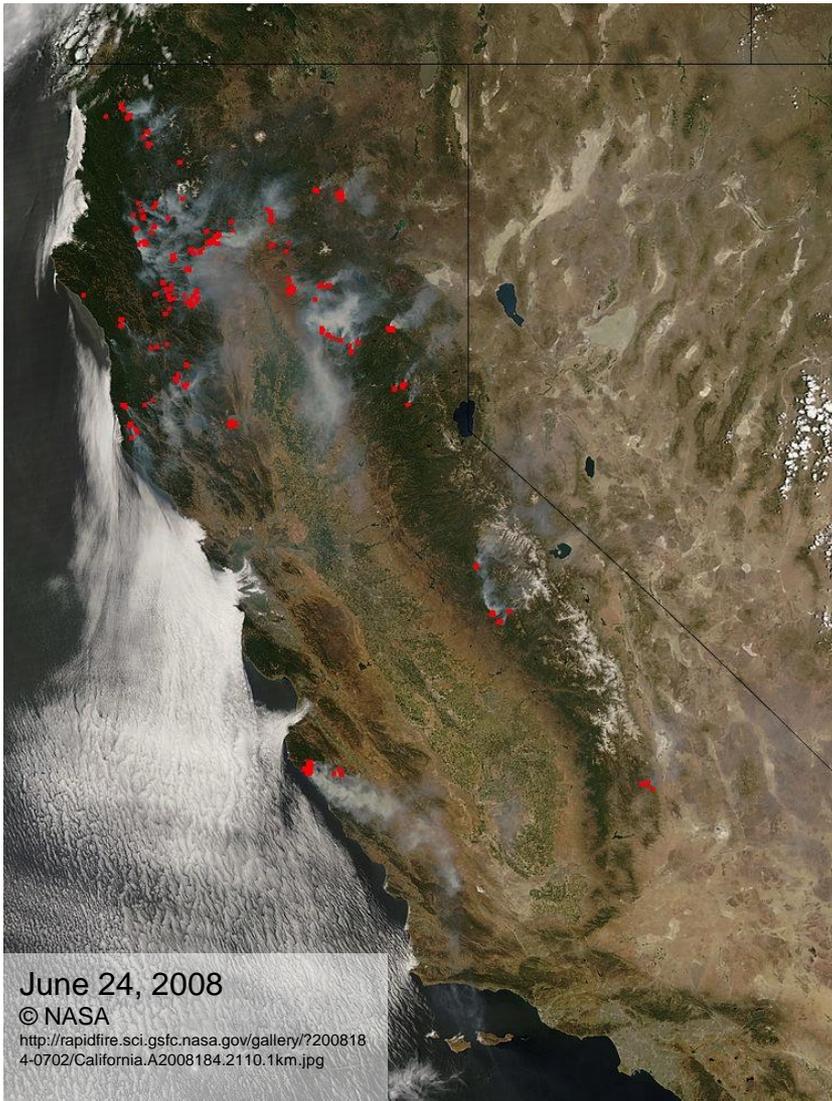


Sudden oak death and wildfire

- *P. ramorum* invading fire-prone CA forests
 - How do the disturbances interact?



Wildfires in Big Sur



Fire in SOD-impacted forests

- SOD monitoring plots in redwood forests
 - Stems before/after fire

61 plots	Burned	Unburned
SOD +	23	8
SOD -	23	7



Fire in SOD-impacted forests

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61 plots	Burned	Unburned
SOD +	23	8
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- Were there synergistic effects in stands experiencing both disturbances?



Species differ in susceptibility

Tanoak

- Fire-sensitive
- High mortality from SOD

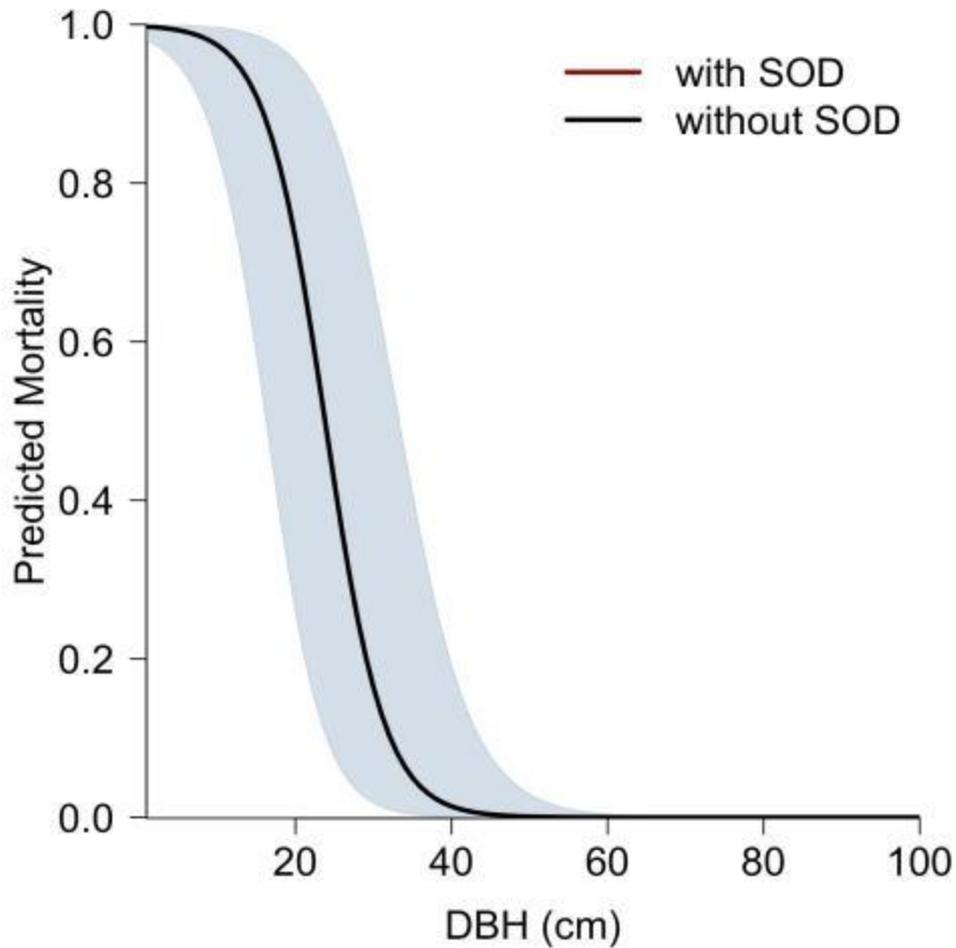
Redwood

- Generally fire resilient
- Negligible SOD impacts

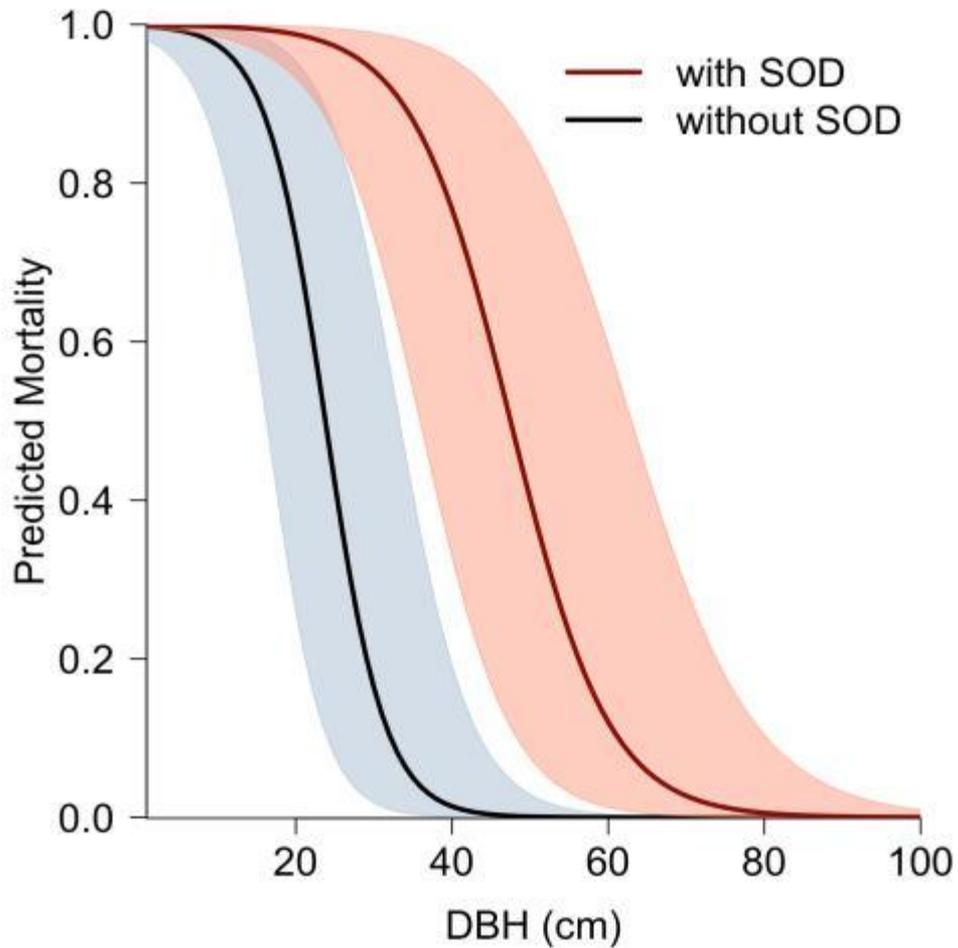
How did the presence of SOD alter fire effects on the dominant trees?

- Tree mortality 2006/07 to 2009:
 - Tree size \pm disease
 - Generalized linear mixed-effects model

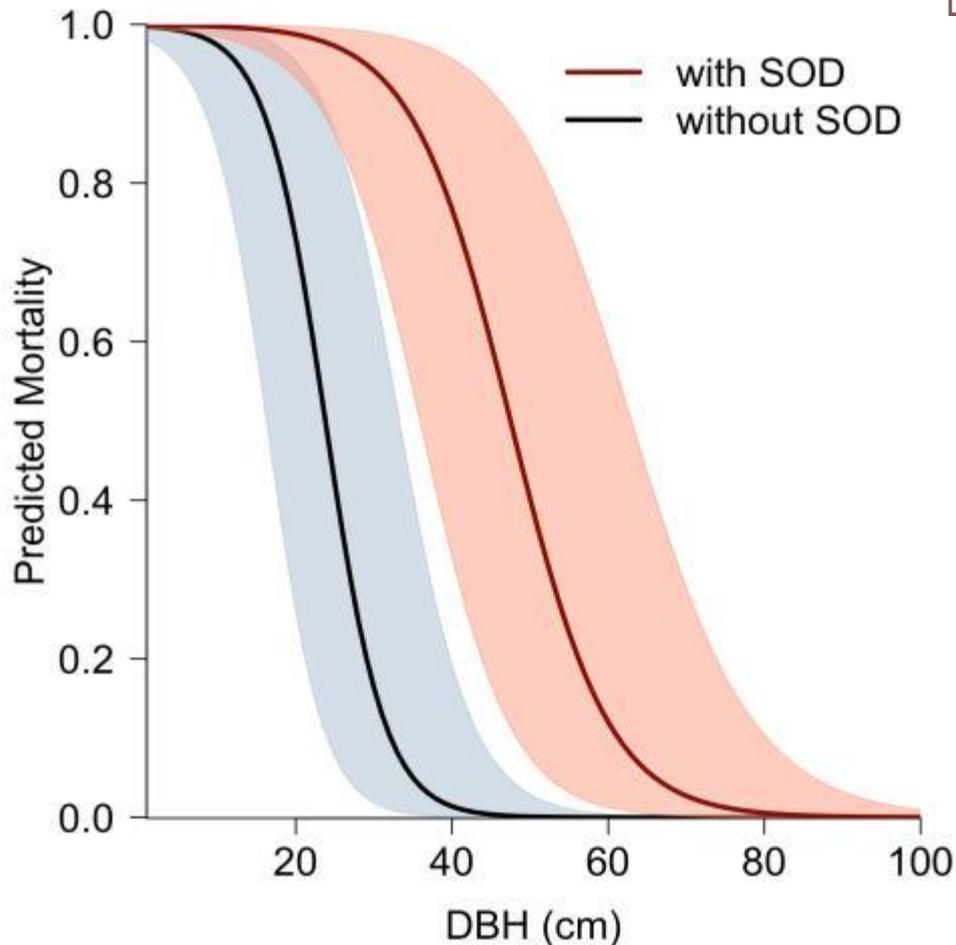
Tanoak post-fire mortality



Tanoak post-fire mortality

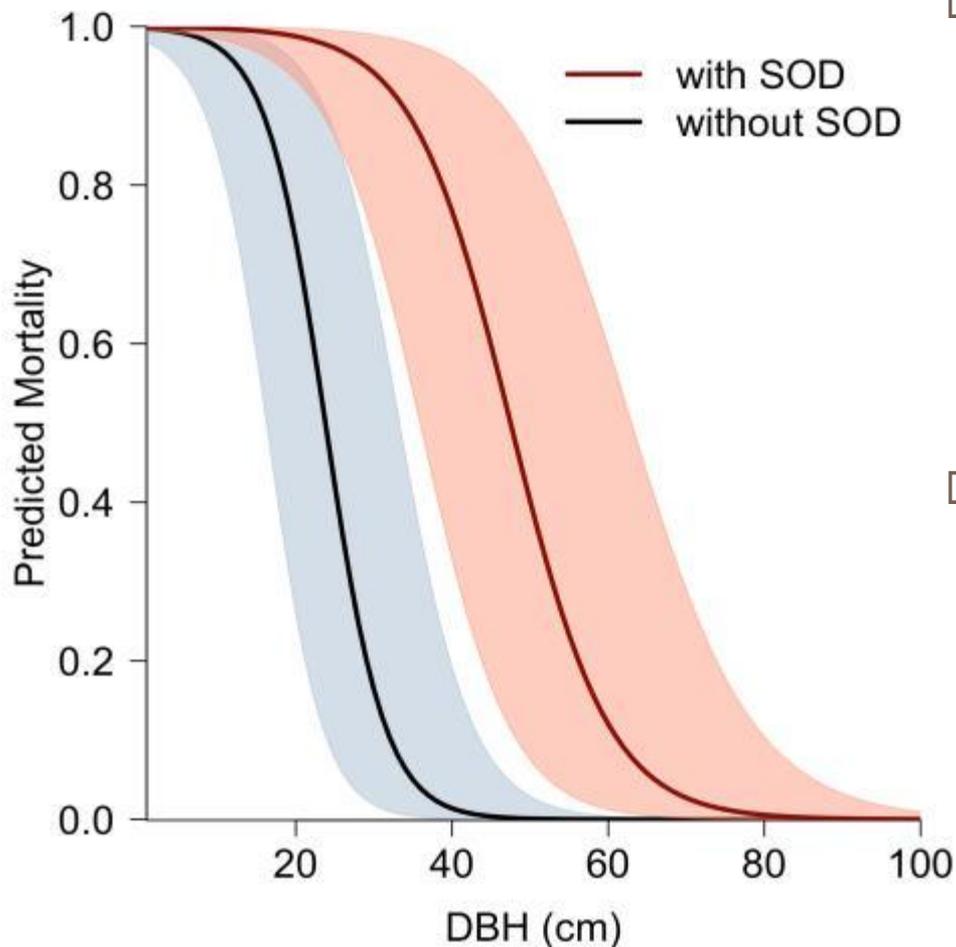


Tanoak post-fire mortality



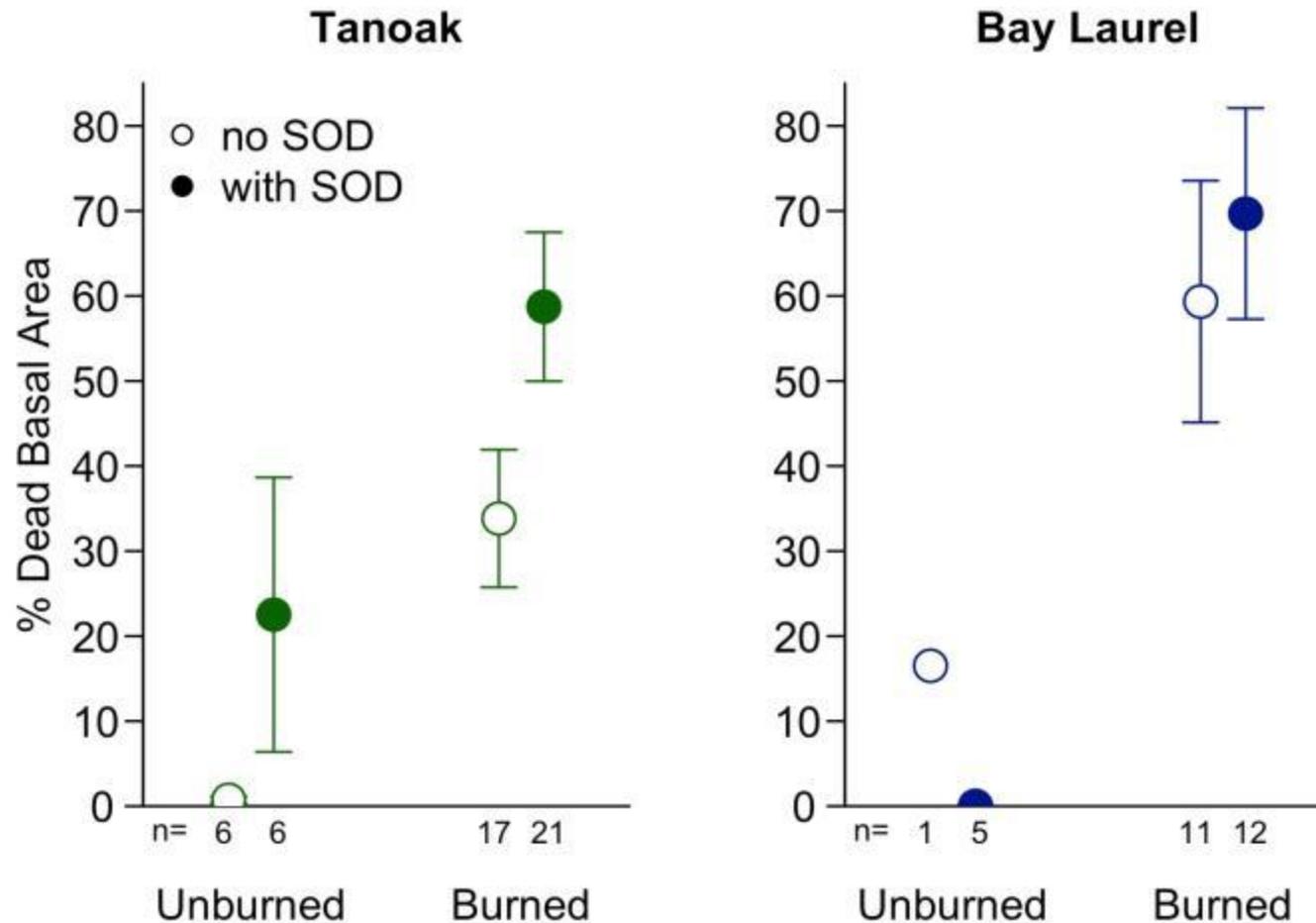
- Joint disturbance increases mortality
 - SOD alters fire impacts?
 - Trees die from SOD?

Tanoak post-fire mortality

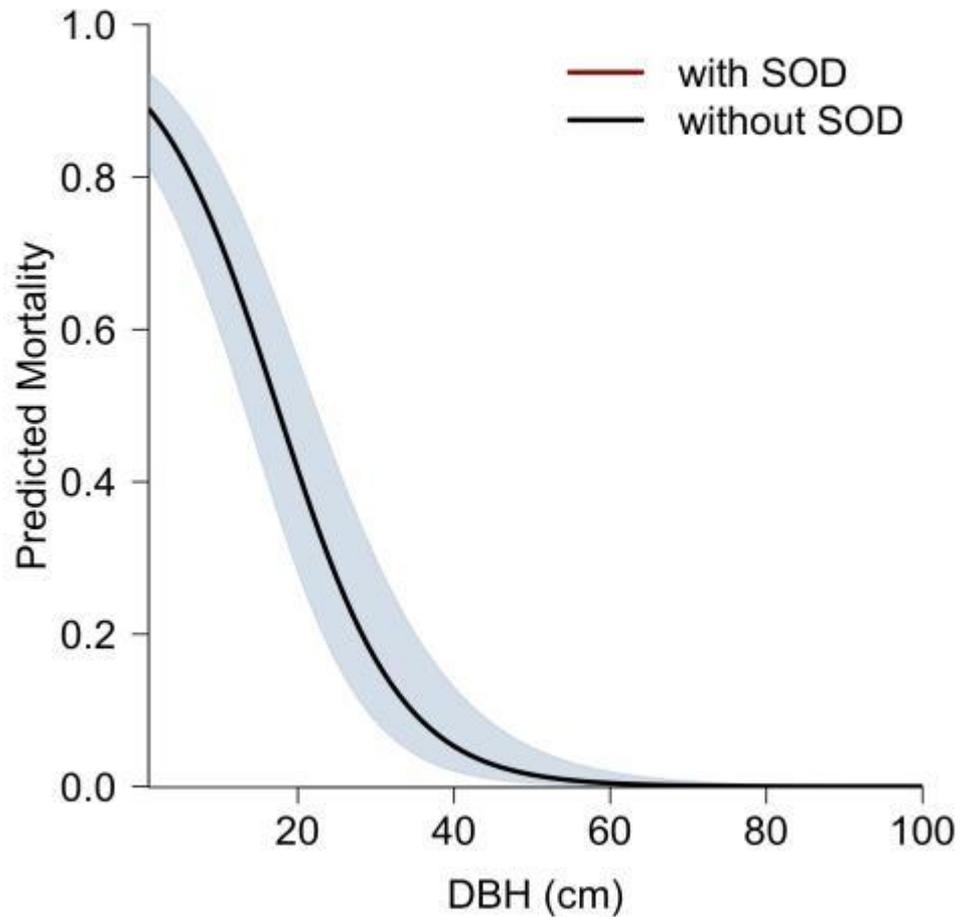


- Joint disturbance increases mortality
 - SOD alters fire impacts?
 - Trees die from SOD?
- Bay laurel does not show a similar mortality increase
 - Also fire-sensitive
 - Does not die from SOD

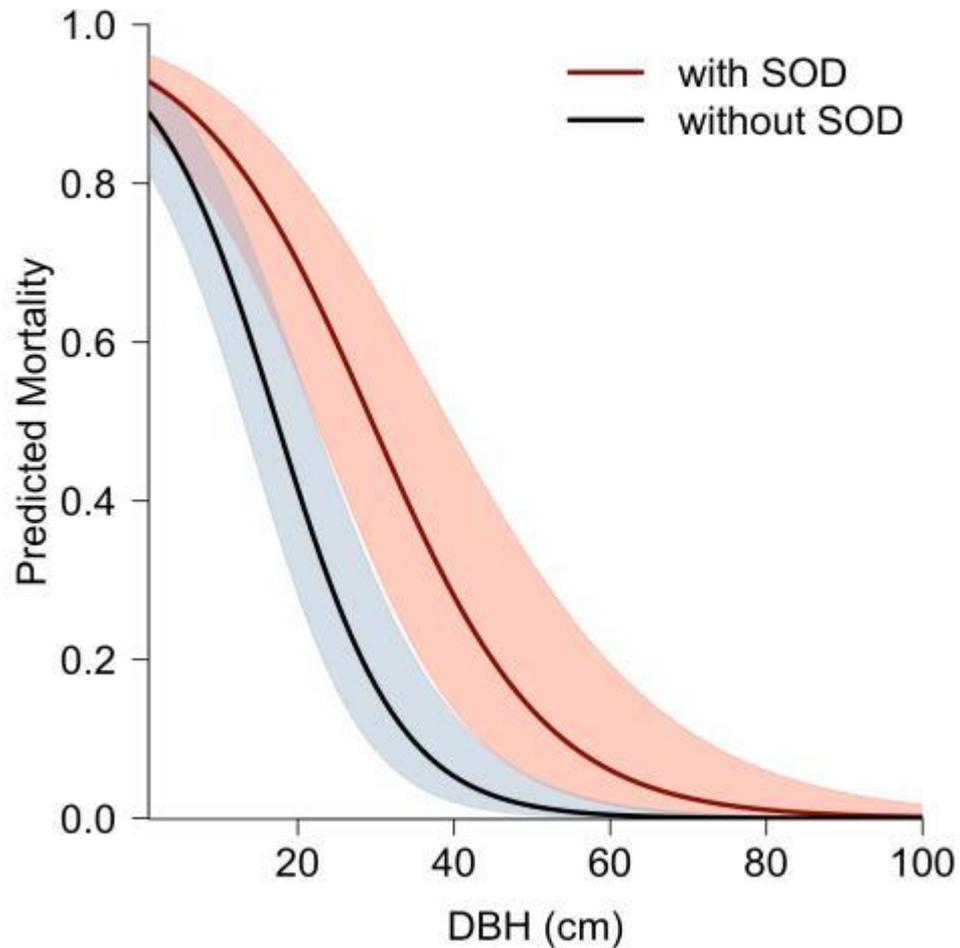
Stand-level consequences



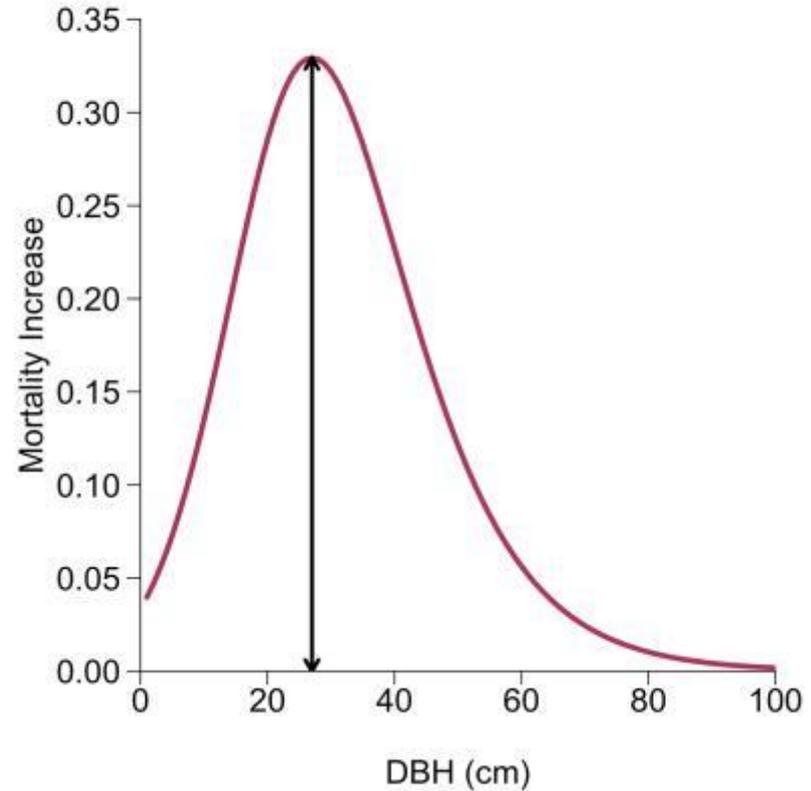
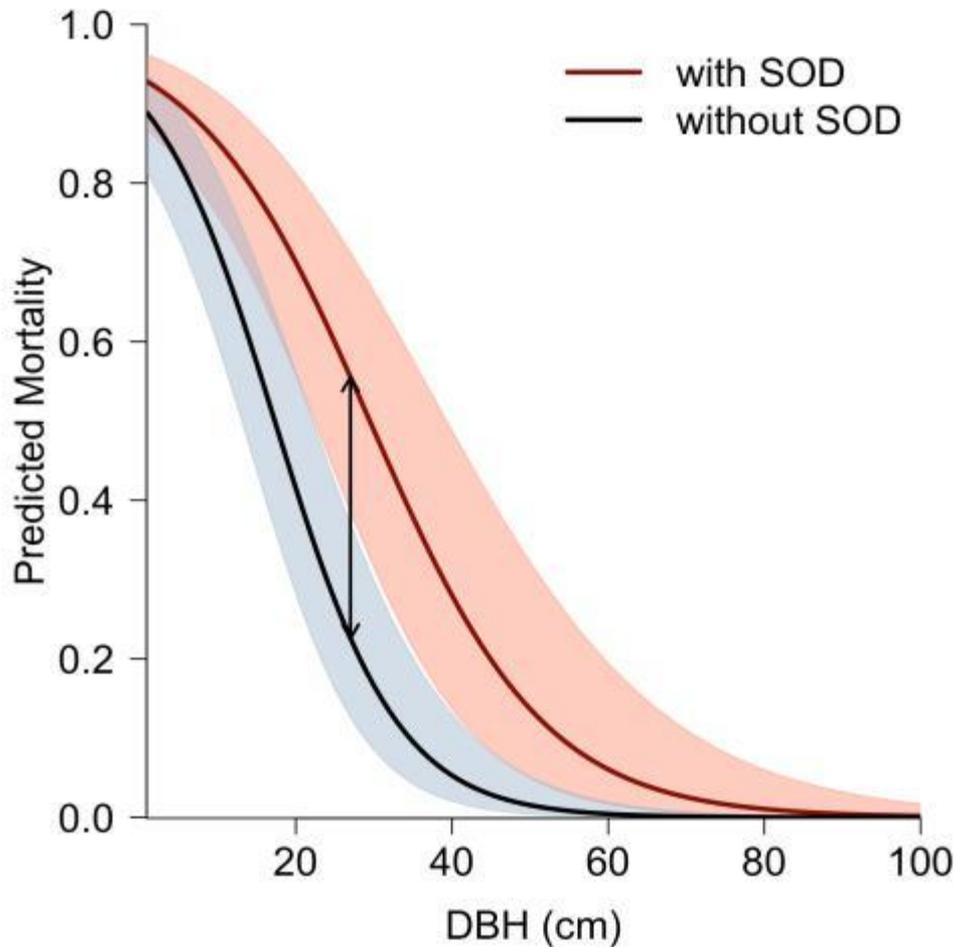
Redwood post-fire mortality



Redwood post-fire mortality



Redwood post-fire mortality

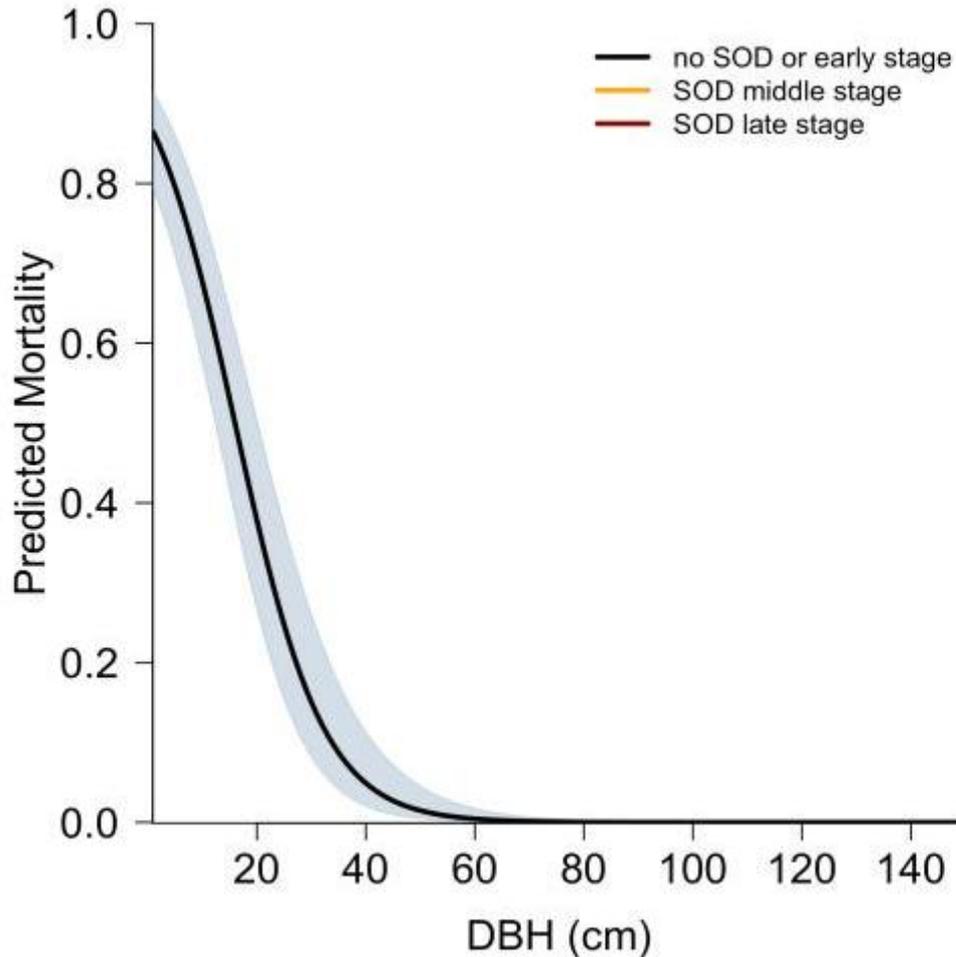


Unexpected redwood mortality

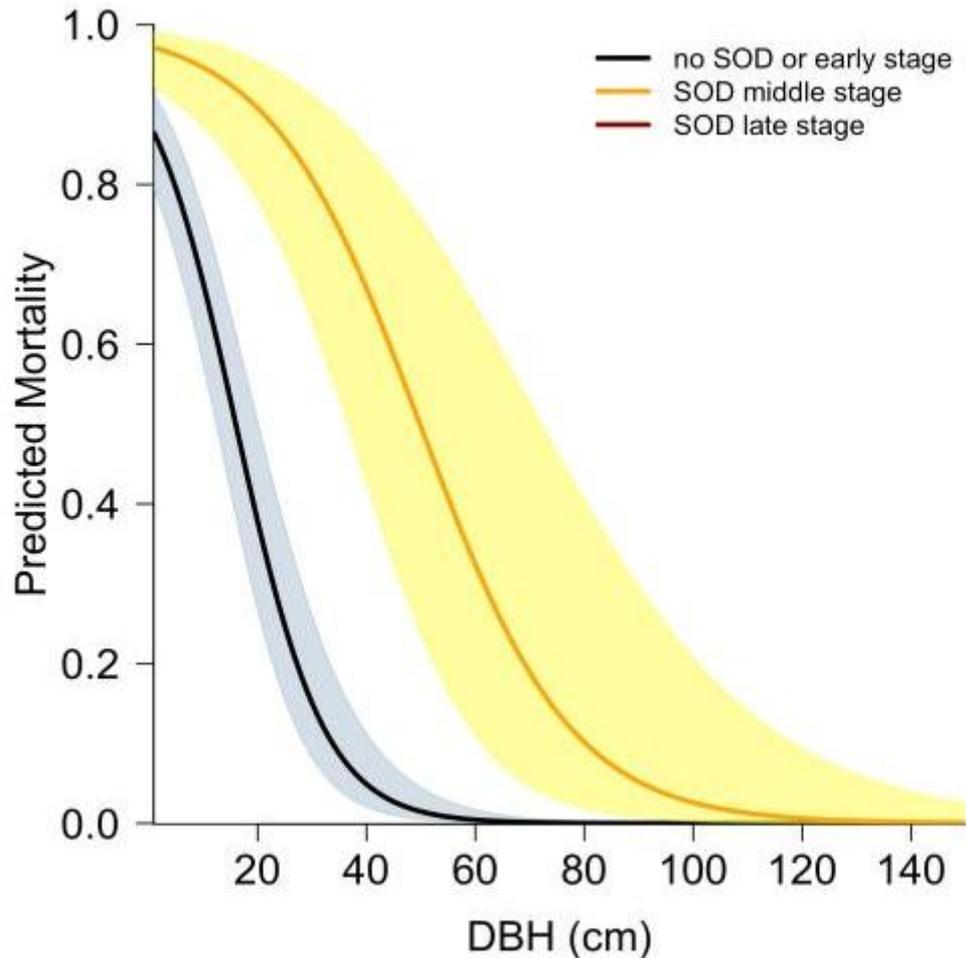
- Size-dependent survival through fire
- Intermediate trees have poorer survival in presence of disease.
 - Not due to direct impact of SOD on redwood.
- How does SOD alter fire impacts?
 - Severity doesn't vary with pathogen presence
 - Stage of disease and type of fuels is important.



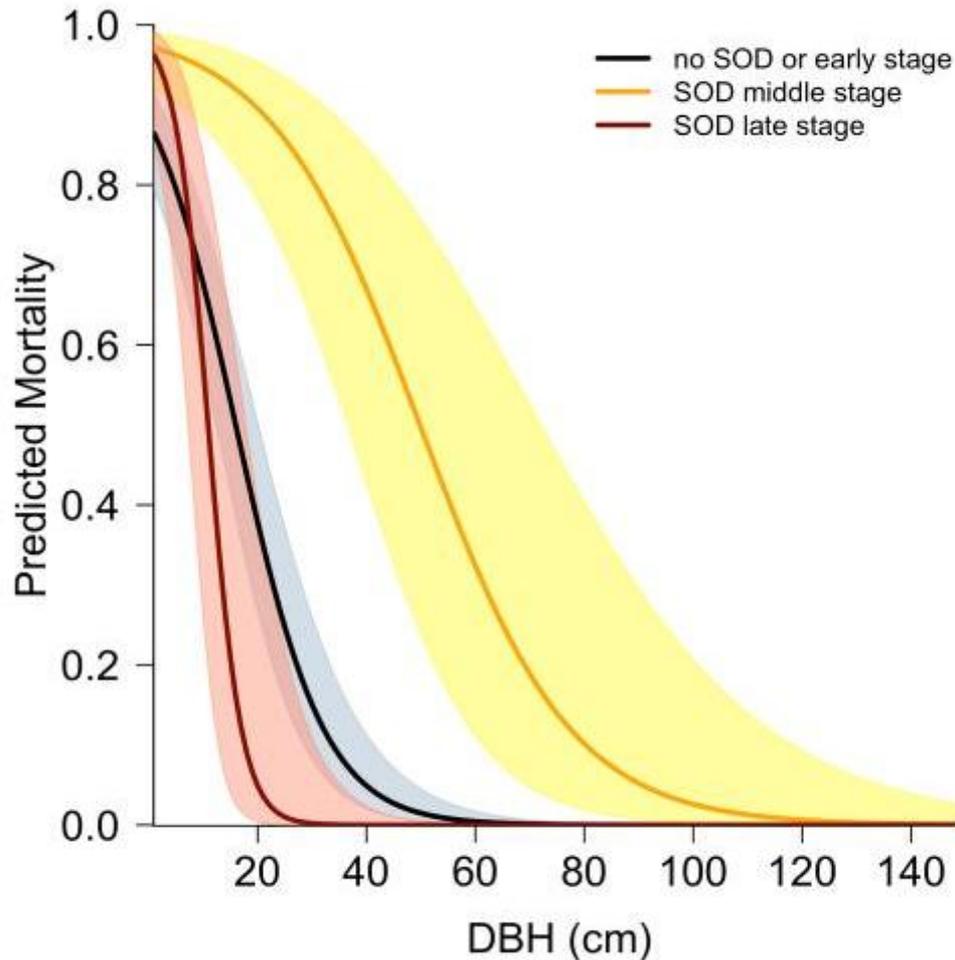
Fuels and mortality risk vary through disease progression



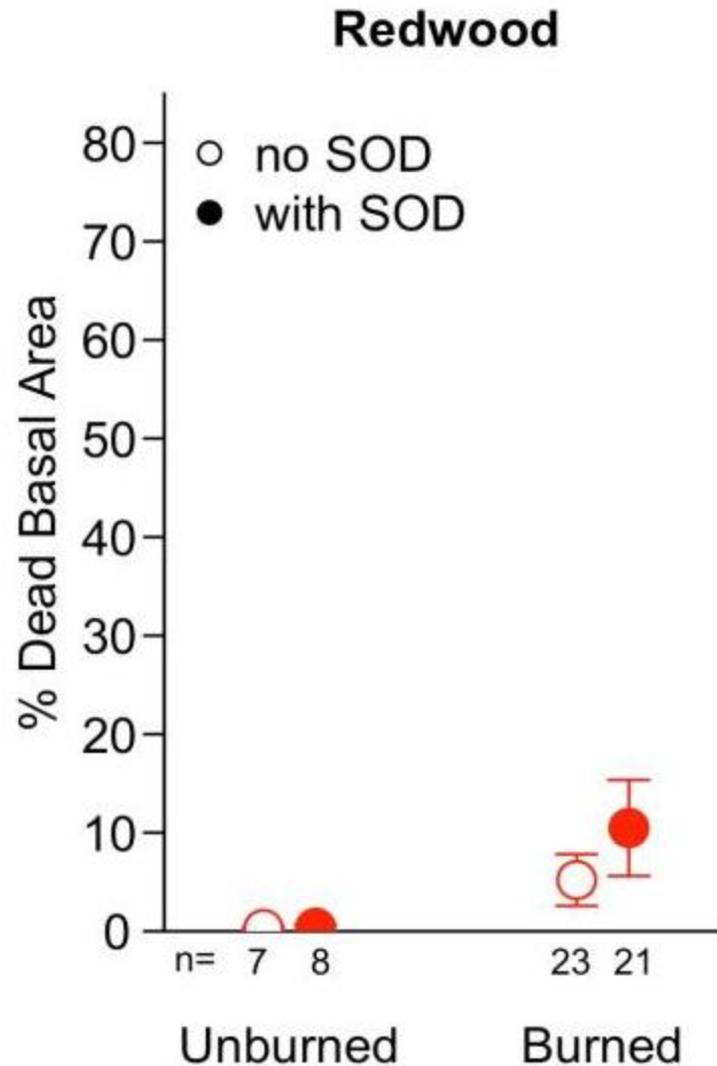
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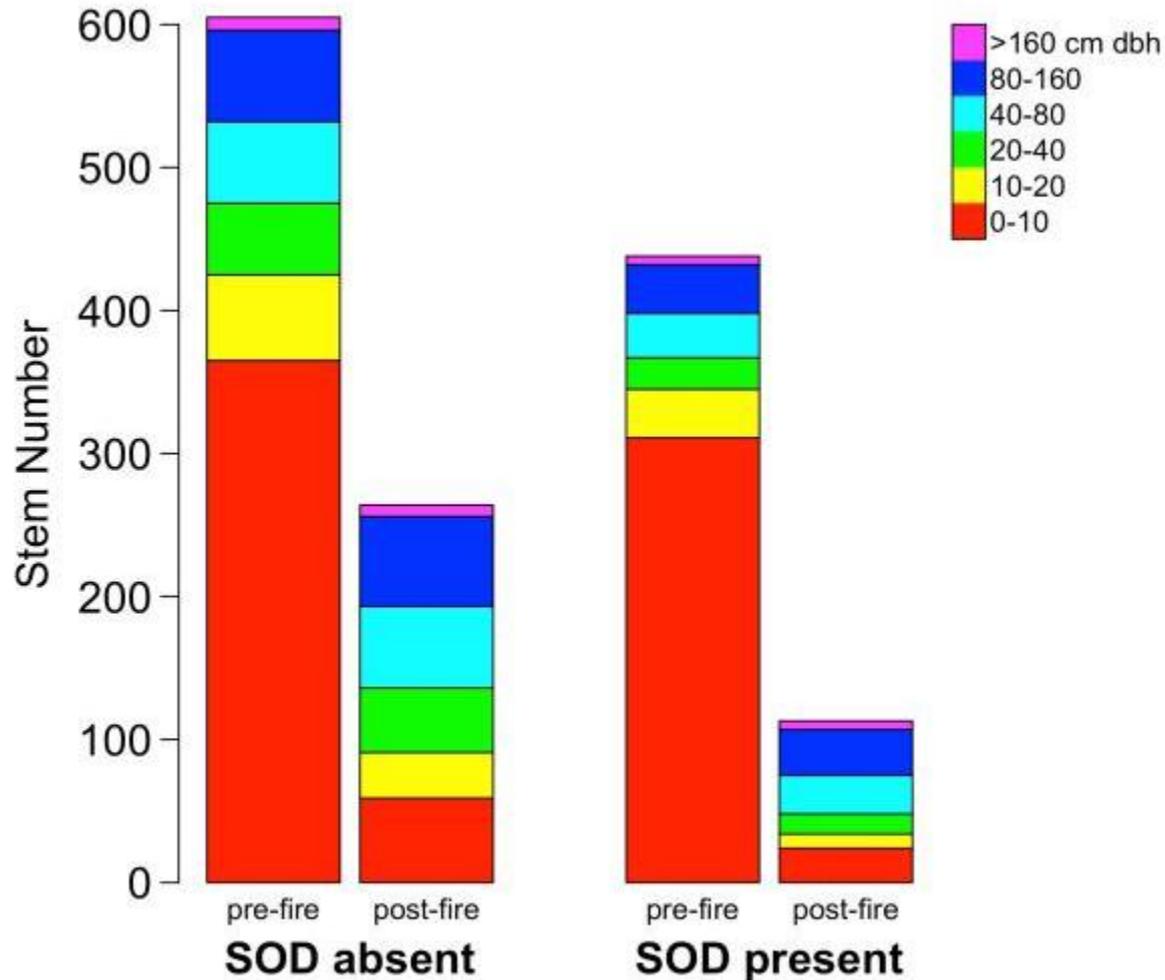
Fuels and mortality risk vary through disease progression



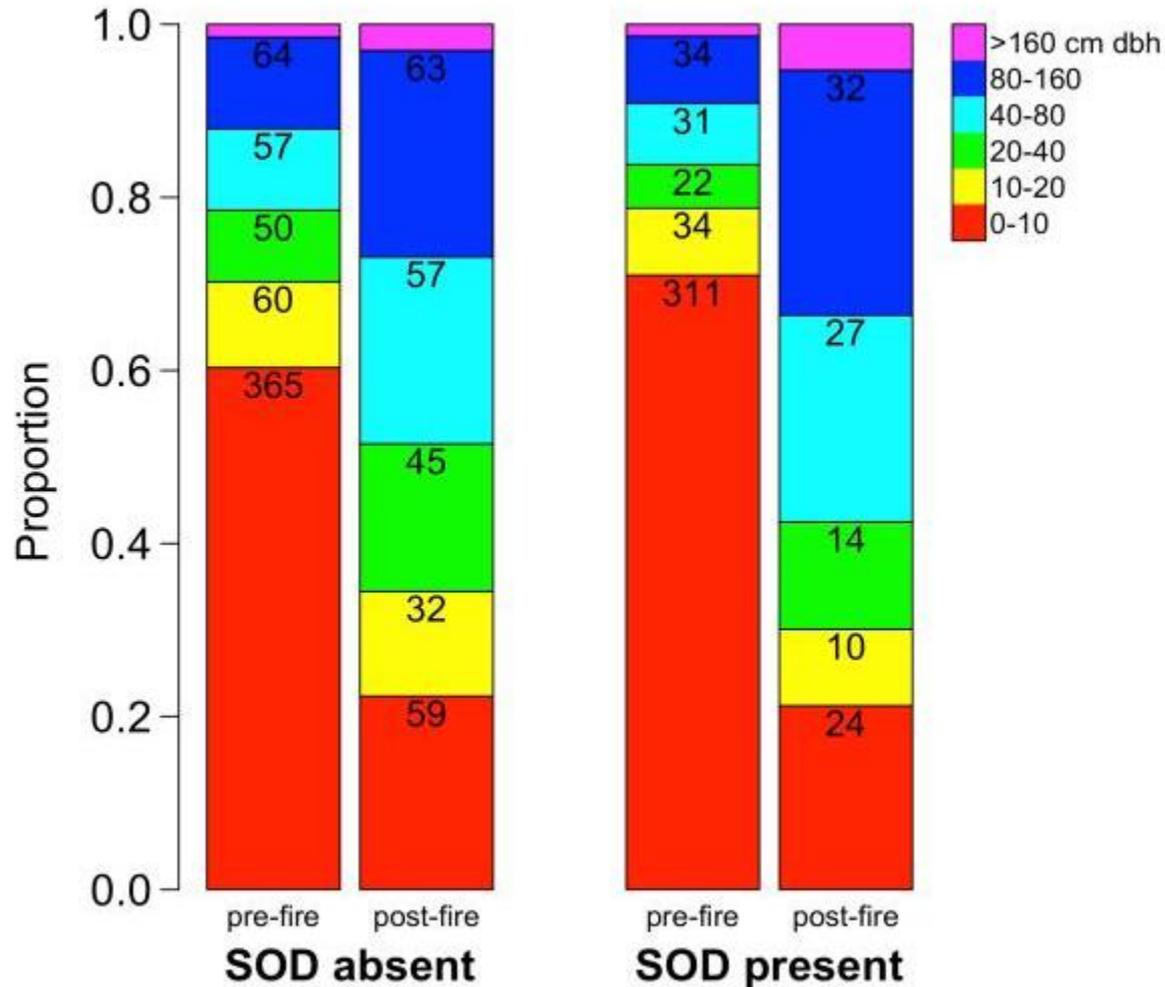
Stand-level consequences



Redwood size distributions



Redwood size distributions



Conclusions

- There are synergistic interactions between SOD and fire
 - Tree mortality is not predictable from the separate effects of either disturbance
- Coast redwood is resilient to either disturbance alone, but becomes unexpected collateral damage both disturbances act jointly
 - Risk changes with stage of SOD epidemic
 - Size-dependent mortality risk alters size structure of redwood stands

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