Do forest practice rules minimize fir mortality from root disease and bark beetle interactions? – a final report

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Outline

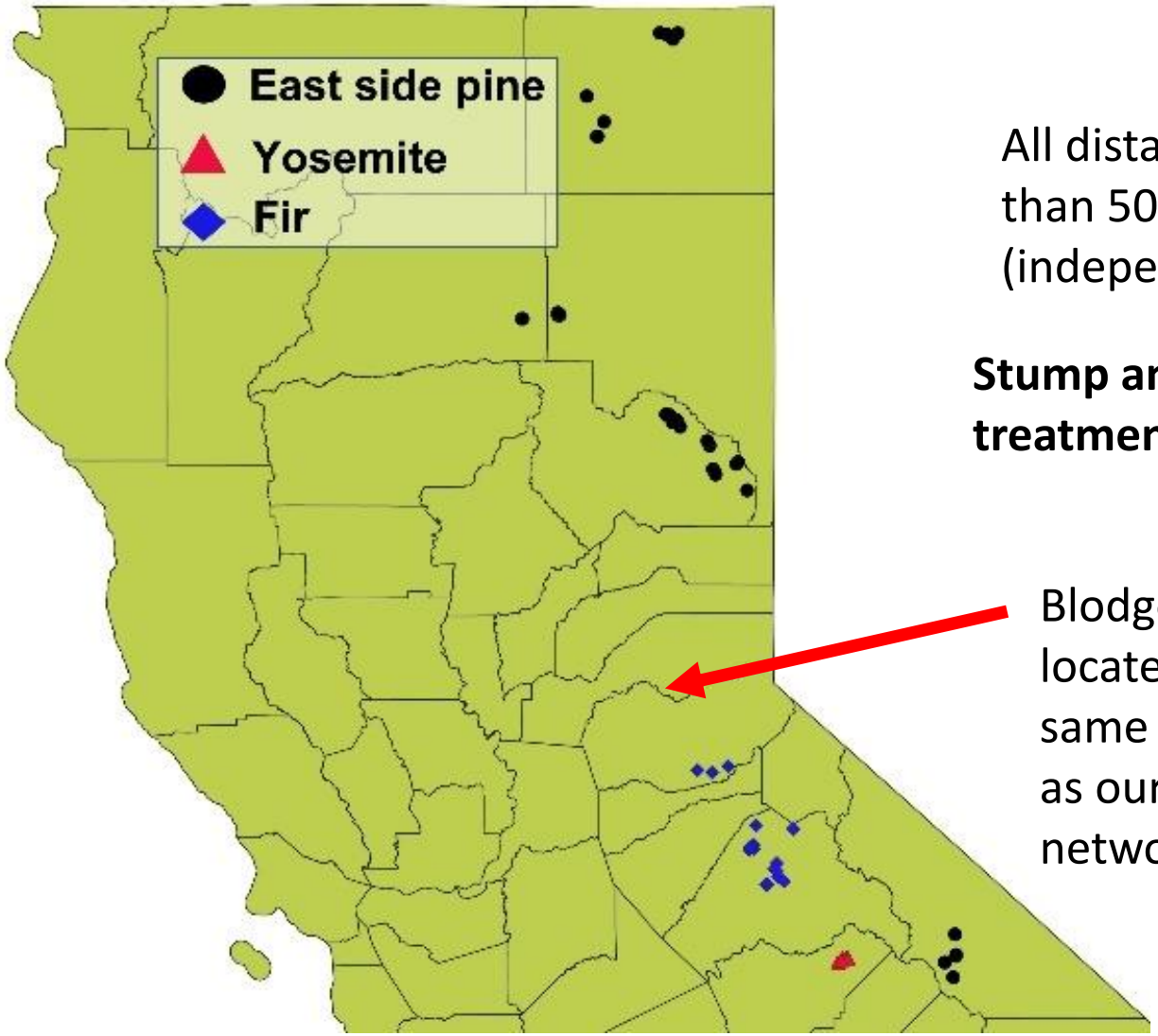
- We provide final reports on the four research products of this work:
- Long-term impacts of Heterobasidion root disease (two studies)
- An experimental evaluation of root disease (Heterobasidion) control in a working forest
- Wildfire implications


Yosemite National Park


Plumas National Forest


Yosemite National Park


Plumas National Forest

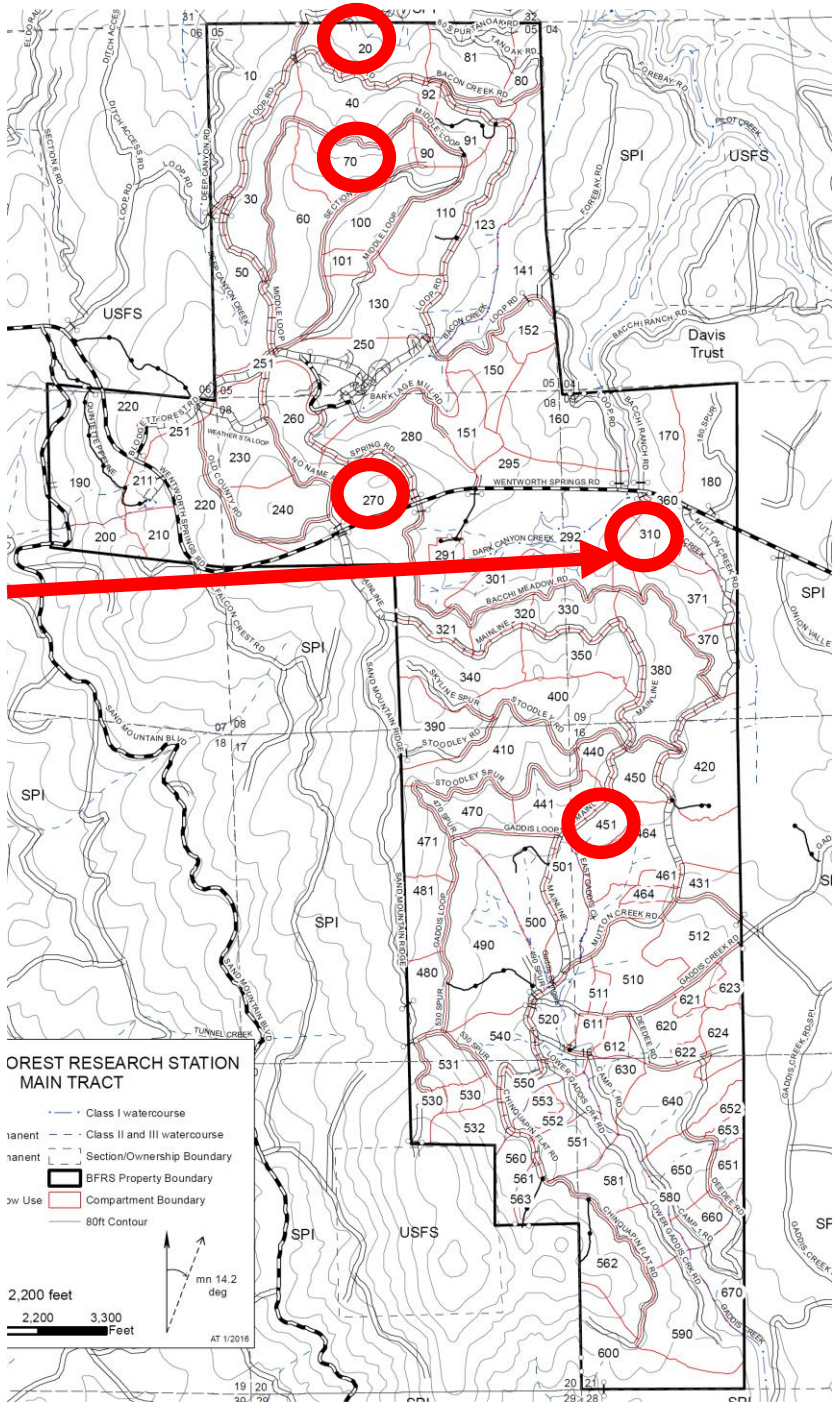


wounding treatment locations

All distances greater than 500m (independent)

Stump and wounding treatment (two sites)

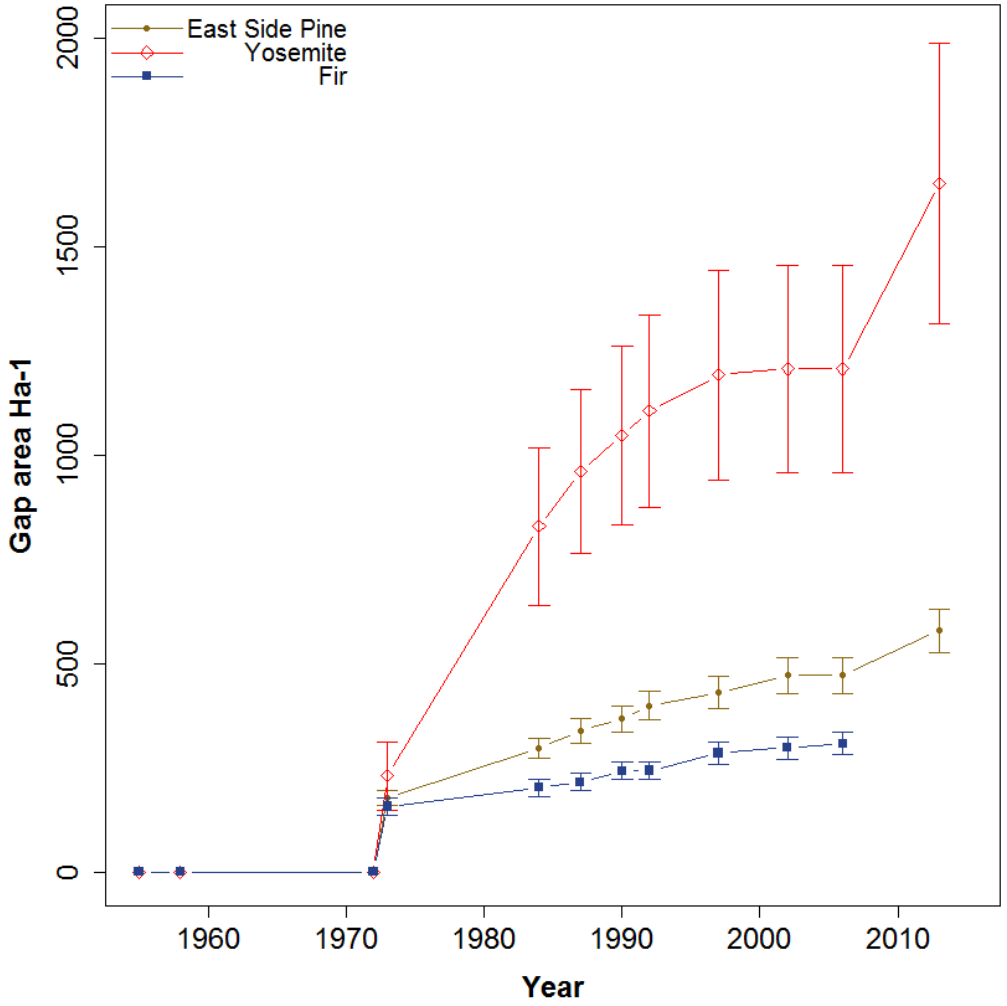
Blodget Forest; located within the same forest type as our “Fir” plot network

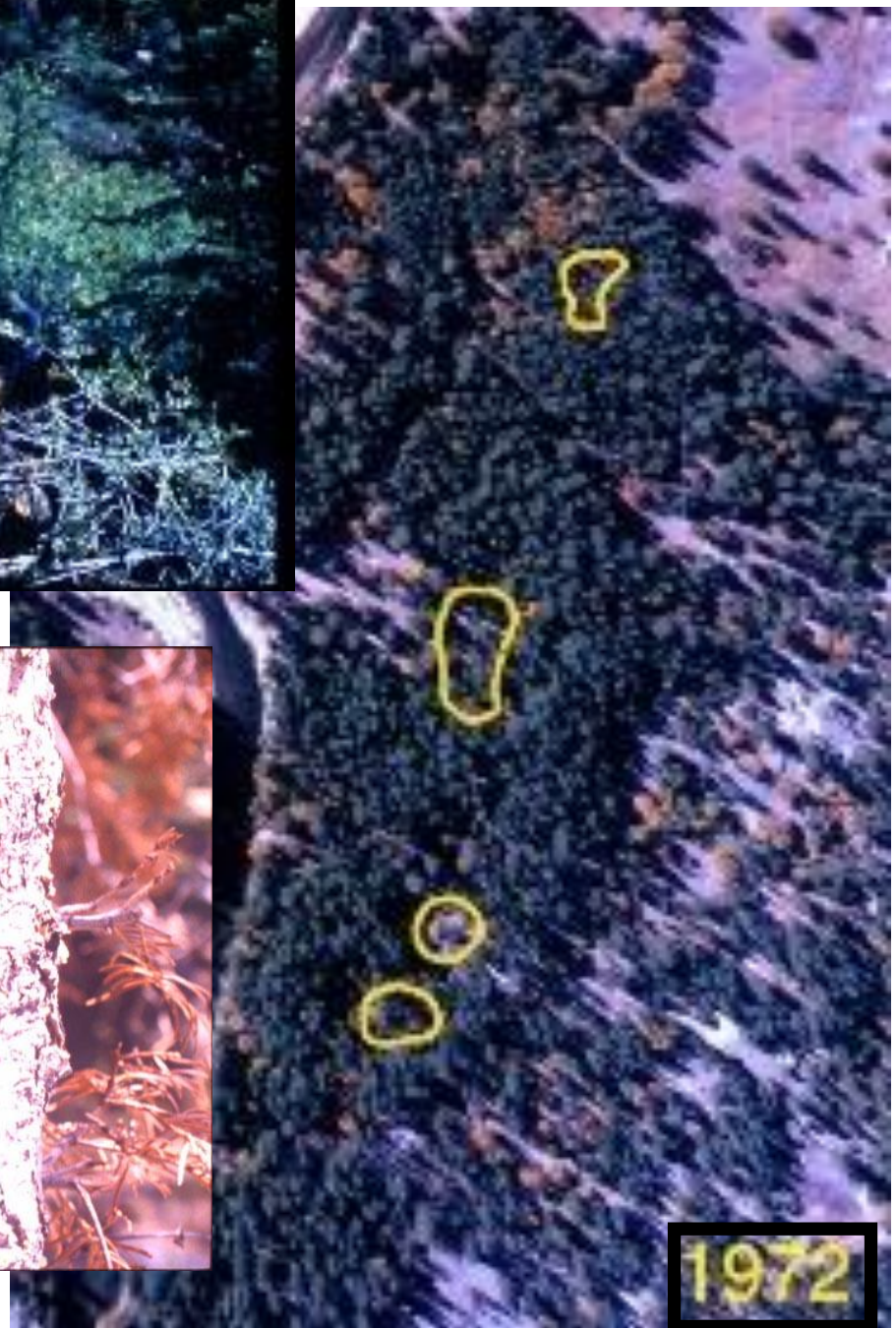


Heterobasidion root disease in California occurs in three distinct systems

- *Heterobasidion occidentale* – a disease of *Abies* (primarily); infects recently cut stumps and directly on tree boles
- *H. irregulare* – a disease of pines and incense cedar
  - Widespread in a single host system in east-side pine forests (Jeffrey and Ponderosa)
  - A single, impactful multi-host outbreak in Yosemite Valley

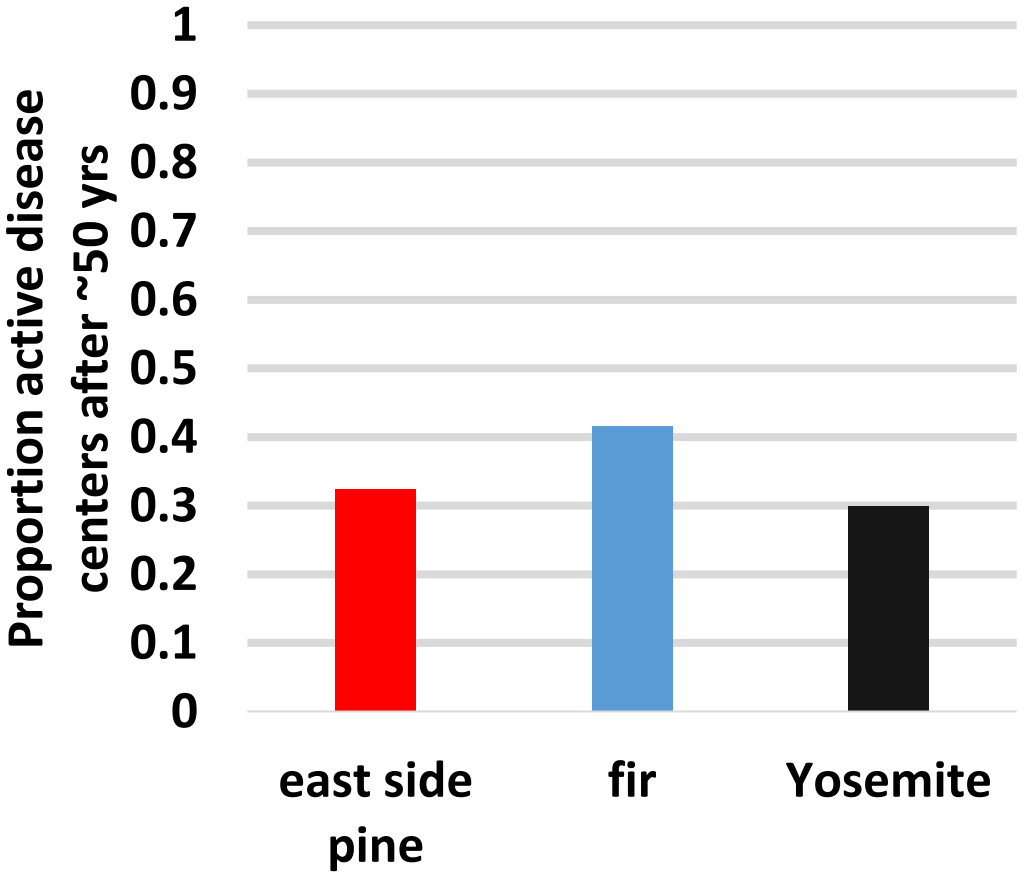
Heterobasidion disease impacts occur in foci and expand rapidly in the first 10-25 years




1972

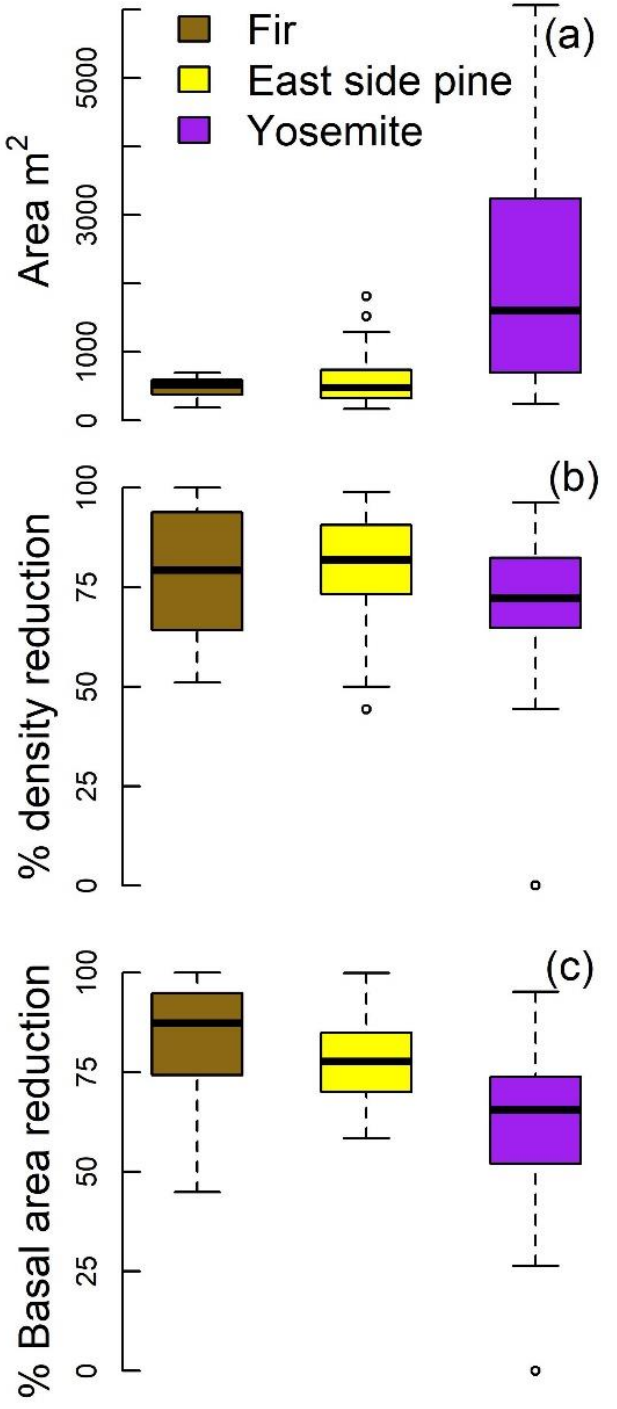

1997

In all disease systems, most centers remain active after 30-50 years, how do within center patterns develop?



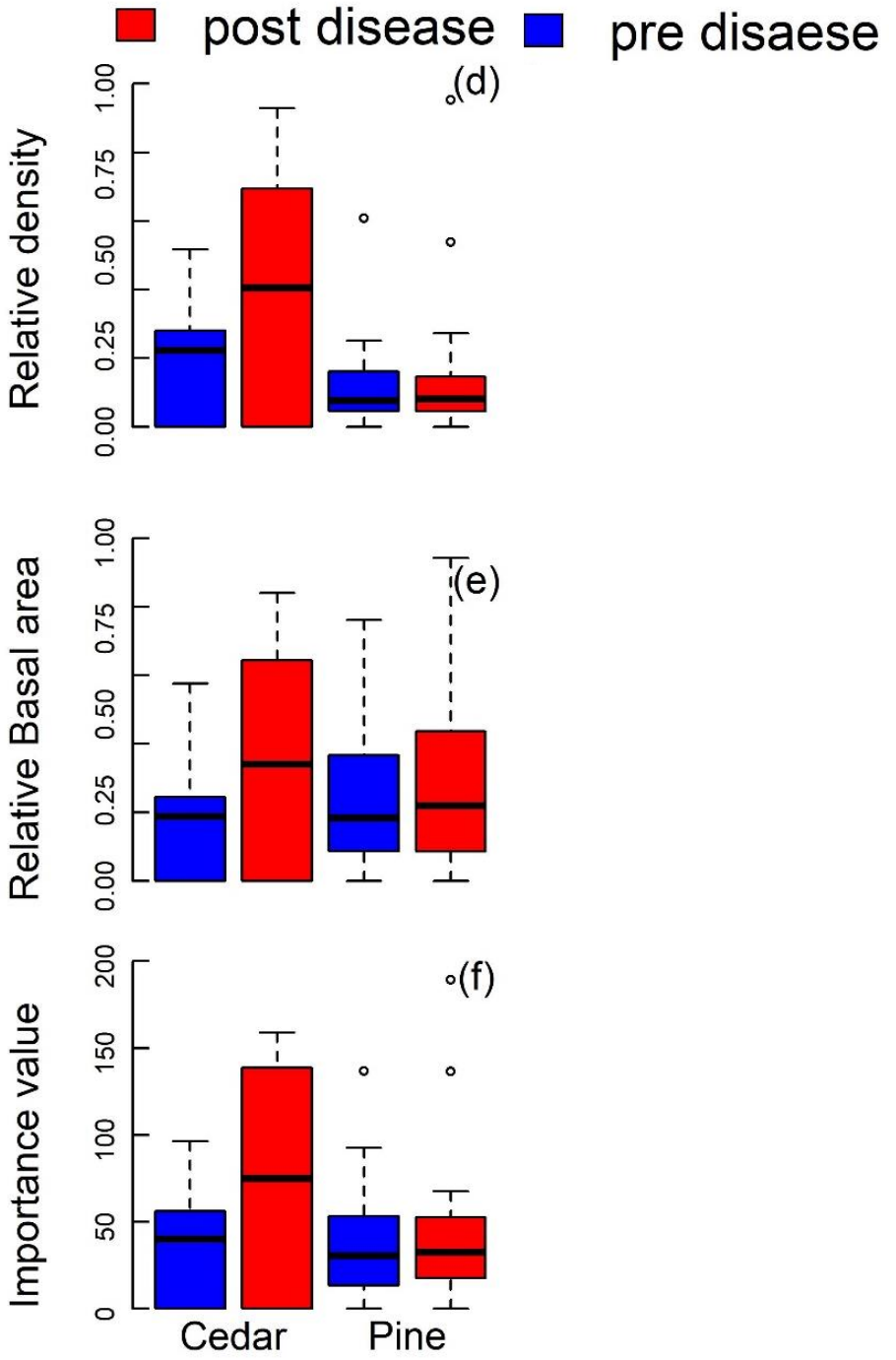
Heterobasidion impacts are long-lasting, at least 50 years but realistically much more

- Changes to forest structure within stands is substantial in terms of density and basal area in all systems
- Disease differs mostly in terms of disease center size, not among systems
- Flores et al (in prep)

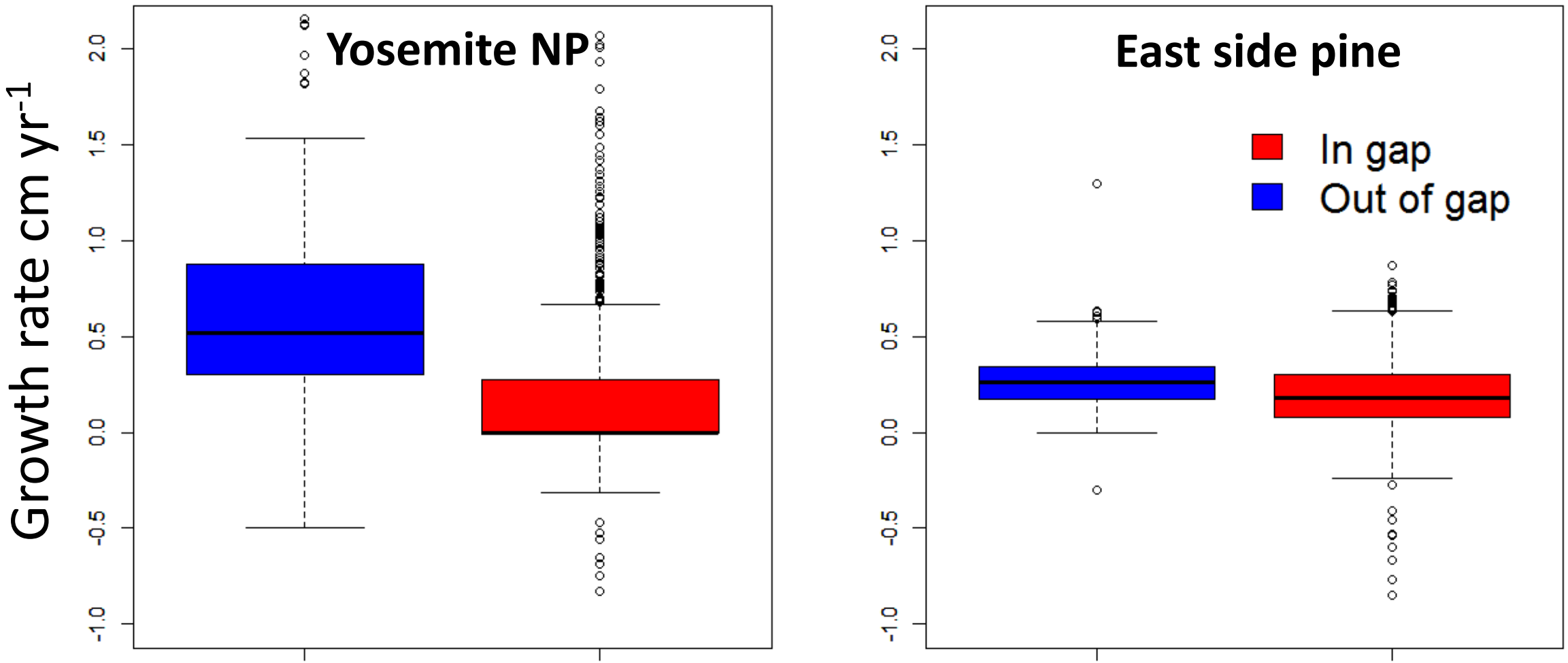


In pine systems, Heterobasidion does not change forest composition much, but in fir systems it favors Incense Cedar

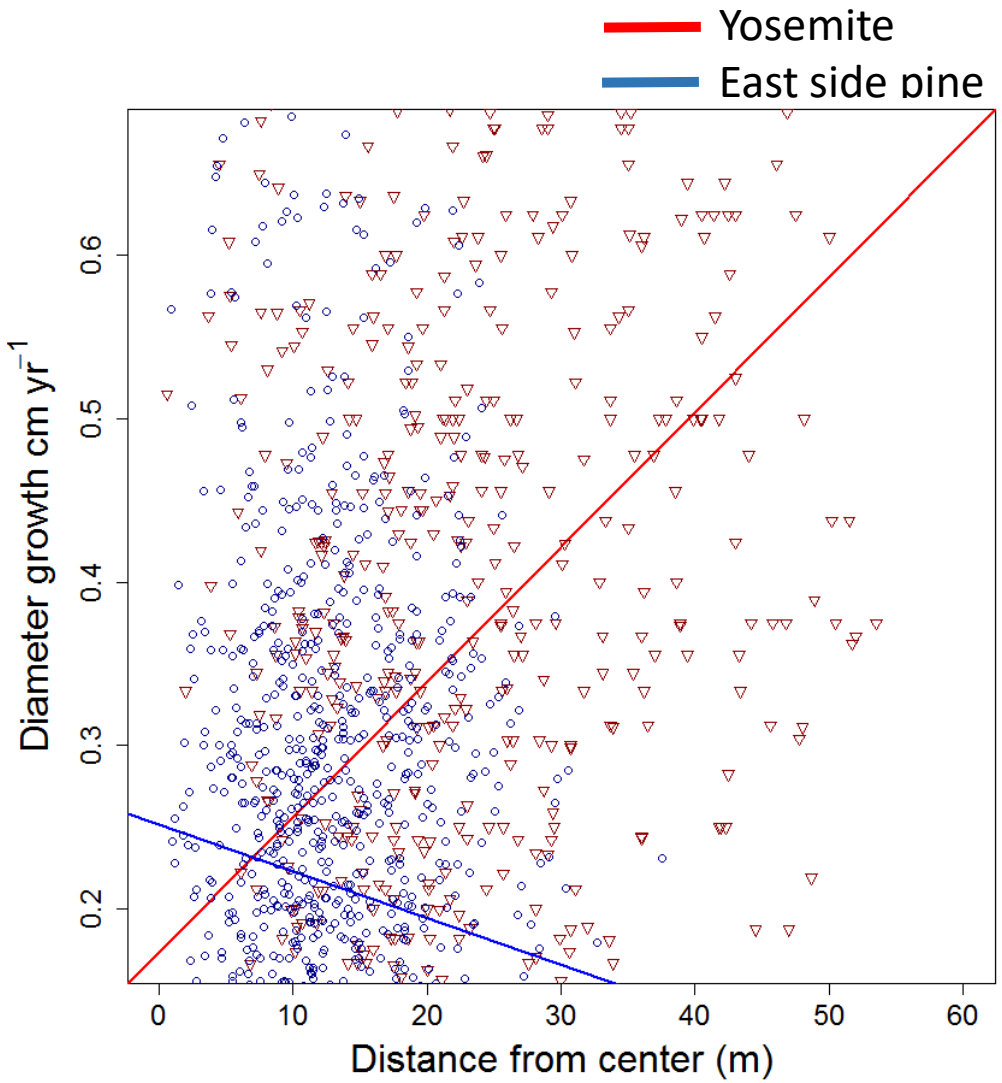
- *H. occidentale* is not a pathogen of Incense Cedar or pine
- In fir forests, the disease increases cedar dominance
- We also found weak evidence the disease increases pine dominance (mostly white pines in this system)
- Flores et al (in prep)



Pine forests: Disease centers have live trees, but their growth is reduced compared to those at the margins



Patterns of growth reduction differ across systems probably due to amounts and spatial variation in inoculum



Field experiment

- Does a California-native biocontrol provide protection against root disease emergence?
- Site location; Blodgett Forest (UC Berkeley)
- Treatments at 5 sites
  - Fir plantation (1)
  - Second growth with variable density and previous silviculture (4)
- This site has a long history of Heterobasidion and bark beetle research, both are widespread within the forest

Wounding treatment; Aim 1 – can we prevent stem infections of Heterobasidion?

- 5 sites; 40 trees per site
- 4 treatments on 30 trees
  - Borates
  - Urea
  - Control (wound – no treatment)
- Positive controls
  - Liquid Heterobasidion inoculum applied immediately to wound – local Blodget isolates
  - Control (wound – no treatment)
- *Scolytus ventralis* trapping on teach tree (sticky traps)

Stump treatment; Aim 2 – how well does a CA based biocontrol compare to common chemical controls?

- 2 sites; 120 trees
- Harvested in August 2019
- Three treatments plus a control, randomly applied
  - Borates
  - Urea
  - *Phlebiopsis* **
- *Phlebiopsis,* Blodgett isolates; High stumping – stump treatments applied 2-6 weeks after cutting

Phlebiopsis gigantea Stump treatment (Aim 2)

- *Phlebiopsis* (Pg – Rotstop®) is registered with an Eastern US strain, USFS has placed a moratorium on using Rotstop in Western forests
- Works **very** effectively in humid temperate forests; what about western forests with drier climate?
- Garbelotto collected 8 strains of Pg in California (<u>two from Blodgett!!!</u>)

Photos: Luana Giordano

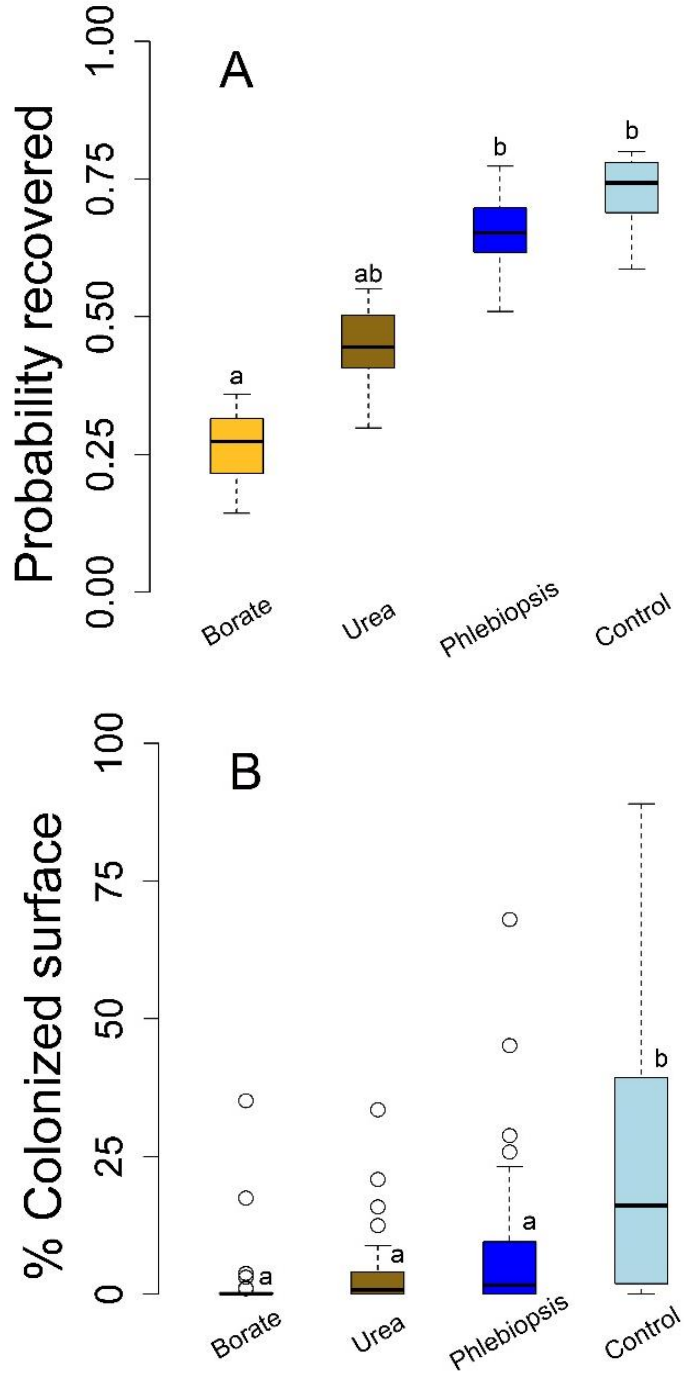

PLEASE DO


BEETLE TRAP


HDX

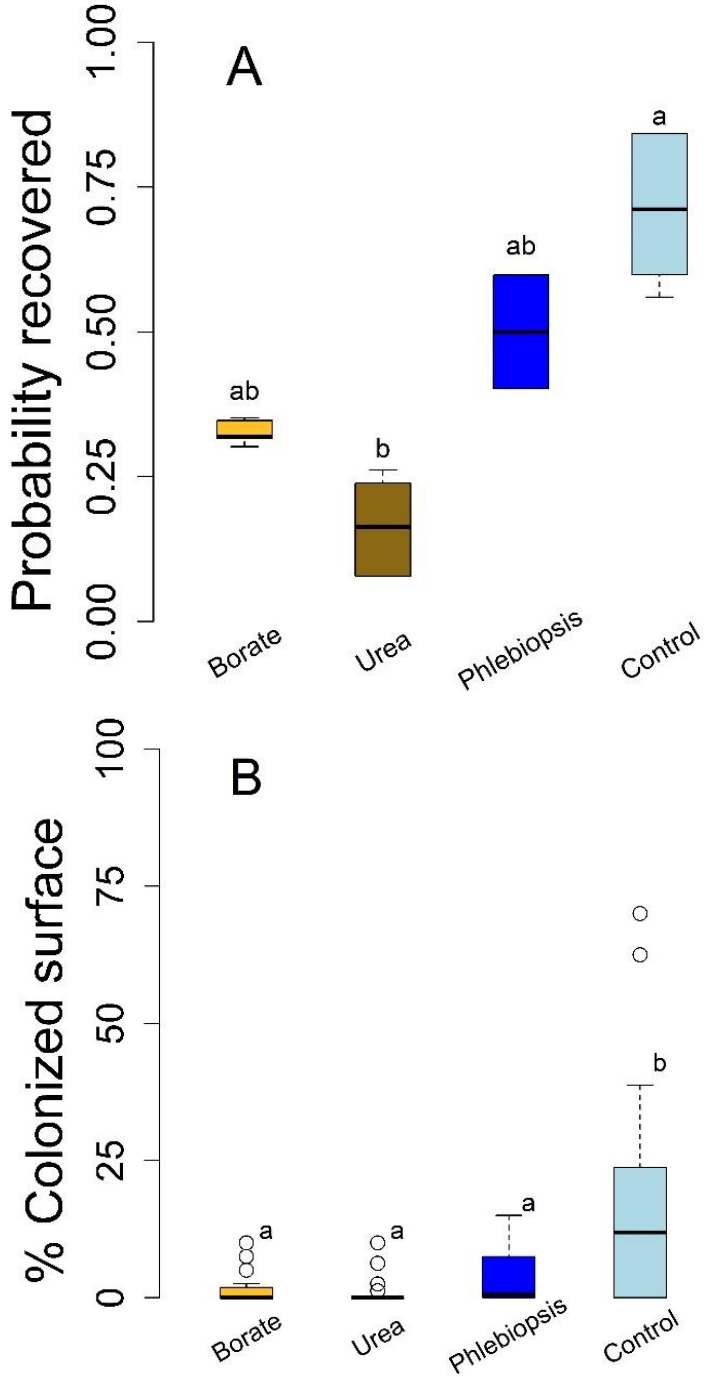
Results – stump treatments

- Study results (1 yr post treatment)
- Biocontrol (Pg) provided comparable reduction in pathogen growth to Borates and Urea compared to no treatment
- Borates and Urea were more effective in preventing pathogen establishment overall
- Results were confirmed by the laboratory block experiment
- [Poloni et al. 2021]



Lab results matched stump treatments

- Again, Pg was effective in limited pathogen growth but not establishment
- Borate and Urea both prevented and reduced pathogen growth
- An experimental one-week delay between inoculation and chemical/biological control had no effect
- [Poloni et al. 2021]

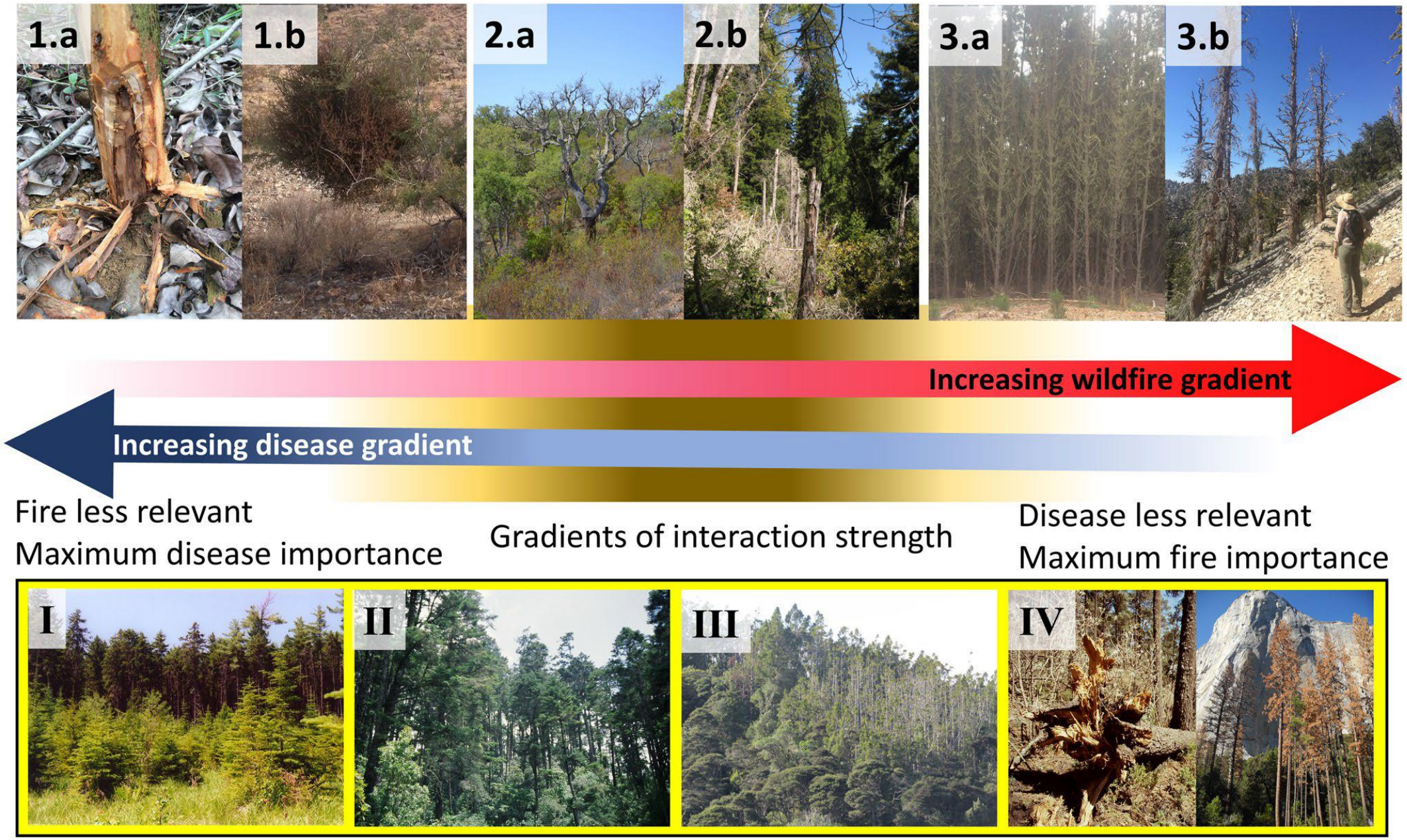


Wound treatment – one year post treatment

- No pathogen was recovered on any treatment including positive and negative controls
- *S. ventralis* was recovered, but was not associated with treatment
- Direct infection of wounds does occur, but we could not induce this… what ecological interactions are we missing?
- Poloni et al. 2021

What is next?

- Much of the east side pine plot network burned in the Dixie fire, did disease centers alter fire impacts?
- Confirmation of Pg in drier east side forests is underway by the Garbelotto lab
- Confirming Pg results in a broader set of forests will help get this tool into foresters' hands
- Is *H. occidentale* an endophyte?


1.a
1.b
2.a
2.b
3.a
3.b
Increasing wildfire gradient
Increasing disease gradient
Fire less relevant
Maximum disease importance
Gradients of interaction strength
Disease less relevant
Maximum fire importance
I
II
III
IV

[Cobb 2022]

Participants and other support

- Adrian Poloni (MS)
- Alex Flores (undergraduate fellow)
- These funds also supported training of
  - Jacqueline Rose (MS)
  - Daniel Keeley (MS)
  - Gissella Quiroga (undergraduate)
  - Brian Sipe (undergraduate)
  - Hannah Romero (undergraduate)
- Thanks to Blodgett (!!!); Stanislaus, El Dorado, Plumas, Inyo, Lassen, Modoc NFs

- EMC – primary support
- Cal State ARI program
- HSI fellowship (Flores – ARI)
- McIntyre Stennis (USDA NIFA)
- Forest Service Research - PSW
- Publications (so far)
  - Poloni et al. 2021
  - Cobb 2022
  - Flores et al (in prep, this year; Forest Pathology)
  - Cobb et al. (in prep, next year)