

Effects of sudden oak death on plant community structure and regeneration in the Big Sur ecoregion of California



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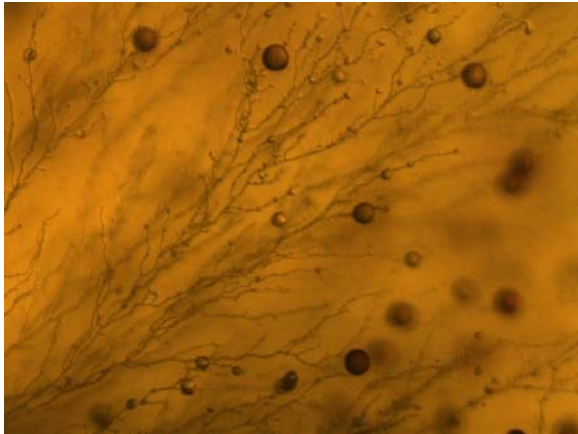


Phytophthora ramorum

- An emerging, generalist pathogen causing “sudden oak death”
- Infects >40 genera
- Mainly spread by California bay laurel
- Lethal infections in *Quercus spp.* and *Lithocarpus densiflorus*
- Infections favored by warm, wet springs



Key hosts and infection types



Phytophthora ramorum



coast redwood



California bay laurel



coast live oak



canyon live oak



coast live oak



tanoak



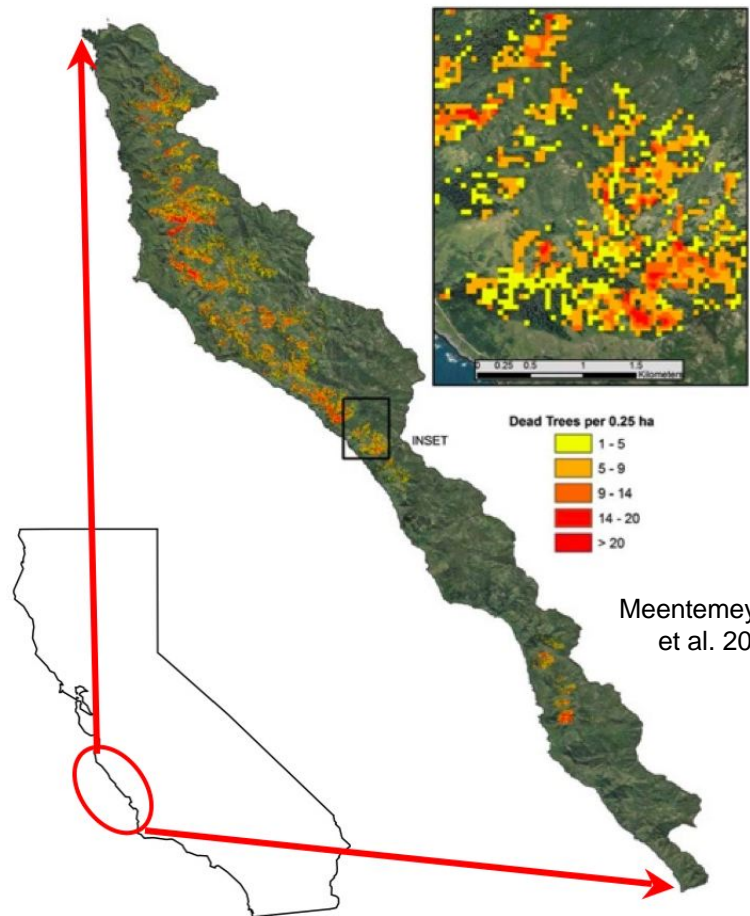
tanoak

innoculum
sources





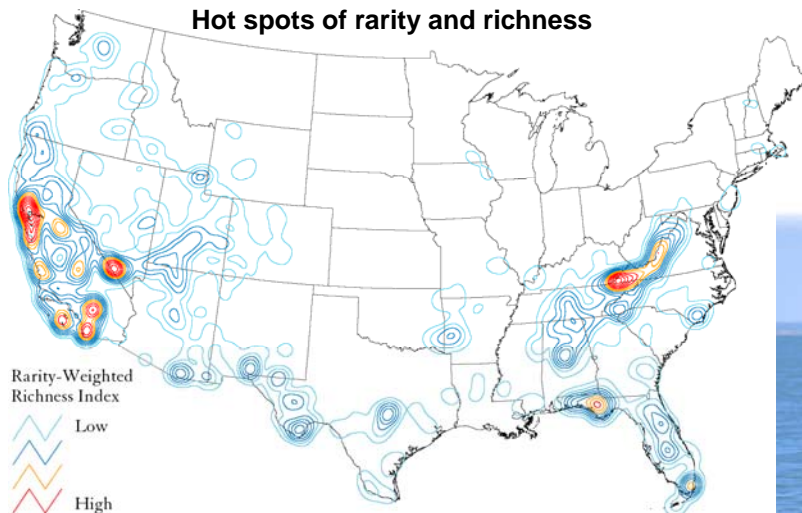
Distribution of Sudden Oak Death as of June 5, 2008



Big Sur, California



- Ecologically rich
- High conservation priority
- Ecology of region was little studied
- Heavily impacted & disease-free zones
- Relatively few major landowners



The Nature Conservancy, 2000. *Precious Heritage*

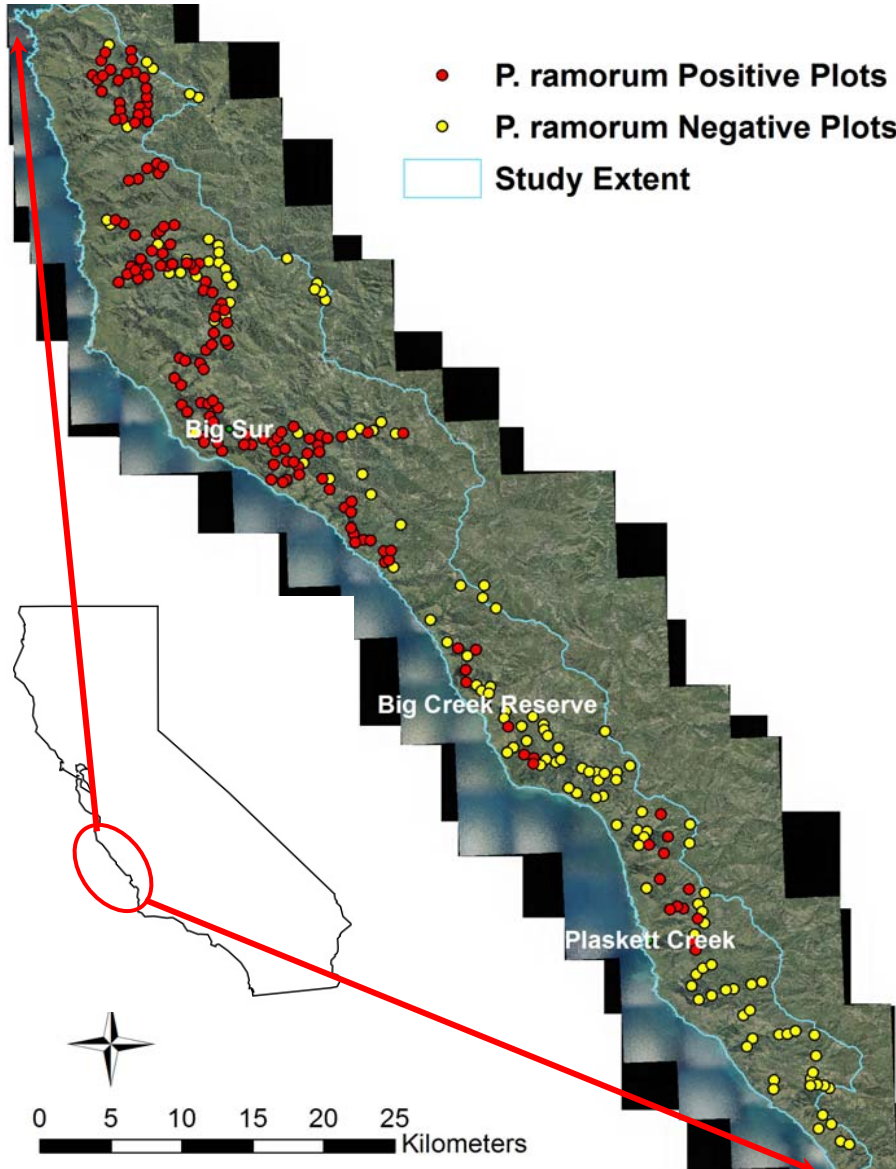


Big Sur Project Objectives

- Establish a network of ecological monitoring plots
- Set goals and priorities for management
- Place SOD in the context of overall management in the region
- Develop an outreach program that involves local communities in adaptive management



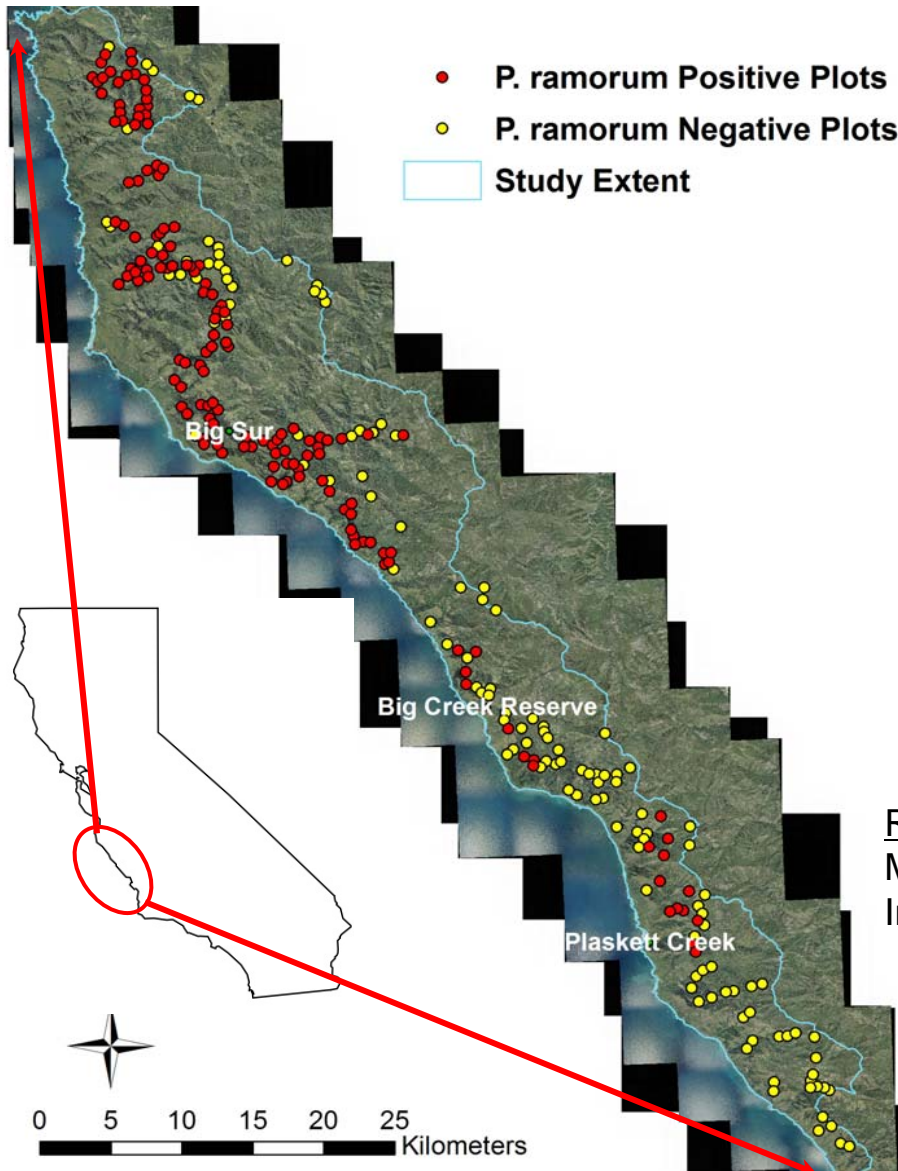
Big Sur Forest Plot Network (est. 2006-2007)



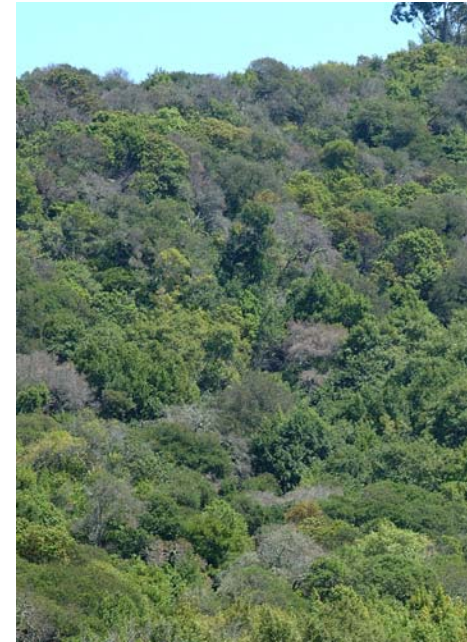
- 280 500-m² plots
- Stratified across watersheds, forest type, fire history, and SOD mortality
- Baseline data
 - Species composition and size distributions
 - *P. ramorum* symptoms
 - Coarse woody debris
 - Seedling/sapling regeneration

*data from 175 plots established in 2006

Big Sur Forest Plot Network (est. 2006-2007)



Mixed-Evergreen Forest
Mortality: coast live oak
Shreve's oak
Innoculum: bay



Redwood Forest
Mortality: tanoak
Innoculum: bay
tanoak



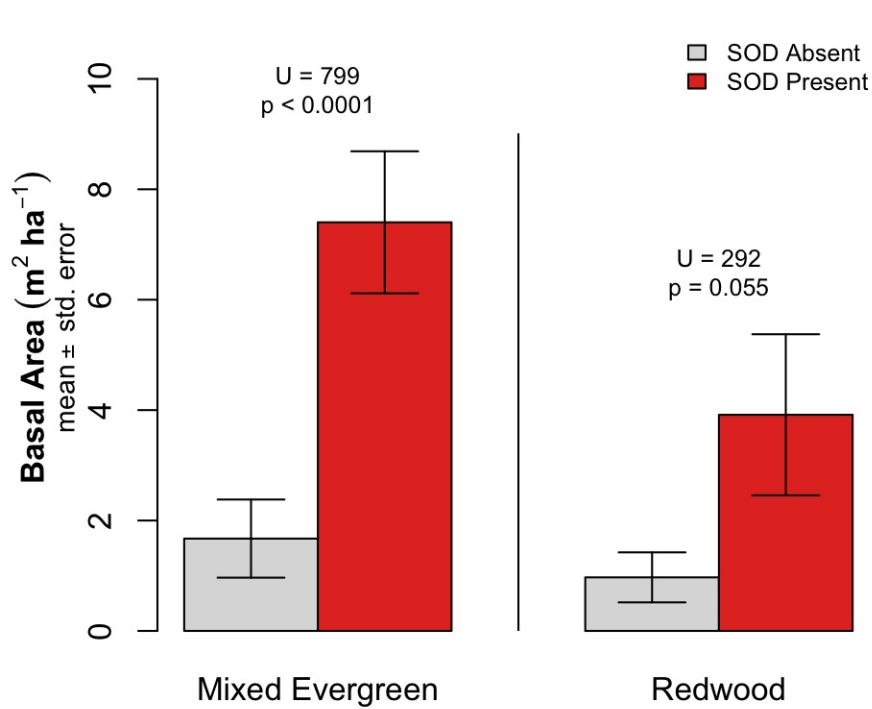
How has SOD impacted forest structure?

1. Has selective mortality led to shifts in species composition?
2. What is the regeneration trajectory?
3. How might SOD interact with wildfire?

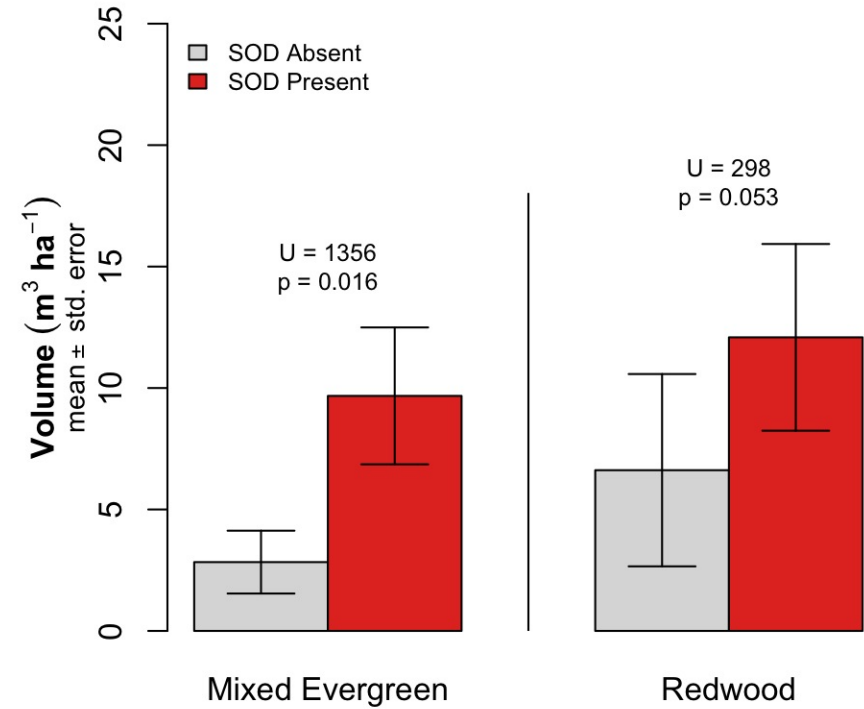


Impacts on Oak and Tanoak Mortality

Standing Dead

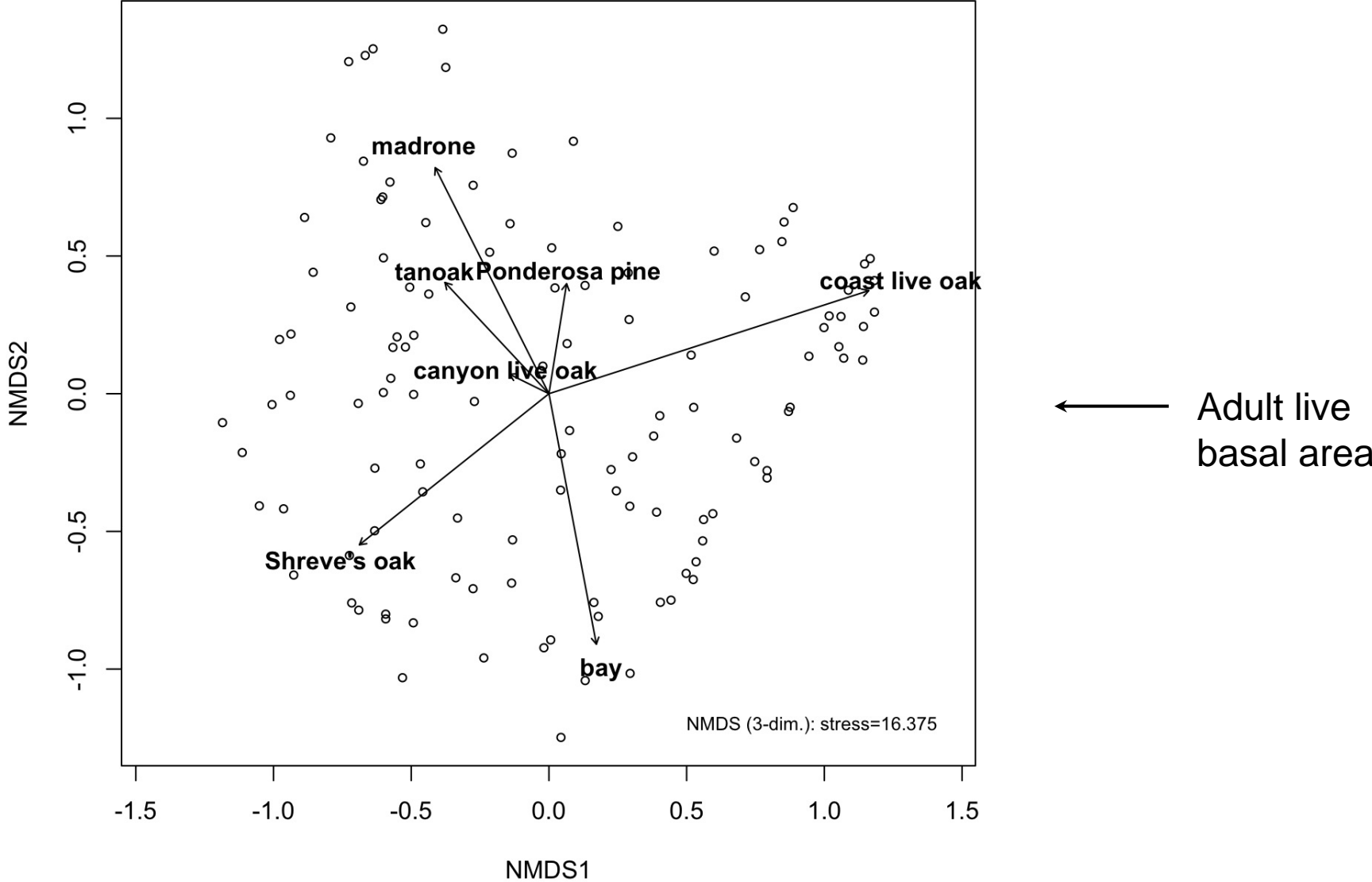


Downed Logs



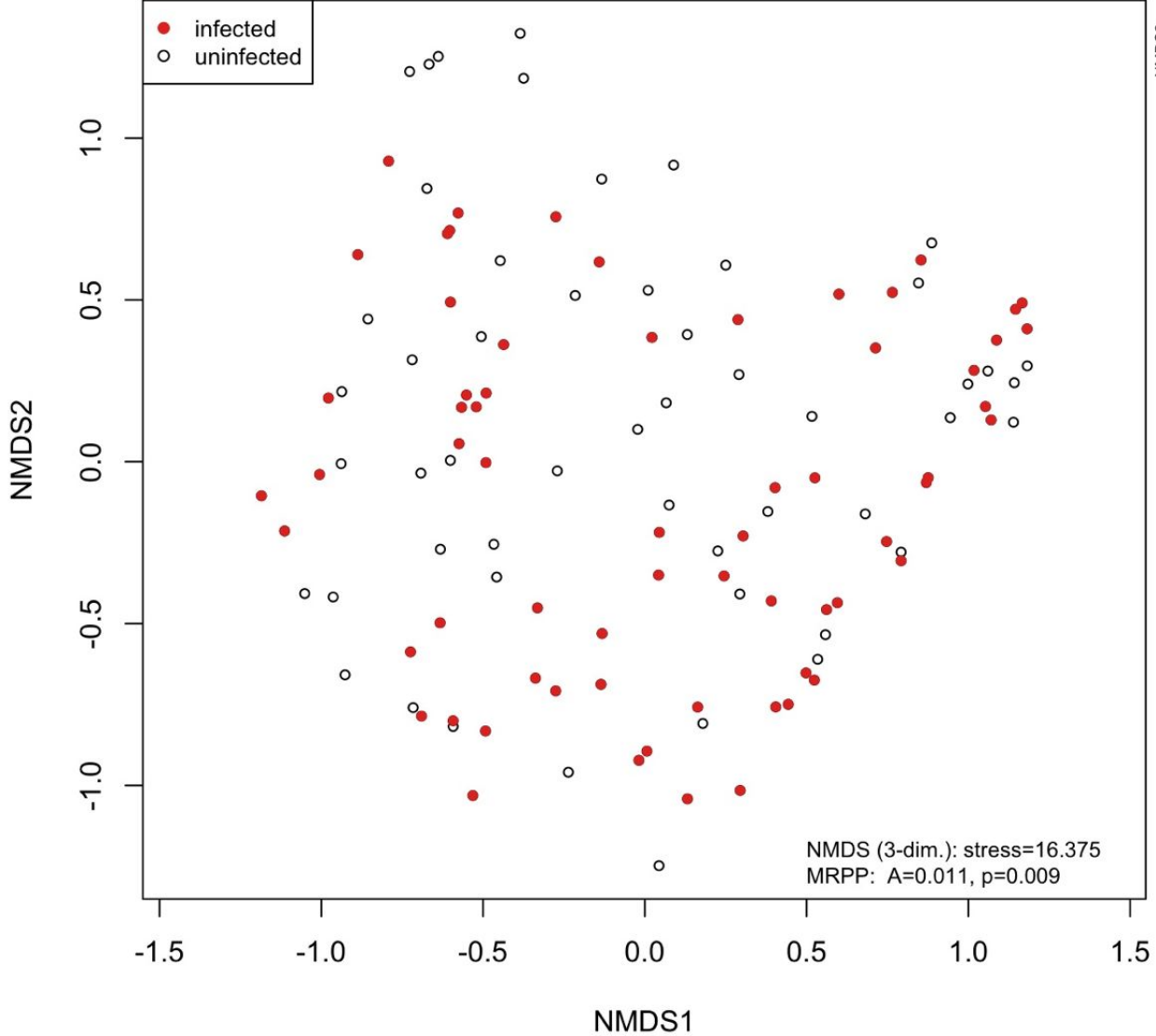
Community Shifts

Mixed-Evergreen Forest: Live Basal Area

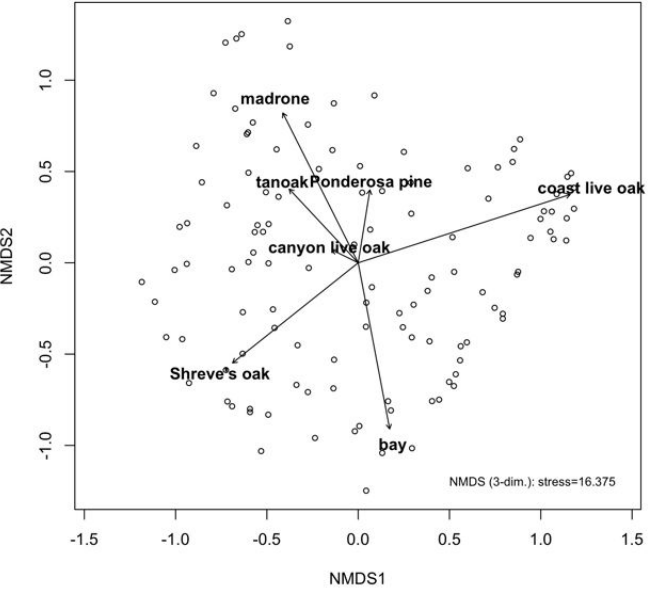


Community Shifts

Mixed-Evergreen Forest: Live Basal Area



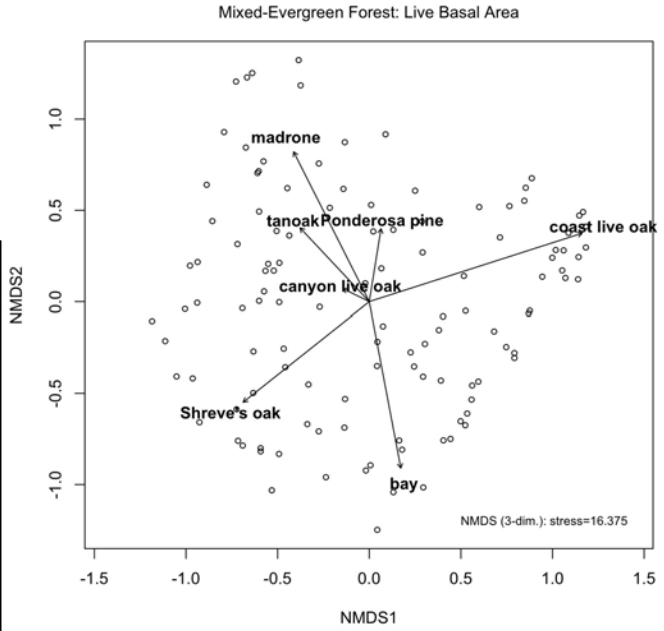
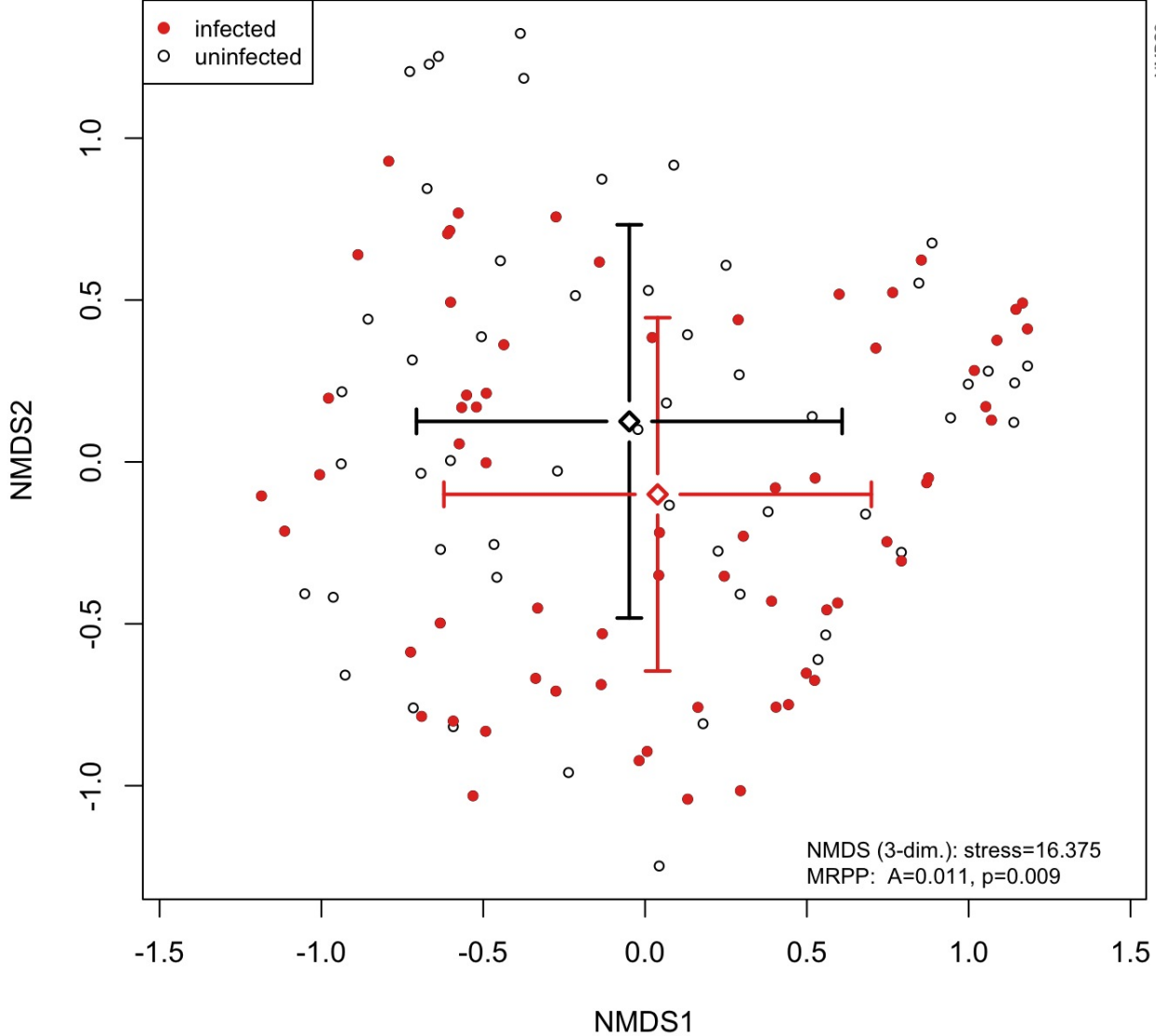
Mixed-Evergreen Forest: Live Basal Area



← Adult live basal area

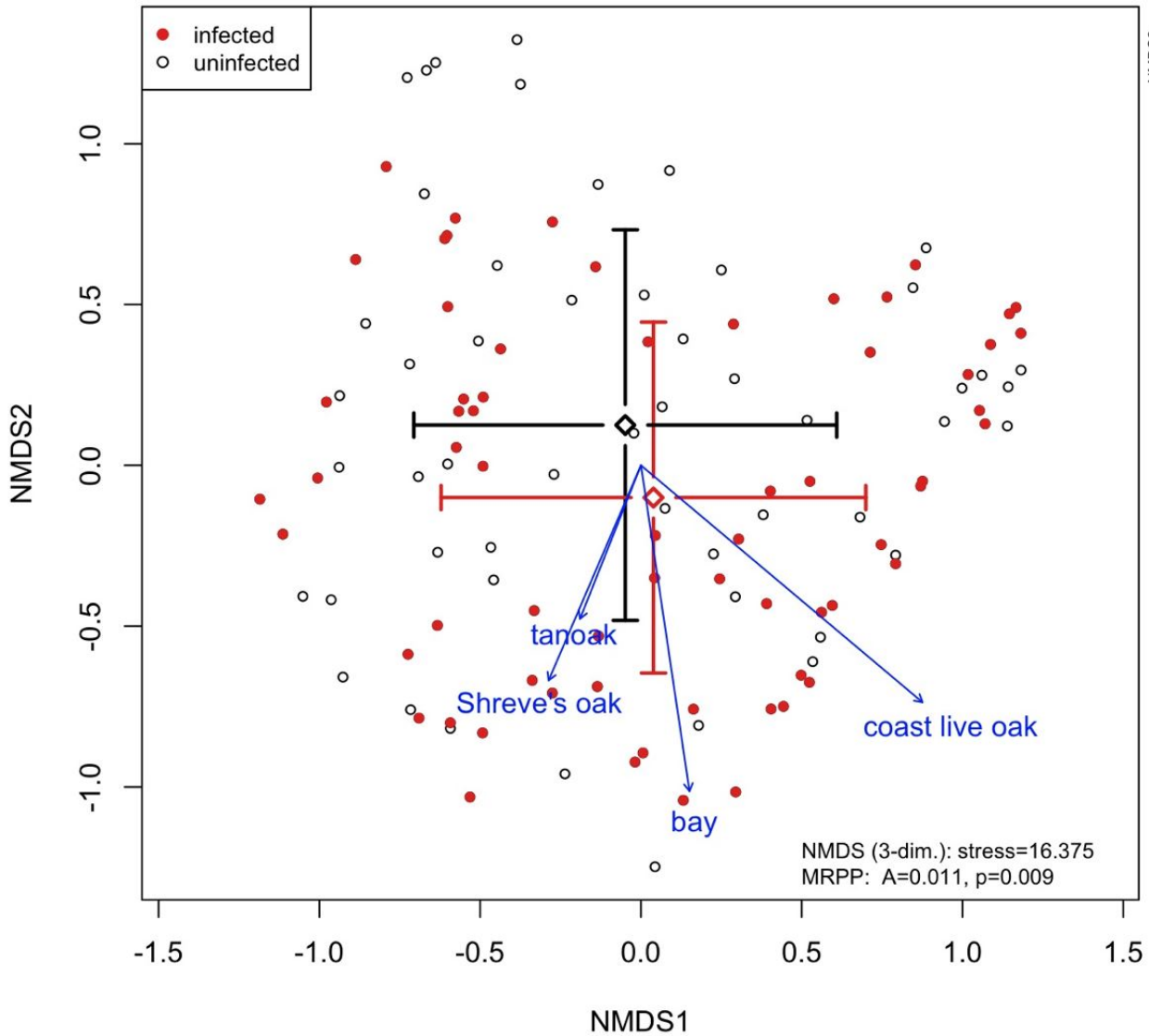
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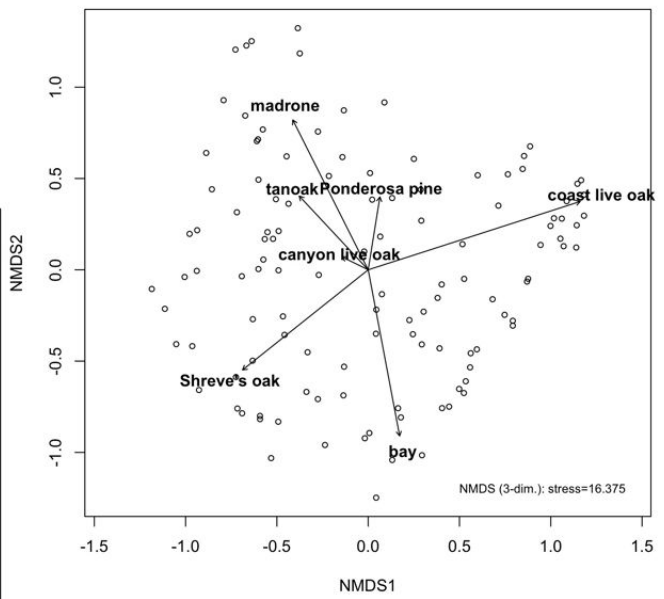


Community Shifts

Mixed-Evergreen Forest: Live Basal Area



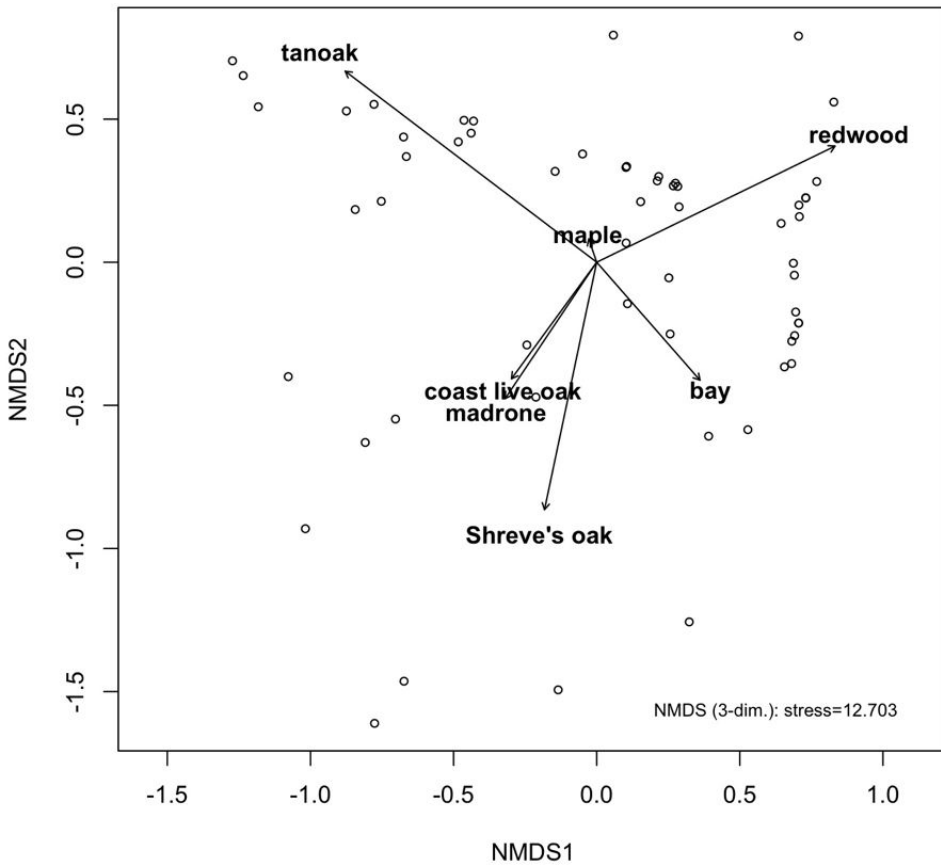
Mixed-Evergreen Forest: Live Basal Area



- ← Adult live basal area
- ← Proportion of all stems that are dead or symptomatic

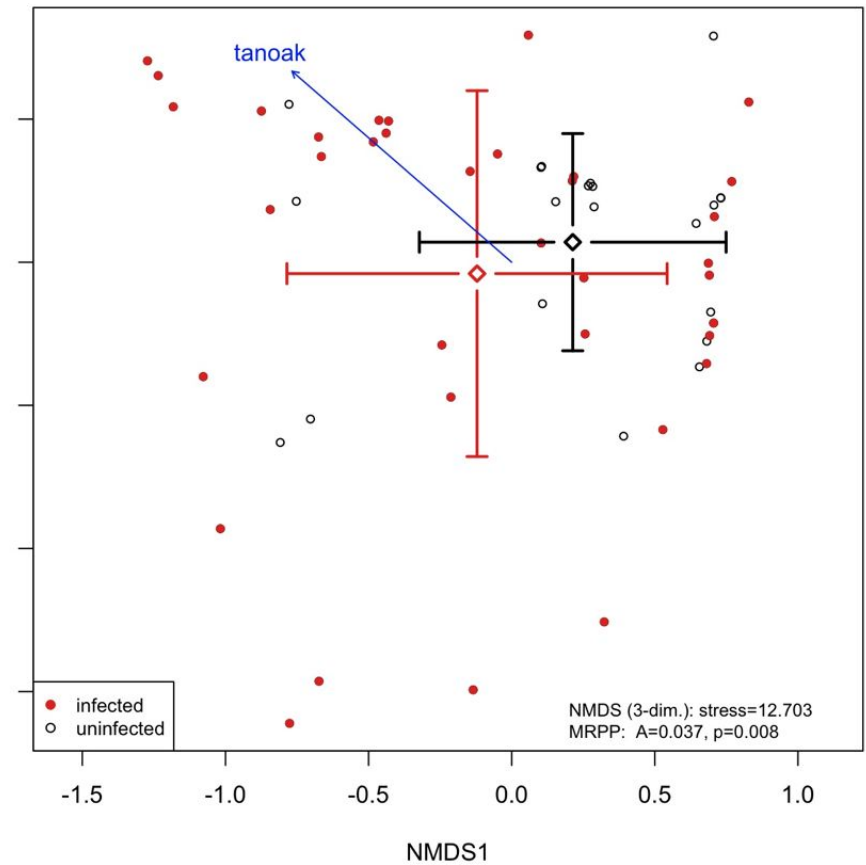
Similar shifts in Redwood Forest

Redwood Forest: Live Basal Area



← Adult live basal area

Redwood Forest: Live Basal Area



← Proportion of all stems that are dead or symptomatic

How has SOD impacted forest structure?

1. Has selective mortality led to shifts in species composition?
 - Great variability in composition within and among infected and uninfected plots
 - Inferred mechanism: Shifts in species composition are correlated with increasing proportions of symptomatic/dead trees of susceptible host species



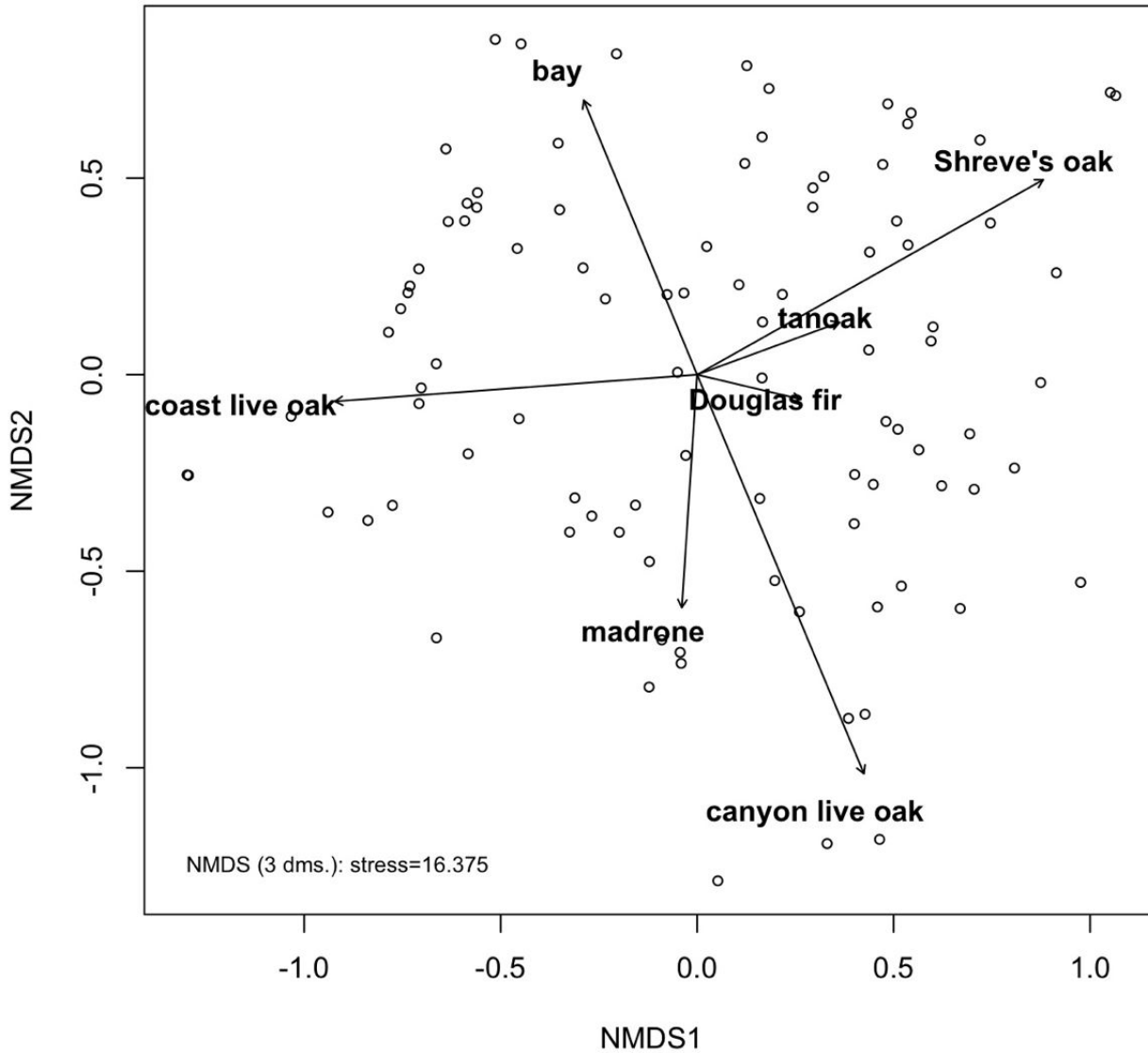
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Forest Advanced Regeneration

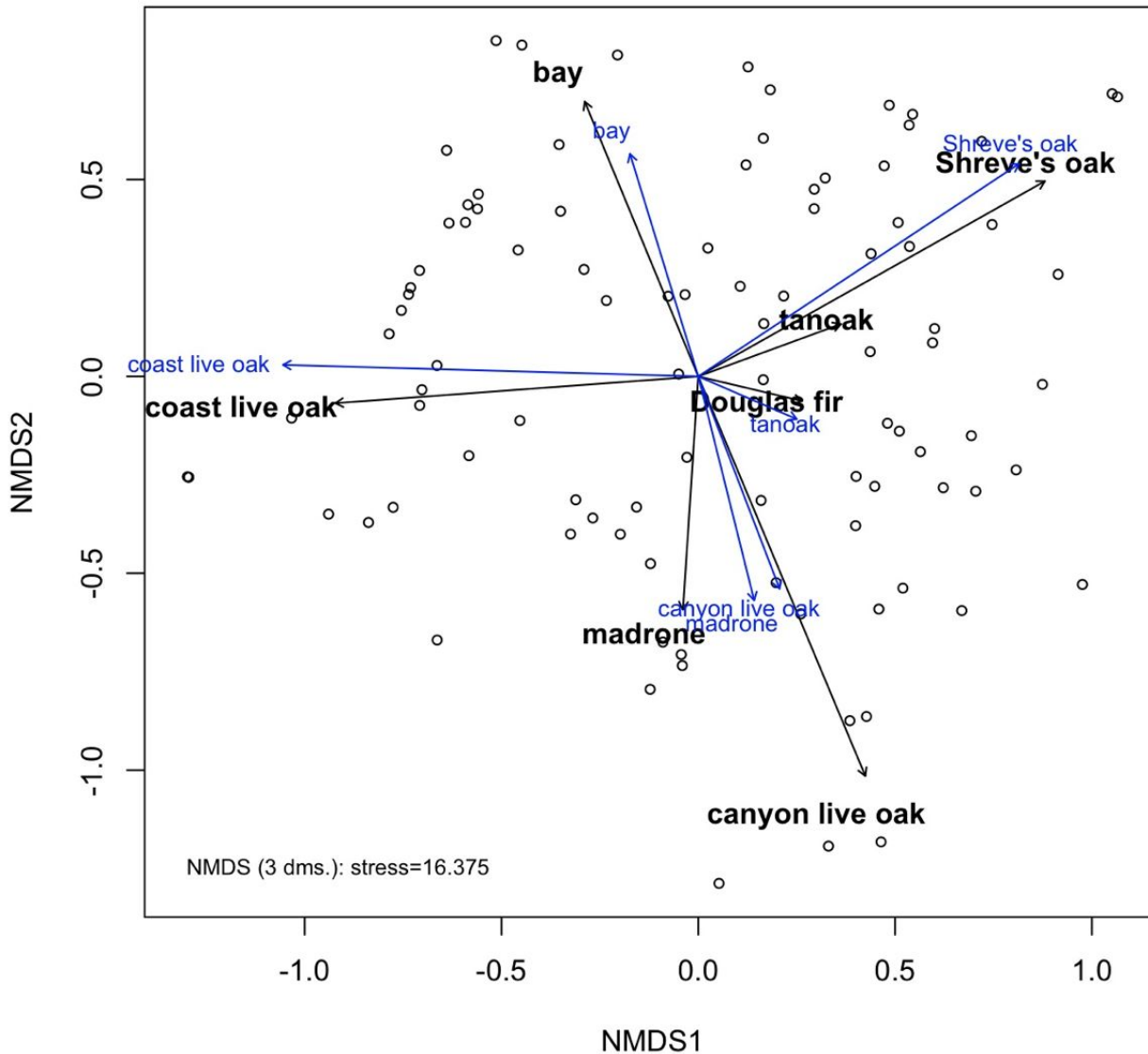
Mixed-Evergreen Forest: Advanced Rengeneration



← Seedling/sapling density

Forest Advanced Regeneration

Mixed-Evergreen Forest: Advanced Rengeneration



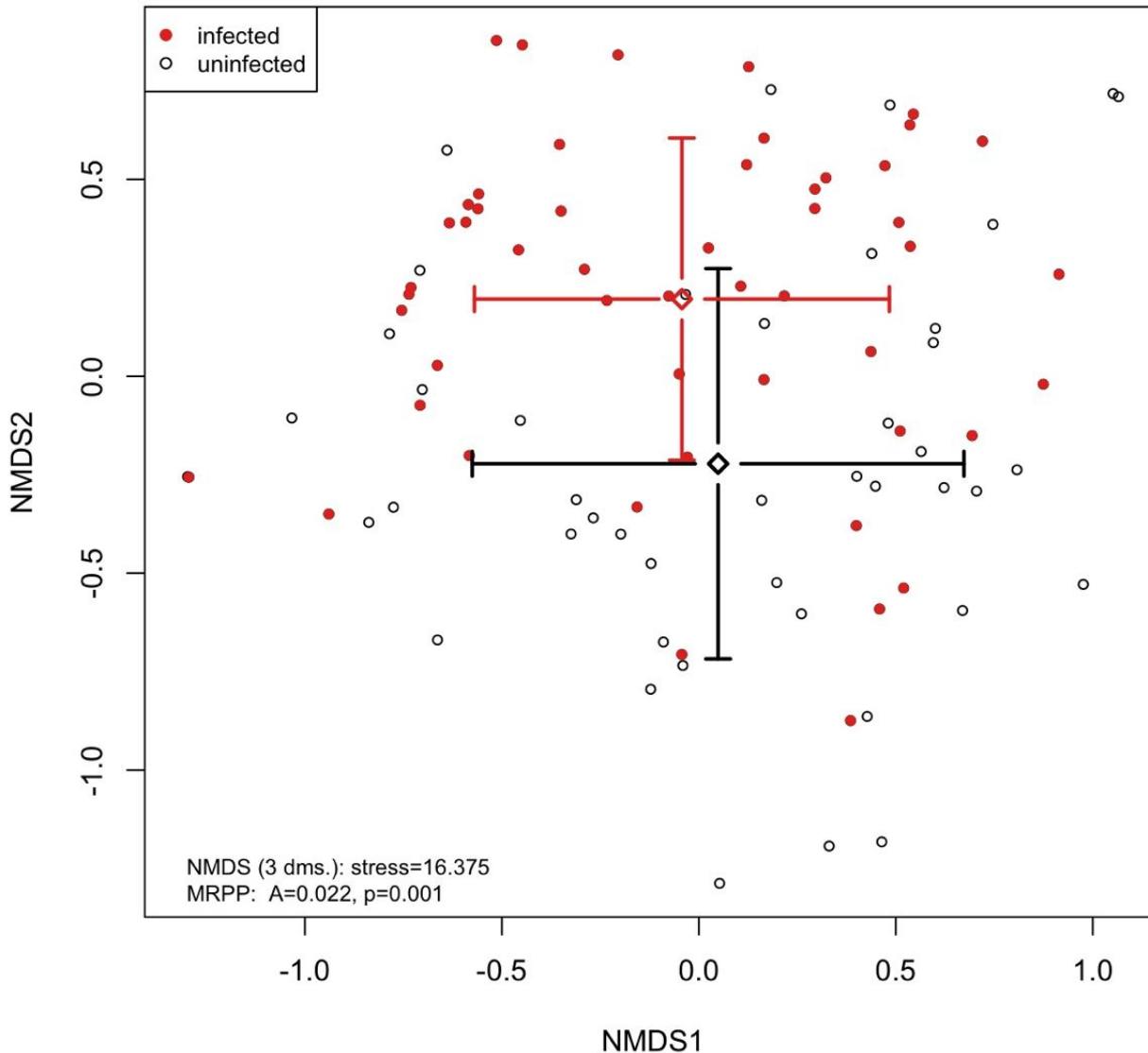
← Seedling/sapling density

← Adult basal area

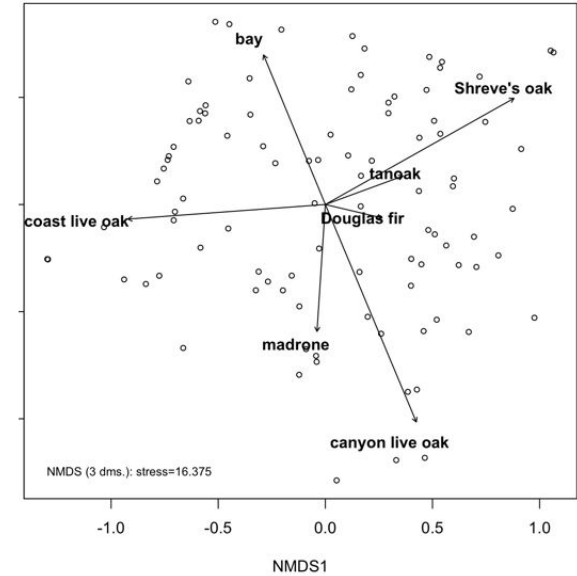
- Seedling/sapling abundance correlated with adult abundances

Forest Advanced Regeneration

Mixed-Evergreen Forest: Advanced Regeneration



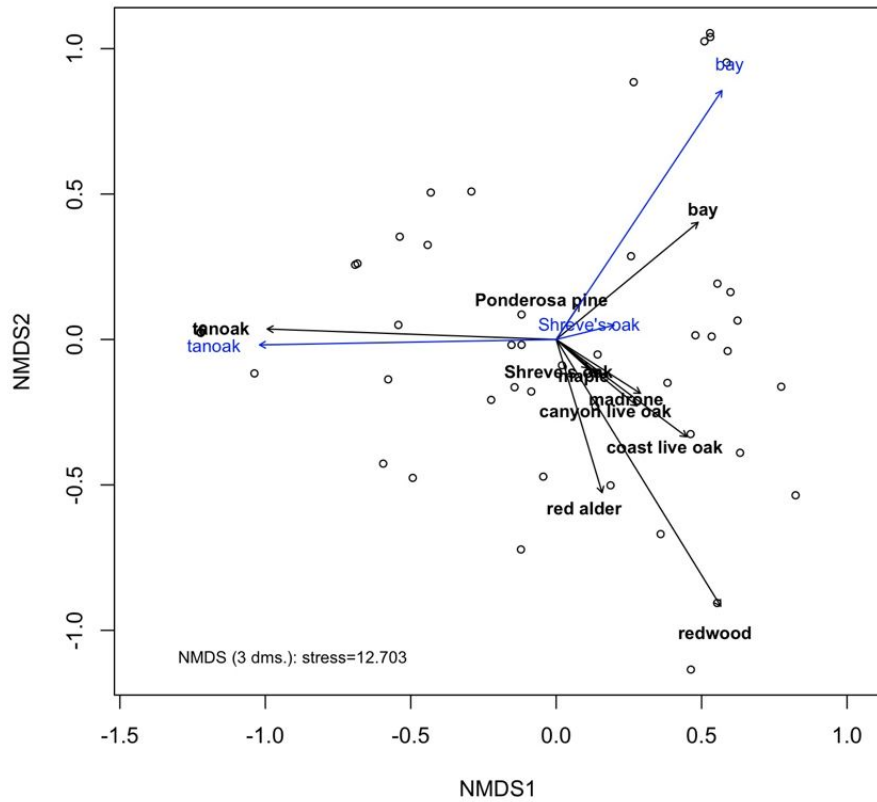
Mixed-Evergreen Forest: Advanced Regeneration



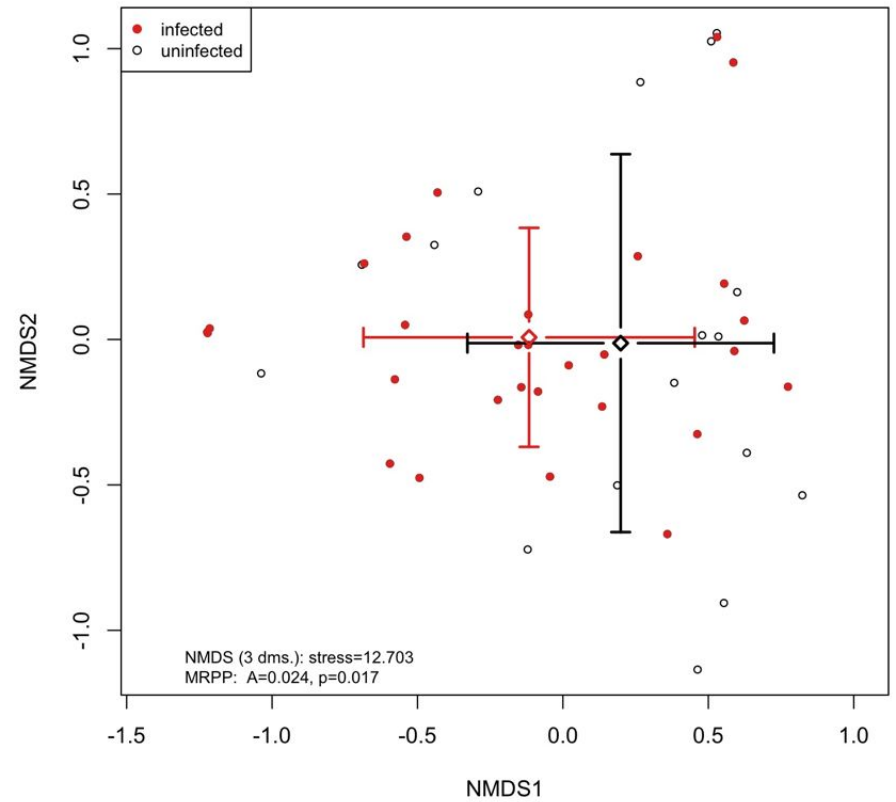
- Seedling/sapling abundance correlated with adult abundances
- Significant difference in SOD-impacted plots, but large within-group variation

Redwood forest regeneration

Redwood Forest: Advanced Rengeneration



Redwood Forest: Advanced Rengeneration



How has SOD impacted forest structure?

2. What is the regeneration trajectory?

- Understory composition differs between uninfected and infected plots
- Seedling abundance tracks the adult composition
- With greater adult mortality, regeneration may become dominated by hosts with non-lethal infections.



How has SOD impacted forest structure?

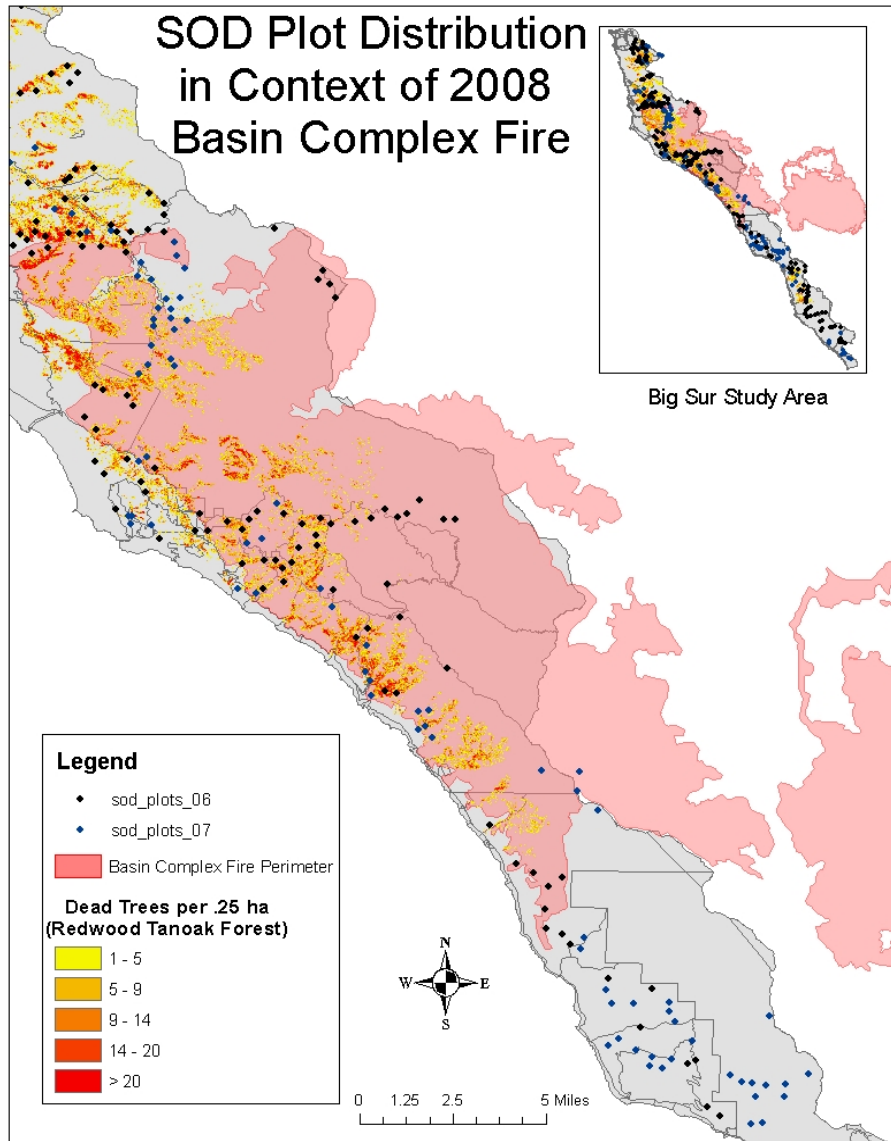
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2. What is the regeneration trajectory?
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California wildfires - July '08



Big Sur - Basin Fire



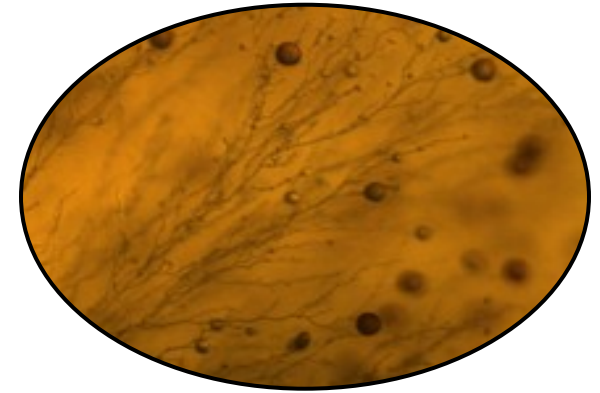
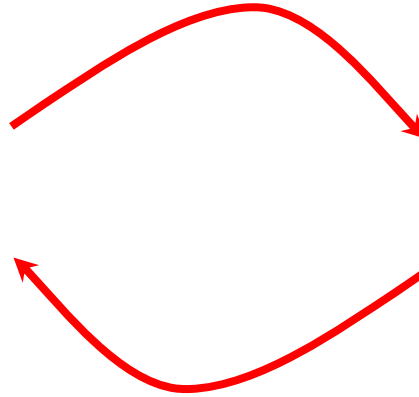
- Started June 21, 2008
- 100% contained on July 27, 2008
- Burned approximately 66,000 hectares
- ~1/3 plots within perimeter



Interacting disturbances



Fire



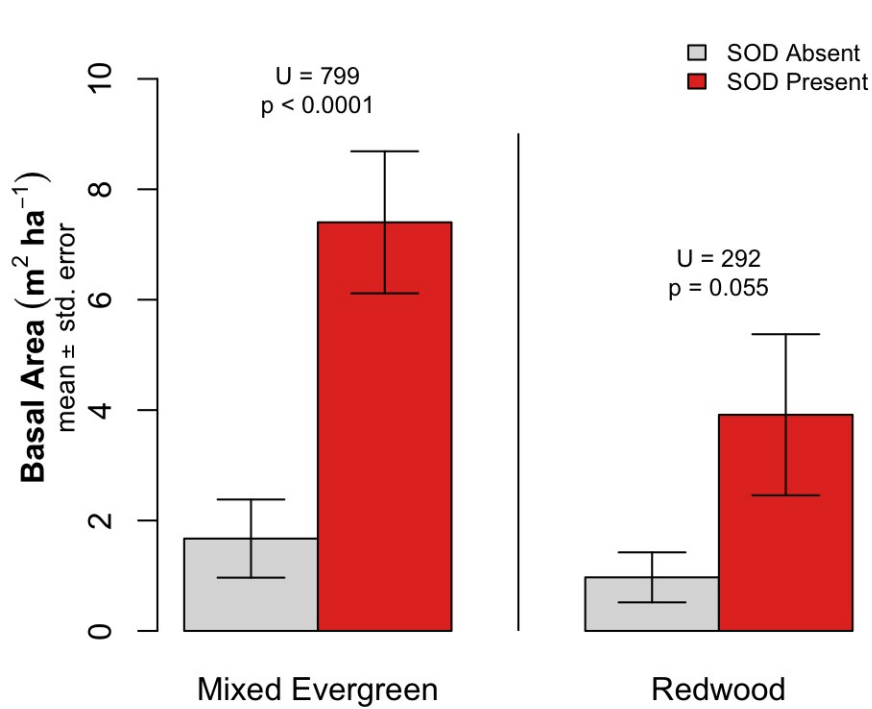
Phytophthora ramorum

fuel loads
community structure

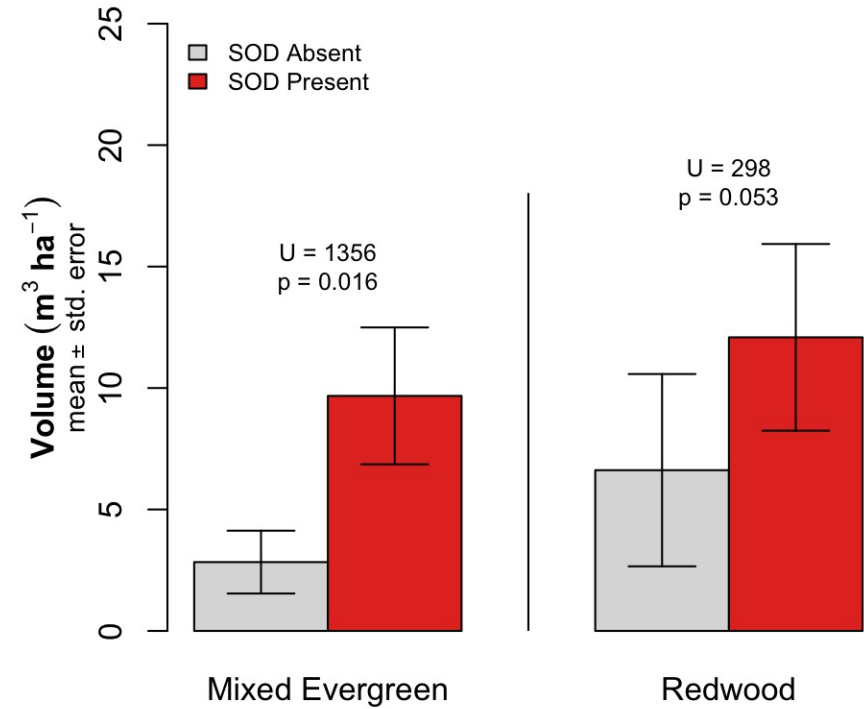
pathogen survival
innoculum pressure

SOD increases fuel loads

Standing Dead



Downed Logs





Acknowledgements

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Gordon & Betty Moore Foundation

Lab & field assistance

Kamyar Aram

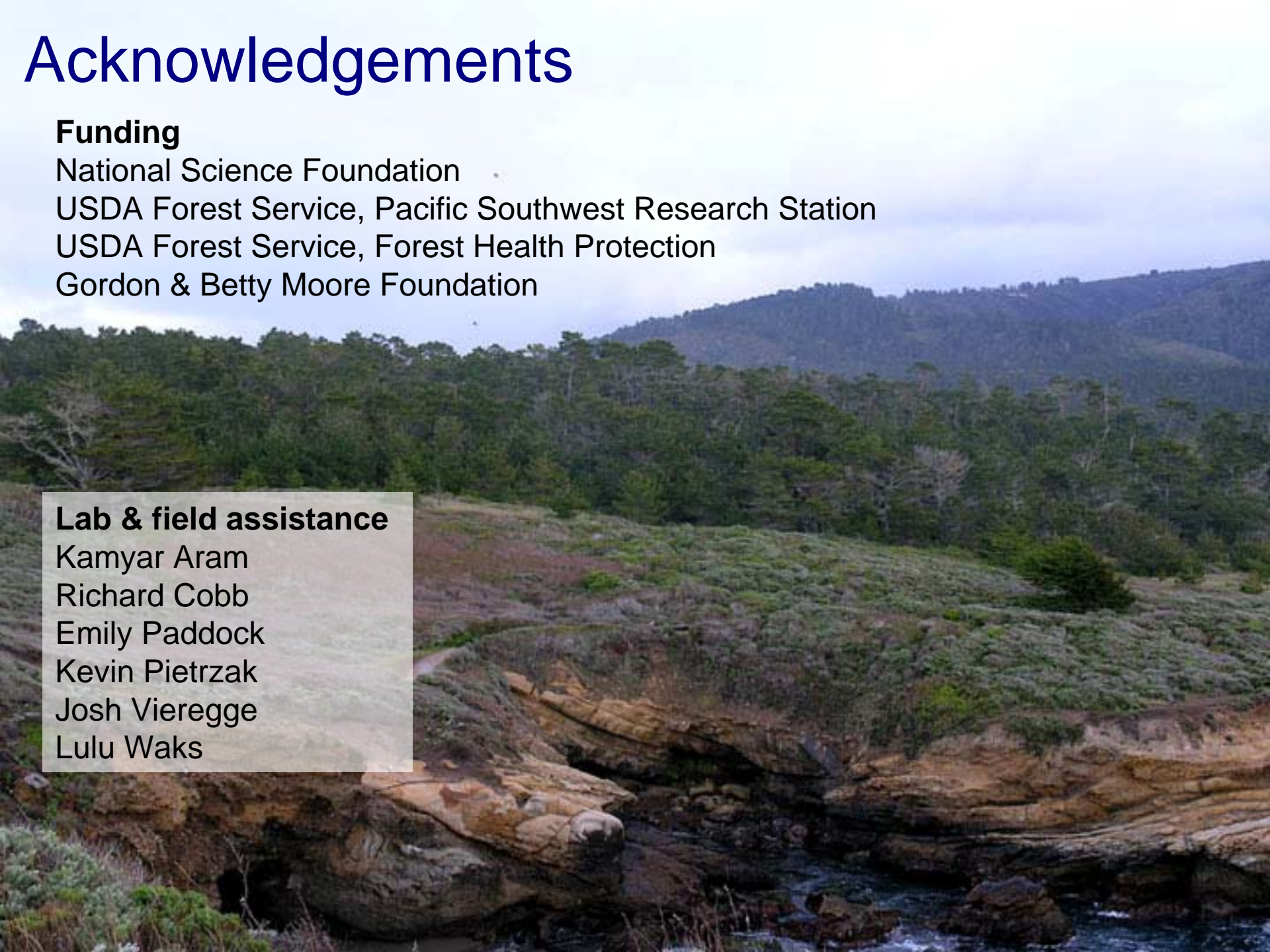
Richard Cobb

Emily Paddock

Kevin Pietrzak

Josh Vieregge

Lulu Waks



Confirmed Susceptible Species

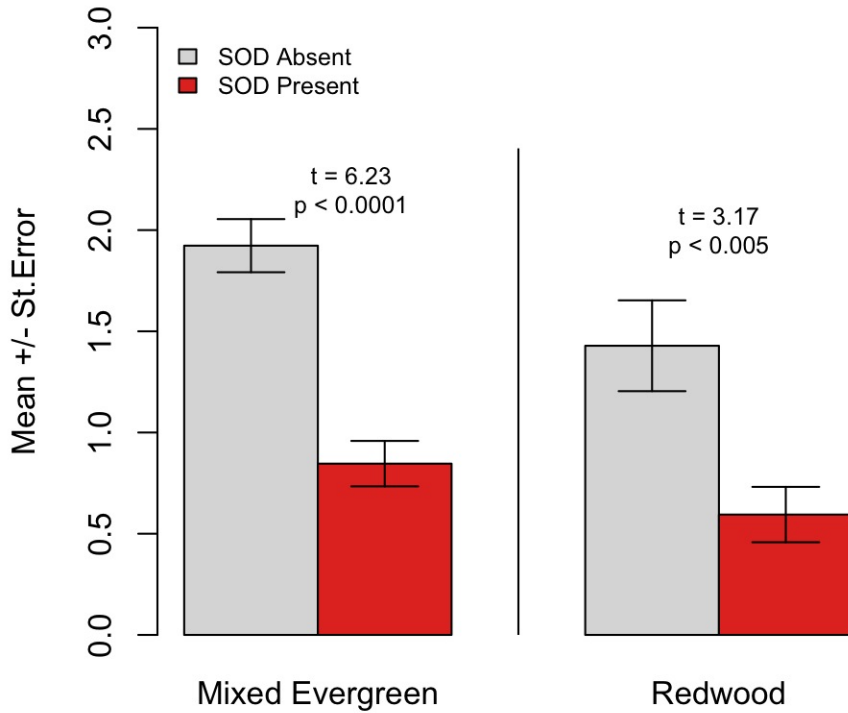
(As of March 2008)

California native species

Andrew's clintonia bead lily	European turkey oak	Myrtle-leaved Distylium	Sheep laurel
Ardisia	European yew	Northern red oak	Shreve's oak
Bearberry	Evergreen huckleberry	Oleander	Southern red oak
Bigleaf maple	Evergreen maple	Oregon ash	Spicebush
Blueblossom	False Solomon's seal	Oregon grape	Spike witch hazel
California bay laurel	Formosa firethorn	Osmanthus	Spreading euonymus
California black oak	Fetterbush	Pacific yew	Star magnolia
California buckeye	Goat willow	Persian ironwood	Strawberry tree
California coffeeberry	Grand fir	Pieris varieties	Striped bark maple
California hazelnut	Griselinia	Planetree maple	Sweet bay laurel
California honeysuckle	Holly	Poison oak	Sweet chestnut
California maidenhair fern	Holly olive	Prunus species	Sweet Cicely
California nutmeg	Holm oak	Red fir	Sweet olive
California wood fern	Horse chestnut	Red lotus tree	Tanoak
Camellia species	Hybrid witchhazel	Red tip photinia	Toyon
Camphor tree	Japanese evergreen oak	Redwood ivy	Viburnum varieties
Canyon live oak	Laurustinus	Rhododendron species	Victorian box
Cascara	Leucothoe species	Roble beech	Vine maple
Chinese witchhazel	Lilac	Rosa species & hybrids	Western maidenhair fern
Chinese guger tree	Loropetalum species	Rugosa rose	Western starflower
Coast live oak	Madrone	Salal	White fir
Coast redwood	Magnolia varieties	Salmonberry	Winter's bark
Dogwood species	Manzanita	Scotch heather	Witch hazel
Douglas fir	Michelia	Scribbly gum	Wood rose
Eastern Joy Lotus Tree	Mountain laurel	Sessile oak	Yew
European ash			
European beech			

Fire and decreased SOD infection

Total Fires Recorded



Years Since Last Fire

