Ongoing Studies of North Coast Bishop Pine Decline

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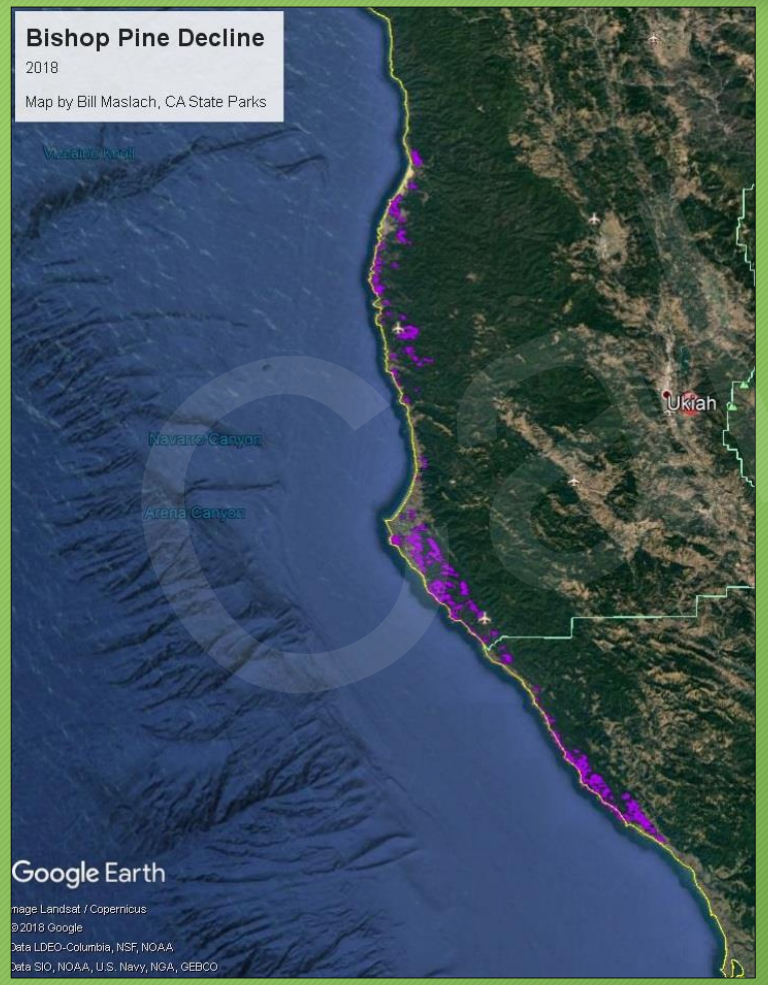
Bishop pine die-off: ca. 2000-present



Map: Bill Maslach, CA State Parks

Plan for the Current Study

- Catalog pests found on bishop pine in the study area
- Core trees to understand establishment dates and growth patterns
- Look at soils for oomycete pests and to relate physical characteristics to tree decline
- Document the decline
- Continue the cycle into the future

Methods

- Establish sites from north to south, including:
  - Pure bishop pine stands
  - Bishop pine mixed with other tree species
  - Pygmy/oligotrophic-soils bishop pine stands
- 0.1-ha plots
- Each tree:
  - Diameter
  - Pest inventory
  - Gall rust and mistletoe ratings
  - Crown density
  - % branch dieback in crown

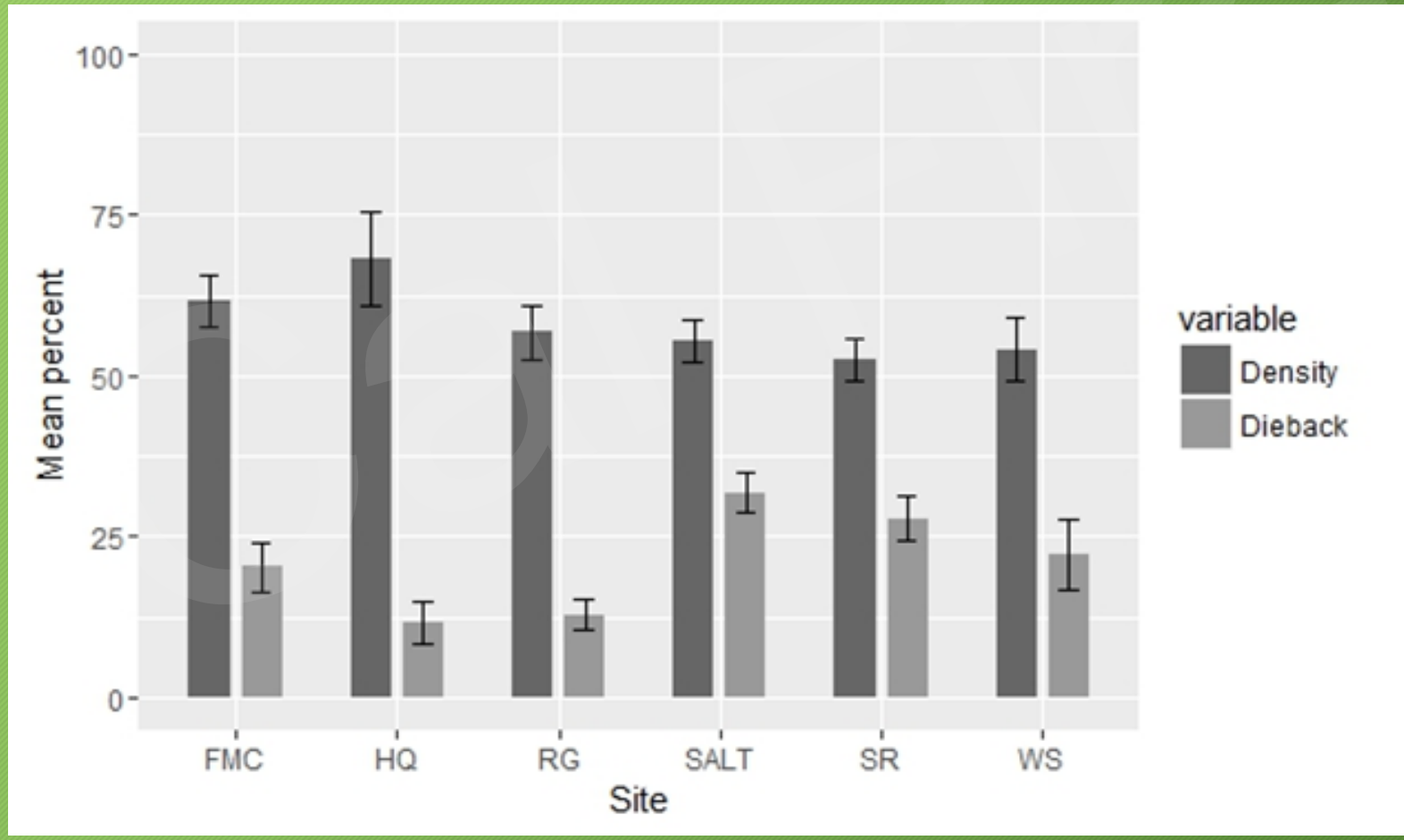
Methods

- Selected trees:
  - Tree height
  - Core
- Each plot:
  - Soil sampling in fall/winter and spring/summer, followed by baiting for *Phytophthora* spp.
- Each site:
  - 100-cm soil pits to record selected soil physical characteristics (e.g., color of horizons, texture, fine root presence, structure, etc.) and chemical characteristics (e.g., pH)

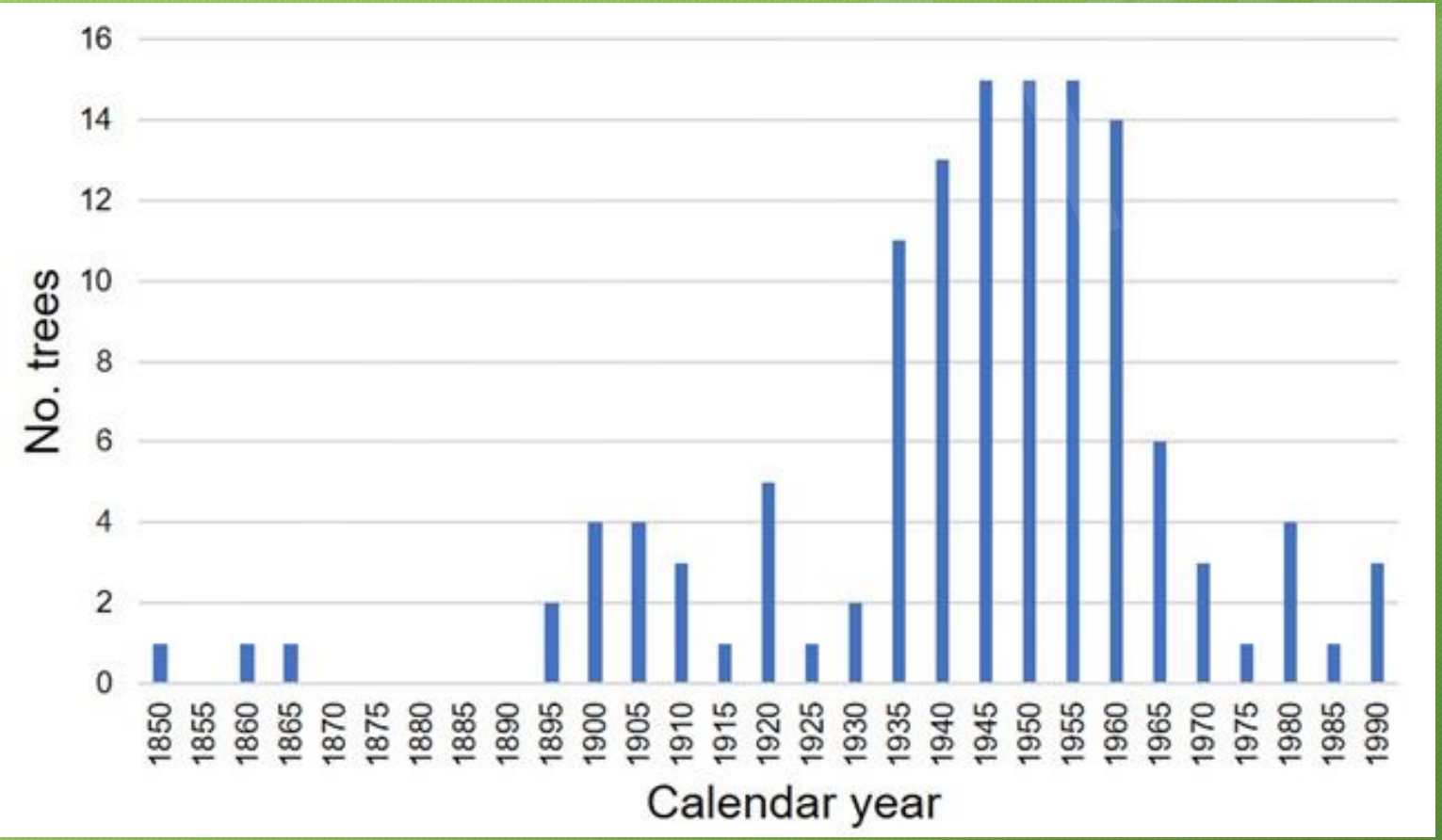
Results: Tree statistics

- Mean diameter per plot
  - All trees: 19.7-56.7 cm (7.8-22.3 in)
  - Pines: 21.8-76.6 cm (8.6-30.2 in)
- Mean density per plot
  - All trees: 210-890 stems/ha (85-360 stems/ac)
  - Pines: 120-510 stems/ha (49-207 stems/ac)
- Basal area per plot
  - All trees: 8-113 m^2/ha (35-492 ft^2/ac)
  - Pines: 5-90 m^2/ha (22-392 ft^2/ac)

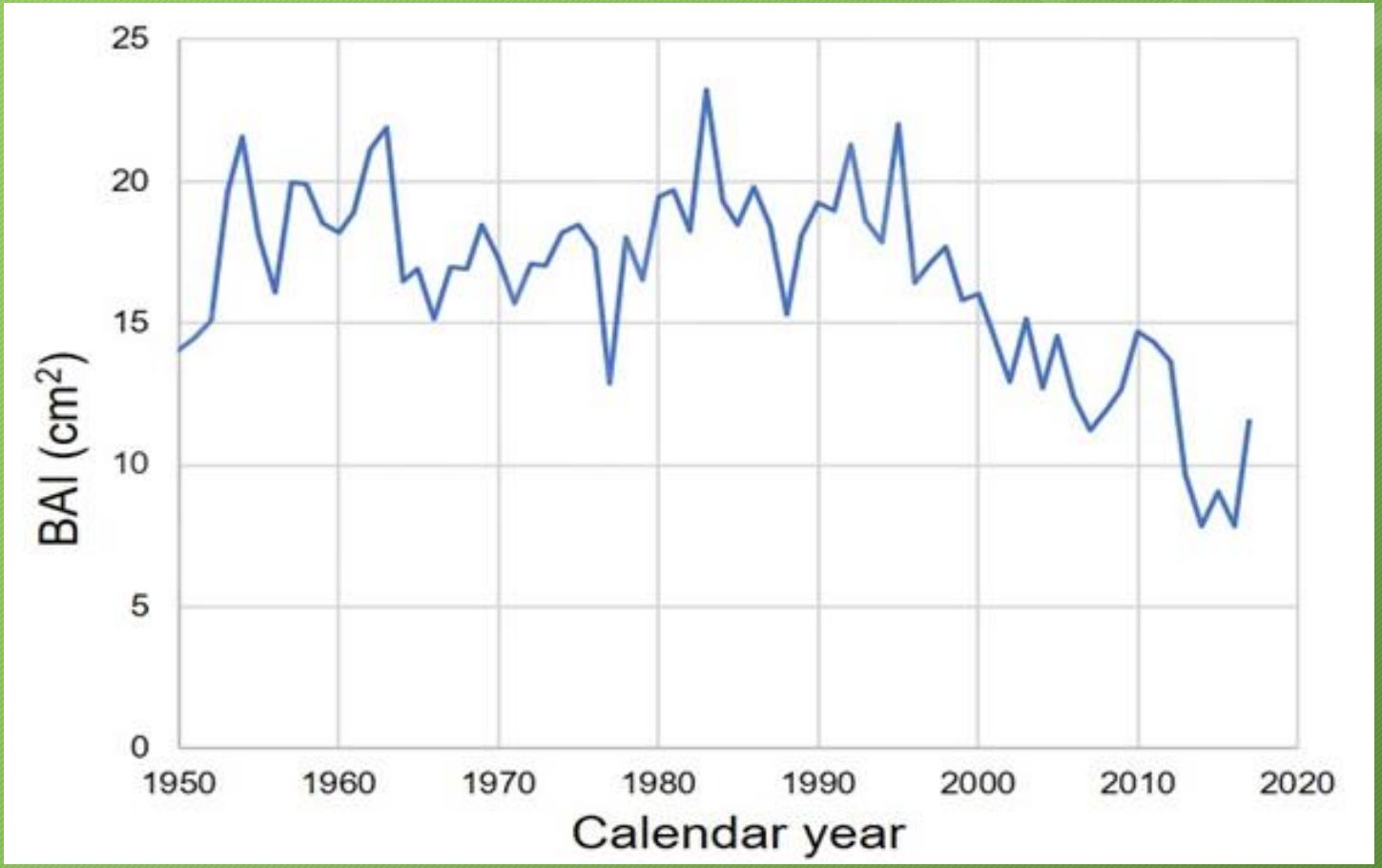
Results: Crown condition



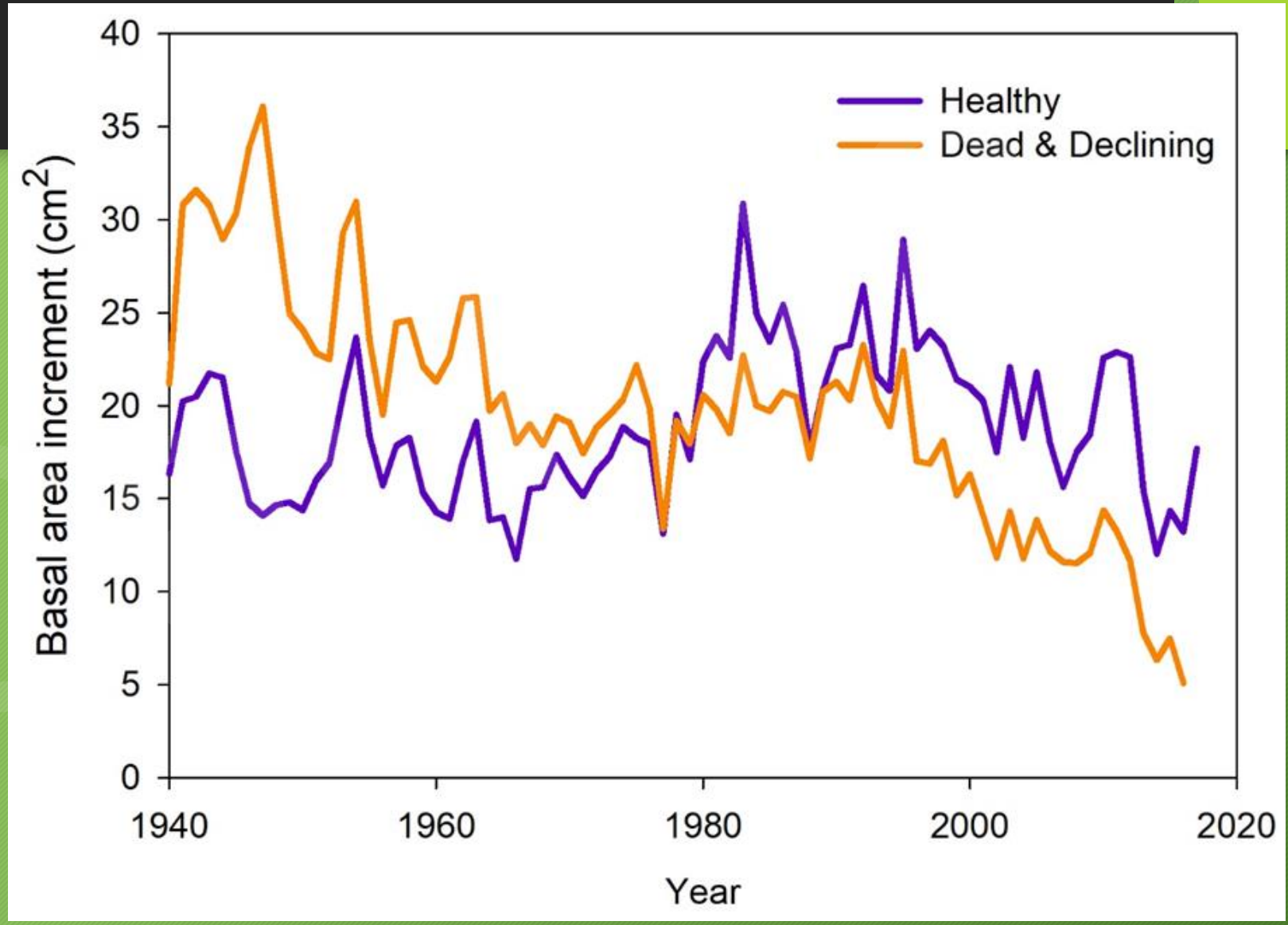
Results: Tree establishment



Results: Tree growth



Tree growth


Healthy
Dead & Declining
Basal area increment (cm2)
40
35
30
25
20
15
10
5
0
1940
1960
1980
2000
2020
Year

Results: Pests

Pest scientific name	Common name / disease caused	Plant part affected
***Armillaria* sp.**	Armillaria root disease	Large (structural) roots
Phaeolus schweinitzii	Schweinitzii root disease	Large (structural) roots
***Onnia* sp.**	Tomentosus root disease	Large (structural) roots
Phytophthora cinnamomi	Phytophthora dieback	Fine roots
Phytophthora cambivora	Phytophthora dieback	Fine roots and root crown
Elongisporangium* (= *Pythium*) *undulatum	Pythium root rot	Fine roots
Pythium dissotocum	Pythium root rot	Fine roots
***Rhizoctonia* sp.**	Rhizoctonia root rot	Fine roots
Fusarium circinatum	Pine pitch canker	Branches and stem
***Phomopsis/Diaporthe* sp.**	Phomopsis canker	Branches and stem
Diplodia scrobiculata	Diplodia blight	Branches and stem
Arceuthobium littorum	Coastal dwarf mistletoe	Branches and stem
Porodaedalia* (= *Phellinus*) *pini	White pocket/heart rot	Stem
Endocronartium harknessii	Western gall rust	Branches and stem
Dendroctonus valens	Red turpentine beetle	Lower stem
Ips plastographus	Coastal pine engraver	Stem
Pseudips mexicanus	Monterey pine Ips	Stem
***Hylastes* sp.**	bark beetle	Stem
Hylurgops porosus	bark beetle	Stem

Rogues' gallery

Phytophthora cinnamomi (photo: Chris Tominello-Ramirez)

Porodaedalia (=Phellinus) pini

Western gall rust

More rogues

Dwarf mistletoe

Bark beetles

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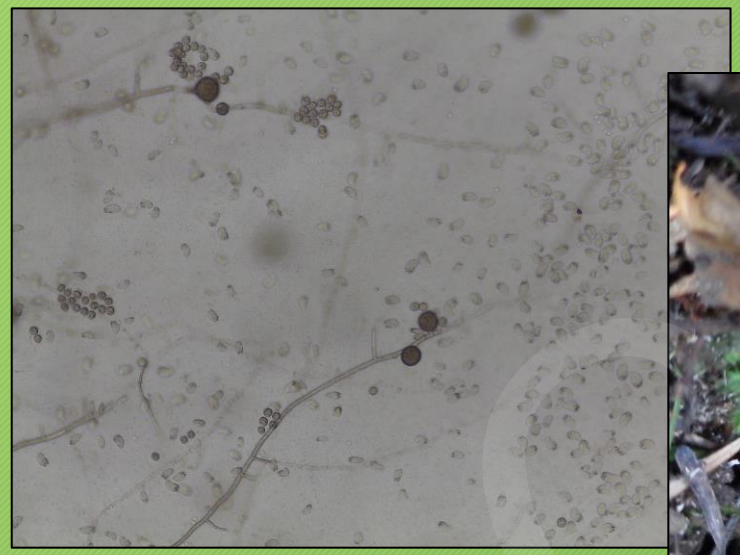


Elongisporangium (=Pythium) undulatum

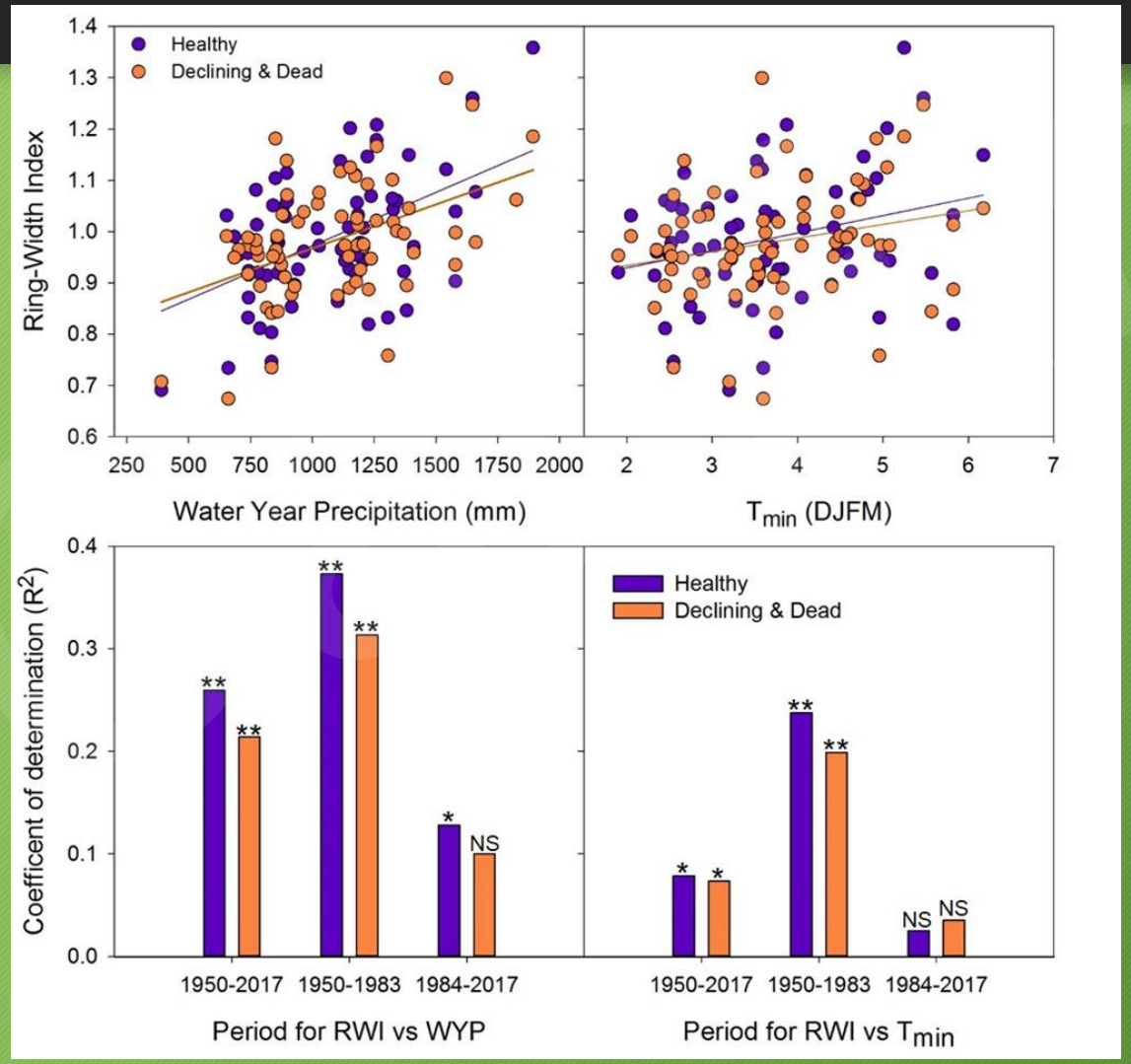
Armillaria sp.

Phaeolus schweinitzii

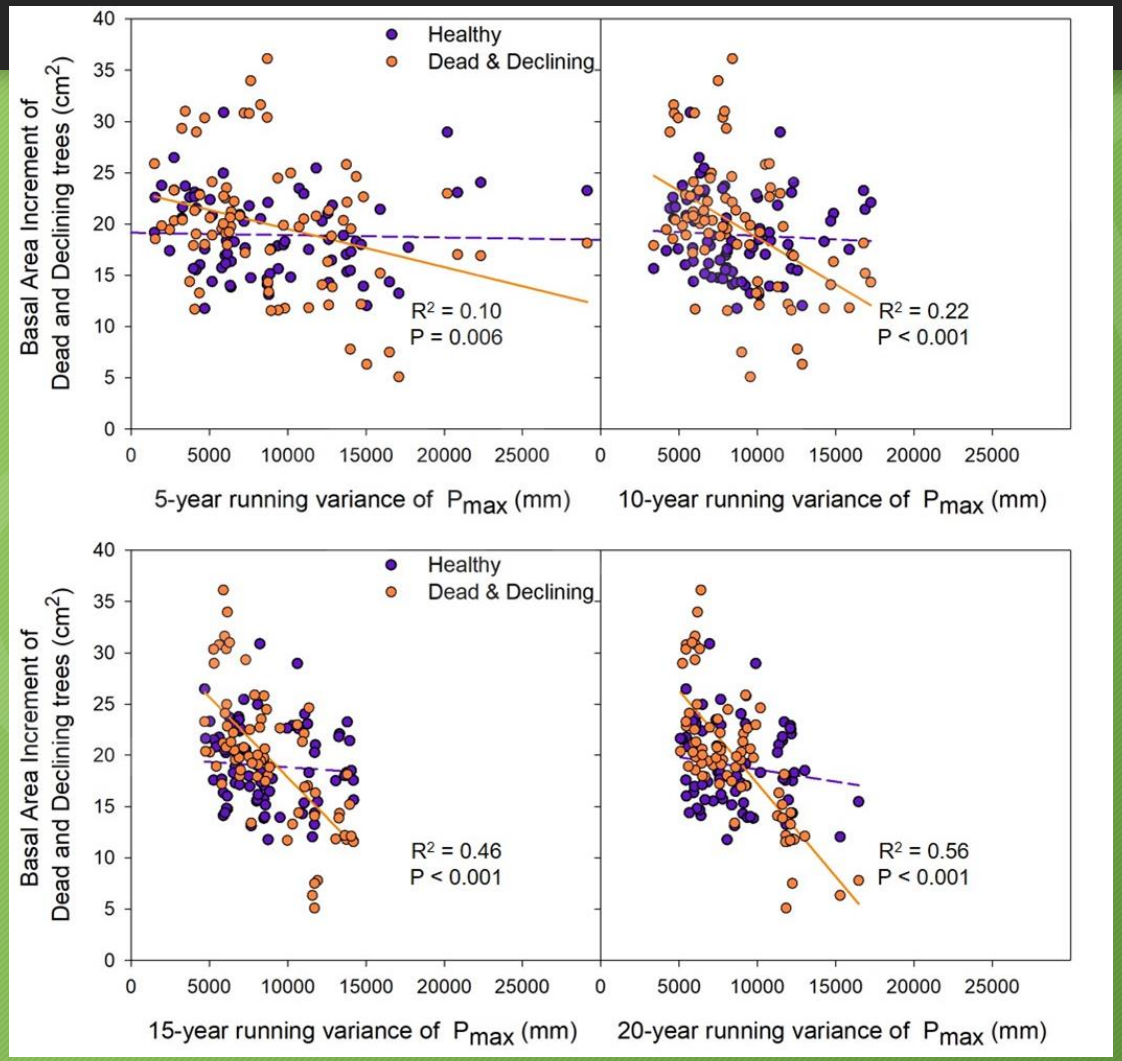
Soils

Site	Sand%	Silt%	Clay%	pH	Classification
McKerricher	74-88%	6-17%	6-9%	5.6-5.8	Inceptisol
Virgin Creek	88-89%	6-7%	4-6%	5.6-5.8	Entisol
State Parks HQ	48-61%	29-36%	10-15%	5.4-5.6	Entisol
Russian Gulch	45-49%	33-36%	18-19%	5.2-5.8	Alfisol
Woodlands	35-55%	14-24%	21-47%	4.2-5.0	Ultisol
Sea Ranch	40-72%	20-33%	8-28%	5.4-5.8	Ultisol
Fisk Mill Cove	40-56%	19-24%	20-41%	5.6	Ultisol
Salt Pt Pygmy	61-71%	10-30%	1-19%	4.4-4.8	Ultisol

Sensitivity to Temperature and Precipitation



Variance in Monthly Precipitation



Thank you

- USDA Forest Service, Forest Health Monitoring, Evaluation Monitoring
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- The Sea Ranch Association