



TANOAK BIOGEOGRAPHY

POTENTIAL RISK FROM INTERACTING DISTURBANCES

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June 22, 2012

Sudden Oak Death 5th Science Symposium

Center for Applied GIScience

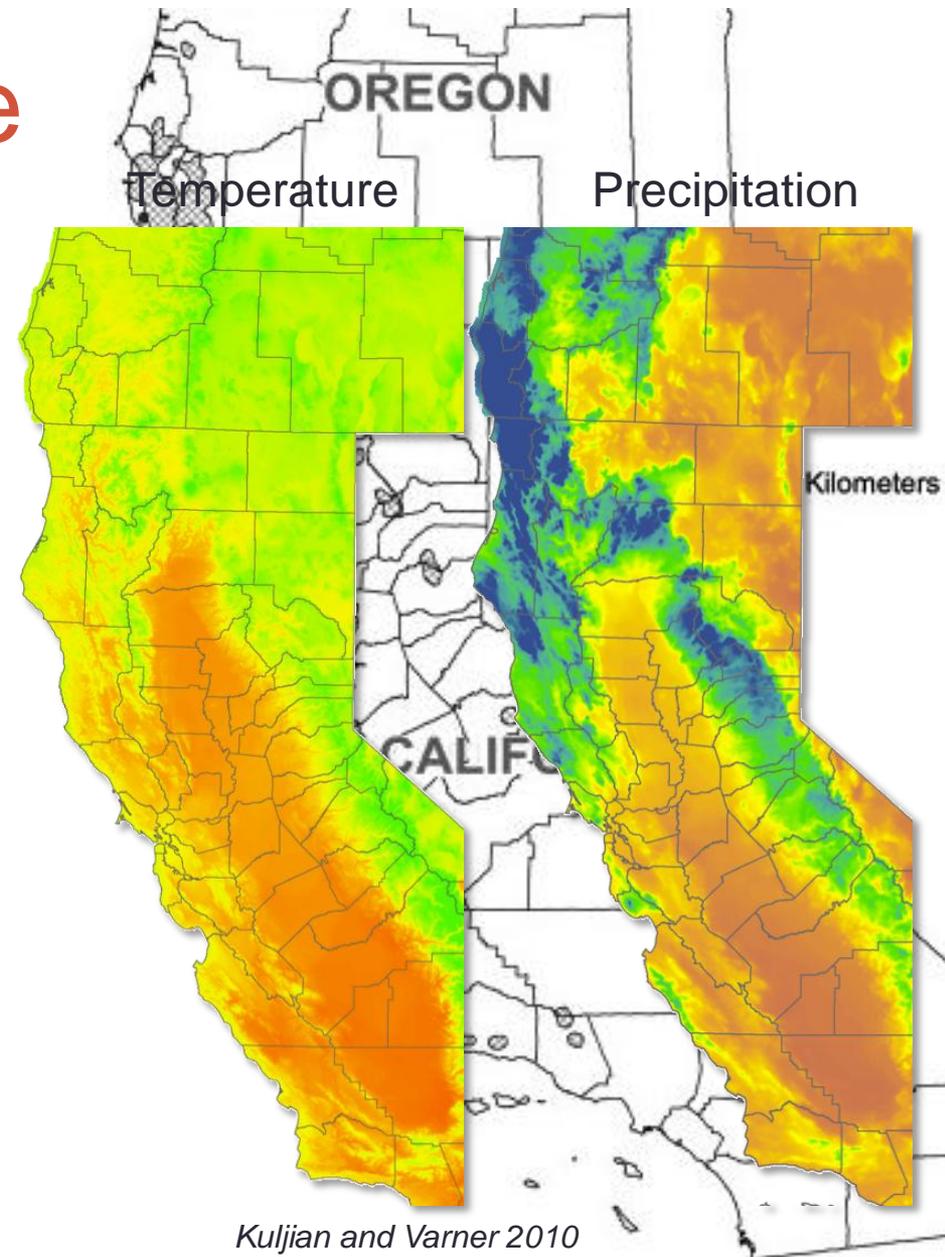
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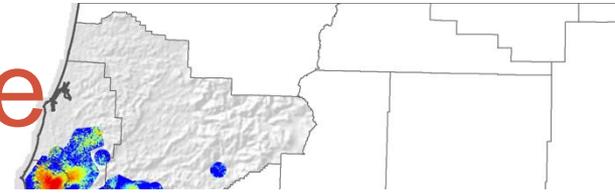


Geographic Range

- Key ecosystem component
 - Ecological & cultural resource
- Broad range
 - Environmental variation
 - Complex and shifting disturbance regimes

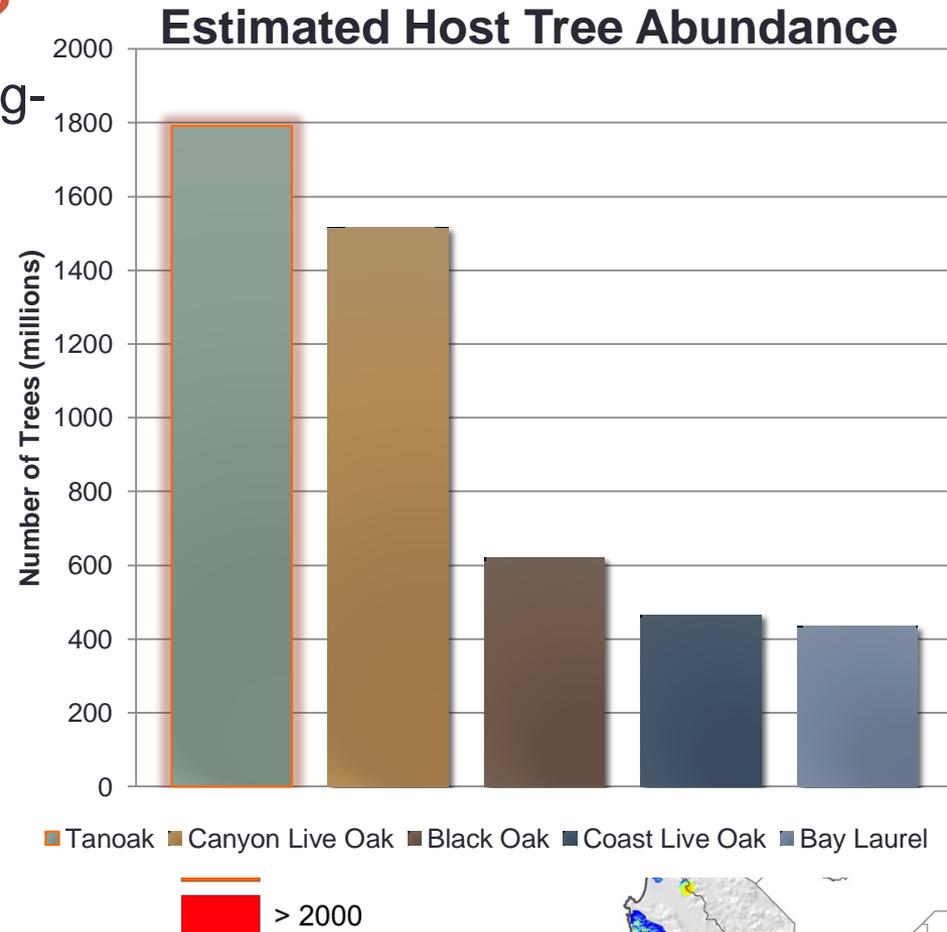


Distribution and Abundance

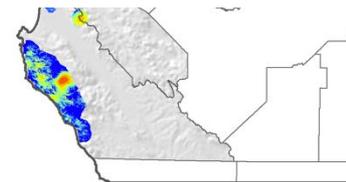


• How much tanoak is there?

- FIA and Rizzo-Meentemeyer long-term monitoring plots
- Estimated host abundance throughout range
 - ~1.8 billion tanoak trees
 - 68.4 Tg of carbon
- Heterogeneous population
 - Coast Range and Klamath Mountains of CA and OR
 - Central CA
 - Sierra Nevada

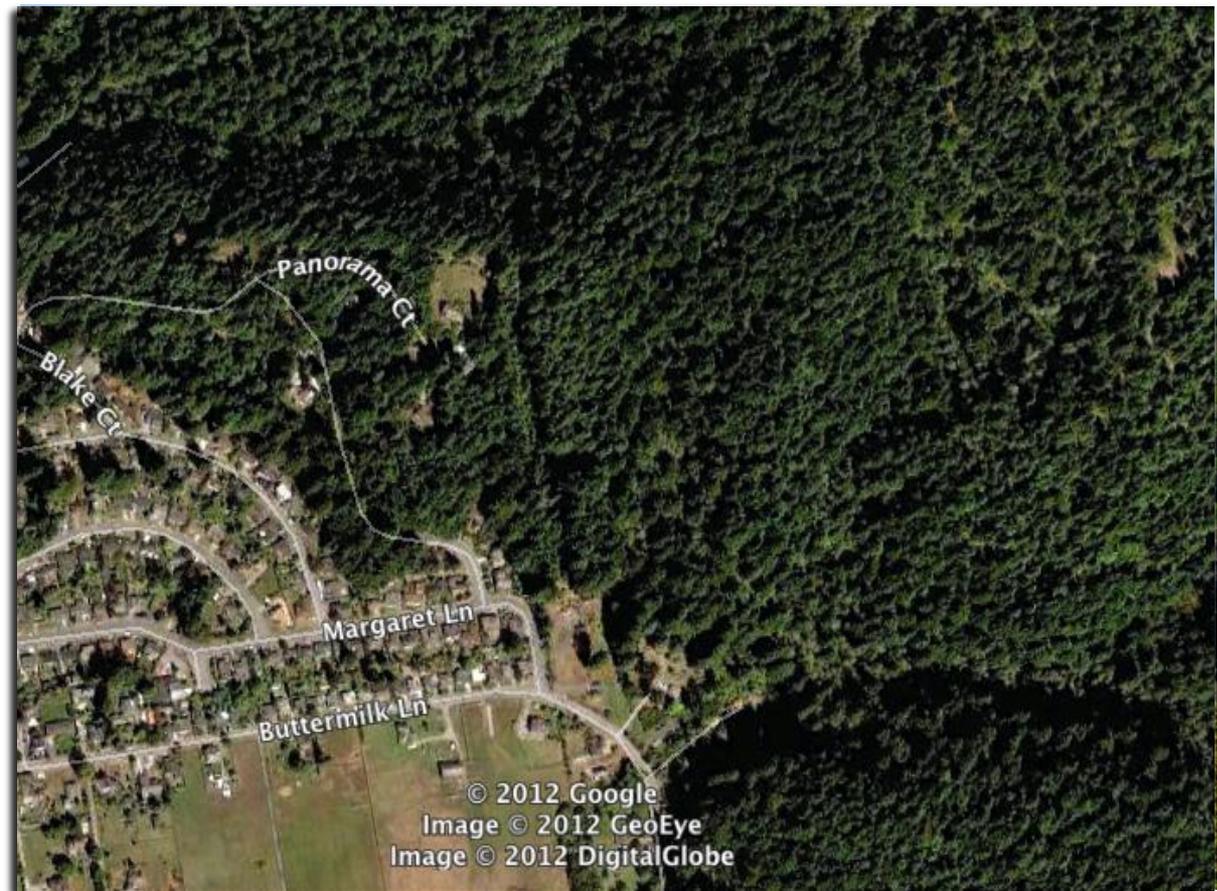


Lamsal et al. 2011



Disturbance Risks to Tanoak

- **Disease**
 - SOD
- **Fire**
- **Silviculture**
- **Development**



Improving our knowledge of these processes

Risks to Tanoak: Where?

- Faces increasing risk of decline
- Geographic Distributions
 - Varying risk levels
- Coincidence & Interaction
 - Additive and nonlinear effects



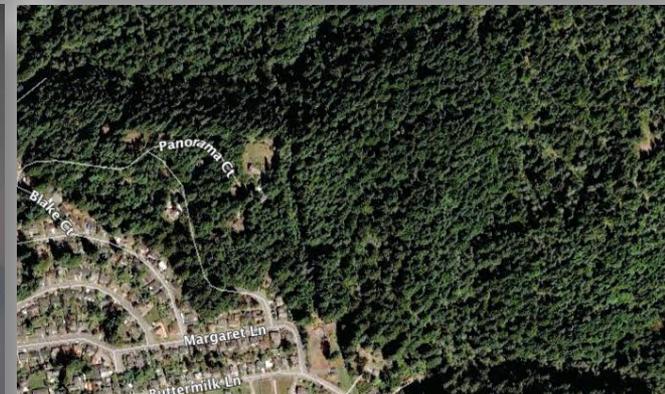
Disease



Silviculture



Fire



Development

Disturbance Interactions

Metz et al. 2011



Objectives

- **What is the potential range-wide risk of tanoak decline from these complex disturbance regimes?**
 - Range-scale model of disturbances and interacting effects
 - Application to management goals



Modeling Risk

- **Heuristic approach**

- Weight disturbance effects based on published research
- Simplifying assumptions
 - Four risk factors
 - Categorical rankings
 - Allow only two-way interactions
 - Limit to one interaction per cell – keeping the strongest effect

Disease



Silviculture



Development



Fire



Risk Interaction Model

Direct Effects

Interaction Term

$$P = \frac{\sum_i^n W_i R_{ij} + [W_i^1 R_{ij}^1 \times W_i^2 R_{ij}^2]^y}{\sum_i^n W_i}$$

P : the risk level in a grid cell in the output model

R_{ij} : the rank of factor i at location j

W_i : weight assigned to the i^{th} factor

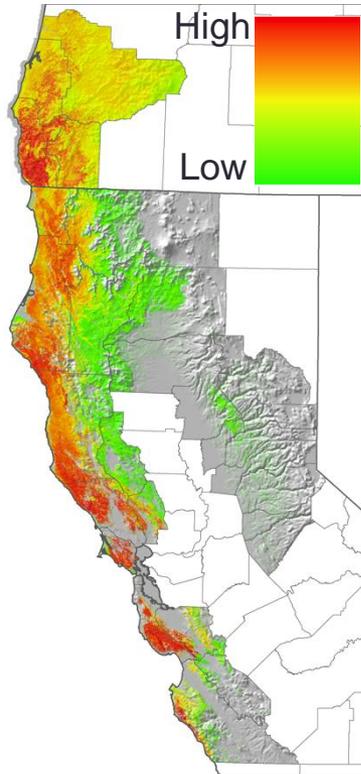
y : interaction effect

Risk Factors	Rank	Weights
Silviculture	0-3	3
Disease	0-3	2.5
Development	0-3	1
Fire	0-3	0.5

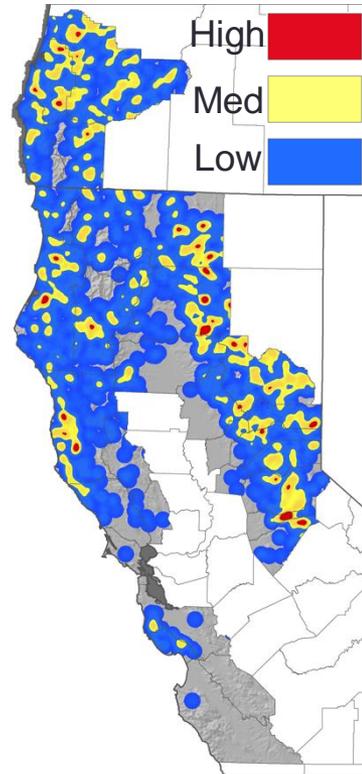
Possible Interactions	Effects
Disease x Fire	X^2
Disease x Silviculture	X^2
Fire x Silviculture	$X^{0.5}$
Disease x Development	X^1
Fire x Development	X^1
Development x Silviculture	X^1

Mapping Risk Factors

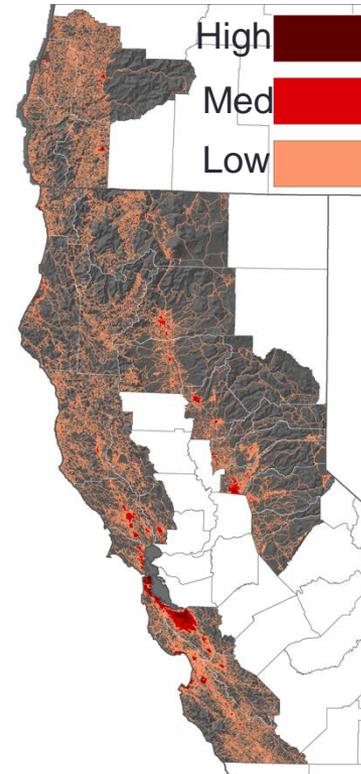
Disease



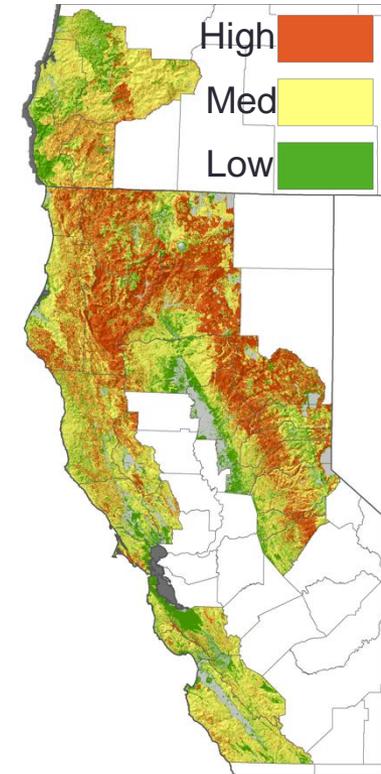
Silviculture



Development

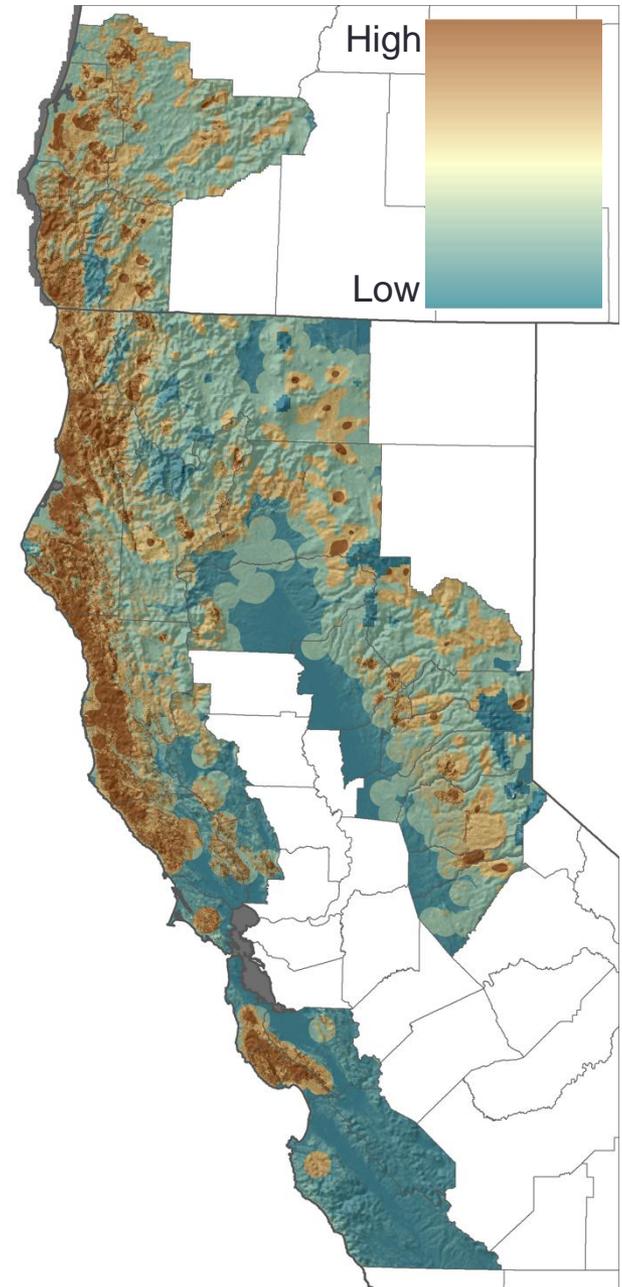


Fire



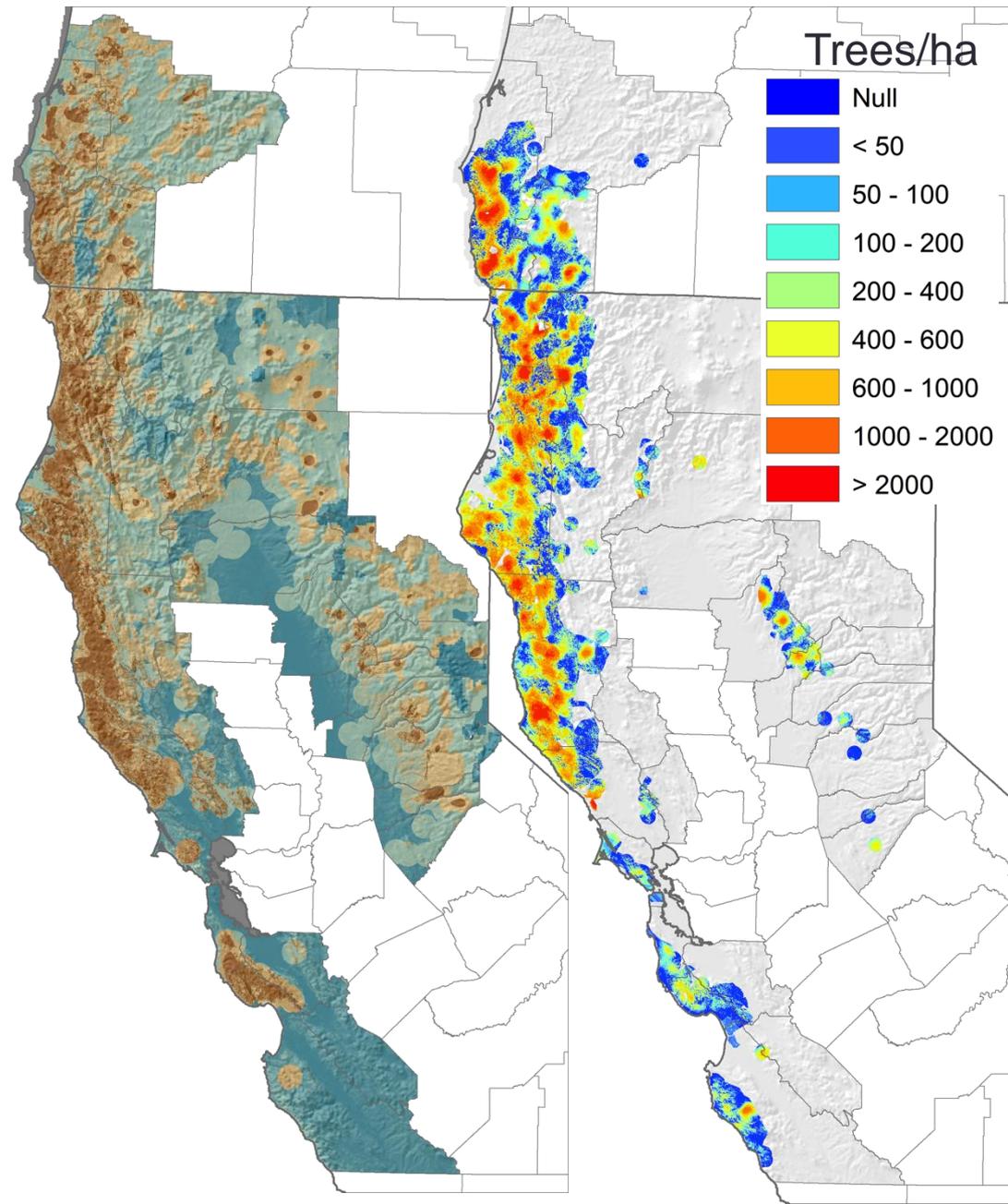
Result: Potential Risk

- Geographic variability in tanoak risk
 - **High Risk**
 - Coast Range
 - Klamath Mountains
 - Santa Cruz Mountains
 - **Low-Moderate Risk**
 - Sierra Nevada, Big Sur



Conclusions

- **Where will tanoak persist?**
 - Reservoir populations
- **Management goals?**
 - Protect high risk
- **Next:**
 - Impacts to community structure
 - Local extinction



Acknowledgements



**Ross
Meentemeyer**



**John
Vogler**



**Tomas
Vaclavik**



**Marketa
Vaclavikova**



**Dave
Rizzo**



**Richard
Cobb**



**Margaret
Metz**



References

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