TANOAK BIOGEOGRAPHY
POTENTIAL RISK FROM INTERACTING DISTURBANCES

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Geographic Range

- Key ecosystem component
  - Ecological & cultural resource

- Broad range
  - Environmental variation
  - Complex and shifting disturbance regimes

Kuljian and Varner 2010
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

Estimated Host Tree Abundance

- Tanoak
- Canyon Live Oak
- Black Oak
- Coast Live Oak
- Bay Laurel

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
Disturbance Interactions

DISEASE

FIRE

Photo by Kerri Frangioso

Photo by Kerri Frangioso

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
Risk Interaction Model

\[ P = \frac{\sum_{i}^{n} W_i R_{ij} + \left[ W_i^1 R_{ij}^1 \times W_i^2 R_{ij}^2 \right] y}{\sum_{i}^{n} W_i} \]

- \( P \): 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

**Possible Interactions**

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Rank</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silviculture</td>
<td>0-3</td>
<td>3</td>
</tr>
<tr>
<td>Disease</td>
<td>0-3</td>
<td>2.5</td>
</tr>
<tr>
<td>Development</td>
<td>0-3</td>
<td>1</td>
</tr>
<tr>
<td>Fire</td>
<td>0-3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Effects**

- Disease x Fire
- Disease x Silviculture
- Fire x Silviculture
- Disease x Development
- Fire x Development
- Development x Silviculture
Mapping Risk Factors

Disease

Silviculture

Development

Fire

Meentemeyer et al. 2004
PNW_FIA Database
NLCD
FRCC; CDF; ODF
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
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References


