

Lessons for Assisted Migration in Coastal Forests From Foliage Diseases

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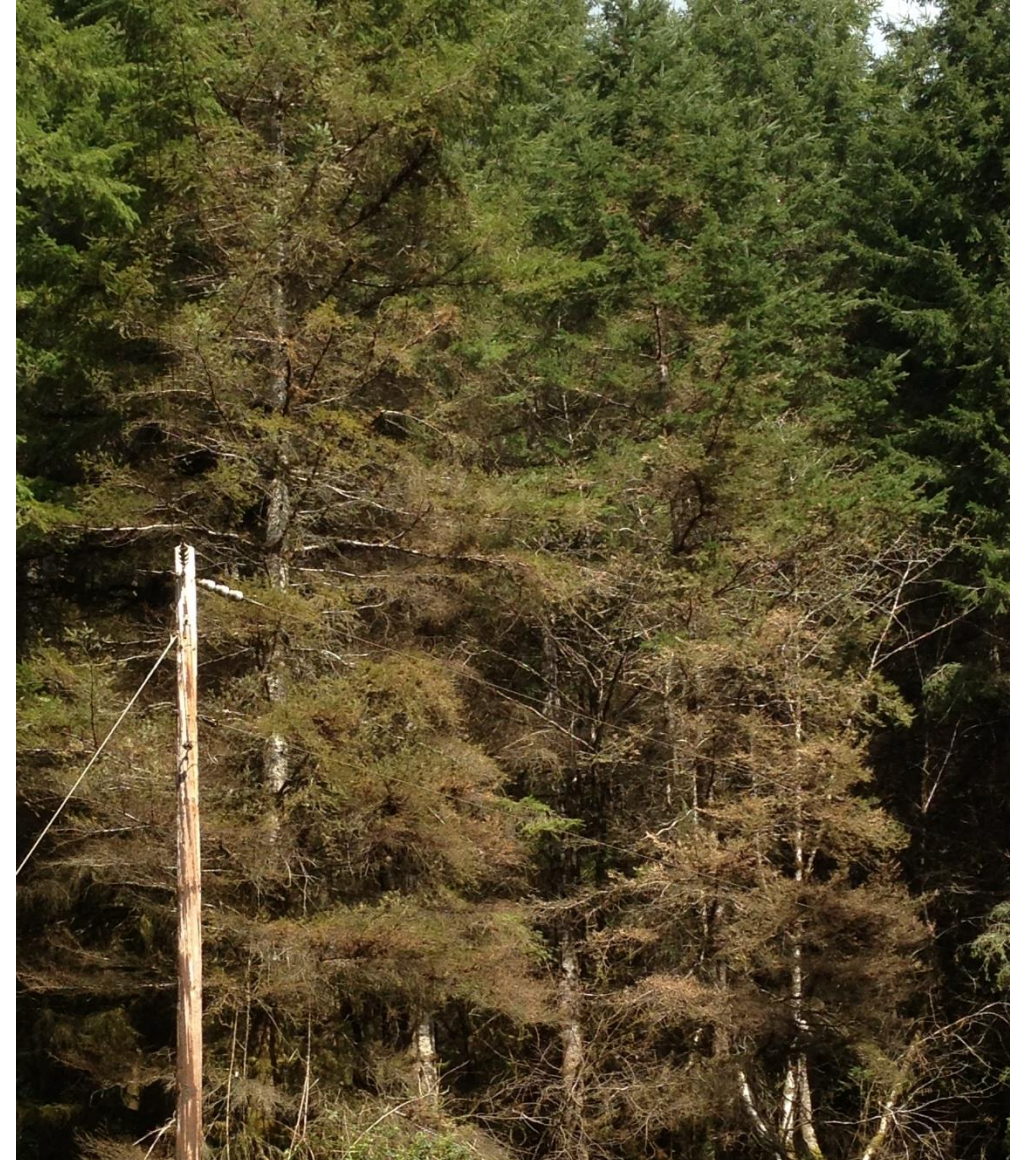


Focus on Foliage Diseases of Douglas-fir

- Swiss Needle Cast
 - *Nothophaeocryptopus gaeumannii*
- Rhabdocone Needle Cast
 - *Rhabdocone* species complex
- Web blight
 - *Rhizoctonia* species
- Phytophthora needle cast of Douglas-fir
 - *Phytophthora pluvialis*



Web Blight



Phytophthora needle cast
of Douglas-fir

Swiss Needle Cast



Rhabdocline Needle Cast



Swiss Needle Cast on the coast.

(photos Rob
Flowers, ODF)



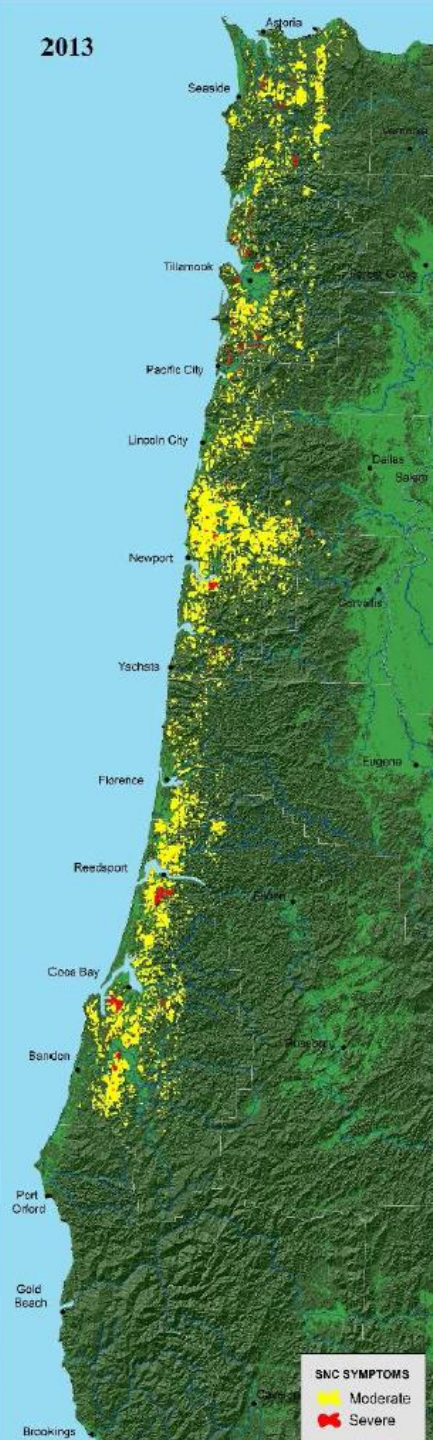
1996



2004



2013



2014



SNC SYMPTOMS
Moderate
Severe

SNC SYMPTOMS
Moderate
Severe

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Moderate
Severe

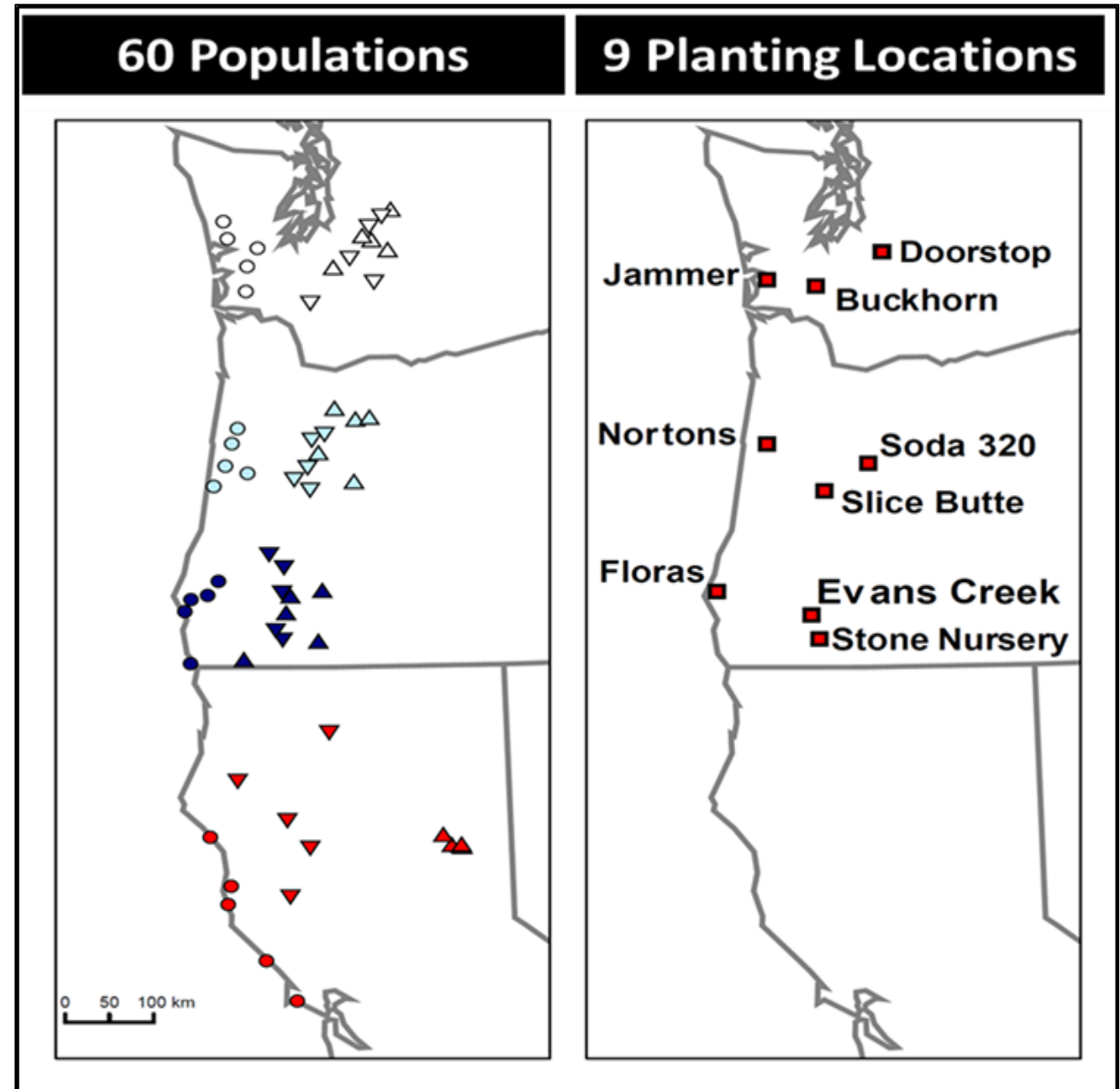
SNC SYMPTOMS
Moderate
Severe

The Douglas-fir Seed Source Movement Trials

- A reciprocal planting trial installed by USFS PNW Research Station
- Connie Harrington and Brad St. Clair



Jonathan Burnett photo from UAV



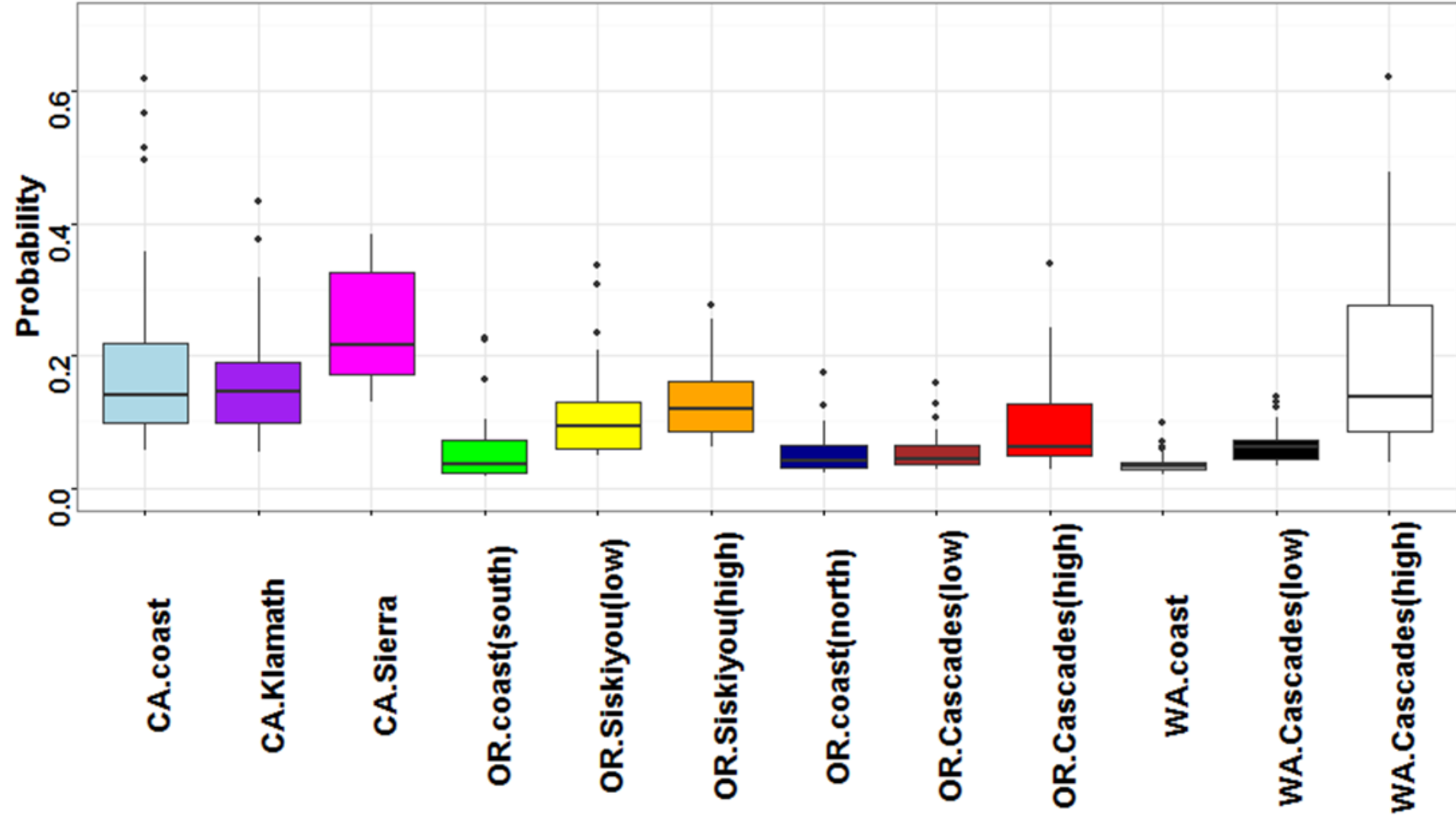
Climate of seed source affects susceptibility of coastal Douglas-fir to foliage diseases

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JOHN BRADLEY ST. CLAIR,⁴ AND LISA M. GANIO⁵

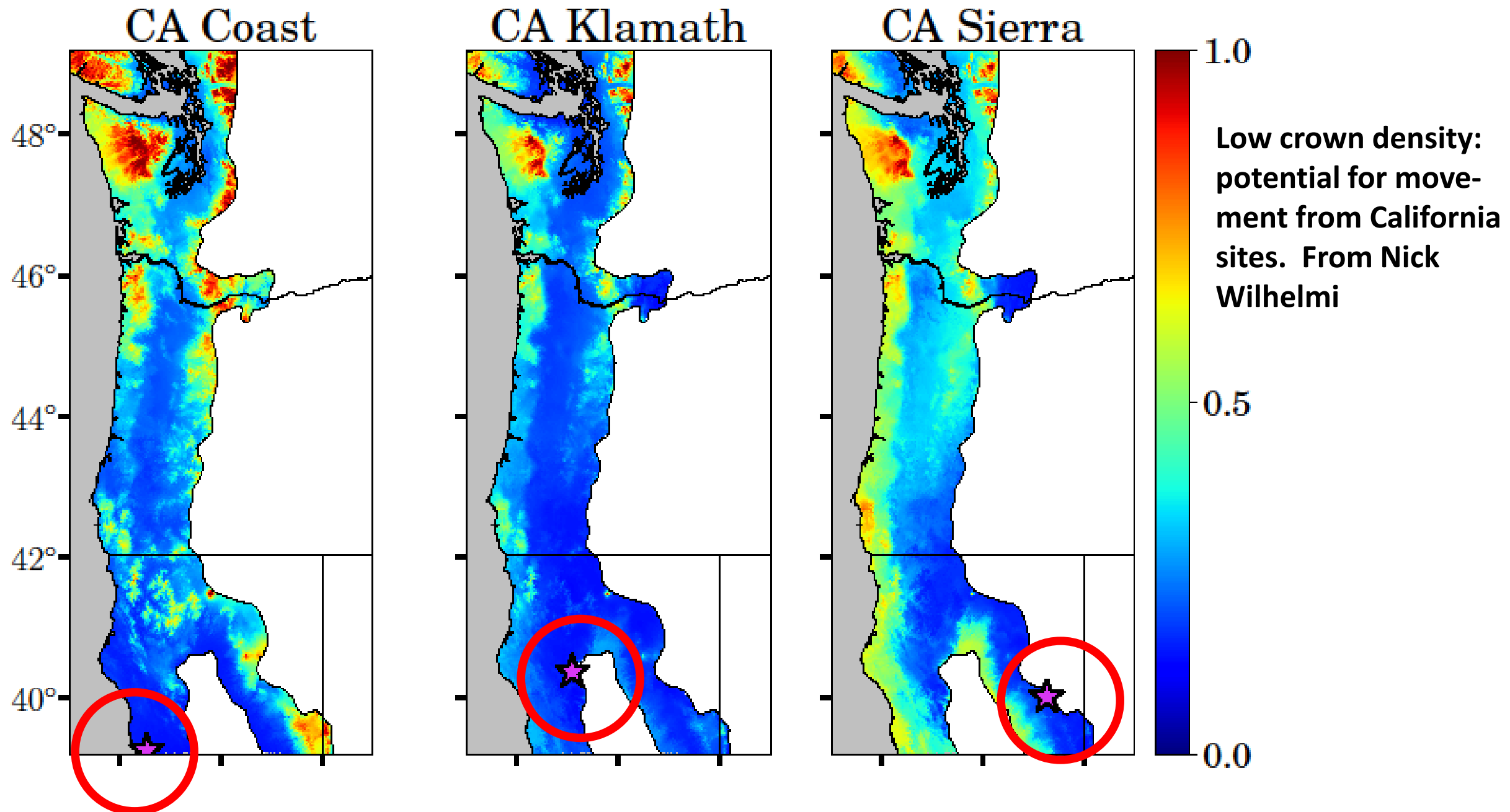


Swiss Needle Cast Effect

Probability of low crown density due to SNC

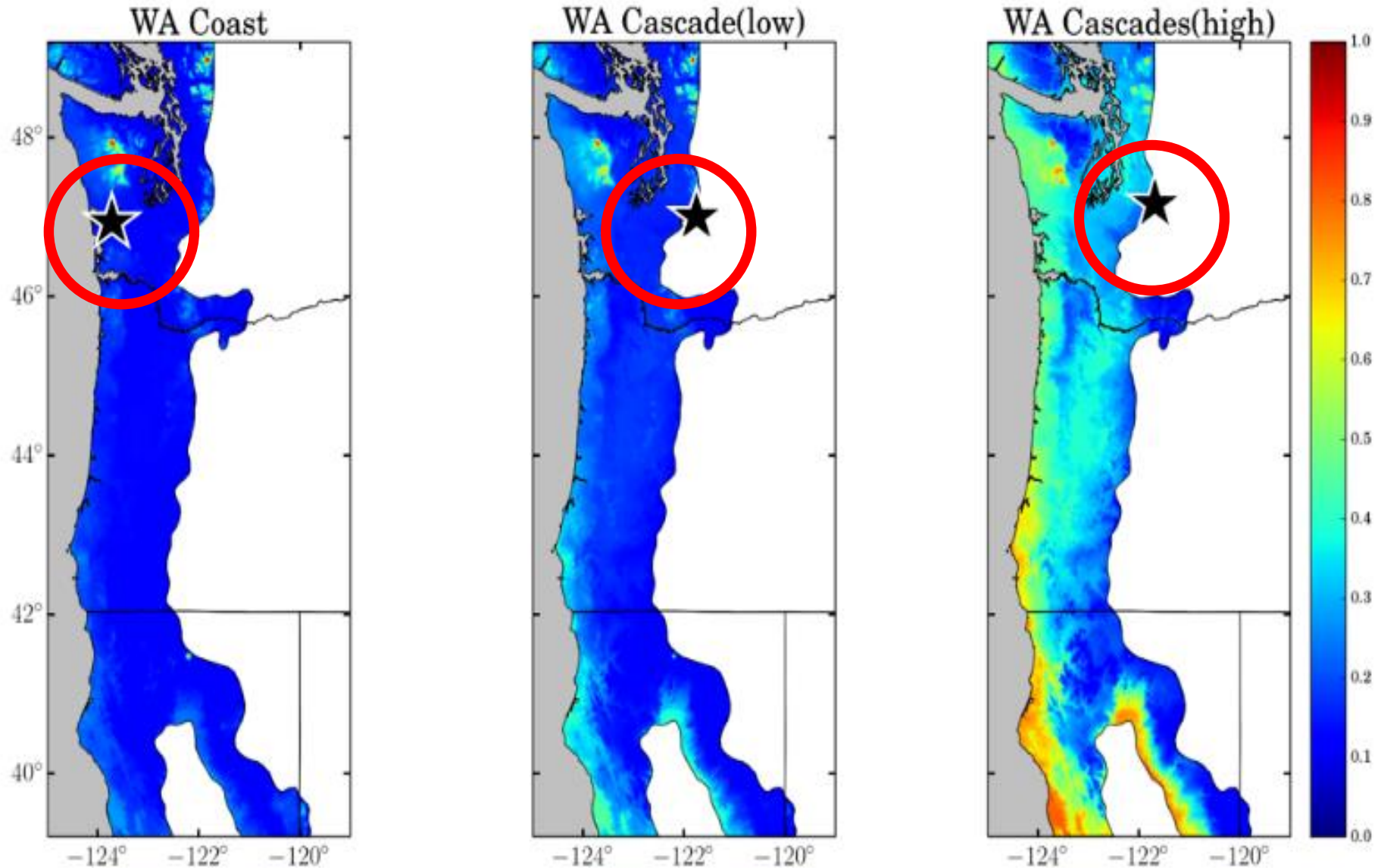


Current Probabilities



Current Probabilities

Low crown density: potential movement from Washington sites

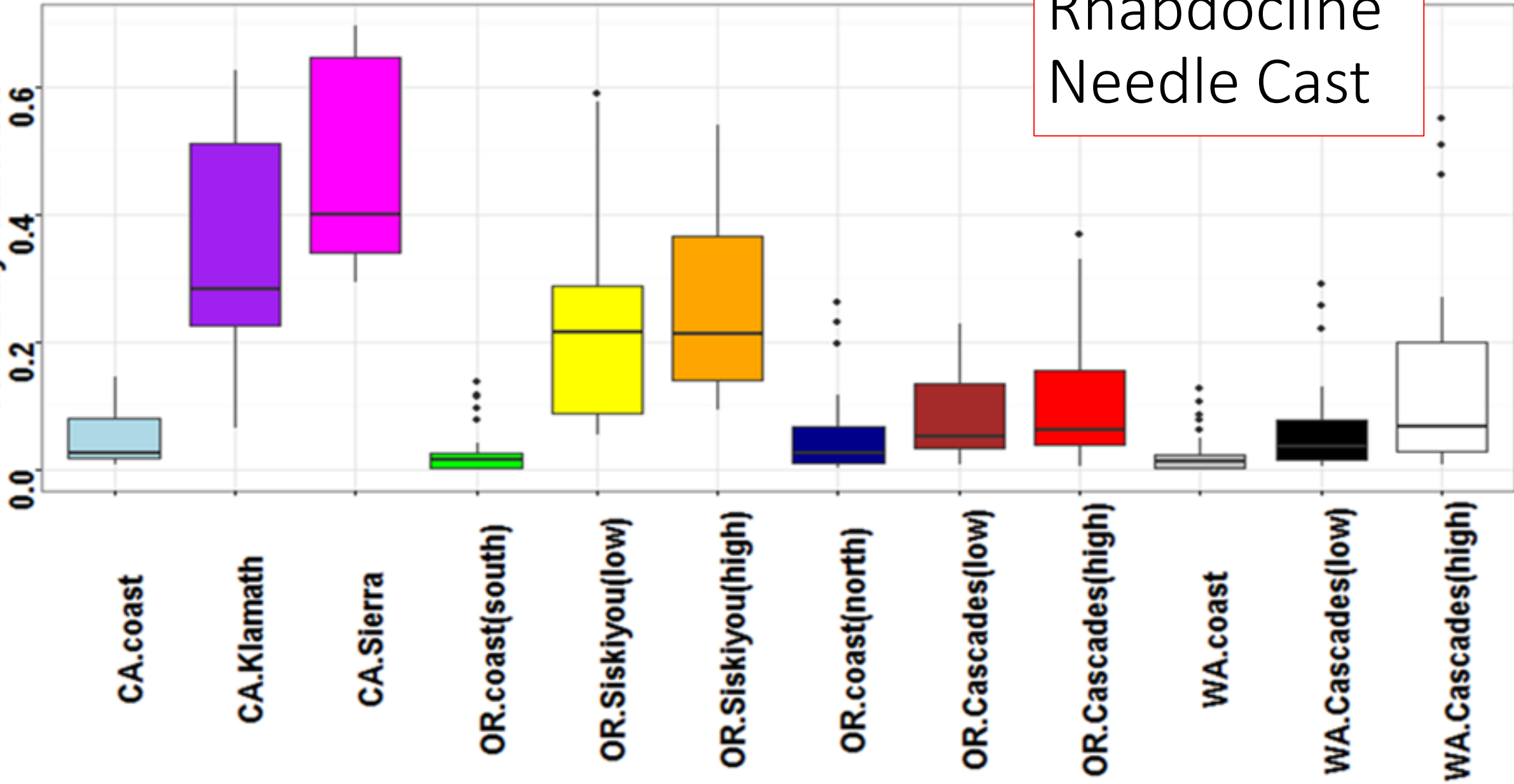


Rhabdocline Needle Cast




B

Probability of Infection



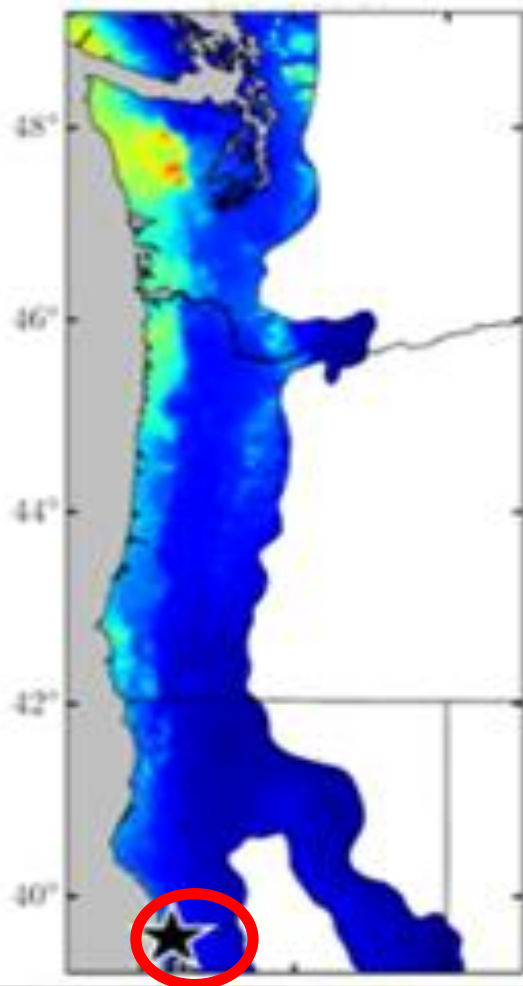
Rhabdocline
Needle Cast

 = location of seed source

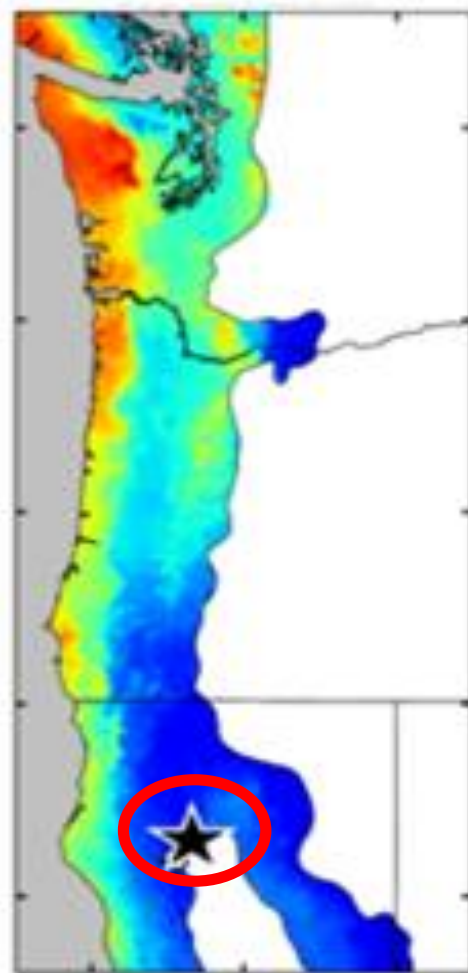
Probability of severe Rhabdocline needle cast if moved from local across west side

Current Probabilities

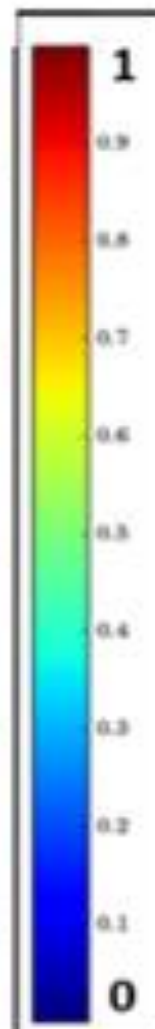
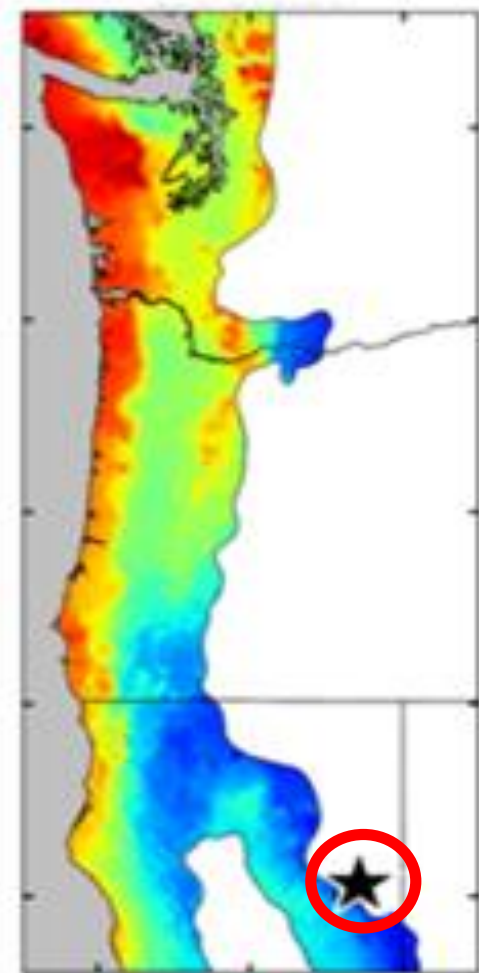
CA Coast




CA Klamath



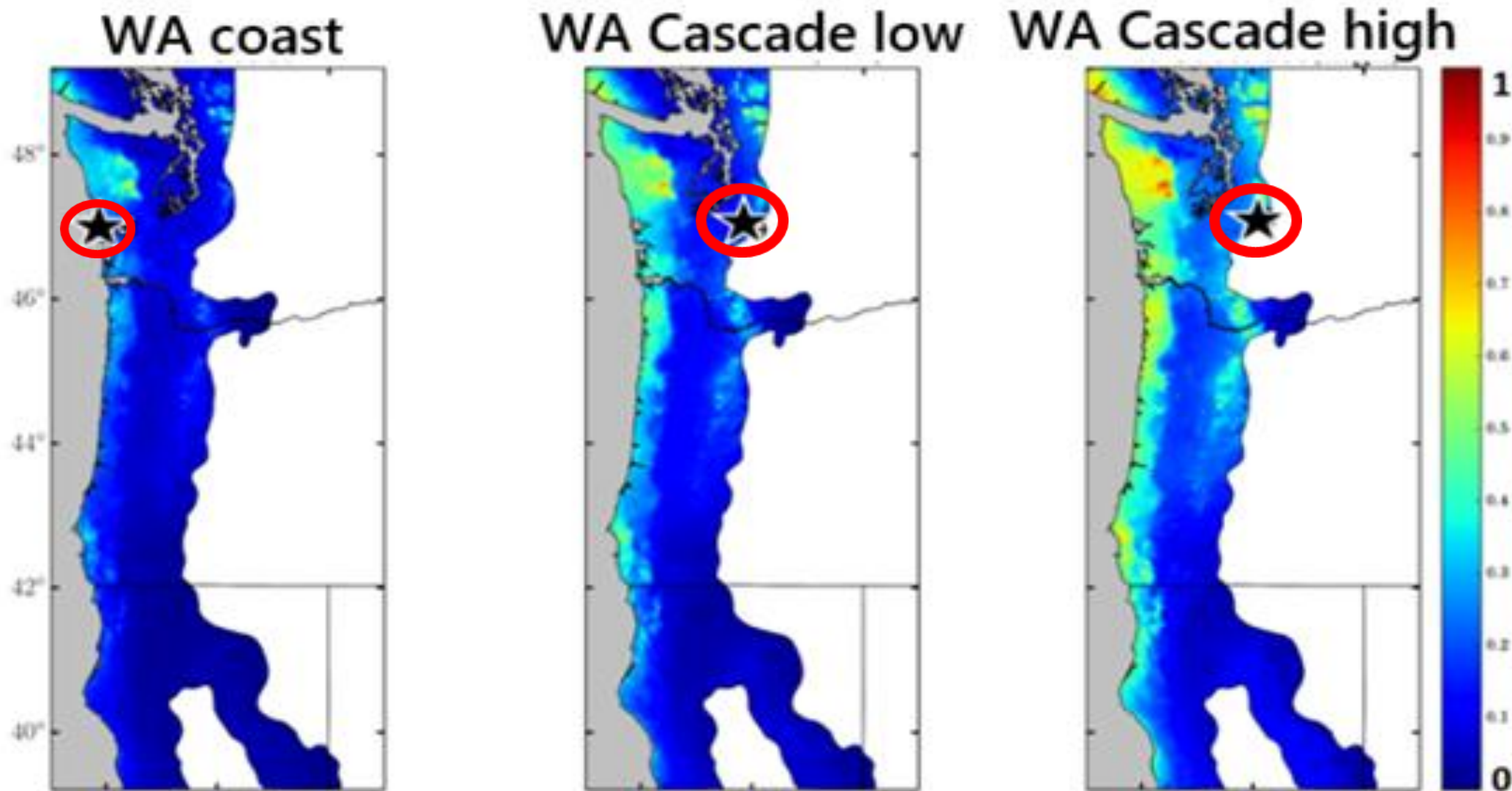
CA Sierra



 = location of seed source

Probability of severe Rhabdocone needle cast if moved from local across west side

Current Probabilities



Key factors associated with needle disease.

- May – September Precipitation
- Winter Temperature
- Continentality
- You increase disease probability when you....
- Move from high elevation to low...
- Move from dry to wetter...
- Local always among the most tolerant or resistant to local disease pressure.





Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Short-term climate trends and the Swiss needle cast epidemic in Oregon's public and private coastal forestlands

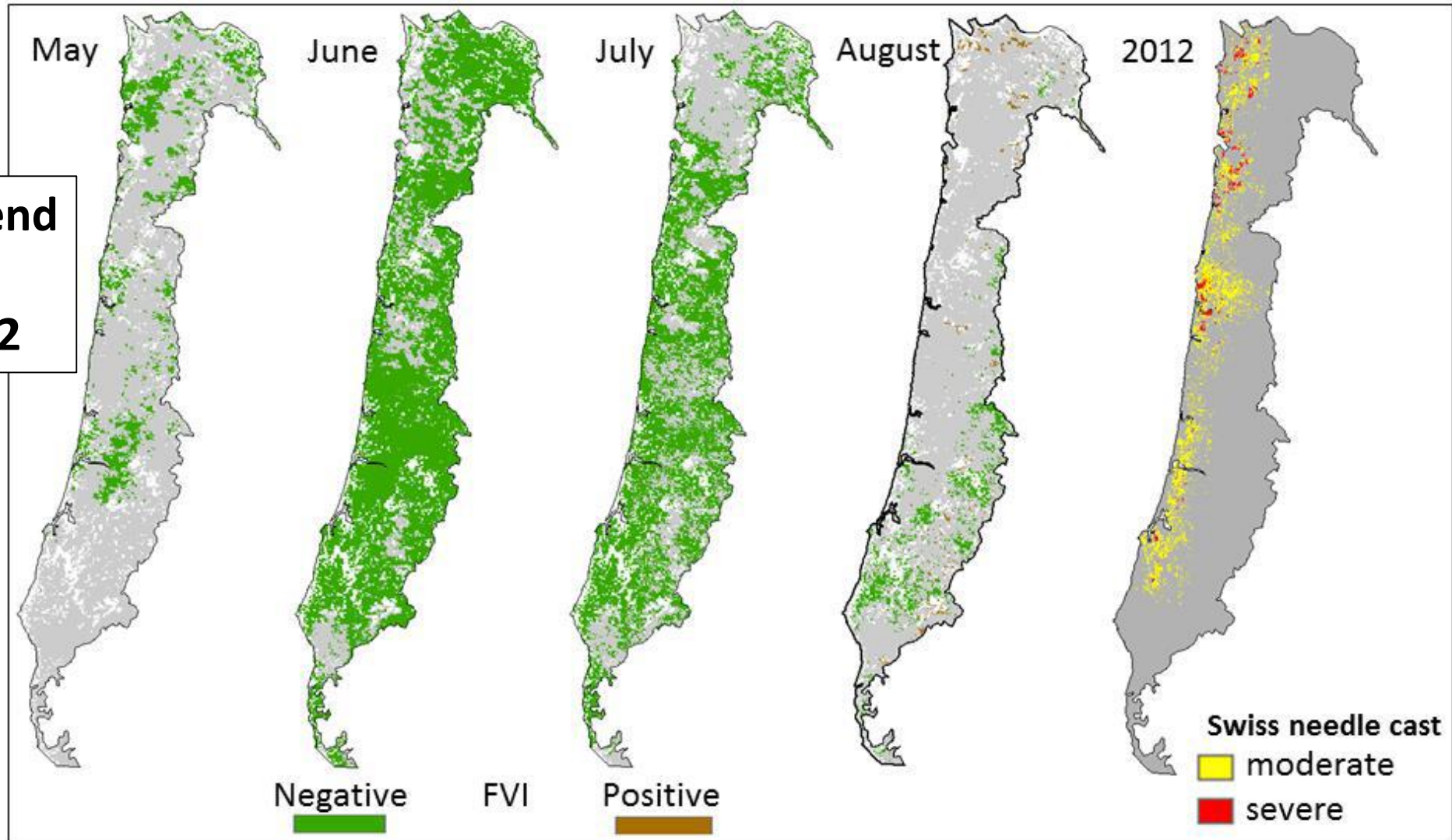
David J. Mildrexler^{a,*}, D.C. Shaw^b, W.B. Cohen^{a,c}



Forest Vulnerability Index = Land surface temperature – Water Balance

Water balance = Precipitation - Evapotranspiration

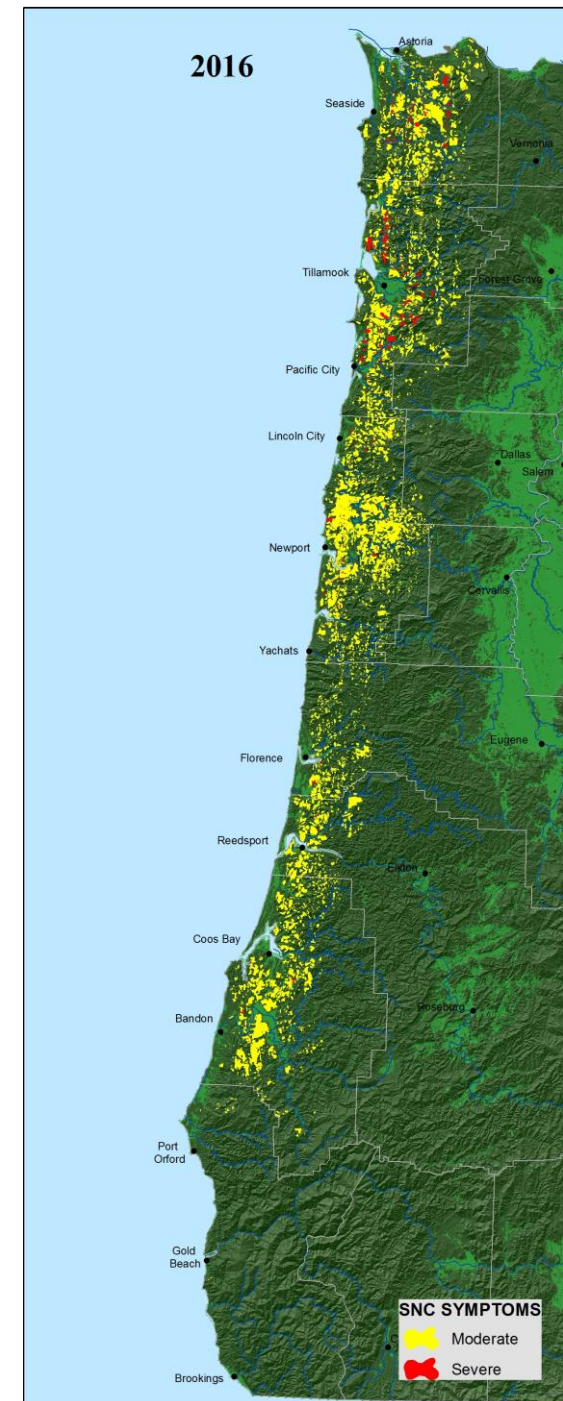
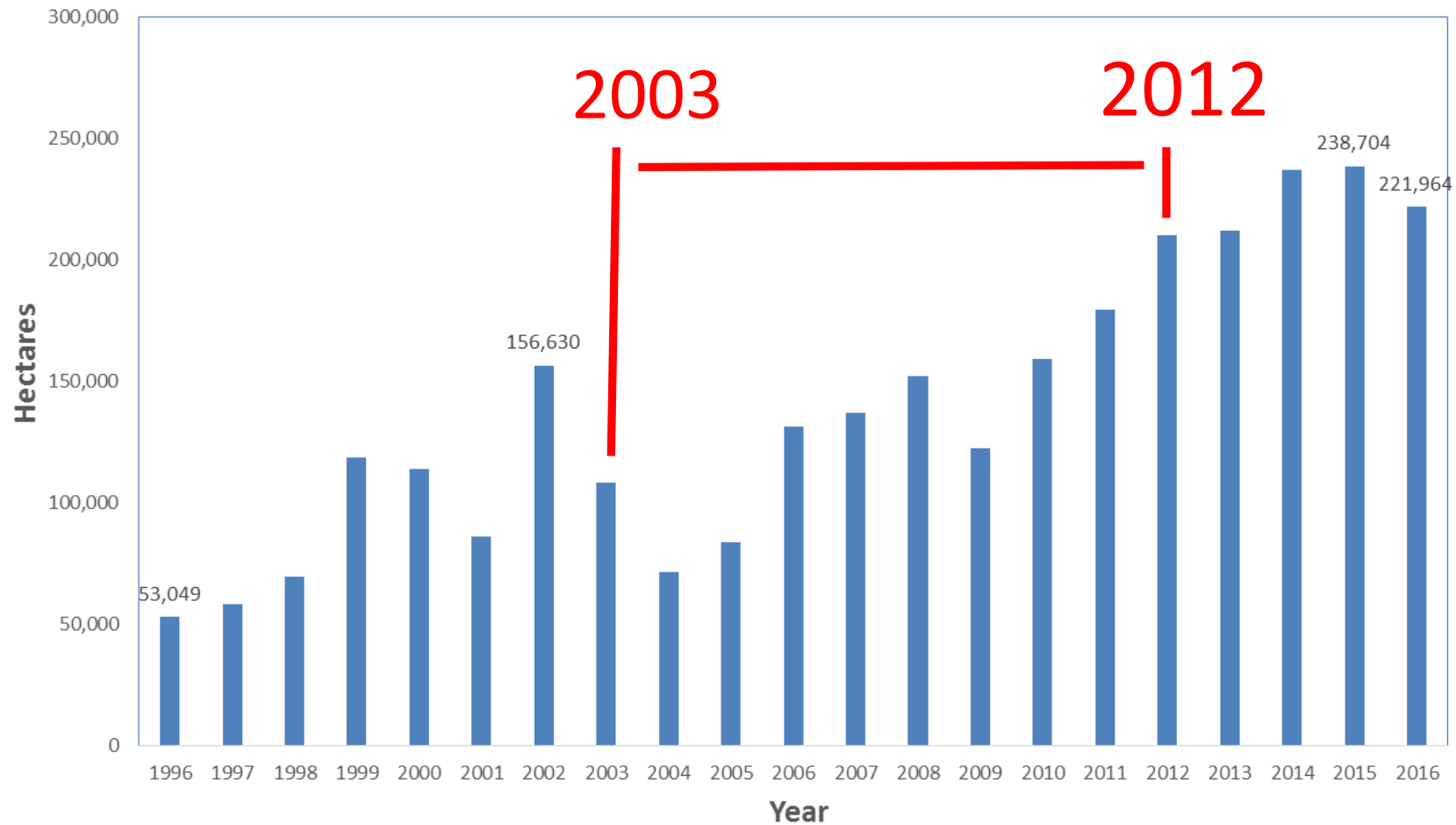
Decreased temperatures and increased water balance resulted in negative FVI values



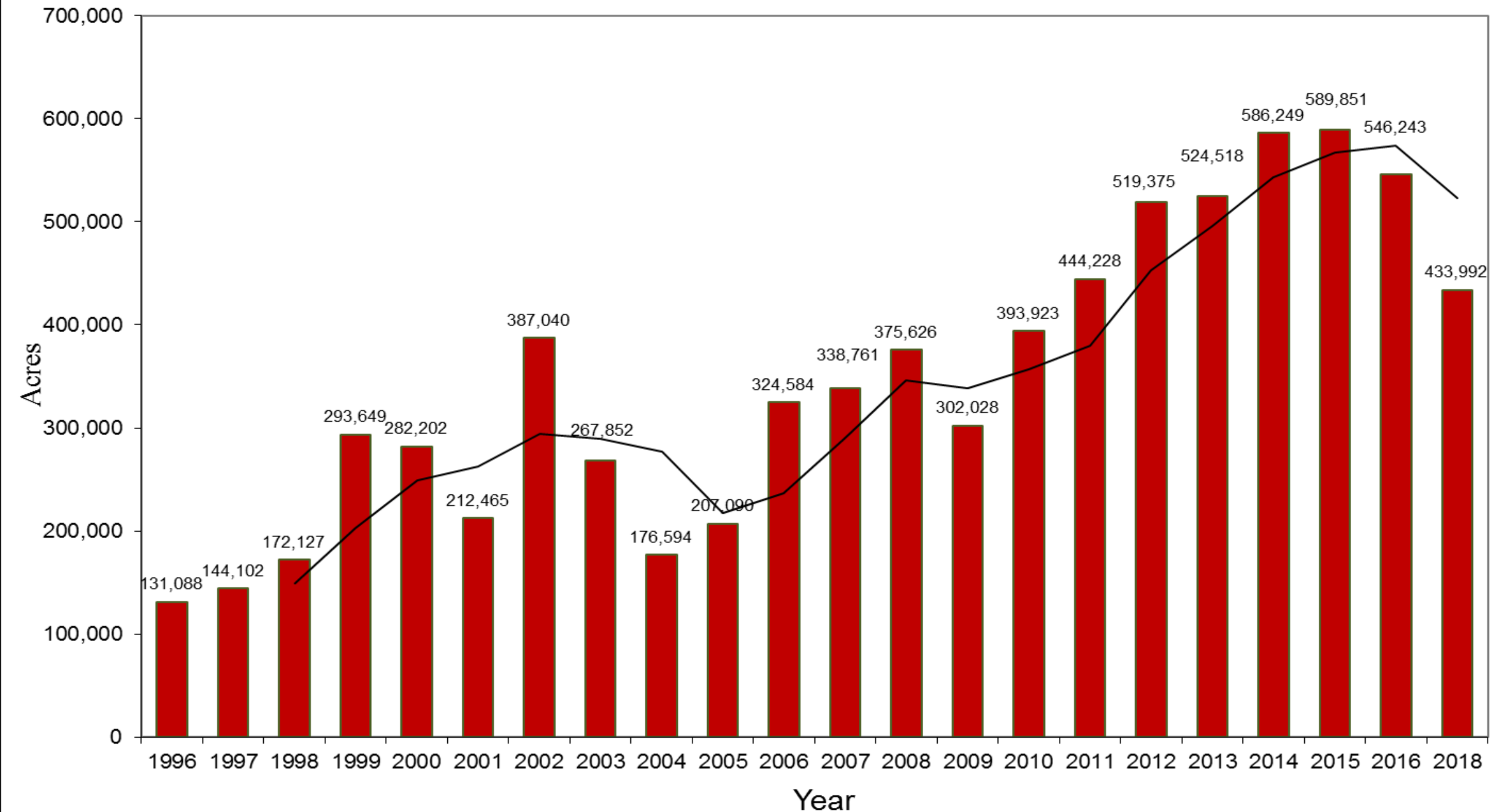
Swiss Needle Cast in Oregon
2016 = 221,964 ha

Cooperative Aerial Survey
ODF/USFS FHP 1996-2016

Area of Douglas-fir forest with Swiss needle cast symptoms, 1996-2016



Area of Douglas-fir forest with Swiss needle cast symptoms, 1996-2018



A low-angle photograph looking up at a dense forest canopy. Sunlight filters through the leaves, creating a dappled light effect. Several dark, thick tree trunks are visible, reaching upwards. The leaves are mostly green, with some showing signs of autumn. The sky is visible through the gaps in the foliage.

Questions?

Principles for assisted migration

- Protect native biodiversity
- Avoid transporting soil, debris, and plant material
- Interpret species distribution models with extreme caution
- Look regionally for adaptive traits



KMX: hybrid b/w Monterey pine and knobcone pine
Drought tolerant hybrid hammered by foliage disease and rust

Principles for Assisted Migration for Native Forests

- Use only regionally tested plant materials for deployment on large scales to prevent introductions of maladapted seed sources
- Control pests in plant materials by growing in the region and inspecting nurseries
- Limit the movement of a species to the obvious needs of the species to survive



KMX hybrid
Monterey X Knobcone