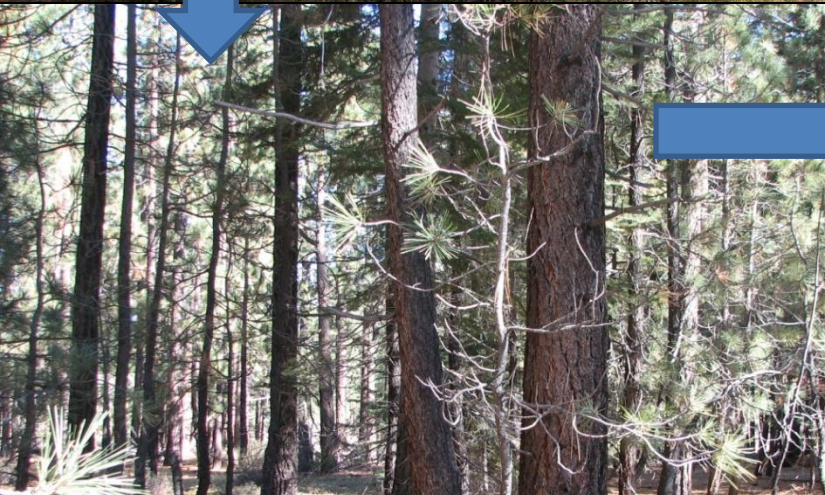


# **Tree Mortality in Forests of the Lake Tahoe Basin from 1985-2010: Influences of Tree Density, Forest Type, and Climatic Variability**

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**University of Nevada, Reno**





## Project Background

- Fire exclusion & 19<sup>th</sup> century logging led to unnaturally dense forests
- High density leads to mortality: increased competition , increased transfer pests & pathogens



**How does stand density influence mortality risk?**

**Is this relationship variable over larger spatial scales and longer time series?**



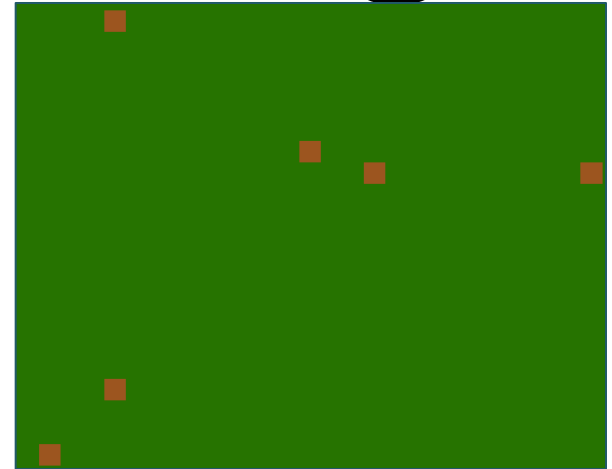


# Remote Sensing

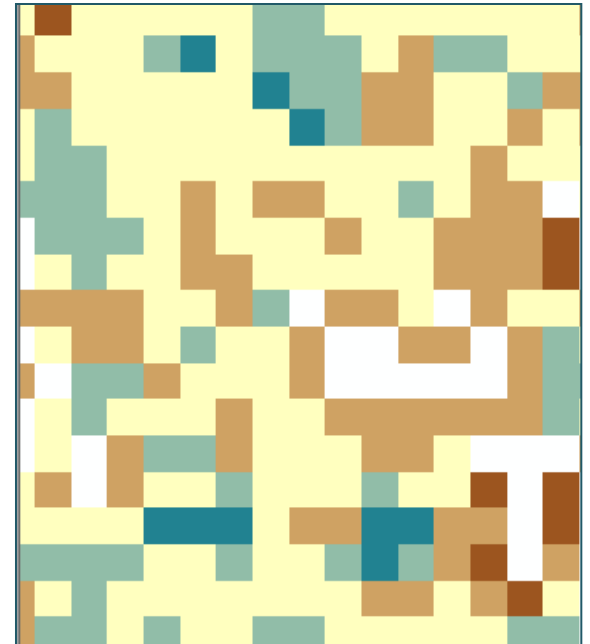


Vegetation Indices

Mortality:  
Binary



Stocking Level:  
Continuous



# Spectral Signature of Canopy Mortality

## 3. Gray Attack

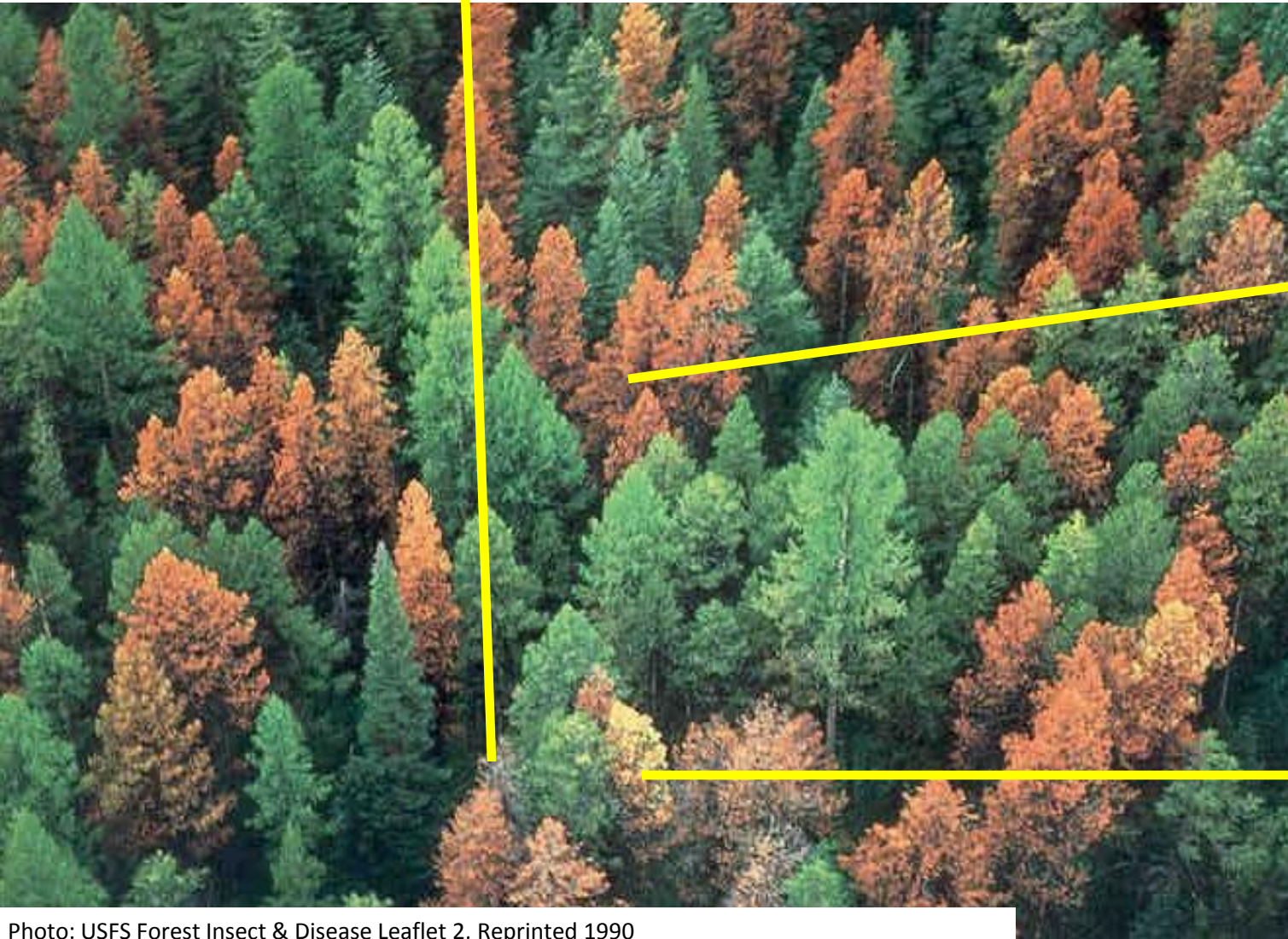
Red to Needle Drop, exposing gray branches

## 2. Red Attack

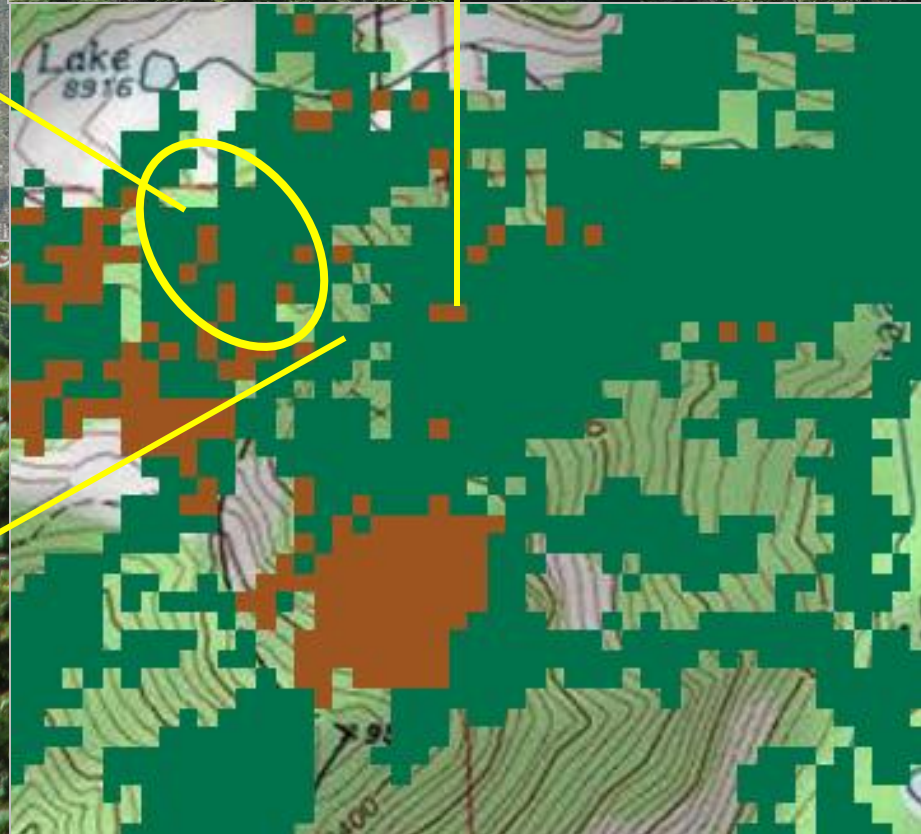
Lime-Green/  
Yellow  
to Red

## 1. Green Attack

Green-Lime  
Green-Yellow









# Defining Mortality

Different levels due to:

- mortality/damage agent
- outbreak v non-outbreak
- spatial spread throughout 30m pixel

Spectral signatures we see are discrete steps in one mortality event.

Did not use pixels showing canopy mortality events in previous four years.





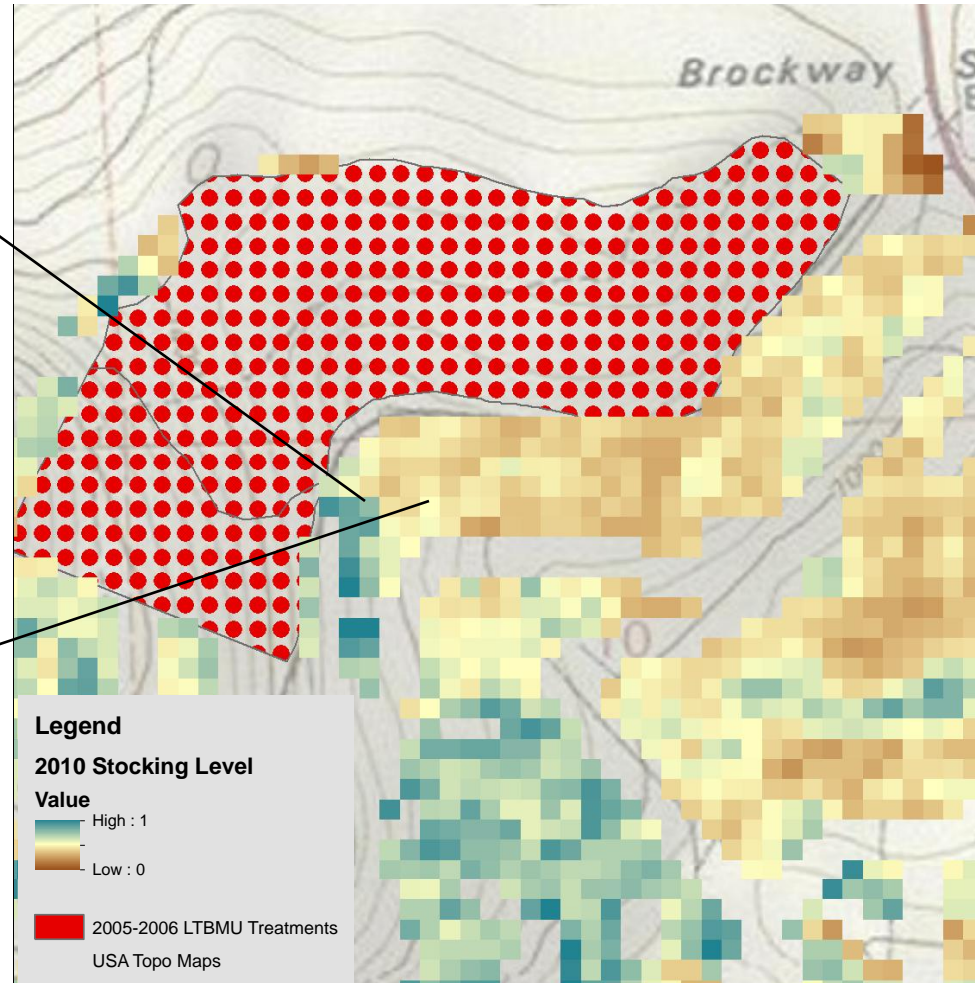
# Stocking Level



Stocking = .75



Stocking = .3



## Legend

### 2010 Stocking Level

#### Value

High : 1

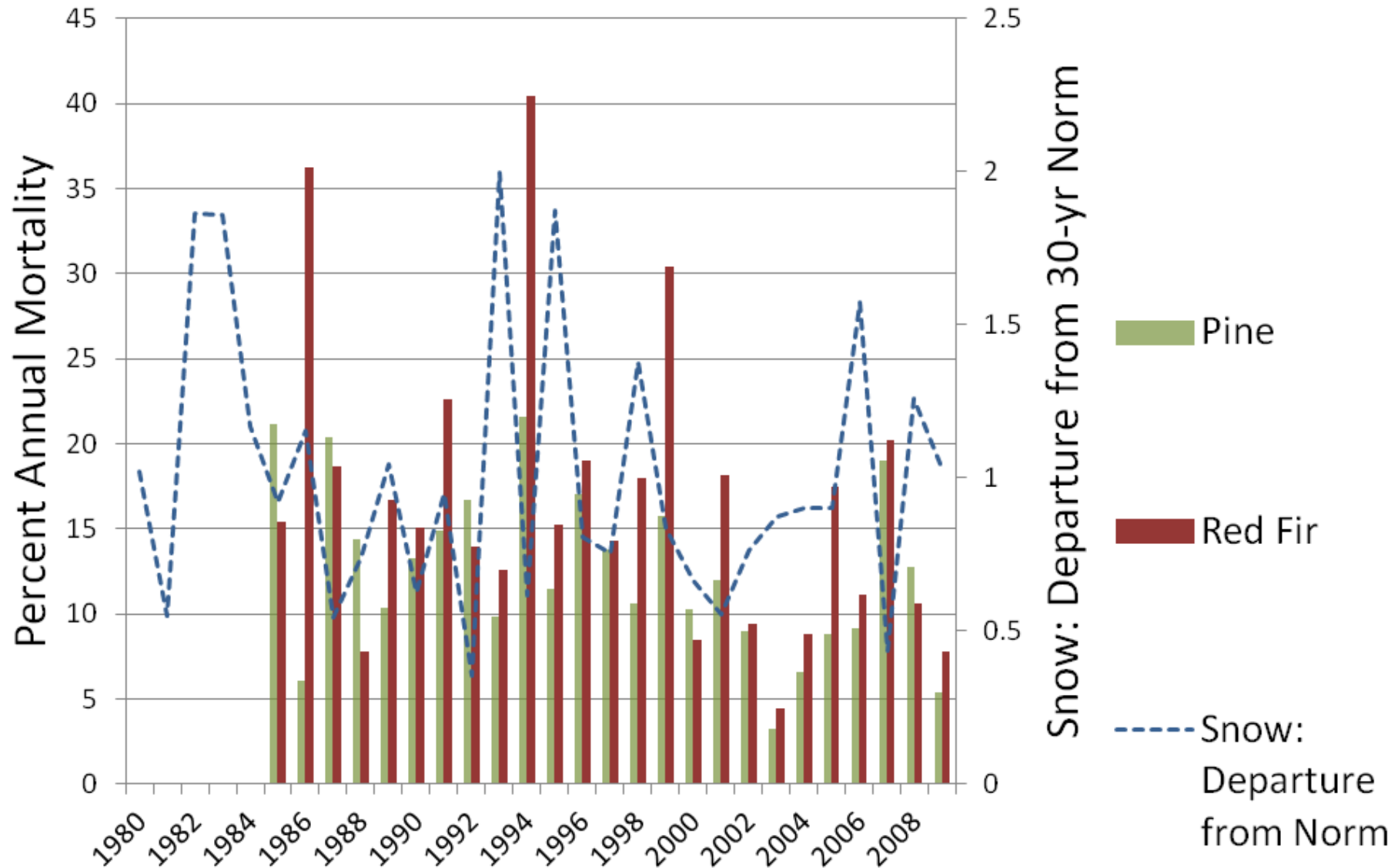
Low : 0

2005-2006 LTBMU Treatments

USA Topo Maps

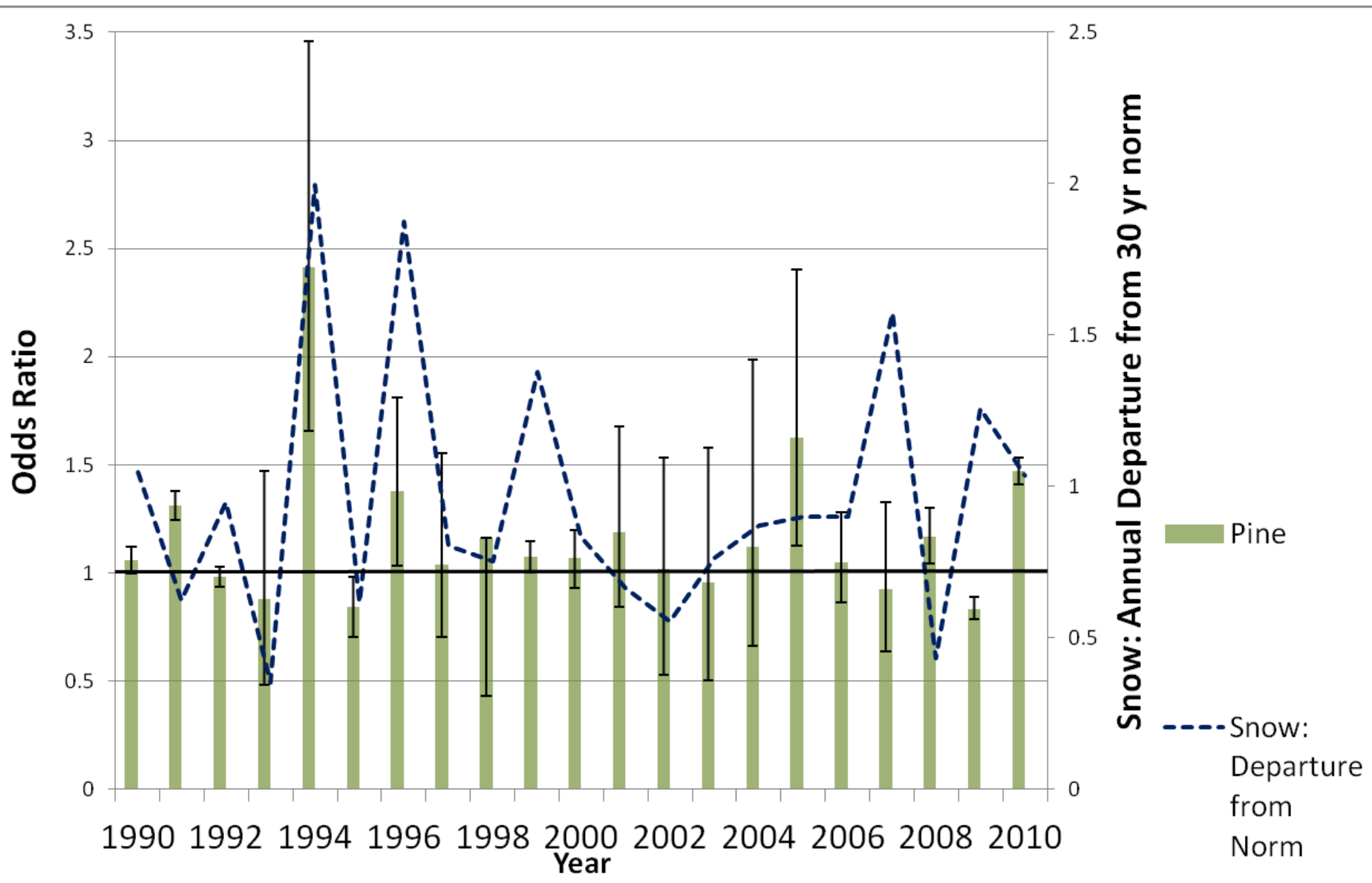


# Climate & Tree Mortality Trends



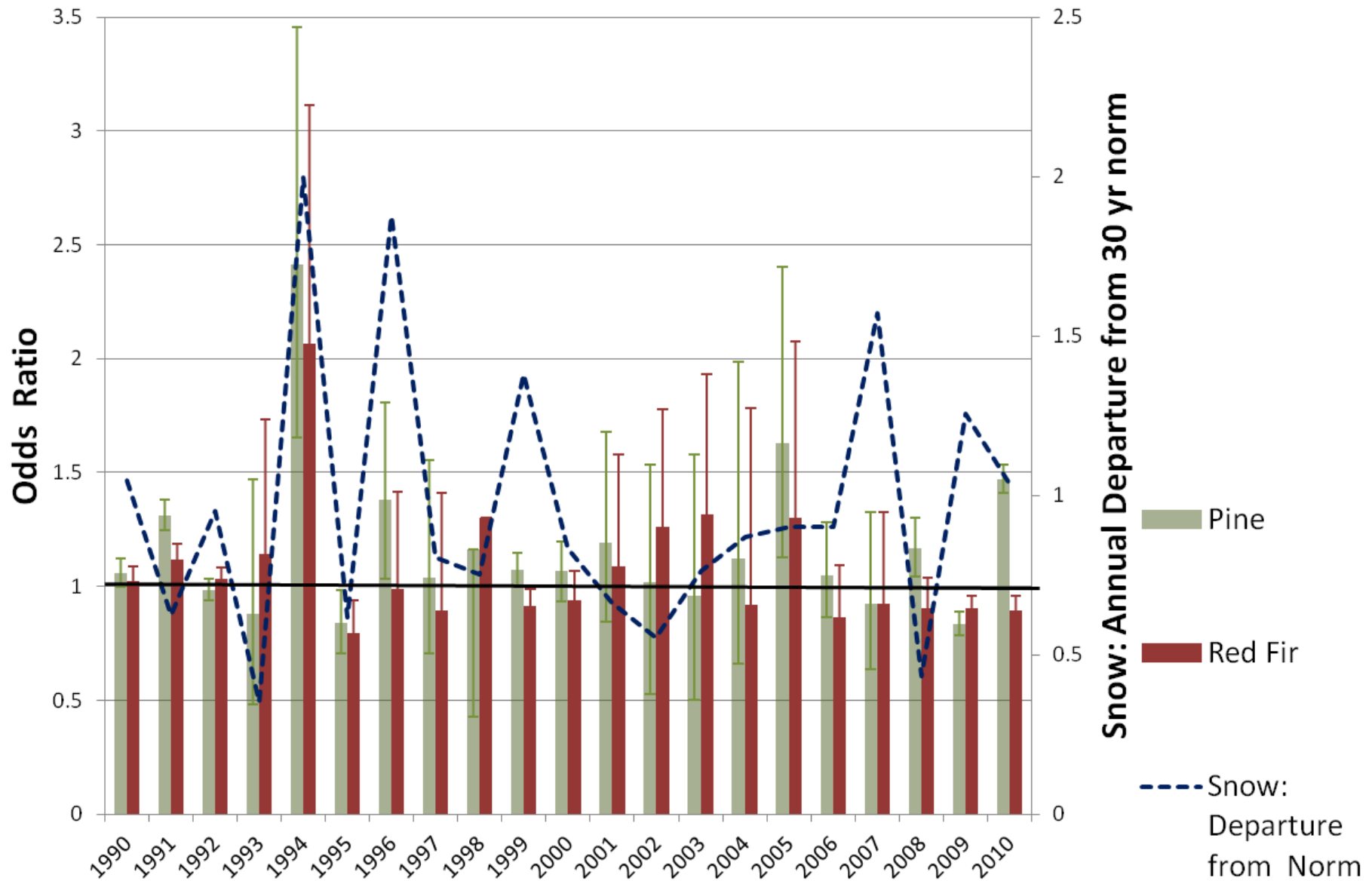


# Strength of Density Dependent Mortality



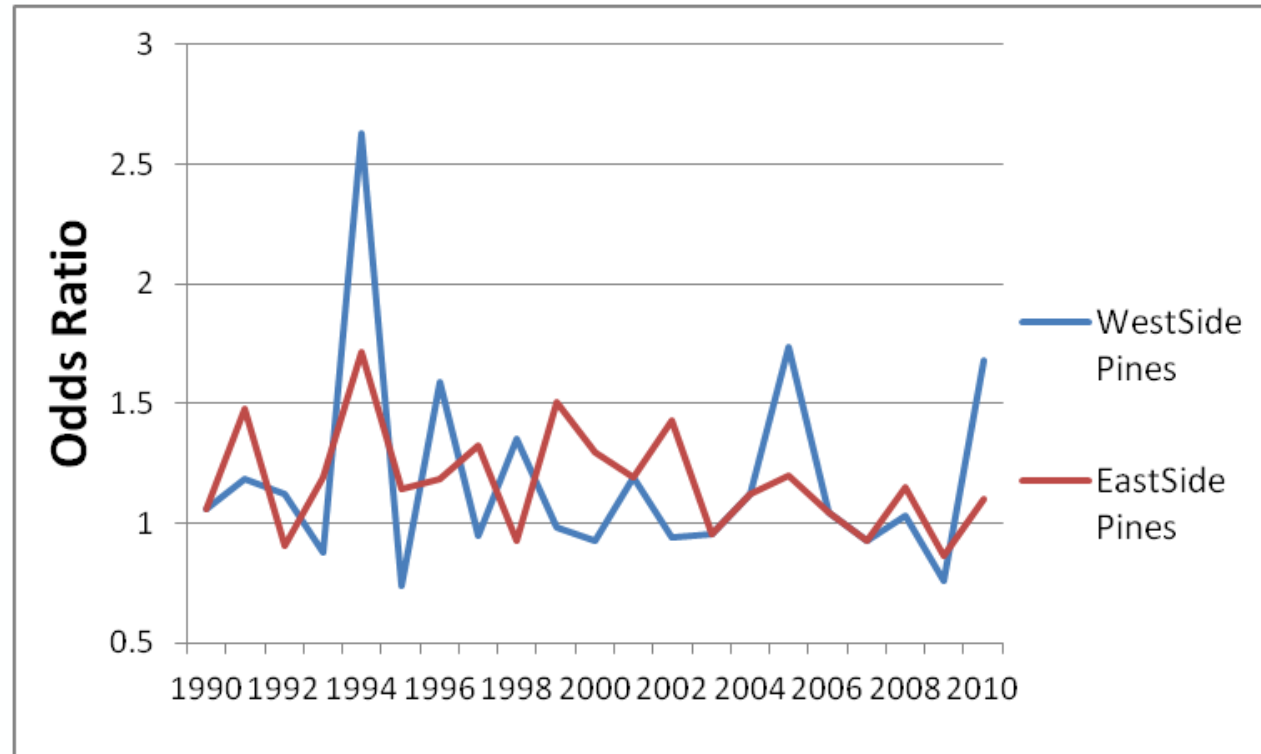
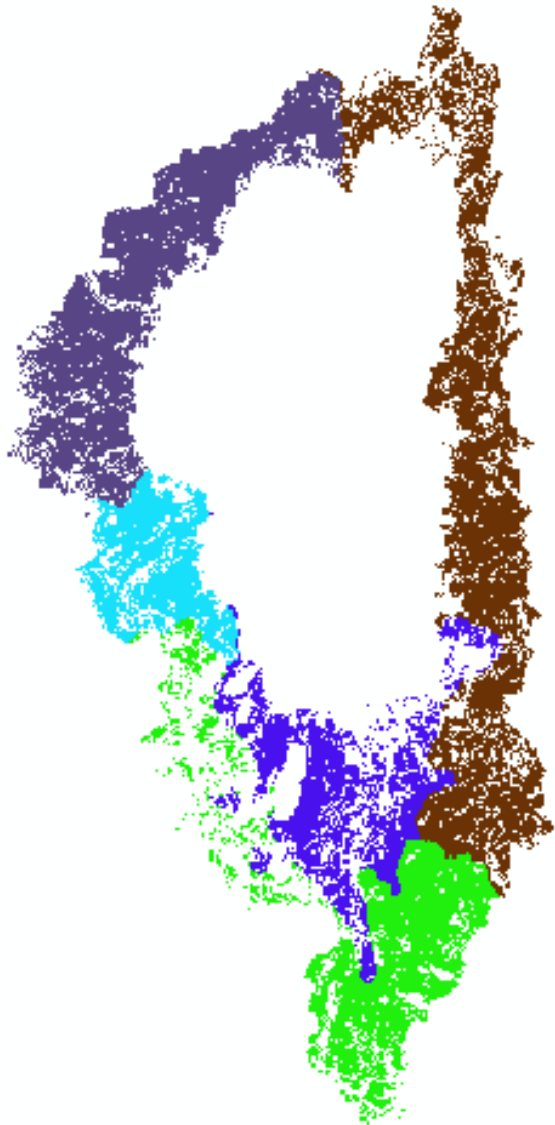


# Strength of Density Dependent Mortality





# Finer-Scale Variation in Density Dependent Mortality







**How does stand density influence mortality risk?**

- On average, weakly increases risk of mortality

**Is this relationship variable over larger spatial scales and longer time series?**

**Climate**

- Variable within and between drought periods

**Forest Type**

- Difference in magnitude between Pine and Red Fir

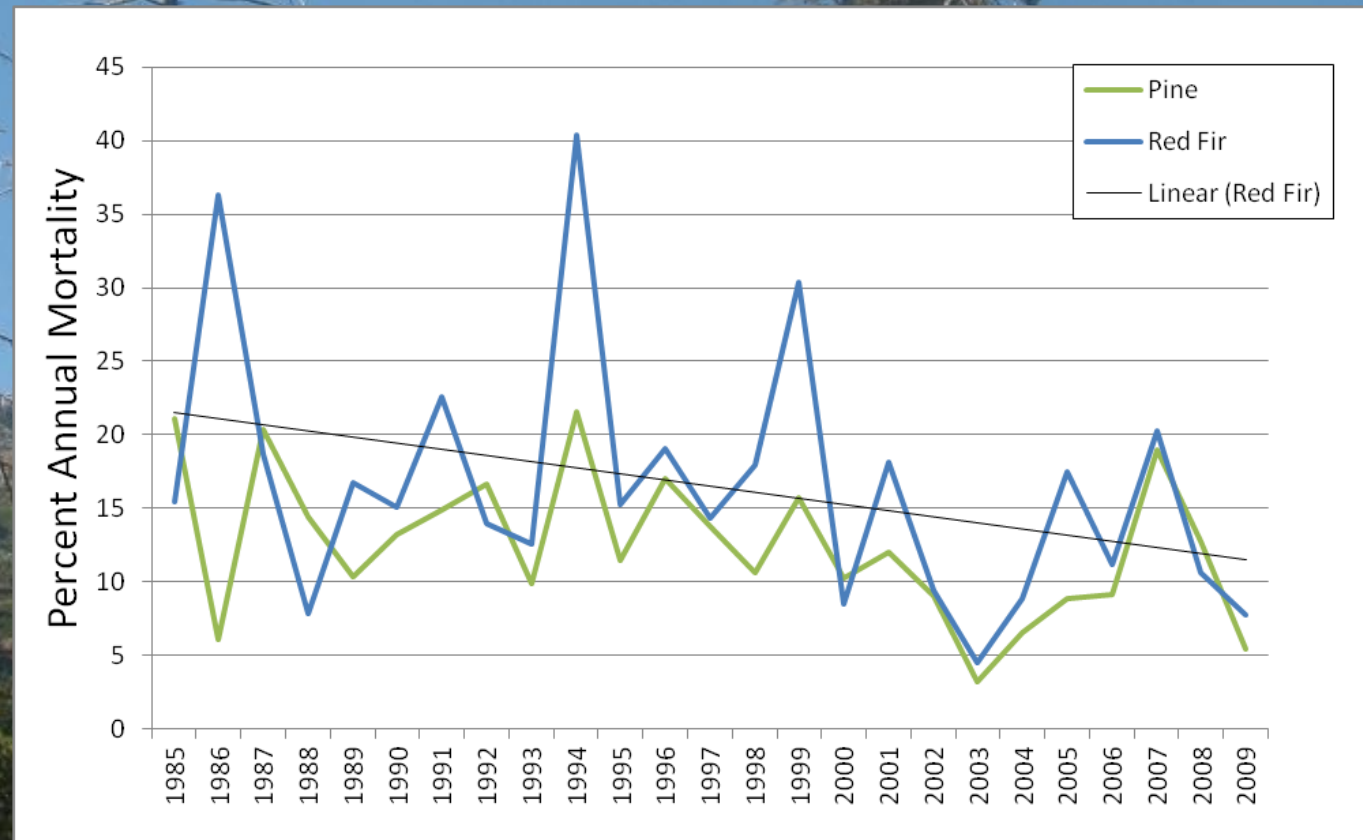


# Role of Density Dependent Mortality

- “Natural Thinning”

## Controls on Mortality

- Bottom-up v. Top-down







## Acknowledgements

- Yuanchao Fan & Isabel Munck
- Bob Nowak
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- Lake Tahoe License Plate Program