New Proposal

Site-stand dynamics and pine beetle mortality in ponderosa pine ecosystems

Implications for density management

Companion Study to CAFS 19.75

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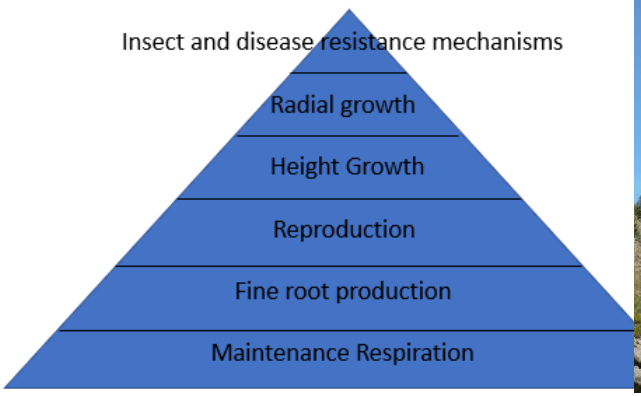
Presenter: Haley Anderson

Justification

- Pine beetles are bark beetles endemic to North America which colonize (and kill) weakened trees
- Individual or small group mortality is historically characteristic, but large-scale mortality (epidemics) is not
- Thinning stands to reduce competition reallocates available resources to residual trees, thereby improving the tree's resistance mechanisms to insects and disease
- Climate change will likely alter the thresholds at which stands become susceptible to bark beetle epidemics
- Existing models that provide density thresholds to reduce bark beetle susceptibility are region-specific, broad, lack abiotic or climatic information, or are difficult to replicate
    - i.e. grams of wood produced per square meter of leaf area per year



Hypotheses or Objectives

- Explore site/stand variables related to pine beetle susceptibility to create a susceptibility model
- Incorporate climate and abiotic data into susceptibility models for both western and mountain pine beetles (*potential expansion into southern pine systems*)

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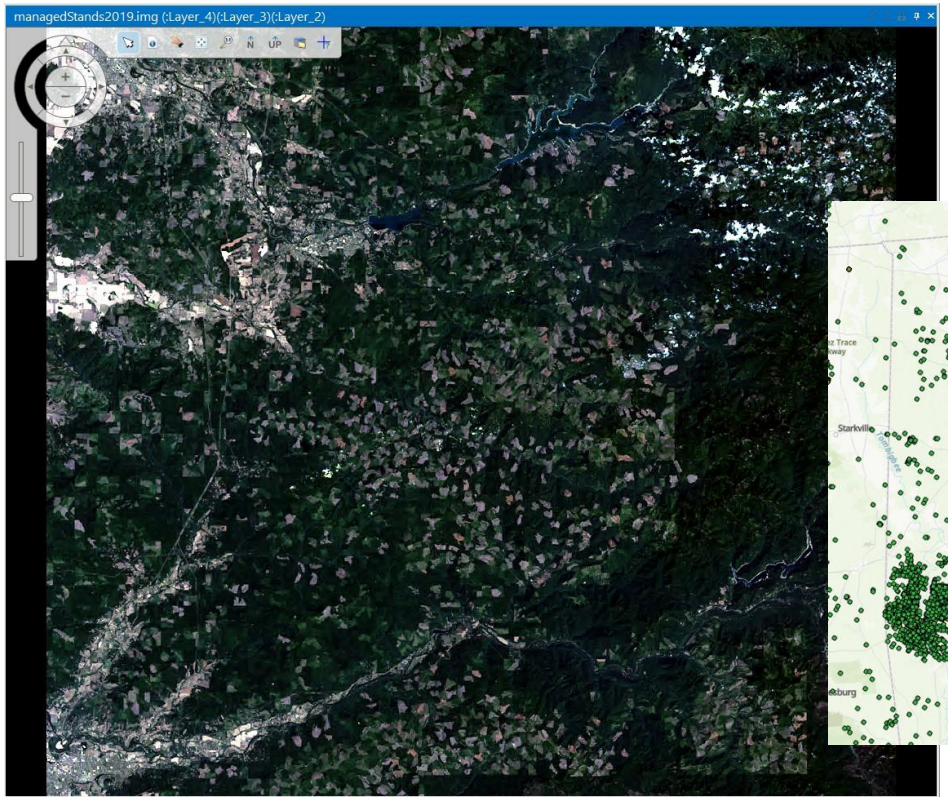
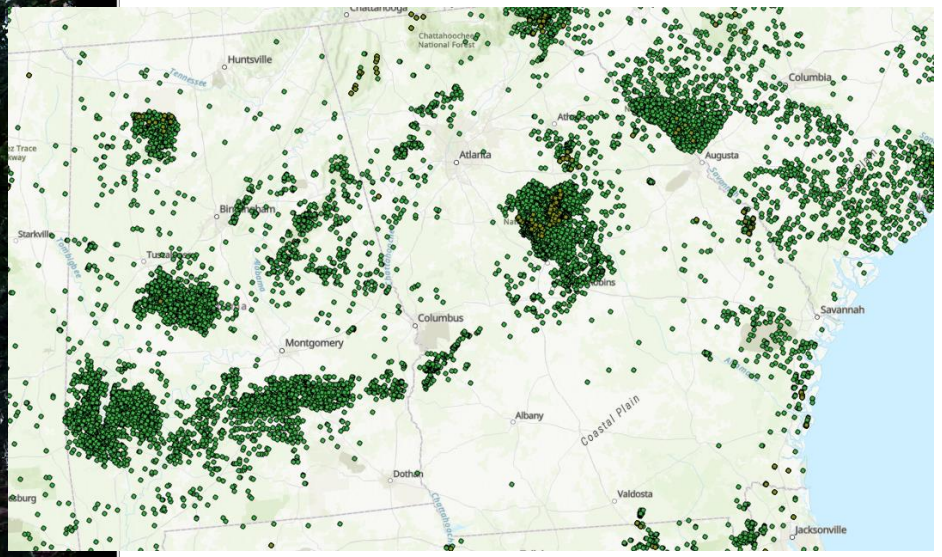
Methods





- Collect available pine beetle outbreak data
- Utilize available remotely sensed imagery (GEE) to correlate site/stand factors at 30-meter pixel scale (temperature, precipitation, NDVI
- Utilize *in situ* plot data to correlate to site/stand factors at stand scale (density, species composition)

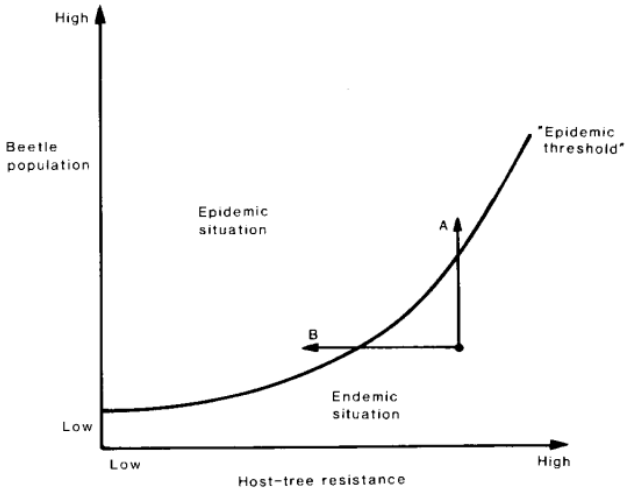
Major Findings

Suggested Density Thresholds for Reducing Mortality in Ponderosa Pine

Year	Author(s)	Suggested density threshold(s)	Region of Study	Beetles of focus
1976	Sartwell and Dolph	150 ft^2 basal area	Oregon and Washington	Mountain Pine Beetle
1982	McCambridge and Stevens	90 ft^2 basal area	Black Hills	Mountain Pine Beetle
1983	Larsson et al.	78 ft^2 basal area	Eastern Oregon	Mountain Pine Beetle
1995	Oliver	SDI 230	Sierra Nevada (California)	*Dendroctonus* (unspecified)
2013	Zhang et al.	SDI of 500 trees per hectare	Western Sierra Nevada and Blue Mountains	Mountain and Western Pine Beetles

- Variability in density thresholds and stand density metrics
- Thresholds only exist for Mountain Pine Beetle, or Mountain/Western Pine Beetle combined
- Each study is specific to one locale

Major Findings



Site/stand variables reported for estimating **Mountain Pine Beetle** susceptibility – ponderosa pine

Author(s)	Year	Variable(s)	Region(s)
Stevens et al.	1980	Stand structure, mean stand diameter, basal area	Black Hills
McCambridge et al.	1982	TPA and Western Dwarf Mistletoe presence	Northern Colorado
Larsson et al.	1983	Grams of wood produced per square meter of leaf area per year	Eastern Oregon
Schmid and Mata	1992	Growing Stock Level (mean stand diameter and tree spacing)	Black Hills
Schmid et al.	1994	Mean stand diameter, stand density, spacing	Black Hills
Munson and Anhold	1995	Basal area, average DBH of p. pine, proportion of p. pine, number of infested trees	Colorado Plateau
Olsen et al.	1996	TPA, Basal Area, QMD, minimum diameter, range of tree diameters	Black Hills
Negrón and Popp	2004	Ponderosa pine basal area	Colorado Front Range
Negron et al.	2008	P. pine basal area in trees >25.4 cm and ponderosa pine stand density index	Black Hills
Knapp et al.	2013	Radial growth rates (basal area increment)	Western Montana

Deliverables

- Identification of size/density thresholds for mountain/western pine beetle
- Determination if and at what point in stand development climatic conditions induce pine beetle outbreaks
- Determination if climate change indicates shifts in pine carrying capacity as a function of site type and species composition
- A western/mountain pine beetle management guide for ponderosa pine stands flexible to climate, species composition, site type, and method of measurement

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Company Benefits

- Targeted density management guidelines in western pine forest ecosystems
- Reduction of large-scale mortality resulting from western and mountain pine beetle epidemics
- More resilient forest stands

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Summary

1) Gain a better understanding of the mechanisms that drive disturbance agents in forest systems will allow for more effective forest management.
2) No cost. Matching existing SDImax modeling CAFS funding with internal sources (UI, perhaps NCASI next year) to provide a value added project.
3) Potential expansion to SPB and southern pine forests through CAFS collaborators and an upcoming AFRI submission.