**PROJECT ID:** CAFS.23.XX

**PROJECT TITLE:** Site-stand dynamics and pine beetle mortality in ponderosa pine ecosystems: Implications for density management

**INVESTIGATOR(S): Mark Kimsey Jr., Haley Anderson, UI (recruiting interested parties at CAFS annual meeting)**

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| **PROJECT DESCRIPTION:**  The University of Idaho proposes to develop a companion ponderosa pine SDImax model (i.e., 19.75) that is sensitive to stressors that precipitate pine beetle (WPB, MPB) mortality outbreaks. These stressors may or may not coincide with traditional density management thresholds that are associated with density dependent related mortality. It is critical to develop a more granular understanding of which site and stand variable combinations contribute to pine beetle outbreaks across spatial and temporal scales. Spatially and temporally explicit models that identify at risk pine ecosystems will enable targeted and timely treatment prescriptions for creating resilient forests. We anticipate this project will have applicability to southern pine forests and susceptibility to southern pine beetle (SPB). Currently, we are developing a proof of concept using time series SPB outbreak data across the southern US and mining Google Earth Engine for imagery pre-outbreak (interannual and lagged annual), which will in turn be associated with climate and other abiotic factors. The proof of concept is in collaboration with Purdue (John Couture), Clemson (David Coyle), and Florida (Aditya Singh) for an AFRI grant submission. |
| **OBJECTIVES:**   * Identify site/stand variables related to pine beetle outbreak susceptibility, * Incorporate temporal time series climate and abiotic data into outbreak susceptibility models for both western and mountain pine beetles, * Develop SDImax density thresholds and management guidelines to aid in reducing epidemic attack potential. |
| **METHODS:**  The study area includes outbreak locations of the western and mountain pine beetles throughout the Intermountain West. Data includes *in situ* plot data (e.g., unfuzzed FIA data, state agency inventory records) and remotely sensed imagery (Landsat 7/8/9 TM/OLI) mined from Google Earth Engine at multiple temporal scales. Site/stand variables, including climatic (temperature, precipitation), abiotic data (latitude, longitude, elevation, slope, aspect, soil type), and stand information (density, species composition) will be explored and analyzed using machine learning to find relationships with western and mountain pine beetle epidemics. |
| **PROJECT TIMELINE:**  Estimated timeline January 2023 to December 2025.  Acquire data for analysis by December 2023  Complete analysis of data by December 2024  Complete management guide(s), incorporate new data into existing tools by December 2025. |
| **EXPECTED DELIVERABLES – ONE YEAR:**   1. Identification of size/density thresholds for mountain/western pine beetle 2. Determination if and at what point in stand development climatic conditions induce pine beetle outbreaks 3. Determination if climate change indicates shifts in pine carrying capacity as a function of site type and species composition |
| **EXPECTED DELIVERABLES – LONG-TERM:**   1. A user-friendly tool that provides effective density management recommendations for ponderosa pine stands flexible to climate, species composition, site type, and method of measurement at the stand-scale for reduced susceptibility of western and mountain pine beetle epidemics across their respective ranges. 2. A dissertation and published peer-reviewed journal article describing the project in detail. |
| **POTENTIAL MEMBER COMPANY BENEFITS:**  Potential time and cost savings by reducing large-scale mortality from pine beetle epidemics, and more resilient forest stands. Density threshold modifiers for existing SDImax models that incorporate pine beetle epidemic risk factors. |
| **NEXT YEAR’S PROJECT BUDGET – NSF/CAFS PORTION:**  $0 additional funds. Current CAFS annual site funding for 19.75 will help support this add-on project. |
| **NEXT YEAR’S PROJECT BUDGET - OTHER SOURCES, INCLUDING SITE-SPECIFIC:**  $15,000 – NCASI – partial Fall 2024 RA stipend/insurance support for Haley Anderson.  Any remaining support required after CAFS/NCASI will be supported through the IFC and any external grant funding secured. |