



## MESM GROUP PROJECT PROPOSAL 2020-2021

### Conservation Strategies for Yellow Pine and Mixed Conifer Forests in San Bernardino National Forest



*Photo Credit: Nathan Wickstrum*

#### **PROPOSERS**

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Anne-Marie Parkinson | Masters Candidate, 2021 | [aparkinson@bren.ucsb.edu](mailto:aparkinson@bren.ucsb.edu) | (858) 705-9109

Hannah Garcia-Wickstrum | Masters Candidate, 2021 | [hannah\\_garcia@bren.ucsb.edu](mailto:hannah_garcia@bren.ucsb.edu) | (805) 760-4030

Samantha Smith | Masters Candidate, 2020 | [ssmith337@bren.ucsb.edu](mailto:ssmith337@bren.ucsb.edu) | (240) 483-2162

#### **CLIENT**

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Nicole Molinari, PhD | Southern Province Ecologist - Pacific Southwest Region | U.S. Forest Service | [nmolinari@fs.fed.us](mailto:nmolinari@fs.fed.us) | (805) 961-5729

Hugh Safford, PhD | Regional Ecologist – Pacific Southwest Region | U.S. Forest Service | [hughsafford@fs.fed.us](mailto:hughsafford@fs.fed.us) | (707) 562-8934

#### **FACULTY SUPPORT**

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Bruce Kendall, PhD | Professor and Associate Dean | Bren School of Environmental Science & Management | [kendall@bren.ucsb.edu](mailto:kendall@bren.ucsb.edu)

## **OBJECTIVES**

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The primary goal of this project is to aid the U.S. Forest Service (USFS) in evaluating past, present, and future conditions of yellow pine and mixed conifer (YPMC) forests in southern California. This information will inform best practices to preserve these vulnerable ecosystems. San Bernardino National Forest (SBNF) will serve as a case study to develop recommendations for the USFS to manage forests for resilience to drought and fire.

Specific objectives include:

1. Conduct an analysis of the natural (historic) range of variability (NRV) of YPMC forests in terms of fire regime, forest structure, and forest composition in the four National Forests in southern California (Figure 1).
2. Analyze how current conditions of YPMC forests in San Bernardino National Forest have deviated from historical conditions.
3. Identify priority conservation areas within YPMC forests in SBNF that are vulnerable to climate change based on projected habitat loss and are in need of conservation efforts based on results from objective 1.
4. Establish conservation strategies and management goals that promote forest resilience under changing climate.

## **SIGNIFICANCE**

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Mixed conifer forests are the most abundant type of conifer forest in southern California<sup>1</sup>. Yellow pine, which refers to Jeffrey and Ponderosa pines, are some of the most drought and fire-resistant conifers in California<sup>2,3</sup>, however their non-serotinous cones makes them susceptible to long-term eradication after stand-replacing wildfires<sup>4</sup> which are becoming more frequent<sup>5</sup>. Additionally, prolonged drought reduces tree resilience to bark beetle attack<sup>6</sup>, which has resulted in the mortality of over 100 million trees in California since 2010, altered forest structure, and increased fire risk<sup>7,8</sup>.

Southern California YPMC forests are considered “sky islands,” or high-elevation habitats that are geographically isolated among many different mountain ranges<sup>9</sup>. Rising temperatures as a result of climate change are forcing species to shift upwards in elevation<sup>10</sup>, however YPMC sky island forests already exist at top elevations. Under most climate change scenarios, these forests are projected to be severely limited or lost indefinitely<sup>11</sup>. The loss of these forests from more severe fires and bark beetle mortality, in addition to habitat loss caused by climate change, threaten the existence and health of forests in California.

SBNF is a popular recreation area visited by 2.4 million people annually<sup>12</sup>. Forests in SBNF provide a broad range of important ecosystem services such as contributing 111 billion gallons of water to downstream watersheds, storing 19 million metric tons of carbon and providing habitat for endangered and threatened species such as the California Condor<sup>12</sup>. YPMC forests cover approximately 25% (over 211,000 acres) of SBNF and comprise 71% of coniferous habitat in SBNF (Figure 2), thus preserving YPMC forests is important to maintain ecosystem services that benefit animals and humans. This project will provide an understanding of the current state and projected future ranges of YPMC forests in SBNF and establish management goals that promote resilience.

## **BACKGROUND**

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The composition and structure of conifer forests across the western United States has been dramatically altered by fire suppression and the cessation of Native American burning<sup>13</sup>. This has resulted in increased biomass and abundance of shade tolerant conifers, which enhances the

vulnerability of YPMC forests to drought and wildfire<sup>14</sup>. In southern California there is no compiled source on historical conditions, which would be an extremely valuable tool to guide management objectives since restoring to these conditions have been shown to reduce vulnerability to drought and high severity wildfire.

However, current and projected future circumstances are vastly different from conditions hundreds of years ago. Restoring forests to historical conditions, in some circumstances, may be infeasible and may require greater inputs of financial resources. This project will combine NRV results with current research to provide the client with feasible management goals that maximize forest resilience under an uncertain future climate, which will allow the USFS to better direct its limited conservation funds to more effectively manage YPMC forests. By understanding the past and present state and projected future ranges of YPMC forests in SBNF, the most vulnerable forests will be prioritized for conservation efforts. SBNF was chosen as the case study for this project since it had the most available historic and current data (Figure 2).

The NRV for YPMC has been analyzed in Sierra Nevada National Forests and coastal National Forests in northern California<sup>15,16</sup>; these will serve as guiding methodology for estimating the NRV for YPMC forests across southern CA. Fire regime, structure, and function are the main components of NRV. Fire return interval for historic and current conditions and fire trends have been assessed for southern California National Forests<sup>5, 17</sup>.

## **EQUITY**

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There is not yet quantitative research on the social impacts of existing or proposed management for YPMC forests. Although this level of analysis is out of the scope of this project, environmental justice (EJ) issues surrounding SBNF may be considered from a qualitative perspective and integrated into the overall discussion of the results. Generally, we plan to examine the role of EJ when determining conservation efforts for YPMC forests.

Literature on EJ issues surrounding National Forests highlights the cultural importance of forests to Native American communities. There are also low-income communities near SBNF<sup>18</sup>. A more robust literature review will explore opportunities to incorporate EJ issues when developing YPMC management goals. Potential areas of research and analysis include: 1) framework for consultations between USFS staff and indigenous groups, including the Serrano and Cahuilla, to prioritize sacred cultural sites for conservation<sup>19</sup>. 2) Explore opportunities to work with local environmental justice groups, like The City Project, who work to increase access to National Forests for all communities<sup>20</sup>.

## **AVAILABLE DATA**

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Several available sources to assess historic and current forest conditions can be used, such as:  
Historical conditions (all publicly available):

- **Wieslander plot data:** 1920s-1930s Vegetation plots. Data includes: forest structure, percent cover of dominant overstory and understory, vegetation by species, soil type, and environmental elements for each site. Approximately 124 plots are in our study area (Figure 2).
- **Wieslander historical photos:** Black and white photographs taken from 1920-1941; approximately 27 are in our study area. The photographs document species, timber stand conditions, and consequence of land use.
- **Literature review:** Journals from early expeditions and published literature.

Current conditions (Data will be provided by the client upon project acceptance):

- **USFS & Enterprise plot data:** Approximately 70 plots were established in SBNF since 2012 by the client in addition to plots established by private filed crews. Data collected includes: height, diameter at breast height, canopy position, health, snag density, and species percent cover.
- **Forest Inventory and Analysis (FIA) data:** Survey of U.S. forests conducted every 5-10 years. A high number of plots within our study region is expected. Data collected includes: tree cover, tree growth, and species composition.

Other public datasets are available to analyze past and present conditions: **CalFire, CALVEG, LANDFIIRE, and Fire Return Interval (FRI)**. Includes (but not limited to) datasets such as fire hazard severity zones, ecoregions, forest density, past fire perimeters, and historic and current FRI. **Future Climate Models (Cal-Adapt):** Publicly available projected climate data.

## **POSSIBLE APPROACHES**

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The general approach will first synthesize information on historic conditions across southern California YPMC forests and then use the SBNF as a case study to evaluate deviations from historic to current day condition. The compiled information will be used to identify forests that are conservation priorities and develop management goals that promote resiliency to guide future conservation. Specifically, the approach will include the following tasks:

1. Estimate NRV for YPMC forest structure and composition in the southern California National Forests by evaluating Wieslander data, historical photos, and literature review. The previous NRVs will serve as a guideline to maintain consistency between regions<sup>15,16</sup>. We will use existing condition data from SBNF to assess how much YPMC forests have deviated from historic conditions in SBNF.
2. Model future ranges of YPMC forests in SBNF using projected climate scenarios from Cal-Adapt. This model would highlight areas that will exhibit the largest changes in temperature and precipitation, which can be used to assess vulnerability to fire, drought, and bark beetle attacks.
3. Map forests that are priorities for conservation to increase resilience to drought and wildfire. This will incorporate outputs from the future climate model and analysis of the deviation of forests from historical conditions. We will work with the client to create guidelines and that determine and rank forest conditions that warrant intervention. We will also provide management recommendations that promote resilience while following current USFS guidelines.

## **DELIVERABLES**

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1. **Analyzed data and literature synthesis** of the NRV for YPMC forests in the four southern California National Forests in addition to a comparison between historic and current conditions in SBNF. Publishable write-up of the NRV will be the client's responsibility by at the conclusion of the project.
2. **Model** results of predicted future range for YPMC forests in SBNF.
3. **Map** that identifies YPMC forests prioritized for forest restoration and conservation under climate change scenarios and increasing fire severity. Guidelines will be established to determine prioritization.
4. **Recommendations** for management strategies and goals that promote resilient forests.

## **INTERNSHIP**

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The U.S. Forest Service can provide an internship with a yet undetermined stipend to enable one student to further the objectives of the project over the summer of 2020. Details such as location and stipend will be provided closer to summer.

## BUDGET

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The budget for this project is not projected to exceed the \$1,300 provided by the Bren School of Environmental Science & Management. Costs will include printing expenses and conference calls.

## CITATIONS

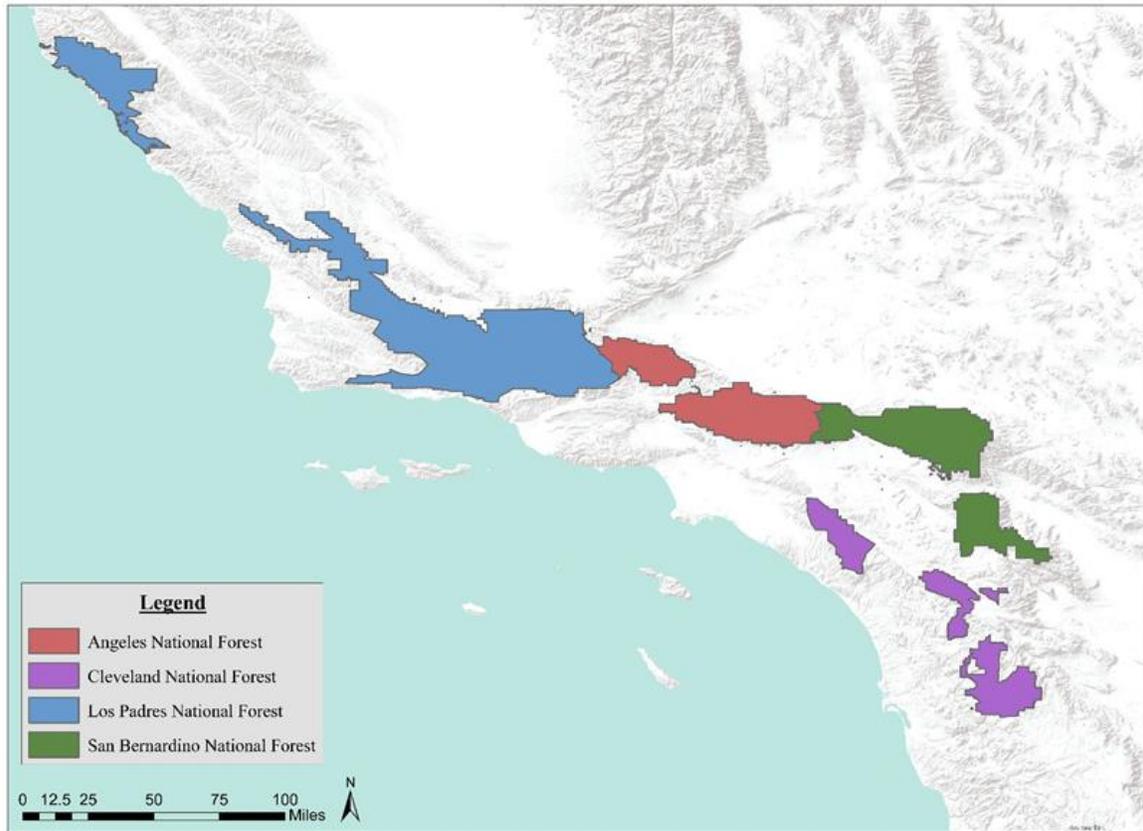
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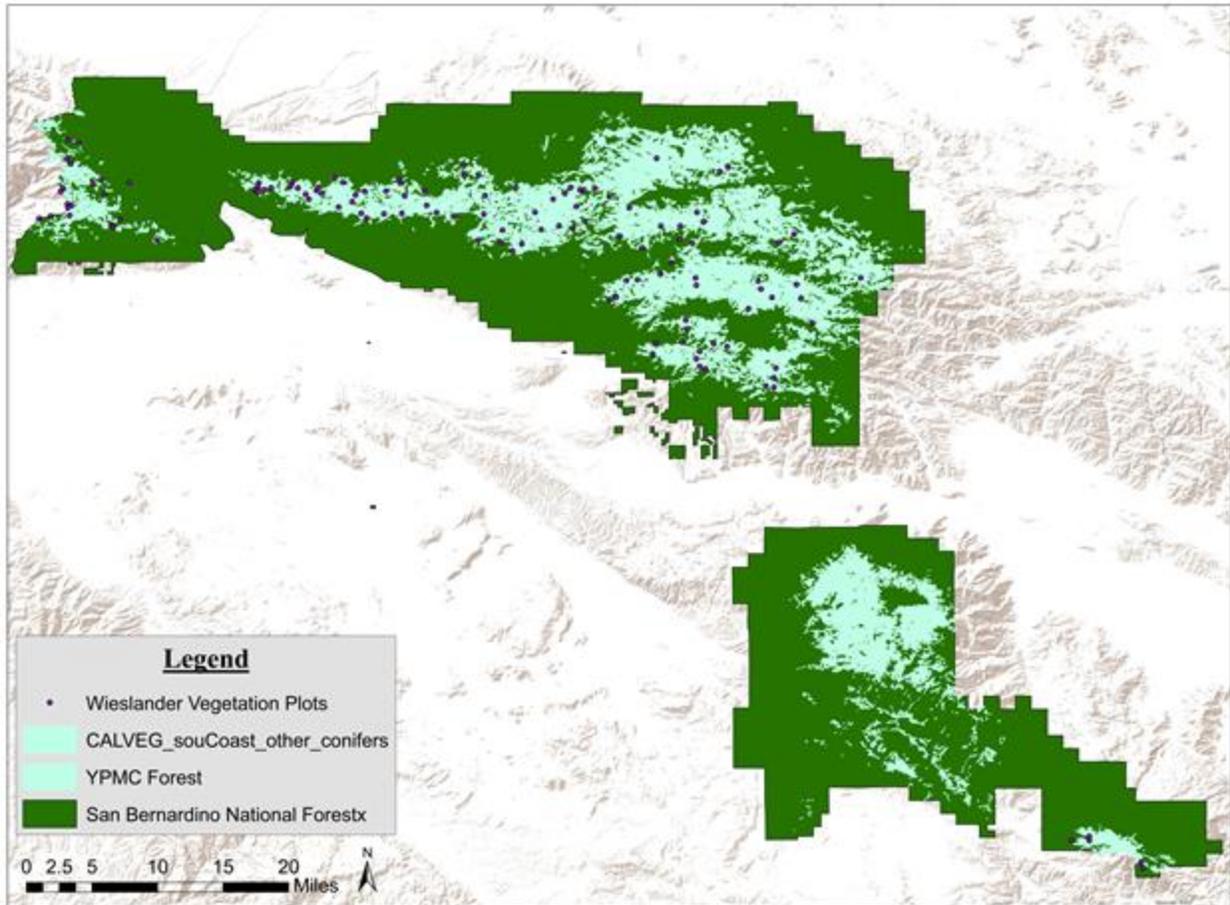
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## SUPPLEMENTAL FIGURES

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**Figure 1:** San Bernardino NF is one of four national forests in southern California (USFS Pacific Southwest Region; Region 5).



**Figure 2:** There are approximately 211,227 acres of YPMC forests in San Bernardino NF. These forests cover 25% of SBNF. Approximately 124 Wieslander vegetation plots and 27 Wieslander historic photos are located in the YPMC.



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**Date:** January 13, 2020

MESM Group Project Selection Committee  
Bren School of Environmental Science and Management  
2400 Bren Hall, University of California, Santa Barbara  
Santa Barbara, California 93106

Dear Bren Group Project Committee,

Conifer forests in southern California occupy a small proportion of the landscape, yet the ecosystem services they provide are immeasurable. Recent drought and high intensity fire have resulted in increased conifer mortality throughout forested areas in the western United States. In southern California, there is opportunity to more effectively manage our forested ecosystems to enhance resilience to drought and fire. To more effectively accomplish this goal, we need to understand the historical and current conditions (e.g. composition and structure) in conifer forests and evaluate how they are expected to change with environmental stressors, like wildfire and drought. This information will be the backbone for creating a conifer forest conservation plan and developing a long-term vision for our treasured conifer dominated landscapes.

I am excited to partner with the Bren School of Environmental Science and Management MESM program to generate a Natural (Historic) Range of Variation (NRV) report that can be integrated into a Conservation Plan for conifer forests throughout USFS managed lands in southern California. The USFS Regional Office has supported the creation of NRVs to guide management decisions, and to date conifer forest NRVs have been generated for the Sierra Nevada (Safford and Stevens, 2017) and Northwestern California (Bohlman et al, *in prep*). These reports have proven incredibly valuable for defining desired and existing conditions for Land Management Plan revisions and project planning. The use of habitat suitability models that inform future conifer extent will be valuable for prioritizing landscapes for management actions that align with future climate conditions. Given the rapid pace of environmental change, the USFS appreciates the opportunity to partner with the Bren School to build capacity to more quickly identify and implement actions that enhance forest resilience in southern California.

The primary USFS contact for the Bren MESM Group will be Nicole Molinari, who serves as the Province Ecologist for the Los Padres, San Bernardino, Angeles and Cleveland national forests. The Province Ecologist will work with the Bren Group to acquire spatial and field data, access historical documents, and promote the findings of the project and integrate them into science-based decision making. The Province Ecologist received her graduate degree from UC Santa Barbara and is familiar with the structure of the Bren Master's program. She has strong affiliations with students and faculty at UCSB and currently serves as a committee member for three graduate students in the Department of Ecology, Evolution and Marine Biology. The Region 5, Regional Ecologist, Hugh Safford, will provide additional oversight to the project. Hugh has authored NRV documents for conifer forests across California and is a proponent of creating a conservation plan for conifer forests throughout southern California.



The USFS can provide a paid internship through one of two cost share agreements already established with the Marine Science Institute at UCSB. The internship can take two forms depending on the interests of the selected intern.

- 1) ***Fuelbreak Restoration.*** This summer internship will center on promoting native species restoration on fuelbreaks on the Los Padres National Forest. In fire prone landscapes, like the Los Padres, fuelbreaks are important landscape features that help firefighters stop or slow the progression of wildfire. At the same time, they can be conduits for the spread of non-native species and represent degraded areas that lack diversity. The Los Padres National Forest seeks a summer intern to help develop a fuelbreak restoration plan that promotes community protection, while enhancing ecological value. The use of drill seeding as a potential restoration method on fuelbreaks will be evaluated. More specifically, the intern will compile data from successful drill seeding projects, identify the appropriate species and seed source for restoration, and help determine where drill seeding will be most effective on the Los Padres National Forest. Stipend = \$5000
- 2) ***Field Crew Member.*** A seasonal field crew member is needed to join the ecology field crew in conducting vegetation inventory and monitoring projects in support of ecological research on public lands in Southern California (primarily the Cleveland, San Bernardino, Angeles and Los Padres National Forests). The field crew member will collect technical data on forest and chaparral stand structure, tree mortality, species diversity, vegetation regeneration, and landscape characteristics at remote field sites. Hired at Lab Assistant I status (\$15.46-\$16.64 per hour) full time throughout the summer months.

I greatly appreciate you considering this proposal. I am excited to work more closely with the Bren School to provide science-based solutions that enhance the sustainability of forested ecosystems across southern California.

If you have questions about this proposal please contact Nicole Molinari at 805-961-5732 or via email at [nicole.molinari@usda.gov](mailto:nicole.molinari@usda.gov).

Sincerely,



KEVIN B. ELLIOTT  
Forest Supervisor