CAL POLY
Natural Resources Management & Environmental Sciences
COLLEGE OF AGRICULTURE, FOOD & ENVIRONMENTAL SCIENCES

California Board of Forestry
2026/27 Effectiveness Monitoring Committee – Request for Research Proposals

Initial Concept Proposal

a) Date submitted: 05/18/2026
b) Title: ***After the Burn: wildfire effects on forest structure, fuels, and landscape resilience in coastal redwood forests***
c) Project #TBA
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g) [redacted]
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i) Swanton Pacific Ranch, College of Agriculture and Environmental Sciences, Mark Swisher and staff

j) **Project description**

i) Project Duration

2 years (24 months)

ii) Background and Justification

Coastal redwood forests are increasingly affected by more frequent and severe wildfires, creating uncertainty about the effectiveness of current forest management practices across the coastal region. While current Forest Practice Rules include requirements related to post-fire management and fuel hazard reduction, limited empirical data exist evaluating their effectiveness in coastal redwood forests under increasing wildfire pressure. This is particularly evident in the footprint of CZU Lighting Complex Fire, which burned 86,509 acres of forest and rangeland in 2020, including significant portions of Swanton Pacific Ranch. As a result, there is still limited understanding of how post-fire forest structure and management practices affect fuel buildup, wildfire hazard, and long-term forest resilience, creating challenges for practical forest operations and post-fire management decisions in coastal redwood forests.

Previous field work conducted at Swanton Pacific Ranch following the 2020 CZU Lightning Complex Fire has documented substantial differences in canopy density, stand structure, and ladder fuel densities across burn severity classes using Continuous Forest Inventory (CFI) methods and hemispherical photography (Kaarakka et al., 2026 in prep; Grupenhoff et al., in prep). High- and moderate-severity burned stands exhibited significant canopy loss, while low-severity and unburned stands maintained greater canopy continuity. These preliminary findings indicate that wildfire severity strongly influences post-fire fuel conditions, regeneration potential, and forest recovery trajectories, yet the relationship between stand structure, canopy closure, and wildfire resilience remains insufficiently validated for coastal redwood forests. Moreover, salvage harvesting has been carried out

in many parts of the wildfire footprint at Swanton, providing an opportunity to evaluate how post-fire management treatments influence fuel loads, vegetation patterns, stand structure, and canopy conditions associated with wildfire hazard reduction, forest resilience, and long-term response to climate stressors and future disturbance.

This project addresses critical scientific uncertainty surrounding the effectiveness of current post-fire management and fuel reduction practices under increasing wildfire risk. Results will provide field-based evidence relevant to evaluating Forest Practice Rules associated with stand density, fuel hazard reduction, and post-fire recovery (e.g., 14 CCR §§ 913, 917, 1051), while improving understanding of how forest structure and canopy conditions contribute to resilience in private timberlands. Although Swanton Pacific Ranch is managed under an approved NTMP, the property still provides an important demonstration site for post-fire treatments and management approaches that are directly applicable to timberlands managed within the purview of THPs. Finally, an additional [and equally important!] objective of this project is to support workforce development in forestry and natural resource management by providing students with hands-on experience in post-fire field inventory, monitoring, canopy assessment, and applied forest management research.

iii) Objectives and Scope

The proposed research project addresses two primary questions; (1) how wildfire severity and post-fire management treatments influence forest structure, canopy conditions, and fuel accumulation in coastal redwood forests, and; (2) how these post-fire conditions relate to wildfire resilience and fuel hazard reduction objectives relevant to current Forest Practice Rules and operational forest management.

In response, this project addresses the following EMC research themes and critical monitoring questions:

Theme 6: Wildfire hazard
- Managing fuel loads, vegetation patterns, and fuel breaks for fire hazard reduction
- Managing forest structure and stocking standards to promote wildfire resilience
- Achieving post-fire recovery and restoration

Theme 12: Resilience to disturbance in a changing climate
- Improving wildfire resilience and ecosystem response to disturbance
- Evaluating ecosystem functional response to fuel reduction and forest health treatments

The project focuses on post-fire coastal redwood stands at Swanton Pacific Ranch affected by the CZU Lightning Complex Fire and evaluates relationships among canopy structure, stand density, fuel accumulation, and forest recovery across a gradient of wildfire severity.

iv) Research Methods

The proposed study will be conducted at Swanton Pacific Ranch in Santa Cruz County, California. Forest inventory plots will be stratified across burn severity classes (unburned, low, moderate, and high) to capture variability in post-fire stand conditions and recovery trajectories. Field measurements will follow Continuous Forest Inventory (CFI) methodologies and include tree and snag inventories, basal area, stand density, regeneration, surface and ladder fuels, downed woody debris, and fuel transects.
Canopy conditions will be assessed using hemispherical photography collected with a fisheye lens camera at systematically distributed plot locations. Images will be processed to quantify canopy density and light availability by calculating canopy-to-sky pixel proportions. These measurements will be compared across burn severity classes to evaluate differences in canopy closure and structural recovery.

Field data will be analyzed to quantify relationships among stand structure, canopy density, fuel loading, and indicators of wildfire resilience. Existing findings from prior field assessments at Swanton Pacific Ranch will support interpretation of post-fire structural changes and canopy responses following wildfire disturbance.

v) Scientific Uncertainty and Geographic Application

This project addresses scientific uncertainty regarding the effectiveness of post-fire forest management and fuel reduction practices in coastal redwood forests, where limited empirical data exist linking canopy structure, stand density, and fuel dynamics following wildfire. Existing regulations and management approaches are largely based on broader forest types and have not been extensively validated in redwood ecosystems experiencing increasing wildfire activity.
The primary geographic application is the **central California coast (Santa Cruz County, Coast District)**, but findings are broadly applicable to **coastal redwood forests,** particularly private and state timberlands managed under FPRs.

vi) Collaborations and Project Feasibility

The project builds upon existing field infrastructure, inventory protocols, and prior research conducted at Swanton Pacific Ranch through California Polytechnic State University by undergraduate and graduate students Kaarakka's and Grupenhoff's research groups. Previous post-fire field measurements and canopy assessments provide an established baseline dataset that supports project feasibility and efficient implementation. Both PIs, Kaarakka and Grupenhoff, have experience conducting and supervising student research and educational field activities at Swanton Pacific Ranch and are well-versed in the ecological and management conditions of the central coast redwood region. Finally, the PIs maintain established collaborations and professional relationships with stakeholders and forest managers throughout the Santa Cruz Mountains, strengthening project feasibility, field coordination, and the broader applicability of student research project outcomes.

vi) Requested Funding

Total funding requested from EMC is **$44,640**, distributed evenly across two fiscal years: **$22,320 in FY 2026–2027** and **$22,320 in FY 2027–2028**. Funding will support student personnel, graduate student tuition, student field research activities, equipment, travel, and student training associated with post-fire monitoring in coastal redwood forests at Swanton Pacific Ranch.

Personnel costs include hourly support for; 1) an undergraduate research assistant conducting field inventory and canopy assessments ($4,200 total) and; 2) graduate student research assistant ($7,200 total), and partial summer salary support for the PIs ($6,300 each for Kaarakka and Grupenhoff). Tuition support for the MS student is included ($10,200 total requested from the grant, two semesters) with a 1:1 tuition match provided through USDA (PI Kaarakka, at-hand) funding for the first year of study (AY 2026–2027). Travel funds support repeated field visits to Swanton Pacific Ranch for data collection and monitoring activities ($2,200 total). Both PIs also have other grants in-hand to support travel and accommodation at Swanton, as well as equipment purchases. Equipment funding will support field-based canopy photography and forest inventory measurements necessary for evaluating post-fire stand structure, fuels, and canopy conditions ($800 total). Overhead is calculated at Cal Poly's indirect cost rate of 20% for California state agencies ($7,440 total) and included in the total project request above.