

[Board of Forestry and Fire Protection](#)

Effectiveness Monitoring Committee  
[Grant guidelines](#)

**Deadline: 5:00 pm PDT May 24, 2023**

**Date Submitted:** May 24, 2023

**Project Title:** Evaluating California oak woodland forest management and its cumulative impacts on wildlife habitat

**Project # (to be assigned by EMC):**

**Principal Investigators, Affiliations, and contact info (email, phone):**

Dr. Tadashi Fukami, Department of Biology, Department of Earth System Science - Stanford University, [REDACTED]

Dr. Elizabeth Hadly, Jasper Ridge Biological Preserve, Department of Biology, Department of Earth System Science - Stanford University, [REDACTED]  
[REDACTED]

**Collaborators and Affiliations:**

Dr. Sheena Sidhu, Jasper Ridge Biological Preserve - Stanford University, [REDACTED]

Dr. Nona Chiariello, Jasper Ridge Biological Preserve - Stanford University, [REDACTED]

Dr. Jorge Ramos, Jasper Ridge Biological Preserve - Stanford University, [REDACTED]

Dr. Laureano Gherardi, Department of Environmental Science, Policy, and Management - University of California Berkeley, [REDACTED]

**Research Theme(s), Critical Monitoring Question(s), and Rules or Regulations Addressed:**

Research Theme 7: Wildlife Habitat - Species and Nest Sites

- Critical Monitoring Question: Are the FPRs and associated regulations effective in protection of nest sites?
- Regulations: 919.12 - General protection of nest sites, and sensitive species classification

#### Research Theme 9: Wildlife Habitat - Cumulative Impacts

- Critical Monitoring Question: Are FRPs and associated regulations effective in (a) characterizing and describing terrestrial wildlife habitat and ecological processes? (b) avoiding significant adverse impacts to terrestrial wildlife species?
- Regulations: 919 - Wildlife Protection Practices

#### Research Theme 10: Wildlife Habitat - Structure

- Critical Monitoring Questions: Are the FRPs and associated regulations effective in retaining (b) native oaks where required to maintain wildlife habitat?
- Regulations:
  - 959.15 Protection of Wildlife Habitat
  - Technical Rule Addendum No. 2 wherein hardwood cover is recognized as a significant biological factor in cumulative impacts assessment.
  - 897- Implementation of Act Intent: forest management shall production or maintenance of forests which are healthy and naturally diverse, with a mixture of trees and understory plants.

#### Research Theme 11: Hardwood Values

- Critical Monitoring Questions: Are the FRPs and associate regulations effective in retaining (b) native oaks where required to maintain wildlife habitat?
- Regulations:
  - 959.15 Protection of Wildlife Habitat
  - Technical Rule Addendum No. 2 wherein hardwood cover is recognized as a significant biological factor in cumulative impacts assessment.
  - 897- Implementation of Act Intent: forest management shall production or maintenance of forests which are healthy and naturally diverse, with a mixture of trees and understory plants.

#### Research Theme 12: Resilience to Disturbance in a Changing Climate

- Critical Monitoring Questions: Are the FRPs and associate regulations effective in (c) meeting ecological objectives and adaptation to future climate? (d) maintaining or recruiting adequate amounts of early- and mid-seral wildlife habitats which are well adapted to future climate?
- Regulations:
  - California Environmental Quality Act
  - Fish and Game Code 1850

**Project Duration and Dates (MM/YY - MM/YY): 12/23 - 03/26**

**Estimated Funds Requested for Project:** Please provide the amount of funding requested from EMC, broken down by year of expenditure, with a brief justification of costs not to exceed 200 words:

- <\$10,000
- \$10,000 - \$25,000
- \$25,000 - \$75,000
- \$75,000 - \$150,000
- >\$150,000

Funding will primarily be used to support field technicians for two seasons. The fuel reduction and forest management treatment will have already been applied prior to the award period (summer 2023) as planned through Stanford University’s campus-wide Wildfire Management Plan on its private land, so no funding is requested for treatment implementation. However long-term research and monitoring is an additional task that goes beyond the scope of the university’s management plan. We see an opportunity to capitalize on this existing fuel reduction work within an oak woodland by layering on research and long-term monitoring. Our limitation in achieving this is human resources, thus we are primarily asking for staff funding (\$84,000). Additional funding is requested for field supplies (\$6000), as well as outreach related to dissemination of results, such as white papers, publication costs, and meetings/conferences (\$6000).

2 Seasonal field technical, 2 seasons (\$30/hr, 700 hrs, 2 years) = \$84,000  
Field supplies \$6,000  
Dissemination and outreach \$6,000

Year 1 = \$45,000 (Jan 2024 - Dec 2024) wages + supplies  
Year 2 = \$45,000 (Jan 2025 - Dec 2025) wages + supplies  
Year 3 = \$6,000 (Jan 2025 - Mar 2026) dissemination costs

**Project Description:** *In not more than 2,000 words, describe the project, including (1) Background and Justification, (2) Research Question(s), including Objective and Scope, (3) description of Research Methods, (4) Scientific Uncertainty and Geographic Applicability, including identified monitoring location(s), and (5) a description of the roles of Collaborators and Project Feasibility.*

1. Background and Justification

Justification:

The Science Advisory Panel of the California Wildfire and Forest Resilience Task Force ([WFRTF](#)) developed a series of regional profiles based on interviewing experts in land management regarding the needs of wildfire and forest management. One of the top concluding recommendations for the California Central Coast is to “*continue research to understand past, current, and future resilience of native ecosystems.*” This is because the Central Coast is

understudied state-wide regarding forest management and wildfire risk mitigation. Specifically, oak woodlands are an understudied ecosystem with 80% of California's coast live oak woodland found in this region.

Central Coast open spaces are managed by numerous landowners, both private and public, many of which have relatively small, forested areas adjacent to dense urban communities. There is a general interest in "catching up" on delayed forest management after decades of low prioritization, and to practice management with an interest in ecological sensitivity and natural resource protection, especially in regard to climate change adaptation. With social pressure due to fire risk, landowners are moving forward with varying forest management treatments but without the time or resources to evaluate their effectiveness in impacting ecosystem structure, functioning, and cumulative impacts, particularly for wildlife habitat.

Here we propose to evaluate forest management of oak woodlands within a spectrum of vegetation retention treatments and to measure the impact on ecosystem health (structure, functioning, and cumulative impacts) using the dusky-footed woodrat as a bioindicator.

#### Background:

The San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) is endemic to the San Francisco Bay Area of the California Central Coast. Its preferred habitat is in the canopy coverage of oak woodlands, chaparral, shrubland, and coniferous forest communities. The woodrat builds complex nests of woody debris that can reach 2.5 m wide and 1.8 m tall, which serve as shelter for a single adult or female woodrat and her pups.

As a CDFW species of special concern, risk mitigation tactics for woodrats include avoidance, buffers, habitat enhancement, and translocation. Typically, Central Coast forest management practitioners use buffers or avoidance. However, it is not always possible to discern if mitigation is successful in avoiding nest disturbance because it can be difficult to evaluate occupancy from nest structure alone, and woodrat activity is generally nocturnal, which restricts easy long-term monitoring due to resource and capacity limitations.

In this proposed research project, we will invest in closely monitoring dusky-footed woodrat nests and additional ecological variables in order to evaluate ecosystem health after forest management and fuel reduction treatments. Woodrats will serve as bioindicator species because they respond to disturbances and interact with multiple species in oak woodlands.

## 2. Research Questions

The proposed research project address EMC's prioritized Critical Monitoring question 12a evaluating "*are the FPRs and associated regulations effective in improving overall forest wildfire resilience and the ability of forest to respond to climate change and variability, and extreme weather events (evaluate ecosystem functional response to fuel reduction and forest health treatments)?*" from research theme 12. Additional research themes addressed include: Wildlife

Habitat – species and nest sites (theme 7), Wildlife Habitat – Cumulative Impacts (theme 9), Wildlife Habitat – Structure (theme 10), as well as hardwood values (theme 11). This project will address EMC critical monitoring questions that have not been previously funded by the grants program, under themes 7, 10 and 11.

Specifically, we have two overarching research objectives:

- 1) Measuring vegetation changes of varying forest management and fuel reduction practices to quantify habitat changes and disturbance
- 2) Evaluating the impact of fuel reduction activities on ecosystem health
  - 2a) by monitoring dusky-footed woodrats
  - 2b) by monitoring ecosystem variables

The project scope will be focused on oak woodland, dominated by coastal live oak, which is representative of the ecotype primarily found throughout the California Central Coast, but also other regions of the state. The dusky-footed woodrat, while endemic to the San Francisco Bay Area, is similar to other woodrat species and small mammals in terms of habitat requirements and ecosystem function. Woodrats are an umbrella species because many other vertebrates, plants, and lichens are known to occupy their nest structures which have been observed to persist for decades. They are both dependent on oaks for their food, habitat, and nest building material but also provide a good proxy for ecosystem health in the undisturbed habitat necessary for them to persist. Given these characteristics, they can inform when vegetation changes disturb ecological health and negatively impact natural resources.

### 3. Description of Research Methods

Treatment and Plot Setup:

The project will be conducted on the private land of Jasper Ridge Biological Preserve (JRBP), a low ridge in the eastern foothills of the Santa Cruz Mountains at the base of the San Francisco Peninsula, about 4 miles west of the main Stanford University campus, in San Mateo County, CA. In summer 2023, JRBP fuel reduction and forest management treatments will be implemented along the perimeter of the preserve, starting from the fence line, and extending in 300ft. Fuel reduction treatments in the oak woodland will be divided into bands of decreasing vegetation removal, similar to the varying scale of fuel reduction practiced in the Central Coast region. All treatments will follow the general prescription of understory thinning, 20ft canopy spacing, and no oak cut. Treatments will be applied as follows to each band, varying in distance from the fence line:

- Band 1 (0 - 100ft): 80% vegetation removal, 20% retention
- Band 2 (100 - 200ft): 50% vegetation removal, 50% retention
- Band 3 (200 - 300ft): 30% vegetation removal, 70% retention
- Band 4 (300 - 400ft): no vegetation removal [control area]

Within each treatment band, 5x5m plots will be placed in pairs: 3 control plots (in retention areas) and 3 disturbance plots (in vegetation removal areas). A second pair of 3 control and 3

disturbance plots will also be placed in each treatment and centered around active woodrat nests. Nest occupancy will be determined by setting camera traps for 4 nights to observe activity prior to plot selection. In the fourth band 3 plots without woodrat nests and 3 plots centered on woodrat nests will be placed for no-treatment control conditions.

#### Data Collection:

Each plot will be monitored prior to treatment (summer 2023), and following treatment for at least the duration of this project (spring 2026), with intention to continue monitoring long-term.

#### Objective 1) Measuring vegetation changes to quantify disturbance

We will quantify and evaluate fuel reduction and forest management in each band by measuring vegetation changes. This will be accomplished by methods of a modified Browns transect and Tree & Snag Inventory. Variables to be measured include:

- Tree count and dbh measures
- height/height to crown base
- Trees per plot by class size, species inventory
- Downed woody debris
- Litter depth

Additionally, changes to canopy and understory will be captured with aerial images, and hemispherical canopy photos.

#### Objective 2) Evaluating the impact of fuel reduction activities on ecosystem health

We will prioritize measuring a subset of many possible variables to evaluate ecosystem health, especially as it relates to dusky-footed woodrat habitat quality in oak woodland ecosystems (research themes 11 & 12).

##### 2a) Monitoring dusky-footed woodrats

Woodrat nest occupancy will be monitored using camera traps placed within each plot to observe the focal nest.

##### 2b) Monitoring ecosystem variables

Following the research themes of Wildlife Habitat – species and nest sites (theme 7), Cumulative Impacts (theme 9), and Structure (theme 10), we will measure variables that inform evaluating ecosystem structure, functioning, and cumulative impacts. Variables to be measured include:

- Plant diversity, particularly invasive species using CNPS Releve and Rapid Assessment Protocols
- Plant biomass by species, including aboveground and belowground components
- Soil carbon, both particulate and mineral associated fractions
- Soil microbial biomass and diversity
- Wildlife activity: acoustic monitoring and point bird counts at each plot site
- Pathogen presence by connecting observations to ongoing SOD monitoring

## Data Analysis:

We will use nested mixed effect models in order to account for fixed and random effects. Plot scale disturbance treatment will be nested within disturbance bands and included as fixed effects whereas individual plots and transects will be included as random effects to account for the repeated measures nature of our experimental design.

## 4. Scientific Uncertainty and Geographic Applicability, Monitoring locations

### Monitoring locations:

The project will be conducted at Jasper Ridge Biological Preserve (JRBP) where we will have full access to monitor and study the impacts of forest management that will be implemented at the preserve in summer 2023. Jasper Ridge is located within the WUI of Santa Cruz Mountains located on the San Francisco Bay peninsula in the California Central Coast region.

### Geographic applicability:

These research questions have been developed through regular engagement with fellow regional land managers through Santa Cruz Mountain Stewardship Network, of which JRBP is a member. Collectively, land managers have conveyed a need for long-term monitoring and study of impacts on woodrats, but have been resource limited. The research outcomes of this project will be immediately applicable to private and public lands with similar ecotypes in the Central Coast region and informative to similar regions throughout the state.

### Scientific uncertainty:

This research project has been inspired through ongoing conversations with landowners and land managers in the Central Coast region who are looking for science-based approaches to natural resource protection and ecologically sensitive forest management where there has been a critical gap. Specifically, coastal oak woodland forest management is understudied relative to other forest systems (research theme 11). Additionally, practitioners express uncertainty in mitigation practices for the dusky-footed woodrats and other small mammals, which have been difficult to monitor long-term. Given our understanding of practitioner needs and requests for scientifically informed practices for our region, we are confident that the outcomes of this project will be immediately valuable to practitioners.

Outcomes of this research will: a) help to fill a critical gap for Central Coast oak woodland forest management, b) inform science-based practices for mitigating impacts to woodrats, and c) be broadly applicable beyond the region to practitioners managing for oak woodlands and small mammals.

## 5. Collaborators and Project Feasibility

### Collaborators:

The project will be led in collaboration by Jasper Ridge Biological Preserve (JRBP) staff scientist, Sheena Sidhu, and UC Berkeley Professor Lau Gherardi, with oversight from JRBP executive director, Jorge Ramos. Professors Tadashi Fukami and Elizabeth Hadly will provide faculty and research oversight to all collaborators.

The project was designed by Hadly, Chiariello, Sidhu, Gherardi, and Ramos. Sidhu will be responsible for treatment implementation (pre-award period, summer 2023). Data will be collected by Sidhu, Gherardi, and seasonal field technicians supported through this funding. Analysis will be conducted by Sidhu and Gherardi, with support from Fukami and Hadly. On-site supervision will be provided by Ramos, with overall research oversight by Fukami and Hadly.

### Project Feasibility:

All collaborators and JRBP staff are experienced in designing, implementing, and completing field research related to ecology and stewardship, with a record of scientific publications. All salaries are fully funded, with additional funding requested only for field technicians to carry out the work under the direction of the collaborating team. All field work will be at Jasper Ridge Biological Preserve with full land management control of the private land by Stanford University. Forest management treatments will be applied prior to the grant award period through university funding for fire risk management. JRBP has served as a field site for multiple large-scale field research projects over its 50 years, with a permanent support staff, and basic reusable supplies and equipment for managing and implementing field work. Given our experience and basic support structure, we are confident in carrying out this project to completion.