Sonoma State University
Center for Environmental Inquiry

Research Proposal

Integrated Vegetation Management on Powerline Rights-of-Ways:

Effects of Vegetation Treatment on Plant Communities and Wildlife Diversity

Submitted to the TREE Fund

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A. Executive Summary

Vegetation management needed to maintain safety in powerline ROWs has significant effects on local ecosystems. A series of studies on the east coast has identified many of these impacts, but translating these results to ecosystems on the West Coast is problematic. Even identical management techniques may have dramatically different effects in different ecosystems.

We propose to establish and begin research on a long-term monitoring network on west coast powerline Rights of Ways (ROWs). Initially, the network will consist of the three study sites in central California: SSU's Fairfield Osborn Preserve, Pepperwood Preserve, and the El Dorado National Forest (Figure 1). These sites are envisioned as collaborative sites where studies by other researchers are actively encouraged.
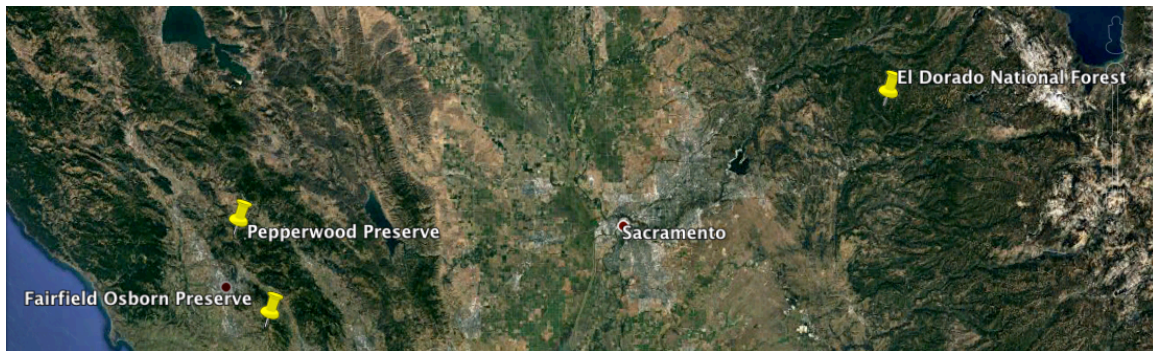

Figure 1. Locations of the Three Proposed Study Sites. Habitat at Fairfield Osborn Preserve consists mainly of oaks, bay laurel, and grasslands.   Pepperwood Preserve includes a mixture of oaks, grasslands, and conifers. The habitat at El Dorado is a mixed conifer forest, located at the edge of the 2014 King Fire.

The primary purpose of the initial research at the three sites is to compare: (1) the relative costs and ability of two integrated vegetation management (IVM) treatments ("mechanical only" and "mechanical-plus-herbicide") to establish low-growing, stable, non-invasive plant communities, and (2) document the effects of these treatments on plants and pollinator behavior.

In this initial 2-year study, we will:

1. Establish 3 long-term monitoring sites on powerline ROWs in California.
2. Initiate a study on the effects of integrated vegetation management techniques on plant and animal communities.
3. Recruit additional research and provide student and public education on ROW management.

Partnerships: We will partner with utility companies, universities, and non-profits throughout the proposed work. Powerline utility company partners, Pacific Gas and Electric Company and Sacramento Municipal Utility District, will be undertaking IVM treatments in all ROWs. Site partners hosting the long-term monitoring sites are Sonoma State University, Pepperwood Preserve Foundation and the US Forest Service. Partners undertaking the work outlines in this proposal include Pollinator Partnership, Shelly Benson, and Pepperwood Preserve. In addition, throughout the proposed effort, we will be working to recruit additional research and industry partners.

Budget: The work will be undertaken over a 2-year period with a cost of $89.1K the first year, and $85.9K the second year (for a total of $175K).

B. Introduction

The longest continuous study of the effects of right-of-way (ROW) vegetation management on local ecosystems began on Pennsylvania State Game Lands in 1953 [e.g., Aurora Consulting, 2013; Bramble and Byrnes, 1983; Holt and Orr]. Although the initial proposal was to study the efficacy of herbicides in vegetation management, the study has grown over the years to include effects on wildlife, pollinator utilization, and other variables. The ROW habitat created through large tracts of forest appears to support increased abundance of small mammals, birds, and pollinators [e.g., Bramble, et. al., 1992; Bramble, et. al., 1997; Bramble, et. al., 1999; Forrester, et. al., 2005; Yahner, et. al., 2002; Yahner, et. al., 2003; Yahner, 2004].

Utility companies across the country have used these results to develop best practices, provide information on impacts, permitting, etc. However, many professionals have questioned whether the results are applicable to other areas of the United States. Especially questionable is the application of results to California ecosystems, with its much drier and more variable Mediterranean climate, more diverse habitats, and high diversity of species. California is recognized globally as a biodiversity hotspot, one of 34 sites on earth that contain 60% of the plant and animal species.

In 2015, Sonoma State and PG&E began exploring the idea of establishing long-term research on the effects of ROW vegetation management in California. Initial studies were undertaken as part of the Nature!Tech Collaborative, which explores how LiDAR and other technologies can be used to enhance academic research into vegetation management practices. Studies included LiDAR-based biomass estimates, microclimate sensor development, wildlife movement, and pollinator use of the ROW at Sonoma State's Fairfield Osborn Preserve [Clark, 2016; Diaz and Halle, 2015; McGuire, 2016a, 2016b; McGuire and Farahmand, 2016; Romero and Clark, 2016; Wininger, 2016; Wininger and Rank, 2015; Zhong and Halle, 2015].

How the Proposed Project Addresses Research Objectives

The primary goal of this proposal is to extend the research from studying the effects of ROWs on ecosystems to include studying the establishment of stable ROW sites on the U.S. West Coast. The proposed three sites are anticipated to provide an initial backbone, with the goal of developing a ROW monitoring network. Similar to the east coast monitoring studies, the purpose of this research is to provide information to utility companies that can inform best management practices for integrated vegetation management (IVM) activities. Working with utility companies, agencies, non-profits, and academic partners, we propose to address the following research objectives:

1. Create a network of long-term monitoring sites on powerline ROWs in California. We will start this process by:

    a. Establishing three long-term ROW monitoring sites in a diversity of California habitats that provide protected areas for research and educational opportunities.
    b. Working with utility companies and researchers to develop common protocols to characterize each site.
    c. Establishing baseline conditions by reconstructing site histories (e.g., fire, grazing, vegetation removal, herbicide applications), and gathering available data from existing research near each site (e.g., LiDAR studies, wildlife camera studies, soil characterization, fire reconstruction)

    Anticipated Products:

    • Maps with location of ROW monitoring sites
    • Site descriptions, including site histories and available data
    • Industry articles

2. Initiate a study on the effects of integrated vegetation management techniques on plant and animal communities. Specifically, we will investigate (1) the relative cost and ability of two types of IVM treatments (mechanical only vs selected herbicide/mechanical) to create low-growing stable non-invasive plant communities and (2) the effects of the two treatments on plants and pollinators. We will kickoff this long-term study at the 3 sites by:

    a. Working with utility companies and researchers to integrate timelines for treatment and surveys, and develop a process for tracking treatment costs (including internal utility company costs).
    b. Establishing research plots at the three ROW monitoring sites
    c. Surveying vegetation and pollinators

d. To the extent possible, compiling and sharing resulting data in professional publications and conferences (see Methods for timing considerations)

Anticipated Products:

- Written descriptions of survey protocols that can be used to conduct identical surveys at additional sites should the network be extended
- Utility cost estimate protocol describing how level of effort and cost for each treatment is tracked
- Map of the locations of research plots at each site
- Summary of changes in vegetation, pollinator abundance, and treatment costs

3. Share information on the project. A long-term objective of the ROW monitoring network is to share research results, encourage studies by other researchers, and create educational opportunities for students and the general public. We will make headway towards these objectives by:

   a. Creating a web portal for researcher, student and public engagement
   b. Inviting researchers, especially those with research interests near the ROW study sites, to planning meetings
   c. Seeding additional research with a small research incentive fund

   d. Hiring university students for field support activities and possible public outreach
   e. Integrating project information and results into existing public tours

Anticipated Products:

- List of resulting conference presentations and submissions to professional or scientific publications.
- Website detailing the location of the network, treatments, and availability for research and education
- List of incentive grants awarded to researchers, other researchers engaged, students benefitting, and public tours

C. Methods

Establish ROW Monitoring Network

We propose to establish 3 sites as an initial ROW monitoring network that supports long-term studies of ROW processes (Figure 1). Prior to this proposal, we visited all three sites with PG&E, SMUD, or TREE fund representatives to ensure that these sites meet the needs for long-term monitoring. The three sites are:

- SSU's Fairfield Osborn Preserve – A 450-acre site with ROW dominated by oaks, bay laurels, and grasslands.
- Pepperwood Preserves – A 3200-acre site that includes a mixture of oaks, grasslands, and conifers.
- El Dorado National Forest – The site chosen is in mixed coniferous forest, located at the edge of the 2014 King Fire. To combat the sire, one section of the ROW was bladed to bare earth and seeded with a USFS approved seed blend. Another section of the ROW burned during the fire. The vegetation in the two sections has responded very differently, and provides an opportunity for documenting differing responses to previous disturbances.

The 3 sites have extensive ROWs, host diverse vegetation types, are adjacent to plant communities with different or no management, and are reasonably protected from intruders. All sites include relatively flat areas making them amenable to effective treatment applications.

In addition, to meeting the above criteria, both Osborn and Pepperwood are protected sites that promote research and education. Because they are on protected lands, these sites provide a somewhat unique opportunity to obtain some background history and document "initial environmental conditions" prior to the initiation of treatment protocols in this proposal [Mahan, pers. comm., 2016]. The sites provide opportunities for using existing data to reconstruct site history, collaborating with researchers on site, and incorporating information about the ROW monitoring network into existing public tours and education programs. A variety of research data are also available at each site, including wildlife camera trapping observations, climate measurements, bird surveys, vegetation surveys, and archeological histories. The datasets that already exist can help document issues of importance to ROW establishment and management [see https://www.sonoma.edu/cei/osborn/ and http://www.pepperwoodpreserve.org for more complete lists of datasets at each preserve].

All 3 sites also have the potential to attract additional partners to undertake other research projects on the ROW monitoring network. The Osborn Preserve and Pepperwood Preserve regularly work with over 60 community partners, participate in regional planning efforts, and support on-going studies from other researchers (e.g., invasive species, fire and fuel loading, plant diseases, and wildlife movements.) At the El

Dorado National Forest Site site, there is potential to develop partnerships with the US Forest Service and Sierra Pacific Industries. Many of the management issues faced by the Forest Service are suitable for being addressed by utility industry IVM practices [e.g., Johnstone, 2008].

Study Design Approach

A priority of this study is that results be publishable in both peer-reviewed journals and technical industry publications. The most important way to ensure publishable results is by creating a sampling design that will allow for rigorous statistical analyses. However, the level of effort is necessarily constrained by budget and trade-offs between level-of-effort and exact questions to be addressed. One of the toughest tradeoffs in the proposal is balancing the need for detailed vegetation mapping with the requirement to include pollinator studies at the sites. In our proposed study design, we took the following considerations into account:

1. Number of Sites: Current priority identified in the TREE Fund RFP is to study ROW processes over a broad geographic range and diversity of habitats. We have chosen sites ranging from near the coast to the Sierra foothills.

2. Number of Treatment Areas (Sections) at Each Site: If we were investigating the IVM response at each of the 3 sites separately and in detail, we would want to increase the number of treatment areas. Each of the 3 sites may contain many different plant community types, and each community type would require at least 6 or more pairs of treatments for statistically rigorous investigation of each site and plant community. This extended approach is outside the scope of this budget, and we propose a sampling design instead that allows comparison of responses to the two IVM treatments across all plant communities and sites.

3. Size of Treatment Areas (Sections): A large number of small IVM treatment areas would be beneficial for statistical rigor, but would be complicated for utility contractors to implement, and increase the likelihood of incorrectly applied treatments. Many large numbers of small sections would also make interpreting pollinator surveys tricky at best. For this study, we have identified 100-m long treatment areas that can be clearly marked with treatment signs for utility contractors.

In summary, the proposed sampling design establishes a network with a broad geographic distribution that focuses on measurement of IVM responses at each treatment area. The design allows for comparison of responses across all sites. If desired, the number of sites and treatment areas can be increased in the future to better understand community-specific responses at each of the specific sites.

Treatment Areas

Two treatments will be applied at each of the three ROW monitoring sites. At each site, we will identify two sections of ROW ~ 200 meters long x 10 meters wide. The initial design calls for each of these sections to be subdivided into 2 treatment areas (Figure 2) and treated either mechanically or with a combination of mechanical means and herbicides. Treatment areas will be clearly marked and include treatment signs for utility partners who will be doing the treatments. An annual site visit prior to each treatment will ensure that signs remain in place.
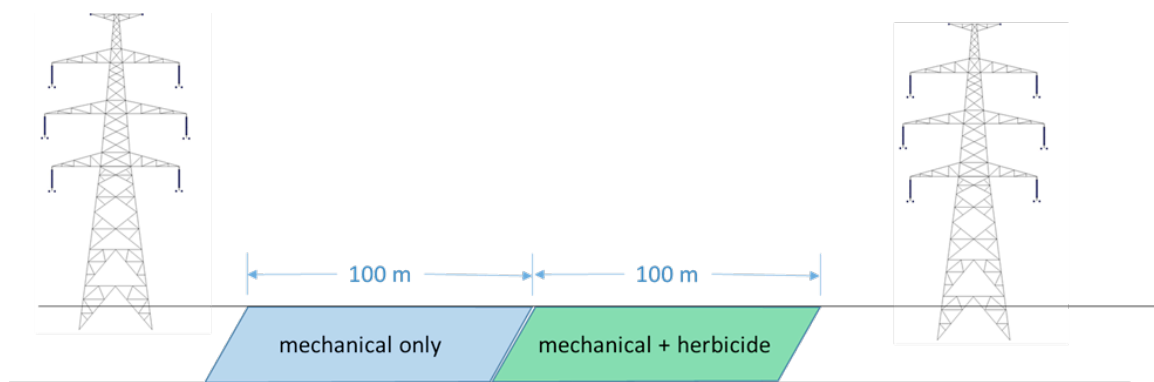

Figure 2. Schematic detailing two treatment plots in a section of ROW. The exact size of each treatment area may vary slightly depending on field conditions.

The two treatments to be investigated are based on standard practices used by utility companies to remove and prevent regrowth of undesirable plants into powerline safety exclusion zones. While the specific approaches to be used will depend on the plant community to be treated, the approaches generally are:

- removal of plant biomass within the fire safety zone of the powerlines. A variety of standard utility company techniques will be used.
- biomass removal followed by selective spot spraying of topical herbicides known to be effective on the particular species being targeted.

Utility company vegetation management personnel will be responsible for deciding on and applying the appropriate treatments. A critical component of this study is to fully document how the treatment is applied on each plot (i.e., how much biomass was removed, which species, etc.) and the cost and level of effort required. We will work with utility company personnel to develop and maintain a process to track cost and level of effort (i.e., internal expenses) needed to apply and document the treatments.

Due to budget restrictions, we propose to limit initial studies to vegetation monitoring and pollinator response. Measuring wildlife and pollinator habitat quality beyond standard vegetation descriptions are not included in the proposal, although future funding could provide an opportunity to determine whether vegetation data collected could be used to quantify habitat quality. We also do not propose to investigate wildlife movements as part of this proposal. However, for both projects, we will explore opportunities for recruiting research partners interested in other ROW processes (such as larger animal movement) using the Researcher Challenge Grants provided for in the budget.

A primary driver of vegetation response is rainfall. Rainfall can determine not only plant growth rates, but also which species germinate and determine the long-term composition of vegetation communities. To place study results in context of changing environmental conditions, we will collect weather data from each of the 3 ROW monitoring sites. Of the 3 sites, only the El Dorado site does not have a nearby weather station. We will install a station there to document rainfall as well as other environmental conditions (temperature, relative humidity, wind speed and direction, and soil moisture).

Planning and Logistics Kick-Off Meeting

We will host a kick-off meeting among utility company (SMUD, PG&E) vegetation management teams and researchers to:

- Discuss sampling design - The meeting will focus on tradeoffs between budget, level of effort, number of plots, plot size, and treatment logistics. While we don't anticipate major revisions to the proposed design, the team may decide to decrease the size of the plots and increase the number of plots per section.
- Identify detailed treatments. We anticipate that the utilities will be providing the expertise needed to characterize specific treatments – both mechanical and herbicide.
- Identify specific schedule for treatments and surveys. A high degree of coordination and partnership is required between utility company (PG&E and SMUD) personnel who will be undertaking the treatments and researchers who will be measuring responses.
- Encourage participation by additional researchers

Establish Site Histories

We will compile histories and available historical observations that can be used to place treatment results in perspective and recruit additional research. The catalogue will include existing data available (e.g., weather data, remote sensing, etc.) either as raw data or published research.

Vegetation Response to Treatments (Lead: Ms. Shelly Benson):

Documenting changes in vegetation caused by ROW management practices is critical for understanding IVM treatment effects. A goal of utility companies is to establish low-growing native communities within the ROW. Long-term changes can include, among others, invasion by non-native species, transformation of habitat types (e.g., forest to shrubland), and structural changes in plant growth.

Although general relevee surveys (mapping percent cover of species) are adequate for documenting IVM response, transect surveys are generally employed by many vegetation researchers who track vegetation changes through time. In order to make the ROW research more broadly applicable, we have decided to use transect surveys for vegetation monitoring. Transects are more labor intensive, but have the additional advantage of quantifying variability within a given plot, and may be more suitable than relevee surveys for detecting subtle changes. We are planning on 10 transects per plot, but this number can be modified if needed during the kick-off meeting.

Each plot will be sampled once per year. Surveys will be conducted in the spring, the best time of year for surveying the dominant flowering species at each location. Survey times will differ at each site, and will be dependent on timing the surveys to capture the dominant flowering species. An annual survey is the minimum needed to document the establishment of low-growing non-invasive species, but is not adequate to capture the annual cycle of all possible flowering species.

Two experienced botanists will perform the fieldwork, assisted by student interns from Sonoma State. Interns will also assist with data entry and analysis.

Pollinator Response to IVM Treatments (Lead: Dr. Victoria Wojcik)

Pollinators are considered a key indicator of general ecosystem health. In 2015, the Pollinator Partnership established monitoring sites at the Osborn Preserve to determine the effects of the ROW on pollinator abundance. Initial results indicate that native bees are more abundant in the ROW than in nearby open habitats.

Many questions remain, however. Previous research has indicated that pollinators may selectively travel along ROW pathways, increasing the distance that they are able to effectively forage. This increases the potential to facilitate connectivity between landscapes that require pollinator and potential refugia. Still, the information that exists regarding the function of ROWs as pollinator habitat is limited. In addition, it is also possible that pollinators and other insects may serve as vectors for diseased such as sudden oak death.

We will expand the pollinator program by adding monitoring sites at the El Dorado National Forest and Pepperwood Preserves. Sites will be located with the IVM plots. The establishment of sites on three preserves will allow pollinators to be studied in a range of climates, habitats, and vegetation treatment types. Future publications could also examine changes of pollinator availability and relationship to regrowth, pollinator use of various ROW habitat resources,, and the influence of vegetation management strategies on pollinator abundance. At a minimum, this effort monitors pollinators in various landscapes over time, adding key information to our understanding of pollinators in natural and managed landscapes.

The first year (2017) will include a final (third) study year at the Fairfield Osborn Preserve, completing a standard sampling protocol of three years at the site. Preliminary surveys of the remaining sites will begin in 2017. Observations will begin in earnest at El Dorado and Pepperwood in 2018. Pollinator sampling may continue at Fairfield Osborn as well in 2018, based on available funding or interest from outside researchers and students.

Pollinator data will be collected every two weeks from the beginning of native plant bloom (approximately April). Data collected will catalogue native bees, butterflies, moths, and flies that are visiting flowering plants (both native and non-native) in each management treatment and sites representative of unmanaged land. Collectively, the observations will allow us to understand patterns in pollinator support for a wide range of species. Observations will be collected by interns working closely with Pollinator Partnership project manager and research director, Dr. Victoria Wojcik.

<u>Partnerships and Outreach (Leads: Dr. Chris Halle and Dr. Claudia Luke)</u>

A long-term objective of the ROW monitoring network is to share research results, encourage studies by other researchers, and create educational opportunities for students and the general public. We will stimulate these activities by:

- Sharing information about the ROW monitoring network – We will create a web portal for researcher, student and public engagement. Website development is an effective tool for communicating with the general public, other utilities, and outside researchers. We will launch a simple web-based platform that can be expanded in the future.
- Recruiting additional research – We will recruit other researchers to engage in research at the ROW monitoring sites by (1) inviting additional researchers, especially those with research interests near the ROW study sites, to planning meetings, (2) distributing information about the study via conversations and the website, and (3) seeding additional research with a small research incentive fund. Grants of $500 - $1K can attract researchers such as graduate students to the ROW monitoring network sites. Examples of ancillary studies that could be leveraged in this manner include work with LiDAR, soil characterization, fire history, large animal movement, and the effects of ROWs on the spread of sudden oak death.
- Sharing research results – In the second year (2018), we will reimburse travel costs for researchers presenting findings at professional conferences.
- Creating training opportunities – Two to four student interns will support field work and data entry, and will additionally serve as public ambassadors for the project.
- Educating the public – We will integrate project information and results into existing regular public tours programs at Osborn and Pepperwood Preserves.

<u>Contingencies</u>

If the primary objectives of the proposal (vegetation and pollinator responses) require more funding than anticipated (e.g., due to unanticipated field conditions, etc.), we will reduce funding allocated for research incentive grants and travel costs and apply savings to field work.

D. Timetable

Here we provide an initial estimate of the timetable and schedule for the 2-year project. The schedule may be revised as required by utility vegetation treatment efforts.

	2017				2018			
	Jan-Mar	Apr-Jun	Jul-Aug	Sep-Dec	Jan-Mar	Apr-Jun	Jul-Aug	Sep-Dec
Planning and Information Gathering								
Kickoff Meeting	■							
Site History Descriptions	■	■	■	■				
Treatment and Cost Tracking Protocols		■	■					
Field Treatments and Research								
IVM Treatment (by Utility Companies)			■				■	
Vegetation and Pollinator Surveys		■				■	■	
Data Analysis			■	■			■	■
Research Incentive Awards	■				■			
Reporting and Communication								
Annual Report and Presentation				#1				#2
Conferences and Potential Publications							■	■
Web Portal			■	■				■
Public Tours	■	■	■	■	■	■	■	■

#1 Annual Report Deliverables
- Site History Descriptions, including maps, site histories and available data
- Link to Web Portal
- IVM Treatment and Cost Tracking Protocols
- Summary of Vegetation and Pollinator Results
- List of Research Incentive Awards and Public Tours

#2 Annual Report Deliverables
- Web Portal Updates
- Summary of Vegetation and Pollinator Results
- List of Research Incentive Awards, Conference Presentations, Publications, and Public Tours

Annual summary reports will be provided electronically to the TREE Fund and utility partners at the end of each calendar year. Earlier write-ups are possible if required, but would be more descriptive of program setup with less emphasis on knowledge gained. An annual end-of-year presentations to PG&E and SMUD senior management will be scheduled jointly. (No budget has been allocated for presentations to the TREE fund on the east coast).

It is anticipated that at least a few years of study will be required prior to making definitive statements regarding the efficacy of the two IVM treatments on vegetation and pollinators. The earliest we anticipate publication would be 2019. However, because pollinator research began two years ago at the Osborn Preserve, it is possible that FOP pollinator observations may be able to be published after the 2017 field campaign.

We propose support within the budget to present at conferences about the project approach and preliminary results. If requested, we could alternatively use these funds to present at industry meetings.

E. Principal Investigator Qualifications Statement

We provide qualifications statements for the lead project managers and researchers engaged in this project.

Project Director: Claudia Luke, Director SSU Center for Environmental Inquiry

Dr. Luke earned her Ph.D. in Zoology from UC Berkeley. She has 20 years of experience directing field stations for the University of California and California State University systems. She served as Principal Investigator for the Coastal Prairie Enhancement Feasibility Study, which investigated various vegetation management techniques and mapped resulting habitats. At Sonoma State University, she serves as Director for three SSU Preserves (Fairfield Osborn Preserve, Galbreath Wildlands Preserve, and Los Guillicos Preserve) which support career development opportunities and innovative research on environmental topics. She has worked extensively with partners and collaborators to build regional research and management collaborations in the areas of watershed management, habitat connectivity, habitat restoration, and environmental education.

Project Manager: Chris Halle, Nature!Tech Lead, SSU Center for Environmental Inquiry

Dr. Halle has extensive experience managing and leading cross-disciplinary research teams to address complex large-scale projects for industry. His areas of expertise include environmental observation and sampling, data quality control, algorithm development, and data synthesis and presentation. As Nature!Tech Lead, he creates industry-academic research collaborations on environmental and technology projects. He assists faculty in scoping and developing projects suitable for classroom instruction, and supervises students undertaking long-term monitoring projects on preserve lands. He led establishment of the camera trapping and microclimate systems on the PG&E Right-of-Way at SSU's Fairfield Osborn Preserve.

Lead Researcher Vegetation Surveys: Shelly Benson, Biological Consultant

Ms. Benson has a Master of Science degree in Natural Resources and Environmental Studies from the University of Northern British Columbia, Canada, 2001. She has worked as a botanist in the San Francisco Bay Area for fifteen years—the past six years as an independent biological consultant. Her expertise is in mapping and classifying vegetation communities, conducting botanical assessments for special status plant species, and designing and implementing vegetation monitoring programs. She is also a lichenologist and works on several projects that use lichens as biological indicators of air quality and climate.

<u>Lead Researcher Pollinator Surveys: Vicki Wojcik, Research Director, Pollinator
Partnership</u>

Dr. Wojcik has been working to protect and promote pollinators with Pollinator
Partnership since 2011. As Research Director she oversees P2's research program,
keeping on top of new and emerging pollinator issues and managing a program set that
includes pollinator habitat conservation and landscape management assessments,
understanding and enhancing agroecosystems, landuse and pesticide policy review,
support for threatened and critical species, and ecosystem service assessments. Her
contributions to pollinator research and conservation include numerous peer reviewed
papers, book chapters, policy pieces, planting guides, and technical manuals. She is
currently leading the pollinator research effort on the ROW at the Fairfield Osborn
Preserve.

F. CV of Principal Investigator or Project Manager

See separately attached 2-page resumes of the Project Director Claudia Luke and Project Manager Christopher Halle

G. Potential Partners List

We provide here a list of all project partners, including names, titles, affiliations and roles on the research team.

Name	Title	Affiliation	Role
Chris Halle, PhD	Nature!Tech Lead	SSU Center for Environmental Inquiry	Project management, site history development, treatment and cost tracking protocols, website development, kickoff meeting, researcher and student recruitment and coordination, climate summaries.
Claudia Luke, PhD	Director	Center for Environmental Inquiry	Project oversight, partner engagement, researcher and student recruitment
Peter Beasley	Vegetation Program Manager Expert	Pacific Gas & Electric Company	IVM Treatments at Osborn, Pepperwood, and El Dorado ROW
Eric Brown	Electric Transmission & Distribution Program Manager	Sacramento Municipal Utility District	IVM Treatments at El Dorado ROW
Shelly Benson, M.A.	Field Botanist	Plant Ecologist	Lead researcher for vegetation surveys
Vicki Wojcik, PhD	Research Director	Pollinator Partnership	Lead researcher for pollinator Surveys
Michelle Halbur, M.A.	Preserve Ecologist	Pepperwood Preserve	Long-term ROW monitoring site host and vegetation survey support
Suzanne DeCoursey, M.A.	Nature!Ed Lead	SSU Fairfield Osborn Preserve	Long-term ROW monitoring site host

We would like to acknowledge the assistance of Professor David Ackerly (UC Berkeley) who provided helpful discussions on the scope of the project and also expressed interest in participating in the project kick-off meeting. Professor Ackerly is performing similar monitoring at Pepperwood Preserves, and is interested researching the role of fire in the Sierras.

We also thank Professor Carolyn Mahan (Pennsylvania State University) for helpful discussions regarding ROW history and research possibilities, as well as kindly sharing the outline of her latest research proposal.

In addition to those identified in the table, we will be working to recruit research and industry partners to collaborate on-going research. Possible partners include Dr. Michelle Goman (soil characterization and fire history reconstruction), Dr. Matthew Clark (LiDAR and Remote Sensing), Dr. Nathan Rank (Sudden Oak Death), Dr. Gurman Gill (Automated Image Processing), Sonoma County Water Agency, Sierra Pacific Industries, and the United States Forest Service.

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I. Budget

Please see attached budget.

The TreeFund requires a 10% match for grant applications (17.5 K in this case). We meet the matching fund requirement through unrecovered institutional overhead costs (65K).

J. Partner Documentation

Attached separately to this proposal are letters of support from partners undertaking field surveys as part of the proposed research: Dr. Vicki Wojcik (Pollinator Partnership) and Ms. Shelly Benson (Plant Ecologist).