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LINKING SOCIAL DYNAMICS TO PRIVATE LAND MANAGEMENT: A STUDY OF
PRESCRIBED BURN ASSOCIATIONS IN NORTHERN CALIFORNIA

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Spencer Klinefelter

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LINKING SOCIAL DYNAMICS TO PRIVATE LAND MANAGEMENT: A STUDY OF PRESCRIBED BURN ASSOCIATIONS IN NORTHERN CALIFORNIA

by

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APPROVED FOR THE DEPARTMENT OF ENVIRONMENTAL STUDIES

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ABSTRACT

LINKING SOCIAL DYNAMICS TO PRIVATE LAND MANAGEMENT: A STUDY OF
PRESCRIBED BURN ASSOCIATIONS IN NORTHERN CALIFORNIA

by Spencer Klinefelter

Prescribed fire is one way to improve the adaptive capacity of communities in the wildland urban interface in terms of managing wildfire risk and meeting socio-ecological goals. In California, Prescribed Burn Associations (PBAs) are a way of organizing private landowners with the goal of engaging in more widespread and frequent prescribed fires. This research uses semi-structured interviews with private landowners, along with key informants from public agencies such as CalFire and Regional Parks, to explore PBA development and functioning in northern coastal California. Sonoma and Marin counties were chosen as the primary study sites as they are represented by the Good Fire Alliance (GFA), an active PBA that has been in existence for several years. We found that the GFA was a diverse community of local residents and fire professionals focused on increasing local capacity with regard to prescribed fire implementation, and that engagement with PBA events and burns increased members' fire literacy. Relationships between local fire agencies and private landowners improved in the years since the PBA's development, and the GFA may be filling a niche for smaller landowners implementing prescribed fire that professional fire agencies might otherwise be unwilling to devote resources toward

ACKNOWLEDGEMENTS

This research would not have been possible without the guidance and mentorship of my committee members, my partner, or my family. Nor would it be possible without those dedicated to bringing back "good fire" to our home landscapes, and the grassroots efforts currently being undertaken to restore fire as a critical ecosystem process to places like California. Ultimately, my work is predicated on millennia of stewardship by indigenous people and their use of fire to achieve cultural goals and enhance ecological health.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

BLM - Bureau of Land Management
CAL FIRE - California Department of Forestry & Fire Protection
FAC - Fire Adapted Community
NPS - National Park Service
PBA - Prescribed Burn Association
USFS - United States Forest Service
WUI - Wildland Urban Interface

Chapter 1: Fire Management in the West & Wildfire Social Science Theory

A Brief History of Fire and Landscape Management in California

Fire is a keystone ecological process for many ecosystems across the American West; it is necessary for numerous species' life cycles and the overall health of many vegetation communities. Such ecosystems are known around the world as fire-adapted systems; fire adapted systems are able to withstand and recover from most low to moderate intensity fires and may deteriorate or ultimately disappear without fire at regular intervals and intensities (Carle, 2008). California, with its Mediterranean climate and annual fall drought, is particularly prone to wildfires. At least 54% of systems in California are considered fire adapted or -dependent (Pyne, 2016; Sugihara et al., 2006). As society has come to better understand fire as a key ecological process in fire-prone landscapes, there has been a pressing need to describe historical fire regimes in order to define land restoration goals in the US West and California (Taylor et al., 2016). In historical times, 4-12 million acres of California (4-12% of the state) burned annually (Anderson, 2005), although the proportion of these acres that were burned intentionally by indigenous land stewards, or by natural lightning strike ignitions, is difficult to discern. Critically, socio-ecological conditions are known to influence fire regimes in places like California (Taylor et al., 2016).

The legacy of fire-adapted and -dependent ecosystems in California is tied to a long history of land management via intentional burning by indigenous peoples to support populations of culturally important plants and animals for food, medicine, and toolmaking. Cultural burning cultivated high levels of biodiversity and maintained a patchwork mosaic of forests and grasslands (Anderson, 2005; Lightfoot & Parrish, 2009). Indigenous cultures

maintained regimes of intentional burning that were spatially and temporally complex, reflecting not only their needs but the needs of plants and other animals, such as grazers' needs for high quality green plants which led to having herd species nearby for hunting (Anderson, 2005; Kimmerer & Lake, 2001). Cultural burning helped to create the landscapes that Spanish and European colonizers encountered when they first came to what is now California. Early accounts from European explorers recount smoke as a constant presence along the coastline. One explorer, Juan Rodríguez Cabrillo, going so far as to call San Pedro Bay near present day Los Angeles Bahia de los Fumos, or "Bay of Smokes" due to all of the fires being set by indigenous hunting parties (Keeley, 2002).

The dependency on fire for ecosystem integrity in California has collided with the ongoing impacts of widespread fire suppression and lack of cultural burning, which for decades have excluded fire from landscapes that evolved with burning as a periodic and critical disturbance. Aggressive suppression of wildfire is known to have significant effects on vegetation communities by reducing fire regimes that would be ecologically beneficial, particularly in coast redwood forests, chaparral, oak woodlands, grasslands, and coniferous forests in the Sierra Nevada (Odion & Hanson, 2013; Steel et al., 2015). Years of fire deficits in which fuels accumulated in forest and chaparral systems have led to an increase in high intensity fires when compared to past eras of burning, and many species that depend on fire have dwindled since indigenous burning regimes were interrupted (Greenlee & Langenheim, 1990; Larson et al., 2013; Marty, 2015; Pyne, 1984; Stephens & Ruth, 2005; Young et al., 2015). This accumulation of fuels threatens human communities and ecosystems alike, akin

to how annual deficits build over time into debt. This "fire debt" has grown over the past century and may take decades to pay (or burn) off.

Within the last few years the State of California has experienced the first known "giga-fire" and largest wildfire in California's recorded history, the August Complex, which burned over one million acres across Glenn, Lake, Trinity, Shasta, Mendocino, and Tehama counties between August and November 2020. California has recorded the deadliest wildfire in recent state history, the 2018 Camp Fire, which claimed 85 civilian lives and injured five firefighters near Paradise, California (Maranghides et al., 2021). Total acres burned by wildfire in the State have risen dramatically over the past decade, from an average of 733,000 acres from 2012-2015 and tripling to 2,200,000 for 2018-2021 (National Interagency Coordination Center, 2017). While these numbers would appear to indicate progress towards the historical acres burned in pre-colonial times that many land management agencies and ecologists say is needed, the intensity, severity, and patterns of many of these large wildfires may be detrimental to ecosystems. The extent of the area burned with high severity by recent wildfires has been increasing in recent decades, and is likely higher than historical levels in some regions (Miller & Safford, 2012). Evidence suggests that repeated high severity fires increase nonnative plant invasions in western forests (Reilly et al., 2020), which can trigger changes in fire regimes, ecosystem transitions, and influence other ecosystem service delivery (e.g., carbon sequestration, water availability, nutrient cycling). Discovering ways to restore fire regimes, and protect them from changes from invasive species, is of utmost importance to reducing wildfire impacts in the US West. California's recent record-breaking catastrophic wildfires, coupled with similar events in other states across the U.S. West, have

catalyzed state and federal agencies to reconsider their management objectives surrounding wildfire management and the use of fire as a land restoration or management tool. New federal plans set the goal of treating over 50 million acres of land with fire over the next 10 years across the country. The 10-year average for prescribed fire projects in the U.S. is just over 24,000 with the 10-year average for acres burned by these projects at just under 2.5 million annually (National Interagency Coordination Center, 2017). Existing data has recorded the number of burns and acreage burned by different land management agencies such as the U.S. Forest Service (USFS), Bureau of Land Management (BLM), and the National Park Service (NPS), and "Other(s)". In 2017, the "Other" category comprised over 198,000 of the 202,000 recorded prescribed fires and over 5 million of the 6.5 million acres burned, meaning that most efforts to get fire on the ground were conducted by non-federal groups and organizations (National Interagency Coordination Center, 2017). These statistics support the idea that continuing to find ways to scale up "other" entities engaged in prescribed burning may be more effective when it comes to getting fire on the ground, and Jakes et al.'s (2007a) notion that certain wildfire management strategies may be best engaged with at a more local level.

Wildfire Social Science and Theory

In recent decades wildfire social science is building upon the work of fire ecologists and the notion that fire is a necessary process for maintaining the health and function of many fire-prone landscapes in the western US. Key social science research has focused on exploring how humans can better live with fire. Borrowing from the fire ecology literature, the pursuit of fire-adapted human communities (FACs) has been an integral part of national,

state, and local policies related to wildfire risk mitigation and management since the National Fire Plan, including the National Cohesive Wildland Fire Management Strategy (Wildland Fire Leadership Council, 2014) and the more recent Wildfire Crisis Strategy (2022). Much of the current wildfire social science research is focused on bridging gaps between what fire scientists and managers say is needed for "all hands, all lands" approaches to landscape restoration and fire risk mitigation and what the fire-prone human communities in particular places can actually do (Charnley et al., 2017; Paveglio et al., 2018a, 2019b; Pixley, 2017). The social contexts and dynamics that influence what management options are socially and/or politically possible for particular communities are sometimes marginalized in the narratives constructed around "living with fire" (McCaffrey et al., 2012; Paveglio et al., 2019a; Paveglio, 2021). Wildfire social science is critical to understanding *why* and *how* fire management occurs across differing spatial scales. Accounting for social factors like values, priorities, motivations, decision processes, resources (e.g., financial, human, skills), and knowledge (locality-specific, technical, scientific) that exist in particular places are intricately related to the shaping of management goals and outcomes (Paveglio et al., 2021).

Social conditions are known to vary widely across contexts, which in turn influences what communities are likely or able to do in the context of fire management (Paveglio et al., 2009; Varela et al., 2014). One framework for thinking about adaptive capacity - the ways in which local social context plays a role in how communities can manage and respond to disturbances such as wildfire (Donoghue & Sturtevant, 2007; Wall & Marzall, 2006) - focuses on four main categories of adaptation characteristics: (1) demographic and cultural, (2) interactions and relationships among local stakeholders and residents, (3) access to

scientific knowledge networks, and (4) place-based knowledge or experience (Paveglio et al., 2018a). This framework, and these four elements, have been used to explore potential "adaptation pathways" for different community archetypes ranging from working lands and rural lifestyle to formalized suburban communities. These archetypes help explain the patterns and variability in how different kinds of communities might adapt to wildfire risk management or respond to a wildfire event in their area. However, this conceptual framework has not yet delved into the social contexts surrounding prescribed fire and its use within these community archetypes. Are all communities interested in and able to use fire as a land management tool? What social or biophysical conditions influence community or individual interest in prescribed fire as a tool? Answers to these questions can help address the current gap in understanding how prescribed fire may be used across different community types and socially heterogeneous landscapes.

Interest in using fire as a restoration and fire-risk reduction tool is increasing across many fire-prone landscapes. Likewise, publications about prescribed fire are increasing in the scientific literature (Kolden, 2019), demonstrating the practitioner and scientific communities' goals of understanding the utility of prescribed fire as a tool and diminishing barriers to its application when its use is appropriate. However, many of the studies published on prescribed fire use have focused on federal lands (Miller & Davis, 2009; Ryan et al., 2013), which highlights a research gap based on the Californian context where the majority of burn projects and acres treated are conducted by non-governmental organizations (Quinn-Davidson & Varner, 2012). Prescribed fire remains woefully underfunded and lacking in institutional support in many regions, particularly in the U.S. West (Kolden, 2019; Quinn-

Davidson & Varner, 2012). This lack of support underlies a consistently documented trend of land managers (including state, federal, and NGOs) being unable to implement more prescribed fire despite their interest in doing so (Hiers et al., 2020; Ryan et al., 2013; Quinn-Davidson & Varner, 2012).

Understanding how socially different populations think about and engage in prescribed fire is necessary when creating tools and programs that will be accessible and useful for communities and private landowners as they work to support larger-scale land management goals. The continuing expansion of the wildland-urban interface (WUI), the area where development and human communities abut or intermix with fire-prone wildlands (Theobald & Romme, 2007), necessitates tailoring programs to new contexts and social conditions. Radeloff et al. (2018) describe how the WUI is a dominant land use type in the US with significant population growth. Total WUI land area grew by 33% between 1990 and 2010, but infill (when more properties are built in the same spatial extent) grew by 41% during the same time frame from 30 to 43 million homes (Radeloff et al., 2018). Population density is an important factor in wildfire management in the WUI because it puts more lives and infrastructure at risk of experiencing an uncontrolled wildfire (Radeloff et al., 2005). Apart from the fact that WUI population growth implies that more property and lives are at risk of wildfire, the composition of the WUI is also changing. For example, the Covid-19 pandemic has altered the composition of some rural communities as residents have moved out of cities and into more rural spaces due to being able to work remotely, or because they are seeking a different kind of lifestyle (Albrecht et al., 2020). In California, affordability of housing under the housing crisis is an influential concern as well, and one of the factors correlated with

WUI growth and expansion (Greenberg, 2021). Furthermore, many of these trends are expected to continue and, in some cases, accelerate in the coming decades (Hammer et al., 2009). All of these variables may influence how WUI communities perceive prescribed fire and whether they consider it an appropriate management tool. While prescribed fire has been implemented in working-landscape (e.g., ranching, agriculture, logging) contexts post-colonization, how other community types use fire remain somewhat uncertain. As the WUI expands, working-landscape and resource-dependent areas may begin to be fragmented by parcel divisions and migration of non-working lands minded people into the landscape. Social fragmentation in the WUI could be detrimental to mission-alignment and consensus-creation around wildfire risk adaptation pathways. Conversely, it may provide an opportunity for the varying strengths of the WUI population in the fireshed to use each other's strengths to better everage programs and resources, collaborate and pool together knowledge or supplies all to better manage their shared landscape. Population dynamics in the WUI is an additional factor that is important to consider in assessing the relationship of people with their landscapes and fire, and also why different communities may choose to engage in prescribed burning or not.

Some approaches to engaging communities and local residents with fire management to build capacity to address wildfire risk include Rural Fire Departments (RFDs), Rangeland Fire Protection Associations (RFPAs), and Prescribed Burn Associations (PBAs). The former two tend to focus mostly on suppression while the latter focuses on using prescribed fire to achieve a range of social, cultural, and ecological goals. While RFDs and RFPAs focus almost exclusively on rural spaces and working landscapes (Colibaba et al., 2021; Stasiewicz

8

& Paveglio, 2017; Paveglio, 2018b), PBAs are becoming more common in the WUI and in areas with more socially diverse populations, including California. PBAs have only been in California since 2018, but have quickly become established in over two dozen counties, ranging from formal 501(c)3s to loose networks of like-minded individuals and landowners sharing common goals of returning fire to the landscape. The range of forms California's PBAs take may allow them to adapt to local needs and contexts better than a more rigid, prescriptive policy might, and provide room for a community to create the kind of program that suits their conditions best. This research focuses specifically on how prescribed burn associations in California develop and function, and explores how they may fit into the larger conversation around creating FACs across the U.S. West in an era of intensifying wildfires.

Chapter 2: An Examination of the Development and Functioning of Prescribed Burn Associations in California for submission to Society and Natural Resources

Introduction

Recent devastating wildfire seasons have intensified calls for more active land management in the western United States (US) to reduce wildfire risk and restore ecosystems that are degraded due to more than a century of cultural fire exclusion and fire suppression (Kimmerer & Lake, 2001; North et al., 2015; Schoennagel et al., 2017). Restoring fire to the western US is needed to meet multiple objectives, including to enhance landscape health, protect human communities at risk of wildfire, and meet a range of ecological, economic, and cultural goals. Broadcast prescribed burning (prescribed burning) - the intentional use of fire on the landscape to meet various ecological, social, or cultural objectives - is one tool to restore fire. These fires are applied to lands under suitable conditions in order to meet both ecological and social goals. One goal is to reduce wildfire risk to communities by addressing the hazardous accumulation of vegetation (i.e., fuel load) due to the lack of active management (Grebner et al., 2021). Prescribed burn associations (PBAs) may address some of the challenges of using prescribed fire on private lands, and may influence local residents' perceptions of fire as a land management tool. PBAs are typically designed for private landowners to aggregate equipment, knowledge, labor, and financial resources in order to more effectively and safely conduct prescribed burns on their lands (Toledo et al., 2014). They represent an ongoing shift in how private citizens are engaging with land management issues in an era of increasingly severe wildfire seasons, and support goals to restore and maintain fire-prone ecosystems. Despite their application in private lands, particularly in the

southeastern US, few research efforts have explored PBA development and functioning in western states, especially the recent PBA surge in California.

PBAs first emerged under the nomenclature in the Great Plains region in the mid- to late-1990s as a way to foster rangeland health improvements, increase forage quality for grazers and wildlife, and reduce woody species encroachment into the prairie landscapes, particularly on private lands (Weir et al., 2016). Other organizations, such as Range Improvement Associations (RIAs), have existed in California since the late 1940s and have created informal networks in rangeland-dominated systems upon which PBAs could grow and/or integrate (Burcham, 1955). Established PBAs have helped expedite prescribed fire application by reducing the risk of applying fire to landscapes by mobilizing additional personnel, collecting and sharing equipment and knowledge, and sometimes acquiring group liability insurance, often through becoming a 501(c)3 non-profit organization (Toledo et al., 2012, 2014; Weir et al., 2016, 2019). PBAs expanded as a model for prescribed fire implementation on private lands across the south and midwest through the 2000s and began being implemented on the Pacific Coast 2017 (Weir et al., 2016). The emergence and use of the PBA model aligns with Fuhlendorf et al.'s (2012) assertion that the future of rangeland management must focus on fire to promote diversity and resilience across these ecosystems. Surveys of PBAs and other prescribed burning efforts conducted across the South (Haines et al., 2001; Kobziar et al., 2015), Midwest (Joshi et al., 2019), and Great Plains (Polo et al., 2020) illuminate key insights into (a) motivations for and (b) barriers toward prescribed burning on private or mixed-ownership lands across regions. Kobziar et al. (2015) identified fuels reduction as the most common goal of prescribed burning efforts amongst public land

managers and private landowners. For public land managers, the cost to prepare and implement burns and staff capacity were two of the most widespread barriers to increasing prescribed fire use on public lands; on private lands, the primary concern was liability (Kobziar et al., 2015). Joshi et al. (2019) found that cognitive factors, like prior prescribed fire experience, as well as the perceived risk of implementing prescribed fire, played a significant role in how landowners and fire professionals engaged with burning. Those with less experience were more sensitive to the risks of burning than those with more experience. Sociodemographic factors (e.g. age, income) had little effect on how individuals perceived the risk of prescribed burning (Joshi et al., 2019). This implies that increasing outreach and education around ways to use prescribed fire may be successful across socially different populations, and that interest in burning may cross traditional demographic divides. Polo et al. (2020) found that while many of their survey respondents supported the use of prescribed fire, few landowners had actually used it, most often due to lack of formal training, equipment, and liability concerns related to the risk of an escaped burn. Collectively, these findings provide reference points from which to consider how individuals and communities in the western US may be thinking about and engaging with prescribed fire. Additionally, existing literature highlights a need to further explore perceptions and motivations towards prescribed fire's use in these wildfire prone but fire suppressed landscapes. Various wildfire social science studies have explored the notion that local social contexts vary widely across communities and exert influence on how those communities approach adapting to wildfire and engaging in fire management (Paveglio et al., 2009, 2015, 2019a; Varela et al., 2014). Many of these studies aim to develop ways to support the creation of Fire Adapted

Communities (FACs) – human communities that are adapted enough to be able to withstand and recover from a wildfire event (Frank et al., 2015; Toman et al., 2013; Wildland Fire Leadership Council, 2014). The ways in which communities can manage and respond to disturbances such as wildfire in their local context is known as adaptive capacity. One conceptual framework for thinking about adaptive capacity, termed "the Interactional Approach", focuses on analyzing over 20 community social and biophysical characteristics across four main categories: (1) demographic and cultural, (2) interactions and relationships among local stakeholders and residents, (3) access to scientific knowledge networks, and (4) place-based knowledge or experience (Paveglio et al., 2018b). These four elements have been used to explore potential "pathways" for different community types to become fire-adapted, ranging from working lands and rural lifestyle to formalized suburban communities. These community "archetypes" may provide a basic framework from which different communities might adapt to wildfire management or respond to a wildfire event in their area. However, this conceptual framework has not yet specifically focused on the social contexts surrounding prescribed fire use within different community archetypes.

We conducted a study of the Good Fire Alliance PBA on the northern California coast to explore characteristics that influenced its initial development and establishment, as well as its ongoing operations. Focusing on PBA establishment and functioning in California is important due to the complex land-use and -ownership patterns in the state, the trends in wildfire impacts and effects, and the need to implement tools for increasing the pace and scale of wildfire risk mitigation work. Additional benefits of studying PBAs include (1) identifying potential pathways for PBA formation and development based on local social

13

contexts; (2) exploring relationships between local residents, land management organizations, and professional fire agencies and how they influence wildfire management; (3) better understanding how PBAs might help achieve broader fire management goals and objectives; and (4) helping place PBAs into conceptual frameworks focused on developing FACs.

Literature Review

Prescribed Fire and Burn Associations

While several wildfire risk reduction strategies exist for reducing the fuel loadings of landscapes, including mowing and mechanical thinning, prescribed fire use is often of lower cost than other more labor intensive options. Prescribed fire also provides ecological benefits that are challenging to mimic, including nutrient cycling and triggering responses from fire adapted species (Hunter et al., 2011; Hunter & Robles, 2020; Toledo et al., 2012). Prescribed fire is sometimes combined with other management strategies, such as mastication or thinning, because of the need to address vegetation build up from the era of fire exclusion policies and the fact that prescribed fire would likely burn too intensely if applied to dense fuel loadings without site preparation in advance (Baeza et al., 2002; Fernandes & Botelho, 2003; Pattison, 1998).

PBAs are a relatively recent development in California. The first California PBA formed in 2018 in Humboldt County, although functionally similar rangeland-focused groups have existed in the State since the mid-1900s (e.g. the Santa Barbara Range Improvement Association, established 1956) (Biswell, 1958; Burcham, 1955). A dozen PBAs existed in California at the time of this study, with six more having formed since (Figure 1). California

14

is often considered to be different from other western fire-prone states due to its particular

history of fire suppression (e.g. a highly militarized suppression agency in CalFire, and the

way the state captures the nation's attention in ways other states with large wildfires do not).

California also contains a large socially diverse population, high population densities, a high

amount and density of wildland-urban interface (WUI) - the area where development and

human communities abut or intermix with fire-prone wildlands (Theobald & Romme, 2007) -

and relatively high levels of wealth and education (Pyne, 2016; Syphard et al., 2007). Land

ownership patterns in California are complex. Public and private lands often overlay a

mixture of fire-prone ecosystems with varying historic and current fire regimes (see

Appendix C maps to compare land ownership boundaries and California vegetation types).

Complex "management mosaic" scenarios have been known to be particularly challenging

for agencies to achieve without the support of local communities and private landowners who

can otherwise block (but also enhance) land management objectives (Epanchin-Niell et al.,

2010). The distribution of private land in California may provide opportunities for – and

necessitate – ground-up and collaborative approaches to landscape-level wildfire

management.

While Kolden (2019) found that most of the increase in burning in the US in recent years

can be attributed to burning performed on non-federal and private lands, the majority of that

increase occurred in the U.S. Southeast. Western public land dominated states, like

California, do not match the pace and scale of increases in the southeastern US. For example,

California had a documented overall decrease in acres burned from 1998-2018, averaging a

200 hectares/year decrease for that time period, and over 90% of the documented prescribed

fires in the northern part of the State were reportedly conducted by public agencies from 2006-2008 (e.g. U.S. Forest Service, State and National Parks) (Kolden, 2019; Quinn-Davidson & Varner, 2012). California State and agency goals express the need to scale up intentional burning efforts in order to protect natural and human communities from devastating wildfires (California Board of Forestry and Fire Protection, 2019). California's stated goal of treating 400,000 acres annually with beneficial fire by 2025 is ambitious given current efforts (~50,000 acres a year). Some have noted that California manages to burn a significantly smaller area than other states (Kolden, 2019); California's 50,000 acres of prescribed fire annually as of 2017 pales compared to Florida's reportedly number of 2.1 million (National Interagency Coordination Center, 2017). Exploring different ways for scaling up prescribed fire use may be necessary for western states, like California, or existing programs might need to be adapted to new contexts (CA Natural Resource Agency, 2022).

The discrepancy between prescribed fire use in California versus other states may be partly attributed to the challenges that face burners on private lands in California, including liability standards (e.g. California's standard negligence law making private burning more risky) and regulatory frameworks that make it difficult to secure permits to conduct a controlled burn (Miller et al., 2020). Several state and agency policy documents (U.S. Forest Service, 2022a; U.S. Forest Service, 2022b) and recent state laws (e.g., SB 332) highlight initiatives that seek to improve capacity and lessen barriers to prescribed fire so that agencies, landowners and organizations can expand current efforts. Some examples include identifying key "firesheds" for priority treatment to reduce risk to human communities in California's Wildfire and Forest Resilience Action Plan, streamlining permitting processes,

developing a state-run training program for prescribed fire personnel, and shifting liability standards to gross negligence for certified California burn bosses in SB 332.

PBAs may represent one tool for addressing prescribed fire goals and needs at the landscape level by bridging the gap between private landowners and land management entities. There is a need to explore the various factors and dynamics that may affect PBA development and functioning in California, especially considering the potential utility of PBAs as a cross community land management and fire risk reduction tool across spatial and social contexts Understanding how PBAs and similar local fire-focused community groups form, how landowners engage in organized prescribed burning activities, and how they think about land management practices more broadly is critical to larger-scale efforts around creating fire-adapted communities (FACs) (Jakes et al., 2007a, 2007b; Kreuter et al., 2008; Stasiewicz & Paveglio, 2017; Toledo et al., 2012). Ultimately, one goal of our PBA-focused research is to assess what opportunities PBAs may represent when it comes to getting more prescribed fire on the landscape on a broad scale, and how they may affect larger community dynamics and perceptions towards land management generally.

Figure 1

The status of community-based burning efforts and/or PBA's in California by counties served. Map credit: Jeff Stackhouse & Katie Roberti

Community-Based Wildfire Risk Management and Prescribed Fire

Community-based wildfire risk management efforts are lauded for often resulting in projects and outcomes that more accurately reflect local conditions, needs (including scale of work), knowledge, and capacities (e.g., skills, equipment, volunteerism, political connections, funding) because the community members are consulted and integrated into land management decision-making processes (Danks, 2001; Ganz et al., 2007; Jakes et al., 2007a, 2011). Not all communities have the same capacities or preferences when pursuing wildfire risk mitigation. Different communities will use varying strategies to reduce wildfire

risk or manage their lands based on an array of factors and local context (Jakes et al., 2011; Paveglio & Edgeley, 2017; Paveglio et al., 2018b). Some strategies may come top-down from states or federal agencies, while others will form at the grassroots level. Prescribed fire has been integrated as a tool into some wildfire adaptation conversations around the US West, but PBA's have yet to receive the significant attention that other popular adaptation tools have (e.g., defensible space and home ignition zone studies).

Existing research suggests that fire-focused collective action programs can foster social cohesion, consensus, and energy amongst community members that can lead to wildfire risk mitigation benefits (Jakes et al., 2007a, 2007b; McGee, 2011). Rangeland Fire Protection Associations (RFPAs), found in Idaho and Oregon, USA, provide analogous examples of local communities self-organizing in order to more effectively confront wildfire management challenges (Abrams et al., 2017; Davis et al., 2017; Stasiewicz & Paveglio, 2017; Paveglio et al., 2018a). Cooperative Weed Management Areas (Parsons, 2011) and Collaborative Forest Landscape Restoration Program projects similarly represent how cross-boundary cooperation around land management and restoration are increasingly supported in policy, in part because they are useful mechanisms for integrating diverse perspectives from multiple interest groups nested within socially diverse landscapes (Schultz et al., 2012). The literature focusing on these and other restoration or fire-related programs offer evidence that more nuanced, place- and culture-specific strategies can promote more effective, long-term cooperative/cross-boundary wildfire management (Marks-Block & Tripp, 2021; Paveglio, 2021). PBAs may represent another manifestation of local capacity-building focused on land management.

One of the goals of leading wildfire management policies (e.g, the National Cohesive Wildland Fire Management Strategy (Wildland Fire Leadership Council, 2014), Wildfire Crisis Strategy (U.S. Forest Service, 2022a) is promoting "fire adapted communities" (FACs) – communities better able to co-exist or live with wildfire. One conceptual framework, termed the "Interactional Approach" (Paveglio et al., 2015, 2018a) explores ways to systematically document a given community's social and biophysical characteristics that contribute to or influence local adaptive capacity, with the goal of creating generalized pathways for like communities to follow towards becoming better fire-adapted. The knowledge, perceptions, and experiences that people have with wildfire and about practices such as prescribed burning, have been shown to vary widely across landscapes (Brunson & Shindler, 2004; Meldrum et al., 2018), reinforcing the notion that purely top-down, cookie cutter policies aimed at creating better FACs are unlikely to be highly effective if they are not tailored to the local contexts and needs of the communities charged with implementing them. Adaptability of programs and policies to local contexts is a factor often tied to assessments of the efficacy of landscape-scale programs or policies (Kelly et al., 2019; Stidham et al., 2014). When spatial patterns of human development and fire-prone wildland vegetation are more mosaic or heterogeneous, there is a potential for multiple community archetypes to be present on the shared fire landscape of interest. The appropriateness of land management options and policy effectiveness in complicated management contexts may vary due to diverging organization or community missions, bureaucracy, local communication networks or lack thereof, and uneven access to resources and programs designed to support local land

management goals (Fischer et al., 2019; Fleming et al., 2015; Paveglio et al., 2015; Syphard et al., 2007).

Although PBAs may be established as a geographically distinct administrative unit or organization, it is unclear the extent to which they reflect community needs. As PBAs are applied outside of rural working landscape contexts and into spaces with more WUI, it will become increasingly important to explore PBA goals and how they cater to the needs of different landowners or communities in the shared wildfire risk landscape where they operate. Critical questions remain around why some landowners engage (or do not) with PBAs, and how PBAs fit wildfire land stewardship goals across different contexts. Due to its differing land use patterns, WUI, social complexity, and recent burgeoning PBA movement, California provides an interesting space to look at how PBAs are operating, who they are interacting with (e.g. landowners, fire professionals, formal land management organizations), and what those relationships look like (see Appendix C for maps of California vegetation types and land ownership). Research focused on California's PBAs is relatively sparse. This research gap is particularly critical as state-wide policies promote prescribed fire as a wildfire adaptation tool across socio-ecological landscapes and communities in California and the United States. Our study aims to examine how PBAs contribute to (1) community adaptive capacity in the face of worsening wildfire risk and (2) increasing the pace and scale of prescribed burning practices to meet agency, state, and federal land management goals. This study uses a case study of the Good Fire Alliance (GFA) PBA in order to explore the following questions:

1. What factors influenced the GFA's development?

2. What factors influenced the GFA's functioning?

Methods

We used a qualitative, inductive approach involving semi-structured interviews. An inductive approach is suitable for studies on topics that have relatively little research on them and therefore have few or no discernable theoretical frameworks to test hypotheses against (Corbin & Strauss, 1990). Qualitative methods provide room for values, perceptions, and understandings to emerge from and in our interactions with study participants, which can provide the basis for future hypotheses. We selected a semi-structured interview protocol to allow for themes to emerge from pre-selected open-ended topics centered on the research questions, and because PBAs in California have thus far received little formal study. Semi-structured interviews are guided by a series of topics and questions that allow for flexibility during the interview process by permitting follow up questions or additional question development when an interesting topic or previously unknown area is uncovered during the interview process (Bryman, 2016; King et al., 2018). Semi-structured interview protocols can be adjusted or followed-up on depending on the interviewee's responses and background, or questions can be modified if an individual works for a particular agency or has relevant expertise on a topic of interest.

Site selection

At the time of this study (Fall 2021), sixteen PBAs were established in California. We sought to study a mature and active PBA, specifically one with significant recent wildfire activity nearby and multiple prescribed burns completed and/or planned. These factors would allow our questions to be answered about establishment, development, and functioning. We

selected the GFA for this study because: (1) the area covered by the PBA has experienced several devastating fires in recent years including the 2017 Tubbs Fire, the 2019 Kincade, 2020 Wallbridge, and 2020 Glass fires (Mandeno, 2021); (2) the GFA is considered more active than other PBAs in the state and was more than two years old when the study was conceived; and (3) the GFA covers a large, socially, and ecologically heterogeneous area in which to explore how different populations in the shared landscape think about and interact with prescribed burns efforts in the region.

The GFA was formally established in 2018 and operates largely in Sonoma and Marin counties north of the San Francisco Bay Area, California, USA (Figure 2) (Callahan, 2021). Sonoma and Marin counties' ecosystems range from open grasslands and oak woodlands to steep maritime chaparral and mixed evergreen forests, along with active rangeland, farmland, and vineyards (See Appendix C for vegetation map of both counties). According to 2010 census data, the populations in our study area vary widely across several socio-economic characteristics, but trend toward middle- and upper class distinctions with the average annual household incomes over $115,000 in Marin and approximately $85,000 in districts of western Sonoma County. Concurrently, approximately 8% and 7% percent of county residents are under the poverty line in Sonoma and Marin counties, respectively, which is half the state average of 16%. Given Sonoma County's high percentage of private land (~89% is privately owned with the other 11% split between local, state, and federal entities) and parcelization (i.e. amount of small landholdings overlaid on the landscape, see Figure 3), selecting the GFA for this study allowed us to explore aspects of local adaptive capacity to wildfire and land management on landscapes with high land-use and -ownership diversity

(often referred to as "management mosaics") (Epanchin-Niell et al., 2010). These aspects include residents' interactions with and relationships between residents and land management organizations, place-based knowledge and experiences across different sub-populations in the area (e.g. ranchers, urban PBA members, and rural lifestyle residents), and reactions to or changing behaviors following experiences with a devastating wildfire. Sonoma and Marin Counties are also characterized by relatively extension WUI development, and WUI development patterns are one variable known to affect wildfire risk through exposure and human-caused ignitions (Paveglio et al., 2019; Radeloff et al., 2018; Schoennagel et al., 2017) (see Figure 4 for a map of Sonoma's WUI and wildfire influence zones). Understanding how a PBA operates under these circumstances will allow us to begin to explore the applicability of PBA-type programs across contexts by focusing on a context where PBA establishment and functioning might be more complicated due to WUI.

Figure 2

Map of the study site counties, Sonoma and Marin, highlighted in green. Data source: Counties.org, 2021

Figure 3

Parcels grouped by size in Sonoma County. Source: Macaulay & Butsic 2017.
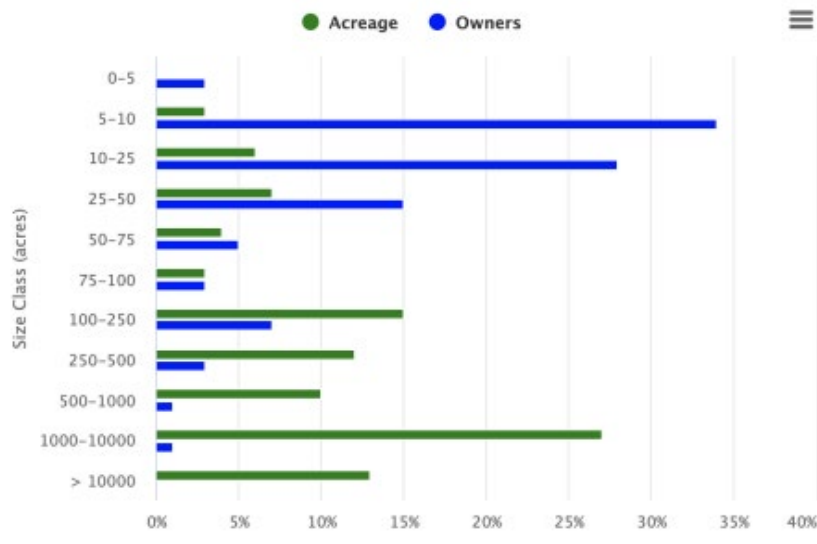
Ownership distribution of the county's private land across different size classes of properties. It describes a) the number of property owners within a particular size class (blue), and b) the percent of total acreage found in a particular size class (green).

Figure 4

Map showing Sonoma County's Wildland Urban Interface, Intermix, and Influence Zone.
Source: CalFire's Fire & Resource Assessment Program (2019).
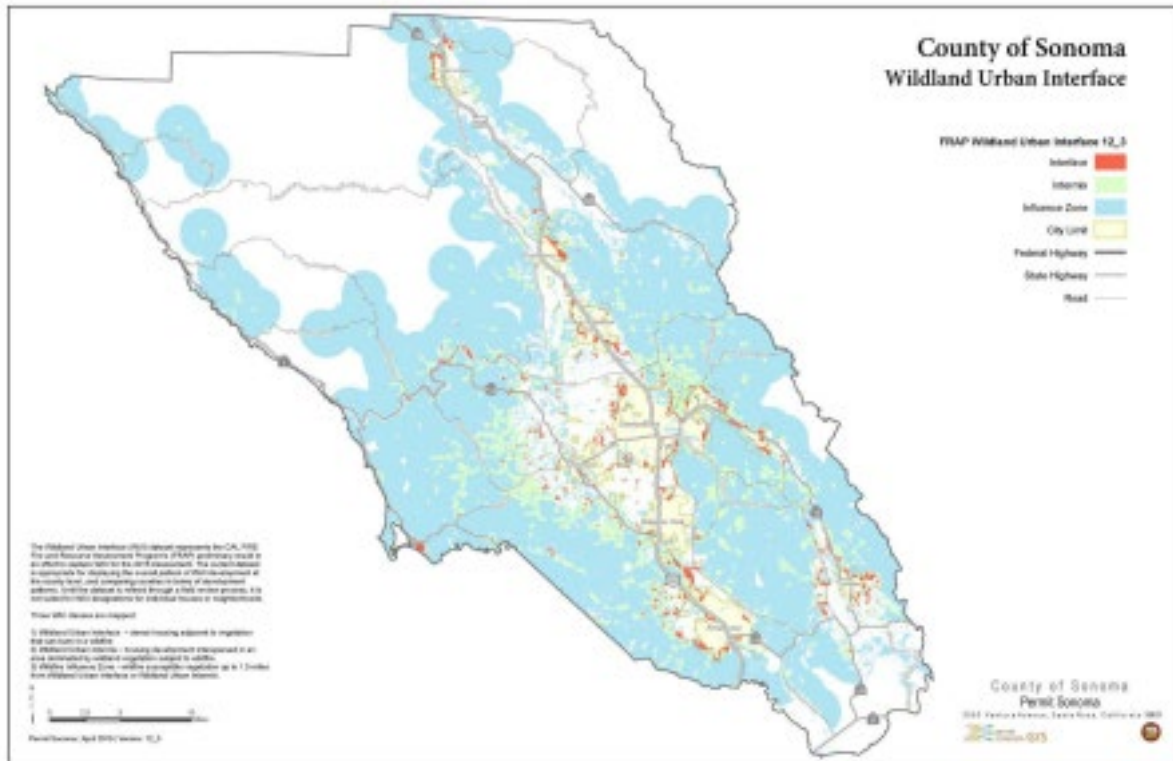
Study Design

We conducted 40 interviews with 45 individuals between November 2021 and April

2022. Due to COVID-19 concerns, interviewees could participate in the study through

multiple modalities, including in-person, over the phone, or via video conference (i.e.,

Zoom). Twenty-seven interviews were conducted in-person with 32 individuals around

Sonoma County; the rest were conducted by phone. Interviews lasted 30 minutes to 3.5

hours, and occasionally included a visit to an area that a landowner burned or wanted to burn.

Theoretical sampling, in which key informants are identified based on their position or

knowledge of a topic, was used in the early stages of data collection (Charmaz, 2000).

Snowball sampling, in which participants provide names of others that may be willing to be interviewed for the study, became a primary participant recruitment strategy thereafter (Bryman, 2016; Lindlof & Taylor, 2017). The key informants included individuals whose professional work focused on prescribed fire and who were involved, currently or previously, in PBAs around California, especially in the study area. These individuals confirmed that the study would be both welcomed by the GFA community and agreed that results could be useful for GFA and other PBA's future development.

Two protocols were created and tailored to two target audiences: (1) professionals and (2) PBA participants (see Appendix A). Interview protocols focused on prescribed fire use and PBA experiences, with questions covering individual relationships to the land, community relationships and history, the different actors who may be involved in the PBA and prescribed burns in the region, and interactions between those actors. Other questions focused on PBA structure, how the GFA is organized, relationships and interactions between agencies, local land management organizations and the GFA, and ongoing operations. Individuals interviewed included private landowners and renters in Sonoma County as well as members who participated in GFA activities but were from other counties. Interviewees also included local nonprofit staff, public agency personnel, and professionals in the wildfire community from organizations such as California Department of Fire and Forestry (i.e.,CalFire), Sonoma Land Trust, Sonoma Regional Parks, and the local Resource Conservation Districts. Interviews were conducted until "theoretical saturation" was reached, a point at which the researchers agreed that no new themes, topics, or names of individuals to

interview were being brought up despite continued snowballing or theoretical sampling efforts; at this point, it is appropriate to cease interview recruitment (Morse, 1995).

Analysis

All interviews were audio recorded and transcribed word for word. Building up from a small sample of instances, emergent themes are compared and contrasted across cases (in this case, interviews) to develop hypothetical explanations for the phenomenon of interest. Thematic analysis consists of increasingly specific rounds of coding that identify, refine, and verify emerging and constructed themes, including their relationships to each other (i.e., patterns) (Bernard et al., 2016; Braun & Clarke, 2006; Kiger & Varpio, 2020). Themes can be both implicit within the data, and actively constructed in order to explore particular research questions and understand experiences, behaviors, and perceptions present within the data corpus (Joffe, 2011).

Once data collection was completed, authors independently coded a subset of the transcripts to develop a preliminary codebook – the list of words or short phrases (i.e., codes) that represent distinct ideas that emerge from the data and coding processes. Our codebook included a code name, a description, an example from the data, and any relationships to other codes. Once the authors agreed upon preliminary codes to establish inter-coder reliability (see Appendix B for code book), all interviews were analyzed through iterative rounds of coding consisting of topical codes (e.g. direct experience on a prescribed fire), focused and descriptive codes (in which first cycle codes were grouped into categories), and pattern codes (which link similar categories together and help draw larger connections between the data) (Saldana, 2021). Finally, pattern codes were collapsed into themes. Themes are broader

ideas, patterns, or concepts that emerge from the data. The multiple rounds of coding served to refine the themes and allowed new themes to emerge until saturation was reached (i.e. no new codes were emerging that supported identified themes). Authors then identified quotes that highlighted and represented the major themes related to our research questions (Boyatzis, 1998), and they are presented with our results below.

Results

Factors Involved in PBA Development

Initial development of the GFA (and its ongoing operations), stems from concerted and collaborative efforts by many of the region's nonprofits. These nonprofits focus on land management and conservation and have experience with permitting, fire implementation, and training access and technical knowledge to assist community-members with their prescribed fire and land management goals. Interviews identified one environmental organization, Audubon Canyon Ranch (ACR), as the epicenter of the movement to organize a prescribed fire program in the region across land ownerships. At the time of this study, ACR had recently created a nonprofit prescribed fire capacity-building program called "Fire Forward" that was described as bringing together "private landowners, public agencies, and conservation partners around a shared purpose of stewarding ecosystems and reducing the impact of wildfire", and training them to become "self-sufficient in prescribed burning". Fire Forward and the GFA are related, but not considered to be the same entity. The GFA was considered to be more grassroots, described as a "community network of neighbors helping neighbors in this area, to try to get good fire on the ground". Fire Forward was a more professional program that helped create burn plans, conduct trainings, and provide the

personnel and equipment necessary for certain projects. Fire Forward had become the de facto coordinator of most, but not all, GFA operations around the region. As one local land management professional stated:

> "...there's a lot of enthusiasm and momentum here in the public, people wanting to reshape their relationship with fire, and develop a skill set around the use of good fire. But, you know, we are starting from a place of very, very, very few people actually knowing what that looks like on the ground, or how to develop those skills or being able to lead that development. So Fire Forward is just a nonprofit program…[the Fire Forward] team is well trained and educated and pretty experienced with prescribed fire, and fire ecology and fire history. And so we're working to bring that capacity to help that Good Fire Alliance community get what it wants and needs."

Volunteers were motivated to get trained and attend burns for a range of reasons including (1) to feel empowered after recent devastating fire seasons, (2) being interested in ecology, (3) wanting to be a part of a community and "do some good", and (4) as a way to get access to training and experience opportunities for a currently held or future job. Most were motivated by a recognition that more active management of fire-prone wildlands is necessary. Interviewees described how older conservation ethos of letting nature "run its course" were giving way to more thoughtful stewardship and the understanding that "inaction is a management decision", leading landowners to seek out resources for how to better manage their land. This shifting viewpoint, in conjunction with the impact of recent fire events, was driving more landowners to reach out to the GFA and Fire Forward about the possibility of getting a prescribed burn on their property, even those who professed to being concerned about the risks. As one landowner said, "There should be more fear about what happens if I don't do it."

Despite resident energy and interest in improving land stewardship through implementing prescribed fire, many reported that actual use was intimidating. The study region boasted

agricultural ties, mostly through vineyards, wineries, and some ranching operations, but some of these business owners were newer to the region and the business. Because of this, few interviewees outside of the professionals and multi-generational ranchers or farmers had experience using fire as a land management tool, meaning that local knowledge of how to get permits, how to burn, and comfort with implementing prescribed fire on private lands was relatively low. Residents with multi-generational roots in the region were more acutely aware of the land-use changes and subsequent loss of fire literacy in the area. As one rancher put it:

> Sonoma County was pretty rural, meaning there wasn't a lot of vineyard outside of the valley floors, prunes, prunes and grapes were in the valley floor. But that was pretty much it, anything outside of those areas was very few homes. And it was all, it was all pretty much either timberland or, grazing, grazeable land… The second thing happened was we started getting homes moving out to the areas. And it started as these houses started increasing out into the wildland, then the chances of doing any kind of burning or anything else wasn't going to happen.

As a region with a high proportion of private land and high biological diversity, there were numerous small land management-focused nonprofits that worked on particular natural resource issues or steward various reserves in Sonoma and Marin counties. Many of these organizations had staff that were interested in using fire on their lands or to achieve organizational goals, and several were in various stages of formalizing their intent to burn lands they own or manage. These entities were also important for facilitating programming, and mentorship opportunities for the public, such as workshops focused on pile burning, or guided tours of areas that had received prescribed fire within the last several years. Many of these organizations, as well as public agencies, were also training staff to use prescribed fire and supported their employees attending GFA burns to gain experience and network with one another. As one professional land manager described:

31

Laguna Foundation, Pepperwood, Sonoma Ecology Center, of course, ACR, state parks, regional parks. Pretty much most of the organizations in Sonoma County that have some kind of natural resource framework, there's usually at least a couple people from those organizations that try to attend these prescribed burns, Good Fire Alliance burns.

GFA events provided a space for staff from different local land management organizations to interact, and their shared interest in fire management helped give rise to other ongoing management projects in the region, such as the Sonoma Valley Wildlands Collaborative, which brought together six different entities that together manage over 18,000 acres along the Sonoma Valley corridor. Private land managers also described GFA events as a way to connect with their peers and share best practices in a more informal space, outside the purview of their other work responsibilities.

Interviewees described how the multiple recent catastrophic fire seasons catalyzed local residents and organizations to look for ways to reduce wildfire risk and engage in more responsible land management, including prescribed fire use. Study participants reported a sense of urgency around performing wildfire risk mitigation actions in the region, in part because of the frequency and impact of wildfire events in recent years, and that this tension fostered interest in the larger region around reducing individual and collective wildfire risk through risk reduction efforts. There were consistent and vivid descriptions of wildfire experiences, and locals expressed a collective sense of trauma from recent fire seasons. Interviewees described participating in GFA events as a way to confront and heal from their trauma. As one resident stated:

> A lot of people come out [to GFA events] who have basically been devastated by wildfires recently, and want to feel like they have some amount of ability to do something about the situation.

Similarly, wildland fire officials describe recent fire seasons as one reason for the broad

interest and surge in prescribed fire use, and for policy shifts outlining its expansion. As one

fire professional put it:

> There's been some really powerful wildfire seasons, especially in the last three to four years… It's been really, really long and protracted wildfire seasons with exceptional outcomes on that front. And I think what that's done is it's really created this need and opportunity for prescribed fire and active fire management to be embraced.

Most interviewees discussed understandings of the importance of returning fire to the

landscape, displaying fire literacy and awareness of the ecological role fire plays on their

landscapes. These understandings often came from workshops they attended put on by

various land management organizations, or through their own research and interest in

indigenous land stewardship practices or prescribed fire. Participants reported finding

prescribed fire appealing because of their observations of landscapes recently burned by

wildfires recovering and appearing healthy, its perceived applicability at various scales (e.g.,

use it on 1/4 acre or use it on 1000), and their interest in learning new land management

skills that would imitate historical human-fire relationships in their area. Many discussed that

returning fire to the landscape was the right thing to do due to their awareness of indigenous

fire use, and expressed that they wanted to see cultural burning return to the landscape. As

one interviewee mentioned:

> I am not aware of any outright cultural burning happening yet, in our region. I know it's part of the conversation. I know, every meeting that I go to that's talking about this, people throw that term out, like we're really supportive of cultural burning. But I haven't seen a cultural burn that has been led by the tribe where we come and observe or support. I know the Yurok tribe is really active with burning, and they even put on their own TREX, which is awesome. I would love to see that kind of capacity here, with our indigenous community.

Factors Involved in Good Fire Alliance Functioning

Interviewees described the GFA as a communication network without any formal structure. Several called the GFA a "listserv" alluding to how the GFA rarely met as an organization and was primarily an email chain for dispersing information about training events, and volunteer burn opportunities. The informality was seen as a positive – individuals and organizations could tap into the larger GFA network as needed when hoping to conduct a burn or engage in other management activities with the GFA acting as a source for labor, skills, and information. The GFA was valued as an easier and cheaper way to implement pile burning or other management actions on private lands than looking for hired help. The lack of formality also allowed for adaptability – the GFA was seen as something that could be molded to whatever the individual or local community needed at the time. One interviewee described the GFA as simply a "knowledge-sharing network". However, not all community members were pleased with the "listserv" nature of the GFA, hoping that the organization would provide more educational and training opportunities for private citizens to assess whether prescribed fire was something they could implement on their own lands. One landowner described trying to determine whether prescribed fire was a viable option for their land as "obstacle after obstacle after obstacle, not only in terms of figuring out what's available, but also in terms of actually doing the process." This discrepancy potentially highlights that the GFA is serving certain community member needs for getting fire on the ground, but that additional organizations or programs might be needed in the region to provide consultations or informational sessions.

Both hosting and attending GFA activities was voluntary. Individuals volunteered to host the GFA as part of a fire-related activity on their private land (e.g., pile burns, prescribed burns) and most GFA members volunteered their time to participate in that activity, although some who worked for land management organizations could attend events as part of their work responsibilities. Requirements for participating in a GFA burn varied depending on who was organizing it. Fire Forward-led burns typically required volunteers to have basic firefighter training - the equivalent of a Red Card for federal and state firefighting agencies - and personal protective equipment (PPE) such as a helmet, fire shelter, leather gloves, and fireline-approved boots, which was often provided to those who did not have their own. Landowner-led burns followed whatever the landowner was comfortable with; this ranged from burning in jeans and t-shirts to full PPE. Fire Forward wrote burn plans, went through site visits, and their staff often acted as Burn Bosses for the actual burns, while landowners often only obtained an air quality permit and/or CalFire burn permit when needed, without going through the more formal process of writing a burn plan. Volunteers that attended burns were most frequently only involved on the actual day of the burn, and did not assist with preparing the unit or with mopping up, although some landowner-led burns did ask volunteers for help with those tasks. This lack of prep and mop up work was one potential limitation of the volunteer-driven model that the GFA relies on that several interviewees brought up, as these tasks related to prescribed fire can be highly time consuming and labor intensive. Some expressed that more burning could be occurring if there were more people willing to do that work in the way GFA members were interested in doing the actual burning. The GFA brought together a diverse group of people united by a common interest in taking

action to positively impact the fire-problem in Sonoma and Marin Counties. As one PBA member described:

> "We have a really beautifully diverse community of people who are coming out to learn how to put good fire on the ground. It's, you know, everything from ecologists and botanists, and tribal members to computer coders, and baristas and artists, and all sorts of other backgrounds and jobs."

In addition to occupational and educational diversity, GFA members included diverse political backgrounds, age groups, abilities, LGBTQ+ community members, and the range of rural to urban demographics. Several GFA members were extra-local, driving up from San Francisco and Oakland or from other northern California counties. One GFA member who came from out of town said they and their peers "come up on the weekend, and... go to these places [we] probably wouldn't ever go to.. because [we] really want this connection to land." GFA members with multi-generational and/or working lands backgrounds valued the GFA for providing an opportunity to host and interact with people they normally would not get to, particularly those from different political backgrounds or who might not have experience with rural life or issues. The PBA seemed to provide a common ground from which seemingly disparate demographics could work together towards common goals. As one resident pointed out: "The diversity of people you get on the fireline, you know, you get rednecks, you get hippies, you get back-to-the-landers, you get urbanites. And they're all there to do the same thing." The welcoming nature created by the GFA and sense of community was emphasized repeatedly throughout the interviews. Interviewees described GFA training or burn opportunities as being welcoming, inclusive, and largely free of the typical hierarchy or egos that they associated with professional fire agencies. The GFA was viewed as a place where demographics traditionally underrepresented in natural resource and

wildland fire management can gain skills, knowledge, and a sense of community while feeling welcome and safer than opportunities that might arise through agency sponsored programs. GFA events were also described as being a safe place to learn and ask "stupid" questions, and facilitators often emphasized that everyone was there to learn.

Despite the capacity and knowledge-building successes of the GFA, participants described several factors limiting the effectiveness of the GFA. Local residents emphasized liability, cost, and capacity as key obstacles to overcome when thinking about implementing a burn, as well as weather and permitting processes. Recent state legislation - SB332 - aimed to reduce the threat of being held liable for an escaped burn in an effort to support expansion of private burning practices. However, most interviewees were unsure about the extent to which the legislation would ultimately impact private burning efforts, and some expressed skepticism that it would bring about significant positive change. As one interviewee stated: I think they passed a bill to try to make certified burners or burned bosses, indemnify them from the liability of it.. But I don't know, you know, I don't know how well it's gonna hold water if something goes wrong, you know, in this day and age, somebody's got to pay for something.

GFA cost concerns largely focused on the prep work that is needed prior to implementing a prescribed burn, particularly in areas where fuels have accumulated over decades. The GFA was considered a useful cost-reduction tool for conducting a burn, but GFA members looking to host a prescribed fire on their property described how it was challenging to galvanize similar volunteer interest in assisting with thinning, mastication, or mowing projects to prepare a site for that burn. In terms of capacity, many PBA members acknowledged that

there was more interest in volunteering at and attending burns than there are opportunities, indicating that the GFA has the capacity to support prescribed fire use on private lands as a larger pace and scale than is currently being implemented, but that the lack of capacity for prep work and planning are limiting factors. Ultimately, interviewees agreed that there is more interest in participating in prescribed fire or pile burn than there are outlets for it, with a particular bottleneck around full-time positions focused on planning and implementing prescribed fire. Several landowners looking to host a burn reported not having the time to learn about these processes themselves on top of their full-time jobs. As one PBA member with a suppression background who wanted to shift towards prescribed fire-focused work described: "Well, I think the big thing is, is that a lot of us, this isn't our job. And a lot of us want this to be our job. And there's not jobs for us." Local land managers stated that a lot of progress had been made over the past few years when it came to working with fire professionals on prescribed burns. One local fire department interviewee described working with the PBA as a "full partnership at this point." Fire officials reported attending to help facilitate PBA training events, and inviting PBA crews to local burns. On the PBA side of things, GFA members did agree that local fire agencies in the region are beginning to implement more prescribed fire. However, GFA members expressed that some tensions remained between the PBA and some sectors of the larger professional firefighting community. Some interviewees described that professional firefighter support varied widely across the region in part due to different jurisdictions and differing levels of comfort with having non-professionals involved with prescribed fire.

Additionally, some land managers and fire professionals expressed skepticism that a PBA consisting mostly of volunteers with other jobs and conflicting interests will be sustainable long term, especially given state and local goals to increase the scale of prescribed fire use nearly tenfold in the coming years. While they acknowledged other barriers, professionals generally agreed that navigating permitting processes and taking on the risk to conduct a burn on lands they manage were obstacles they were able to overcome. Programs like the recently implemented California Burn Boss position, approved through CalFire, as well as legislation that reduces risk for cultural burning (AB642), were steps towards a more forgiving liability landscape in the state. The larger barriers for land managers and fire professionals were the capacity to implement and monitor burns that may require larger organizational changes that PBAs can support, but not entirely fix on their own. As one local fire professional stated:

> You got the environment and you got the liability. And then the third one is the resources available to conduct the burn. If you need fire trucks to do a burn in the fall, because it's going to smolder for four days, you can't expect volunteers to keep going out there day after day, the property owner may not have the means to do it.

Interviewees repeatedly brought up their complex relationship with CalFire, including interactions between the GFA and the agency and their broader perceptions of CalFire's role in implementing prescribed fire. Many GFA members viewed CalFire largely as a barrier to increasing the pace and scale of prescribed fire, whether due to its permitting processes or perceived general unwillingness to officially support private local burners. Others emphasized that the agency should remain focused on suppression and allow other entities to take the lead when it comes to restoring more beneficial fire regimes. As one local resident said:

I said there needs to be a paradigm shift [around prescribed fire]. CalFire does not represent that paradigm shift in any way, shape, or form. You know, they're super good at putting out fires, they should just stick to that. And they should support fire prevention by being on call to put out fires. That's the way I see it.

Trust in local fire agencies was much higher than in CalFire, which many residents viewed as struggling to adjust to new management goals and unable to meet prescribed fire targets. Locals acknowledged that CalFire is doing more burning than they have in recent decades, but had reservations about whether the tool was being used for the right reasons, critiquing CalFire for being more focused on fuels reduction than ecological benefit. As one resident expressed:

They are one of the agencies where I have concerns about just the acreage on a spreadsheet as opposed to the actual outcomes. You know, they're just trying to meet their acreage targets.

While tensions exist between the GFA and CalFire as an entity, working relationships between PBA members and coordinators and local fire professionals are described as productive and mutually supportive. Early on in the PBA's formation, permits were hard to obtain and agency personnel were reluctant to trust private landowners and organizations with using fire as a land management tool. Several years later, local fire agencies and CalFire staff conducting burns regularly invite GFA members to assist on burns when possible, and state and local agency personnel are welcome at GFA events to gain experience and receive training. One local fire professional described the GFA in the following way:

So it's another resource available to help conduct burning, and then if they're out there coaching private landowners, you know, how to implement a burn or how to get a burn planned and implemented, that's a huge, huge deal. So they [the GFA] can kind of do it as a non-government entity, kind of just talking with the landowner directly versus government talking to the landowner and government coming on someone's property. And, you know, if it really turns into, you know, neighbors helping

neighbors, or neighbor B helps neighbor A, you know, it's kind of building up the co-op, you know, to help each other out… so building kind of a sense of community.

Some fire professionals are beginning to accept private burners as a key part of achieving state or agency-wide goals for land management and fuels treatments. Local agency personnel and residents agreed that CalFire is nowhere near meeting its objectives around implementing prescribed fire, and that in counties like Sonoma with high percentages of private land broken up into small parcels, PBAs and private burners will be necessary to achieve acreage targets. As one fire official stated:

> And really, you know, I feel like, increasingly, as we advance towards meeting our pace and scale objectives for the state, we're going to need to rely on PBAs and private burners in general, to carry some of that burden.

Discussion

This study set out to explore PBA development and functioning in California, focused on the GFA operating in Sonoma and Marin counties. We found that recent devastating wildfire seasons, a baseline of fire literacy and understanding of fire as a necessary ecological disturbance force, an established network of NGOs that could support grassroots organization development, and the welcoming, inclusive, and informal nature of the GFA all contributed to the way the PBA formed and operated. Many of the social characteristics we found present in the GFA community are reflected in Paveglio et al.'s (2018b) model for adaptive capacity. However, Sonoma County as a whole does not fit neatly into any of the archetypes previously identified, rather smaller communities within the region exhibit aspects of rural lifestyle, working lands, and formalized suburban WUI communities, as well as non-local urban residents that aren't part of Paveglio's rural-urban WUI continuum due to their distance from federally recognized or defined WUI definitions (Stewart et al., 2007). For

41

example, we found that some, but not all, working landscape community members were actively involved in the PBA because they valued the opportunity to educate newer or extra local residents that did not have their knowledge or skills on how to steward the landscape, demonstrating synergies between different archetypes sharing the landscape. Members from varying backgrounds were finding a common cause within the GFA, which is acting as a meeting point for individuals and organizations with overlapping values and goals to communicate and collaborate.

Relationships with and perceptions of state-level fire service organizations were such that their lesser involvement with private lands burning was considered an appropriate partitioning, with PBA members lauding the safe and less intimidating spaces generated by a grassroots and NGO-supported organization over one intricately tied in with CalFire. Most PBA members interviewed wanted CalFire to provide support and also focus on prescribed fire implementation on lands the GFA could not service. While barriers remain to scaling up prescribed fire on private lands, including liability concerns and issues of capacity, interviewees were largely complementary regarding the increased pace and scale of burning in the region over the past several years through the PBA. Broadly, our findings tie into other findings that suggest local social conditions and value systems influence wildfire adaptation strategies (Shindler, 2002), and that people's knowledge and acceptance of prescribed fire increased after engaging with educational experiences about prescribed fire (Loomis et al., 2001). PBAs may prove to be a powerful tool in enhancing prescribed fire literacy and understandings due to the opportunities for field trip and experiential learning, which has

been documented to significantly impact understandings of other natural resource phenomena (Ewert, 1996; Keen & Mahanty, 2006).

The development of PBAs in California can partially be attributed to recent devastating fire seasons and the work of key individuals who brought the PBA model to the state from the midwest. Having an established program in place and role model PBAs allowed the GFA to take aspects of other models and apply them to its own local context, and provided early opportunities for PBA coordinators and local land managers to get experience with prescribed fire. For the GFA, favorable perspectives on prescribed fire and more active management of wildlands in our study area may be a partial reflection of increased media coverage and public attention after the past decade of wildfire seasons, including the 2020 fire season where wildfires burned 4.2 million acres (1.7 million hectares) in California (National Interagency Coordination Center, 2020). California has experienced fires that have broken state and national records for size, suppression costs, and lives lost, instigating the public to look for ways to prevent and mitigate these disasters. Our analysis is consistent with findings that wildfire events can open windows of opportunity for catalyzing adaptation at the local-level (McGee et al., 2009; Mockrin et al., 2018). Our results also touch on concepts related to the wildfire mitigation paradox (Steelman, 2008), which suggests that a community has a greater incentive to mitigate fire risk through management actions compared to individual landowners. Through their aggregating of knowledge, equipment, and people power, PBAs may be one way that communities can engage in fire management collectively, rather than relying on individual residents and households to take actions on their own.

Our results suggest that PBAs may be more suited to implementing prescribed fire on private lands on their own compared to partnering with larger, professional organizations that are slowed by bureaucratic systems. Our findings suggest that a PBA could be more nimble and better able to meet smaller landowner's needs. In the California context, and in places that reflect similar parcelization with large amounts of small to medium landowners in the WUI such as Sonoma County, PBAs may be able to work more closely with residents to achieve their management objectives, and use local knowledge and people power to staff burns. PBAs may also be a vehicle for spillover issues, e.g. as local residents begin burning more and taking more proactive fire management steps, they may influence their neighbors and social networks to begin doing the same (Warziniack et al., 2019).

Our findings on PBA establishment and functioning show that they may largely rely on pre-existing local capacity in the non-governmental or land management sectors. Relying to some extent on local professional land managers supports existing literature emphasizing that broad land management and fire mitigation policies may be more appealing to local residents when adapted to local contexts (Jakes et al., 2007b; Stidham et al., 2014). For example, our results indicate that many PBA members come out to burns to support their neighbors and fellow community members, rather than larger notions around meeting acreage targets or management strategies put forth by CalFire or the State. Policies that adapt larger statewide goals and objectives to local needs and capacities may ultimately be more successful. Furthermore, locally-based and -focused organizations such as Fire Forward may be better able to build trust with landowners and local partners to conduct burns, as well as sustain those relationships and prescribed fire regimes once they are begun. Additionally, Fire

44

Forward has been able to develop strong working relationships with local CalFire personnel and county fire agencies, further legitimizing the PBAs efforts and community-based burning in their eyes. These findings align with existing studies that highlight the importance of trust between communities and wildfire management agencies when it comes to implementing management decisions (Davenport et al., 2007; Lachapelle & McCool, 2011; Rasch & McCaffrey, 2019). It also supports McCaffrey's (2015) report that emphasizes the need to emphasize local knowledge and context when it comes to fire management, as many residents described frustrations with fire officials who do not know the landscape but are charged with managing it.

While many PBAs and community-based burn cooperatives across the country tout a "neighbors helping neighbor" model and grassroots approach (Weir et al., 2016), the GFA is largely facilitated by formal land managers and conservation organizations with land management experience. This may be in part due to the high number of such organizations in the region, with at least a half dozen managing thousands of acres across Sonoma and Marin counties. The structural support and coordination of land managers and natural resource professionals within the GFA has likely provided a measure of organizational stability and sustainability. These land managers often hold leadership positions on burns and at training events, and have been able to push their respective organizations to begin incorporating prescribed fire into their own management and strategic plans. Having professionals on burns and at GFA events does seem to enhance the PBA's effectiveness, with individuals often providing ecological knowledge and fire literacy to other volunteer members. As compared to grassroots efforts championed by a "spark plug" or high-energy and devoted community

45

member that the rest of the community or group rallies around, organizational structures with redundancy might be able to weather employee or resident turnover more effectively, providing for long-term continuity and security (Bennett et al., 2018; Edgeley et al., 2020). The fact that many of the organizations are long-established and have commitments to prescribed fire use provides a potential fail-safe that other PBAs might not enjoy. These bridging organizations helped build trust and reduce regulatory barriers coming from permitting agencies when implementing private land burns. These findings support Weir et al.'s (2016) notion that strong leaders can overcome barriers to private burning efforts.

While the GFA is effectively coordinated by Fire Forward, it remains an informal entity that can be flexible and adapted as needed to suit landowners' needs and various management objectives. This explicitly informal identity described by many PBA members allows it to function as a pool of volunteers for Fire Forward-led burns, as well as for agency led burns. Landowners can also reach out directly to the GFA when they need assistance on pile burning or other land management activities, and our data indicates that these landowner-led burns are occurring more frequently across the GFA network than they were when the PBA first originated. The community-forming and relationship-building between neighbors, as well as between residents and land management and fire professionals, are key elements in how the GFA continues to operate. The social capital created and enhanced via the GFA's operations is reflective of Schusler et al.'s (2003) characteristics of successful social learning that support collaborative natural resource management, namely diverse participation, multiple sources of knowledge, and open communication between actors. It is important to note however that the informal nature and listserv model through which the

GFA recruits volunteers for burns and training events may not work everywhere, particularly in places where most residents have less flexible work schedules, or don't use email or phones as a predominant method of communication.

Our results mirror previous research looking at how local social contexts influence land management behaviors and the development of fire adapted communities (FACs) (Carroll & Paveglio, 2016; Paveglio et al., 2019a). Particular elements of local social context that arose during data collection and subsequent analysis included shifted understandings of landscape values, perceptions of whose responsibility it is to engage in land management, relationships between local organizations and agencies, and shifts in local demographics as newer residents move into the area. These elements reflect the growing consensus in social science literature focused on wildfires, local adaptive capacity, and FACs that more attention needs to be paid to local social context and that no broad, one-size-fits-all solution will work across socially heterogeneous landscapes (McCaffrey et al., 2012; Paveglio et al., 2019b; Toman et al., 2013). Without understanding how local actors interact and residents' perceptions of the landscape, attempts to introduce solutions or provide resources to assist community efforts may miss the mark. PBAs in general represent locally-originating capacity-building endeavors that are the result of community dynamics, with the GFA a potential model for regions with similar social contexts.

The frustration with enduring recent wildfire seasons and the widespread understanding that suppression is not enough to ensure safe communities and healthy landscapes was present in almost every interview conducted for this study. GFA members are seeking solutions that go beyond wildfire response and purely risk-reduction management; many

view their involvement with the PBA through the lens of ecological restoration, and the regional composition of GFA membership makes it well suited to meeting the needs of local landowners, particularly those who want to implement burns with a more ecological lens. As professional firefighters and agencies tend to be at or beyond capacity for much of the ever lengthening fire season in California (Calkin et al., 2013), conducting burns that achieve various ecological goals during the summer and fall months may be left to PBAs and other organizations that are not engaged in suppression.

The complex land ownership patterns in Sonoma County, and California as a whole, provide examples for how PBAs may be able to navigate fire management on a smaller, neighborhood- or community-level scale in many places with extensive WUI and land ownership mosaics. These same land ownership patterns also represent a challenge for scaling this kind of grassroots burning up, as PBAs may be limited to those landowners who are willing to take on the risk of having a burn on their property. The GFA is in some ways testing how small of an area can be treated with prescribed fire and pushing into areas considered to be typically not appropriate for prescribed fire use due to residential density. Typically, larger landowners in more remote contexts are more likely to use prescribed fire because they may receive less opposition due to the lack of WUI proximity and an escaped burn is less likely to impact structures and infrastructure. Questions remain about whether areas with significant previous histories of grassroots burning, such as those with RIAs, may be more or less likely to engage with the PBA model to reintroduce fire at scale. RIAs may be a more suitable, informal option for some rural, resource-based or working-lands communities to overcome current obstacles to prescribed burning. Liability, capacity, and

funding remain challenges that landowners and PBAs like the GFA must continually

navigate, and while policy solutions are ongoing in California, much work remains to be

done to ensure private lands burners feel safe and supported to do this work on wider, more

meaningful scales.

Residents in our study largely understand that prescribed fire is a critical tool as they look

to protect their homes and livelihoods, and GFA members represent a portion of residents

with the time and willingness to come out and implement that tool on the landscape. PBAs

are not a "silver bullet" to the challenges of wildfire management in the US West, or

anywhere else, but they are increasingly being applied to new contexts that are testing the

limits of PBA applicability to landscapes outside of the southeastern United States and Great

Plains. The GFA reflects the unique social context in which it is embedded, and like many

PBAs is bringing diverse people together to work towards common goals. Future research on

PBAs in California could explore different models that may exist in different regions of the

state, and how their respective structures and networks support or hinder their functioning.

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Interview Protocols

<u>Agency & Professional Interview Protocol</u>

Personal & Community Context

1. What is your history living and working in this region?
    1.1. How did you come to your current position at _____? (FS, CALFIRE, State Parks, etc.)
    1.2. What are the major natural resource issues?
    1.3. Tell me a bit about what characterizes the kind of people living in this area
2. How does your agency fit into the bigger picture of wildfire management in the area?
    2.1. Tell me about your relationships with other groups or individuals involved in wildfire management regionally
        2.1.1. Who do you work with? Who don't you work with?
        2.1.2. Why? Why are those relationships the way they are?
        2.1.3. What is the history between your agency and other entities?
        2.1.4. Your personal history?

PBAs

1. What are your biggest concerns related to wildfire management?
    1.1. How would you rank those concerns?
2. How have (local/regional) wildfire management policies or practices changed in the last five years?
    2.1. How does that influence your job? Relationships with other groups?
3. What is your personal view towards private land management, including Rx burning?
    3.1. Do perspectives of prescribed fire change across your agency?
        3.1.1. Different places in CA? Different individuals in your region?
4. What do you think about the PBA in this area?
    4.1. Walk me through the creation of the PBA.
        4.1.1. What are the steps to forming a PBA?
        4.1.2. What were barriers that needed to be overcome?
        4.1.3. Who was involved?
    4.2. Tell me about your interactions with the PBA
        4.2.1. Burns? Training? Public outreach and education? Smoke communication?
    4.3. Tell me how the PBA functions?
        4.3.1. Organizational structure

  4.3.2. Membership and recruitment

  4.3.3. Requirements and training

  4.3.4. Liability

  4.3.5. Is the PBA you work with effective?

    4.3.5.1. What goals/objectives does it help with? What are some success stories?

    4.3.5.2. Where is it not effective?

  4.3.6. Have the players changed? Who is involved in it now?

 4.4. Have you changed any policies or practices since the PBA formed?

  4.4.1. Agency attitude change? Policy changes?

  4.4.2. Changes in your day-to-day?

5. Have you ever worked or collaborated with the PBA on a Rx burn or other event?

 5.1. What did that look like?

6. What did working with private landowners on prescribed burns or other wildfire management projects prior to the PBA's formation look like?

 6.1. How often did you work with landowners?

 6.2. Did landowners reach out to you or come to events you hosted?

  6.2.1. If not, how did you engage with one another?

7. What do you think about the proliferation and expansion of PBAs across the state more broadly?

 7.1. Describe their effectiveness, in terms of:

  7.1.1. Raising public awareness about wildfire risk, fire management, and Rx fire

  7.1.2. Getting burns on the ground

  7.1.3. Collaborating with your agency

  7.1.4. Collaborating with other agencies

8. How does collaborating with PBAs and private groups influence large scale land management?

 8.1. Has working with the PBA helped you meet your own goals?

  8.1.1. To what extent? How so?

 8.2. What policies or practices could enhance the effectiveness of the collaborations going forward?

9. What do you think the future of fire management looks like in:

 9.1. Your area?

 9.2. California?

  9.2.1. More PBAs? Public-private collaborations?

  9.2.2. Who will lead the way?

Wrap-Up

10.   Is there anything we didn't talk about that you want me to know?
11.   Who else should I make sure I talk to about PBAs and wildfire management in this
        area?

<div align="center">**PBA Member Interview Protocol**</div>

Personal & Community History

1.   Tell me about your own history in the area
        1.1.   How long have you been here?
        1.2.   Tell me a bit about your property or the land you manage
                1.2.1.   Fuel types, topography, invasives, fire risk
                1.2.2.   Pressing natural resource issues on your parcel/managed acres
        1.3.   What drew you to this area?
                1.3.1.   Describe the larger landscape
2.   How would you describe the community in this area?
        2.1.   Do you know or work with your neighbors? Under what circumstances?
                2.1.1.   Give me some examples of situations where you and your neighbors
                          have come together to address issues in your area.
                2.1.2.   How knowledgeable are people in this area about wildfire risk and
                          management?
                2.1.3.   Are there different types of people occupying this landscape?
                          2.1.3.1.   What's their relationship with the landscape?
                          2.1.3.2.   What drives them?
                          2.1.3.3.   What industries are they in?
                          2.1.3.4.   How do they interact with your community?
        2.2.   Knowledge around wildfire or land management?

Wildfire & PBAs

1.   What is your personal experience with wildfire in this area?
        1.1.   In other areas?
2.   How did your interest in prescribed fire begin?
        2.1.   What led to that interest? How long has it been?
3.   Describe your history and involvement with your PBA.
        3.1.   How long have you been a member / participated in burns?
        3.2.   How did you find out about your local PBA?
        3.3.   What motivated you to become involved?
4.   How is your PBA organized?
        4.1.   Leadership, liaisons, training, communication, funding/dues/fees

    4.1.1. How are you notified about a burn or event?

   4.2. Are you notified about wildfires or conditions that may increase the likelihood if wildfires in your area?

   4.3. What sorts of events does it host or support?

    4.3.1. What do you think of these events?

5. What, in your mind, is the most important purpose of the PBA?

6. Tell me about your own experiences with Rx burning?

   6.1. Do you burn your land, or are you mostly helping other people burn theirs?

   6.2. How does it make you feel? What would you like to do in terms of burning, in both short term and long term?

   6.3. What do you think it would take for more burning to occur in this area? How could it get scaled up? Should it get scaled up?

7. How would you describe the PBA in terms of:

   7.1. Getting burns on the ground

   7.2. Reducing local/regional wildfire risk

   7.3. Creating community cohesion

   7.4. Have you taken anything away as a result of your interactions with the PBA?

8. What do you want from the PBA in the future?

   8.1. What do you think they are doing well? What might be improved?

Agency Collaboration

1. What do you think about organizations such as CAL FIRE, Forest Service, etc?

   1.1. How do they approach fire management?

2. Have you ever collaborated with other groups on Rx burns besides the PBA?

   2.1. CAL FIRE?

   2.2. Other nonprofits, land trusts, or public agencies?

   2.3. What did that process look like?

   2.4. If not, do you think collaborating with groups like CAL FIRE or the Forest Service would be beneficial? Why or why not?

3. What do you think the future of fire management looks like in:

   3.1. Your area?

   3.2. California?

    3.2.1. More PBAs? Public-private collaborations?

    3.2.2. Who will lead the way?

Wrap-Up

1. Are there other people who you think I should talk to for this study?

1.1. Are there others who agree or disagree with you?
2. Do you have anything else that I didn't touch on that you think it's important to mention?

Appendix B

Codebook

Second cycle codes aggregated first cycle codes into loose categories focused on similar, larger topics to support theme development.	Initial codes were focused on labeling data with basic topics, ideas, and emergent concepts. First cycle codes tended to be somewhat broad, with many needing to be further parsed apart for more nuanced analysis to take place.	Third cycle codes focused on parsing apart first cycle codes with more nuanced descriptions and specific language from the data corpus. This allowed for more rigorous analysis and also assisted in harvesting representative quotes to support emergent themes.

Second Cycle Codes - Categorizing	First Cycle Codes - Topical	Third Cycle Codes - Descriptive & In-Vivo
Needs & Goals	Need for Rx fire jobs	Rx fire skills are not built into existing land management jobs
		NGO budgets don't currently include money for Rx fire work at scale
		Land managers acknowledge that fire is needed to help them accomplish their goals
		Limited Rx fire-only jobs exist in the region
	Need for whole community engagement	"all it takes is one weak link in a neighborhood"
	Need for relationship building	"we have a long way to go"
		Acknowledgement by CalFire that they can do better outreach to landowners
	Need for active management	"you have to maintain the area around you"
		"we got to get back into doing something with this vegetation."
		Used to do more active vegetation management
		"There should be more fear about what happens if I don't do it."

		"I also think that there's.. an importance to get this work done before the next big fire season comes"
		Can't just own land and not manage it
PBA Actors		
	Suppression background	Some GFA members come with previous wildfire suppression experience
	Burn participants	Local CEOs, elected officials have gone through FFT2 trainings.
		"Very broad swathe of people"
		"Broad mix of people"
		Professional land managers involved in burns
		"I'm super impressed by the diversity of folks"
		People affected by wildfires
		Different kinds of people w/ similar motivations
		Non-landowner want to be involved
		Non-locals driving in to help
		"A lot of young people"
		"Common empowerment & ideology"
	Key players	NoSoCo Fire leading burns
		Fire Forward leading burns
		Private burn bosses leading burns (J.C., P.D.)
		Fire Forward, CalFire, and NoSoCo Fire lead most of the burns
		Land-managing NGOs are getting more involved
		Marshall Turbeville getting things done
		FireSafe Sonoma helping raise awareness
		Lenya and Jeff (Humboldt PBA)

	Tribal involvement	
	Higher education	People with advanced degrees out on GFA burns
		Burn participants have academic interest in Rx fire
		Fire Forward is led by PhD-holder
Rx Fire Perceptions & Experiences	**Don't want a job about Rx fire**	
	Shifts in land management perceptions	Realizing active management is needed
		Didn't used to think about wildfire
		NGOs beginning to incorporate fire into operations and planning
		Looking for new ways to manage land
		More local residents open to learning about Rx fire
		Rx burn observers are common
		Younger fire professionals less sure about Rx fire
		Renewed focus on wildfire risk reduction
	Differing objectives with Rx fire	Fuels reduction as a management goal
		Ecological restoration as a management goal
		Fire Forward/GFA burning from an ecological perspective
		NoSoCo Fire & CalFire burn for fuel reduction
		Mushroom foraging
	Fire as a beneficial ecological process	

	Types of burns	Grassland burns
		Oak woodland burns
		Chaparral burns
		Redwood understory burns
		Mixed timber understory burns
		Mostly small burns, only a few >100 acres
		Different actors leading burns
		WUI burns
	Rx fire perceptions	Organizations support it conceptually, not always operationally
		Acknowledgement that it works, afraid to use
		"a big part of the solution to the fire crisis"
		Working to educate neighbors & broader community
		"so much more natural and beautiful and regenerative."
		"a big fan"
		Potentially useful but challenging to navigate
		"get back control"
		"Exciting to think about"
		"Fire can be good"
		"let's light it up"
		"the conservation community is very interested in burning"
		"it's fun and important"
		"it feels like we're breaking ground"

		"feels exciting"
		Some escapes will be inevitable
		Unsure of what it looks like at scale
	Raising awareness of Rx fire	
	Other management (methods)	Mastication
		Thinning
		Manual brush removal
		Other management methods not as effective at scale
	Rx fire goals	"reduced catastrophic wildfires"
	Resistance to fire	
	Rx fire as best management method	
	Rx fire as a way to get back control post-wildfire	
	Fire as lower class (associated with homelessness)	
	Rx fire as healing	"Really beautiful"
		Fire can be under control
		Rx fire connecting people with nature
	Rx fire experiences	"everyone else is a student"
		Always learning on the fireline
		"imposter syndrome"
		"can't wait to do it again"
		"super exhilarating"
		"feels exciting"
		"used to do a lot"
		"a little bit cowboy"
	Comfort with (using/seeing) fire --->	""

		WUI burning: "logistically complicated and technically difficult"
		Ecologically focused
		Lots of small-scale burns
		"suit up, get ready, go."
		Seeing lots of the same people show up
	Common goals	
	Burning in the WUI	
	Rx fire logistics	Some NGO staff get paid to attend burns
		Lack of knowledge around planning and organizing burns
		Planning a Rx burn takes time, money, knowledge
		Easier to conduct burns in rural areas
		No one entity tasked with overseeing all regional Rx fire efforts
		Preparing a burn unit can be complicated and expensive for landowners
		Rx fire equipment & PPE is expensive
		Longterm planning of burn units focusing on creating landscape-level wildfire protection
	Fire Forward - Goals	FF training events
		FF planning and implementing burns
		FF supporting other local organizations and agencies
	Rx fire accessibility	
	Site selection	Landowners reach out about wanting burns
		Fire Forward looks for vegetation types they want to burn in more

	Wanting to get involved	
	Land management futures	Rx fire jobs in every land managing org
		Goals of multi-thousand acre burns
		Tribal-led burning
		Goals of burning for cultural and ecological health, not just fuels reduction
		Localized capacity to burn in each community
Wildfire Experiences & Changes	Post-wildfire rebuilding	
	Wildfires affecting the community	
	Wildfire challenges	Fear of wildfire causing resistance to Rx fire
		Still rebuilding homes as new fire season occurs
		Insurance cancellation
	(other) Disasters affecting the area	Floods also affect the Sonoma region
	Learning from recent fire seasons	
	Wildfire trauma	Trauma from seeing/smelling smoke
		PTSD diagnoses from wildfire experiences
		"really traumatized by the fires"
		"people are really scared"
	Wanting to help post-fire	
	"Everybody has been impacted by fires"	
	Community identity shaped by wildfire experiences	
	Wildfire-caused exodus	Insurance cancellation
		too expensive to rebuild
		Don't want to hacve to rebuild again

		Pre-emptively moving to avoid losing bome
	Wildfire awareness	**New landowners becoming aware of wildfire risk**
	Wildfire as catalyst	**Feeling the need to help after the '17 fires (Tubbs)**
		"want to make a difference"
		"everybody has admittedly been impacted"
		"strong sense of urgency"
		"a sense of community identity"
		"had to sort of make very large adjustments"
		Using Rx fire to feel in control
		Catastrophe leading to change
		"shifted our mentality"
		Starting to think about fire more after experiencing wildfire
	Might not rebuild	
	Wildfire planning / preparation	
	"Tired of the fires"	
	Post-wildfire changes	**"more prepared"**
		"what else can I do to protect this land"
		More interested in land management than before
	Stay and defend	
	"There's a sense of panic, right, like every wildfire season now"	
	Home hardening	
Barriers & Limitations	**Weather**	**Too wet to burn**
		Too hot/dry to burn
	Mismanagement	

	Liability concerns	Landowners/the public are afraid of escapes
	PBA limitations	Volunteer-based - member's jobs/families can conflict with burns
		Lack of paid positions to do this work
		Lack of awareness that PBA exists / what it can do
		Lack of formalization can make the PBA challenging to get help from
		"No leadership just scattershot"
		PBAs help with burns but often not the prep that is needed beforehand
		Not able to meet landscape-wide management goals
		Not enough burns compared to interest
		Lack of support from CalFire/local fire agencies
		Mostly able to accomplish small burns only
	Lack of information	
	Barrier - physicality (of Rx fire work)	
	Permitting barriers	Smoke permits
		CalFire burn permis
	Money as limitation	Prepping a burn unit can be expensive
		Hiring an RPF/contractors can be expensive
		Not a lot of rx fire-focused jobs
	Management misconceptions	
	Rx fire / wildfire tensions	Rx fires getting reported as wildfires by the public
	CalFire's capacity for Rx fire	CalFire burns less than it used to
		Older personnel remember Rx fire knowledge, younger personnel never learned it

		Few personnel focused on Rx fire
	Knowledge as limitation	Landowners don't know Rx burn techniques, logistics, planning
		PBA members can perform basic Rx burns, but lack skills for more complex burns
	Limitation - existing structures	CEQA processes aren't set up for Rx burning
		Lack of Rx fire professional industry
		Firefighters focus on a lot more than just vegetation management
		CA liability law
		Lack of central cohesive land management plan/organization for the region
		Various barriers/limitations compounding atop one another
	Land management conflicts	Protecting biodiversity vs. fuels reduction
		Native plant landscaping vs. home hardening
	Limitation - capacity	
	Planning not doing	Lots of similar collaborative efforts in the region meet, but a common perception is they don't accomplish much more than communication
	Old ways of doing restoration	
	Muir management	Management by doing nothing
	Differing environmentalist demographics	
	Tension between development and land management	
	Rx fire policy	SB 332
		New liability legislation
		CARX qualification program
	Climate change	

	Equity	
Sonoma Community	**Growing up burning**	
	WUI Expansion	
	Rx fire geographic differences	**Lots of burning in north and west county**
	Sonoma Community Characteristics	**Nearly everyone has been affected by wildfire**
		High amount of private land
		Mostly small landowners (<25 acres)
		Expanding WUI
		Rural lifestyle landowners becoming more common
		Remaining working rangelands tend to be large (>1000 acres)
	Landowner interest	**More interest than Fire Foreward has capacity**
	Vineyard criticism	
	Absentee Landownership	
	Grew up local	
	Importance of local knowledge	
	Spatial aspects	**Burns tend to be <25 acres**
		Burns occuring in north/west county (Healdsburg, Cloverdale, Skaggs Spring Road)
	New landowner	
	Social fragmentation	**Many organizations/collaborative efforts exist that overlap but don't communicate with one another**
	Working landers' knowledge	**Awareness of historic firebreaks**
		Heavy equipment experience
		Knowledge of fire behavior
	Community Needs	**Mismatch between what the local community wants and what CalFire needs**

	Parcelization	Lots of small landowners in Sonoma Co.
	Early burning	Used to burn more
	Importance of working landers	
	Land use	Vineyards
		Working rangeland
		Private forestland
		Working timberland
		WUI
	"You're only as safe as your neighbor is"	
	Working lands	
	Community history	Multigenerational ranching families
		landowners burning was more common in the past
		Grasslands used to be bigger
		Used to be more working lands
	Wealthy alternatives	
	Sonoma land ownership characteristics	~90% private land in Sonoma Co.
		Less than 1% federal land
	Relationships to land - family	
	Relationships to land - recreation	
	Relationships to land - ecology and scientific	
	Relationships with land	
	Identity	
	Work history & motivations	Grew up local
		Experienced wildfire
		Grew up recreating outside
		Moved to Sonoma for college

		Interested in natural resource management
Agency Perceptions & Operations	**CalFire criticism**	**Slow to implement more Rx burning**
		Not nearly enough capacity
		Lack of ecoogical knowledge around fire
		"could be better"
		"reduced capacity"
		Colonizing fire
		"a fucking boys club"
		Don't acknowledge bigger picture
		"still suppression oriented"
		Gatekeeping Rx fire
		Slow to change
		"not as capable as they once were"
		Not aware of local knowledge
		Unhelpful for individual small landowners
		Acreage-focused
		Piecemeal support of local Rx fire efforts
		Slowing down CARX approval
	Agency-tribe collaboration	
	FRAP operations	
	CalFire operations	**Supports some GFA burns**
		Plans and leads burns
		Mostly focused on wildfire suppression
	CalFire structure & development	
	Different agency approaches to Rx fire	
	Changes in fire culture	
	Anti-suppression	

		Fire professionals can be skeptical of GFA members and operations
	Agency-GFA tensions	
		Different communication styles on the fireline
	Firefighter job limitations	
	Local fire capacity	NoSoCo Fire is the only agency doing Rx burning
		Most local fire departments don't burn
PBA Structure	PBA differences	
	Informal structures	Some burns are word of mouth only
		Some burns only need cotton clothing/gloves
		Kids and observers attending GFA burns
		Non-FFT2 qualified individuals can participate on some burns
		Friends wokring to prep burn units together
	FF fellowship	
	Conflating ACR & Fire Forward with the GFA	
	PBA recommended	Individuals hear about the PBA from friends
	Privileged to be abe to volunteer with the GFA	
	Cross-organization collaboration	
	PBA volunteerism	Most GFA members are purely volunteers
	PBA structure	The GFA is not Fire Forward
		The GFA is a listserv network
		Lots of NGO and agency personnel involved in operations and steering committee
	"There's just a lot of passionate, young people"	
	FF-GFA relationships	
	Fire Forward - Structure	FF is small but looking to expand

	Rx fire volunteering	
	NGO presence	Sonoma Land Trust
		Sonoma Ag. & Open Space
		Sonoma Regional Parks
		Pepperwood Preserve
		Audobon Canyon Ranch
	Academic involvement	UC ANR staff on steering committee
		Some burns have research objectives
	Other PBA-esque models	
	Local networks	Neighbors learning from one another
		Local community newspapers and information sharing
	Land manager (involvement)	Many professional land managers attend burns
PBA Operations	GFA operations	"getting work done"
		Pile burning workshops
		Rx burns in Sonoma Co., Lake Co, Marin Co.
	Training opportunities	S130 field days
		NWCG courses
		Training burns
	Fire Forward operations	
	Agency-led	CalFire-led burns
		NoSoCo Fire-led burns
	Government involvement	
	PBA & agency collaboration	NoSoCo Fire leads burns, invites GFA
	NGO roles	NGOs still figuring out how to be involved
		ACR leading the way
	Still figuring things out	
	Cross-boundary	

	Community-based programs	
	Pace & scale	**Not enough Rx burning happening**
		Rx burning has increased in recent years
		Not meeting acreage targets
		Most burns are <30 acres.
	PBA social dynamics	**"Culture of learning and growth"**
		NGO staff Volunteering on burns to build relationships with local fire professionals
		Wanting to help the community
		"a fun community"
		"my best friends in the community"
		"everybody is.. intererested in learning"
		"be a part of the solution"
		"an intimidating space"
		Safe to ask questions
	Lack of returning	
	Safety	
	Covid impacts	
PBA outcomes	**PBA outcomes**	**Wanting to learn more**
		Fireline qualifiied individuals
		Landowners coming away more comfortable with fire
		NGO/agency staff qualified to help on burns
		"getting work done"
		Rx fire-focused jobs
	Building resilience	**Fire Forward Fellowship - developing qualifications, building local capacity across different organizations**
		Interest in more FF-like orgs in the area
		CARX program
	Community through fire	**GFA burns emphasize community**

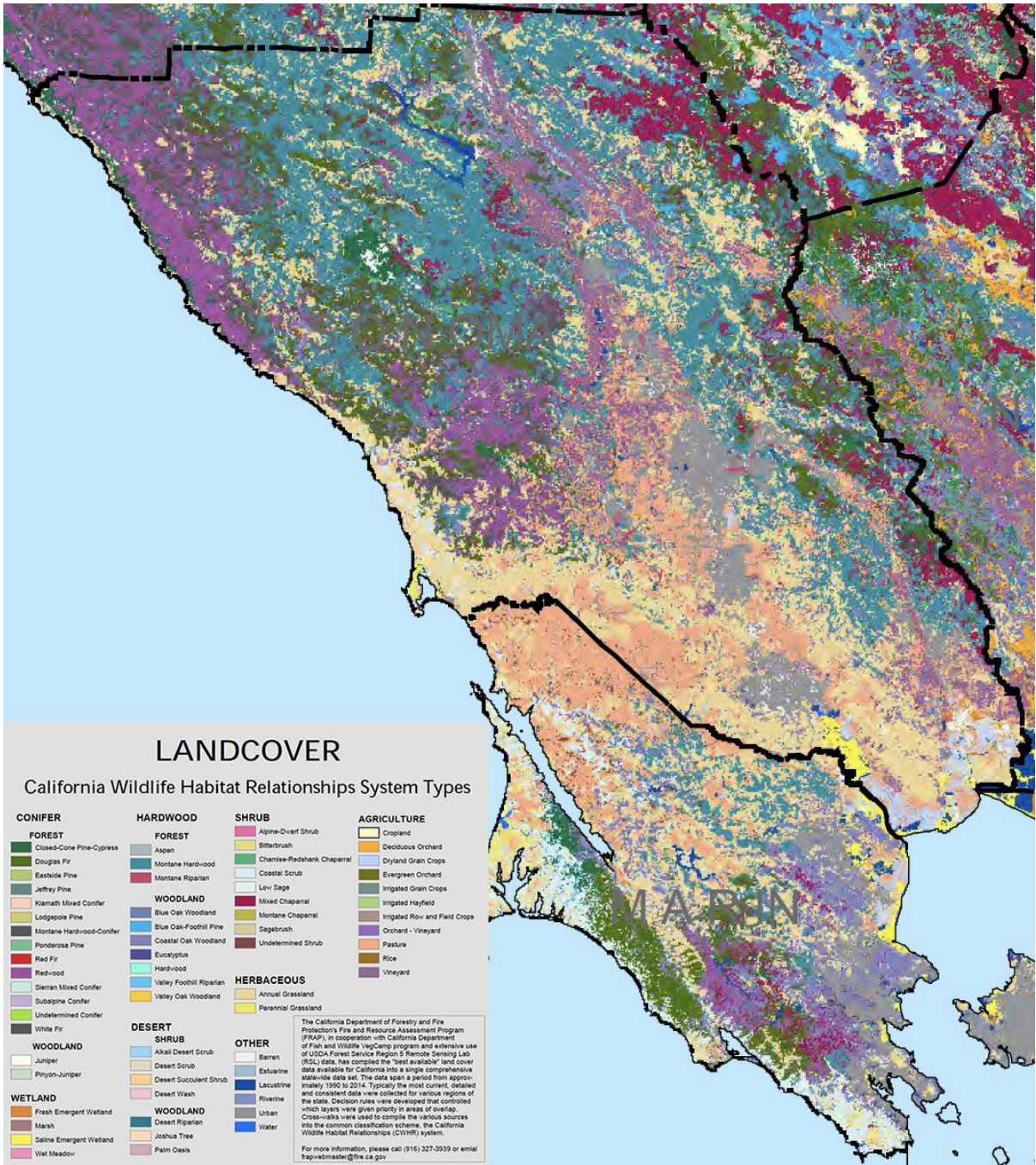| | Ground-up led | |
	Neighbor helping neighbor	
	Rx to wildfire pipeline	
	Landowner led	Burns organized and coordinated by local residents rather than Fire Forward or fire professionals
	Learners becoming leaders	GFA members who learned Rx fire techniques are now helping teach new members
	PBA as pipeline to fire	
	Capacity buildng	Fire Forward is a capacity building organization
		Fire Forward / GFA training opportunities
		Training burns
		"Atmosphere of learning"
		Collaborations between GFA, Fire Forward, and NoSoCo Fire
		Fire Forward Fellowship
	Rx fire jobs	
	Common empowerment & ideology	
	Trust (building between agencies and PBA members)	CalFire did not trust Fire Forward or the GFA early on
		Local fire agencies trust GFA burners
		"More of a full partnership than it used to be"
	Education	Small Rx burns as training/educational opportunities
		Landowners need more education on management options
		"Everyone is still learning"

Maps

California Vegetation Types. Source: CalFire's Fire & Resource Assessment Program (2019).

California Land Ownership. Source: CalFire's Fire & Resource Assessment Program (2019).

LANDCOVER

California Wildlife Habitat Relationships System Types

CONIFER

FOREST
- Closed-Cone Pine-Cypress
- Douglas Fir
- Eastside Pine
- Jeffrey Pine
- Klamath Mixed Conifer
- Lodgepole Pine
- Montane Hardwood-Conifer
- Ponderosa Pine
- Red Fir
- Redwood
- Sierran Mixed Conifer
- Subalpine Conifer
- Undetermined Conifer
- White Fir

WOODLAND
- Juniper
- Pinyon-Juniper

WETLAND
- Fresh Emergent Wetland
- Marsh
- Saline Emergent Wetland
- Wet Meadow

HARDWOOD

FOREST
- Aspen
- Montane Hardwood
- Montane Riparian

WOODLAND
- Blue Oak Woodland
- Blue Oak-Foothill Pine
- Coastal Oak Woodland
- Eucalyptus
- Hardwood
- Valley Foothill Riparian
- Valley Oak Woodland

DESERT

SHRUB
- Alkali Desert Scrub
- Desert Scrub
- Desert Succulent Shrub
- Desert Wash

WOODLAND
- Desert Riparian
- Joshua Tree
- Palm Oasis

SHRUB
- Alpine-Dwarf Shrub
- Bitterbrush
- Chamise-Redshank Chaparral
- Coastal Scrub
- Low Sage
- Mixed Chaparral
- Montane Chaparral
- Sagebrush
- Undetermined Shrub

HERBACEOUS
- Annual Grassland
- Perennial Grassland

OTHER
- Barren
- Estuarine
- Lacustrine
- Riverine
- Urban
- Water

AGRICULTURE
- Cropland
- Deciduous Orchard
- Dryland Grain Crops
- Evergreen Orchard
- Irrigated Grain Crops
- Irrigated Hayfield
- Irrigated Row and Field Crops
- Orchard - Vineyard
- Pasture
- Rice
- Vineyard

The California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP), in cooperation with California Department of Fish and Wildlife VegCamp program and extensive use of USDA Forest Service Region 5 Remote Sensing Lab (RSL) data, has compiled the "best available" land cover data available for California into a single comprehensive statewide data set. The data span a period from approximately 1990 to 2014. Typically the most current, detailed and consistent data were collected for various regions of the state. Decision rules were developed that controlled which layers were given priority in areas of overlap. Cross-walks were used to compile the various sources into the common classification scheme, the California Wildlife Habitat Relationships (CWHR) system.

For more information, please call (916) 327-3939 or email frapwebmaster@fire.ca.gov

Sonoma & Marin County Vegetation Map. Replicated from: CalFire's Fire & Resource Assessment Program (2019).