Fire and Sustainability: Considerations for California's Altered Future Climate

Authors
Moritz, Max
Stephens, Scott L.

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FIRE AND SUSTAINABILITY: CONSIDERATIONS FOR CALIFORNIA'S ALTERED FUTURE CLIMATE

A Report From:
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Prepared By:
Max A. Moritz and Scott L. Stephens
University of California, Berkeley

WHITE PAPER

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Preface

The Public Interest Energy Research (PIER) Program supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The PIER Program, managed by the California Energy Commission (Energy Commission), annually awards up to $62 million to conduct the most promising public interest energy research by partnering with Research, Development, and Demonstration (RD&D) organizations, including individuals, businesses, utilities, and public or private research institutions.

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The California Climate Change Center (CCCC) is sponsored by the PIER program and coordinated by its Energy-Related Environmental Research area. The Center is managed by the California Energy Commission, Scripps Institution of Oceanography at the University of California at San Diego, and the University of California at Berkeley. The Scripps Institution of Oceanography conducts and administers research on climate change detection, analysis, and modeling; and the University of California at Berkeley conducts and administers research on economic analyses and policy issues. The Center also supports the Global Climate Change Grant Program, which offers competitive solicitations for climate research.

The California Climate Change Center Report Series details ongoing Center-sponsored research. As interim project results, these reports receive minimal editing, and the information contained in these reports may change; authors should be contacted for the most recent project results. By providing ready access to this timely research, the Center seeks to inform the public and expand dissemination of climate change information; thereby leveraging collaborative efforts and increasing the benefits of this research to California's citizens, environment, and economy.

For more information on the PIER Program, please visit the Energy Commission's website www.energy.ca.gov/pier/ or contact the Energy Commission at (916) 654-5164.

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Abstract

In addition to reducing greenhouse gas emissions, policies to achieve a sustainable coexistence with wildfire should be enacted now. This paper recommends a variety of actions that should be taken regardless of the many uncertainties in predicting future fire regimes. Adoption of a risk-based framework for fire management, reintroduction of fire to fire-prone ecosystems and careful use of fire surrogates, creation of new and flexible policies, and a serious reevaluation of urban planning and building in fire-prone locations are needed to reach a sustainable coexistence with fire in the future. Our future cities and communities must be less susceptible to wildfire damage, and the ecosystems upon which we depend must be made more resilient to further disruptions in fire regimes.

1.0 Introduction

Fire is an important natural disturbance in terrestrial ecosystems across the planet, and especially so in fire-prone portions of California (Figure 1). There are, however, relatively few studies about interactions between wildfire and projected climate change in California (Malanson and Westman 1991; Davis and Michaelson 1995; Miller and Urban 1999; Lenihan et al. 2003; Fried et al. 2004). Little is therefore known about how future fire regimes will ultimately behave. The timing and patterns of fires will be driven by several factors, including spatio-temporal probabilities of ignitions, precipitation amount and timing, and drought cycles (Stephens et al. 2003). For example, longer fire seasons, greater climatic variability, and more lightning strikes have been predicted by some (Price and Rind 1994; McKenzie et al. 2004), but these projections may only be valid at very coarse spatial scales. We also face large uncertainties about shifts in the frequency and intensity of extreme fire weather episodes, which could have major consequences for fire regimes under climatic change scenarios (Davis and Michaelson 1995; Field et al. 1999; McKenzie et al. 2004; Moritz et al. 2004).

Because our knowledge is imperfect, we focus here on recommendations that meet a variety of future needs related to wildfire in California. Given projected population growth in California (possibly doubling in the next few decades) and how future climates may change, policies to achieve a sustainable coexistence with wildfire must be enacted now. In addition to reducing greenhouse gas emissions, our future cities and communities must be less susceptible to wildfire damage, and the ecosystems upon which we depend must be made more resilient to further disruptions in fire regimes.

2.0 A Risk-Based Framework for Fire Planning and Management

We will always be faced with questions about the level of resources to commit to fire-related activities, whether for hazard mitigation or to reintroduce a needed natural disturbance in California eco-systems. Such questions are only going to multiply under an altered future climate. What we lack is a specific level of accept-able risk to plan for and a framework for evaluating fire-related decisions. For example, there are policies and planning guidelines to accommodate other natural hazards that affect the landscapes we inhabit. Planning requirements may exist for areas within a 100-year floodplain, and we have engineering solutions for infra-structure to withstand earthquakes of different magnitudes. If a fire approaches

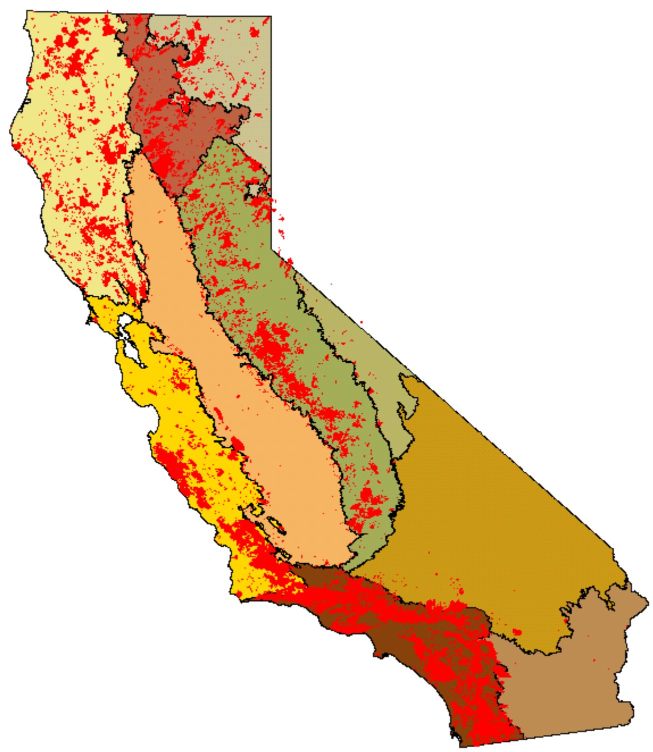

Figure 1. Mapped fire history of California. Fire perimeters for the last several decades (since 1950 in some areas, but back to ~1910 in others) are shown in red, over the ecoregions of California (Hickman 1993). (Fire data maintained by California Department of Forestry and Fire Protection.)

a specific location, what flame lengths are acceptable and how much prior vegetation clearance is needed to achieve that level? Do we want to prepare for the 90th, 95th, or 99th percentile worst fire weather day? How do we view events greater than that magnitude? What probability of undesirable outcomes—escaped fires, unnatural fire severities, and losses of lives or structures—do we allow? To answer these questions, we need the scientific basis for evaluating different alternatives; however, it is ultimately a social and political process to identify the level of risk and losses we can tolerate.

Because scarce resources are typically allocated among several competing needs, our decision framework must incorporate the costs and benefits related to fire. Such an approach needs to include the ecological benefits of a naturally functioning fire regime or the possibility of fire surrogates, as well as the future economic value of spending resources on some fire-related activity now. We need the ability to evaluate the costs and benefits of spending funds tomorrow on retrofitting homes in a fire-prone location (e.g., a one-time expenditure likely to reduce home ignition by X%), versus fuel reduction efforts there (e.g., treatments that require ongoing maintenance, reducing flame lengths or fire spread rates by Y%), while also factoring in adverse ecological and economic effects of activities that cause erosion or the spread of invasive species. Decision frameworks that incorporate some of the important variables mentioned here have been proposed (e.g., Miller et al. 2000; Finney 2005), but California lacks one that is comprehensive and flexible enough for complex fire-related decisions.

3.0 Creating Resilient Ecosystems

Despite the complexity inherent in local fire regimes, regional fire activity can oscillate in phase with year-to-year climatic variability (Clark 1988; Swetnam 1993). For example, the area burned annually across the southern United States tends to decrease in El Niño years and increase during La Niña years (Swetnam and Betancourt 1990). In some parts of California, however, the relationship between fire and climate oscillators appears to be more variable (Keeley 2005). As climate changes, it is likely that relationships between fire and climate oscillators may also change, accentuating the physical stresses that ecosystems will already be facing. The possibility of such scenarios requires the creation of resilient ecosystems that are capable of incorporating disturbances (insects, disease, drought, fire) without mortality outside a desired range. Natural variations, or reference conditions derived from historical ecological data, can be used to assist in the definition of desired future conditions (Swetnam et al. 1999; Stephens and Fulé 2005), but we must be clear that managing for ecosystem conditions that occurred 150–200 years ago is probably not appropriate for the next century.

Increased application of the existing federal Wildland Fire Use (WFU) policy in remote areas of California would allow fire to be reintroduced into a variety of ecosystems (Stephens and Ruth 2005). Admittedly, there is risk inherent in such a policy. Nonetheless, fires ignited by lightning and allowed to burn through WFU in these remote areas can produce positive effects, provided they are carefully managed and monitored. Without extensive use of WFU, fuels management techniques in many ecosystems will be needed at appropriate spatial scales and arrangements (Finney 2001), or many of California's ecosystems will remain susceptible to future climate changes and uncharacteristic fire. Broader implementation of the WFU policy would offer an unprecedented opportunity to gather valuable ecological and organizational information about outcomes across an array of regions and landscapes. Creation of fire-resilient landscapes is critical because we have learned that the question is not if California's diverse ecosystems will burn, but when, where, and with what intensity.

Because of scientific uncertainties and the difficulty of precisely predicting future fire regimes, adaptive management programs must be incorporated into future management decisions to allow for continued learning and evaluation (Shindler and Cheek 1999; Stephens and Ruth 2005). This will allow managers, scientists, and the public to determine if management actions are actually producing resilient ecosystems, and if they are not, new ideas can be attempted to meet this objective. It is critical that information gained from adaptive management programs actually be used to refine management procedures; adaptive management activities cannot simply be academic exercises, nor should they be allowed to continue based on faulty assumptions.

4.0 Creation of New Fire Policies

Sustainable fire policies must respond to complex social, political, and economic forces. Currently, there are diverse opinions among executive branch officials, Congress, federal agencies, state and local governments, Tribes, environmental groups, commodity groups, and international organizations as to what should actually be done to reduce the impacts of changing climates and to minimize the area impacted by uncharacteristically severe wildfire. Policymaking depends on technical and scientific information, but the choices made are inherently political ones (Stephens and Ruth 2005). For this reason, even if a particular issue is relatively uncomplicated and the design of a solution may be easily understood, policy formulation is often complicated. Substantive objectives, such as fuel hazard reduction, must compete for legislative and administrative attention and resources with other worthwhile objectives and programs. Budgetary concerns, for example, may override even the soundest programmatic proposals (Stephens and Ruth 2005).

When developing new fire policies it is critical to differentiate between the diverse ecosystems in California (Figure 1). Indeed, one of the most common mistakes with current fire policies is their inability to distinguish between ecosystems that can have very different fire regimes (Dombeck et al. 2004; Agee and Skinner 2005; Stephens 2005; Stephens and Ruth 2005). Some ecosystems, such as chaparral, are adapted to and require high-severity fire; mixed-severity fire regimes may be more characteristic of high-elevation forests or those in moist coastal environments. Still others, such as ponderosa pine and mixed conifer forests, are adapted to more frequent, low-to-moderate-intensity fire regimes. Policies enacted to manage the complex interaction between fire and future climates must differentiate between ecosystems that have fundamentally different fire regimes.

5.0 The Wildland-Urban Interface/Intermix Problem

Urbanization and fragmentation of natural habitats has been recognized as a major source of ecological degradation (Soulé 1991; Collinge 1996; Booth and Jackson 1997; Theobald et al. 1997). Furthermore, the primary reason we worry about wildfire is that people have developed formerly natural landscapes, building their homes and communities in fire-prone areas. To focus attention on where such development is occurring, the boundary between developed and wildland areas is sometimes referred to as the wildland-urban interface (WUI), or the wildland-urban intermix (WUI) in the case of lower-density housing. Expansion of the WUI is an important environmental issue across the United States, and there are more homes in the California WUI than in any other state (> 5 million; Radeloff et al. 2005). It is therefore imperative that we reexamine how future urban growth and fire hazard in the WUI can be mitigated (Reams et al. 2005), regardless of the climate change scenario in question.

To achieve a more sustainable coexistence with wildfire, there are two fundamental goals to achieve in future housing developments. The first is to adopt urban planning guidelines that reduce the expansion of the WUI itself, producing more compact urbanized areas with less convoluted boundaries. While this shift may present a host of political challenges, it is one of the few ways to produce future communities that both minimize their ecological impact and are more easily defensible in a wildfire situation. The difficulty of evacuating people from WUI communities during wildfires is another solid justification for limiting expansion of the WUI (Cova 2005). The second goal for future housing is to adopt much more stringent building codes in fire-prone WUI communities. Although it will take a large outreach effort to educate the public about retrofitting existing construction (e.g., high-risk wood shingle roofs), we have a chance now to ensure that much of the WUI of 2020 and beyond is built in a more fire-safe manner. Meeting the two planning goals specified here should result in a greater separation between incompatible processes on either side of the unterface, increasing the chances for fire to burn freely in our wildlands and with fewer losses on the urbanized side.

6.0 Conclusion

We are at a turning point, given the likely impacts of climate change and anticipated population growth in California. In addition to reducing greenhouse gas emissions, we must adapt and change course now, which could eventually lead to a sustainable coexistence with wildfire. Ultimately, the goal is to allow us to continue living on or near California's fire-prone landscapes, while also ensuring the long-term functioning and persistence of the ecosystems upon which we depend. Adoption of a risk-based framework for fire management, reintroduction of fire to fire-prone ecosystems and careful use of fire surrogates, creation of new and flexible policies, and a serious reevaluation of urban planning and building in the WUI are needed to reach a sustainable coexistence with fire in the future. The recommendations made here are not comprehensive, but they do provide a minimal roadmap for living with fire in California under an altered future climate.

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