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Western Ecological Research Center

Publication Brief for Resource Managers

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Fire in California's Ecosystems

California represents one of the most fire-prone regions in North America. To further the proper management of these unique ecosystems, USGS fire scientists and colleagues have contributed chapters to *Fire in California's Ecosystems* (University of California Press). These in-depth studies of the ecological role of fire and management implications cover some of the most critical regions in the state.

***Fire as a Physical Process*—**Jan van Wagtendonk (USGS) describes fire as a physical process including combustion, fuels, fire weather, fire behavior, and fire effects. Detailed discussions show how the physical environment influences fire behavior and effects such as ignition, fire spread, crowning, and mortality. As a physical process, fire reacts to and influences other ecosystem components. The current physical and biological environments of California ensure that fire will continue to be a dynamic force.

***Fire as an Ecological Process*—**In this chapter, Neil Sugihara (Forest Service), Jan van Wagtendonk (USGS), and Jo Ann Fites-Kaufman (Forest Service) explore fire as a dynamic ecosystem process by first examining fire in the context of general ecological theory, then discussing the concept of fire regimes, and finally by developing and applying a new framework for classifying fire regimes that better allows us to understand the patterns of fire as processes within ecosystems. Management actions can alter fire regimes and thereby change the role fire plays in those altered ecosystems.

***Sierra Nevada Bioregion*—**Jan van Wagtendonk (USGS) and Jo Ann Fites-Kaufman (Forest Service) describe the role of fire in the Sierra Nevada, which covers approximately 17% of the state. Historically, fires varied from high-intensity crown fires in foothill chaparral to low-intensity surface fires in the lower montane forests. Decades of fire exclusion in these forests have resulted in a shift from frequent, low-intensity fires to less frequent, large fires. Fuel accumulations, brush, small trees, and dense forests produce very different conditions for the inevitable fire that occurs, whether from lightning or human sources. Restoring the role of fire in the Sierra Nevada is complicated by developments that encroach into the wildlands and by strict air quality regulations, and success is contingent upon society's ability and willingness to keep fire an integral part of these ecosystems.

Management Implications:

- In the Sierra Nevada bioregion, fire and fuel management practices that most closely mimic natural fire regimes have the greatest potential for success.
- In the South Coast bioregion, fire management needs differ markedly between the montane and the foothill subregions.
- The greatest alterations to fire regimes and negative effects of fire in the Southeastern Deserts bioregion have occurred in the middle elevation desert shrubland and grassland zone, suggesting that is where fire management activities should be focused.
- Fire can clearly facilitate alien plant invasions in some regions and there is little reason to suspect that fire alone will ever be a long-term solution to their management. Because fire interacts with other abiotic and biotic factors, its outcomes must be looked at in an integrative context.

***South Coast Bioregion*—**Jon Keeley (USGS) covers the South Coast bioregion, which has the highest peaks outside the Sierra Nevada, yet more than 50% of the landscape is below 1500 ft, resulting in complex fire environments. This region comprises only 8% of the land area of the state, yet it is home to more than 55% of the population, producing difficult fire management problems. These problems are illustrated by contrasting montane forests with foothill chaparral. Forests have experienced a century of fire exclusion, and fire hazard is high as a result of increased fuels. Managers are faced with an immediate need for fuel reduction treatments in order to reduce the fire hazard for human safety and diminish negative ecosystem impacts. In contrast, in the lower foothill zone, fire suppression has not reduced the natural fire frequency, rather fires are largely anthropogenic and more numerous than historically. The primary resource need is for reducing fire activity that threatens much of the native shrubland with type conversion to exotic grassland. Due to the huge urban populations, strategic placement of fuel treatments at the wildland-urban interface is needed for fire hazard reduction.

***Southeastern Deserts Bioregion*—**Matt Brooks (USGS) and Richard Minnich (University of California, Riverside) describe the ecology and management of fire in the deserts of California. Historically, fire was relatively infrequent in this bioregion, but the invasion of non-native annual grasses and increased rates of ignition by humans have led to increased frequency and extent of fires during the latter 1900s. Fires are now considered a significant threat, especially in relationship to their effects on plant communities and wildlife species such as the desert tortoise. However, these threats vary among ecological zones, and the authors describe these variations among five zones that they define. The middle elevation desert shrubland and grassland zone—upper ecotones of creosotebush scrub and blackbrush scrub vegetation types—is where most of the threats from fire currently occur. Potential management actions for mitigating the effects of fire are also discussed.

***Fire and Invasive Plant Species*—**Rob Klinger (USGS), Matt Brooks (USGS), and John Randall (The Nature Conservancy) explain the often complex relationship between fire and invasive non-native plants from three perspectives: general interrelationships between fire and invasive plants, specific examples of how fire can promote plant invasions and how invasions can promote alteration of fire regimes, and the use of fire as a management tool to control non-native species. Rather than looking at fire as just a stand-alone process, special emphasis is given to how fire interacts with other ecological processes to determine rates and extent of invasion into burned areas. Outcomes from management burns are highly variable both spatially and temporally, and the dearth of long-term studies precludes any broad generalizations to be drawn from outcomes from management burns. Current perceptions will likely undergo substantial shifts as the quality of information improves in ensuing years. The chapter concludes with an overview of the conservation, ecological, and social context of fire and invasive species, and topics such as interactions with large-scale environmental changes and multi-trophic level studies.

***The Future of Fire in California's Ecosystems*—**The editors conclude the book with a look at the future of fire and land management in California. It is clear that the population of California will continue to grow, the wildland-urban interface will continue to expand, wildlands will be valued as both habitat and open space, and the regulation of fire and other land management activities will continue to increase. These conditions make it paramount that fire be considered in all land management and planning decisions. The understanding of fire and its role in ecosystems is vital to making these decisions.

Citations (chapters are in order of discussion above and appearance in book):

Sugihara, N. G., J. W. van Wagtendonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thode (eds). 2006. Fire in California's Ecosystems. University of California Press. 596 p.

Van Wagtendonk, J. W., Fire as a Physical Process, p. 38–57.
Sugihara, N. G., J. W. van Wagtendonk, and J. Fites-Kaufman, Fire as an Ecological Process, p. 58–74.
Van Wagtendonk, J. W. and J. Fites-Kaufman, Sierra Nevada Bioregion, p. 264–294.
Keeley, J. E., South Coast Bioregion, p. 350–390.
Brooks, M. L. and R. A. Minnich, Southeastern Deserts Bioregion, p. 391–414.
Klinger, R. C., M. L. Brooks, and J. M. Randall, Fire and Invasive Plant Species, p. 499–519.
Sugihara, N. G., J. W. van Wagtendonk, J. Fites-Kaufman, K. E. Shaffer, and A. E. Thode, The Future of Fire in California's Ecosystems, p. 538–543.