CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Ecological effects of alternative fuels treatments: Highlights from the Fire and Fire Surrogates study

McIver, J.D.; Stephens, S.L.; Agee, J.K.; et al. 2013. Ecological effects of alternative fuel-reduction treatments: highlights of the National Fire and Fire Surrogates (FFS) study. International Journal of Wildland Fire, 22(1): 63-82.
http://www.schwilk.org/publications/pubs/McIver+Stephens+etal-2012_FFS-Highlights_IJWF2012.pdf

Fuel reduction treatments are commonly employed in the seasonally dry forests of the United States. They include mechanical treatments, such as thinning and mastication, as well as prescribed fire. Prescribed fire is a more ecologically attractive option because it most closely resembles natural fire, which has been largely limited in these ecosystems for a century. However, due to social, operational, and ecological constraints, mechanical treatments are often easier to implement than prescribed fire, and they are often used in its place.

The National Fire and Fire Surrogates (FFS) study was designed to evaluate differences among alternative fuels reduction treatments in seasonally dry forests throughout the country, and to test the assumption that mechanical treatments might be used to accomplish the same stand structure and ecological goals as prescribed fire.

Methods

FFS was conducted at 12 seasonally dry forest sites in the U.S.—5 in the east and 7 in the west. Treatments were applied between 1998 and 2004, were replicated 3 to 4 times at the stand level, and generally included an un-manipulated control, prescribed fire only, mechanical only, and mechanical + prescribed fire.

Management Implications

- Treatment effects are most often subtle or short-lived. If managers want to make lasting changes, treatments must be applied at high enough frequencies to prevent rebound to pre-treatment conditions.
- Fire has unique effects on ecosystems, and most effects cannot be emulated with any other treatments.
- Treatments are associated with desirable and undesirable outcomes, and managers should consider these "tradeoffs" when planning treatment activities.
- Different treatments favor different habitats and species, but the use of fire may promote a more balanced, heterogeneous community structure—one in which species with diverse needs may coexist.
- Eastern forests will need more frequent treatment, due to their relatively higher productivity.
- Long-term monitoring is critical for gauging project success and for adaptive management.

Though detailed prescriptions varied by site, all treatments shared a common short-term objective: that at least 80% of the basal area would survive if subjected to a head fire under 80th percentile weather conditions.

FFS sites were used to look at relationships between the different treatments and six primary ecosystem components: 1) vegetation, 2) fuels, 3) soils and nutrients, 4) fauna, 5) bark beetles (in pine-dominated sites), and 6) root diseases and dwarf mistletoe. In most cases, variables were measured in the years immediately before and after treatment, and for up to 4 years post treatment.

Results

FFS findings were synthesized into five main themes useful for managers: 1) effect size and duration, 2) surrogates, 3) tradeoffs, 4) habitat effects, and 5) restoration.

Effect size and duration

Across the range of ecosystem components, researchers found a unifying theme: many ecological variables had a modest and transient response to treatment, whether mechanical or fire. Responses after a single-entry treatment were either subtle or non-existent, and even in places where post-treatment changes were significant, those changes didn't last more than a couple of years. If managers are hoping to make lasting changes, treatments will need to be applied at high enough frequencies to prevent rebound to pre-treatment conditions.

Fire surrogates

For most of the ecological variables included in the FFS study, mechanical treatments did not serve as a surrogate for fire. Fire has unique effects on ecosystems—from fuel consumption and small tree mortality to changes in soil chemistry and exposure, as well as enhanced within-stand heterogeneity and species richness—and it is not possible to produce those effects using mechanical treatments alone.

Tradeoffs

The desirable outcomes of certain treatments may be offset by associated undesirable outcomes. The FFS study identified three of these "tradeoffs": 1) prescribed fire reduces surface fuels, but it can also reduce coarse woody debris, which has important habitat values; 2) treatment-related disturbance intensity is related to exotic plant cover and richness; and 3) prescribed fire can weaken high-value trees and attract bark beetles, which can further weaken and/or kill high-value trees.

Habitat effects

Treatments favored species whose life history needs were most closely met by post-treatment conditions; for example, fire increased light and heat at the forest floor, reduced shrub cover and increased grass cover, and thus favored species that thrive in drier microhabitat conditions. In general, active treatments—especially those that include fire—increased plant diversity, enhanced colonization of disturbance-adapted species, and reduced cover of plants adapted to more mesic environments, which were likely less common in these ecosystems prior to the fire suppression era. The use of fire increased spatial patchiness, which promoted a more balanced community structure—one in which species with diverse needs (e.g., disturbance or no disturbance, open forest or dense forest, etc.) could coexist.

Restoration

Due to the relatively short timeframe of the FFS study, it's difficult to assess long-term effects of treatment; however, the authors are confident in four predictions regarding long-term restoration plans in seasonally dry forests: 1) restoration to pre-settlement conditions will require persistent management that includes repeated treatments; 2) eastern forests will need more frequent treatments, due to their high productivity; 3) if used alone, mechanical treatments may cause these systems to diverge from conditions created with fire; and 4) long-term monitoring is critical for gauging efficacy and for adaptive management.

Conclusions

The FFS study indicates that although all treatments generally have modest and transient effects on dry forest ecosystems, mechanical treatments are not surrogates for fire, due to the complex and unique effects of fire on the landscape. However, both types of treatment will be necessary for restoration of seasonally dry forests in the United States, since mechanical treatments are often easier to implement and can be more effective in altering overstory structure and composition. A successful restoration strategy in these systems would include persistent management with repeated use of both prescribed fire and mechanical treatments.