Developing Fire Management Strategies for Tejon Ranch

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***Client*: Tejon Ranch Conservancy**

Background

Nestled at the crossroads of four major ecological regions and spanning more than 270,000 acres, Tejon Ranch is the largest contiguous piece of private land in California, and an important locus of biodiversity. Under a recent agreement, the vast majority of the Ranch will be set aside for permanent conservation. Protected areas will be managed by the Tejon Ranch Conservancy, whose mission is to "preserve, enhance, and restore the native biodiversity and ecosystem values of the Ranch and Tehachapi Range for the benefit of California's future generations." A particular challenge that the Conservancy faces is how to manage fire, which is both a serious threat and an important ecological process.

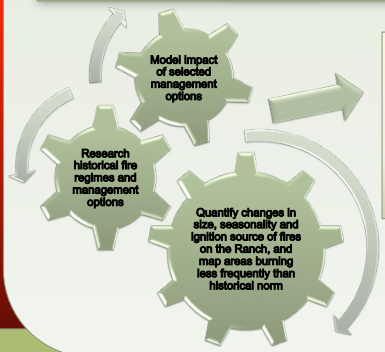
Why is fire management important?

In addition to its implications for human safety, fire has significant effects on wildlife habitat, vegetation composition and overall ecological functioning. Some of the Ranch's ecosystems are adapted to periodic wildfires, while others are relatively fire-intolerant. In either case, changes in the frequency and severity of wildfires can have a major impact on the Ranch.

Objectives

Identify post-European settlement changes to fire regimes.	*Identify key uncertainties pertaining to the fire ecology and management of the Ranch's major ecological communities.*
Evaluate the impact of alternative management strategies, climate change, and development on vegetation communities and fire regimes.	*Develop fire management recommendations for each major ecosystem type.*

Methods



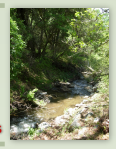
Final Report

- Analysis of changes in the Ranch's fire regimes
- Modeling and cost analysis for selected management options
- Management goals, concerns and specific recommendations for each major ecological community

Recommendations

- **Goals**: Preserve native species; maintain biodiversity
- **Concerns**: Proliferation of nonnative species; impacts of fire and grazing on community composition
- **Recommendations**: Continue fire suppression; consider burning test plots if native species declining

Grasslands



- **Goals**: Maintain mosaic of ages; mitigate spread of fire regime-altering invasive species
- **Concerns**: Increased sedimentation; high fuel loads; increased ignitions
- **Recommendations**: Assess feasibility of tamarisk removal; survey fuel loads in high risk areas

Riparian Systems

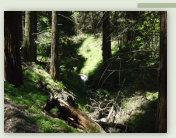
Photo Credit: Tejon Oaks 2011

- **Goals**: Prevent type conversion; promote oak regeneration; maintain mature overstory
- **Concerns**: Fuel build-up; lack of oak regeneration
- **Recommendations**: Monitor fuel loads and oak recruitment; avoid active fuel treatments unless compelling need exists

Oak Woodlands

- **Goals**: Reduce risk of wildfire; prevent loss of shrub species diversity
- **Concerns**: Proximity to sensitive desert vegetation; frequent burning threatening obligate seeding species
- **Recommendations**: Continue fire suppression; no strong case for prescribed burns

Chaparral



- **Goals**: Prevent type conversion; promote mature, open forest structure
- **Concerns**: Increased forest density; dangerous fuel dynamics; risk of extensive stand replacing fires
- **Recommendations**: Monitor fuel loads and forest density; consider thinning treatments and exclusion of grazing

Conifer Forests

- **Goals**: Prevent type conversion
- **Concerns**: Disturbance; invasive/wildfire cycle
- **Recommendations**: Monitor invasive annual grasses such as *Bromus tectorum*; continue fire suppression

Joshua Tree Woodlands and Mojavean Scrub

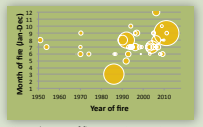
Conclusions

Our analysis suggests that the Ranch's fire regimes may be changing. Fires on the Ranch have become more numerous in recent years and, unlike in the region as a whole, they may be increasing in size. But these changes appear to be unevenly distributed: even with greater numbers of fires in recent decades, parts of the Ranch are actually burning less frequently than historical norms. As climate change intensifies, and continued development leads to more anthropogenic ignitions, the Ranch's fire regimes may continue to shift.

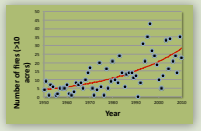
Understanding these shifts is likely to require improved monitoring of fuel conditions. With the exception of fire suppression, which appears to be appropriate across the Ranch, adaptation measures will vary by ecological community. In some communities, such as montane conifer forests, active management may be necessary to prevent type conversion. Where active management is necessary, lighter treatments over a larger area are likely to be more cost-effective than intensive thinning in a smaller area.

Results

Fire Size, Seasonality and Ignition



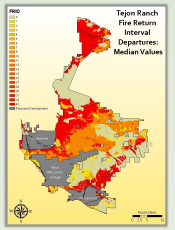
Size and season of fires occurring on Tejon Ranch. The size of each circle reflects the relative area burned.



Number of fires per year in the region. A Poisson regression was used to represent the relationship between number of fires and year.

To better understand the nature and occurrence of fires on the Ranch, we analyzed **fire size**, **frequency**, and **source of ignition** for fires occurring on the Ranch since 1950. Fire frequency increased over the past 60 years. In addition, average fire size was approximately two times larger since 1980 than in the period between 1950 and 1979. As a result, the total area burned since 1980 is approximately 13 times greater than the area impacted by fire prior to 1980. There is also some indication that fires may be occurring outside of the historical fire season. The majority of fires with identified ignition sources are the result of human activities, such as vehicle or equipment use. Increases in fire size, frequency, and season on the Ranch may be the result of these anthropogenic ignitions as well as climate change.

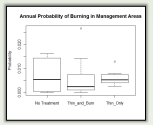
Current Fire Frequency



Fire return interval departure (FRID) map for Tejon Ranch.

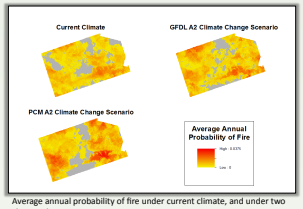
In order to understand how the Ranch is departing from historical fire regimes—and, specifically, to take into account areas that are burning less frequently than historical norms—we used **fire return interval departure (FRID)** analysis. The map on the left illustrates what we found: areas in yellow and orange are burning somewhat less frequently than they did historically, and areas in red are burning much less frequently. Olive-colored areas are burning as often as they did in the past, or more often. It is important to note, however, that many of the high-departure (i.e., red) areas are grasslands, an ecological community where there is considerable uncertainty about historical fire regimes.

Future Fire Frequency



Annual probability of burning under current climate scenarios.

We utilized a spatially explicit forest landscape model called **LANDIS-II** to simulate the possible effects of development, climate change, and fire management strategies across a portion of the Ranch. Modeling these factors allowed us to better understand their interactive effects on fire and ecosystem succession, and provided insights into how the Ranch may change in the future. Our results indicate that climate change may lead to an increase in the annual probability of fire, particularly in areas already prone to frequent fire. Management treatments in conifer forests (thinning and prescribed burning) had no significant effect on fire frequency.



Average annual probability of fire under current climate, and under two climate change scenarios.

Acknowledgments: Frank Davis (Faculty Advisor); James Frew and Christina Tague (Advisors); Thomas H. Maloney, Michael D. White, and Phoebe Prather (Clients); Tejon Ranch Conservancy and the ACE Group (Funders); Carla D'Antonio, Charles Jones, Bruce Kendall, Gary Libecap, Paula Schiffman and Alexandra Syphard (Advice on Particular Questions)

Website: http://fiesta.bren.ucsb.edu/~tejonfire/index.html