



**ECOLOGY AND MANAGEMENT OF OAK WOODLANDS ON TEJON RANCH:
*RECOMMENDATIONS FOR CONSERVING A VALUABLE CALIFORNIA ECOSYSTEM***

Project Members:

Anderson Shepard
Andrew Krieger
Serra Hoagland
Shannon Moy

Project Advisor:

Frank Davis

ON THE WEB AT [HTTP://WWW.BREN.UCSB.EDU/~TEJONOAKS/](http://www.bren.ucsb.edu/~tejonoaks/)

Introduction

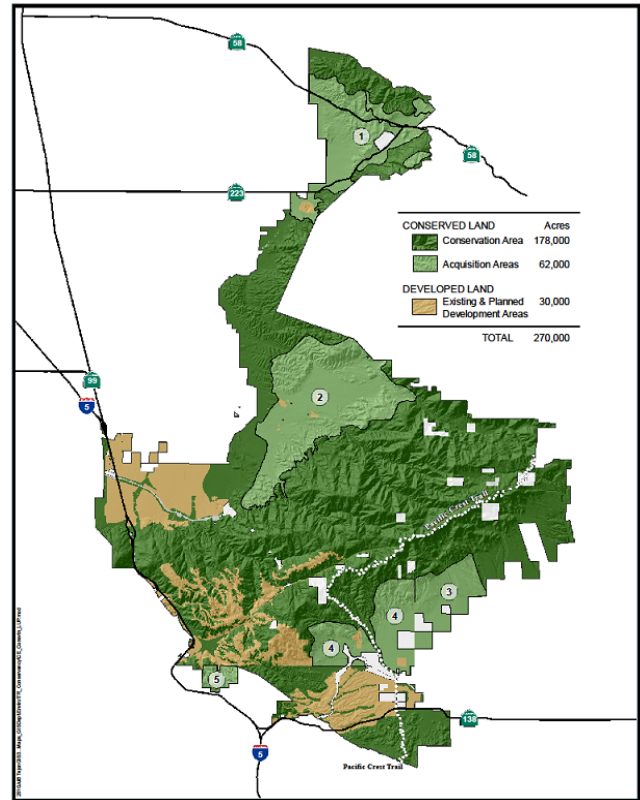
Tejon Ranch is the largest contiguous private property in California. Located in Kern and Los Angeles Counties, the Ranch encompasses 270,000 acres at the convergence of four major ecological regions: the western Mojave Desert, the San Joaquin Valley grasslands, the Tehachapi Mountains, and the California transverse range. The Ranch is home to rare and endemic species and a variety of vegetation communities including some of the most intact oak woodlands remaining in California, all located within 100 miles of Los Angeles.

Oak woodlands are important and merit this research because of the role they play within the overall ecosystem. They serve as a home to a myriad of animals as well as a diverse community of understory plants. Large oak trees provide cavities for birds to nest in, including the Purple Martin, a species of concern in the region (Shuford and Gardali 2008). Oak Woodlands are considered to be among the most diverse habitats in California (Pavlik 1991, Brussard et al. 2004).

Background

In 2008, the Tejon Ranch Company, owner of Tejon Ranch, and a coalition of conservation organizations signed the landmark “Tejon Ranch Conservation and Land Use Agreement” (the Agreement).

Under the Agreement, the Tejon Ranch Company may develop 30,000 acres of Tejon Ranch while 178,000 acres of the Ranch are committed to permanent conservation. In March of 2011 an additional 62,000 acres were purchased for permanent conservation. The Agreement also established the non-profit Tejon Ranch Conservancy whose mission is to “preserve, enhance, and restore the native biodiversity and ecological values of Tejon Ranch and the Tehachapi Range for the benefit of California’s future generations”. In pursuit of this mission, the Conservancy is charged with developing a Ranch-Wide Management Plan (RWMP) that will employ an adaptive management strategy to manage conservation values of the Ranch as well as current land uses permitted under the Agreement including hunting,



cattle grazing, and filming. The goal of our project is to assess the current and future condition of oak woodlands on the Ranch and make recommendations for the management of these systems for the RWMP.

Research





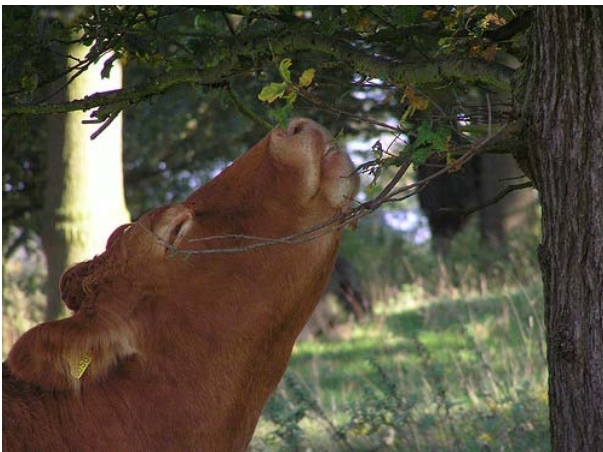
From July 2010 to September 2010, group members collected soil, tree, and understory data in 105 oak woodland plots.

This field data provided baseline information about the current status of oak woodlands on Tejon Ranch and was used throughout our project as a foundation dataset for various analyses.

Once field work was completed, our research focused on answering five guiding management questions that would assist in the development of the RWMP. These questions and our primary results are summarized below.

How are current land management practices affecting Tejon's oak woodlands?

The three main management practices that influence oak woodlands are grazing, fire and hunting. Grazing and hunting generate revenue but also have a substantial impact on oak woodlands.



Depending on the intensity, duration and seasonality of grazing, livestock can impact seedling recruitment – both directly by predation and indirectly by reducing the competition from annual grasses. Grazing can also alter soil properties, bulk density, and infiltration rates.

Fire influences oak woodlands by altering the fuel load, understory assemblage and composition, and soil properties.

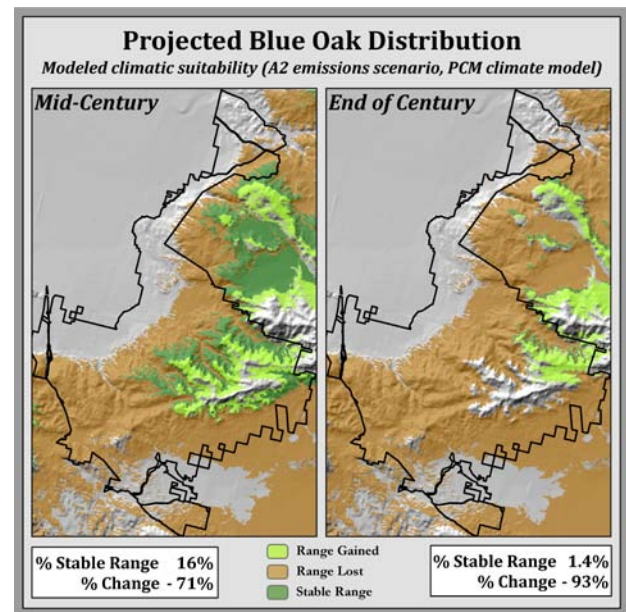
Lastly, hunting impacts oak woodlands by altering the herbivore populations (deer, elk, and pigs) and the understory community.

Directly connecting the results from our field data to particular grazing, fire, and hunting management actions was beyond the scope of our project. We recommend that the Conservancy establish

experimental plots in order to determine the effect of each management action.

What are the potential effects of climate change on the oak woodlands of Tejon Ranch?

Oak woodlands are predicted to shift and lose habitat in response to climate change (Kueppers et al. 2005). We modeled future oak distribution on the Ranch with species distribution models using the Intergovernmental Panel on Climate Change's A2 emission scenario and two general circulation models.



We found a general decline in climatic suitability for oaks on the Ranch between now and mid-century and further reductions by the end of the century. The overall trend is movement upslope and toward north facing aspects. Our results showed similar conclusions for both models and for all species. Fortunately, the presence of varied topography on the ranch may serve as refugia, helping to buffer oak woodlands from severe habitat loss due to climate change.

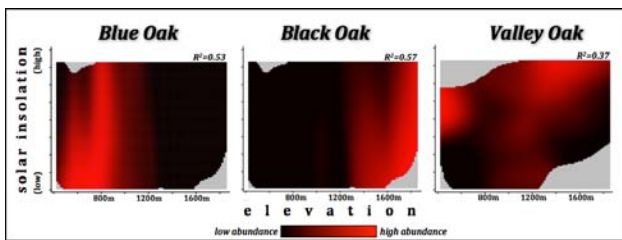
How does the structure of oak woodlands on Tejon Ranch compare to those in the rest of CA?

We compared our results to a statewide forestry report (Bolsinger 1988) which included an inventory of California's oak woodlands. We found that in general, Tejon's valley and black oak woodlands were better stocked than those found elsewhere in the state. Blue oak woodlands showed a similar but less prominent trend. Tejon Ranch's blue, valley, and black oak trees also tend to be larger than those in the rest of the state.



What is the current extent, distribution, and condition of the oak woodlands on Tejon Ranch?

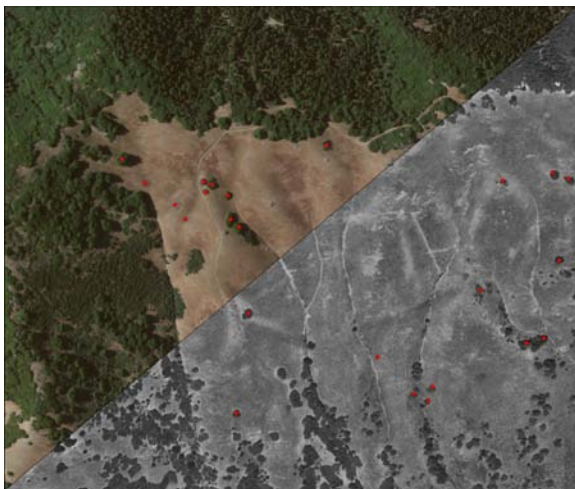
An environmental gradient analysis, with elevation and solar radiation as the primary explanatory variables, was used to further characterize Tejon’s oak woodlands.



We found that blue oaks (left) are more abundant on north-facing slopes at lower elevations, and shift to south-facing slopes at higher elevations. Black oaks (center) are found almost exclusively above 1200 meters and are more abundant on north-facing slopes at lower elevations and south-facing slopes at higher elevations. Valley oaks (right) exhibit a bi-modal distribution with high abundance on valley floors, and flat to south-facing ridge tops above about 1200 meters.

How are the oak woodlands changing over time, and is there a regeneration problem?

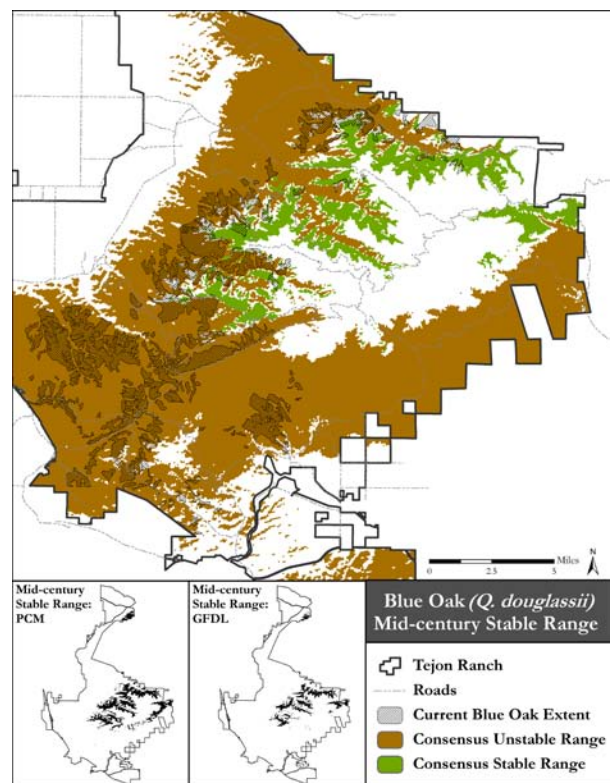
A historical photo analysis was used to determine how the oak woodlands are changing over time.



More than 2000 trees were tracked over a 57 year period. We found that over this time period there has been a slow but significant decline in the oak populations on the Ranch.

Recommendations

The slow but significant population decline observed in our research will lead to decreases in oak populations of about 9% over the next 50 years if current trends continue. We recommend that managers take actions to reverse this decline and stabilize oak population numbers. Research has shown that increasing recruitment from the seedling and sapling stages out of the browse layer, and into the adult tree stage is the best way to increase oak recruitment at the population level. Placing small, individual cages around saplings and large seedlings is the most cost-effective way to protect them from ungulates and allow them to escape the browse layer. Large scale exclosures can also effectively protect seedlings and saplings from ungulate browsing, but are significantly more expensive.



Significant range shifts may occur due to climate change and it is therefore important that managers focus their efforts in areas where climatically suitable habitat is predicted to be stable over the next 50 years. These areas are climatically suitable for oak species today, allowing recruitment and establishment of new oaks, and will remain suitable into the future, decreasing the likelihood of mortality due to climate change.



While there is relative confidence in estimates of the magnitude and direction of temperature change over the next 50 years, significant uncertainty exists regarding whether future climates will be wetter or drier. For this reason we recommend managers target 50-year stable range areas for which there is consensus by both “warmer wetter” and “warmer drier” climate models.

Finally, because we recommend that managers actively protect existing seedlings and saplings, these efforts must take place in existing oak woodlands where blue, valley and black oak seedlings and saplings are present.

Summary

Our research characterized the blue, valley, and black oak woodlands on Tejon Ranch. We found that the ranch’s oak woodlands are relatively large and well stocked compared to oak woodlands elsewhere in California. Tejon Ranch lies within the southern part of blue, valley, and black oak ranges, and as a result oak woodlands on the ranch are found at relatively high elevations due to the warmer, drier climate.

Using comparative historical air photo analysis, we determined that the oak populations on Tejon Ranch are undergoing a slow but significant decline. We also modeled how the distribution of oaks on the ranch will shift due to climate change and predicted significant shifts in range, especially for blue oak.



We recommend that managers use individual cages to protect a number of seedlings and saplings from ungulate browsing in order to allow them to escape the browse layer.

These management actions should be focused in areas predicted to be climatically suitable habitat over the next 50 years in order to maximize the likelihood that

management actions are effective over a long time horizon.

Acknowledgements

We would like to thank the all the individuals who supported and guided us throughout the duration of our project, especially our faculty advisor, Dr. Frank Davis, and our clients at the Tejon Ranch Conservancy, Dr. Mike White and Tom Maloney.

References

- B. Pavlik, 1991. *Oaks of California*, Los Olivos, CA: Cachuma Press; California Oak Foundation.
- C. Bolsinger, *The hardwoods of California's timberlands, woodlands, and savannas* (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Res. Bull. PNW-RB-148, 1988), p. 148.
- C. Tyler, B. Kuhn, F. Davis, *The quarterly review of biology* 81(2) (2006).
- L. Kueppers, M. Snyder, L. Sloan, E. Zavaleta, B. Fulfrost, *Proceedings of the National Academy of Sciences of the United States of America* 102(45), 16281-16286 (2005).
- P. Brussard, F. Davis, J. Medieros, B. Pavilik, D. Sada. 2004. *Planning Principles, Uncertainties, and Management Recommendations*, Report of the Science Advisors For the Placer County Natural Communities Conservation Plan and Habitat Conservation Plan.
- S. Phillips, R. Anderson, R. Schapire, *Ecological Modelling* 190, 231-259 (2006).
- Tejon Ranch Company, (2008) (available at http://tejonranchconservancy.org/images/uploads/rwa_exec.pdf).
- W. Shuford, and T. Gardali, 2008. *California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California*. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.
- www.hemsworth.us. Accessed April 9, 2011. Caged seedling photo.

