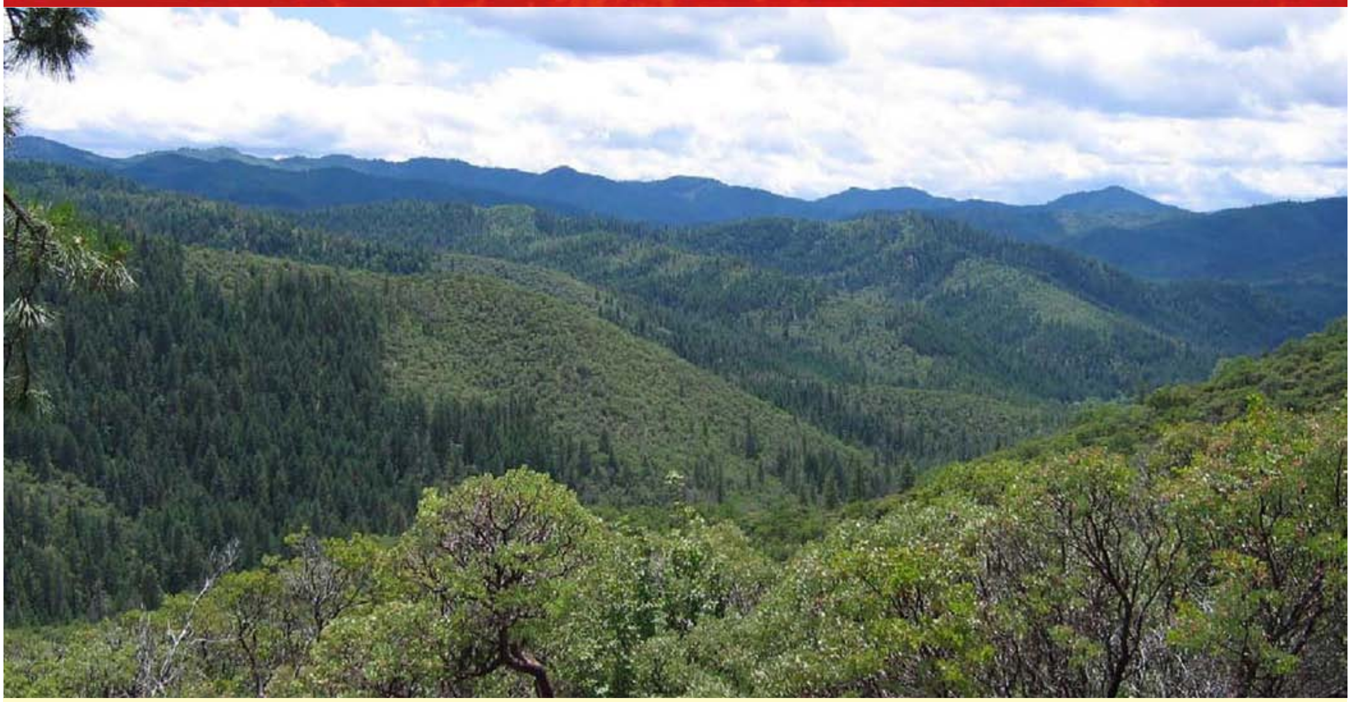
Joint Fire Science Program
Fire Science Brief
RESEARCH SUPPORTING SOUND DECISIONS



Rarely studied until now, the non-coniferous ecosystems of southwestern Oregon encompass a patchwork of vegetation types including chaparral and oak woodlands. Credit: K. Perchemlides and D. Coen.

To Thin or Not to Thin: Assessing the Consequences of Fuel Reduction Treatments for the Non-coniferous Ecosystems of Southwestern Oregon

Summary

Over time, fire exclusion has caused the accumulation of fuels and changes in vegetation structure and composition in many western ecosystems. This is commonly assumed to have also occurred in the oak woodlands, shrub lands and grasslands of southwestern Oregon. As a result, land managers of the Medford District of the Bureau of Land Management (BLM) have sought to reduce fuel-loads using a variety of thinning methods including mechanical mastication and hand-cutting, piling and burning. As of the mid-1990s, these treatments have been used on thousands of acres annually of the Ashland Resource Area (ARA) of the BLM. Since non-coniferous ecosystems of southwest Oregon were seldom studied, researchers hoped to achieve a greater understanding of the ecosystems by studying the plant communities and their relation with the environment such as slope, elevation and soils. Researchers also needed to gather information about the region's historical condition as well as observe how plant communities in the chaparral components of the area responded to thinning treatments. Above all, researchers sought to determine the effectiveness and consequences of these treatments—not only for the native and non-native plant species, but for ecosystem preservation and restoration.

Key Findings

Effects of thinning treatments, 4 to 7 years after treatment:

- Increase in woody debris cover,
- Spread of native annual forbs and native annual cover,
- Decrease in native perennial forb cover and proportion of cover comprised by native perennials,
- Expansion of exotic annual grasses and decrease in exotic annual forbs,
- Lack of canopy and shrub regeneration,
- Increase of total herbaceous cover, and
- No change in native species diversity, native bunchgrass cover or oak regeneration.

A richly diverse landscape

The Applegate Valley Adaptive Management Area near Ashland, Oregon contains some of the least understood plant communities in the Pacific Northwest. In a region characterized by a Mediterranean-type climate, this study focused on non-coniferous ecosystems with up to 126 plant species, including community types such as grassland, Manzanita Chaparral (*Arctostaphylos viscida*), Ceanothus Chaparral or "buckbrush" (*Ceanothus cuneatus*), and mixed shrub and oak woodland (*Quercus garryana*), all supporting numerous native grass and forb species.

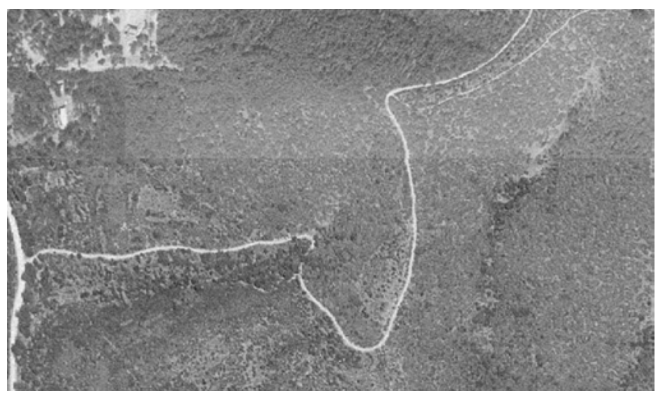
Today, due to expansion of residential property into the rural vicinity of the Applegate Valley Adaptive Management Area, the need for effective fire management is more pertinent than ever.

After being cut manually, several hand piles are prepared for burning. Credit: K. Perchemlides and D. Coen.

Mechanical mastication being performed using a Slashbuster™. Credit: K. Perchemlides and D. Coen.

Reducing the chance for fire

Since 1996, the Bureau of Land Management (BLM) Medford District has performed landscape-level fuel-reduction treatments on more than 17,000 acres of chaparral and oak woodlands in the Applegate Valley. Treatment methods included manual thinning, where woody vegetation is hand-cut, piled and burned, and mechanical mastication, (typically using a Slashbuster™), where small trees and shrubs are mechanically fragmented to the stump and then strewn, resulting in a layer of coarse woody debris. For this study, fuel reduction had been applied previously as part of routine treatments and prescribed fire was not used.



View from the air: area of oak and chaparral before thinning. Credit: BLM.

Striking results: same area of oak and chaparral after thinning. Credit: BLM.

Thinning methods are typically used to assist with fuel reduction or restoration of historic habitats. Treatments are intended to help land managers avoid high severity fires, protect humans and their property, open up overgrown closed canopy areas and safely reintroduce fire to the landscape. There are ecological concerns about thinning, however, which led researchers to explore the possible consequences of these treatment methods when applied in chaparral communities dominated by various mixtures of manzanita or buckbrush. What were the effects on native plant species? Would invasive plants spread and dominate the landscape? And, would the soil be affected by the heavy debris layer and burn pile scars? Overall, the responses to these fuel-reduction treatments and effects on native plant systems were relatively unknown, requiring researchers to perform in-depth monitoring and examination.

Post-treatment results years later

You see before-and-after pictures everywhere, and they typically say volumes about what once was and what's changed. The same holds true for this study. To compare the past plant communities with the present, the research team established 30 paired transects in unthinned and thinned areas of vegetation; thinned areas had been treated 4 to 7 years prior to sampling. In a specific treatment unit, only one pair of transects was created per vegetation community so that sampling could better represent the landscape. Precisely matched, the vegetation areas had experienced no recent disturbance other than thinning.

Researchers selected sample areas and transect locations based on canopy cover (that provided by trees and shrubs), and herbaceous cover, such as tree and shrub seedlings, grasses and forbs. Transect pairs were also divided between manual and mechanical treatment types.

Study results indicate that compared to native perennials, native annual species responded favorably to thinning treatments. In fact, cover by native and exotic annual species totaled more than 82 percent on thinned sites but only 44 percent on unthinned sites. A particularly notable outcome was the expansion of native annual forbs, which displayed the highest increase after thinning while native perennial forbs declined. Native perennial grass cover did not differ between treated and untreated sites. By and large, it was apparent that there was an increase in annual dominance and decrease in perennial species cover overall.

Exotic annual grass cover displayed a strong presence at unthinned sites and that presence only grew after thinning. A pre-existing concern, these exotic annual grasses responded favorably to thinning and their cover more than doubled at thinned sites. At sampled transects, researchers discovered eleven species of exotic annual grasses with nine of those species identified as noxious or invasive. While exotic annual grass cover showed a significant increase, cover by exotic annual forbs decreased.

Despite an increase in total herbaceous cover, researchers determined that thinning treatments did not enhance species diversity of the study area. Although species diversity was not significantly affected by treatments, annuals have outgrown the perennials. While overall proportions of cover of native and exotic species did not differ between treated and untreated transects, the trend towards increasing dominance by annuals, including exotic annual grasses, is of concern. It was also noted that regardless of treatment type, the effects on plant communities after 4 to 7 years were very similar.

"I think what was surprising was that for as long as the study looked at, 4 to 7 years, these treated communities were still acting like they were brand-new, like they'd just been thinned. They were dominated by annual plants with a major presence of exotic annual grasses. We expected that, this long after treatment, there would be more domination by native perennial grasses and forbs than there was in untreated communities. That was the hope and the expectation, but it's not what's happening. I think that the herbaceous species response was a big surprise, and a big disappointment," said Dr. Pat Muir, Co-Principal Investigator.

According to other studies of chaparral systems in California, shrub cover regenerated rapidly within the first three years post-fire. However, in this study, researchers did not see the same increase in shrub regeneration following manual treatments. The difference in shrub regeneration between thinned and unthinned sites was small; shrub regeneration comprised less than 2 percent cover at thinned sites. Even if low shrub regeneration is helpful for land managers and fuel-reduction objectives, it may indicate that thinning treatments could lead to ecosystem type-conversions and ultimately result in a negative impact on the restoration of chaparral ecosystems.

Mapping unknown territory

To truly understand a complicated mix of vegetation, it must first be analyzed, categorized, and mapped. For this study, it was essential to first determine the factors that were responsible for the existing vegetation pattern so researchers could better understand the vegetation dynamics and ecological processes. Up to this point, the specific plant communities and their response to the environment, disturbance and thinning treatments were largely unknown.

"A critical piece of this project was done by Dr. Paul Hosten and Eric Pffaf, the mapping of the non-coniferous communities and examining the relationship of the community types to environmental features. We didn't have a good vegetation map for that part of the state, nor had anybody really done an analysis of plant communities in relation to the environment," states Muir.

Researchers defined thirteen plant assemblages from 425 stands, focusing on stands that included a wide variety of vegetation and environmental characteristics. Based on species composition, the assemblages represented grassland, shrubland and woodland vegetation types of the Applegate Valley.

Next, the team used regression techniques to examine the distribution of structural and compositional components of stand-level non-conifer vegetation relative to soil, topography, and past fire management across the Applegate Valley landscape.

(Top)Taken in 1915, this photo helped researchers determine the shrubland conditions of the area prior to fire exclusion. (Bottom) Many years later, this 2004 photo was taken in the exact same location to compare pre-settlement shrubland conditions with existing conditions.
Credit: P. Hosten.

A pre-existing condition?

Sometimes you can look into the past to uncover the future. With this study, researchers did just that by referring back to historic reports, vegetation maps and photos from the early 20th century to characterize pre-settlement shrubland conditions and the possible effects of fire exclusion. There is the assumption that the landscape was more open prior to fire exclusion, however, according to historic literature, shrublands were extensive at the time of Euro-American settlement. Substantiating this old literature, a collation of historic anecdotes, and repeat photos taken by researchers in the exact same locations as the historic photos show that chaparral and high canopy woodlands existed in the area long before fire exclusion practices were active.

It is evident that fire exclusion practices have had an effect since then. Some plants observed in this study have become taller or more dense as a result of fire exclusion. And repeat photos show a decrease in fire-mediated meadows while soil-maintained meadows remain open.

According to current stand structural data, different patterns of vegetation change are observed with topography, geology, and soil. Models based on chronological and spatial patterns of stand structure emphasize that the time that has passed since the last fire and water balance help explain the current distribution of structural variables and patterns in fire severity. This concept is further illustrated by the trees ability to grow rapidly in relatively moist soil to attain a fire-safe size prior to the next fire.

Several distinct differences can be found in vegetation responses between wildfire and fuel reduction. All disturbances result in an increase in annual grasses and forbs, though fire elicits a much stronger chaparral-like growth and flowering response from bulb plants. In 1915, a historic study at Matney Gulch in the Applegate Valley indicates that native annuals may have played an important role in post-fire vegetation dynamics, helping explain why chaparral sites appear predisposed to domination by both native and non-native annuals. This site also showed an initial domination by Ookow (Dichelostemma congestum), a bulb plant.

The Matney Gulch study and associated historic anecdotes also highlight the role of high fire severity in thinning the shrub seed bank. In contrast, the few manually treated sites that experienced unusually high heat in interspaces between pile burns show a more chaparral-like vegetation response characterized by very dense germination of the shrub seed bank. Researchers also discovered that there were relatively few shrub seedlings on fuel-reduction sites that lacked fire. It is quite likely that formerly open woodland areas that are currently dominated by understory shrubs previously supported more bunchgrass than they do now. It's possible that as shrub seed banks under woody canopy proliferate and bunchgrasses decline (heavy grazing by livestock may be implicated in this process), a site may be predisposed to more chaparral-like dynamics as a result of wildfire or fuel-reduction treatments.

Studies have shown a historic precedent for the occurrence of chaparral in southwestern Oregon. Repeat photos also demonstrate losses of fire-mediated meadows from midslopes to ridge tops, and of open woodlands with large single-stemmed trees. Since plant communities such as true chaparral have developed under high fire-severity conditions and are unlikely to be altered by fire exclusion, former meadows and open woodlands should become the favored locations to overlay fuel reduction with restoration. Sites of historic chaparral dominance, however, do not appear to be good candidates for restoration via either of the manual or mechanical fuel-reduction treatments. Instead, data suggest that chaparral stands thinned to very low residual shrub densities without follow-up prescribed burning may convert to annual-dominated systems with expanded cover of exotic annual grasses following fuel treatments.

Reduce and conserve

One thing is clear—fuel-reduction treatments have an impact, whether performed by hand or machine. And it was up to researchers to evaluate whether or not the treatments were effective on multiple levels.

In this study, there was inconsistency as to whether or not the combined goals of fuel-reduction and ecosystem restoration were met. It appears that restoration was a suitable goal for sites with a greater presence of oak trees but not for chaparral-dominated sites, which should only be treated for fuel reduction. Fuel-reduction treatments did reduce chaparral canopy fuels, however, there was a significant increase in ground fuels, particularly at mechanically masticated sites, where coarse woody debris is prevalent. As a result of increased surface fuel, there may be a higher risk of ignitions and severe impact to the soil at thinned sites where slash remains. Altering the fire regime and potential burn severity, thinning treatments could have harmful effects on vegetation structure and composition, habitat and ecosystem processes. Researchers recommend performing additional research in this area.

Furthermore, the perception that the ecosystem is shifting to a more annual-dominated system appears to be coming true. As exotic annual grasses spread and native perennials and shrubs show little regeneration after manual treatment, there is concern about the restoration and conservation of the native plant communities. Researchers understand that while fuel-reduction goals are imperative, it would be ideal to pursue fuel reduction, restoration, and ecosystem preservation simultaneously.

New prescriptions to consider

By engaging in this study, researchers have a better idea of how thinning treatments affect the shrub lands and oak woodlands of southwestern Oregon. This information also enables researchers to provide recommendations to fire and land managers on how to potentially reduce the expansion of exotic species and domination of annual plant species within the herbaceous community after treatment. Recommendations include:

- Retaining a higher level of post-thinning shrub canopy cover and increasing the size of control areas to help represent the unthinned areas more thoroughly.
- Reducing the size and connectivity of thinning units.
- Using prescribed fire as a follow-up treatment, allowing native plant communities and fire-dependent chaparral shrub species to recover after thinning.
- Performing fall seeding of native perennial grasses and forbs following fuel reduction or combine with prescribed fire.
- Establishing more explicit fuel-reduction and ecological restoration goals for thinning treatments for each specific vegetation community and treatment area.

It is also essential that managers recognize the role of stand replacement fire in local fire-dependent plant communities. Researchers recommend setting aside areas of the landscape to experience wildfire without human intervention. A landscape planning approach could be used to highlight areas where fuels require reduction to favor the control of fire and ensure the safety of existing structures, while other areas could answer the need for conservation.

Above all, researchers strongly agree that there is much more to be learned about this complicated landscape. Further collection of pre-thinning treatment data is advised, to allow for assessment of treatment effects. Long-term monitoring of the effectiveness of fuel-reduction treatments at reducing fire hazard and about their impacts on plant communities is recommended. Continued research on the historic vegetation structure and fire regimes relative to various treatment types is also needed to determine if current thinning methods are ecologically appropriate. By continuing to try new alternatives, clarify goals and objectives and gather more information, land managers can design thinning treatments that limit negative outcomes and enable greater success for ecosystem restoration where it is truly needed.

Management Implications

- Explore alternative methods and prescriptions.
- Increase monitoring of vegetation and fuel-reduction impacts of various treatment methods.
- Collect more baseline data on pre-thinning vegetation and fuel conditions, historic conditions, and fire regimes.
- Perform additional research on fire severity and consequences in untreated and treated sites.
- Recognize that chaparral-type dynamics, including the temporary domination of herbaceous vegetation by bulb plants, occurred historically within the southwestern Oregon landscape.
- Favor fuel reduction in plant communities that show structural/compositional changes, such as former meadows and oak savanna, that would lead to altered fire behavior relative to historic times.
- Focus on fuel reduction at strategic locations with regard to fire-fighting rather than dispersing treatments throughout the chaparral landscape.

Further Information: Publications and Web Resources

Perchemlides, Keith. 2006. Impacts of Fuel Reduction Thinning Treatments on Oak and Chaparral Communities of Southwestern Oregon. Corvallis, OR: Oregon State University. 48 p. MS Thesis. http://oregonstate.edu/~muirp/FuelsReductionSWOregon/index.html

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Scientist Profiles

Dr. Patricia Muir is a Professor of Botany and Plant Pathology and Director of the Environmental Sciences Undergraduate Program at Oregon State University in Corvallis, Oregon. Her research interests focus on the effects of human activities, including land management practices, air pollutants, and fire on plants.

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