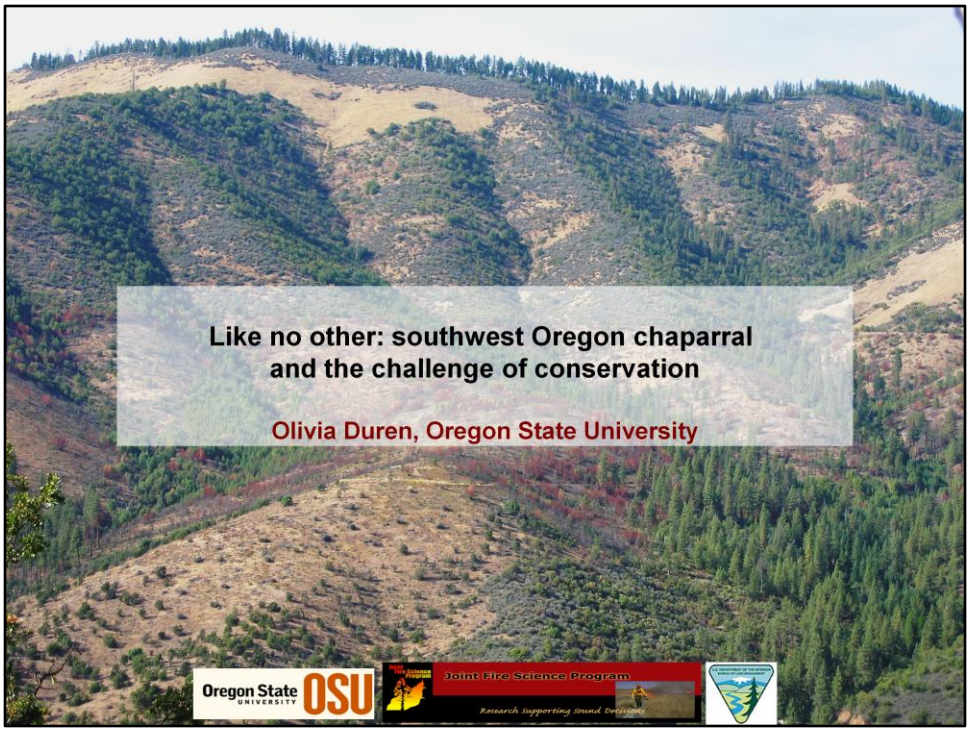
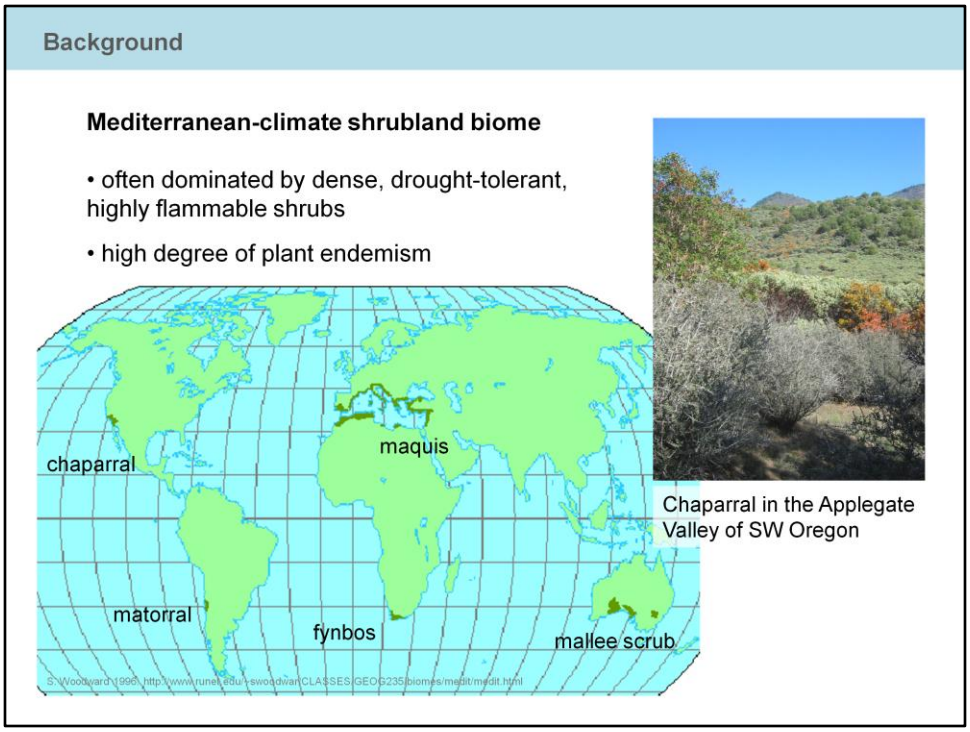



This presentation was given to the Native Plant Society, Siskiyou Chapter, Southern Oregon University, 21 Oct. 2010.




Chaparral is one of many comparable communities around the world in other areas with Mediterranean climates. Mediterranean-climate shrublands are often on the west coasts of continents, roughly between 30 and 40 degrees latitude, where cold offshore ocean current is present [1].

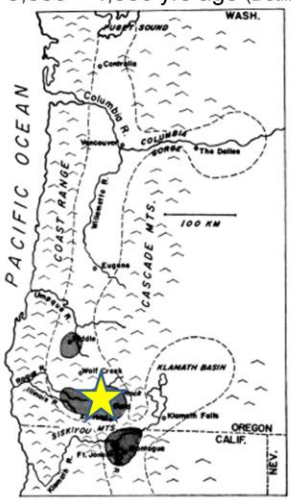
The communities are often dominated by dense shrubs with evergreen, drought-tolerant, highly flammable vegetation; shrub species are often adapted to persist after fire (either as resprouts or through fire-cued seed germination) [2].

## Background

**Range of chaparral**

Present (Barbour and Billings 2000)

8,000 – 4,000 yrs ago (Detling1961)



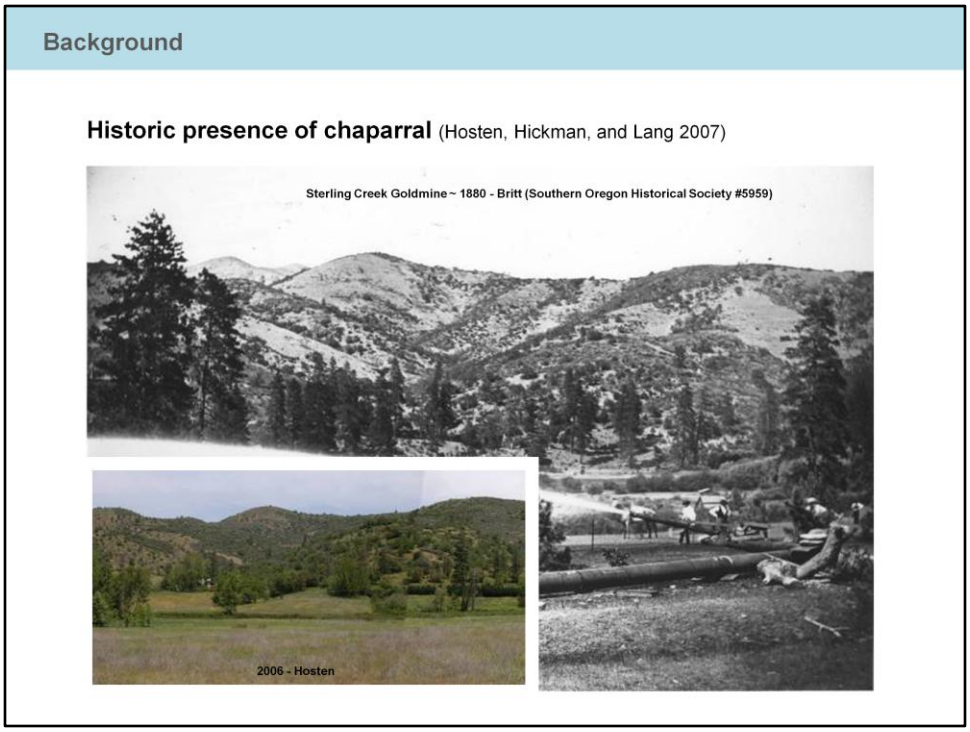

Chaparral shrubland ecosystem runs from Mexico and the southwest US all the way to Riddle, OR, which is considered the very northernmost tip of this ecosystem [2, 3].

When the climate was warmer 8,000 – 4,000 Yrs ago (Middle Pliocene), it extended all the way to the Puget Sound; this evidence is from the fossil and pollen record [3].

But the climate cooled, and the chaparral range contracted; the Siskiyou Mountains have isolated SW OR chaparral from CA chaparral for 4,000 years [3].

Oregon chaparral does some peculiar things compared to CA chaparral, as we shall see.

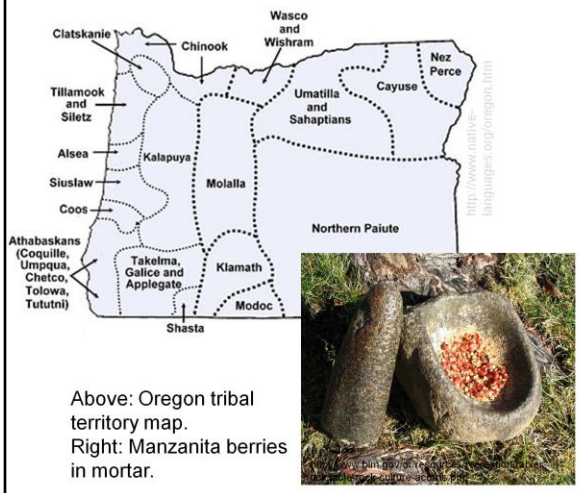
This part of SW OR is unique because it contains the driest valleys west of the Cascades [4], and therefore is the last bastion of this Mediterranean-climate community.




At the time of Euro-American settlement of southwest Oregon's interior valley, in the early 1850s, the Public Land Surveys documented the presence of expanses of dense manzanita and ceanothus shrubs [5]. Early photos also document the historic presence of shrublands [6].

## Background

**Local Native American uses of chaparral plants**




Above: Oregon tribal territory map.
Right: Manzanita berries in mortar.

**Manzanita**

- berries eaten
- leaves medicinal
- wood for pipes and cooking

**Ceanothus**

- basketry

**'Brush'**

- barriers for hunting
- stockades around villages
- tunnels for travel and escape

Local Native American tribes, such as the Takelma, used resources found in chaparral. There are ethnographic accounts of people eating manzanita berries, particularly when mixed with sugar pine nuts or acorn flour, manzanita leaves for medicinal purposes, manzanita wood for pipes and for cooking because of its low smoke and high heat; of using ceanothus for basketry materials; and of constructing barriers of brush to facilitate deer hunting and also as a stockade around villages [7, 8]. I've also heard that Native Americans constructed tunnels through tree-sized manzanita for the purposes of travel and escape from enemies; a friend from the Redding area said that one can still stumble across these tunnels today.

## Background

*"The crookedest, ugliest and most obstinate bush you ever saw."* -Taylor 1853

**Chaparral ecosystem services**

- landscape-level heterogeneity
- sustains unique flora and fauna
- stabilizes slopes and decreases erosion
- Nitrogen fixers - enriches soil, important browse
- Carbon sequestration (Luo et al. 2007)
- placeholder for global climate change

Having worked in chaparral, I agree with this early settler in his opinion that chaparral is the 'most obstinate bush you ever saw' [6; this source in turn references Pullen 1996].

But what ecosystem services do chaparral shrublands provide?

Landscape-level heterogeneity – relatively small part of the landscape here, and are a unique habitat that contribute to diversity on the landscape

Sustains unique flora and fauna, including some spp of concern [e.g., see 9]

Grows on the 'worst' sites on hot, dry, steep slopes where little else grows - stabilizes slopes and reduces erosion

Ceanothus is a N-fixer - enriches soil. Relatively high protein content – important browse for deer and sheep [10]

One study found that old-growth chaparral (100 yr; chamise) sequestered C at a rate similar to old-growth forests [11].

Placeholder if climate warms, and source of propagules for northward movement of this community type?

and…

## Background

*"The crookedest, ugliest and most obstinate bush you ever saw."* -Taylor 1853

**Chaparral ecosystem services**

- landscape-level heterogeneity
- sustains unique flora and fauna
- stabilizes slopes and decreases erosion
- Nitrogen fixers - enriches soil, important browse
- Carbon sequestration (Luo et al. 2007)
- placeholder for global climate change
- aesthetics

Aesthetics – many of the chaparral species and landscapes are quite beautiful.

I have to say that working in chaparral is a bit like being in an iron maiden, the medieval torture device shaped like a human case with spikes on the inside. But it was a real treat to witness these old-growth chaparral stands in places that not many people go.

Background

**Types of chaparral in southwest Oregon**

**Montane**

- above 3000 – 4000 ft
- greenleaf manzanita (*Arctostaphylos patula*) and deerbrush (*Ceanothus integerrimus*)
- shrubs resprout after fire

I've been speaking about one type of chaparral, but really there are two types of chaparral in southwest Oregon:

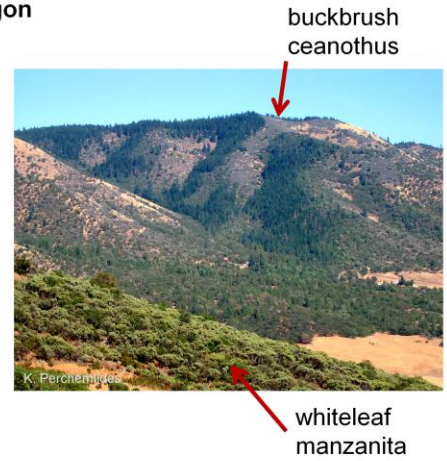
> Montane chaparral – tend to be higher elevations (above 3,000 – 4,000 ft) and dominated by shrubs which resprout after fire, such as greenleaf manzanita (*Arctostaphylos patula*), and deerbrush (*Ceanothus integerrimus*)

Background

**Types of chaparral in southwest Oregon**

**Interior Valley**

- 1600 – 4000 ft
- whiteleaf manzanita (*Arctostaphylos viscida*) and buckbrush (wedgeleaf) (*Ceanothus cuneatus*)
- shrubs do not resprout after fire




I will continue to focus on the low to mid elevation (1,600 – 4,000 ft) chaparral of the interior valleys and foothills. Interior valley chaparral is dominated by shrubs which don't resprout after fire, including whiteleaf manzanita (*Arctostaphylos viscida*) and buckbrush (*Ceanothus cuneatus*). (Other shrubs that do resprout after fire co-occur, such as mountain mahogany and birchleaf cercocarpus, but these species tend to be minor components.)

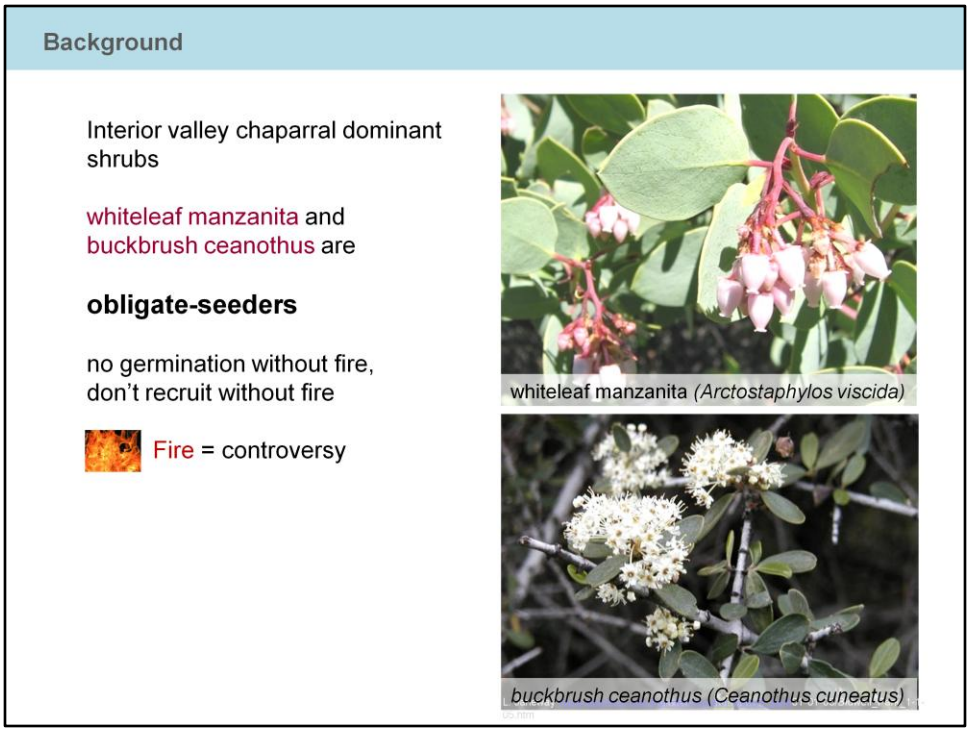
## Background

**Types of chaparral in southwest Oregon**


buckbrush ceanothus, but not chaparral

Just to be clear…

Chaparral has dense shrubs with more or less continuous canopy. The two spp. that dominate interior valley chaparral – whiteleaf manzanita and buckbrush ceanothus – also occur as scattered shrubs under trees, but these areas are not considered chaparral.




Whiteleaf manzanita ranges down to the southern Sierra Nevadas [12], and buckbrush ceanothus can be found into Baja, Mexico [13].

These species have been well-studied in CA, and their seeds have been found to require fire for germination – this germination type is called 'obligate seeder' [14, 15]. In CA and in other Mediterranean climates, shrubs with obligate seeder germination are generally unable to successfully recruit in the absence of fire [e.g., 16, 17].

Whiteleaf manzanita and buckbrush ceanothus have an intimate relationship with fire, and fire is at the center of the chaparral controversy, but more on that later.

**Background**

High-severity fires are characteristic of chaparral

Important for chaparral persistence


Left: High-severity fire in SW OR chaparral.

Right: Whiteleaf manzanita regeneration from seed after fire.

The relationship of fire to the chaparral community as a whole is also fairly well-understood, in southern California in particular. The aboveground tissues of chaparral shrubs are easily killed by fire [14[, leaving very few or no survivors – high-severity fires are characteristic across the range of chaparral [18], as you may know if you've seen news clips of fires burning around Malibu in California.

In fact, high-severity fires are important to chaparral persistence because they clear encroaching trees [19], and more heat stimulates better seed germination (up to a point) [20].

**Field Study**

Interior valleys of southwest OR among least studied in west

Chaparral here different than in CA?

We studied age structure

- species biology of recruitment and survival
- past interactions of chaparral and fire

But most everything we know about chaparral in general, and about whiteleaf manzanita and buckbrush ceanothus in particular, is from studies in CA [21]. As I mentioned earlier, chaparral in southwest Oregon is at the northernmost limit of this vegetation type, and has been isolated from CA chaparral for the last 4,000 years [3], and one of least studied areas in west [22, 23]. Could it be different?

We decided to look at age structure in chaparral in the Applegate Valley, because age structure can tell you something about both species recruitment and survival biology, and about how communities have interacted with fire in the past [this study is described in full in 24].

**Why** do we need to understand
SW Oregon chaparral
species biology, ecology, and relationship with fire?



Let's back up a minute. Who cares? Why do we need to know anything about SW Oregon chaparral species biology, ecology, and relationship with fire?

Land managers – mandate to conserve the public resource

How can we conserve what we don't understand?

Pressure to act in the absence of information

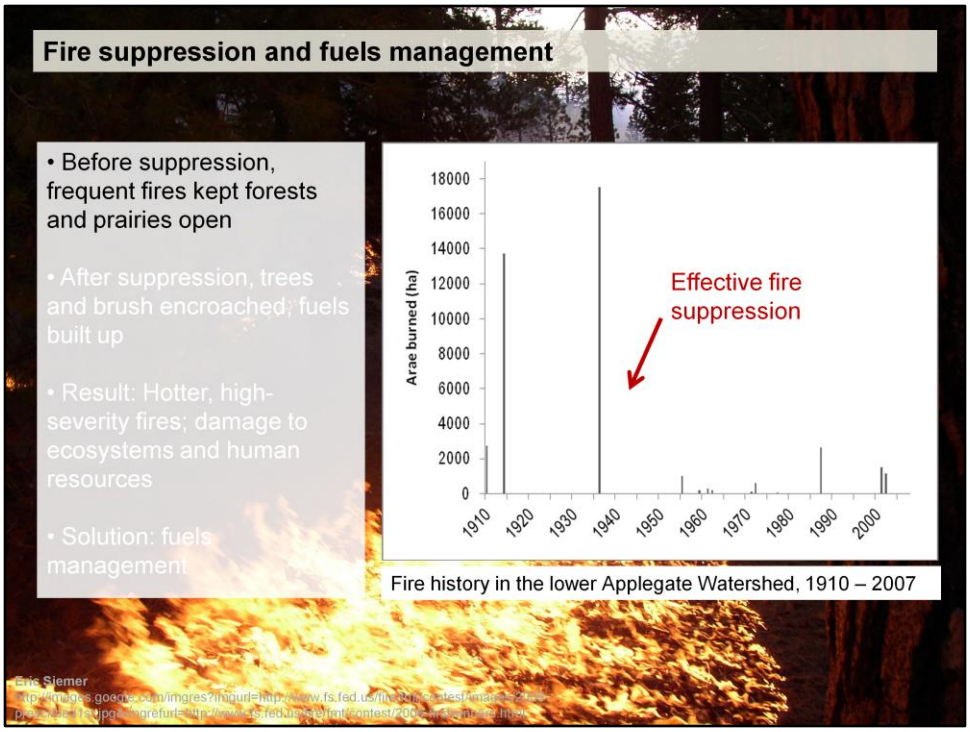
**Study Objective:**

**Better information for better management**

Because we live here, amid the chaparral. The people that manage the land on which chaparral grows – here, largely the Bureau of Land Management (BLM) – are responsible for conserving resources on that land the best they know how. How can we conserve this landscape when we don't understand it?

At the same time, managers of public lands are not often allowed to do nothing – they must make guesses and act, even in the absence of information.

The major point of our study was to generate more information about SW Oregon chaparral ecology for better management.

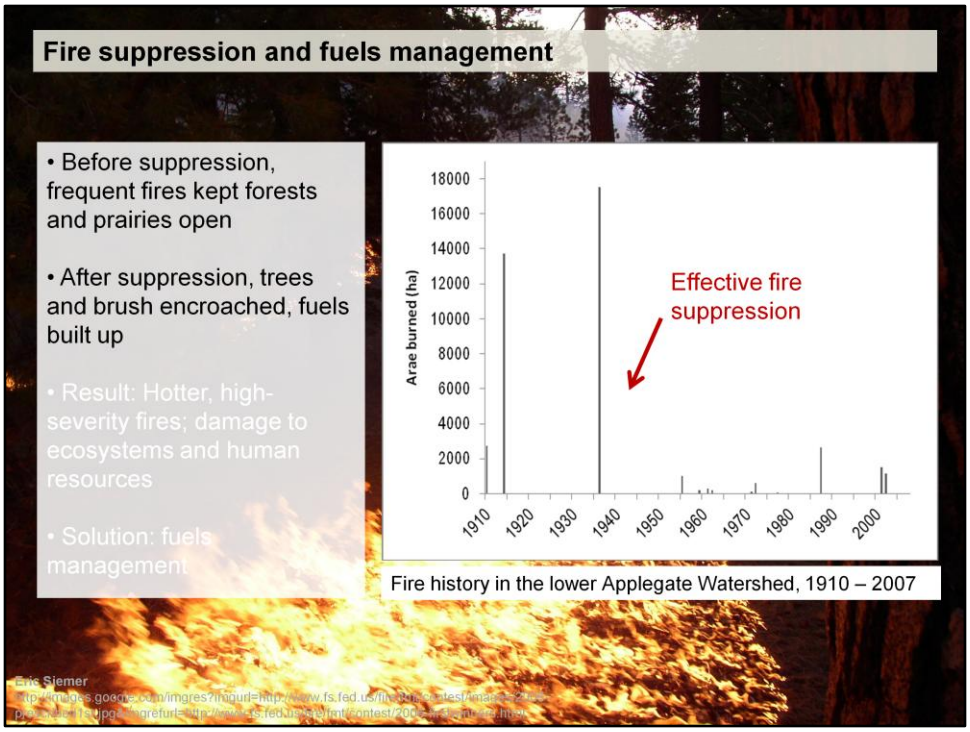



So, how has chaparral been managed so far?

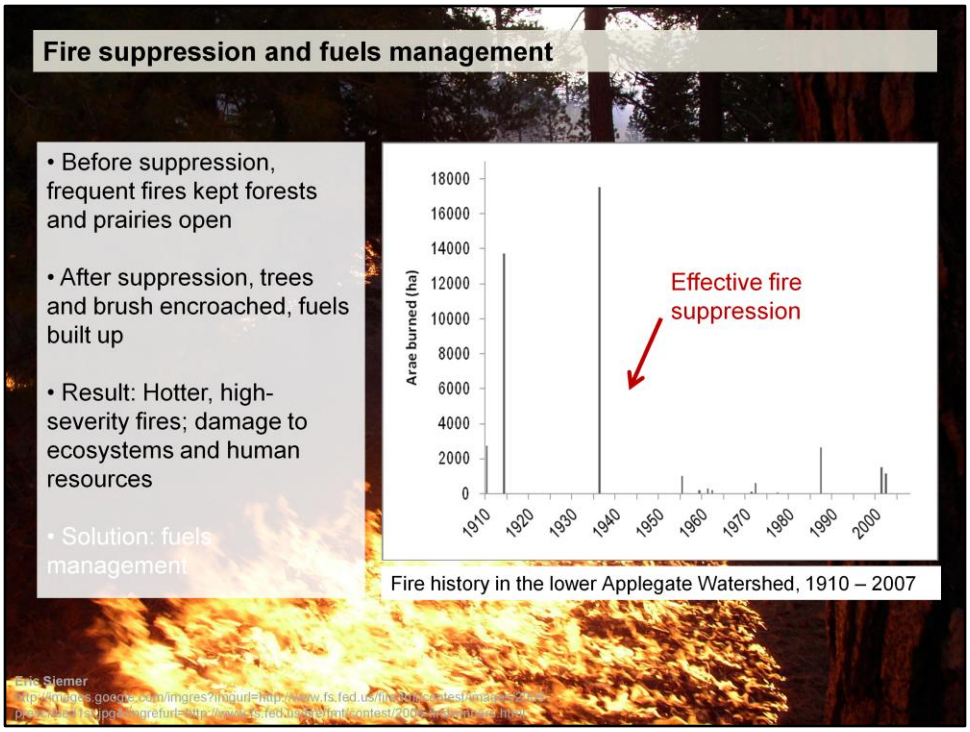
There's an idea that's become very popular among land managers and among the public, and it's the idea that fire suppression has universally changed all ecosystems.

The story goes that fires used to burn frequently and keep the prairies and forests open and keep brush out of them.

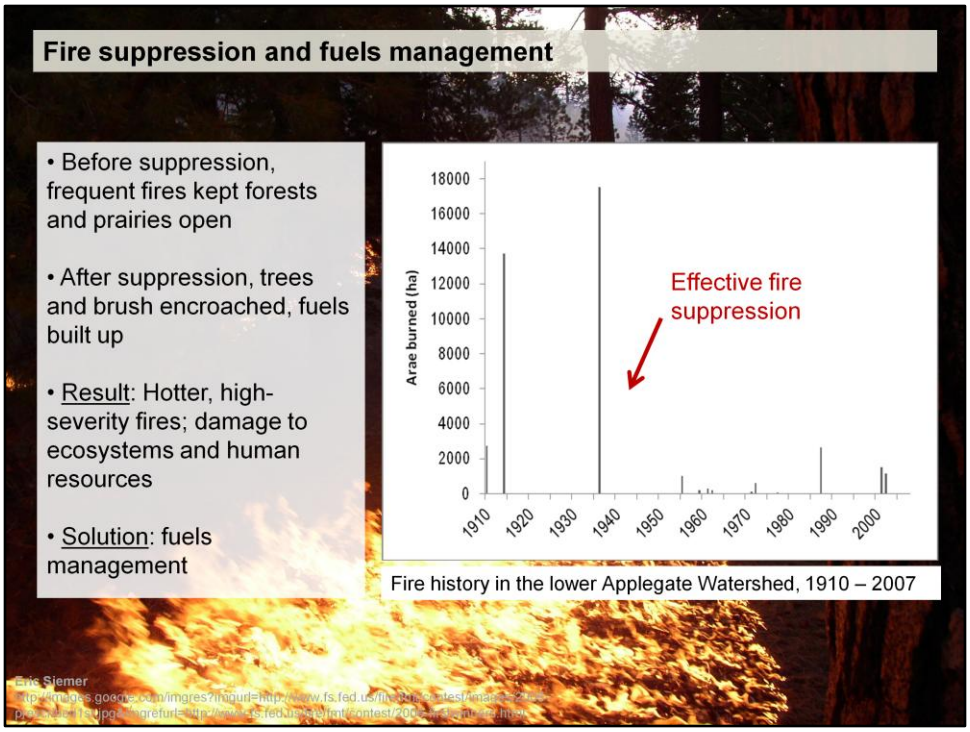
[Data for fire history graph from 25.]




Since the policy of fire suppression became effective, fires have decreased and prairies and forests have filled in with trees and brush.




When fires do burn now, they burn with much higher severity, damaging ecosystems and human property. This information is well-founded in numerous studies, and we know it to be true for many ecosystems, including the forests of southwest Oregon [e.g., 19, 26, 27].




A favorite solution to fire suppression is fuels treatments, which can restore ecosystems by removing extra trees and shrubs that have encroached in the absence of fire, and that contribute to higher-severity fires that harm ecosystems and people's houses [28].


But has fire suppression universally affected all ecosystems? What about chaparral?

**Fuels management in chaparral**

- In the absence of information, the fire suppression model assumed to be true
- 12,000 acres/yr since mid-1990s, including in chaparral

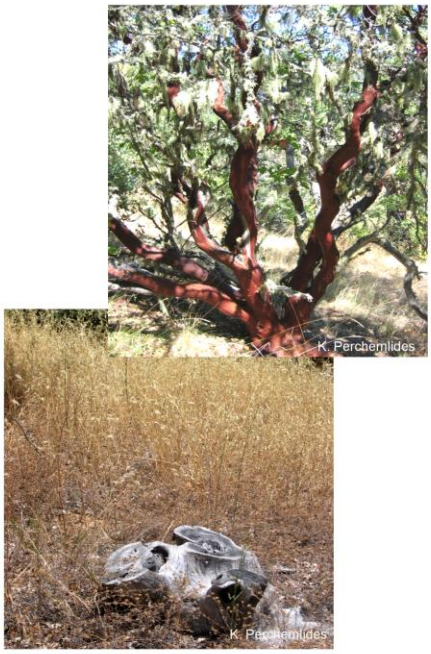

In the absence of better information about southwest Oregon chaparral, the model of fire suppression effects has been assumed to be true [28, 29].

In fact, many people believe that chaparral is an unnatural artifact of fire suppression, even though it was documented by the first settlers and land surveyors.

The BLM has been treating over 12,000 acres a year with fuels reduction since the mid-1990s, including in chaparral [30]. The most common treatment is cutting shrubs by hand then piling and burning them ("hand-cut pile and burn" treatment).

**Impacts of fuels reduction in chaparral**

- $300-$1,400+ per acre, public resources scarce
- can benefit native annuals, but also establishment and spread of exotics
  (Perchemlides, Muir, and Hosten 2008)
- wildlife impacts – can change bird composition
  (Seavy, Alexander, Hosten 2008)
- slow growing – treatment effects unknown but long-lasting




But, fuels reduction treatments do have their impacts.

They're expensive and labor intensive, and resources are scarce [cost from 31].

Fuels treatments can benefit native annual plants, but also help noxious weeds establish and spread [32, 33].

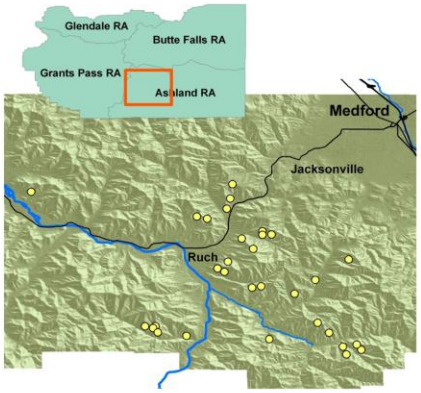
Impacts on dependent wildlife are largely unknown. A recent study partnership between BLM and Klamath Bird Observatory found that treatments can change bird composition [34].

Chaparral communities are very slow-growing. Treatments have very long-lasting effects, and we don't know what those effects are.

## Field Study

31 field sites, most shrubs already cut

age structure – distribution of ages in a stand

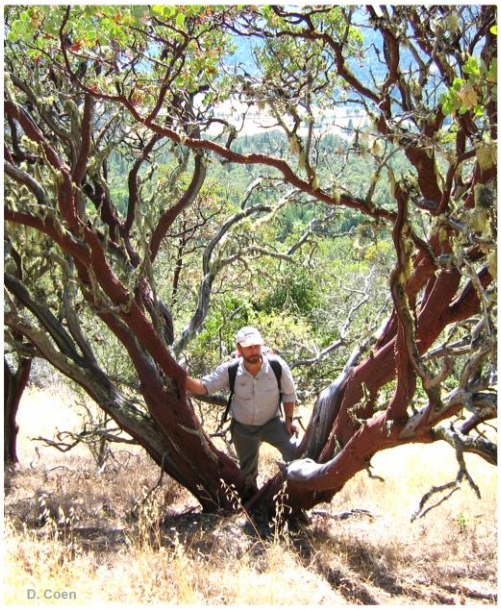



Back to our study of chaparral ecology. We had 31 sites in the Applegate Valley, mostly in areas already treated for fuels reduction.

In a nutshell, we studied age structure by taking a slices of wood from the bases of 15-25 randomly-selected shrubs in each stand, counting the rings, and looking at the distribution of ages in a stand.

## Results

- Oldest manzanita ≥ **146 yr**
  44 manzanita ≥ 100 yr
- Oldest ceanothus ≥ **114 yr**
  3 ceanothus ≥ 100 yr
- Diameters of 100 yr old shrubs
  **4" – 20"**




So what did we find?

First of all, we found that whiteleaf manzanita and buckbrush ceanothus can grow to be absolutely massive, and can attain ages older than most people –the oldest manzanita was at least 146 yrs old, and the oldest ceanothus was at least 100 years old. Old shrubs ranged from small to large; like many people, you can't tell how old they are by looking at them.

**Results**

Chaparral in SW Oregon is different from chaparral in California:

"obligate-seeders", but can **recruit without fire**

fires high severity, but sometimes **fire survivors**

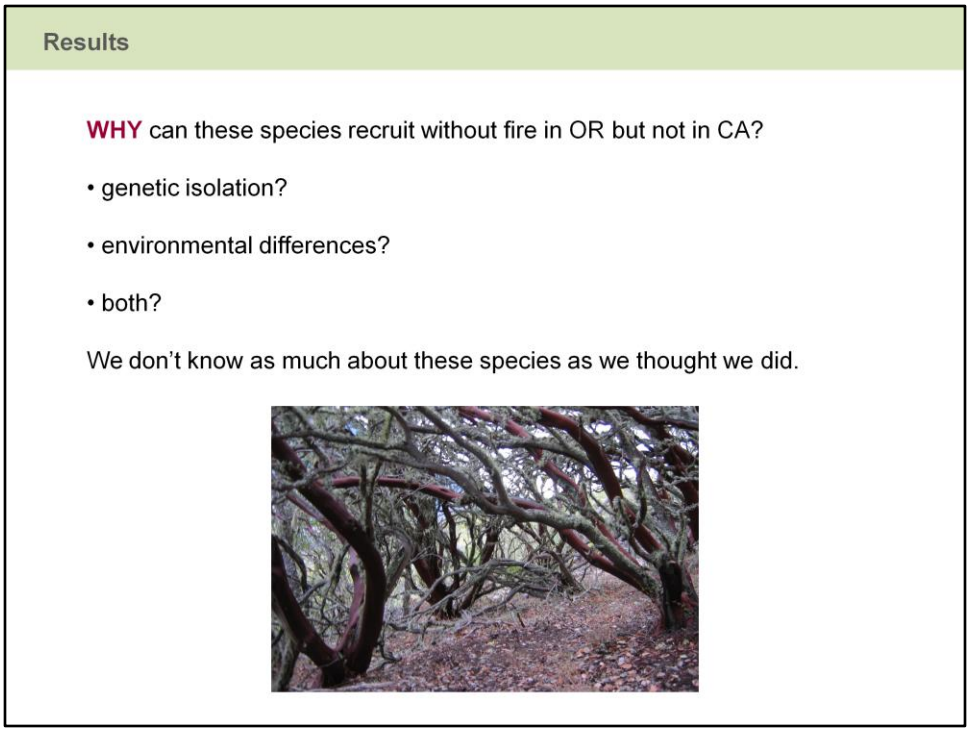
Buckbrush ceanothus shrub that recruited without fire

We also found that chaparral in SW Oregon is different from chaparral in CA, even in chaparral composed of the same shrub species:

-It may not be a surprise to you locals, but we found that whiteleaf manzanita and buckbrush ceanothus can successfully recruit in the absence of fire, even in intact, robust chaparral – this is rare in other Mediterranean type ecosystems [17, 35-37]. Shrubs that recruited in the absence of fire had suppressed growth rates [38], but persisted to at least 46 yr of age.

- We also found that even though fires in chaparral were high-severity and killed most shrubs, they left some shrub survivors, unlike fires in southern CA.

- So, in California chaparral and in other Mediterranean climates where researchers have studied so far, intact stands of obligate-seeder shrubs have been even-aged [16, 17, 39]. But in southwest Oregon chaparral shrublands, the norm is for stands to be uneven-aged.




Why? Why can whiteleaf manzanita and buckbrush ceanothus successfully recruit without fire in southwest Oregon and not in CA? Let me be clear that germination of these species in Oregon is still an order of magnitude greater when stimulated by fire [40, 41], and that recruitment of new shrubs into intact, robust chaparral is slow (average 46 new shrubs per ha per decade), but in CA it hasn't been observed at all.

- Maybe there has been genetic divergence between chaparral in Oregon and in CA, since they've been isolated from each other for the last 4,000 yrs [3].

- Maybe species are responding to the wetter conditions in the north of the chaparral range. One study showed that ceanothus germinates better when it's both wet and hot [42], a combination which may occur less often in CA.

- Maybe it's both genetics and environment. Some species cued to recruit in post-fire environments can track geographic or environmental trends [43, 44].

Whichever hypothesis is correct, I think it means that we don't know as much about these species as we thought we did, and the outcome is that SW Oregon chaparral is a different animal, so to speak, than the chaparral that has been studied in CA.

**Results**

Clues from fire survivors about SW Oregon chaparral ecology:

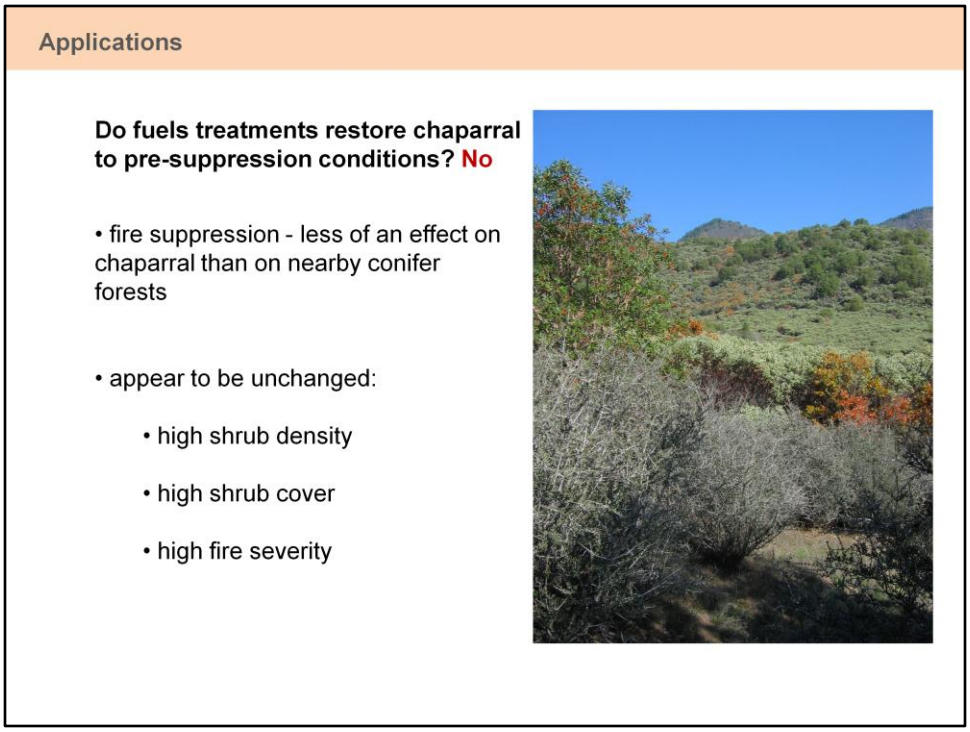
- fires were high-severity before and after fire suppression
- unlike CA, fires were patchy
- chaparral in SW Oregon may withstand more frequent fires

What do the presence of shrubs that survived fire tell us about the SW Oregon chaparral ecosystem?

- Well, there weren't many survivors – we found that, as in CA chaparral [18], fires were high severity and killed the majority of shrubs. This was true of fires that burned before effective fire suppression, in 1936, and of fires that burned after fire suppression, in 1982.

- But, the fact that some shrubs survived fire tells us that fires in SW Oregon chaparral may burn in a patchy way that is different from the huge sweeps of fire that you may have seen video footage of CA.

- Shrub fire survivors also tell us that SW Oregon chaparral may be able to withstand more frequent fire than CA chaparral. Shrubs that reproduce only by seed need enough time between fires to establish, reach maturity, and build up sufficient seed stored in the soil – many studies have found that if fire wipes out the whole stand before this can happen, chaparral will go extinct at that location [e.g., 37, 45]. Shrubs that are obligate seeders generally need at least 20 yr between fires to build up replacement-level seedbanks [ e.g., 46]. But if fires in SW Oregon chaparral leave a shrub or two to start replenishing seedbanks right way, the stand may be able to partially regeneration if another fire comes before the new flush of shrubs can mature. (Nonetheless, very frequent fire is still very likely to degrade SW Oregon chaparral and should be prevented where conserving chaparral is an objective.)




Do fuels treatments in chaparral effectively restore pre-fire suppression structure and function?

According to our study, no.

Fire suppression appears to have had less of an effect on chaparral than on nearby conifer forests:

Shrub cover and density appears to have been high both before and after fire suppression [for cover, compare high pre-suppression cover in 41 with high post-suppression cover in 33].

Recruitment of shrubs in the absence of fire adds an average of 46 new shrubs per ha each decade (this is roughly equivalent to an addition of 2.3% canopy cover). However, stands also self-thin through time. We found that, unlike conifer forests, the density of shrubs decreases the longer the stand is unburned. (We did not study changes in fuel loading over time.)

Fires appear to have burned hot and with high severity both before and after fire suppression.

This result is similar to California, where there is also little evidence that fire suppression has been associated with changes in chaparral structure or fire severity [47, 48].

Applications

**Current fuels treatments don't re-create pre-suppression structure or function**

Shrub cover in treated stands is **> 7xs lower** than in undisturbed stands

Shrub cover retained by treatments is **> 7xs greater** than left by fire

Treatments don't stimulate natural levels of regeneration of shrubs or post-fire endemics (Perchemlides et al. 2008)


Untreated and treated manzanita chaparral

Fuels treatments as they're currently practiced don't recreate pre-suppression chaparral structure or function:

Shrub cover in treated stands is **> 7xs lower** than cover in undisturbed stands [compare cover in 40 and 41]

Treatments don't mimic the function of fire:

Shrub cover retained by treatments is **> 7xs greater** than cover left by fire [compare cover in 40 and 24]

Because hand-cut pile and burn treatments don't have a stand-level fire component, the treatments don't stimulate natural levels of regeneration of shrubs or plants endemic to post-fire chaparral [33]

Applications

**Does chaparral need restoration?**

**Maybe???**

Fire is key to chaparral persistence, fire suppression has decreased fire

But, some chaparral retains ability to regenerate after 100+ yrs without fire (Keeley et al. 2005)

Above: Enormous whiteleaf manzanita.

Left: Burn pile scars in treated chaparral, Applegate Valley

Does chaparral even need restoration from damage caused by fire suppression?

The answer is a definitive I don't know, and a less definitive maybe.

The fire history record clearly shows fire in chaparral has diminished since fire suppression became effective, and as we've seen, fire is essential to the continued functioning of chaparral. What if seeds stored in the soil die before the next fire comes to stimulate germination?

One study in Sierra Nevadas of CA found that chaparral unburned for over 100 yrs retained its ability to recover after it was finally burned [49]. We need similar information for chaparral in SW OR. Are very old stands 'decadent' and in need of replacing or not?

## Applications

**What should managers responsible for conserving chaparral do?**

Goals to reduce fire hazard and conserve incompatible

'Natural' – let hot, high-severity fires burn

But…

So what should managers responsible for conserving chaparral do?

Because chaparral appears to naturally burn hot and high severity, it appears that mandates to both restore chaparral and reduce fire hazard are in conflict.

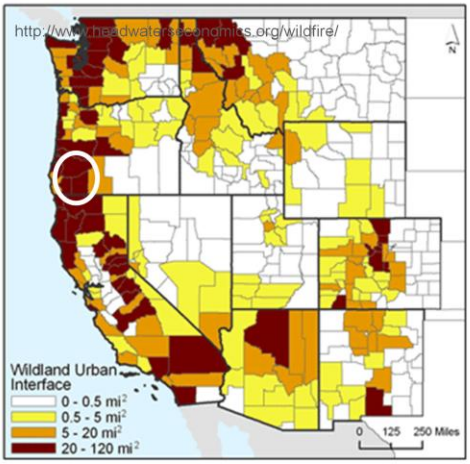
The most 'natural' thing to do may be let it burn in hot, high severity fires. But what if you live in this house, surrounded by chaparral?

## Applications

**More important (politically) than conservation – fire hazard reduction to human resources**

Highest wildfire risk in
- Josephine and Jackson counties

Public-private land
- checkerboard – possibility of lawsuit drives decision-making




Josephine and Jackson counties 1st and 2nd in west for Wildland Urban Interface wildfire risk (Gude et al. 2008)

There's the conservation mandate, but the much more important objective for managers, politically, is reducing fire hazard to timber, houses, and other human resources.

Josephine and Jackson counties were ranked #1 and #2 in west for residential area adjacent to wildlands – this is a huge wildfire risk [50].

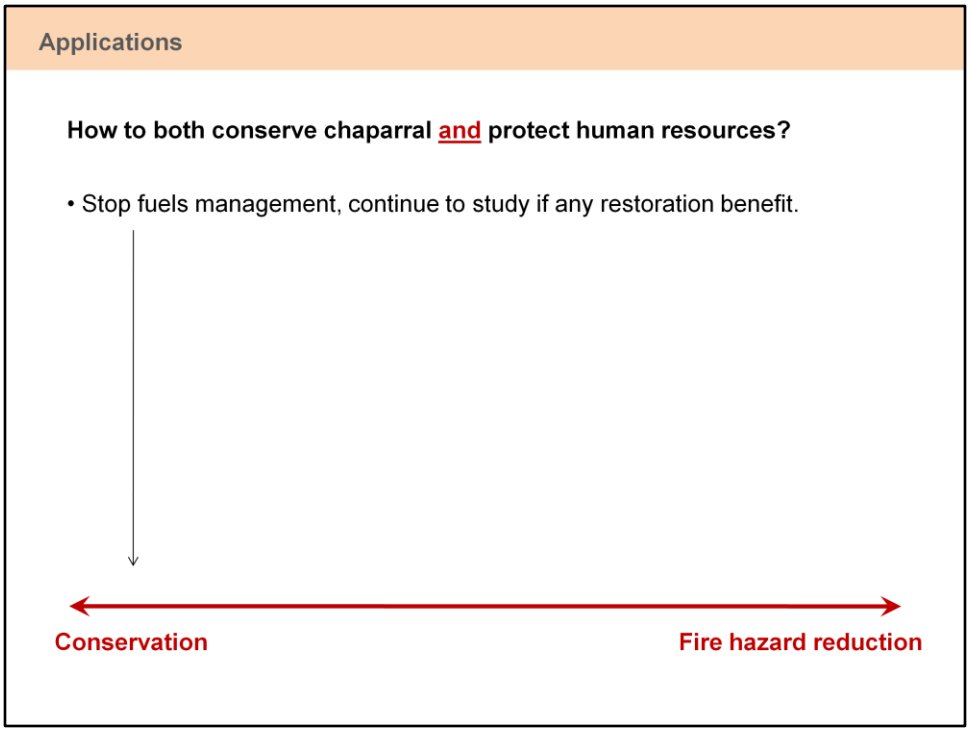
In much of the west, public land is in a checkerboard pattern with private land, so public land managers have to be careful of their neighbors. Managers live in fear of getting sued, and that drives much of their decision-making.

Applications

**How to both conserve chaparral and protect human resources?**

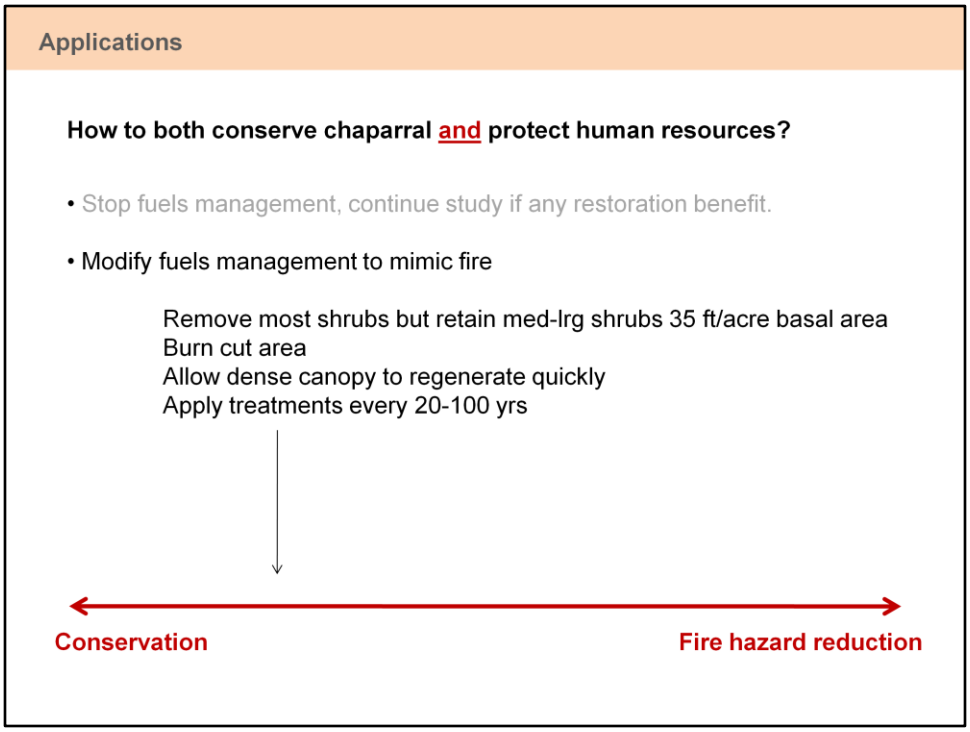
The burning question, so to speak, is how to both conserve chaparral and protect human resources.

Last March (2010) we met with the BLM, presented our results to them and talked about why we thought fuels treatments were not restoring chaparral, and what changes need to happen. I'll try to summarize parts of that conversation here.




To conserve chaparral, one idea is to just stop fuels reduction in it. If we study it more and find it has been degraded by less fire, we can go from there.

On the continuum of strategies from conserving chaparral to reducing fire hazard, this strategy probably leaves a lot of unhappy people.

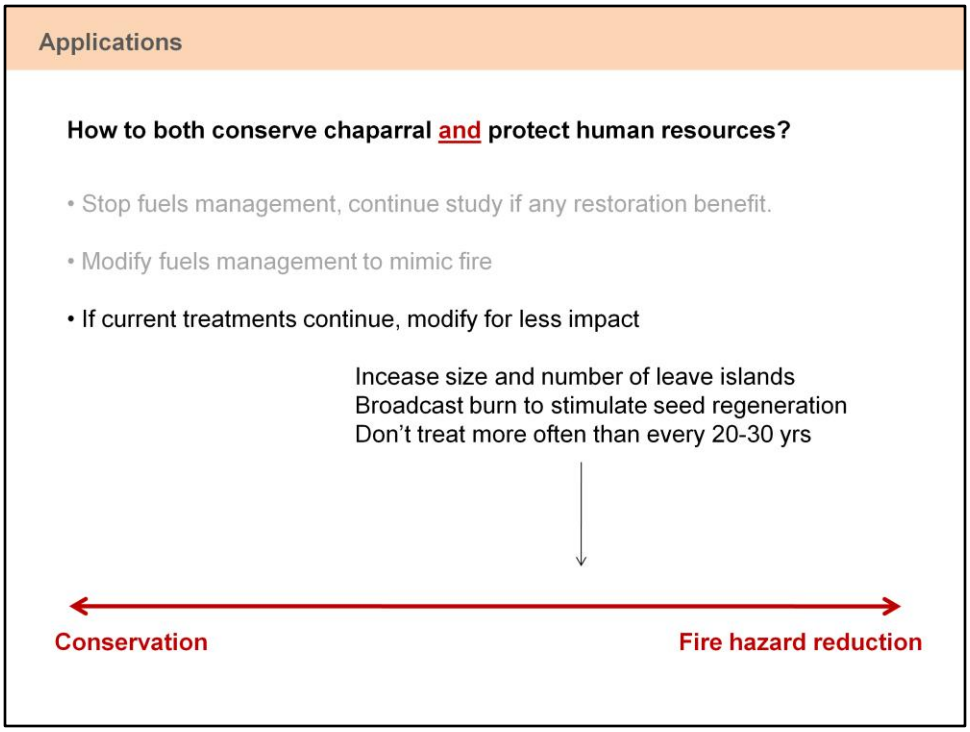



If we could develop fuels treatments that mimic the natural function of fire, what would that look like?

If we based our treatment model on observed chaparral structure and function prior to fire suppression, we would mimic fire by:

- Removing most shrubs but retain medium to large-sized shrubs whose trunks add up to 35 feet/acre
- Burning the cut area hot enough to stimulate seed germination of shrubs and forbs
- Allow a dense shrub canopy to regenerate quickly
- Apply treatments every 20-100 yr

Aside from the question of whether such treatments are even necessary, this kind of treatment may still be too far away from reducing fire hazard for many people, and people in turn pressure public land managers.

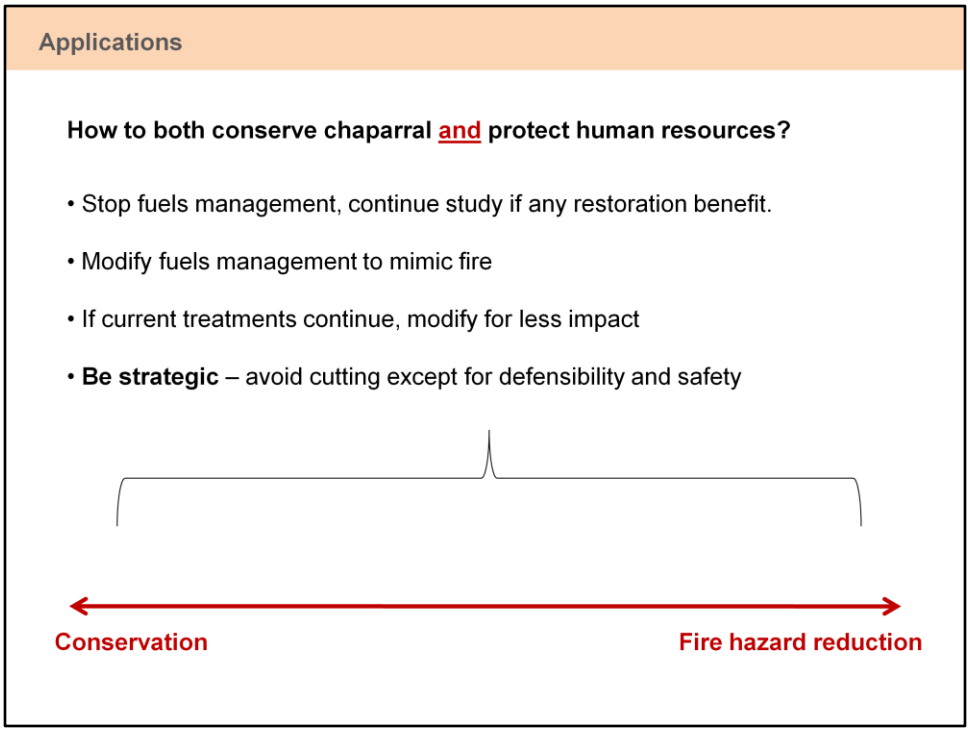



If treatments similar to those currently implemented continue, we suggest modifications for less impact:

- The size and number of leave islands (untreated areas) should be increased
- Treated sites should be broadcast burned to stimulate seed germination
- Sites not be treated more often than every 20-30 yrs.

The fuels guys at the BLM say that treatments are already shifting in the direction away from creating evenly-spaced shrub 'orchards' and toward leaving larger shrub patches uncut.

The BLM has tried broadcast burning treated sites, but this kills all the shrubs they didn't cut. These species are very easily killed by fire. The public is also very wary of any burning.




Wherever we treat, we should be strategic. We should avoid cutting except where needed to increase defensibility and firefighter safety.

Due to the shortage of money, the BLM has had to make fewer treatments 'count' more – they are increasingly interested in strategic treatments. Treatments are being planned near people's houses, roads, and ridges, and less in the so-called middle of nowhere.

Applications

**Need more information:**

- Do fuels treatments reduce fire hazard?
- What happens to treated landscapes in the long term? Monitoring.
- How are dependent wildlife species impacted?

We also need more information about treatments:

- We actually don't understand very well whether these fuels treatments will work to reduce fire damage. So far, one observation here suggest that they don't work in conditions of severe fire weather [51], but we need information on how they work under other conditions.

- What happens to treated landscapes in the long term? We need extended monitoring on consequences for native and exotic plants.

- We need more information on how dependent species like wildlife are impacted by treatments.

And, the BLM still has a whole list of their own questions to which they need answers for better management.

## Applications

No treatment will remove fire hazard

Klamath region diversity has evolved with fire, will continue to burn

Fire-safer living

Of course, there is no treatment that will completely remove the fire hazard. The well-known diversity of the Klamath region has evolved in concert with fire [22], and this region will continue to burn, fire suppression notwithstanding.

There has been progress made in learning to live in chaparral and dealing with inevitable fire both here in southwest Oregon [31] and in California [52].


The first step toward chaparral conservation, however, is valuing chaparral in the first place. It hasn't been very popular in southwest Oregon – it takes up space that could instead grow forage for cows or timber, and it is no fun to crawl through. The public fears fire, and likes neat and tidy landscapes.

However, I hope that I have convinced you that chaparral is worth something. Right now, I believe that the biggest step we can take toward chaparral conservation is convincing land managers and the public that it has a right to be here in the first place.

# Thank You!

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**Website:**

Search: "fuels reduction southwest Oregon"

http://people.oregonstate.edu/~muirp/FuelsReductionSWOregon/



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