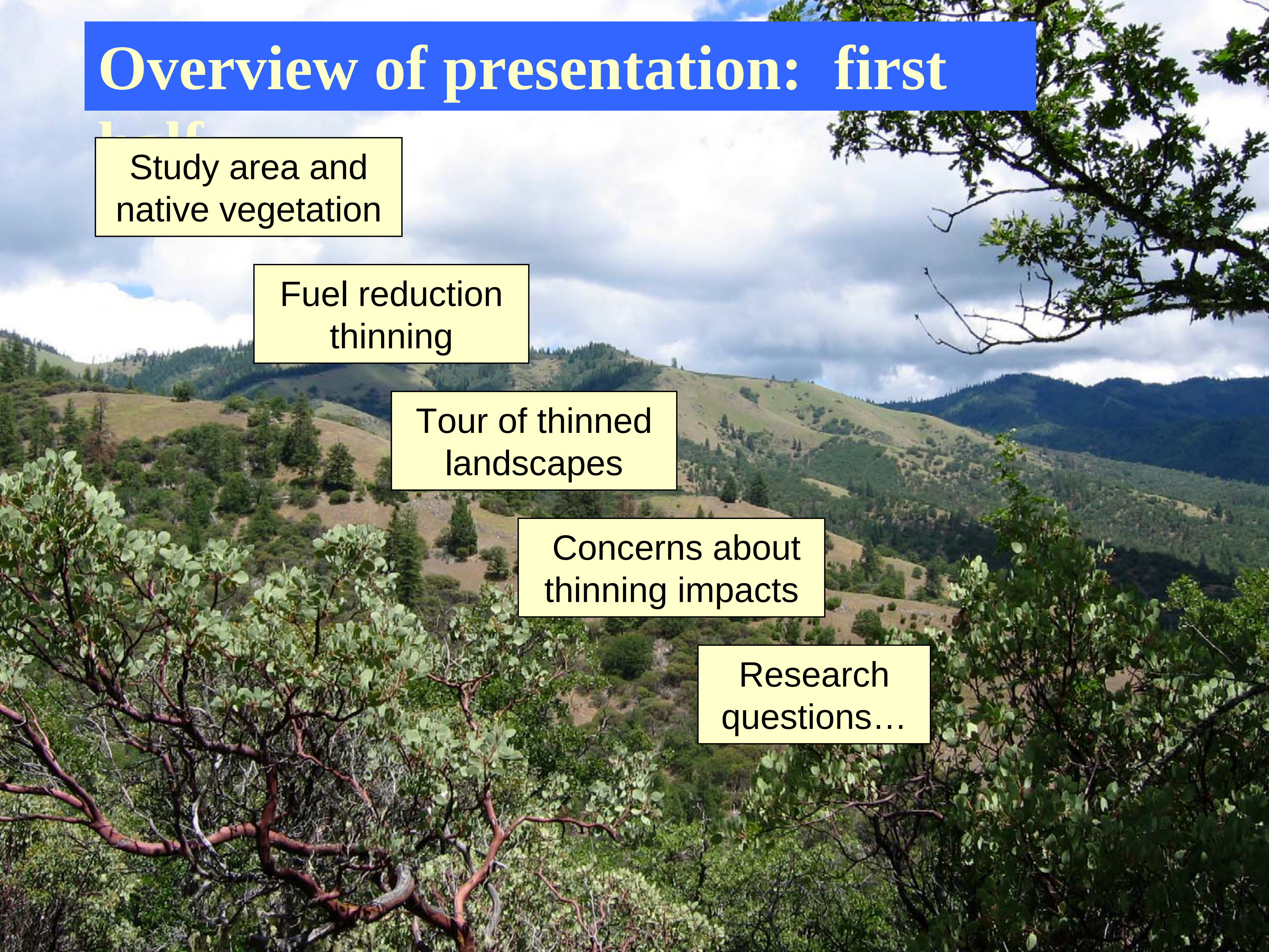
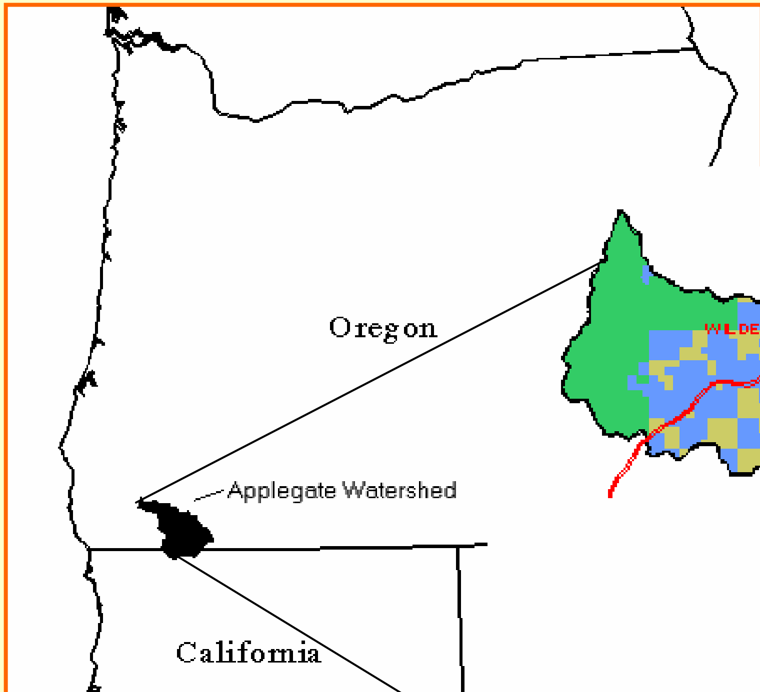
Impacts of Fuel Reduction Thinning on Chaparral and Oak Communities of Southwestern Oregon

Overview of presentation: first half



- Study area and native vegetation
- Fuel reduction thinning
- Tour of thinned landscapes
- Concerns about thinning impacts
- Research questions…

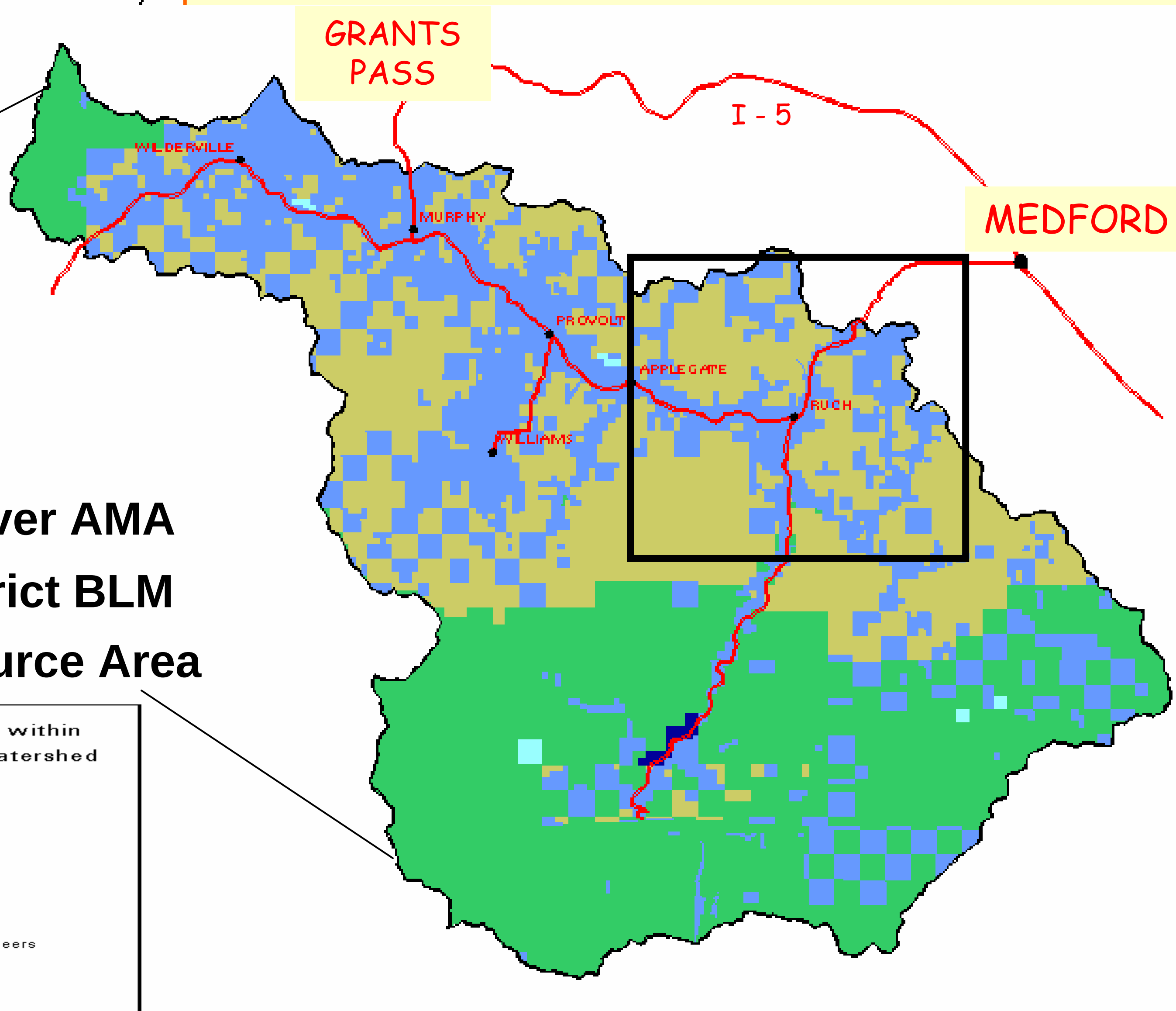
Study area:

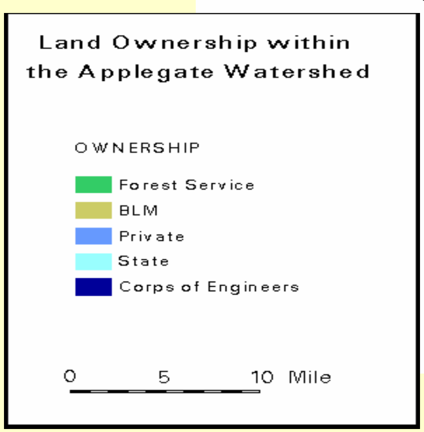


Applegate River AMA

Medford District BLM

Ashland Resource Area

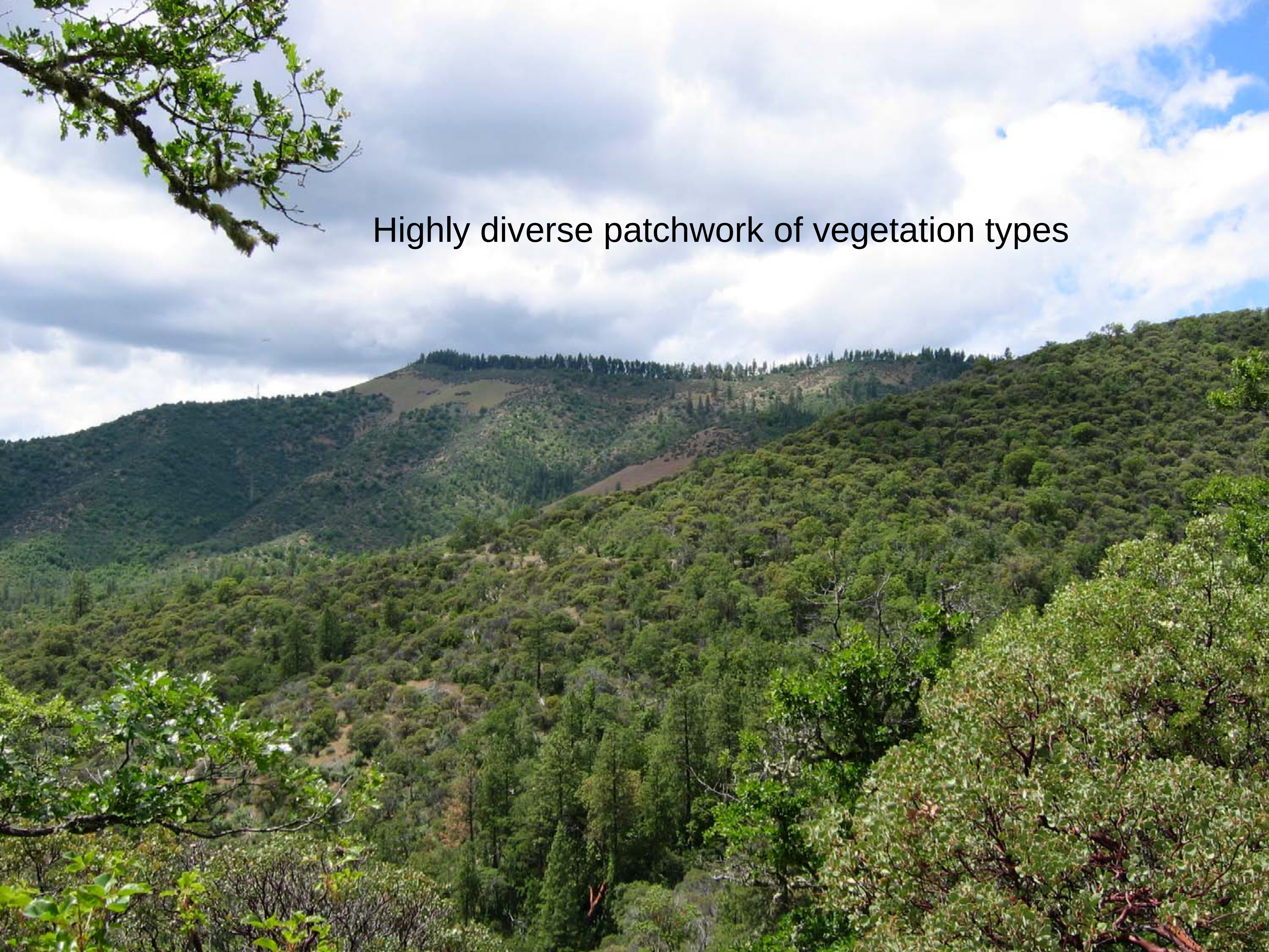


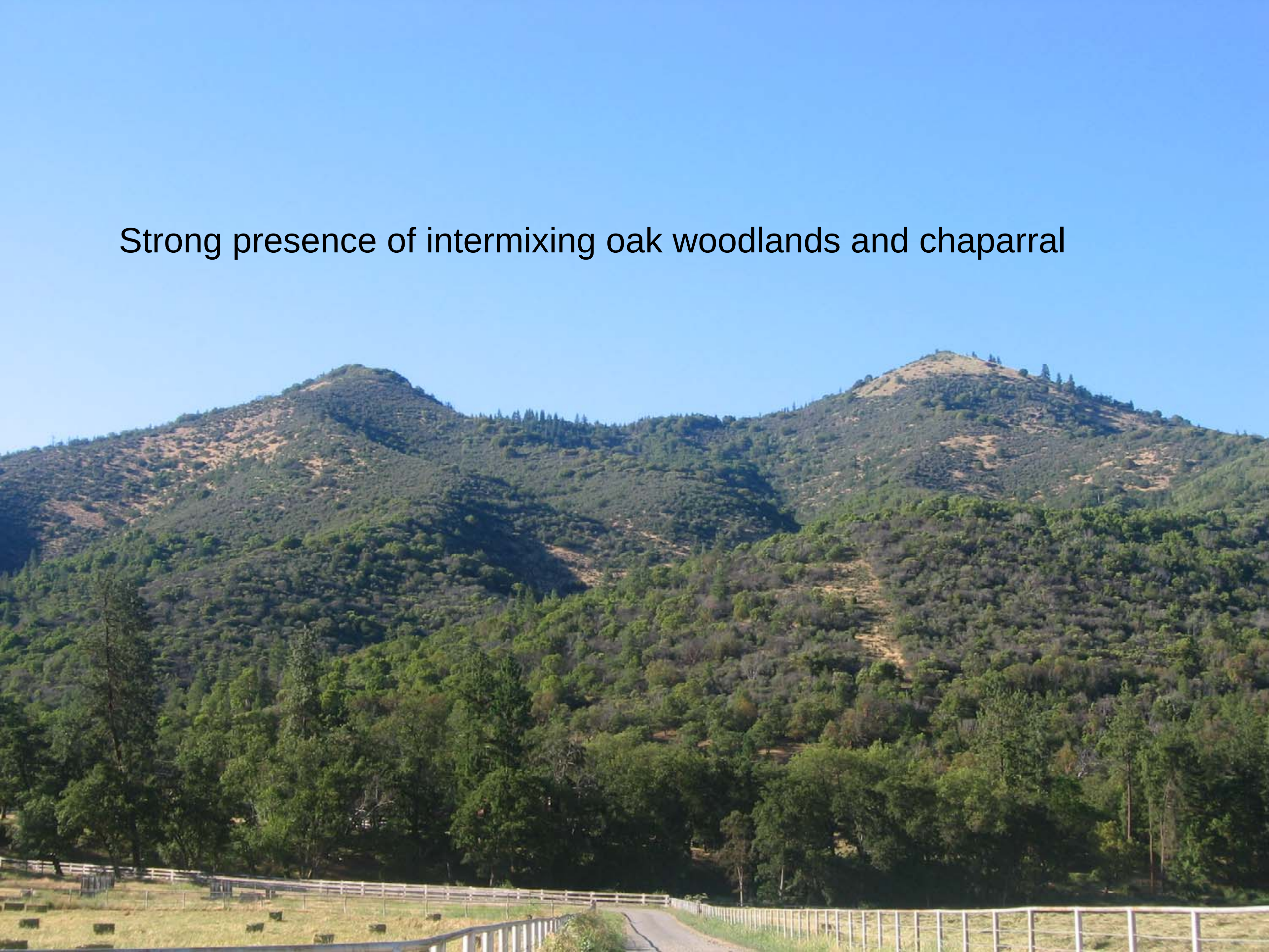


www.reo.gov/ama/locations/applegate.htm


Klamath/Siskiyou bioregion, Mediterranean type climate

Unique intersection of several floristic regions


Highly diverse patchwork of vegetation types


Strong presence of intermixing oak woodlands and chaparral

Diversity of chaparral and oak communities

Diversity of chaparral and oak communities…

Manzanita chaparral: *Arctostaphylos viscida*

Diversity of chaparral and oak communities…

Ceanothus chaparral
“Buckbrush”:
Ceanothus cuneatus

Diversity of chaparral and oak communities…

Mixed shrub and oak:
Quercus garryana,
A. viscida and *C. cuneatus*

Native grasses:

Achnatherum lemmonii

Bromus carinatus

Bromus laevipes

Elymus glaucus

Elymus elymoides

Festuca idahoensis

Festuca californica

Poa secunda

Native forb families:

Apiaceae

Asteraceae

Boraginaceae

Fabaceae

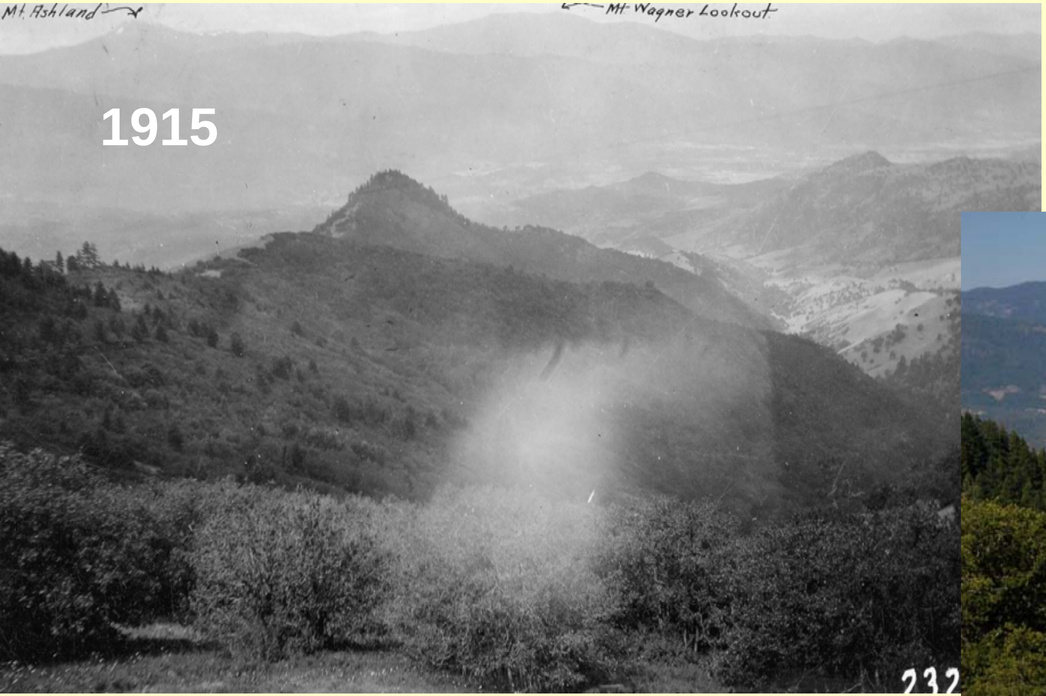
Liliaceae

Lamiaceae

Onagraceae

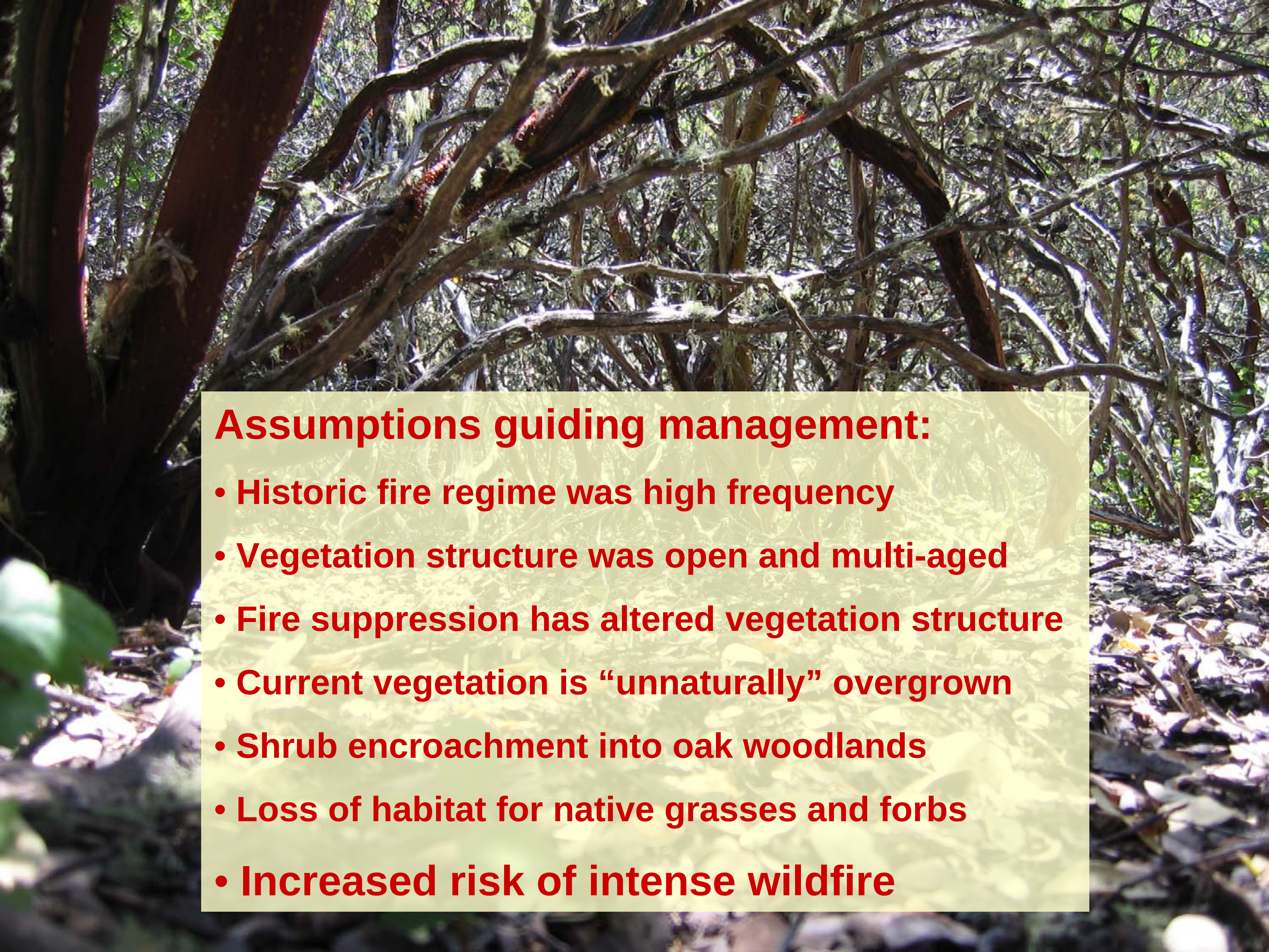
Historic fire regime and landscape vegetation structure:

- Native American burning and wildfire
- European settlement: land clearing, farms and ranches
- Past century of logging, mining, grazing and fire suppression
- Current town and residential expansion into rural areas
- **Lack of research on pre-European conditions in this area**



- Chaparral natural local vegetation
- Extent and stand structure unknown

Photos courtesy of Paul Hosten, Medford BLM



Assumptions guiding management:

- Historic fire regime was high frequency
- Vegetation structure was open and multi-aged
- Fire suppression has altered vegetation structure
- Current vegetation is “unnaturally” overgrown
- Shrub encroachment into oak woodlands
- Loss of habitat for native grasses and forbs
- **Increased risk of intense wildfire**

Fuel reduction thinning

Medford District BLM:

- Landscape-scale thinning program
- 1000’s hectares annually since mid-90’s
- 7000+ hectares of chaparral and oak from 1996 to present



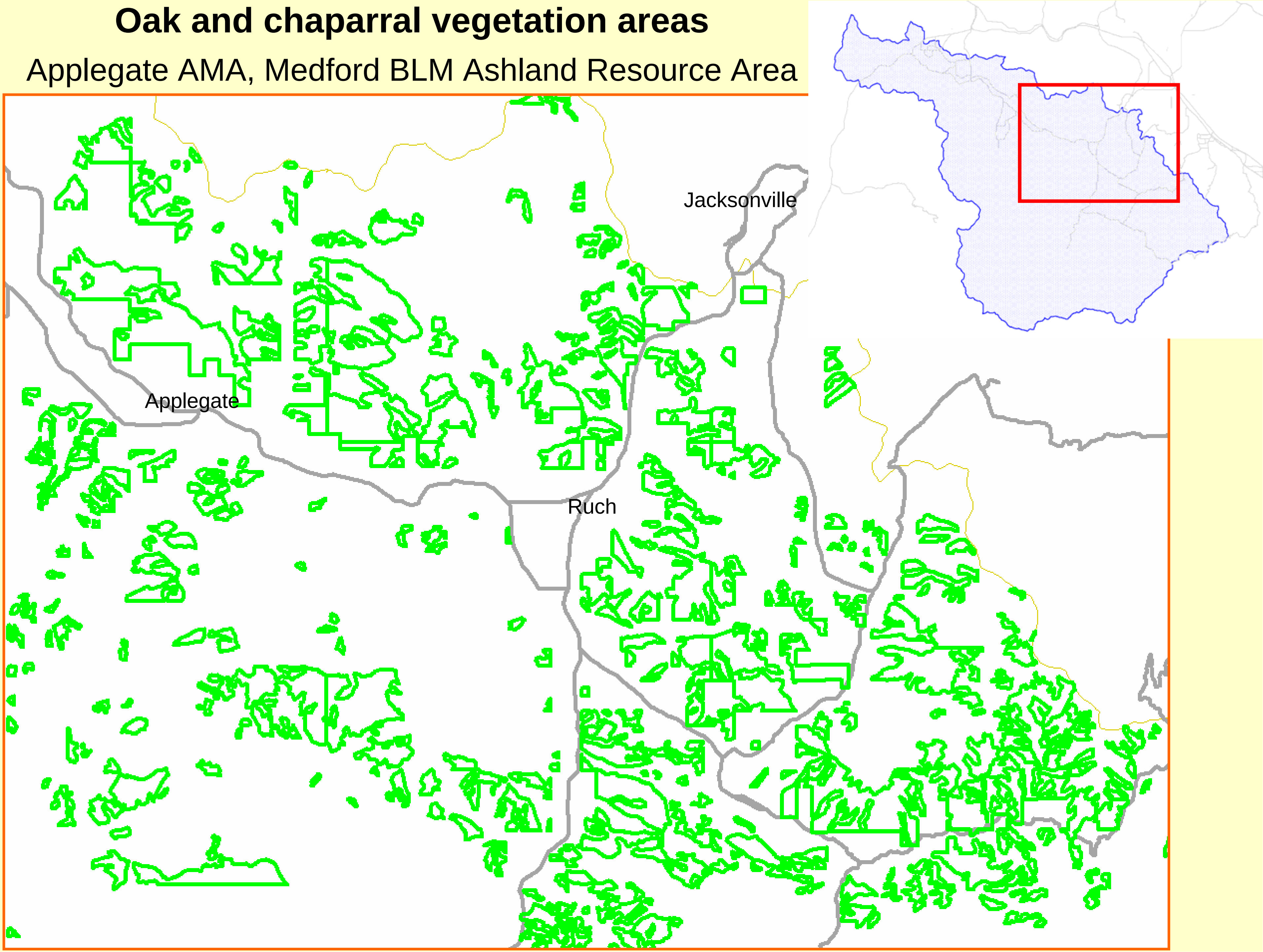
Fire control reasons for thinning:

- Avoid unnaturally high severity fires
- Protection at Rural-Interface-Areas
- Landscape compatible with fire control

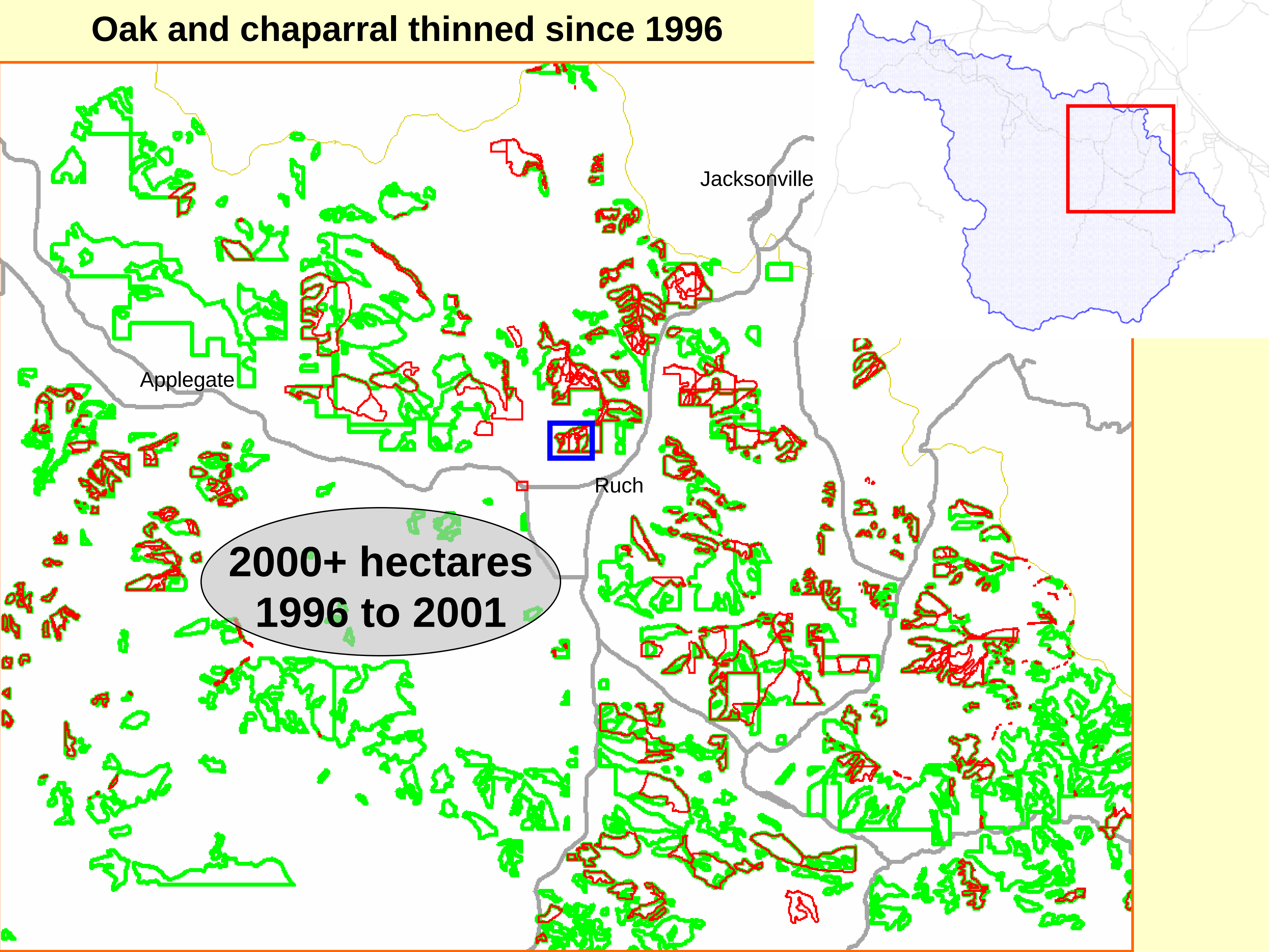

Restoration reasons for thinning:
• Restore historic oak-grassland habitat
• Open up overgrown closed canopies
• Safely reintroduce fire: prescribed burns

Oak and chaparral vegetation areas

Applegate AMA, Medford BLM Ashland Resource Area



Oak and chaparral thinned since 1996



Area of mixed oak and chaparral vegetation before thinning:

Same area of oak and chaparral after thinning:

Landscape-scale thinning…


> 90% stem density reduction


> 70% canopy cover reduction


Landscape without thinning


Landscape after thinning

Manual thinning: Hand-cut, pile and burn

Burn pile soil scars

Photo courtesy of Kendra Sikes, OSU

Mechanical mastication: Slashbuster™

Slashbuster wood debris…


…four years later

Ecological concerns about thinning:

- **Fire-adapted native plant communities…**
- **Fire suppression and thinning both unnatural**
- **Response of native plant systems unknown**
- **Possible loss of native soil seed banks**
- **Spread/dominance of invasive plants**
- **Soil impacts: debris layer and burn pile scars**
- **Lack of monitoring program/study of impacts**

<u>Big picture questions:</u>

What are the ecological impacts of these fuel reduction thinning treatments?

Are thinning treatments achieving restoration goals?

Main research question:

Overall treatment effect?

How are native herbaceous communities responding to thinning treatments? **(herbaceous = grasses and forbs, plus tree and shrub seedlings)**

Are treatments allowing invasive species to expand or take over?

Are canopy species of trees and shrubs regenerating after thinning?

What are the longer-term outcomes after 4 to 7 years post-treatment?

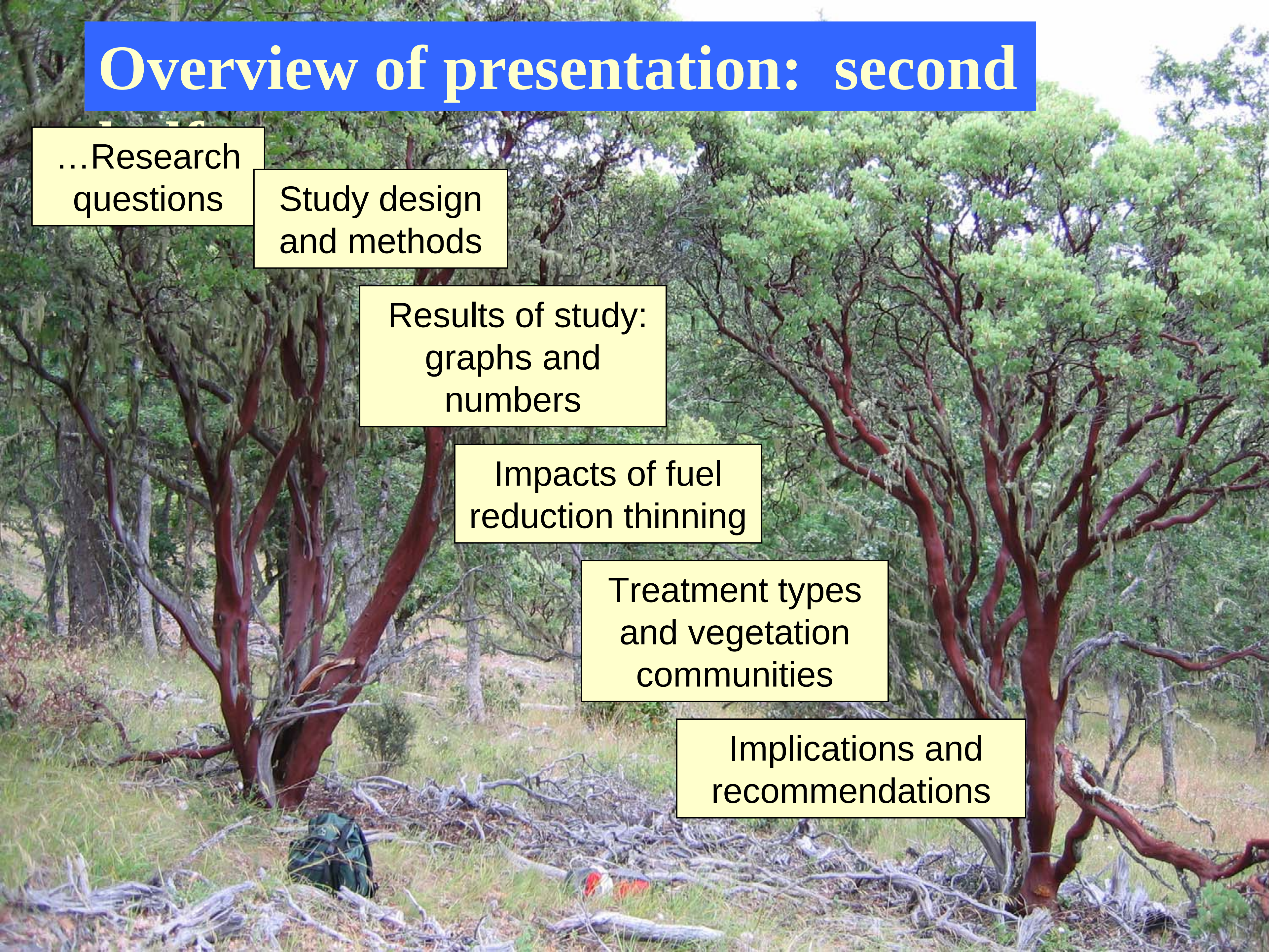
Additional research questions:

Do Slashbuster and manual thinning have different impacts?

<u>Additional research questions</u>:

Do manzanita, ceanothus and mixed shrub/oak have different herbaceous communities…

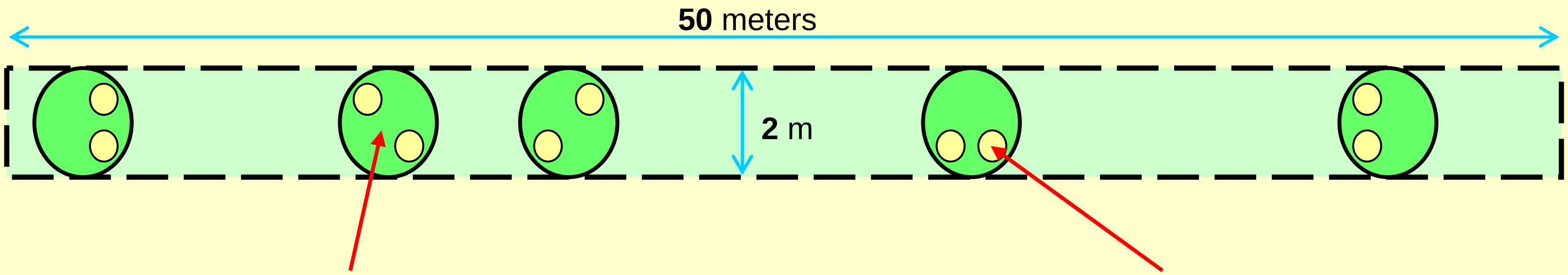
…and different responses to thinning?


Overview of presentation: second
…Research questions
Study design and methods
Results of study: graphs and numbers
Impacts of fuel reduction thinning
Treatment types and vegetation communities
Implications and recommendations

Paired transects study design:

- Find sites matched except for thinning treatment
- Sample transects inside and outside of thinned area
- Difference between thinned and unthinned **=** treatment effect

Sampling method for each transect:



Canopy cover plots (5):

- **Trees and shrubs**:

species

% cover

size class

stem counts

- **Burn pile scars** (% cover).

Herbaceous cover plots (10):

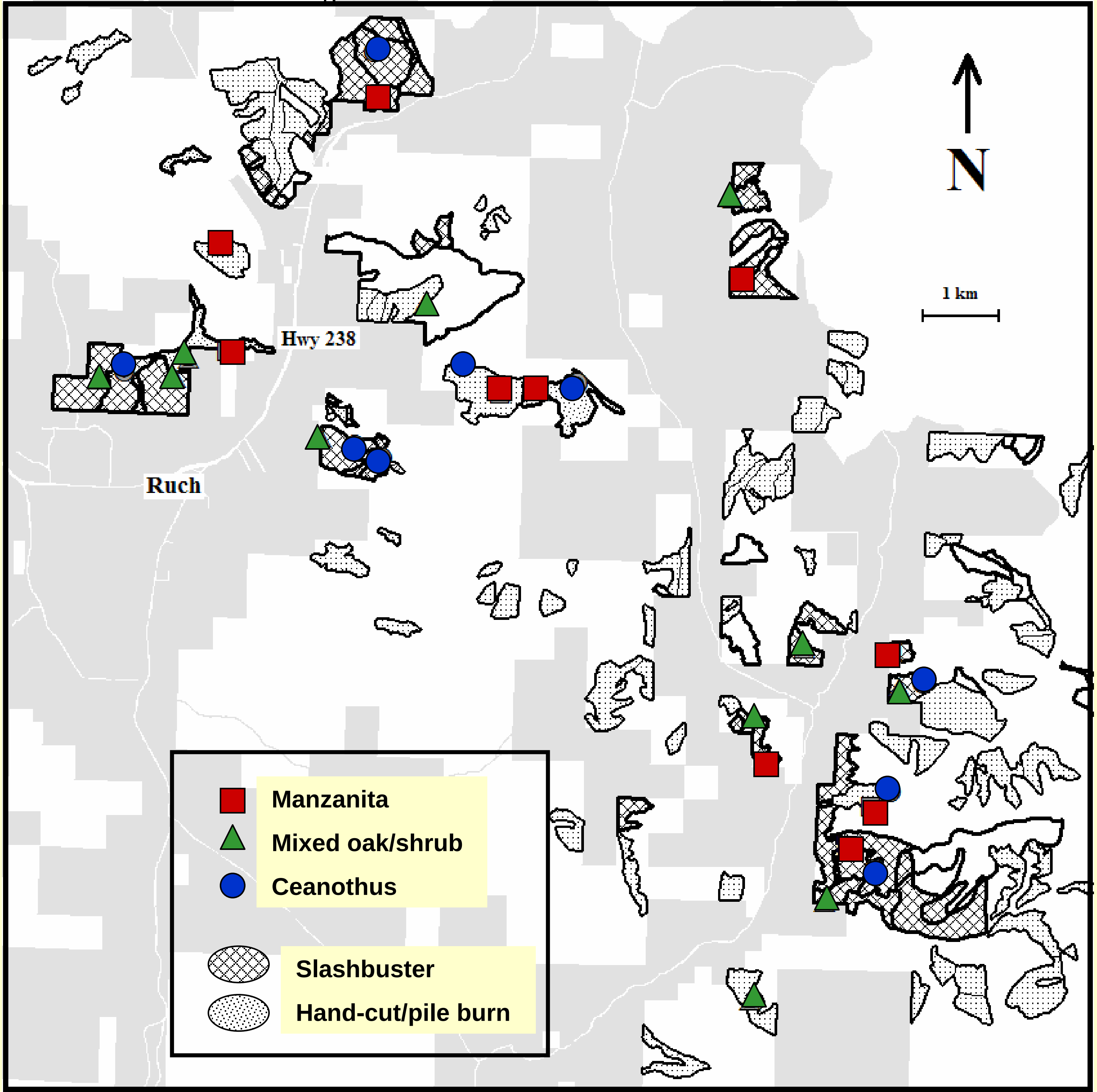
- **Grasses, forbs, tree and shrub seedlings**:

species

% cover

- **Substrate** (% cover):

soil, litter, wood debris.



N
1 km
Hwy 238
Ruch
Manzanita
Mixed oak/shrub
Ceanothus
Slashbuster
Hand-cut/pile burn

30 transect pairs total

18 Slashbuster
12 Hand-cut/pile-burn

10 Manzanita
11 Mixed oak/shrub
9 Ceanothus

All sites thinned 1998 – 2001

Sampled June – July 2005

Span of 4 to 7 years post-treatment

Elevation 500m to 1000m

Southeast to southwest exposures

Slopes from 10^o to 35^o

126 species total

As trait categories:

101 Native

25 Exotic

70 Annual

56 Perennial

As functional groups:

10 Native perennial grasses

1 Native annual grass

11 Exotic annual grasses

30 Native perennial forbs

46 Native annual forbs

12 Exotic annual forbs

Categories and functional groups
= summary variables for analysis

Data Analysis Process

transect data & within-pair difference data

non-parametric statistical tools

Multivariate analyses:
Species % cover data

Ordinations: graphical summary - data patterns

MRPP tests: differences between groups:

- thinned : unthinned
- treatment types
- vegetation communities

Univariate analyses:

Single variable tests:
differences in means

- Wilcoxon sign-rank
- Wilcoxon rank-sum
- Kruskal-Wallis

Correlations: with ordination axes

Results – simple answers:

Summary of ordination and MRPP analyses

- *Was there a treatment effect?*

  Yes! Both site conditions and herbaceous species composition.

- *Do vegetation communities differ?*

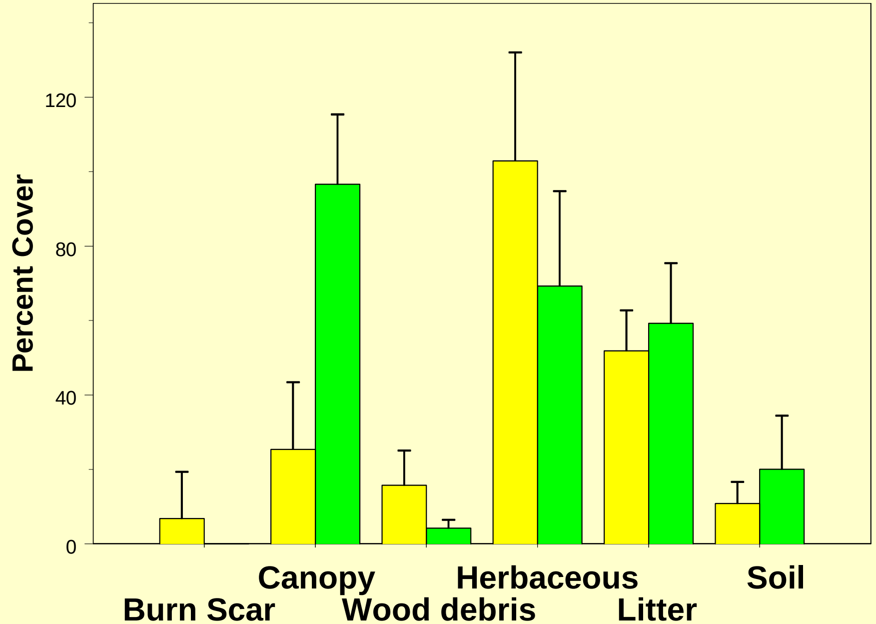
  Yes…herbaceous composition differs, response to thinning probably differs.

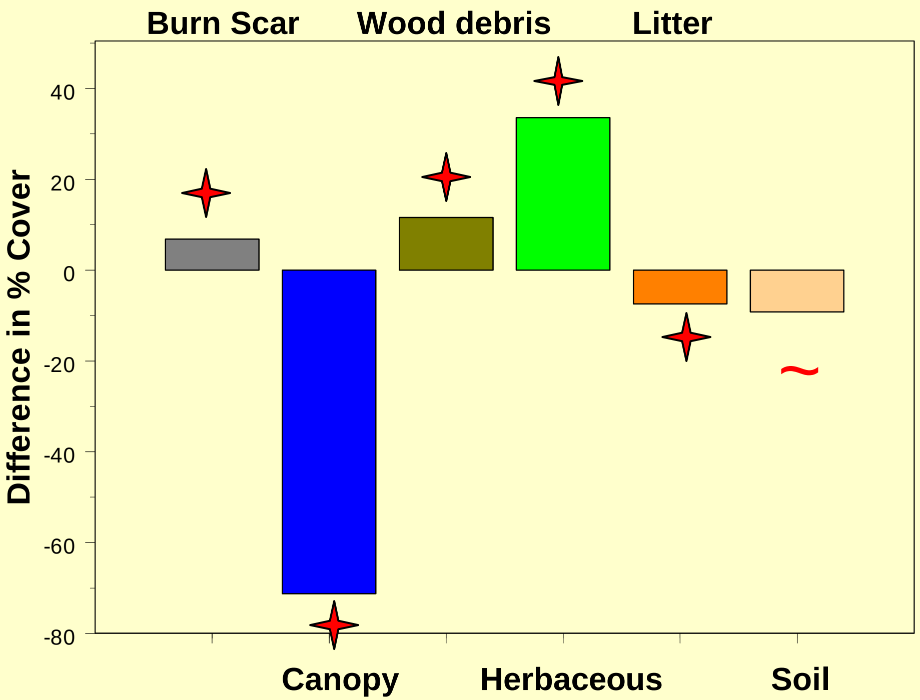
- *Do treatment types differ in impacts?*

  No overall, but…

  Yes within vegetation communities.

Overall treatment effect: Site conditions



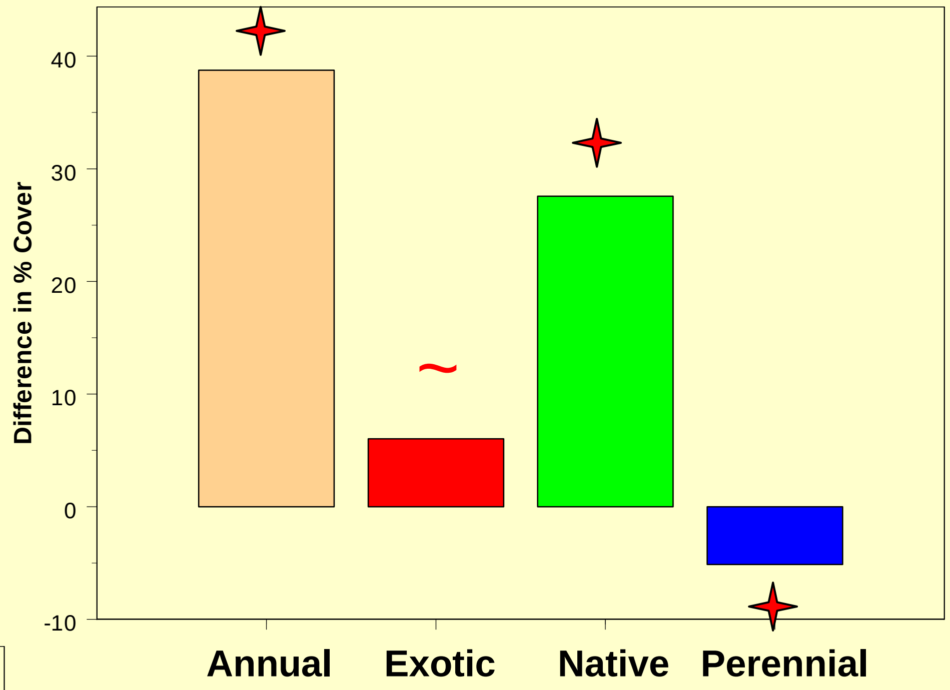


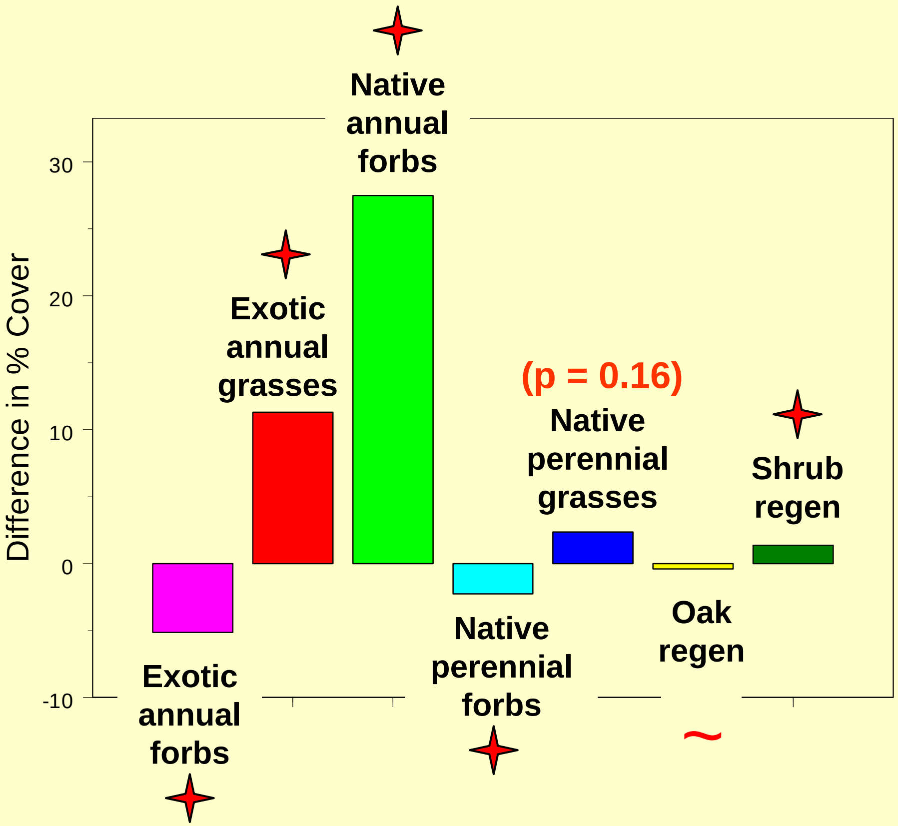
Yellow = thinned

Green = unthinned

✦ = significant (p < 0.05)

Overall treatment effect: Herbaceous percent cover



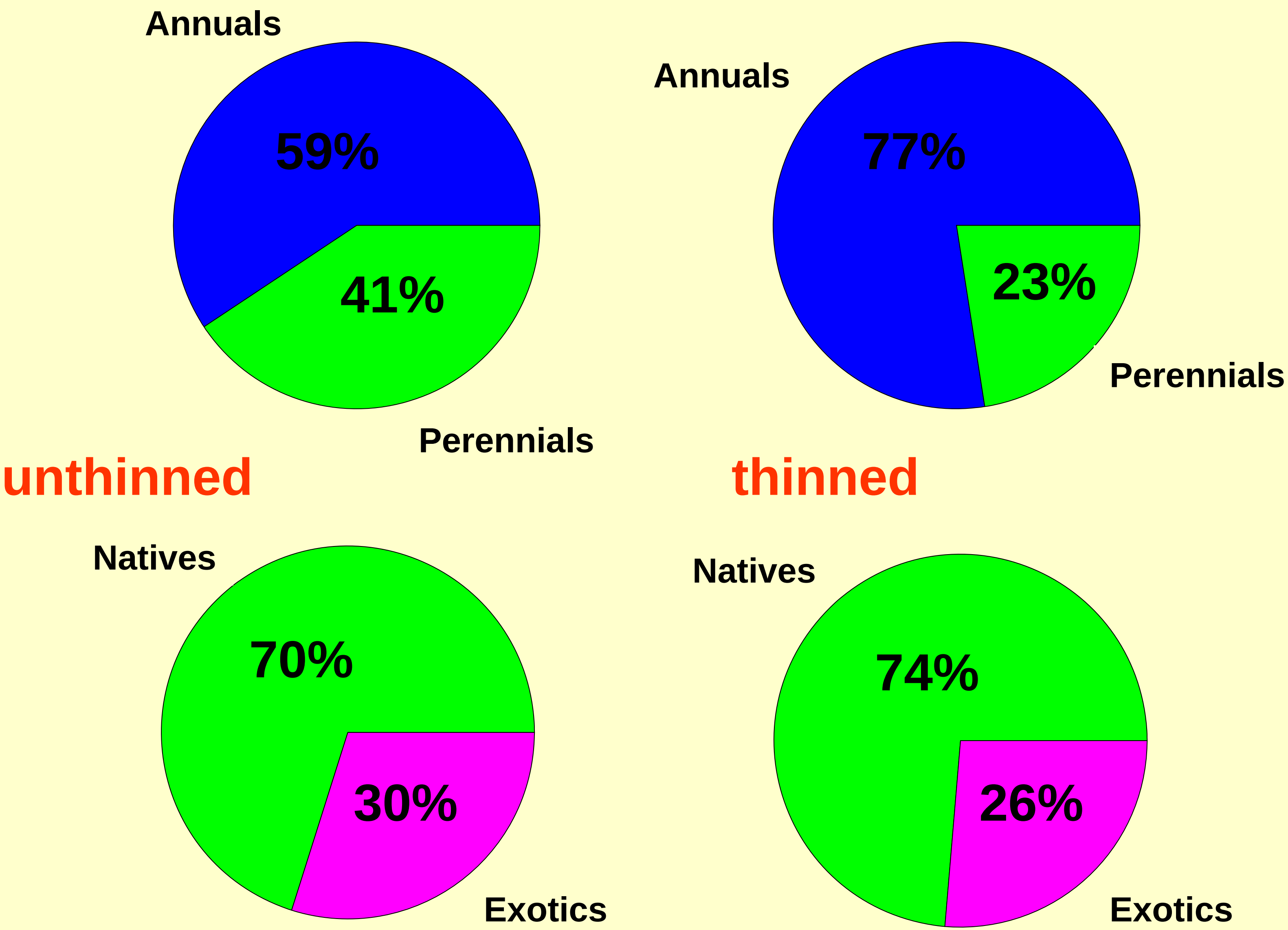


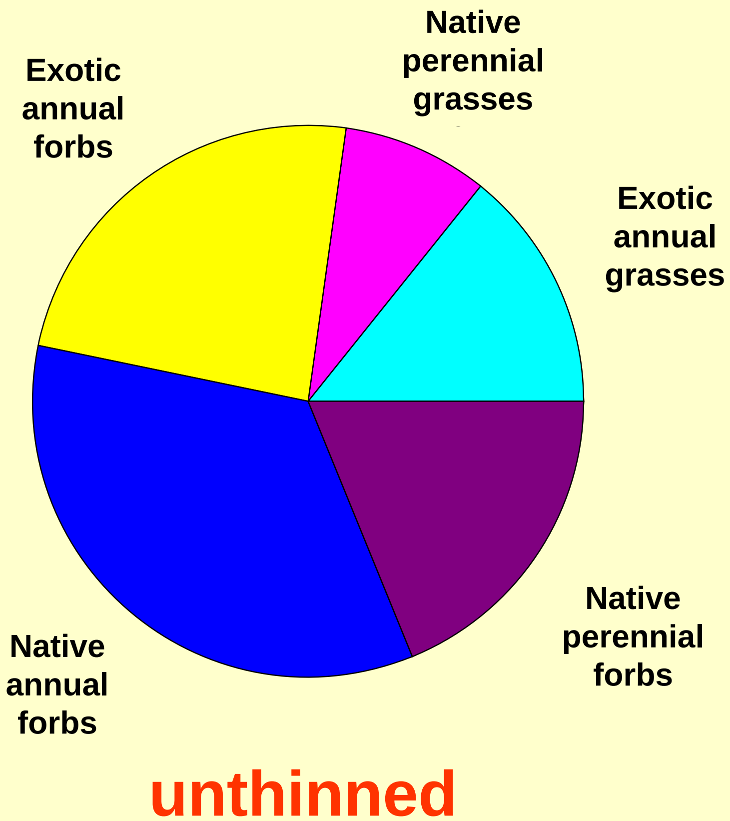
= significant (p < 0.05)

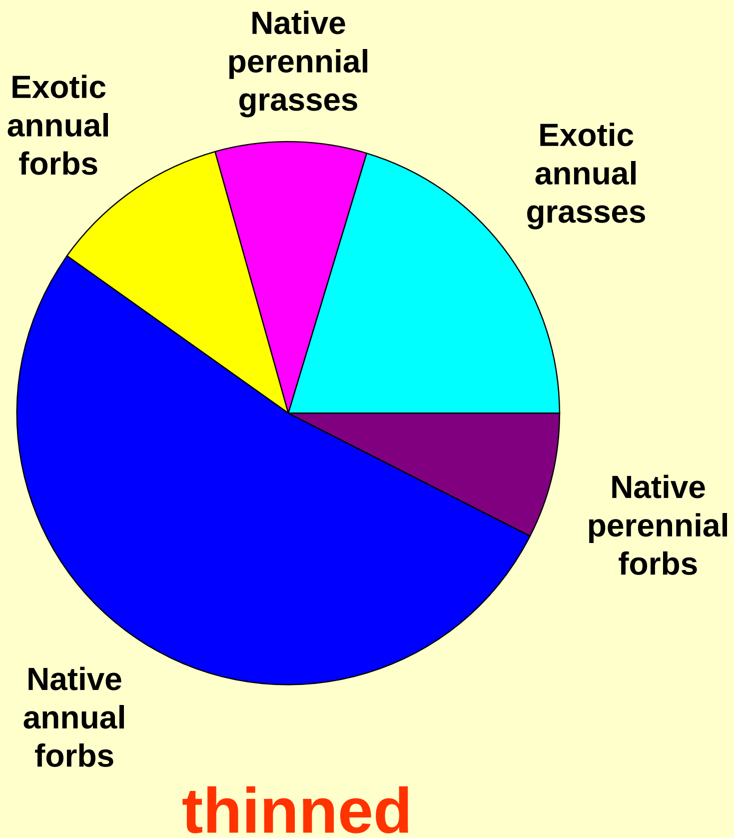
~ = suggestive (p ~ 0.07)

Overall treatment effect: Community composition

Proportions of total herbaceous cover







Overall treatment effect: Community composition

Proportions of total herbaceous cover

Overall treatment effect summary

- Increase in total herbaceous cover
- No change in species diversity
- Increase in annuals / decrease in perennials
- Increase in exotic annual grasses
- No change in native perennial grasses
- Decrease in exotic annual forbs
- Increase in native annual forbs
- Decrease in native perennial forbs

Thinning methods and vegetation communities

- Vegetation communities differ in herbaceous composition.
- Treatment impacts different – when control for vegetation community.
- Sample sizes too small…
- Additional research – account for vegetation communities.

1. (Keeley et al. 1981)
2. (Sikes 2005)
3. (USDI BLM 1999)

Results in context:

My findings (4 to 7 years):	Other perspectives:
• Loss of perennials, near-doubling of annuals after thinning.	• Post-fire initial dominance by annuals, but perennials dominate within five years.[1]
• Native annual forbs and exotic annual grasses dominate over longer time span.	• Annual and exotic species increased during the first two years after thinning.[2]
• Shrub regeneration very low, accounts for < 3% cover.	• Post-fire shrub regeneration reaches ~50% within 3 years.[1]
• No increase in native perennial grass cover or regeneration of oak trees.	• Thinning presented by BLM as oak/perennial bunchgrass ecosystem restoration.[3]

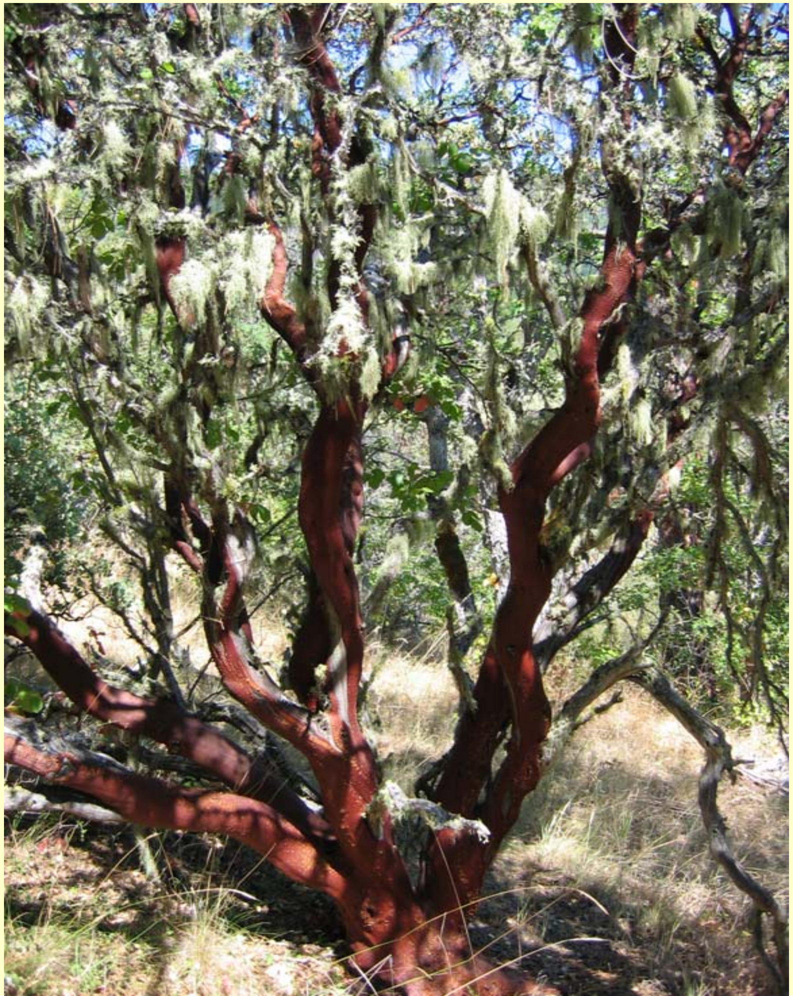
Lack of expected post-thinning succession

Early-post-disturbance type herbaceous community composition

Native annual forbs (44%) and exotic annual grasses (17%)

Minor cover of perennial herbaceous and canopy species

Potential for type-conversion to annual-dominated system



Why? Fire-related adaptations and impacts…

Fire-cued germination for native shrubs and forbs
Explains near-absence of shrub regeneration
Developing shrub canopy alters herbaceous
Lack of fire-cues = altered native forb germination
Loss of native soil seed bank – fire suppression
Burn pile scars may favor exotic / annual species

Exotic annual grasses

Present in unthinned stands (8%) – area's disturbance history
Thinned cover more than doubled: ~ **20%** average cover
Invasive – aggressively out-compete native species
Alter herbaceous composition – potentially alter fire regime

Exotic annual forbs decreased, but +/- replaced with exotic grasses…

Conclusions: Ecological impacts of fuel reduction thinning treatments

- **Persistent unintended negative impacts:**
  - Big increase in annual dominance
  - Expansion of exotic annual grasses
  - Loss of native perennial forbs
  - Native canopy regeneration very low
- **Not successful as ecosystem restoration:**
  - No improvement in native bunchgrass cover
  - No increase in oak regeneration
  - No increase in native species diversity
  - Loss of native perennial cover
- **Some positive impacts:**
  - Big increase in native annual cover
  - Substantial decrease in exotic annual forbs

Adaptive management recommendations:

- Lack of research and monitoring undermines adaptive management
  -- more study of treatment type
  and vegetation community differences

- Treatment planning needs to include provisions for monitoring

- Research historic conditions, fire regime and fire suppression
  -- ecologically appropriate thinning treatments and **goals**

- Experiment and apply alternate / additional prescriptions
  -- increased canopy retention
  -- seeding of native perennial species
  -- decreased size and connectivity of thinning units

*" The **Applegate Adaptive Management Area** is a land allocation wherein experimenting, learning and adapting is the primary intent while maintaining an operational project program…. This is accomplished by the Ashland Resource Area through establishment of a technically-oriented research and monitoring program staffed with scientists closely tracking the success of management for ecological trends…. Where appropriate, adjustments, based on monitoring results are incorporated into future projects."* ***(USDI BLM 1999)***

Thanks and Acknowledgements:

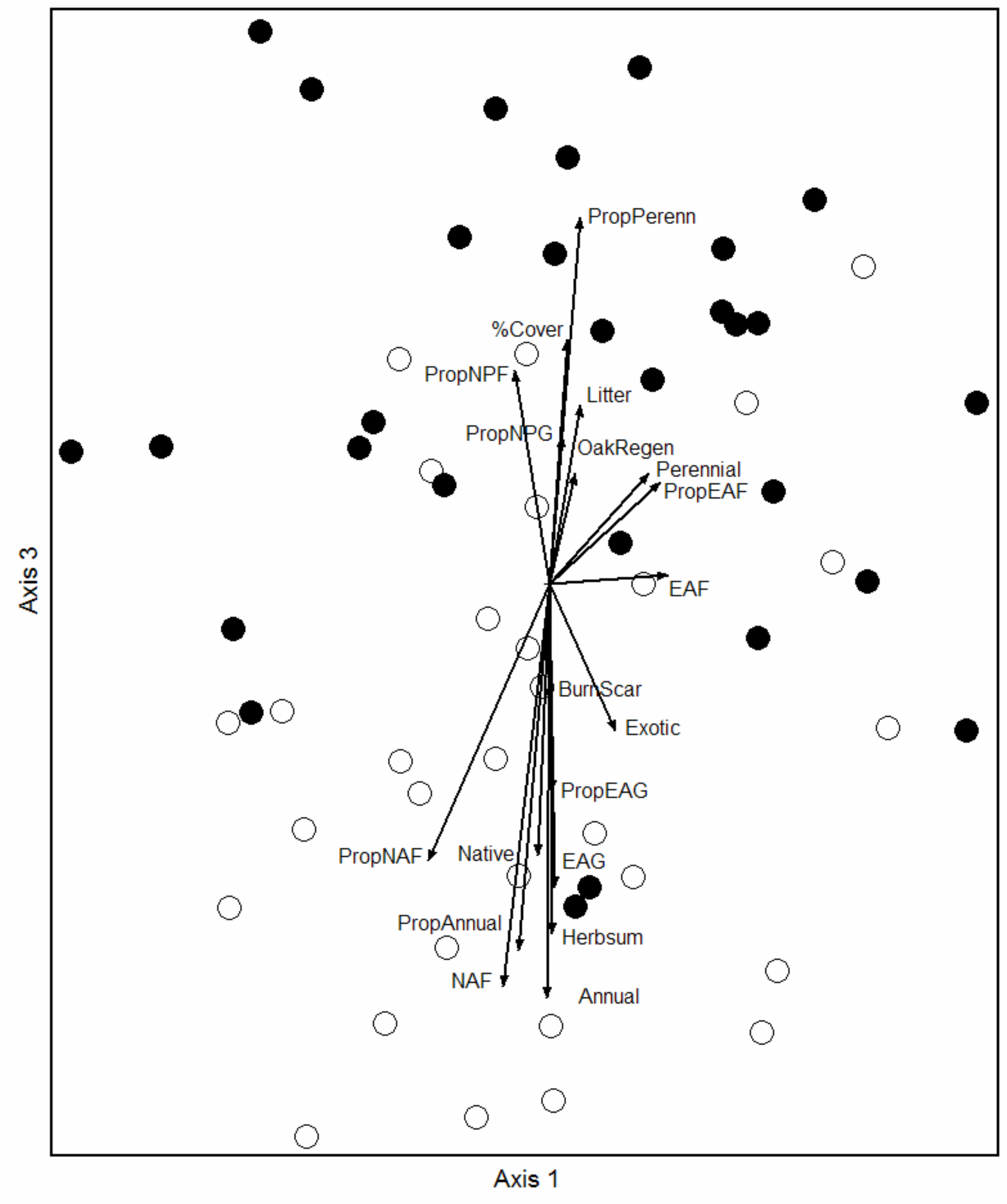
Funding: Joint Fire Science Program

At OSU: Pat Muir, Bruce McCune, Richard Halse, David Hibbs, Kendra Sikes

At The BLM: Paul Hosten, Al Mason, Ed Reilly, Annette Parsons, Eric Pfaff

Field assistance and photography: Debora Coen

Variable Name (as given in text)	Abbreviated as:	tau
Canopy cover (woody species > 0.3 m)	% Cover	**0.489**
Wood debris cover	WoodDebris	-0.147
Burn scar cover	BurnScar	**-0.334**
Litter cover	Litter	**0.404**
Bare soil cover	Soil	-0.036
Total herbaceous cover	Herbsum	**-0.604**
Species richness	Richness	-0.245
Native species richness	NatRichness	-0.101
Shannon-Weiner diversity	Diversity	-0.057
Native Shannon-Weiner diversity	NatDiversity	0.120
Native species cover	Native	**-0.527**
Exotic species cover	Exotic	**-0.320**
Annual species cover	Annual	**-0.682**
Perennial species cover	Perennial	**0.328**
Exotic annual grass cover	EAG	**-0.570**
Native perennial grass cover	NPG	0.259
Exotic annual forb cover	EAF	0.092
Native annual forb cover	NAF	**-0.666**
Native perennial forb cover	NPF	0.192
Proportion of native species	PropNative	0.107
Proportion of exotic species	PropExotic	-0.107
Proportion of annual species	PropAnnual	**-0.664**
Proportion of perennial species	PropPerenn	**0.664**
Proportion of exotic annual grasses	PropEAG	**-0.480**
Proportion of native perennial grasses	PropNPG	**0.371**
Proportion of exotic annual forbs	PropEAF	**0.315**
Proportion of native annual forbs	PropNAF	**-0.522**
Proportion of native perennial forbs	PropNPF	**0.435**
Oak regeneration	OakRegen	**0.314**
Conifer regeneration	ConRegen	**0.328**
A.viscida and *C. cuneatus* regeneration	ShrubRegen	-0.090

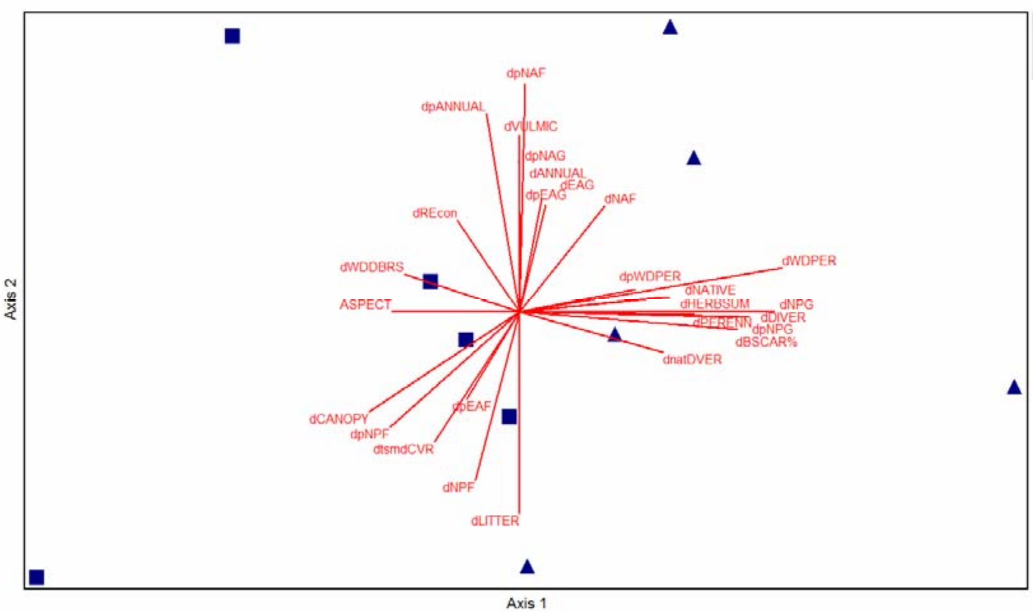


Variable	p	Mean Difference	Thinned Mean	Thinned SD	Unthinned Mean	Unthinned SD
% Cover	**0.000**	**-71.25**	**25.38**	**18.07**	**96.63**	**18.79**
WoodDebris	**0.000**	**11.56**	**15.76**	**9.35**	**4.20**	**2.27**
BurnScar	**0.003**	**6.83**	**6.83**	**12.56**	**0.00**	**0.00**
Litter	**0.028**	**-7.41**	**51.84**	**10.93**	**59.25**	**16.20**
Soil	*0.056*	*-9.18*	*10.84*	*5.82*	*20.03*	*14.43*
Herbsum	**0.000**	**33.61**	**102.90**	**29.15**	**69.27**	**25.51**
Richness	0.380	0.70	28.93	5.33	28.23	7.12
NatRichness	0.951	0.00	21.97	4.47	21.97	4.99
Diversity	0.622	-0.06	2.56	0.29	2.62	0.34
NatDiversity	0.139	-0.13	2.30	0.30	2.43	0.33
Native	**0.000**	**27.58**	**74.59**	**22.37**	**47.01**	**15.81**
Exotic	*0.074*	*6.03*	*28.29*	*21.05*	*22.26*	*15.59*
Annual	**0.000**	**38.76**	**82.42**	**32.74**	**43.66**	**25.09**
Perennial	**0.016**	**-5.14**	**20.47**	**9.37**	**25.61**	**11.26**
EAG	**0.000**	**11.31**	**19.50**	**18.93**	**8.19**	**8.76**
NPG	0.165	2.36	6.51	7.15	4.15	5.79
EAF	**0.032**	**-5.14**	**8.65**	**6.58**	**13.79**	**12.28**
NAF	**0.000**	**27.48**	**46.72**	**22.43**	**19.24**	**12.49**
NPF	**0.028**	**-2.26**	**6.18**	**4.07**	**8.43**	**4.76**
PropNative	0.181	3.53	73.66	14.35	70.13	15.43
PropExotic	0.435	-3.53	26.34	14.35	29.87	15.43
PropAnnual	**0.000**	**18.14**	**77.47**	**14.17**	**59.33**	**19.59**
PropPerenn	**0.000**	**-18.14**	**22.53**	**14.17**	**40.67**	**19.59**
PropEAG	**0.001**	**6.18**	**17.12**	**13.15**	**10.94**	**11.28**
PropNPG	0.959	1.02	7.60	9.12	6.58	8.80
PropEAF	**0.000**	**-9.31**	**9.10**	**7.02**	**18.41**	**12.28**
PropNAF	**0.000**	**17.60**	**44.08**	**16.36**	**26.47**	**13.51**
PropNPF	**0.028**	**-8.16**	**6.30**	**4.31**	**14.46**	**9.11**
OakRegen	*0.073*	*-0.39*	*1.73*	*1.89*	*2.13*	*2.04*
ConRegen	0.415	-0.03	0.03	0.09	0.05	0.14
ShrubRegen	**0.000**	**1.37**	**1.67**	**2.32**	**0.30**	**0.42**

Variable	ARC Subset, 5 MM, 5 HPB Pairs			CEA Subset, 5 MM, 4 HPB Pairs		
	tau	MM Mean Difference	HPB Mean Difference	tau	MM Mean Difference	HPB Mean Difference
Herbsum	**0.422**	18.94	59.21	0.167	42.03	45.41
Native	**0.333**	19.83	27.89	-0.111	41.59	29.56
EAG	0.200	1.29	33.59	**0.389**	3.62	20.53
NPG	**0.422**	0.94	5.23	0.029	-0.54	-0.45
NAF	**0.467**	21.57	28.92	-0.056	45.25	36.91
NPF	**-0.333**	-4.28	-3.59	0.000	-4.43	-0.26
PropPerenn	-0.200	26.10	27.44	**-0.389**	23.88	18.22
PropEAG	0.156	2.32	20.24	**0.389**	-2.60	9.07
PropEAF	**-0.378**	-2.07	-13.35	0.111	-5.47	-8.27
PropNPF	**-0.422**	-11.90	-14.62	0.111	-9.21	-6.27

HPB vs MM

Within Manzanita



HPB vs MM

Within Ceanothus