

Surface fuel loadings in mulching treatments in Colorado coniferous forests



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Joint Fire Science Program

Research Supporting Sound Decisions

www.fire-science.gov

**Colorado
State
University**

Fire Exclusion



Photo: Gary Chancey, USFS



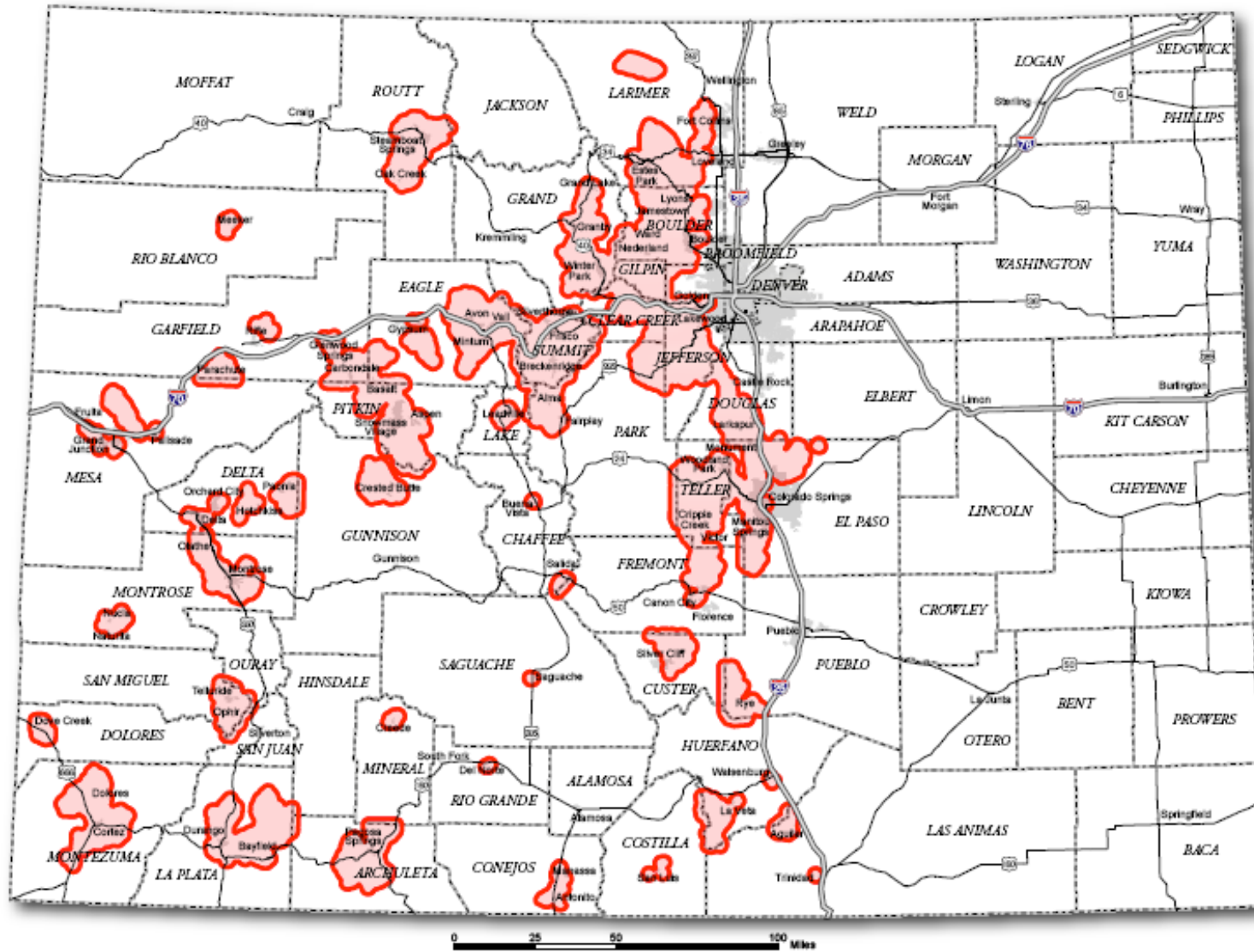


Photo by Terry Tompkins, BHNF

Wildland / Urban Interface



Interface Areas of High Wildfire Risk in Colorado



-  Red Zone
-  Cities
-  County
-  State
-  Interstate
-  US Highway

Red Zone Population:
 748,350 (1990 Census)
 979,851 (2000 Census)

Homes in Red Zone:
 370,000 (1990 Census)
 474,000 (2000 Census)

Red Zone Acres:
 6,300,000 (2000)



Map Created September 2004
 Colorado State Forest Service



Mulching Treatments

Surface and ladder fuels cut into small chunks or chips





Mulching Treatments



Compact layer of
many small pieces

Wood biomass
is left on site

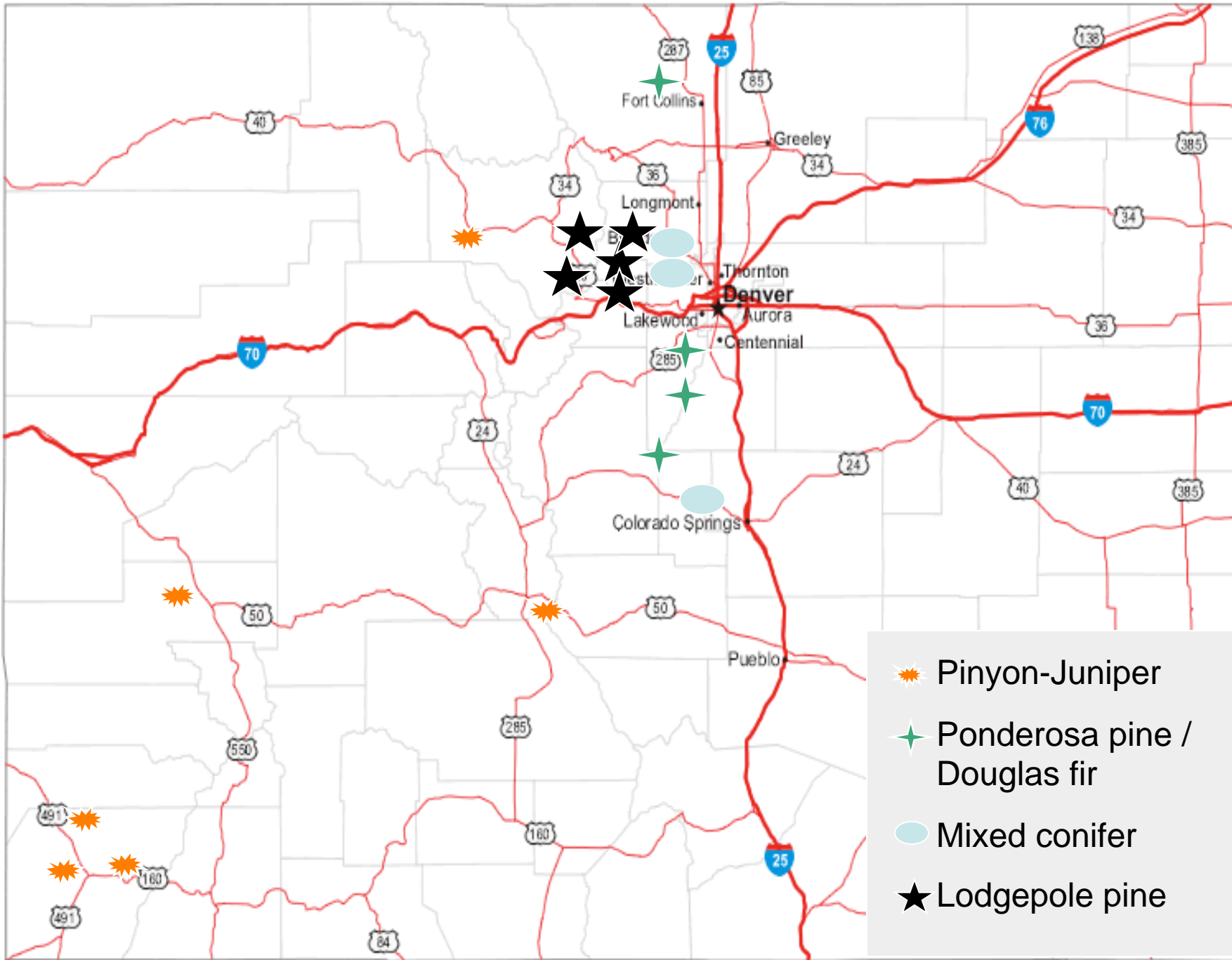


Objective

Quantify changes to forest floor

- Fuel loadings
- Fuel size distribution





Interstate Highways



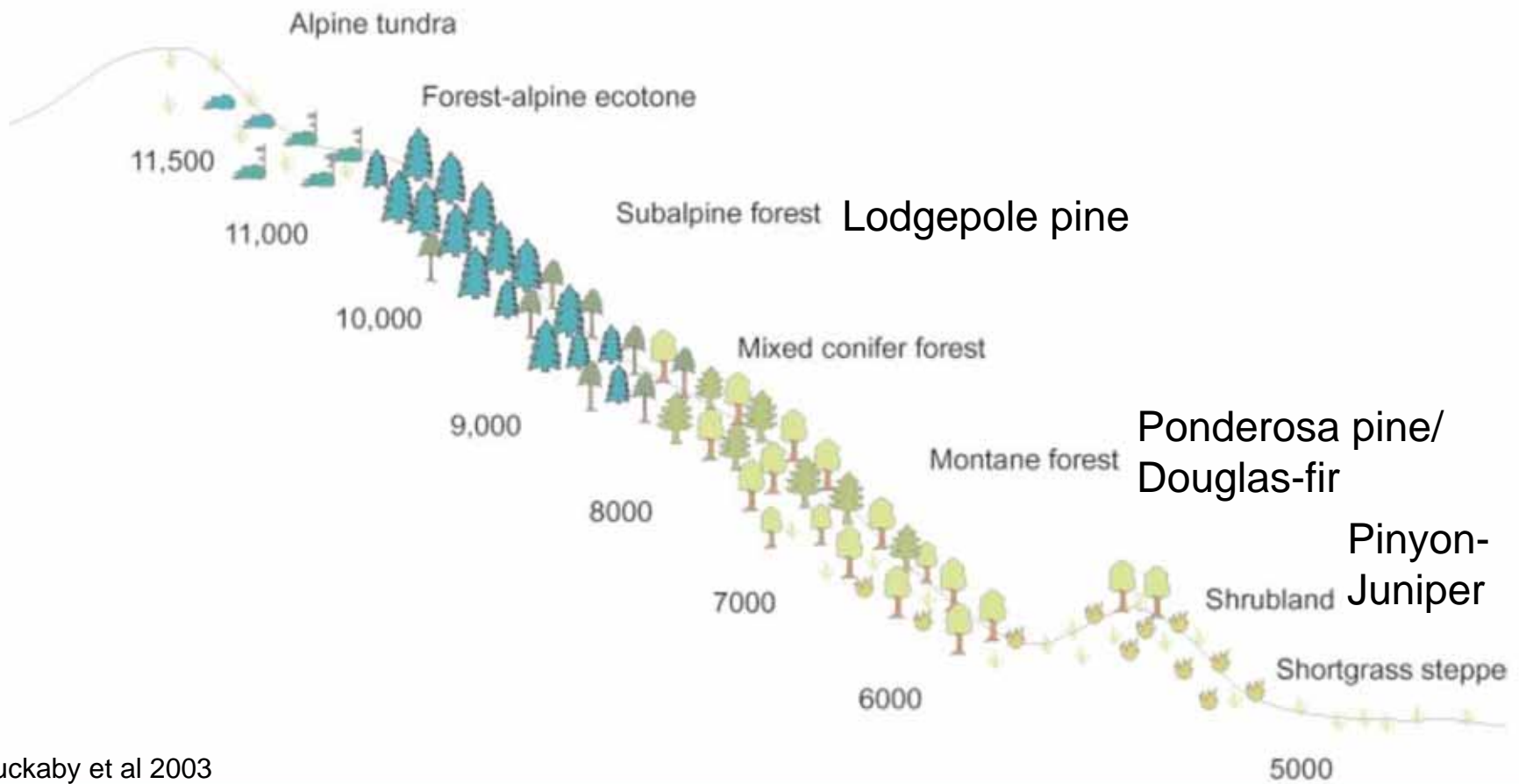
US Highways

0

100 KM

100 Miles

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Huckaby et al 2003

Tree density reduction

Ecosystem	Untreated Basal Area (m ² /ha)	Mulched Basal Area (m ² /ha)	% 	Untreated TPH	Mulched TPH	% 
Pinyon-Juniper	22	12	47	1247	392	69
Ponderosa pine / Douglas-fir	27	9.5	65	2258	202	91
Lodgepole pine	38	10.5	73	2783	472	83

Sampling

- Sites 2 to 4 years post-treatment
- Paired study areas
 - Untreated and Mulched areas
- 3 50-m transects per study area
- 25 1-m² quadrants per transect



Sampling: Fuel load estimates

- At each study site 9-m² quadrants established
- Measured total fuel depth at 5 points in quadrant
- Estimated %cover of each fuel size class







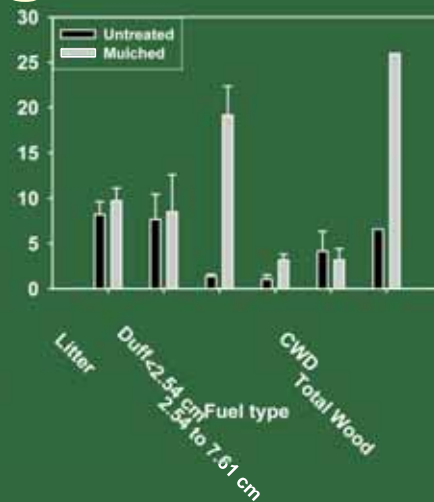
Ros Wu

Pinyon Pine/Juniper



Mulching in Pinyon Pine/Juniper: Changes to fuel loads

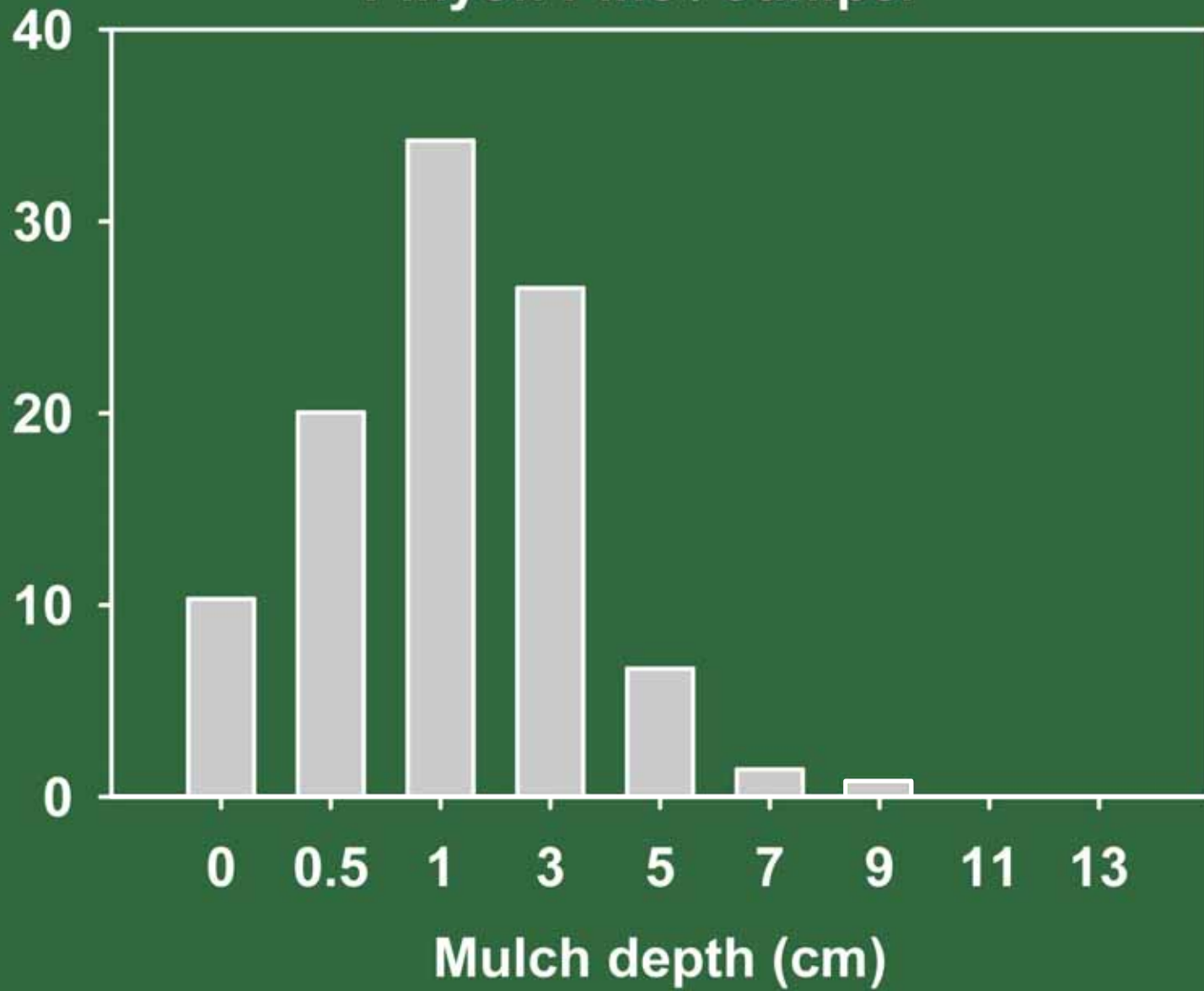
- No difference in needle litter fuel load
- 520% increase for fuels <2.54 cm
- 205% increase for fuels 2.54 to 7.61 cm
- 208% increase for Total woody debris
 - Untreated: 8 Mg/ha⁻¹
 - Mulched: 26 Mg/ha⁻¹



Mulching in Pinyon Pine/Juniper: % of Total Fuel Load

Fuel size (cm)	Untreated	Mulched
0 to 0.6 (1 hr)	19	30
0.6 to 2.54 (10 hr)	19	45
2.54 to 7.62 (100 hr)	13	12
>7.62 cm (1000 hr)	50	13

Pinyon Pine / Juniper



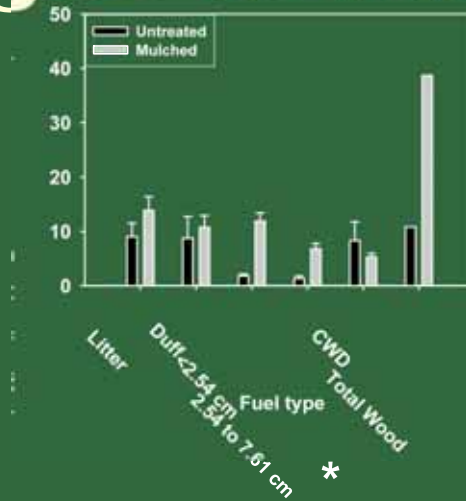


Ponderosa pine / Douglas-fir



Mulching in Ponderosa Pine: Changes to fuel loads

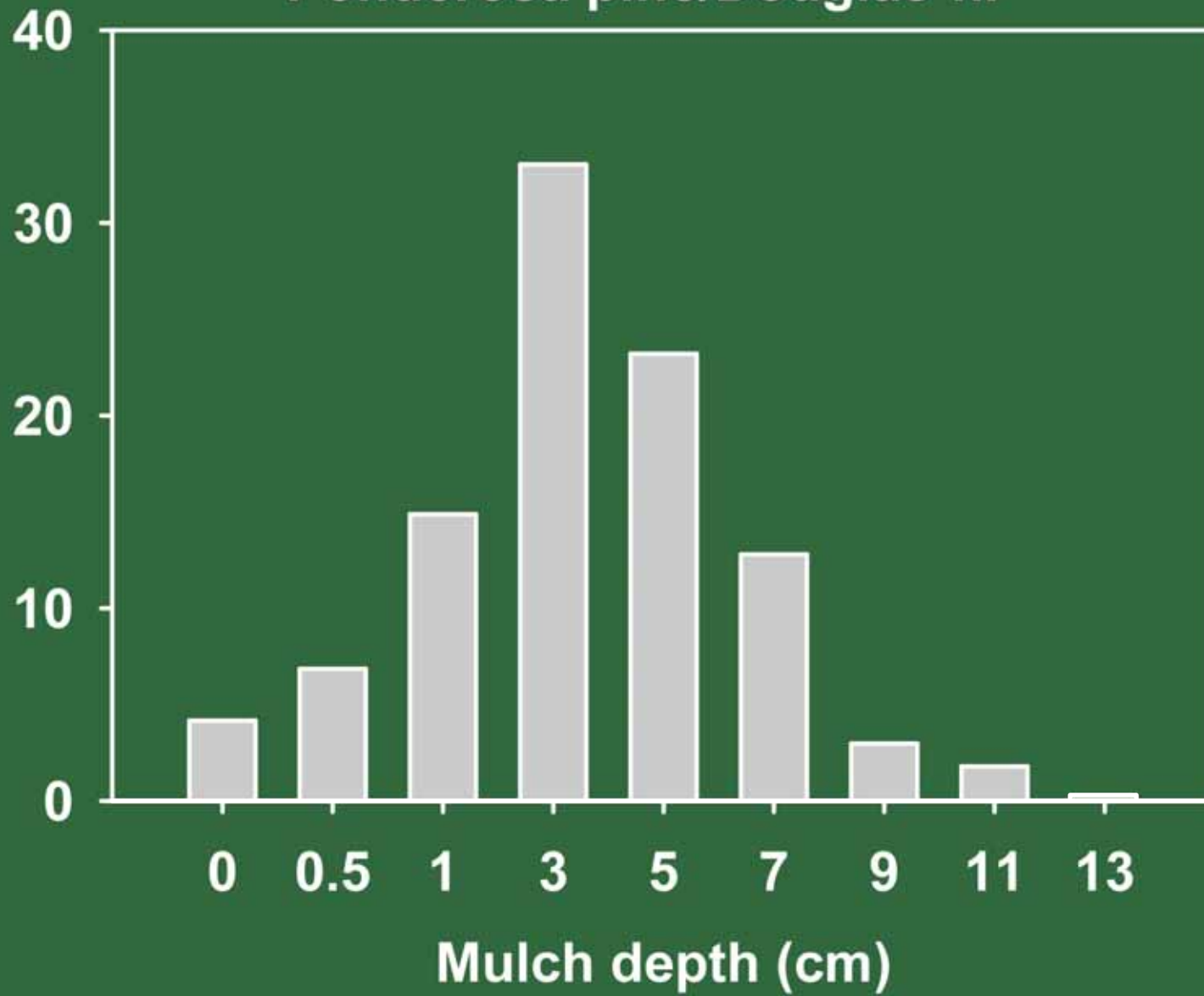
- 50% increase in needle litter fuel load
- 560% increase for fuels <2.54 cm
- 415 % increase for fuels 2.54 to 7.61 cm
- 257% increase for Total woody debris
 - Untreated: 11 Mg/ha⁻¹
 - Mulched: 39 Mg/ha⁻¹



Mulching in Ponderosa pine / Douglas-fir: % of Total Woody Fuel Load

Fuel size (cm)	Untreated	Mulched
0 to 0.6 (1 hr)	7	21
0.6 to 2.54 (10 hr)	4	48
2.54 to 7.62 (100 hr)	12	18
>7.62 cm (1000 hr)	77	14

Ponderosa pine/Douglas-fir





Rocky Mountain Region Archive, USDA Forest Service,
Bugwood.org

UGA1441133

Lodgepole Pine



Mulching in Lodgepole Pine: Changes to fuel loads

➤ No difference in needle litter fuel load

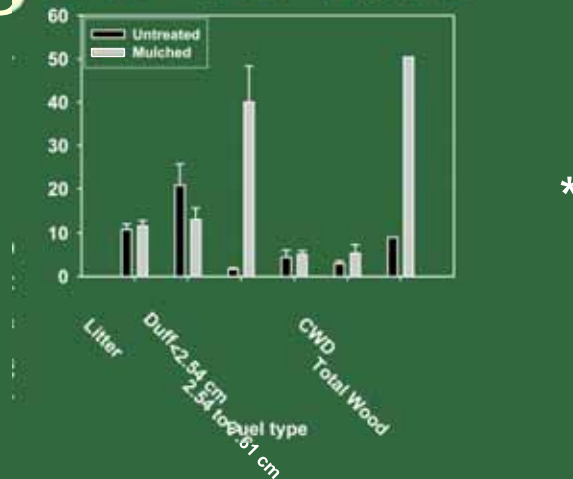
➤ 2295% increase for fuels <2.54 cm

➤ Similar fuel loads for fuels >2.54 cm

➤ 463% increase for Total woody debris

➤ Untreated: 9 Mg/ha⁻¹

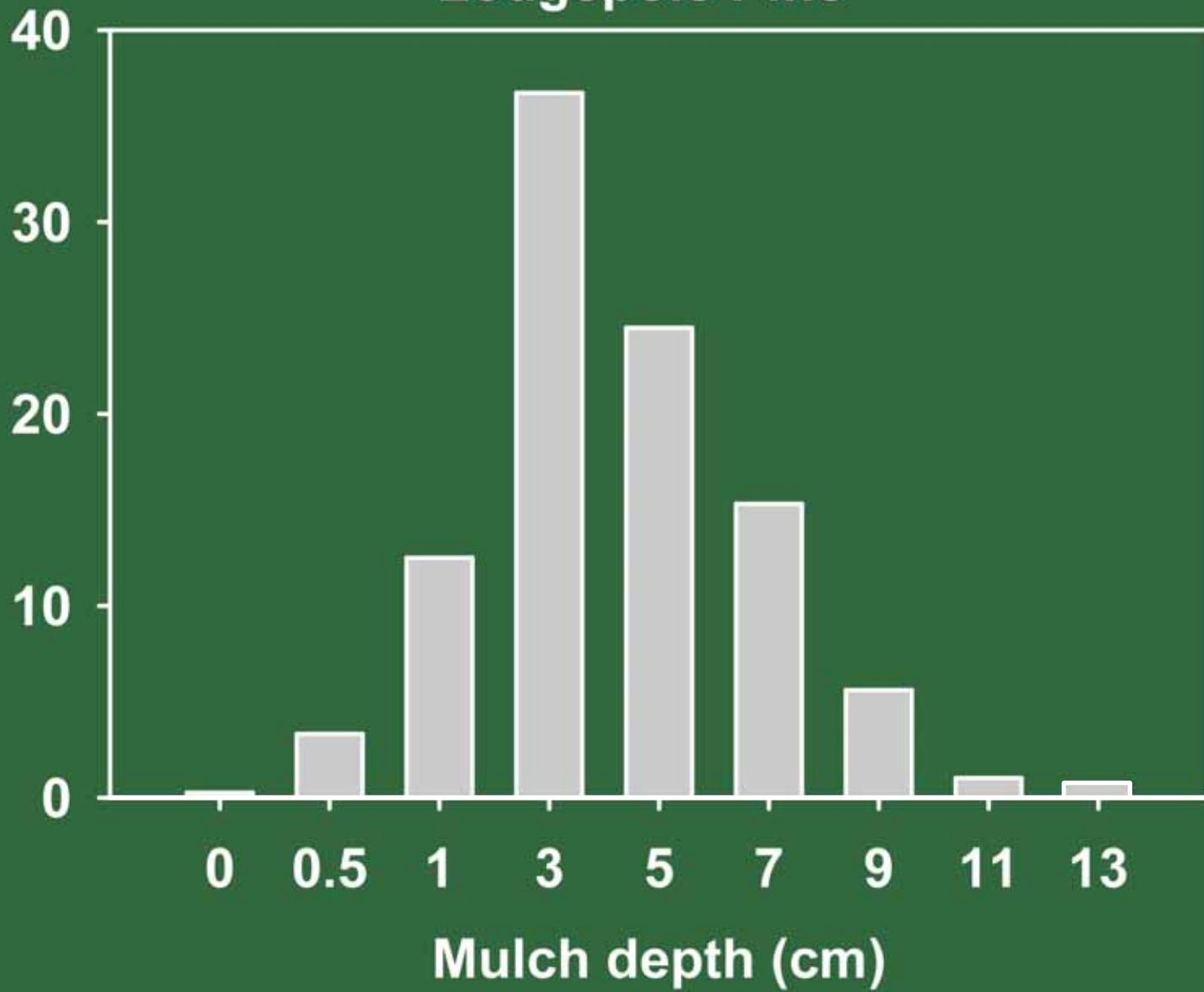
➤ Mulched: 50 Mg/ha⁻¹



Mulching in Lodgepole pine: % of Total Woody Fuel Load

Fuel size (cm)	Untreated	Mulched
0 to 0.6 (1 hr)	11	38
0.6 to 2.54 (10 hr)	8	42
2.54 to 7.62 (100 hr)	49	10
>7.62 cm (1000 hr)	32	11

Lodgepole Pine



Mulching changes fuelbed characteristics

Ecosystem	Untreated Litter:Fine Woody Fuels	Mulched Litter:Fine Woody Fuels
Pinyon Pine/ Juniper	5.3	1.3
Ponderosa/ Douglas Fir	11.7	1.7
Lodgepole	11.5	0.61



Summary

- Mulching treatment redistributed the stand biomass from the vertical to the horizontal



Summary

- Total surface woody fuel loads increased 208% to 463%
 - Lodgepole pine > Ponderosa pine > Pinyon pine
- Largest contributor to surface fuel loading was found in the smaller sized fuel classes instead of the coarse woody debris



Summary

- Change in fuelbed characteristics due to mulched will change surface fire behavior
 - reduced rate of spread, shorter flame lengths, more smoldering, and possibly increased soil heating



- Mulch depth varied across ecosystems and sites
 - Pinyon-Juniper: majority within 0.5 to 3 cm
 - Ponderosa pine/Douglas-fir and Lodgepole pine: majority 1 to 7 cm





Acknowledgements

- Joint Fire Science
- Steve Culver, Lara Duran, Todd Gardiner, Kristin Garrison, Dan Huisjen, Patrick McCoy, Pat McLaughlin, Ken Reed, Kirsta Scherff, Matt Schulz, Kathy Seiple, Diana Selby, John Smeins, Scott Wagner, Brenda Wasielewski, Julie Watkins, Dan Weber, Denise White, Ros Wu, Bill Wyatt
- Field assistance
 - Brett Wolk, Akasha Faist, Natalia Canova, Tony Harp, Jake Davidson, Jen Allgood, Jason Blair, Lance Asherin, Paula Fornwalt, Jenny Ventker

Questions?



2005 Workshop

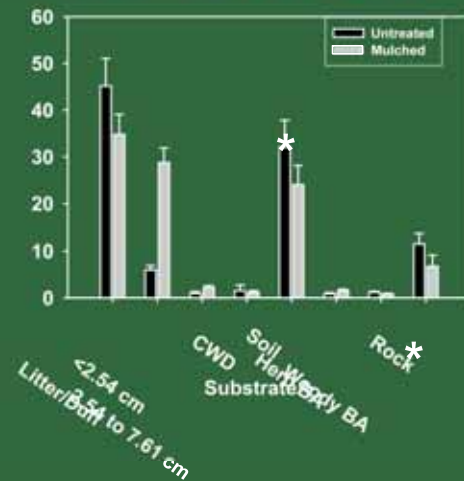
- Attendees: Managers and scientists
- Discussed experiences and concerns about mulching treatments
- Developed a list of high priority research needs
- Joint Fire Science Proposal

Mulching in Pinyon Pine/Juniper: Shifts in forest floor cover

➤ Decrease in
litter/duff
cover

➤ Decrease in
soil cover

➤ Increase in
woody debris
<2.54 cm



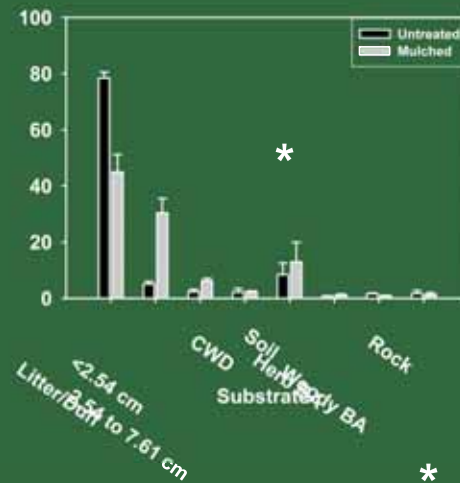
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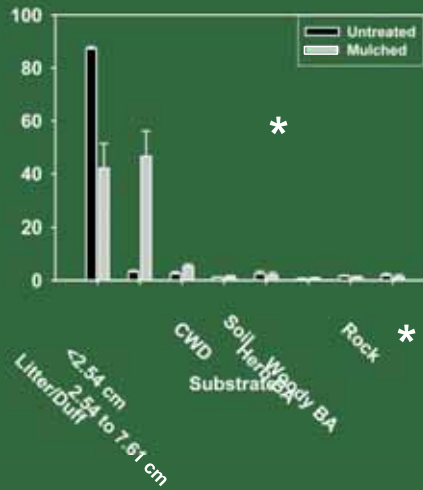
Mulching in Ponderosa Pine: Shift in forest floor cover

- Decrease in litter/duff cover
- Increase in woody debris <7.61 cm
- Largest increase in <2.54 cm woody debris



Mulching in Lodgepole Pine: Shift in forest floor cover

➤ Decrease in
litter/duff cover



➤ Increase in
woody debris
<7.61 cm

➤ Largest increase
in <2.54 cm
woody debris

➤ Similar trends in
Ponderosa