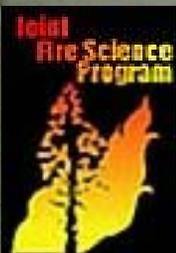


The effects of mulching treatments in the forest herbaceous layer of Colorado coniferous forests



Monique Rocca, **Colorado State University**
Michael Battaglia, Charles Rhoades, and Michael Ryan,
USFS Rocky Mountain Research Station



Motivation



- Fire suppression, expansion of WUI
- Fuels reduction treatments widespread
- What to do with harvested biomass?

Disposal method	Problem
Timber sale	small diameter wood not merchantable
Rx fire	smoke concerns, risk of escape
Lop and scatter	fire hazard, unsightly
“Mulch” and leave on site	the perfect solution??

- Consequences for ecosystems poorly understood

Why care about the understory?

- Herb layer contains most of the plant diversity.



- Exotic species → management concern.



- Understory herb and shrub biomass
→ fuel future fires
 - Good or bad?
Depends...

Research Goal:

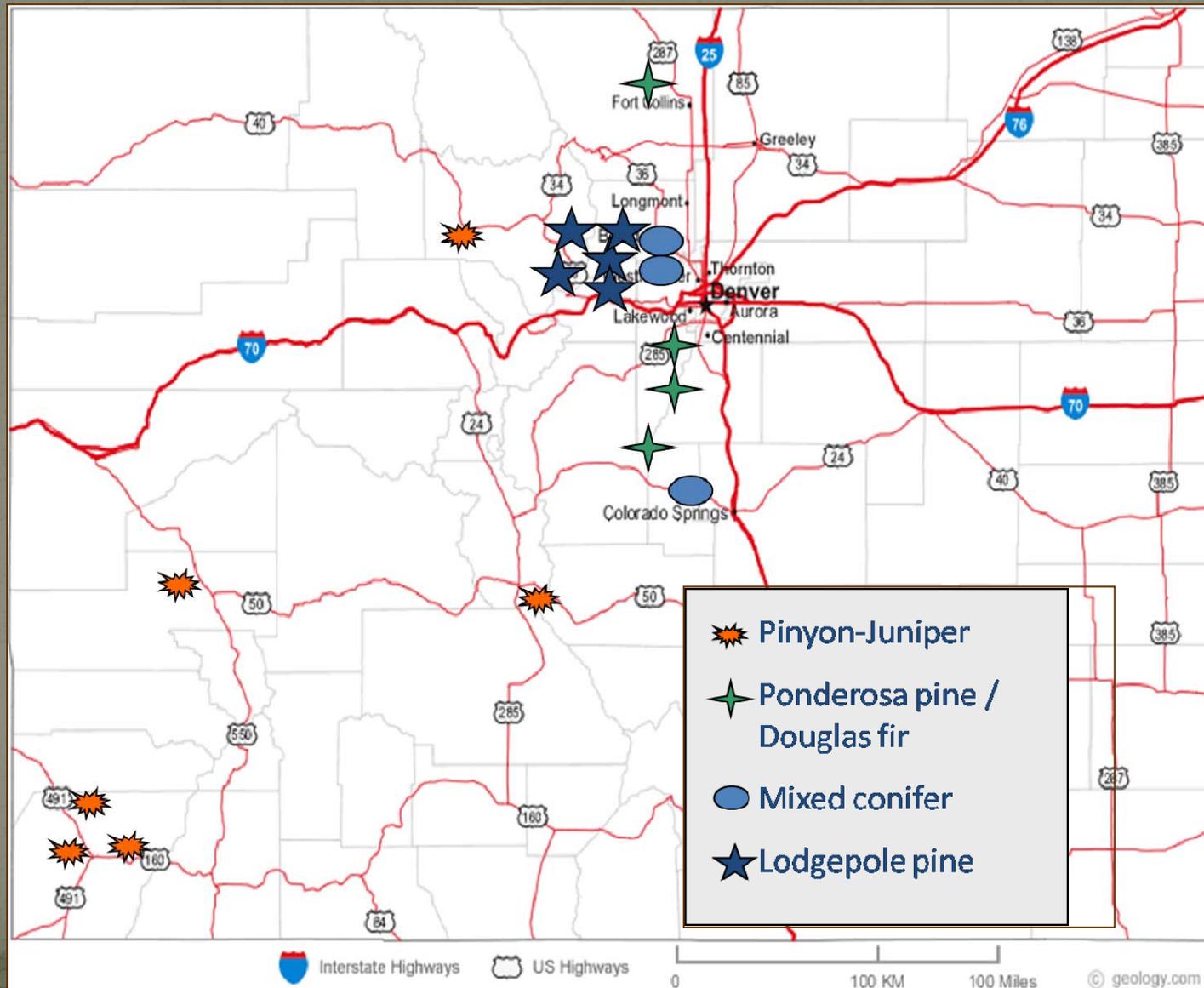
How will understory plants respond to the simultaneous impacts of overstory thinning and woody biomass addition?

- Understory cover
- Species richness
- Species composition



Study Sites

Colorado



Methods

- Paired masticated and untreated sites
- Sampled 2 to 4 years after treatment
- 3 50-m transects per study area
- 25 1-m² vegetation quadrats per transect

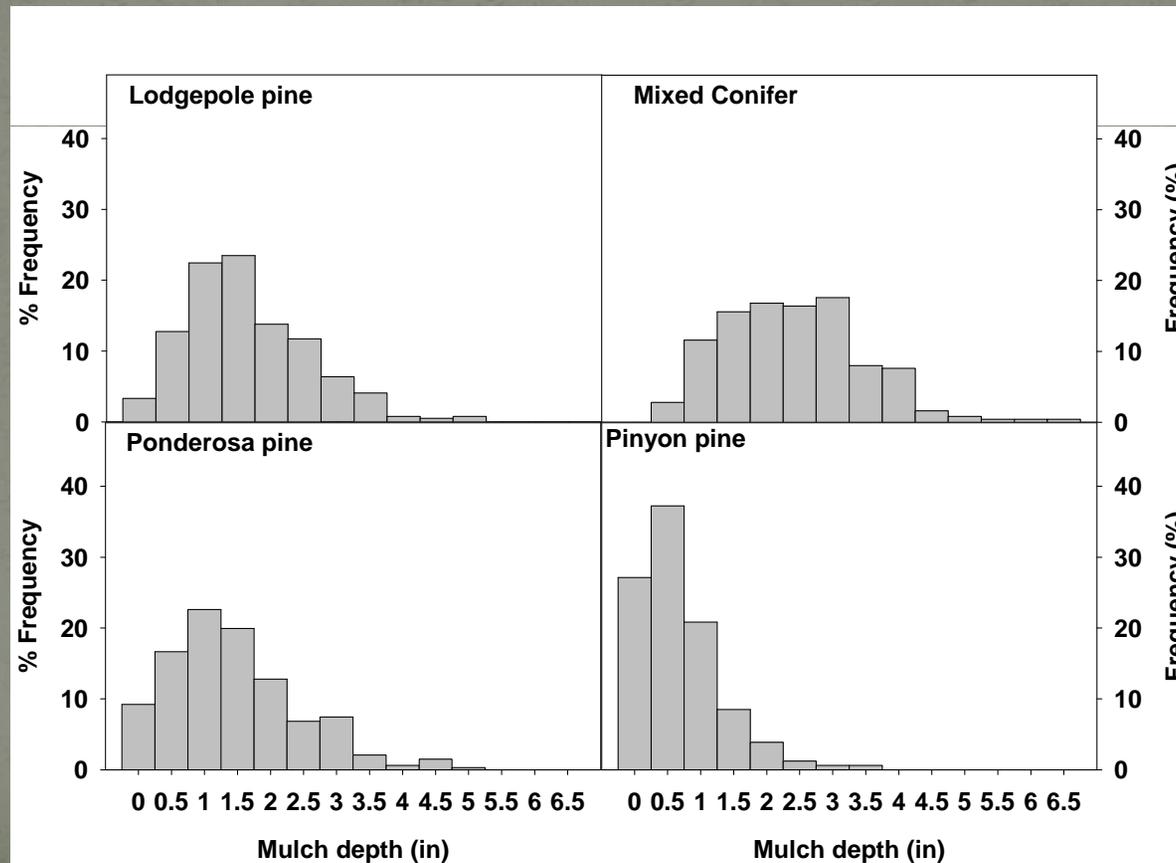
Thinned
using
mastication



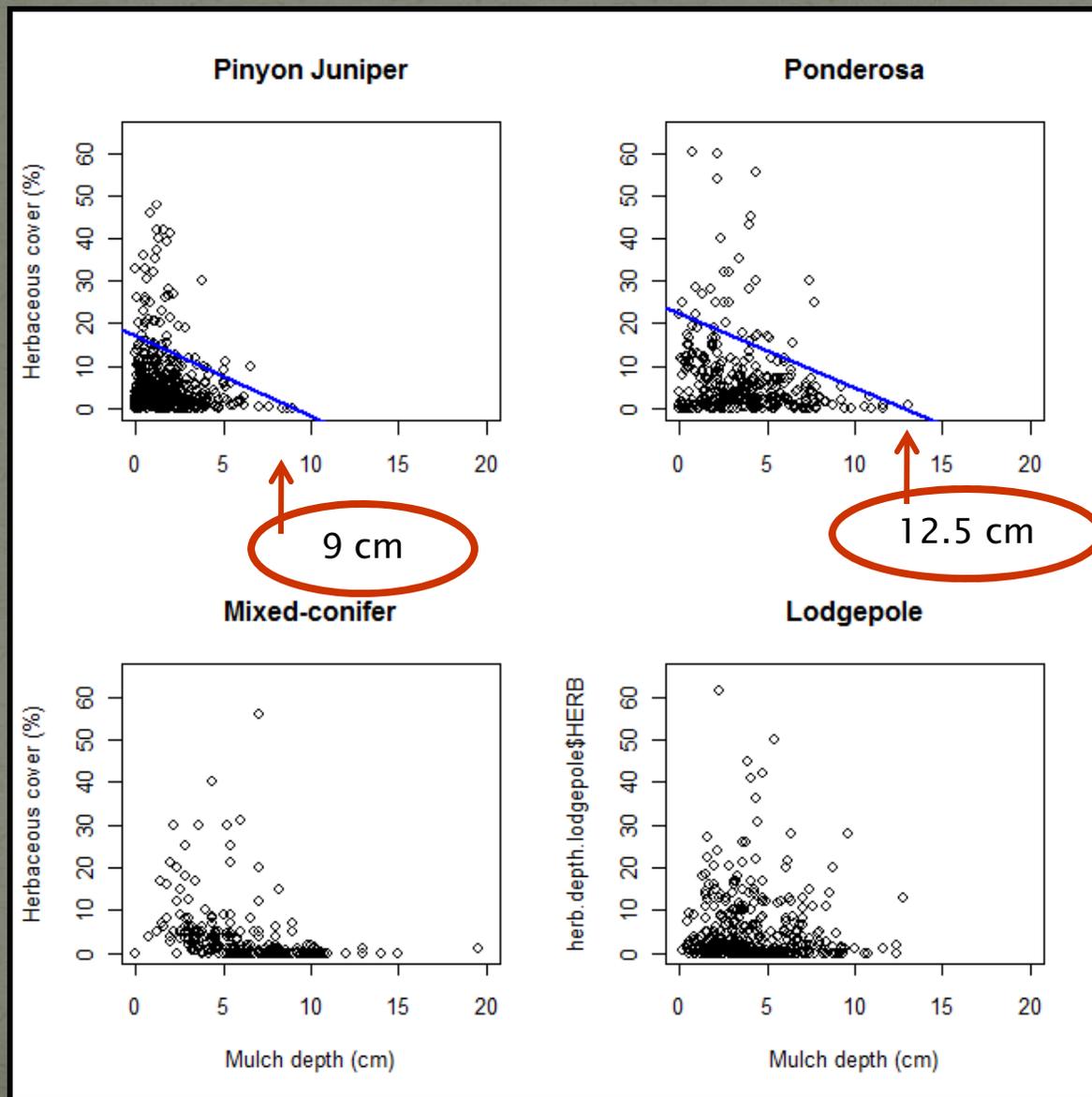
Untreated

Q1: Does mulch suppress understory herbaceous vegetation?

- Took advantage of variable mulch depth at 1 m²-level



Results: Cover vs. Mulch depth



—
90th percentile
(~upper limit)

Note: mulch has
settled for 2-4 yrs

Q2: Does overstory thinning and mulching affect understory cover?

- Predictions:
 - Shrub cover will be...?
 - Herbaceous cover will be...?
 - Will it vary by ecosystem??



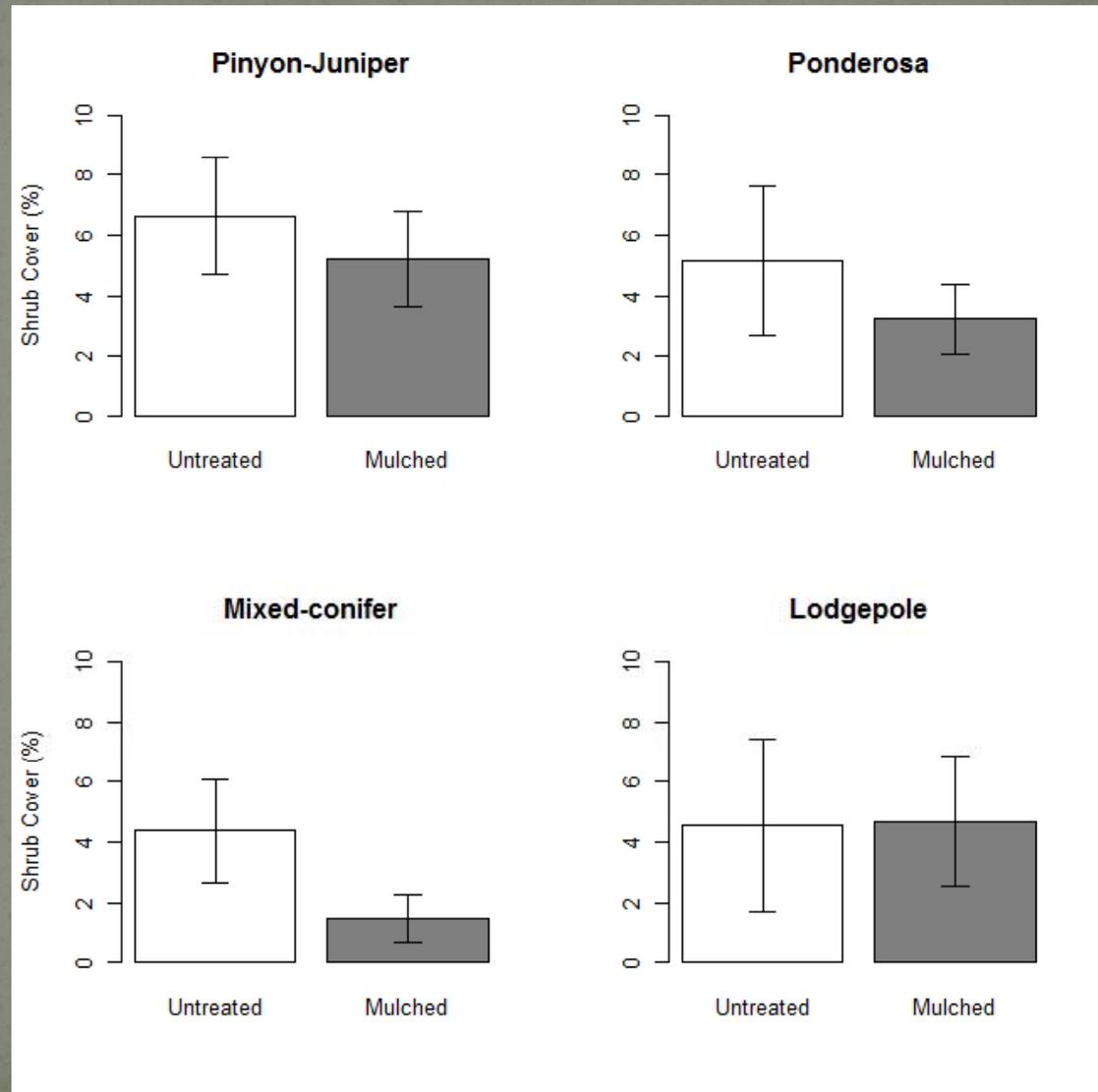
Mulched Pinyon-Juniper



Mulched Mixed-conifer

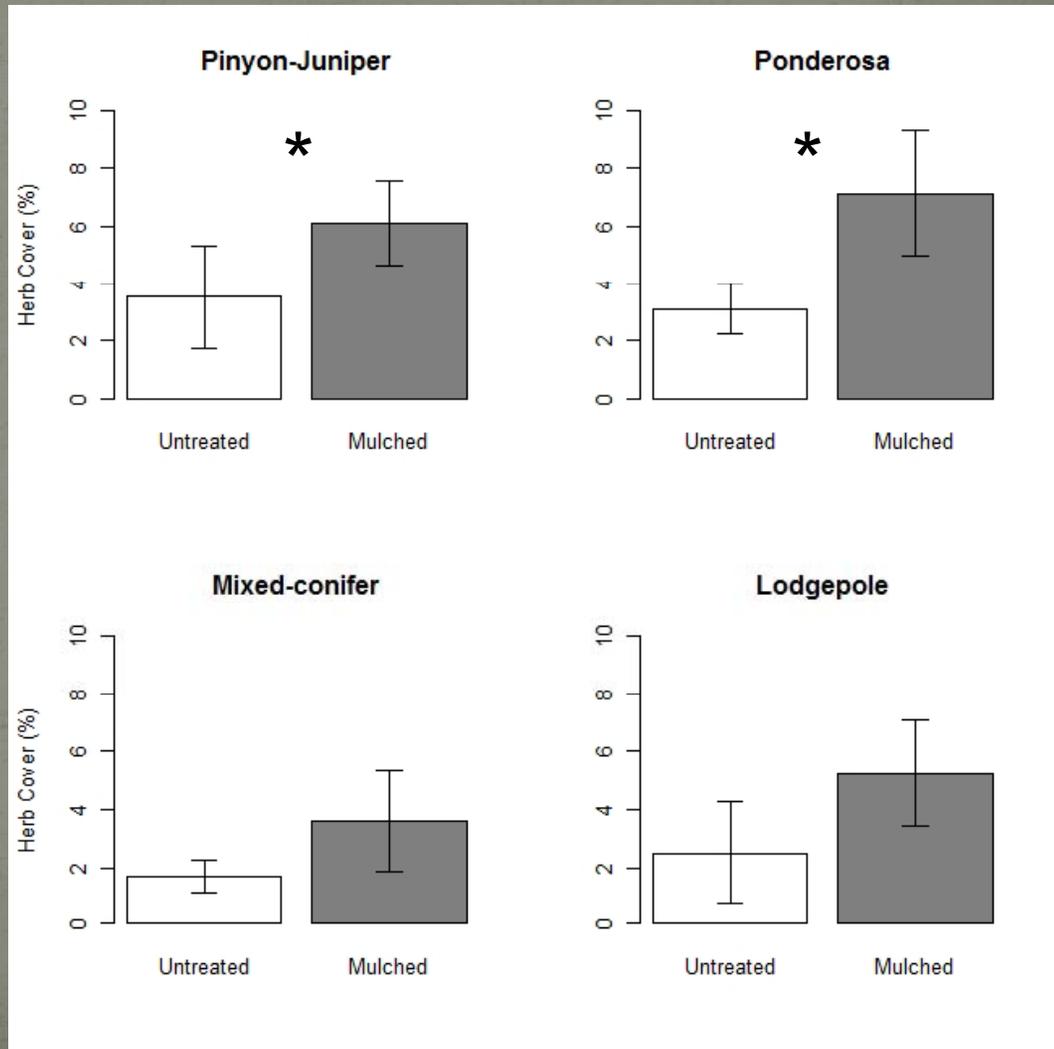
Results: shrub cover

Shrub cover:
no differences



Results: herbaceous cover

Herb cover: higher in mulched pinyon-juniper and ponderosa



Why herbaceous response in PJ and Ponderosa, and not elsewhere?

Perhaps...

- Lodgepole and M-C have greater canopy reduction, and heavier mulch loads than Ponderosa and PJ
- However, if veg suppressed by the mulch, expect negative relationship between mulch depth and understory cover

Ecosystem	Untreated avg BA (m ² /ha)	Mulched avg BA (m ² /ha)	Avg Basal area reduction
Lodgepole	38	11	73%
Mixed-conifer	38	4	89%
Ponderosa	27	10	65%
Pinyon-Juniper	22	12	47%

Why herbaceous response in PJ and Ponderosa, and not elsewhere?



Alternatively...

- More herbs present to respond quickly to open canopy in PJ and Ponderosa
- Availability of propagules may limit understory flora in Mixed-conifer and Lodgepole
- Pattern may change with time-since-treatment

Q3: Do mulching treatments affect understory species richness?

- At the subplot (1 m²) scale, no ecosystem showed differences in species richness between treatments.
- At the plot scale, only pinyon–juniper had higher richness in mulched (avg. 20 species per plot) than untreated (15 species per plot; $p=0.04$).



Q4: Do mulching treatments increase the cover and/or richness of exotic species?

- Overall exotic species abundances were low on average. No ecosystem showed differences in exotic cover between treatments.
- At the plot scale, ponderosa had higher richness of exotics in treated stands ($p=0.01$).
- At the ecosystem level, exotic species were observed more often in mulched areas than in untreated areas.

Results: Exotics

Exotic species observed across the four ecosystems

Ecosystem	Untreated	Mulched
Pinyon-Juniper	<ul style="list-style-type: none">• 6 species• cheatgrass abundant at 3 sites	<ul style="list-style-type: none">• 16 species• cheatgrass at the same 3 sites
Ponderosa	<ul style="list-style-type: none">• essentially absent	<ul style="list-style-type: none">• 11 species• Canada thistle, prickly lettuce, mullein, dandelion most common
Mixed-conifer	<ul style="list-style-type: none">• none	<ul style="list-style-type: none">• 4 species• Canada thistle by far most common
Lodgepole	<ul style="list-style-type: none">• essentially absent	<ul style="list-style-type: none">• 6 species• Canada thistle by far most common

Q4: Do mulching treatments change understory species composition?

Analysis methods:

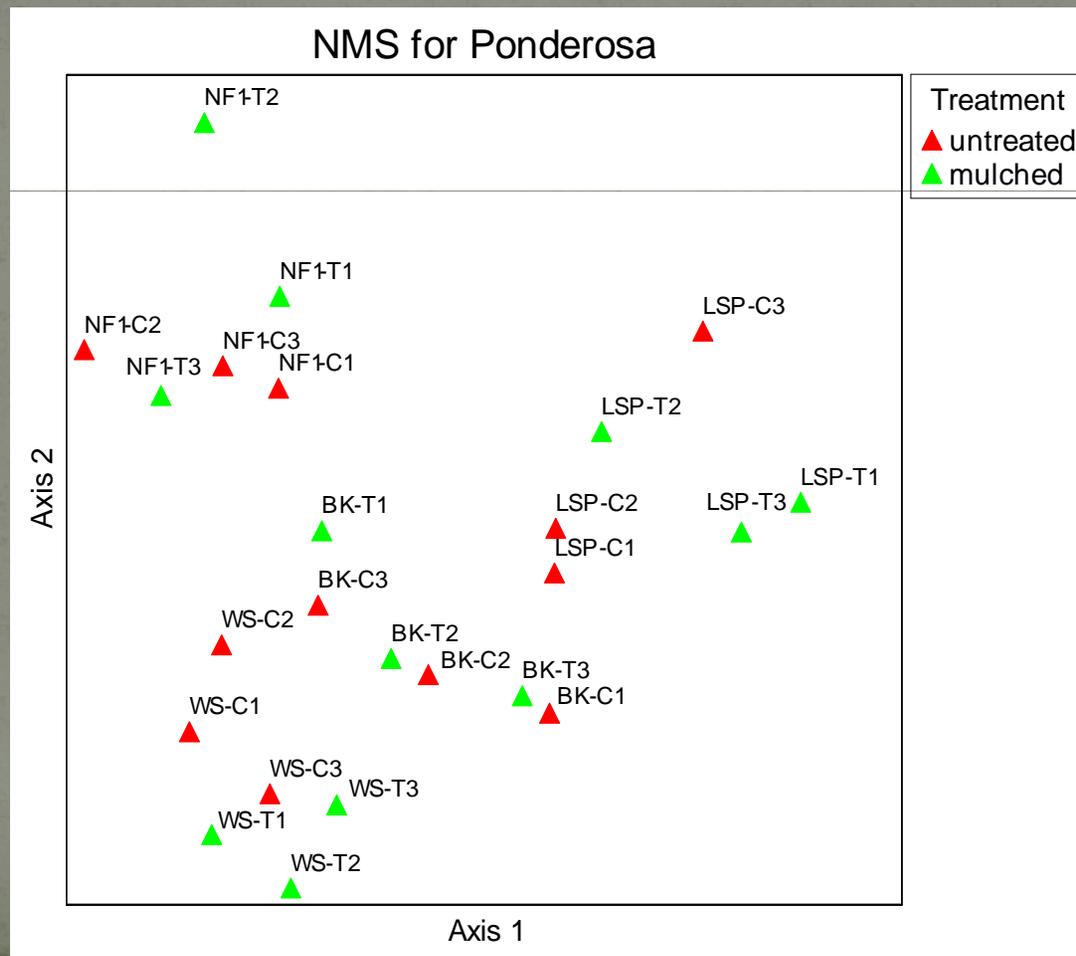
- Each ecosystem considered separately
- *Are plant communities more similar within treatments than between treatments at a site?*

PERMANOVA

- Where significant differences observed, use **NMS ordination** to identify the species/groups of species causing the differences

Results: Composition

- No mulching effect on composition at 17 of 18 sites (Permanova)



Pinyon Juniper



- 6 sites
- No significant compositional differences between mulched and untreated plots
- Exotics:
 - A few (6) present in untreated plots, notably **cheatgrass**
 - Where cheatgrass present, found in both untreated and mulched plots
 - Mulched plots collectively supported 16 exotic species

Ponderosa pine



- 4 sites
- No significant compositional differences between mulched and untreated plots
- Exotics:
 - Essentially absent from untreated plots
 - Mulched plots collectively supported 11 exotic species—**Canada thistle, prickly lettuce, mullein, dandelion** most common

Mixed-conifer



- 3 sites
- No significant compositional differences between mulched and untreated plots
- Exotics:
 - No exotics observed in untreated stands
 - 4 exotics observed in mulched stands, with **Canada thistle** by far most common

Lodgepole pine



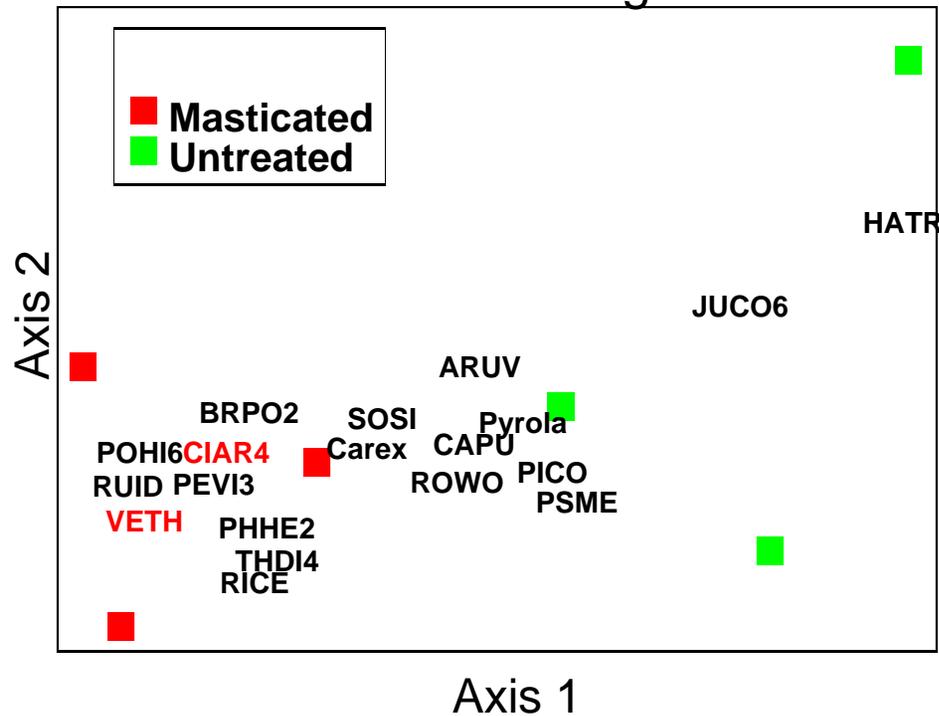
- 5 sites
- No compositional differences between treatments at 4 sites, but one site had a significant difference.
- Exotics:
 - Very few exotics observed in untreated stands
 - 6 exotic species observed in mulched stands, with **Canada thistle** by far the most common

Aside: What's different about Winiger?

Site was chipped while all other sites were masticated...



NMS for Winiger Site



Chipping vs. "Mastication"

Chipping	Mastication
Small, uniform woody pieces	Variety of sizes and shapes
Forms compact mat of mulch	Less compact
Physical barrier may prevent establishment of some species and favor others	No intact physical barrier--fuels often "mixed-in" with forest floor
May affect soil moisture	Unlikely to affect soil moisture



Summary and Conclusions

- In 4 Colorado forests types:
 - Herbaceous cover in Ponderosa and PJ appears to increase following canopy opening, despite suppression of herbs with deep mulch.
 - Mulching treatments did not appear to affect species composition when considered as a whole.
 - Exotic species more not highly abundant, but were more often observed in treated plots: may increase with time.
- Ecological effects of mulching treatments will likely depend on the ecosystem type, and perhaps also on the size and shape of wood particles.

Thank you

