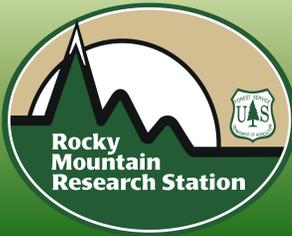


Long-term ecological effects of mastication fuels reduction treatments in Colorado



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Background

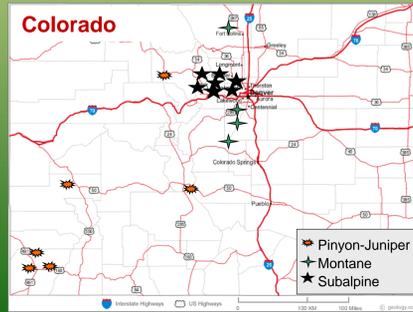
•Overall objective: Assess the long-term effects (6-9 years) of mastication treatments on tree regeneration, soils, and plants with emphasis on how ecological responses vary with mulch quantity and arrangement and through time.

•This research builds on an previous study that measured fuel loads, understory vegetation and soil resources in recently masticated treatments (2-4 years).

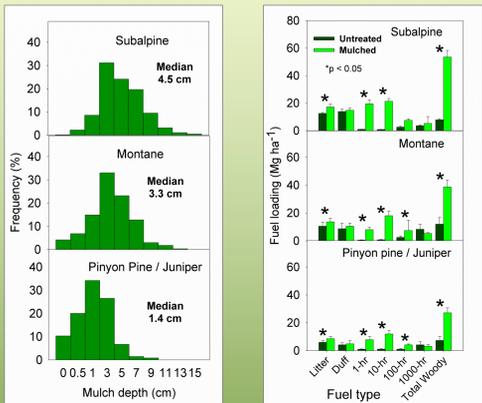
•Mastication treatments shred, chop, or chip unmerchantable material and deposit the biomass (mulch) on site.

Site Locations

Forest Type	Overstory Basal Area				Ownership
	Elevation (m)	Untreated (m ² ha ⁻¹)	Mulched (m ² ha ⁻¹)	Reduction (%)	
Subalpine / Mixed Conifer					
<i>Pinus flexilis</i> (44%), <i>Pinus ponderosa</i> (38%)	2900	32.6	8.9	73	Private
<i>P. contorta</i> (98%)	2818	32.7	13.8	58	CO State Park
<i>P. contorta</i> (100%)	2800	31.3	15.7	50	USFS
<i>P. contorta</i> (58%), <i>P. ponderosa</i> (30%), <i>Pseudotsuga menziesii</i> (12%)	2760	34.8	3.4	90	USFS
<i>P. contorta</i> (100%)	2657	38.3	12.4	68	Private
Montane					
<i>P. ponderosa</i> (94%), <i>Pseudotsuga menziesii</i> (6%)	2360	16.7	7.4	56	USFS
<i>P. ponderosa</i> (58%), <i>Pseudotsuga menziesii</i> (42%)	2300	28.6	13.7	52	USFS
<i>P. ponderosa</i> (58%), <i>Pseudotsuga menziesii</i> (32%)	2130	26.2	6.7	74	Private
<i>P. ponderosa</i> (50%), <i>Pseudotsuga menziesii</i> (50%)	2100	36.0	17.2	52	CO State Park
Pinyon-Juniper					
<i>P. edulis</i> (89%), <i>Juniperus</i> sp. (10%)	2400	30.2	5.5	82	BLM
<i>P. edulis</i> (39%), <i>Juniperus</i> sp. (61%)	2250	12.7	4.9	61	USFS
<i>P. edulis</i> (65%), <i>Juniperus</i> sp. (35%)	2200	17.2	6.4	63	BLM
<i>P. edulis</i> (12%), <i>Juniperus</i> sp. (88%)	2200	37.6	22.6	40	BLM
<i>P. edulis</i> (22%), <i>Juniperus</i> sp. (78%)	2170	23.2	15.1	65	BLM
<i>P. edulis</i> (16%), <i>Juniperus</i> sp. (84%)	1915	11.5	2.5	78	BLM



How are mulch depths and fuel loads distributed?

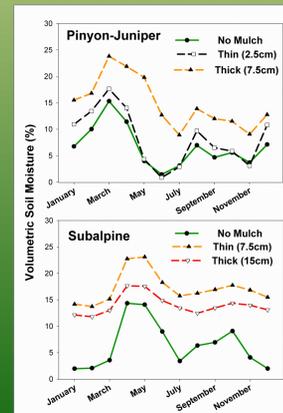
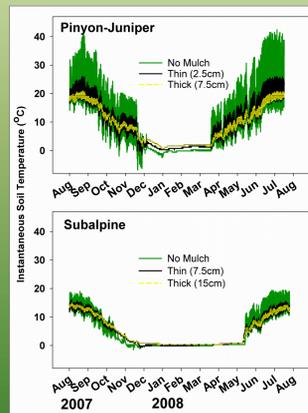


Mulch Depth Experiment: How deep is too deep?

•Mulch depth was experimentally manipulated to create "thick" and "thin" mulch depths that exceed operational-scale depths.



•Mulched plots generally increase soil moisture.



•Mulched plots have moderated temperature fluctuations and lower max summer temps.

Operational-Scale

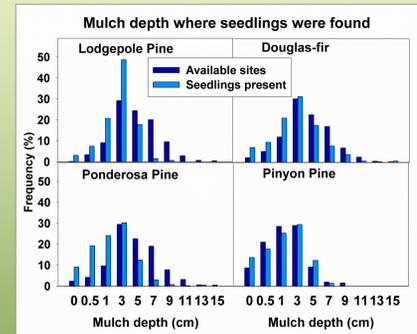
•Variability of mulch depth creates different microsites.

•Median mulch depths range from 1.4 – 4.5 cm.

•1 and 10 hr fuels dominate woody fuel loads in mulched areas (67 and 78%).

•Total woody fuel loads increased 3-8 fold following treatment.

Do trees regenerate in mulched areas?



Operational-Scale

•Tree seedlings can establish in mulch depths up to 7 cm, but prefer depths less than 4 cm.

•How is seedling density related to mulch depth?:

•Less exposed mineral soil

•Mulch = favorable microclimate

•Variability in seed production

•Climatic factors since treatment

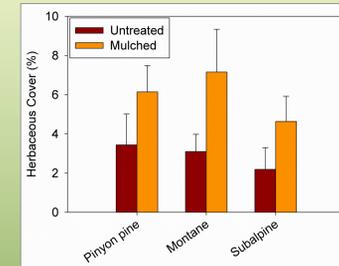
In-progress / Mulch Depth Experiment

•A seed sowing experiment will shed light on several potential factors affecting seedling establishment.

•Seeds of four tree species were sown in thick and thin mulch depths.



Does mulch suppress understory plants or increase exotics?



Operational-Scale

•Mulch does not suppress herbaceous cover; overall cover of herbs doubled in mulched areas.

•Exotic plant cover was unchanged, but montane forests had higher exotic plant richness.

•At the ecosystem level exotic species were observed more often in mulched areas, but cover was low.

Ecosystem	Untreated	Mulched
Subalpine	• essentially absent	• 6 species • Canada thistle most common
Montane	• essentially absent	• 11 species • Canada thistle, prickly lettuce, mullein, dandelion common
Pinyon-Juniper	• 6 species	• 16 species • cheatgrass at essentially the same sites

In-progress

•Herbaceous cover will be re-assessed in 2012 (6-9 years post-treatment).

•Non-native species concerns will be evaluated.



Is soil available N altered by the addition of mulch residue?

Operational-Scale

•IER-N was about 50% higher in mulched areas in subalpine and montane forests

•Mulching increased IER-N at two pinyon-juniper sites, but had no effect at the other four sites.

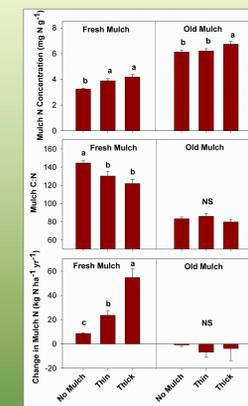
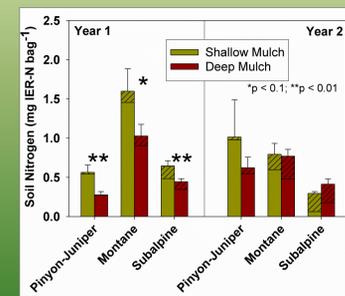
Forest Type	Total IER Nitrogen	
	Untreated	Mulched
Subalpine	1.04 (0.11)	1.51* (0.19)
Montane	0.96 (0.10)	1.46* (0.15)
Pinyon-Juniper	0.98 (0.10)	0.98 (0.09)

Two-way Anova, Main Effects		F	p
Treatment		8.260.004	
Forest Type		0.260.774	
Treatment x Forest Type		2.120.121	

Data are mean (SE); * denotes p < 0.05

Mulch Depth Experiment

•Plant available soil N was reduced under heavily-mulched plots the first year, but the effect did not persist.



In-progress / Mulch Depth Experiment

•Are tree seedlings planted in thin and thick mulch beds nitrogen-limited?

•Four tree species were planted in 2011 and will be assessed for survival, growth, and foliar N.

•Greater change was observed in thick mulch beds and for fresh material.

•Fresh mulch immobilized N and effects increased with depth.

•Five year old mulch released N regardless of depth

