Impacts of forest biomass removal on soil quality and forest productivity

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Some Current Forestry Issues

- 73 million acres of Overstocked Forest in West (USFS, 2003)
- 40 million dead acres of beetle killed forest in BC/Alberta, 4 million CO/WY
- Longer fire season, increasing fire severity
- Increasing Cost of Transportation and biomass Removal
- Biomass removal can have negative impacts on future productivity

Solutions to Current Situation

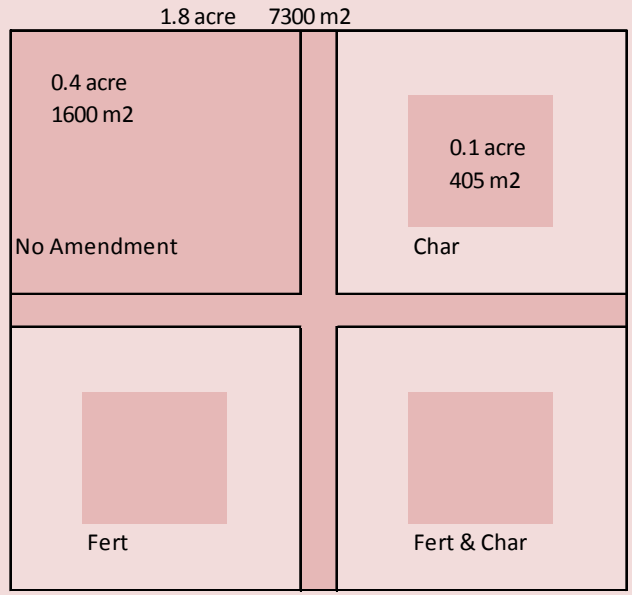
- Thin forest to increase resiliency from Insects/disease, fires
- Utilizing low-value biomass for energy production

Experimental Design

Thinned to ~25% of original volume
3 slash retention rates (none, All, or Double)
Biochar will be added at ~3,000 lbs/ac
Fertilizer (N) at 688 lbs/ac

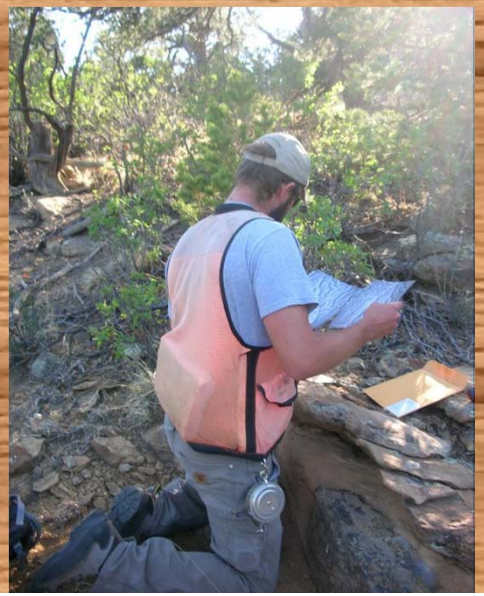
Unthinned control		Thinned and No slash retention (0)	
no amendment	fertilizer	no amendment	fertilizer
biochar	fertilizer & biochar	biochar	fertilizer & biochar
Thinned and All slash retained (1x)		Thinned and Double Slash retained (2x)	
no amendment	fertilizer	no amendment	fertilizer
biochar	fertilizer & biochar	biochar	fertilizer & biochar

Thinned and all slash retained (1x)



Questions

- How will the soil physiochemical/biological properties change due to thinning and different rates of slash retention?
- How will the soil physiochemical/biological properties change due to the different soil amendments?
- How will subsequent tree growth respond to the different biomass removal rates and can soil amendments compensate for the removal?



Data Collection

- Tree growth responses: Crown response, B.A., volume
- Soil physical/chemical properties: Bulk density, Macro/Micro nutrients, Soil Organic Matter content, Soil Moisture/Temperature
- Soil biological activity: Soil respiration (CO_2 fluxes), Microbial Biomass, Enzyme activity

U of I Exp. Forest Stand Characteristics

Lower Stand	B.A. ft2/ac	QMD	TPA	SDI
0x	32.37	5.55	193	75
Doug-fir	9.28	7.24	33	19
Grand-fir	6.52	5.47	40	15
Lodge Pole	8.11	5.20	55	19
Ponderosa	7.78	5.21	53	19
Western Larch	0.67	3.14	13	2
1x	31.60	6.43	140	69
Doug-fir	10.47	8.36	28	21
Grand-fir	8.65	6.11	43	19
Lodge Pole	3.73	4.99	28	9
Ponderosa	6.89	5.62	40	16
2x	16.31	4.66	138	41
Doug-fir	2.26	5.75	13	5
Grand-fir	5.23	6.93	20	11
Lodge Pole	3.00	4.69	25	7
Ponderosa	5.80	3.70	78	16
Control	69.08	4.49	628	174
Doug-fir	12.44	4.61	108	31
Grand-fir	17.70	3.45	273	50
Lodge Pole	17.87	4.88	138	44
Ponderosa	9.62	5.11	68	23
Western Larch	11.42	7.24	40	24

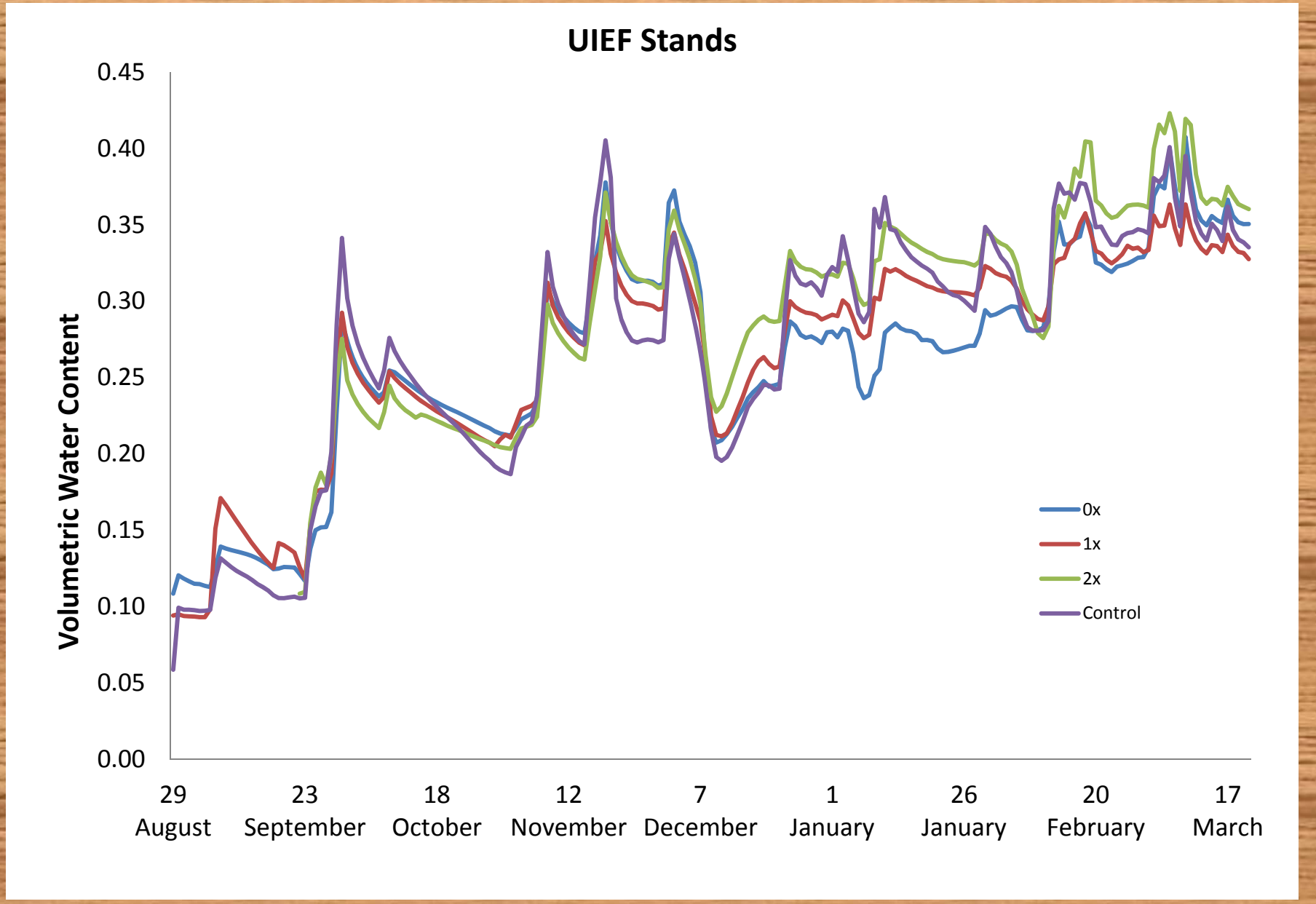
Upper Stand	B.A. ft2/ac	QMD	TPA	SDI
0x	20.00	4.94	150	49
Doug-fir	2.25	6.42	10	5
Lodge Pole	1.20	6.63	5	3
Ponderosa	16.55	4.74	135	41
1x	33.96	5.92	178	77
Doug-fir	0.70	7.17	3	1
Lodge Pole	0.10	2.72	3	0.3
Ponderosa	33.16	5.94	173	75
2x	15.65	4.84	123	38
Doug-fir	5.34	7.48	18	11
Lodge Pole	0.10	2.72	3	0.3
Ponderosa	10.21	4.27	103	26
Control	74.72	4.57	655	187
Doug-fir	6.14	3.88	75	16
Grand-Fir	0.02	1.34	3	0.1
Lodge Pole	0.60	3.31	10	2
Ponderosa	67.89	4.70	563	168
Western Larch	0.05	1.89	3	0.2

Laird Park Stand Characteristics

South Stand	B.A. ft2/ac	QMD	TPA	SDI
0x	39.2	6.1	193	88
Doug-fir	20.7	6.8	83	44
Grand-fir	0.5	2.7	13	2
Western Hem	7.2	8.1	20	14
Red cedar	10.8	5.1	78	26
1x	37.8	5.9	198	86
Doug-fir	25.5	7.0	95	54
Grand-fir	2.8	4.8	23	7
Red cedar	9.5	4.7	80	24
2x	43.2	6.3	203	96
Doug-fir	34.2	7.3	118	71
Grand-fir	0.8	3.0	18	3
Western Hem	3.2	6.8	13	7
Western Larch	0.7	7.3	3	2
Red cedar	4.2	3.8	53	11
Control	235.9	5.3	1528	557
Doug-fir	94.5	6.2	456	210
Grand-fir	13.8	5.3	91	33
Western Hem	36.0	7.4	121	74
Red cedar	91.6	4.4	860	233

North Stand	B.A. ft2/ac	QMD	TPA	SDI
0x	36.4	5.9	193	83
Doug-fir	30.0	6.4	135	66
Grand-fir	0.6	3.4	10	2
Western Hem	2.1	5.6	13	5
White Pine	0.6	6.8	3	1
Red Cedar	3.0	4.1	33	8
1x	42.8	6.6	183	93
Doug-fir	26.0	6.4	115	57
Grand-fir	2.1	5.6	13	5
LodgePole	0.2	3.7	3	1
Western Hem	12.1	8.6	30	24
Western Larch	1.4	7.2	5	3
Red Cedar	1.0	3.3	18	3
2x	24.5	5.4	153	57
Doug-fir	19.6	5.9	103	44
Grand-fir	0.3	3.1	5	1
Western Hem	2.2	5.7	13	5
Red Cedar	2.4	3.7	33	7
Control	170.8	4.2	1742	441
Doug-fir	110.7	6.1	547	248
Grand-fir	17.6	2.3	618	58
LodgePole	2.9	7.2	10	6
Western Hem	36.8	3.9	445	98
Red Cedar	2.7	2.0	122	9

Soil Moisture at Experimental Forest



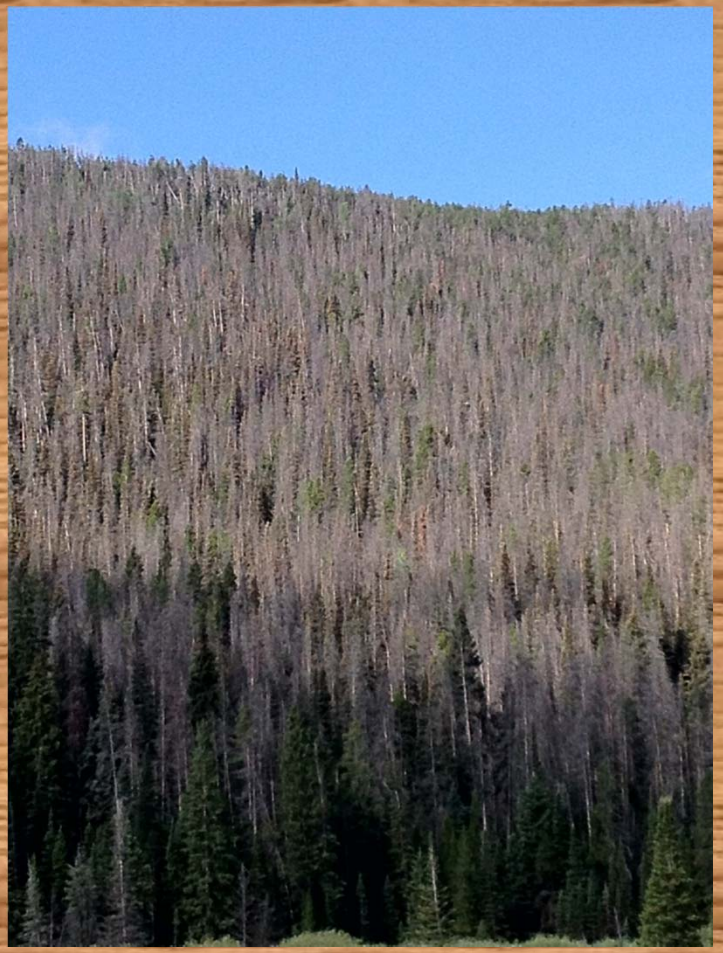
Expected Forestry results

- Thinning will increase growth of individual tree volume
- Fertilizer will have a short-term effect on growth
- Increasing amounts of slash retention will increase individual growth over the long-term

Expected Soil Results

- Positive relationship with increasing slash retention rates and soil physiochemical/biological properties; however these will not be detectable in the short-term
- Fertilizer will have a short-term effect on soil properties, but will dissipate with time
- Biochar will have increasing positive effect on soil properties with time

Q/A
Thanks for your time!



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