

# Using remote sensing for forest management and restoration: a case study

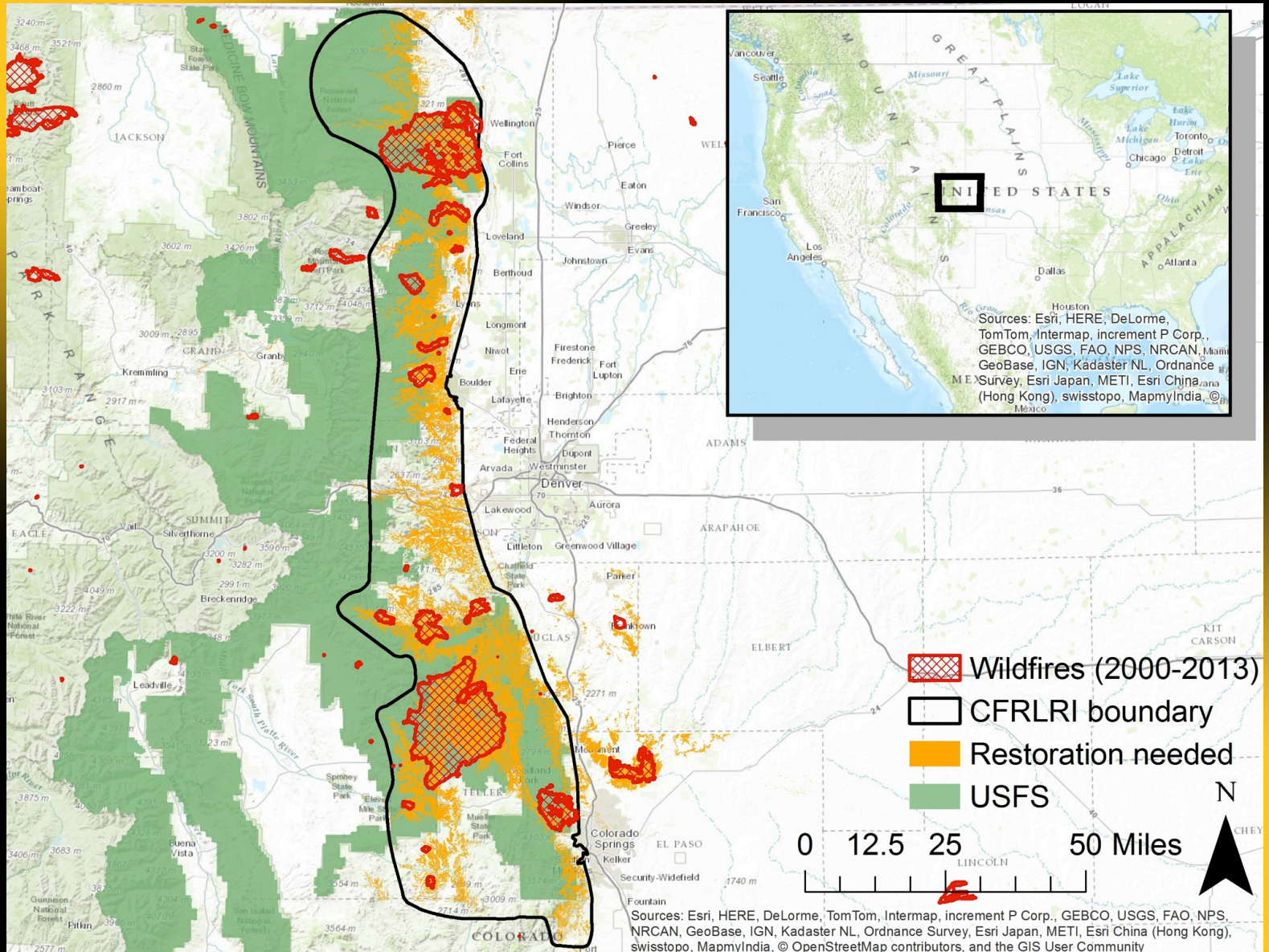
Dr. Yvette Dickinson

9<sup>th</sup> April 2015

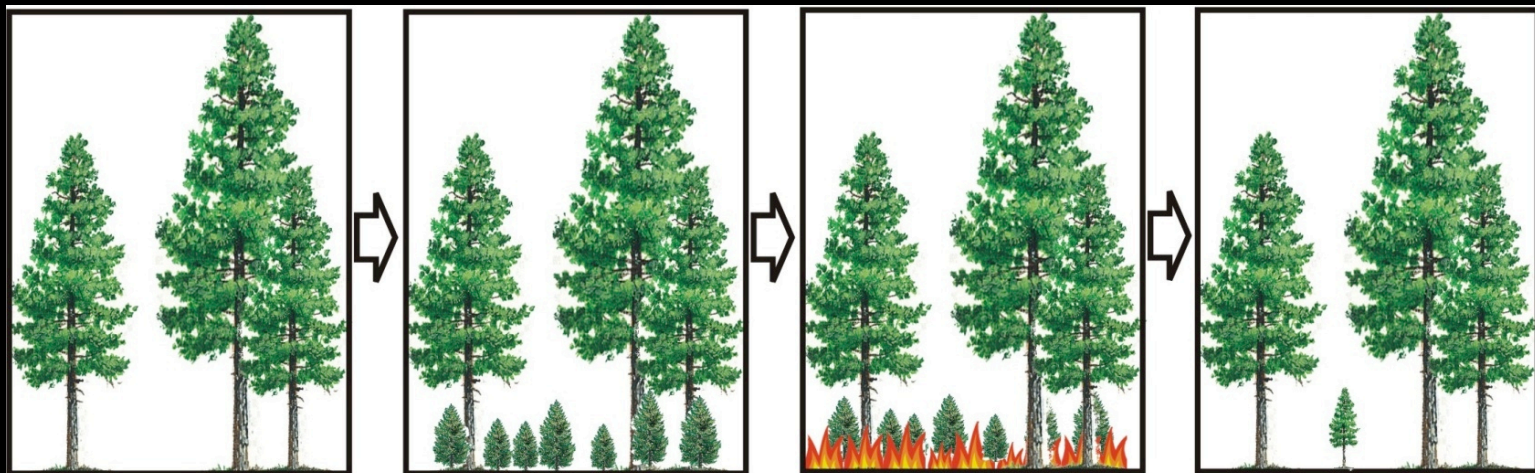


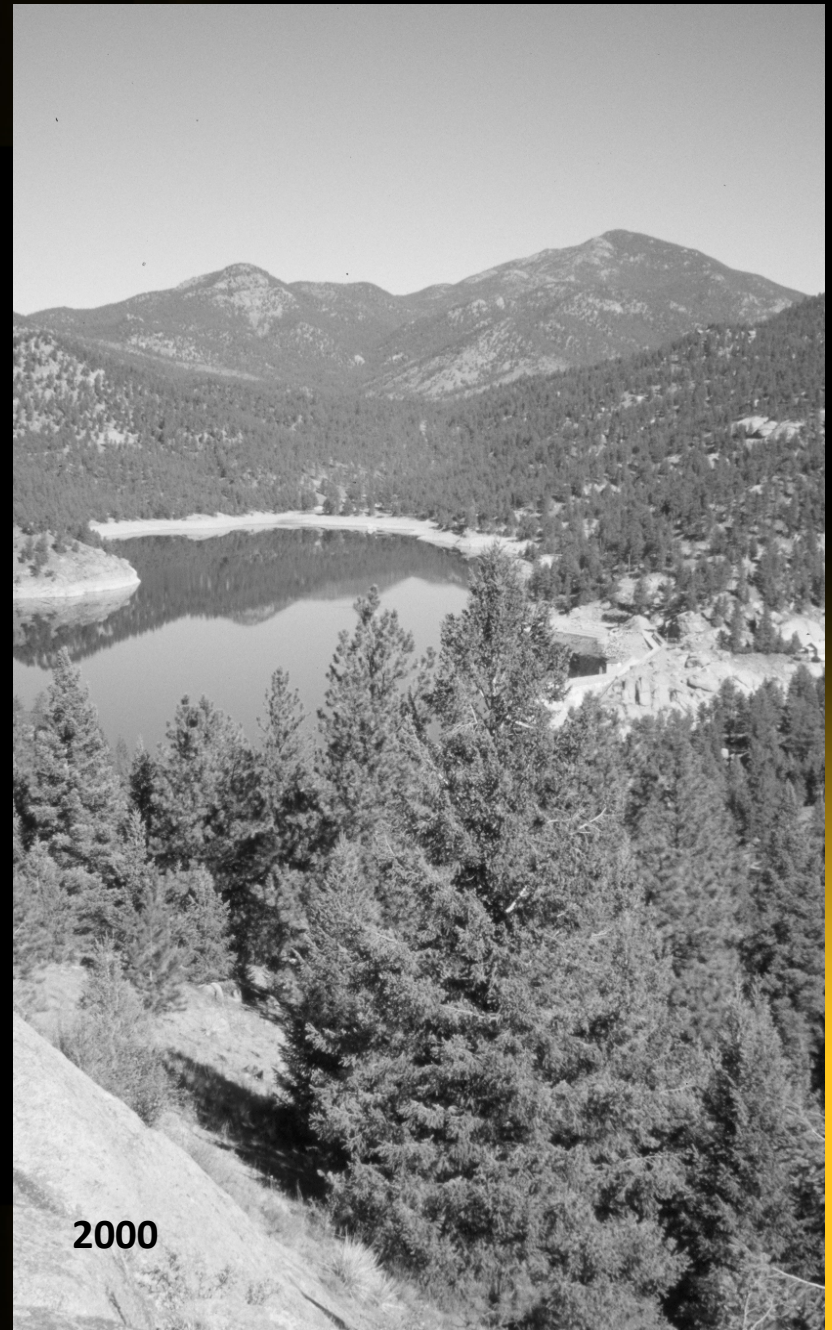
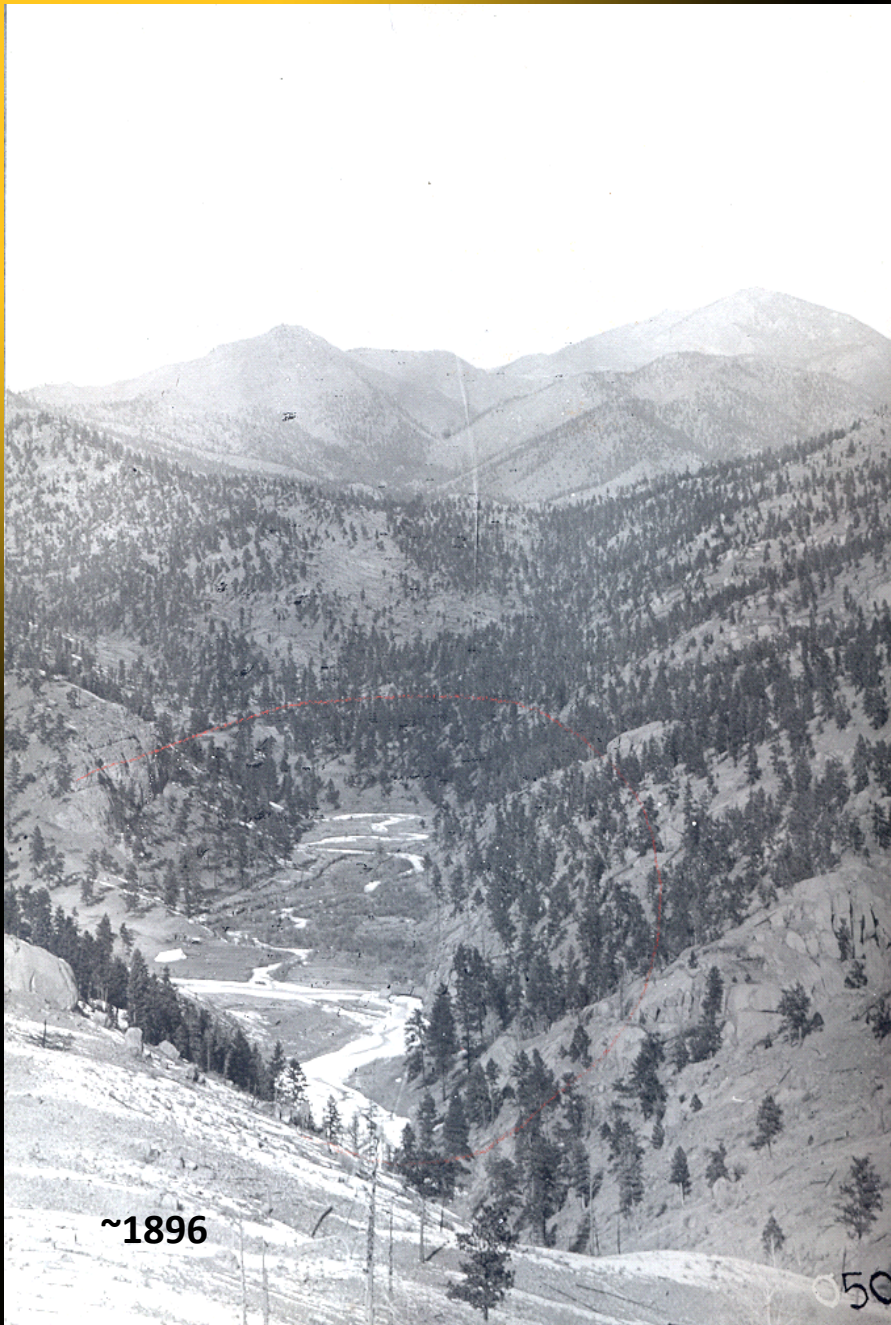
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INSTITUTE

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# Historical mixed-severity fire regime





Images: Dr Mike Battaglia, USFS Rocky Mountain Research Station

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1899



2000



Images: Dr Mike Battaglia, USFS Rocky Mountain Research Station

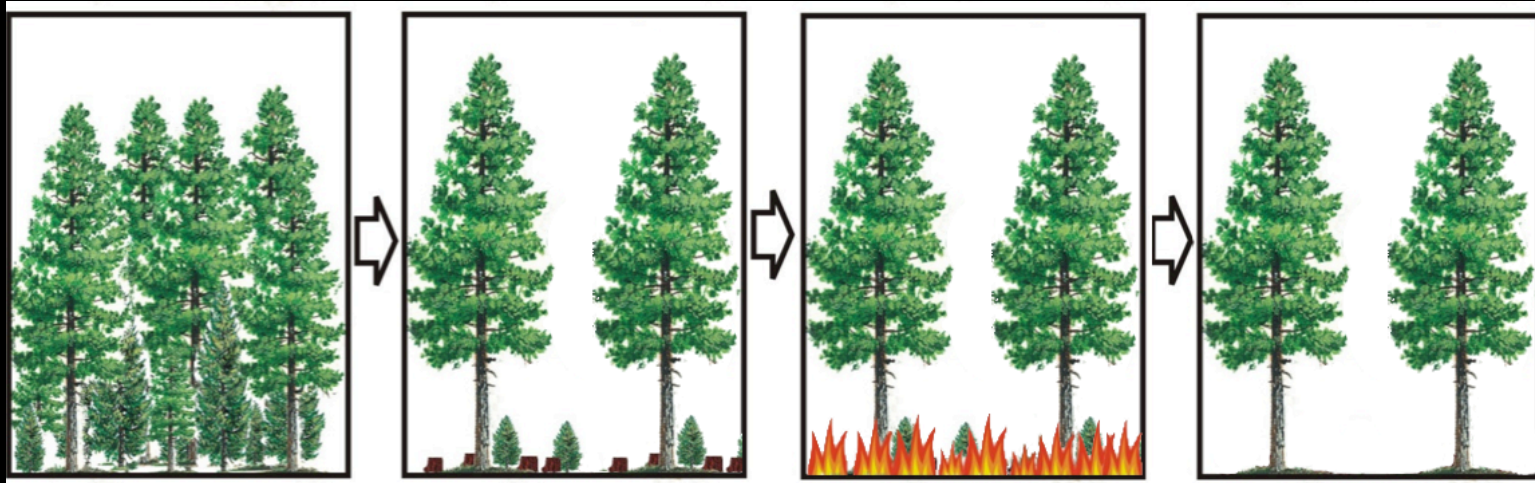
# Current situation



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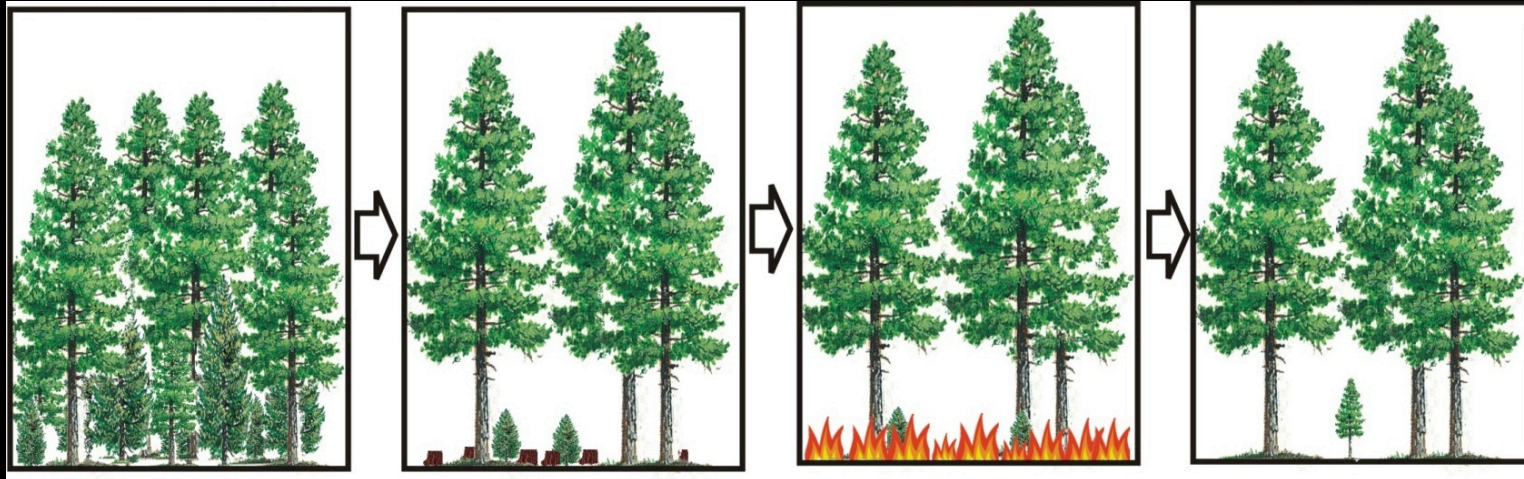
Year	Size (acres)	Name
1989	2,100	Black tiger fire
1996	11,900 (10 structures)	Buffalo creek fire
2000	10,800 (51 structures)	Hi meadow fire
2000	10,599 (18 structures)	Bobcat gulch
2002	137,760 (600 structures and 5 deaths)	Hayman fire
2010	6,388 (>174 structures)	Four mile canyon fire
2012	7,685	Hewlett gulch
2012	87,284 (>250 structures and 1 death)	High park fire
2012	18,247 (346 homes and 2 deaths)	Waldo canyon fire
2013	14,280 (486 homes)	Black forest fire

# “Traditional” hazardous fuels mitigation

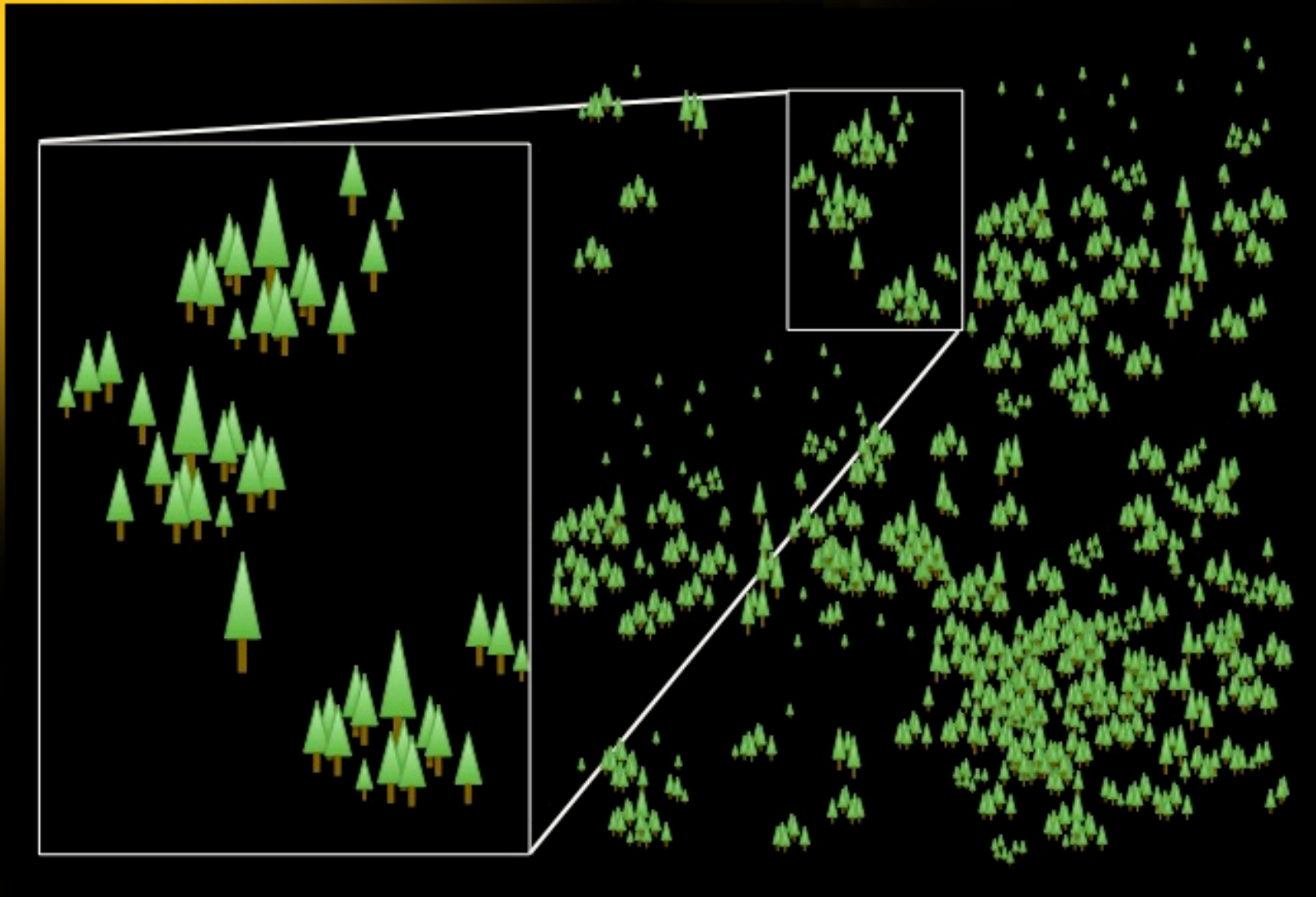




# “Groupy-clumpy” restoration



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# Colorado Front Range Landscape Restoration Initiative



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Image: Jeff Cadry

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Images: Jeff Cadry

## Stand-scale analysis

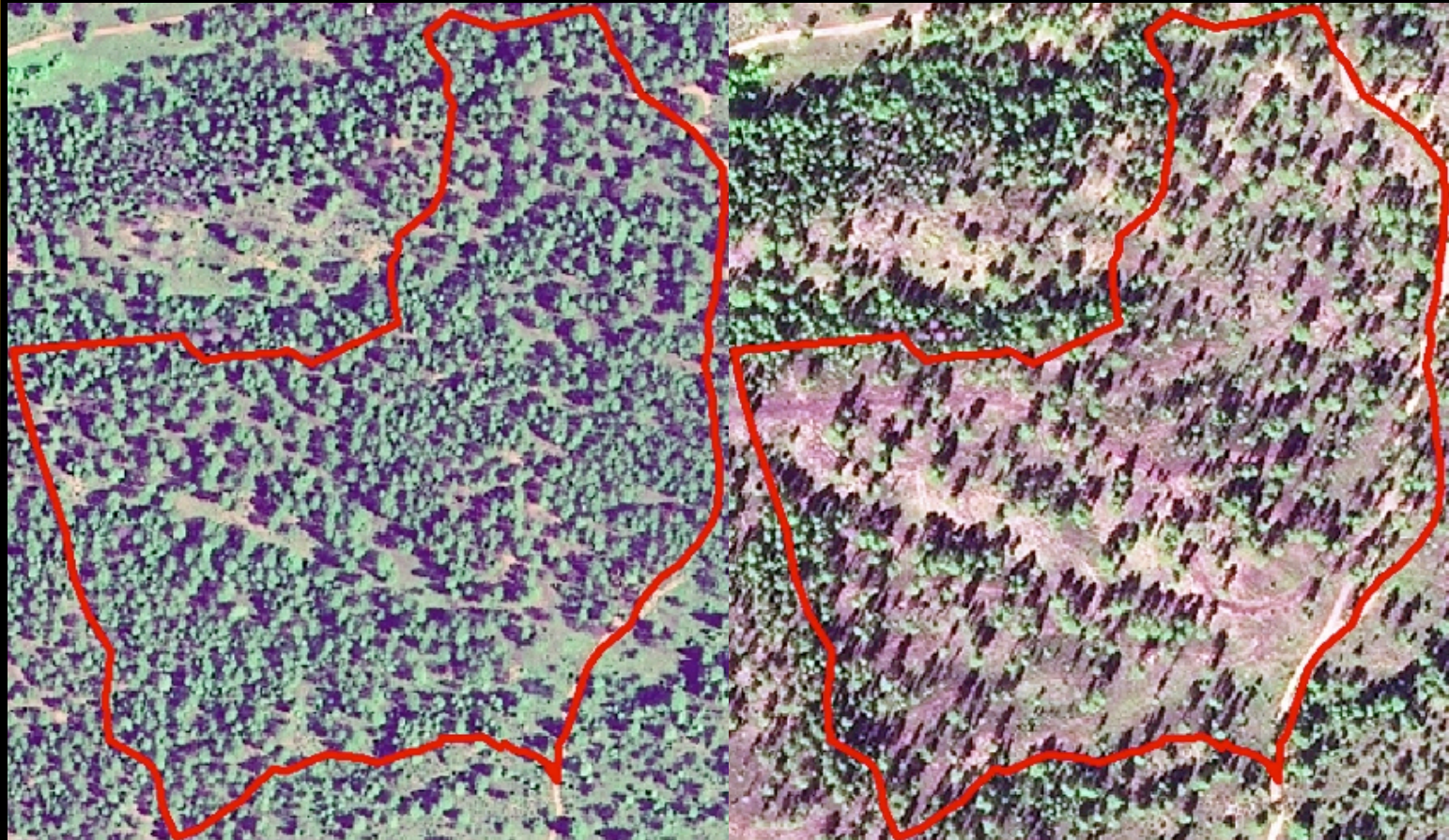
- National Aerial Imagery Program imagery (free, 4-bands, every 3 years)
- 2.4m resolution
- Derive simple ratio
- Classify images to map canopy cover
- Analyze patterns using FRAGSTATS

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Ryan Quinlan Treatment Unit 8 (18 acres)

Pre-treatment

Post-treatment

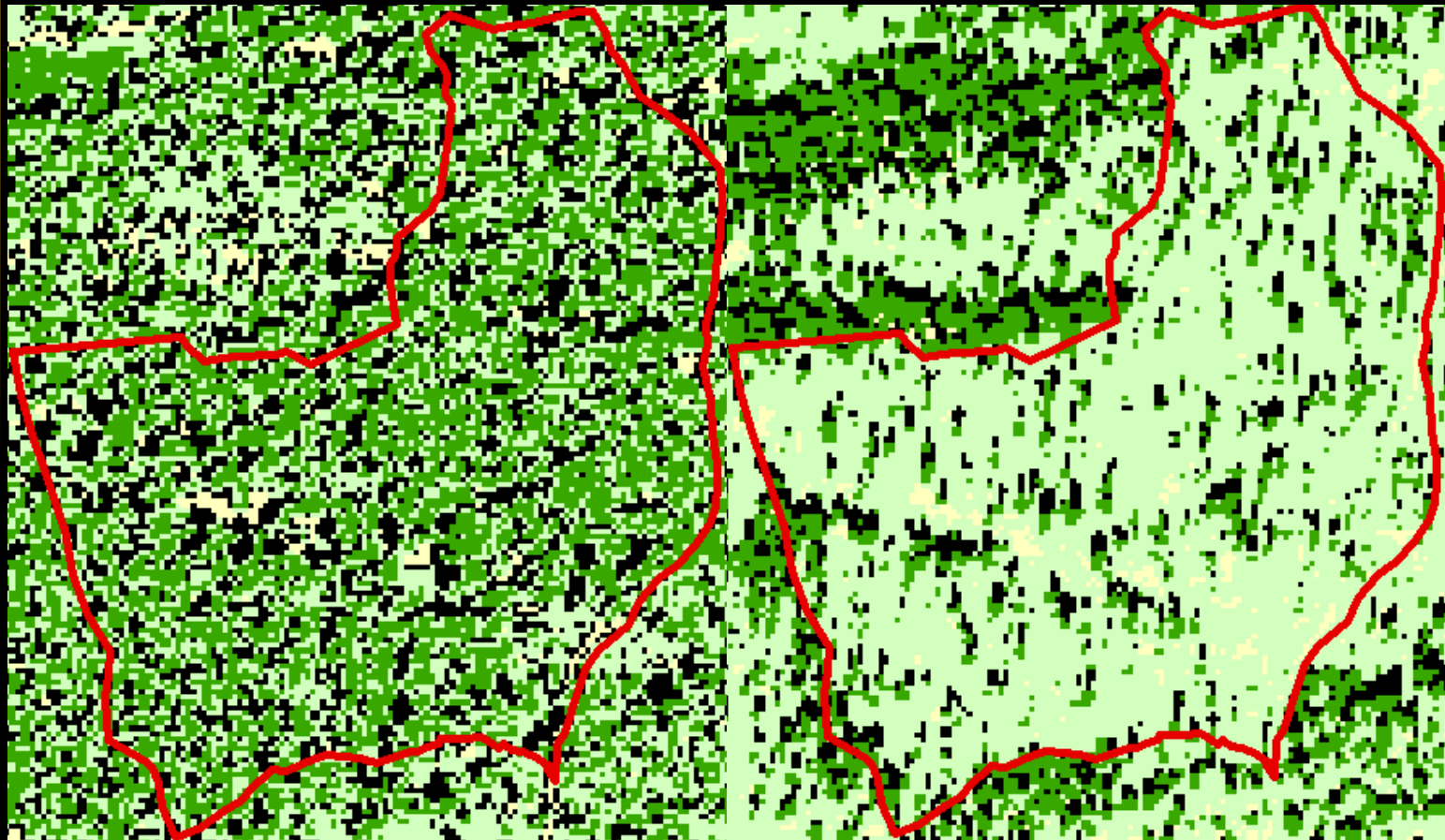


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Ryan Quinlan Treatment Unit 8 (18 acres)

Pre-treatment

Post-treatment

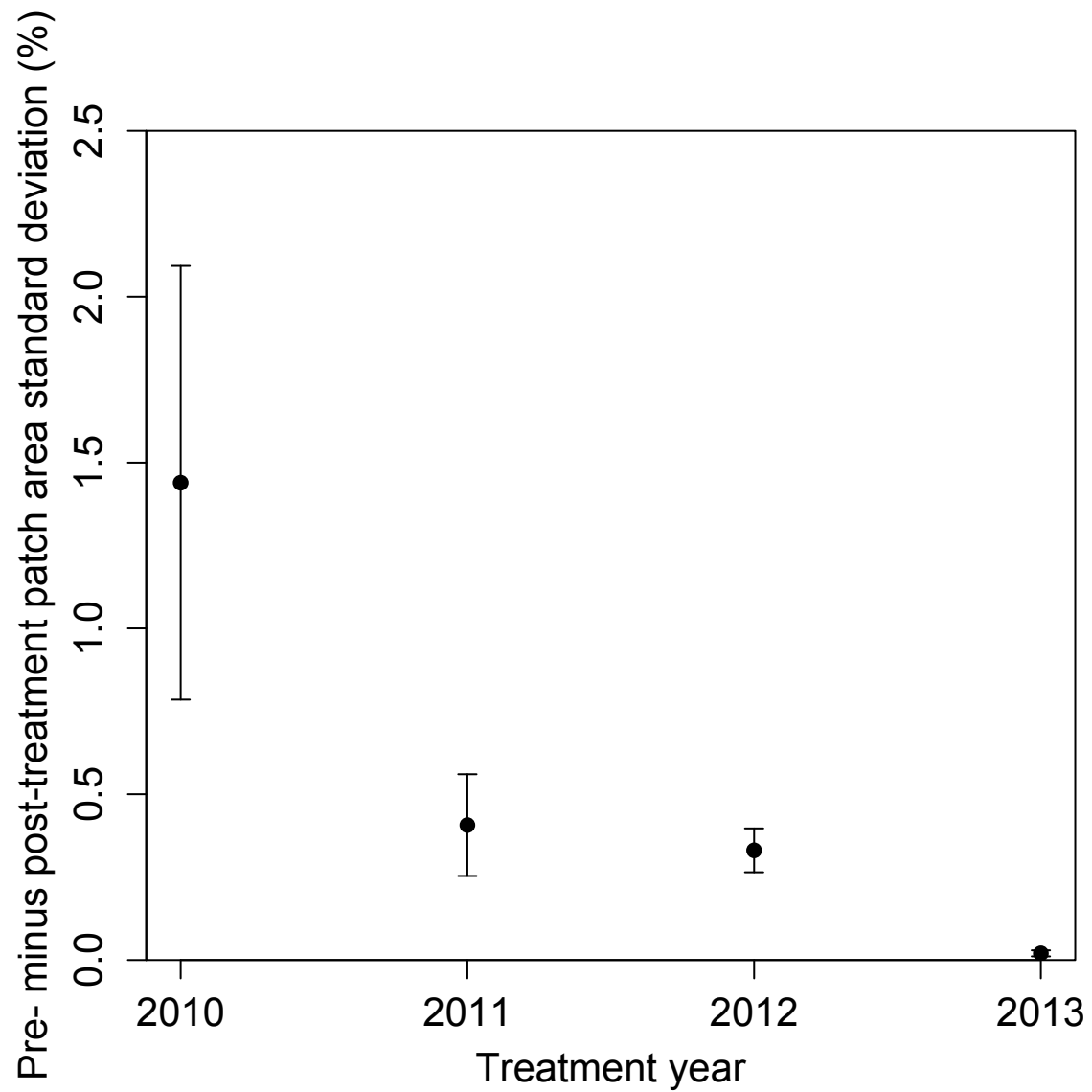




Metric		Pre-treatment		Post-treatment		Desirable trend
		Mean	(Std Dev)	Mean	(Std Dev)	✓/✗
PLAND (%)*		43.6	(13.2)	25.8	(10.3)	✓
LPI (%)*		21.9	(21.9)	6.5	(8.7)	✓
AREA (ha)	Mean*	0.051	(0.115)	0.011	(0.010)	✓
	Range*	6.321	(12.566)	1.516	(2.678)	✗
	Std Dev*	0.358	(0.628)	0.074	(0.124)	✗

129 treatment units, 2010-2013

\*Ranked ANOVA, P<0.05



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Metric		Pre-treatment		Post-treatment		Desirable trend
		Mean	(Std Dev)	Mean	(Std Dev)	
ENN (m)	Mean*	5.42	(1.17)	6.37	(1.19)	✓
	Range*	10.36	(14.69)	17.8	(13.9)	✓
	Std Dev*	1.21	(1.40)	2.45	(1.92)	✓
ENRP (m)	Mean*	2.32	(0.67)	4.65	(2.53)	✓
	Range*	14.25	(1.31)	25.72	(10.97)	✓
	Std Dev*	1.90	(0.83)	4.03	(2.19)	✓

129 treatment units, 2010-2013

\*Ranked ANOVA, P<0.05

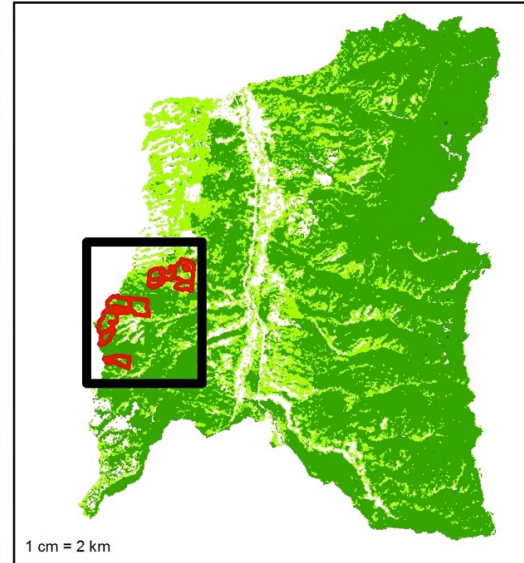
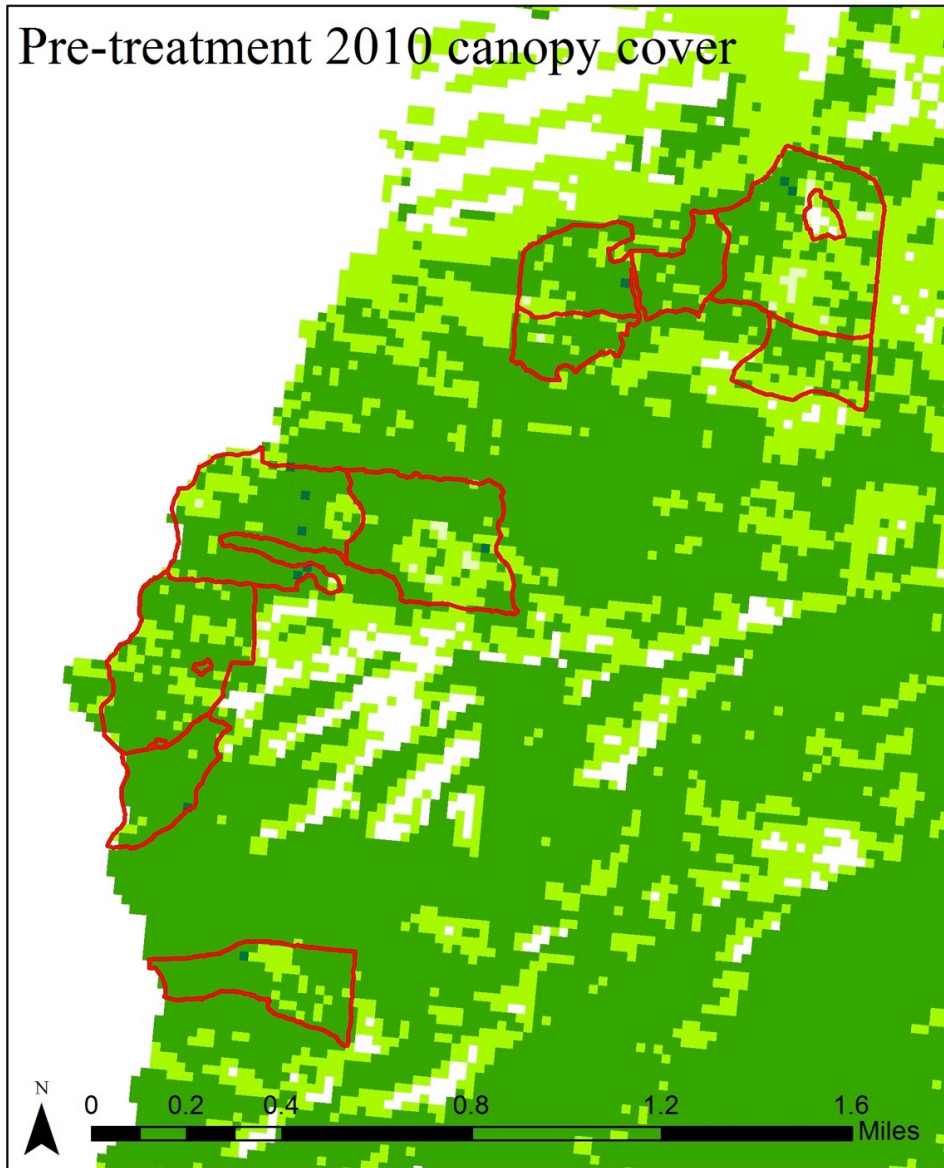
## Conclusions







- Generally achieving desired outcomes
- Adaptive management is making improvements over time
- Managers need to maintain focus on increasing heterogeneity

## Landscape-scale analysis

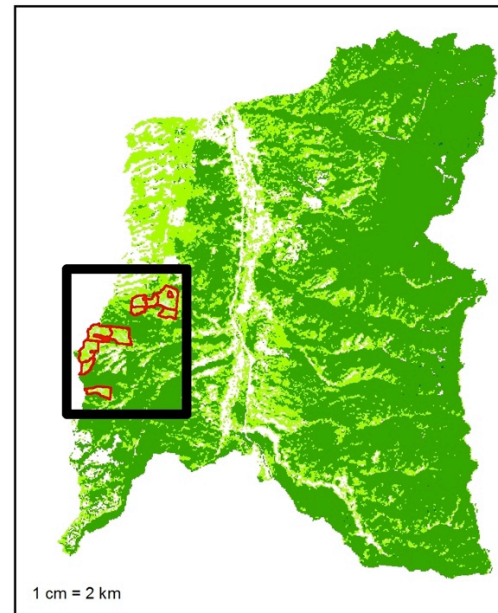
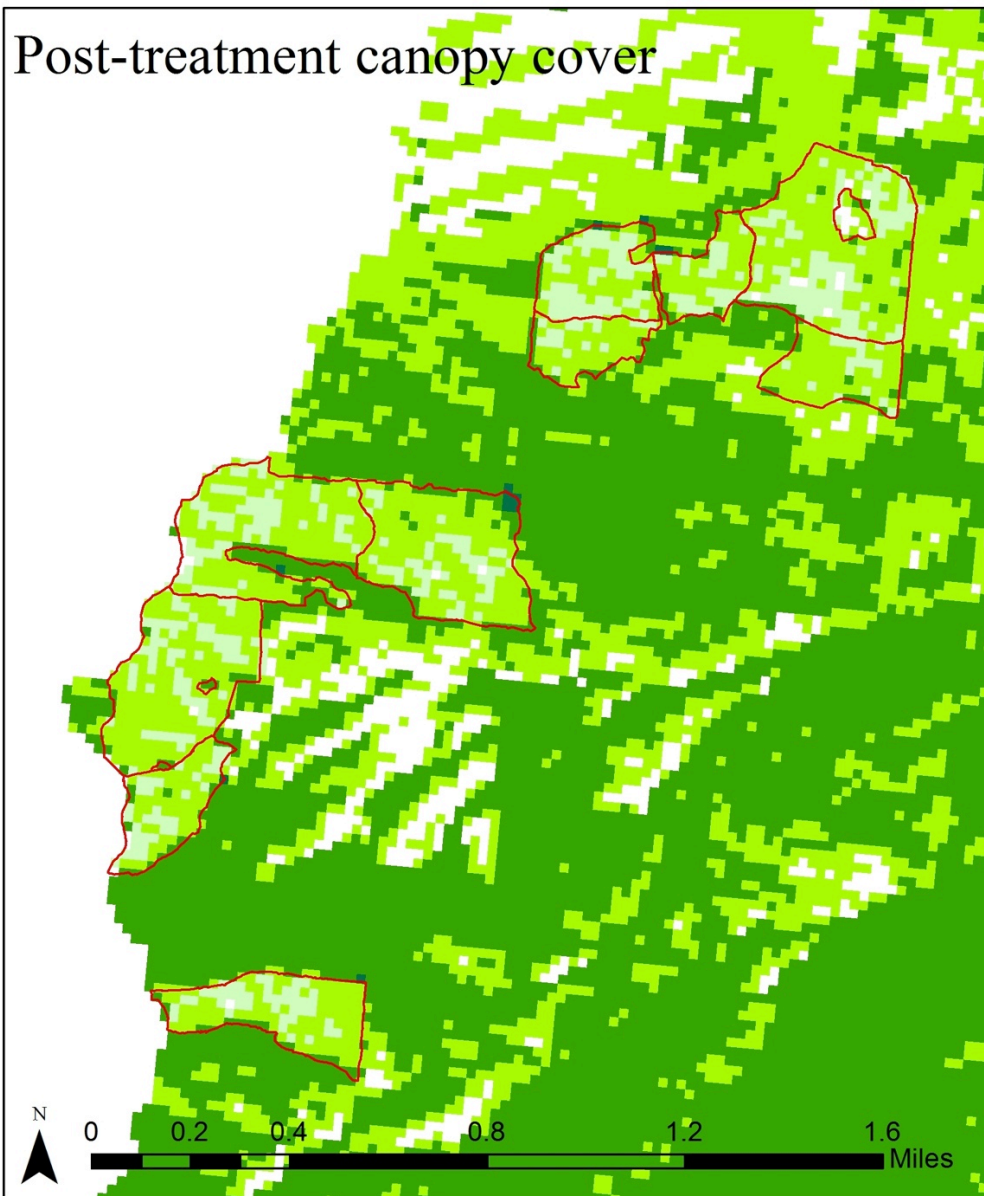
- Use stand-scale analysis to update LANDFIRE canopy cover data
- 30m resolution
- Canopy cover divided into classes
- Analyze pattern using FRAGSTATS
- Compare patterns of canopy cover over entire HUC12 watershed







Pre-treatment 2010 canopy cover



-  Treatment area
-  Non-forest
-  Sparse
-  Low
-  Moderate
-  Dense

Post-treatment canopy cover



-  Treatment area
-  Non-forest
-  Sparse
-  Low
-  Moderate
-  Dense

			AREA (ha)			ENN (m)		
	PLAND	LPI	Mean	Range	Std Dev	Mean	Range	Std Dev
Non-Forest	-	-	x	-	-	-	-	-
			(-1%)					
Sparse	✓	✓	✓	✓	✓	✓	x	x
	(+1413%)	(+973%)	(+405%)	(+1180%)	(+1038%)	(-48%)	(-49%)	(-73%)
Low	✓	✓	✓	✓	✓	-	-	-
	(+2%)	(+14%)	(+5%)	(+14%)	(+13%)			
Mod	✓	-	✓	-	x	✓	-	-
	(-1%)		(-5%)		(-3%)	(+1%)		
Dense	x	-	x	-	✓	✓	-	✓
	(+2%)		(+6%)		(+18%)	(+4%)		(+3%)



## Conclusions

- Methods are being implemented
- Collaborators are considering the results (alongside other monitoring) in adaptive management decisions
- Approach could be adapted to other projects

## Further information

- Dickinson, Y.L. and Giles, E. (2014) *Monitoring landscape-scale forest heterogeneity: A protocol*. CFRI-TB-1404. Colorado Forest Restoration Institute, Ft Collins, CO. 24p.
- Pelz, K.A., and Dickinson, Y.L. (2014) *Monitoring forest cover spatial patterns with aerial imagery: A tutorial*. Colorado Forest Restoration Institute, Colorado State University, Technical Brief CFRI-TB- 1401. Fort Collins, CO. 47 p.
- Dickinson, Y.L. and the Front Range Roundtable Spatial Heterogeneity Subgroup (2014) *Stand- and Landscape-Scale Desirable Forest Structures for a Restored Front Range*. Colorado Forest Restoration Institute, Colorado State University, Technical Brief CFRI-TB-1402, Fort Collins, CO. 18 p.
- Dickinson, Y., Giles, E., Pelz, K. and Howie, J. (2015) *Stand- and landscape-scale forest heterogeneity on Colorado's Front Range: monitoring report of the spatial heterogeneity subgroup for the 2010-2013 restoration treatments*. Colorado Forest Restoration Institute, Colorado State University, Monitoring Report CFRI-MR-1501. Fort Collins, CO. 177p.
- Dickinson, Y., Giles, E., Pelz, K. and Howie, J. (In Review) *Have we been successful? Monitoring horizontal forest complexity for forest restoration projects*. Ecological Restoration.

Available at: <http://coloradoforestrestoration.org/>

# Acknowledgements



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Questions?

