

Mechanized Forest Fuel Treatments: Analyzing Machine Efficiency across Variable Landscapes

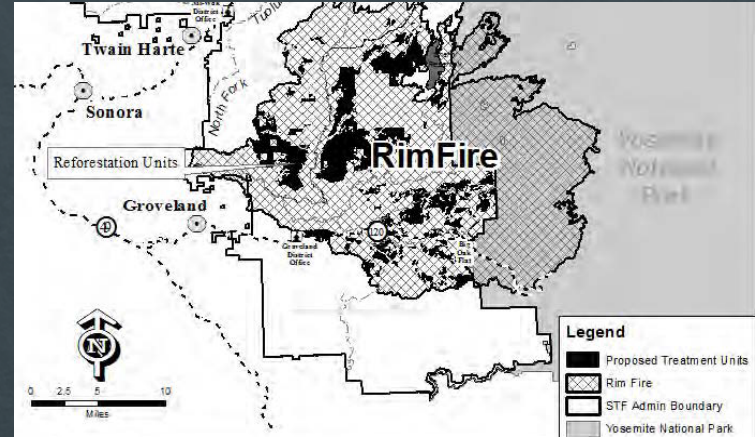
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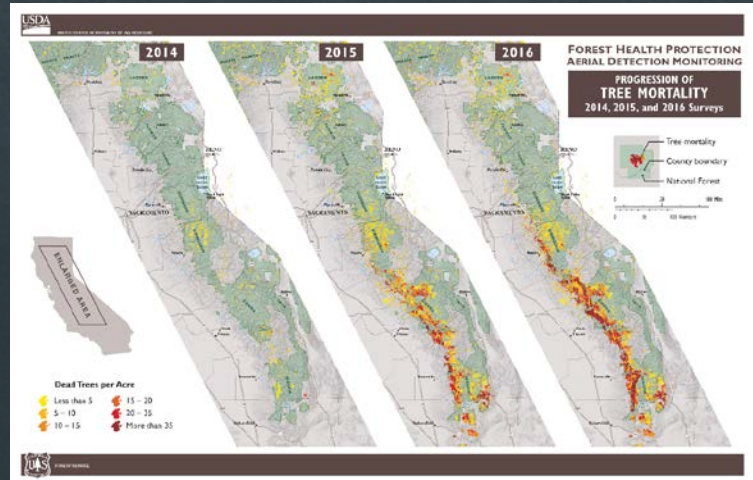
² Professor, Department of Environmental Science and Policy, University of California, Berkeley

California Megafire Risk

- ◆ 1900s Fire suppression policy
- ◆ Drought induced mortality (USFS Aerial Detection Survey)



Survey Period		New Mortality
2010 – Sept 2014	4 years	10 million trees
Sept 2014 – Oct 2015	> 1 year	30 million trees
Oct 2015 – May 2016	8 months	26 million trees



Wood Disposal Options



Prescribed Fire

- ◇ Standalone Treatment
- ◇ Labor Intensive
- ◇ Small Opportunity Window
- ◇ Reduced Air Quality



Pile + burn

- ◇ Paired Treatment
- ◇ Litigation Risk
- ◇ Reduced Air Quality



Chip + Remove

- ◇ Paired Treatment
- ◇ Generates Revenue
- ◇ Market Access Accessibility



Mastication

- ◇ Standalone Treatment
- ◇ No Landing Requirement
- ◇ Short Term Surface Fuel Increase

Management Solution: Mastication

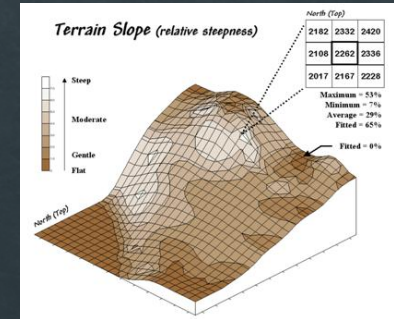
◇ Relative Advantage:

- ◇ Scalable
- ◇ Low air quality impact
- ◇ Fewer weather constraints
- ◇ Market integration potential

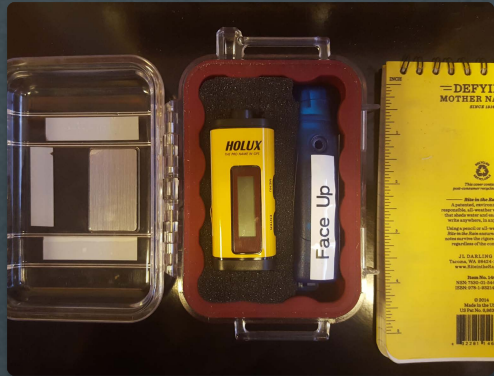


◇ Gaps in Optimization

- ◇ Site-specific production rates
- ◇ Changing operating cost and constraints with new technology



Research Goals



Tracking Productivity

Develop cheap, scalable approach to modeling mastication productivity



Field Test

Field test new method to demonstrate proof of concept



Slope Dependent Rate

Model productivity as it relates to detailed terrain features, i.e. slope

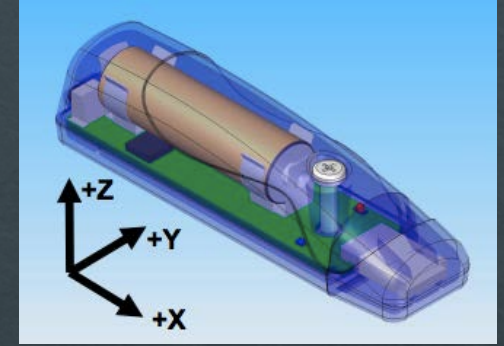
Existing Cost and Productivity Method

- ◇ Position Tracking
 - ◇ Labor intensive
- ◇ Activity Tracking
 - ◇ Manual shift reports
 - ◇ High automation cost
 - ◇ Product-based metric
- ◇ Cost Modeling
 - ◇ Region specific



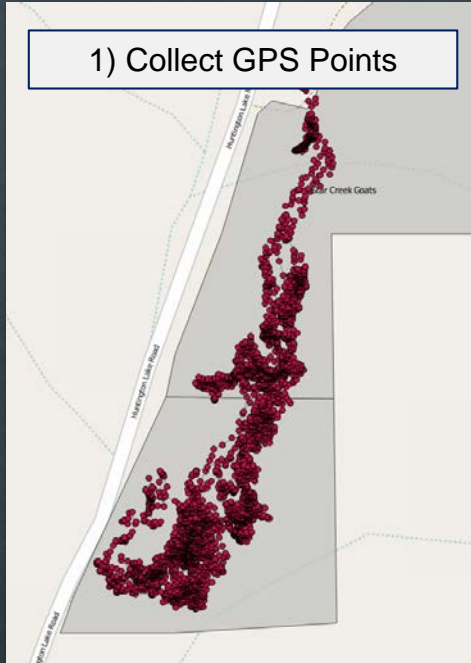
New Cost and Productivity Method

- ◆ Position Tracking (GPS)
 - ◆ Automated collection
 - ◆ Product based rates
- ◆ Activity Tracking (Accelerometer)
 - ◆ Automated collection
 - ◆ Manual shift reports
- ◆ Cost Modeling
 - ◆ Region specific
 - ◆ Open source software



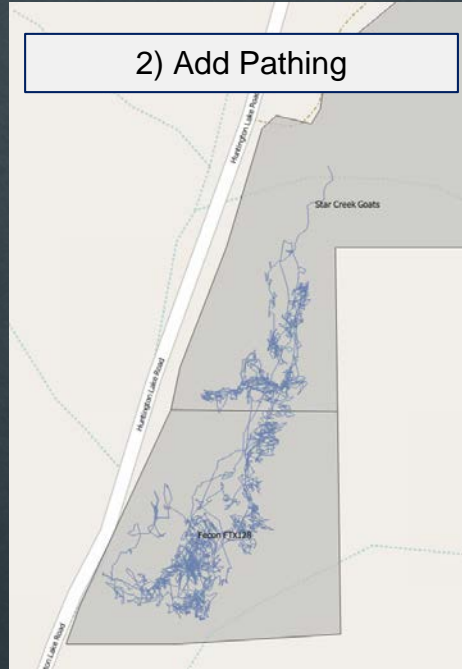
How Does it Work ? - GPS

1) Collect GPS Points

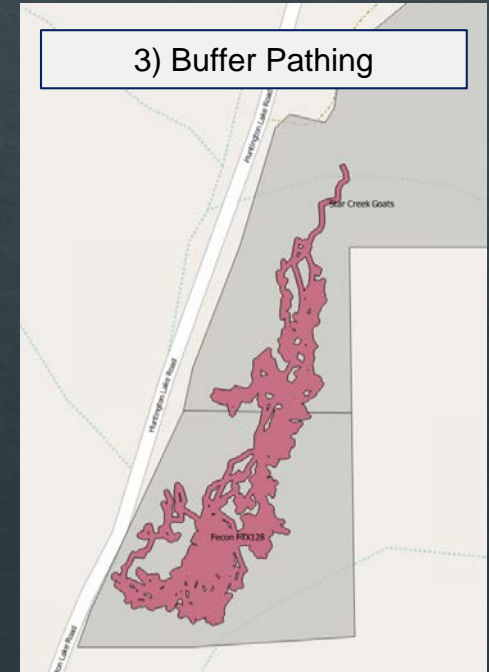


GPS Tracking @ 5 second interval = 9600 points per 8 hour shift

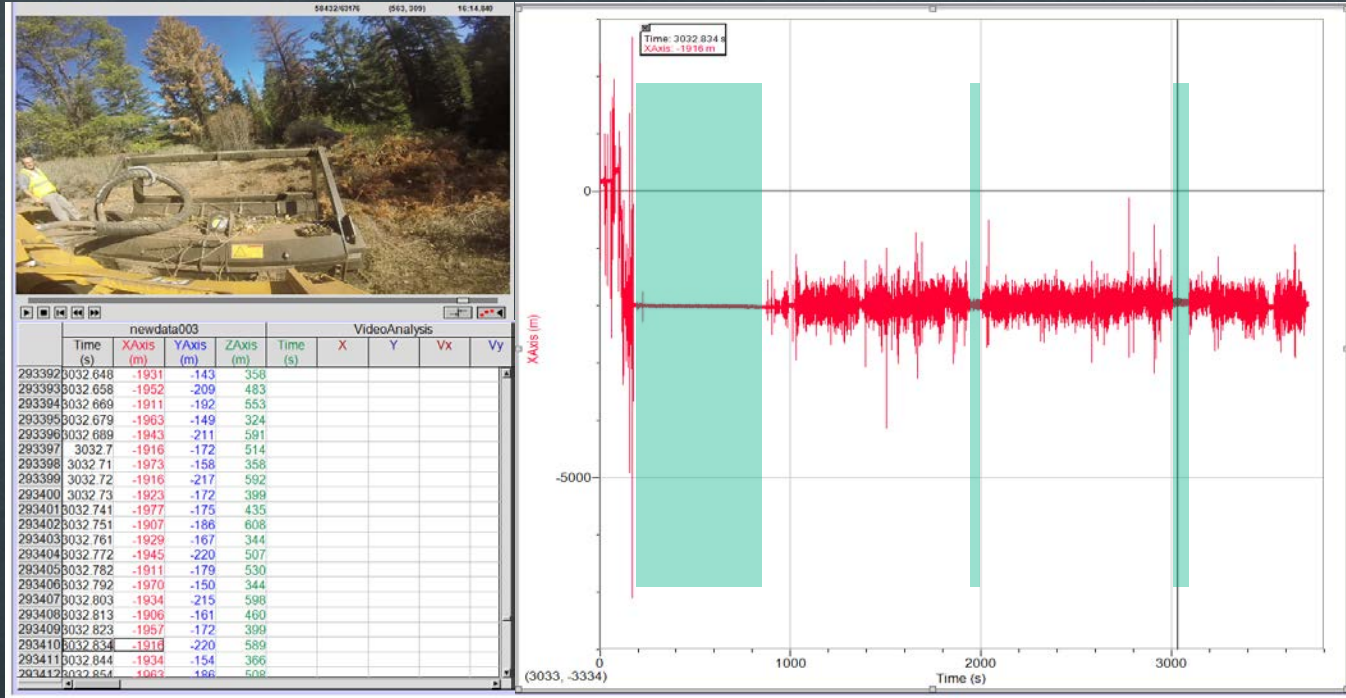
2) Add Pathing



3) Buffer Pathing

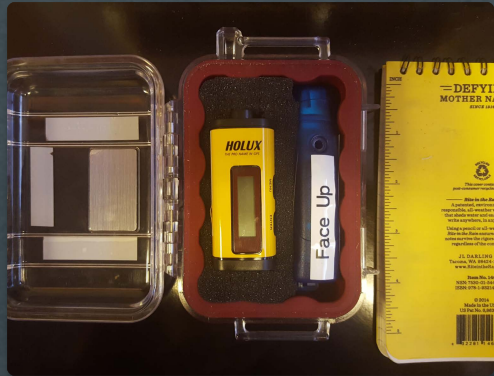


How does it work? - Accelerometer



Vibration Tracking @ 100 hz frequency = 2.8 million points for each 8 hour shift

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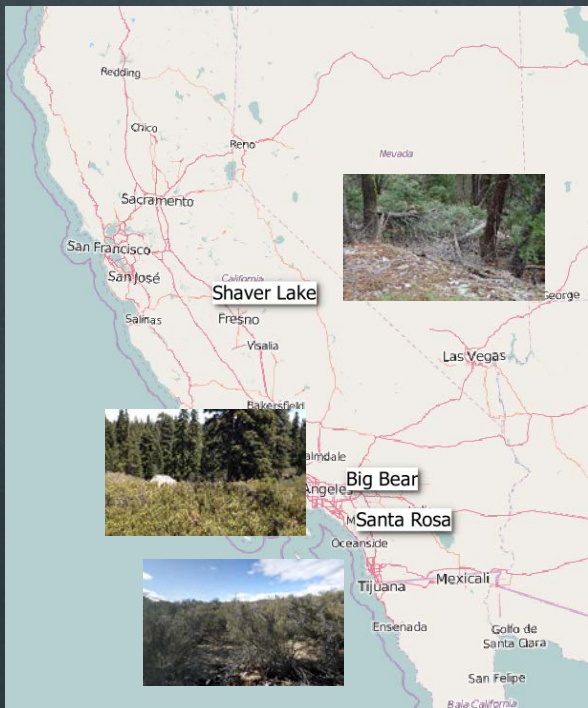


Slope Dependent Rate

Model productivity as it relates to detailed terrain features, i.e. slope

Keeping up with the Masticators

3 Biological
(Hand Crew + Goats)
6.5 Acres (2.7 ha)



4 Mechanical
(Skid Steer /
Integrated)
19.3 Acres (7.8 ha)



4 Mechanical
(Boom-mounted)
46.1 Acres (18.7 ha)



Mastication Approach



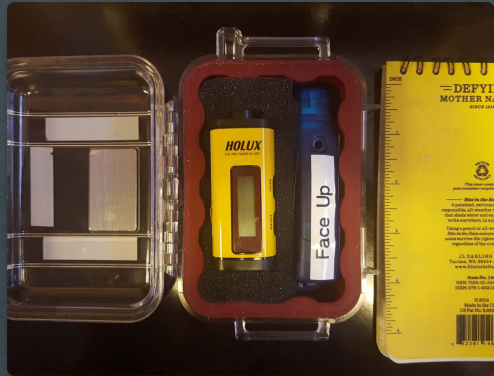
Mastication Productivity and Cost

Treatment Type	Treatment System	Shaver Lake		Big Bear		Santa Rosa	
		Production (hour/ acre)	Cost Rate (\$/acre)	Production (hour/ acre)	Cost Rate (\$/acre)	Production (hour/ acre)	Cost Rate (\$/acre)
Hand Crew	CCC Hand Crew	7.5	1,681.63	-	-	-	-
Hand Crew	Ramona Tribe	-	-	-	-	14.0	2,713.78
Goat Herd	Star Creek Land Stewards	8.1	330.74	-	-	-	-
Boom Mount	John Deere JD 210G	9.9	614.50	-	-	-	-
Boom Mount	Kaiser S2 Spider	3.7	426.46	-	-	3.5	398.97
Boom Mount	Takeuchi TB290	8.2	348.37	5.5	233.64	9.1	385.43
Boom Mount	Timbco 425 D	-	-	1.6	166.56	-	-
Integrated Machine	FAE - Prime Tech PT175	2.2	166.21	2.6	192.34	1.4	107.41
Integrated Machine	Fecon FTX 128L	2.7	203.48	3.4	253.88	1.0	73.54
Skid Steer Mount	Caterpillar 299D	2.0	122.81	4.5	274.16	1.3	76.86
Skid Steer Mount	Takeuchi TL 12	2.6	112.12	3.9	168.70	1.8	77.13

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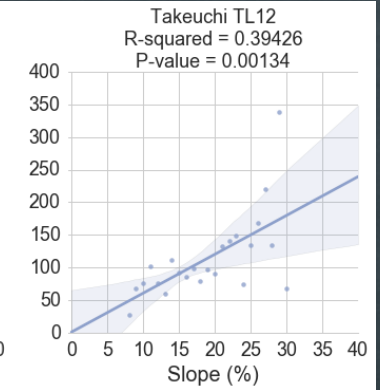
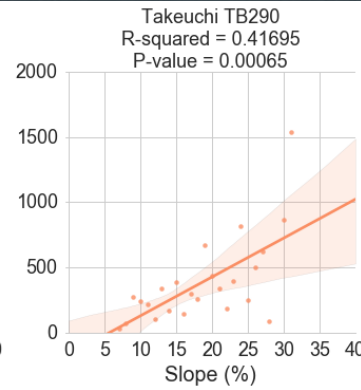
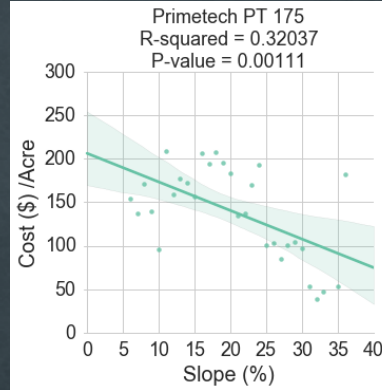
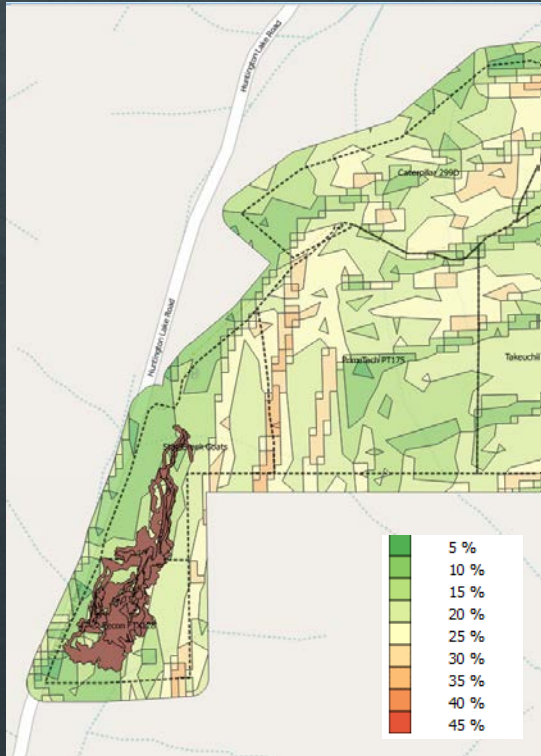
Field test new method to demonstrate proof of concept



Slope Dependent Rate

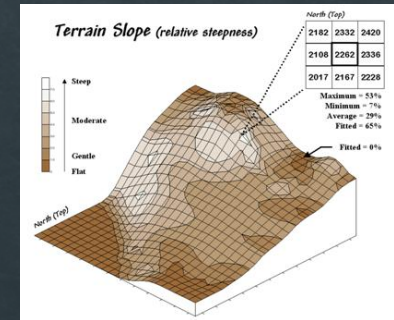
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Slope Dependent Productivity and Cost



Summary

- ◆ Low cost tracking system
 - ◆ Simultaneous tracking at a fraction of previous cost
 - ◆ Open source analytical tools
- ◆ Replicable across different landscape and treatment configuration
- ◆ High precision data capture:
 - ◆ Model site/operator?/slope dependent production rate



Acknowledgements

◆ Project Analysis

- ◆ John Shelly
- ◆ Matthew Potts (Chair)
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- ◆ Jenny Palomino



◆ Implementation and Monitoring

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