Fire Behavior in Tree Mortality

Fire Behavior Assessment Team (FBAT)

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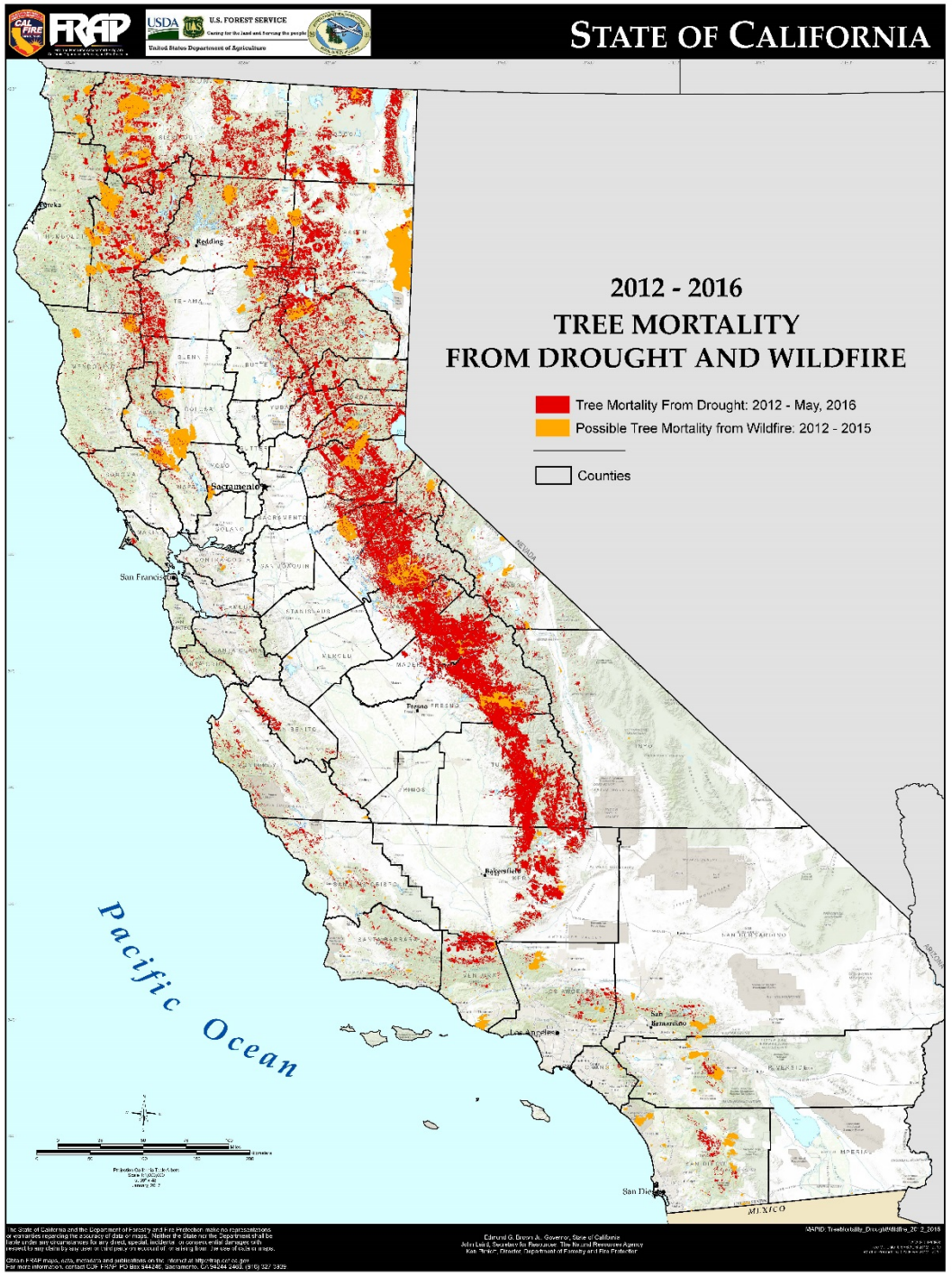
The Forest Service Pacific Southwest Region asked FBAT to answer the question, “What is the actual fire behavior in tree mortality areas?”



FBAT=

a unique module focused on the collection of fuels, fire behavior and fire effects data on active wildland fire incidents

- Collaboration of Fire managers, Researchers and Wildland Fire Modules
- Coordinate actions with IMT and Division Supervisors
- Can be ordered through ROSS
- No consistent program funding

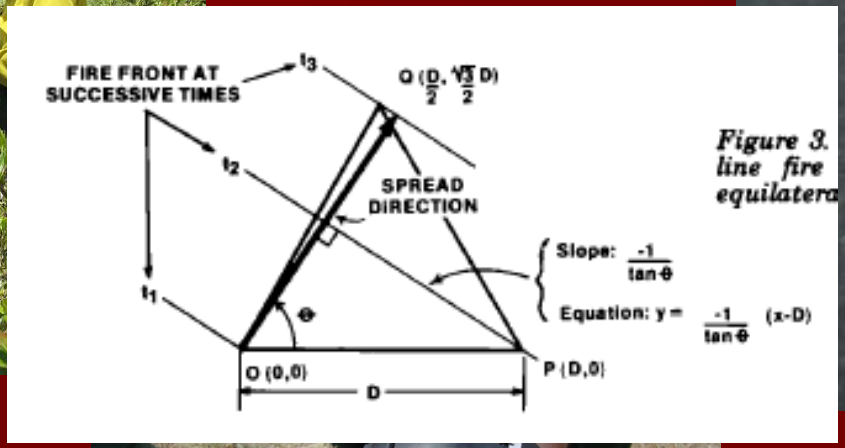


Figure 3. line fire equilatera

2016-2017

FBAT tree mortality approach:

– short-turnaround intelligence

– Needed a lot of datapoints fast

Cedar	2016	Sequoia NF
Schaeffer	2017	Sequoia NF
South Fork	2017	Yosemite NP
Pier	2017	Sequoia NF

Cedar Fire

- Some initial questions
  - How does tree mortality affect the thresholds for torching and sustained crown-fire spread?
  - Are spotting distances substantially different from fire behavior model predictions?
  - Do crown fire runs spread faster than predicted by fire behavior models?
  - Are moisture contents of foliage on dead trees similar to dead and down fuels?

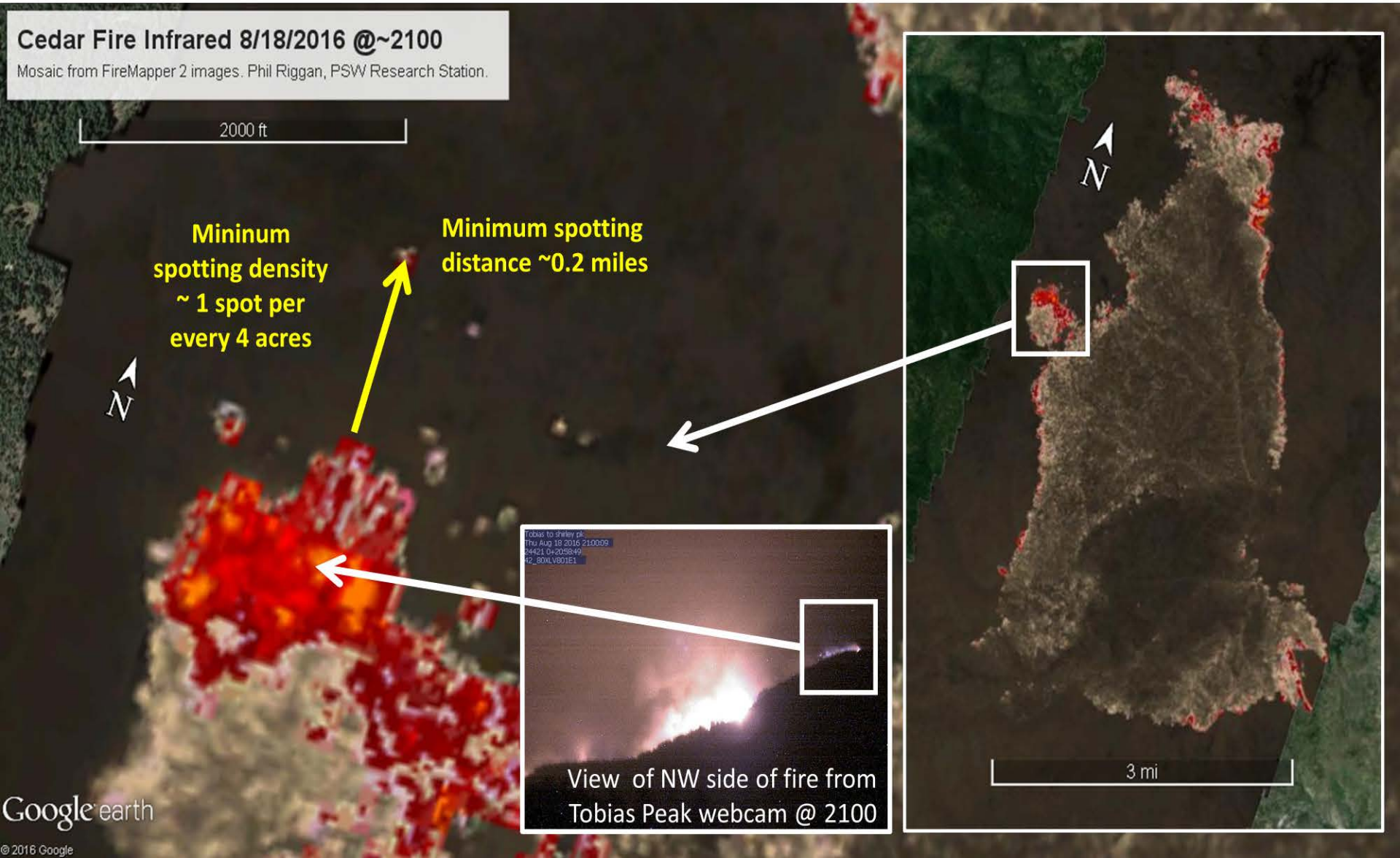
Cedar Fire

- Plots
- Aerial Imagery
- Fuel Moistures
- Observations

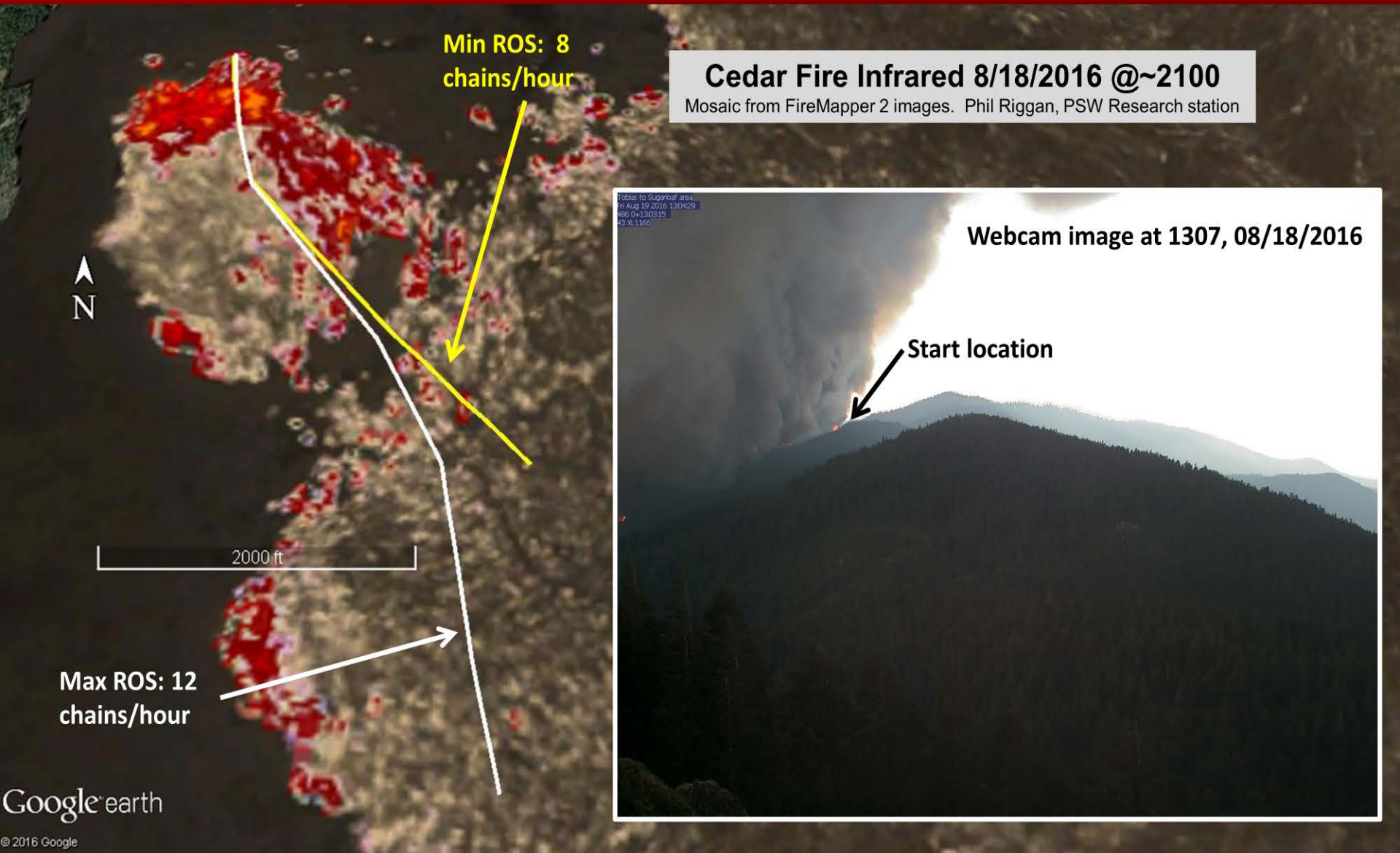
Cedar Fire - Plots

- 3 of 7 Plots burned, mainly slow, patchy burns, isolated torching
- Video from plots and observations captured ember production and torching

Cedar: Aerial Imagery - spotting



Cedar: Aerial Imagery - ROS



Cedar Fire - Observations

- Did observe torching at relatively low wind and slope (winds 2-3, 40% slope, backing/flanking fire)

Cedar Fire – Fuel Moistures

Species	Class	Moisture %	Standard Deviation	Number of samples	Critical intensity (BTU/ft-s)
Ponderosa pine	Dead	7	1	8	73
	Live	120	13	15	926
Incense cedar	Dead	7	1	6	69
	Recent dead	30	6	4	190
	Live	113	31	11	863
Manzanita, green leaf	Live	115	19	8	
Manzanita, white leaf	Live	131	23	15	

Cedar Fire – Key Messages

- Dead and dying trees have lower moisture contents which allows canopy fuels to
- Observational evidence of dead trees torching at low winds and slope
- Anecdotal evidence of high levels of ember production in areas with dead trees

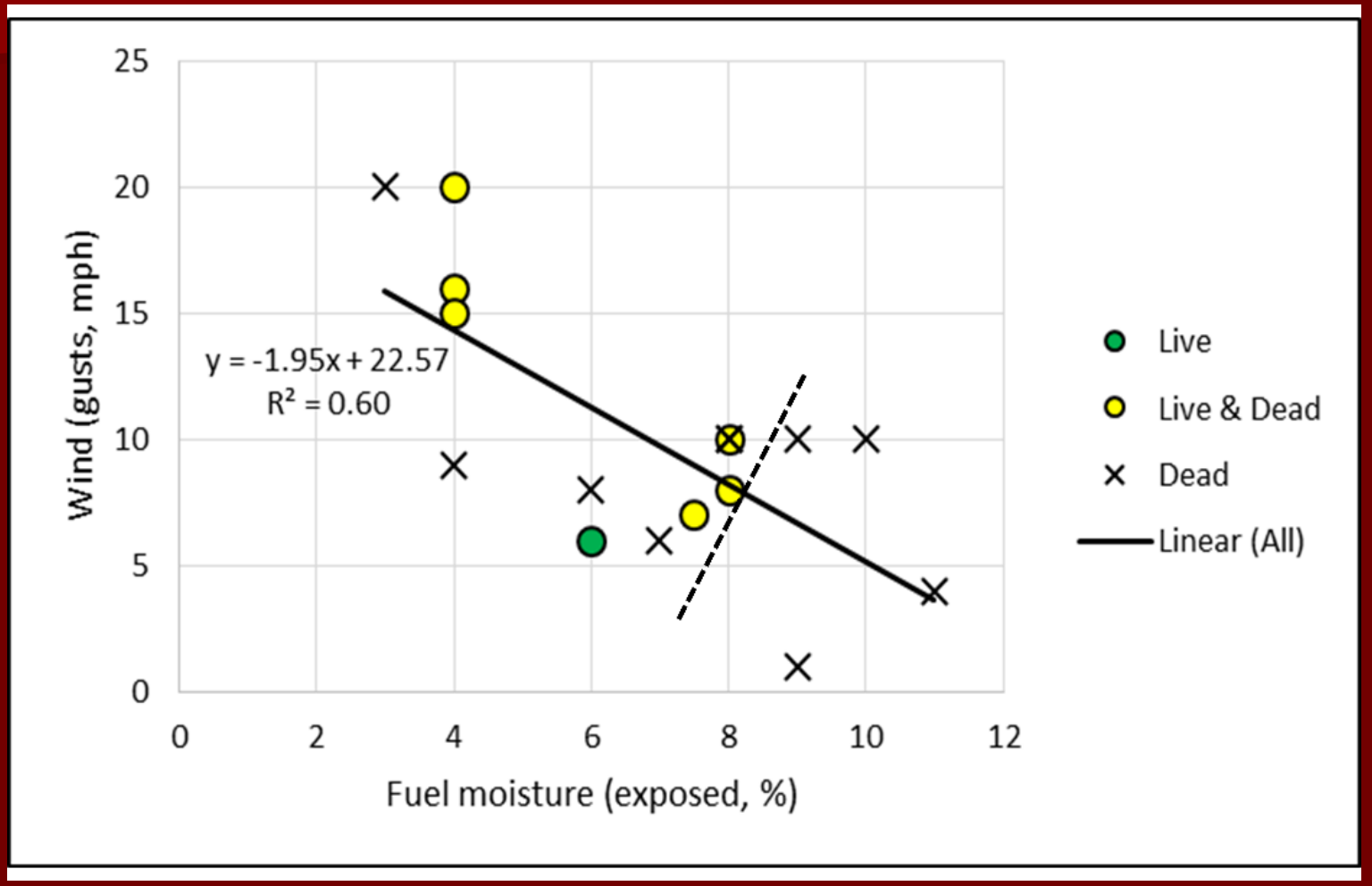
Pier Fire

- Plots
- Observations

Fire Behavior in Plots

Plot	Fire Type	Direction of spread	Wind speed (mi/hr)	Flame Length (ft)	ROS (ch/hr) camera	ROS (ch/hr) sensors
1	Surface fire, individual and group torching	Uphill, spreading SE	20 (NA)	5 – 40	26	N/A
2	Creeping and surface fire	Variable	N/A	0 – 4	Variable and slow	N/A
5	Moderate surface fire, with isolated high activity	Uphill, spreading NE	11 (7)	N/A	N/A	1-2
6	Mainly low intensity creeping and surface fire	Some uphill, some backing, generally NE	NA	N/A	N/A	0.5
7	Surface fire, with individual and group torching	Flanking W, and uphill to the N	33 (10)	5 – 30	8	7

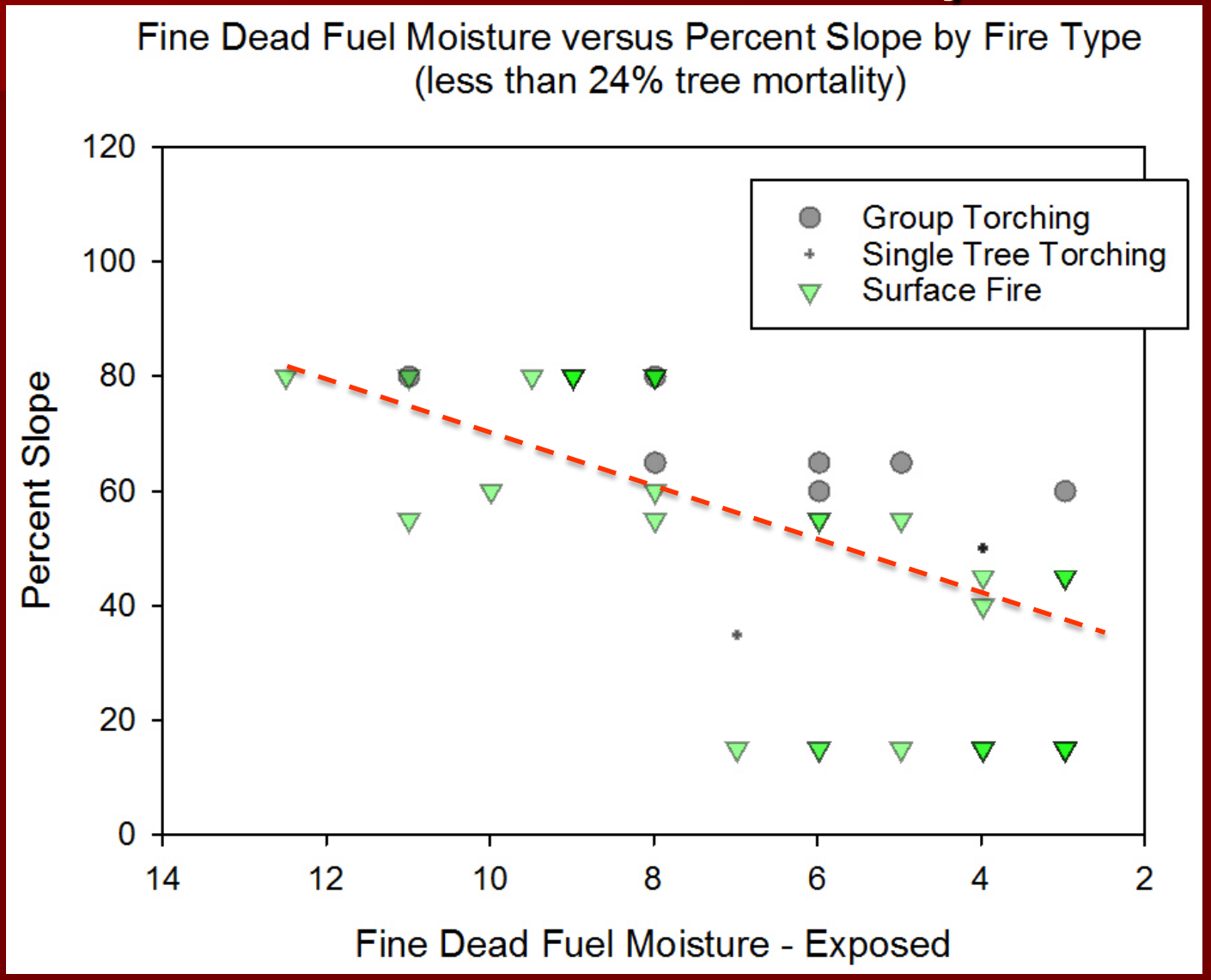
Torching events on Pier Fire



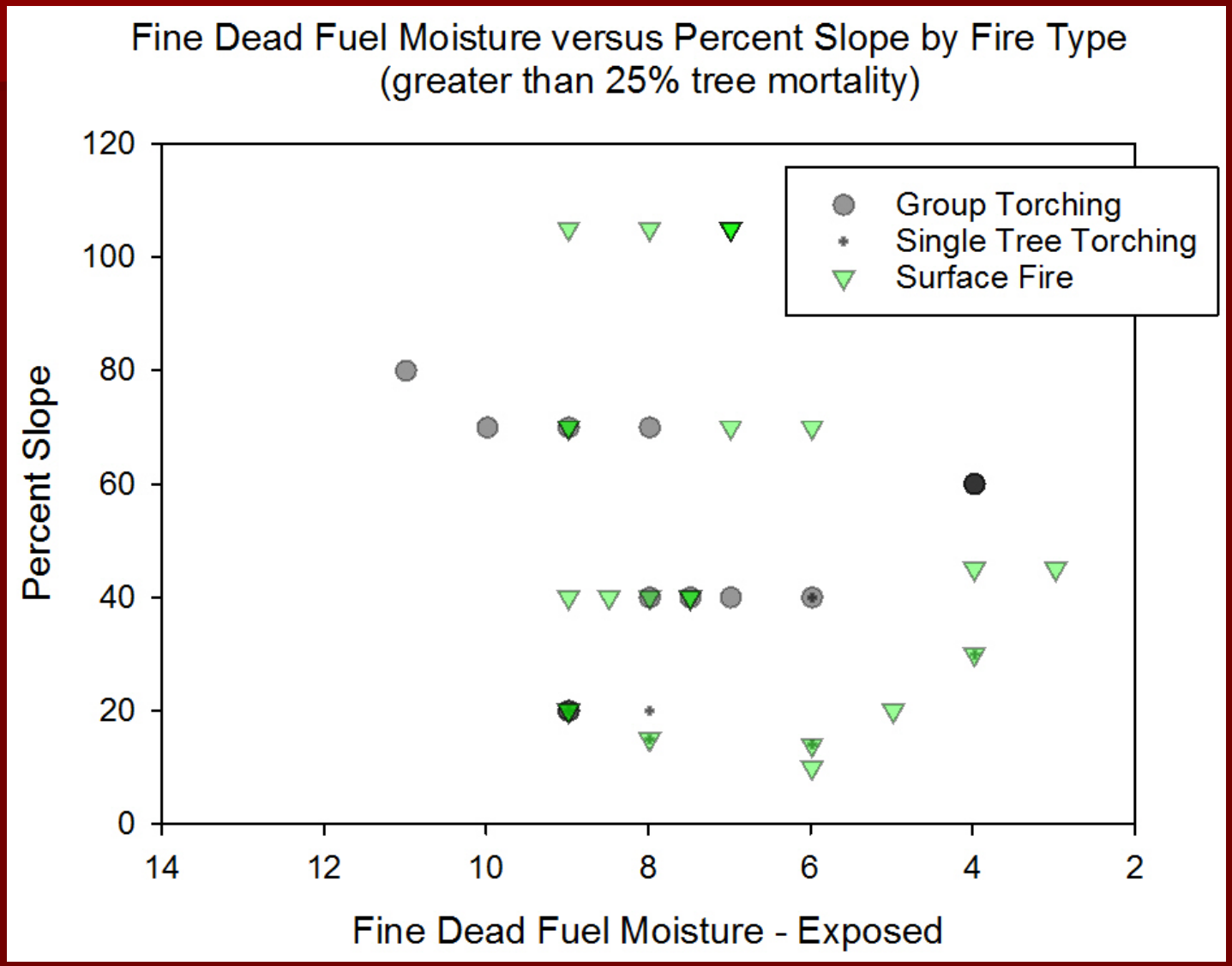
Pier Fire Conclusions

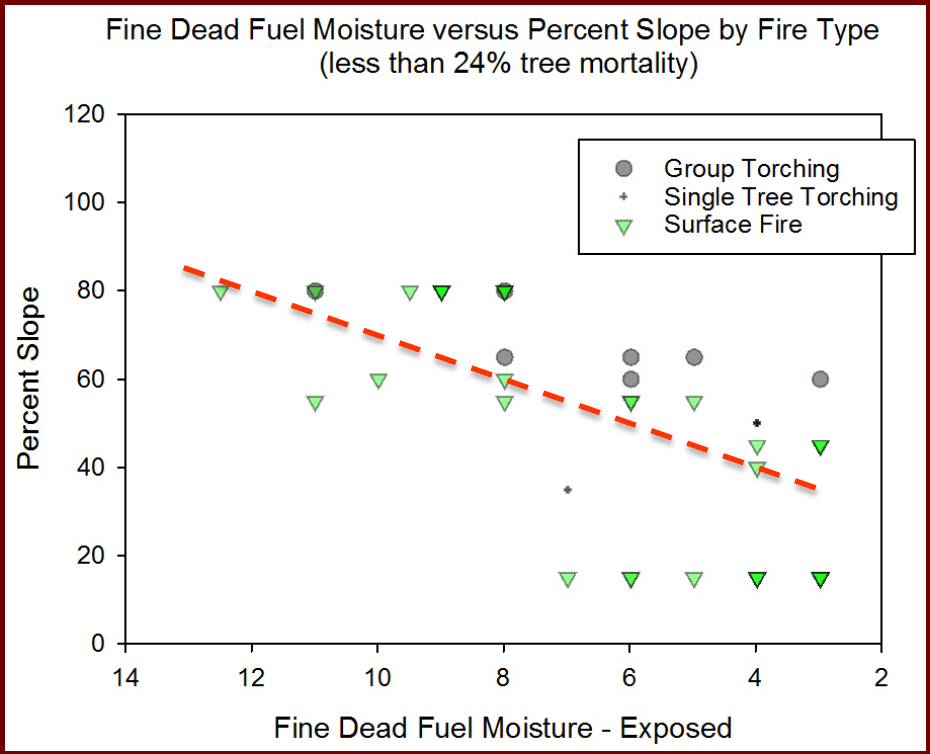
- Dead trees (red phase) torched in lower winds and wetter fuel moistures than live trees.
- No evidence of grey phase or older red phase trees torching.
- Evidence of intense surface fire in grey phase.
- Fire appeared to climb the boles/bark of dead trees more readily than live trees.

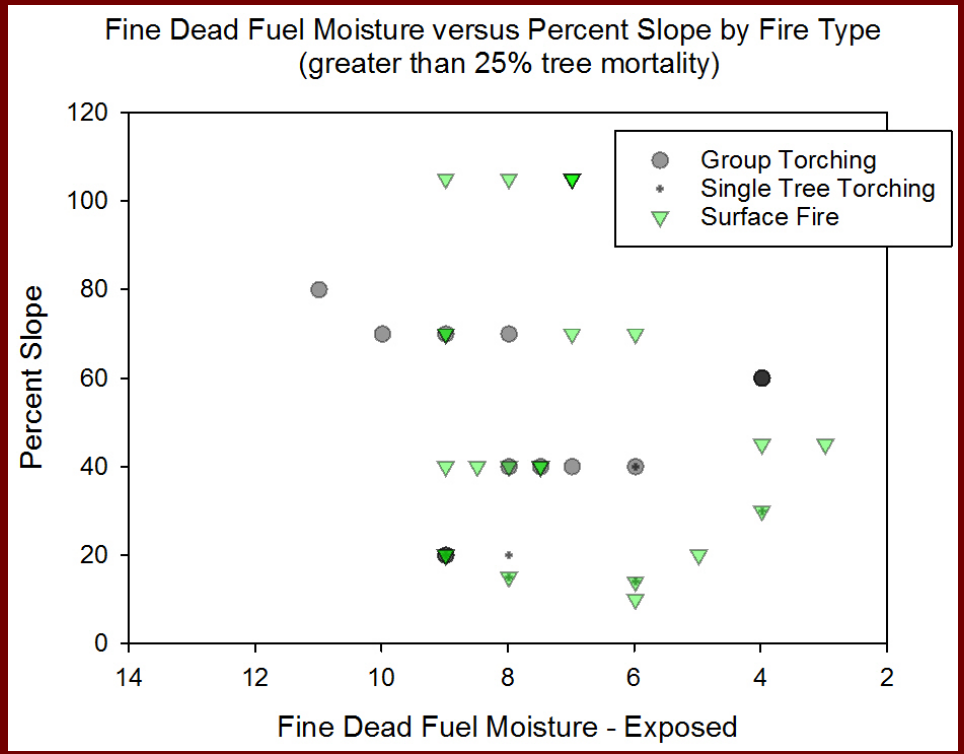
Torching in relation to Fuel Moisture and Slope – in little tree mortality



Torching in relation to Fuel Moisture and Slope – in moderate/high tree mortality




Fine Dead Fuel Moisture versus Percent Slope by Fire Type
(less than 24% tree mortality)
Group Torching
Single Tree Torching
Surface Fire
Percent Slope
120
100
80
60
40
20
0
14
12
10
8
6
4
2
Fine Dead Fuel Moisture - Exposed


Fine Dead Fuel Moisture versus Percent Slope by Fire Type
(greater than 25% tree mortality)
Group Torching
Single Tree Torching
Surface Fire
Percent Slope
120
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Fine Dead Fuel Moisture - Exposed

Summary – what we know

- Dead trees have lower moisture
  - less intense surface fire is required to ignite canopies
- Field observations also indicate that
  - Dead trees torch at lower slopes and higher fuel moisture conditions
- Anecdotal observations indicate higher ember production and tree bole breakage for dead trees

Summary – what we know

- Red phase (dead needles attached) is diminishing in some areas and transitioning to grey phase (dead needles dropped)
- More red phase at higher elevations in red fir
- As dead trees accumulate on the ground = different fuels, fire intensities, resistance to control and safety concerns.

Summary – what we don't know

- Crown fire rates of spread, flame length or spotting distances for areas with mortality
  - Difficult to observe or precisely measure intense fire behavior during early days of incident
- Exact slope/fuel moisture threshold for transition from surface fire to canopy fuels
  - Need more analysis
  - May need more data

FBAT reports, video, contact

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