Forest floor consumption and tree injury after prescribed burning old-growth pine sites in California

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Background

- Fire exclusion can cause large duff accumulations around tree bases
- Burning additional duff may cause increased cambium injury and tree mortality

Objective

- Test if raking duff away from tree bole is a viable treatment option to reduce tree mortality when reintroducing fire

Methods

- 3 burned sites
  - LVNP
    - Natural fuels
  - LNF
    - Activity fuels
    - Masticated fuels
- 2 unburned control at LVNP and LNF
- At each site, trees were paired
    - Raked
    - Unraked

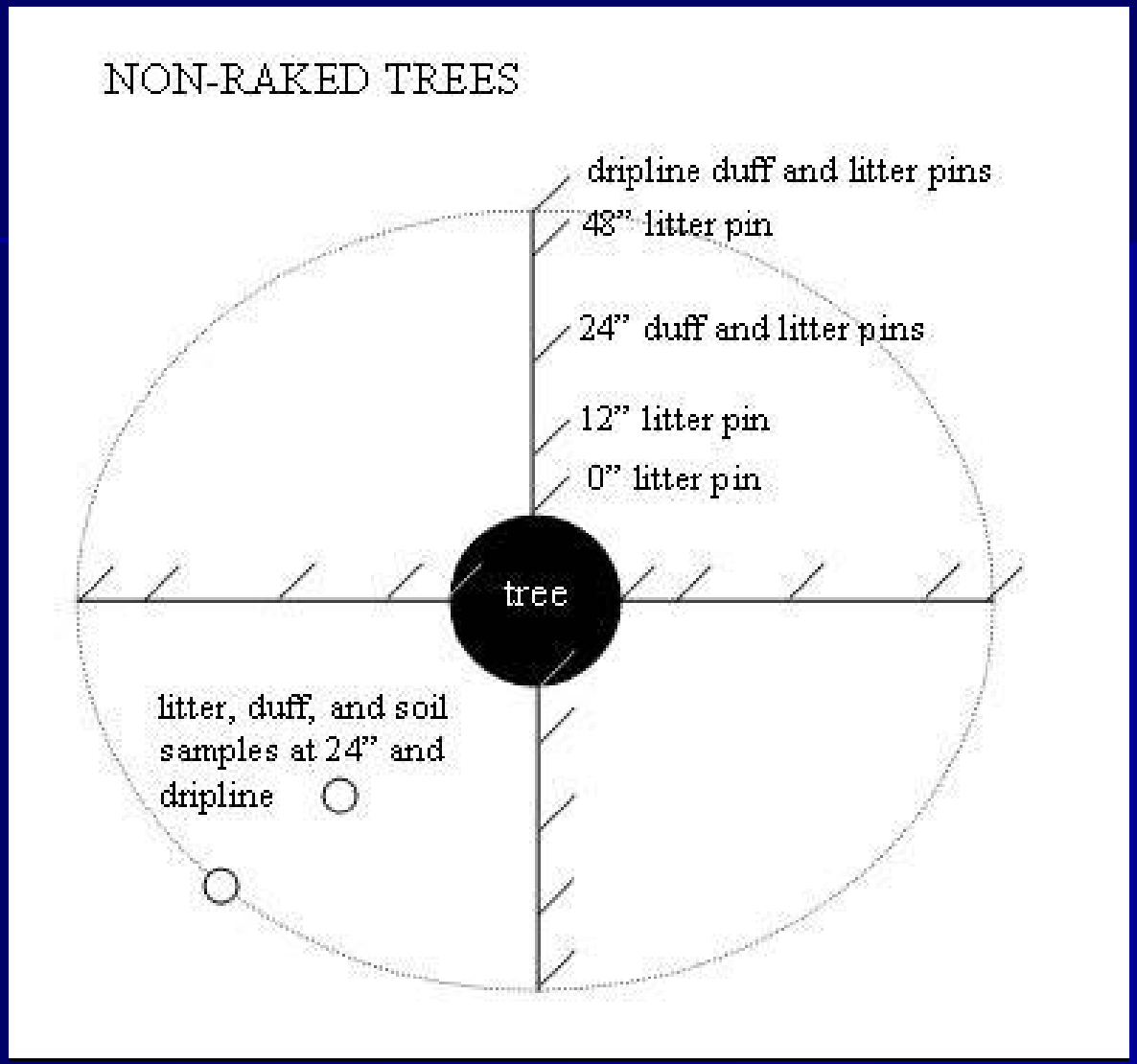
Tree Characteristics

- Ponderosa and Jeffrey pine

Site	N	Height	DBH	Duff Depth	Crown Ratio
LNF	180	(34.9 m) 114.5 ft	90.7 cm (35.7 in)	12.3 cm (4.8 in)	.63
LVNP	200	(38.4 m) 126 ft	102.1 cm (40.2 in)	11.9 cm (4.7 in)	.81

Methods

- Removed duff and litter from bole to 2’ for raked trees in 2003 and 2004
- Installed small fuel transects around each sample tree for loadings
- Installed duff pins around each sample tree to measure duff depth and consumption
- LVNP site burned in June 2005
- LNF sites burned in October 2005


NON-RAKED TREES
dripline duff and litter pins
48" litter pin
24" duff and litter pins
12" litter pin
0" litter pin
tree
litter, duff, and soil samples at 24" and dripline

Methods

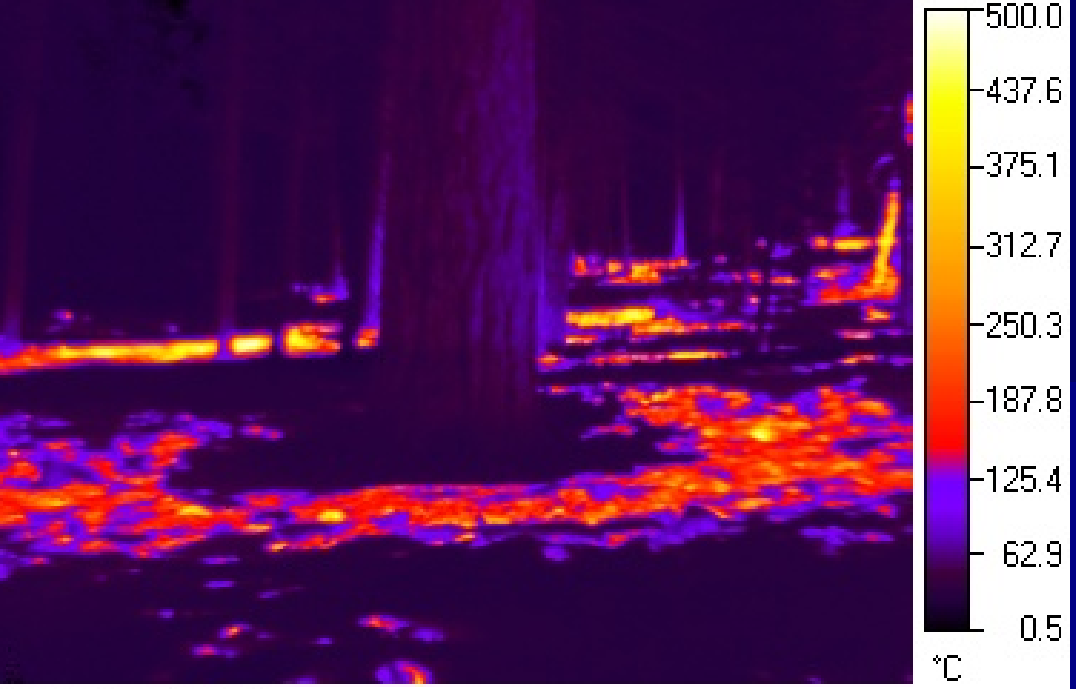
- Installed thermocouples to record soil temperatures immediately before burns
- Collected fuel moistures samples during burns

Tree Measurements

- DBH
- Total height
- Crown base height (pre/post)
- Keen's vigor class (pre/post)
- Crown volume scorched
- Cambium injury
- Beetle attacks
- Fuel consumption

Raking

- Average time to rake away one duff mound was 6.3 minutes for a crew of 2-3
- Areas with shrubs took 8.0 minutes
- Areas without shrubs took 5.6 minutes



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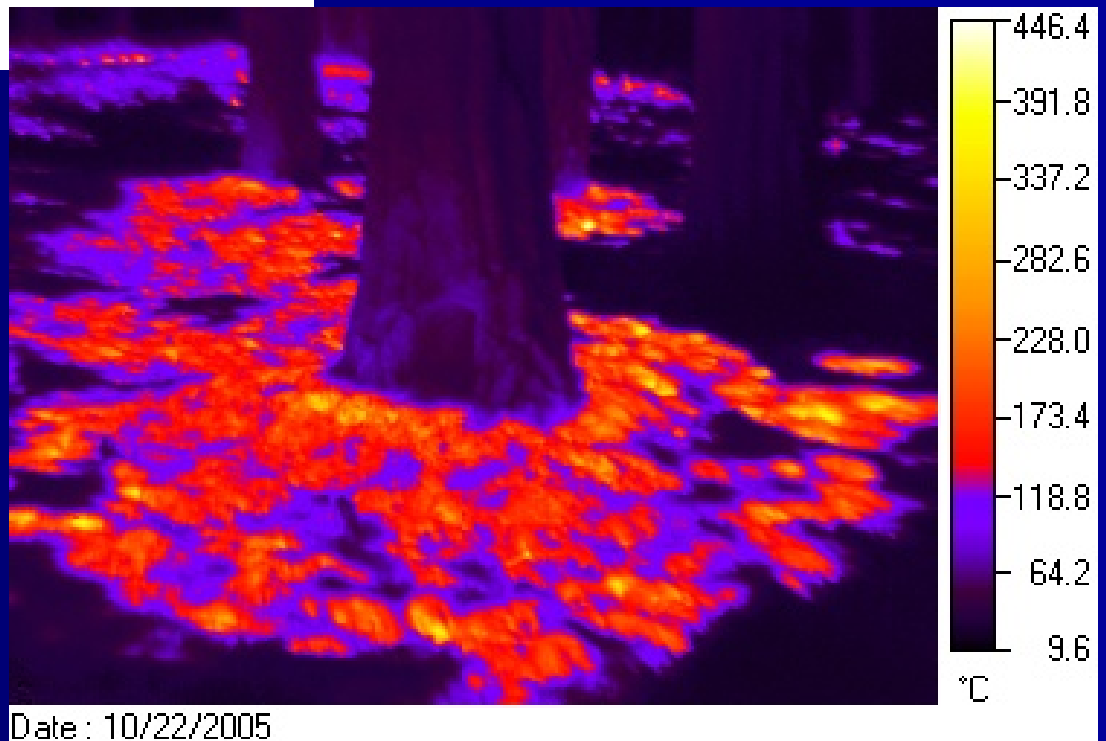

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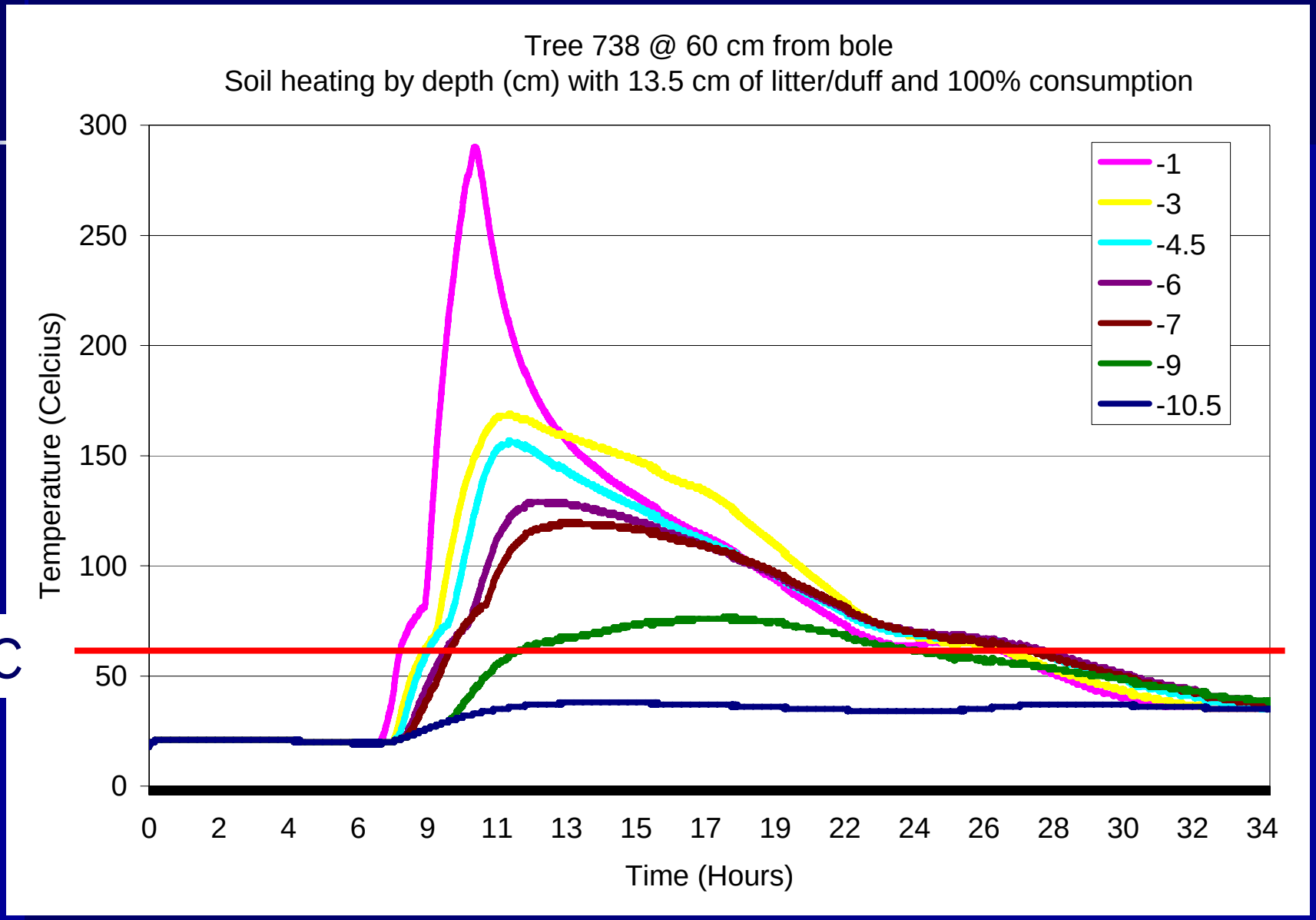
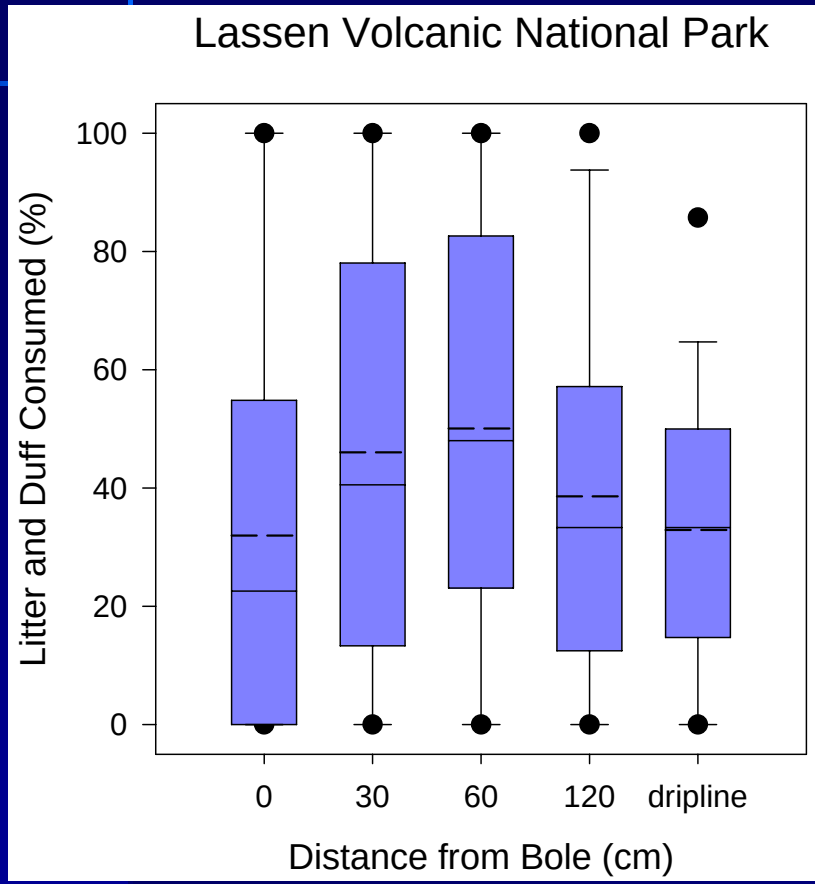
Soil Heating

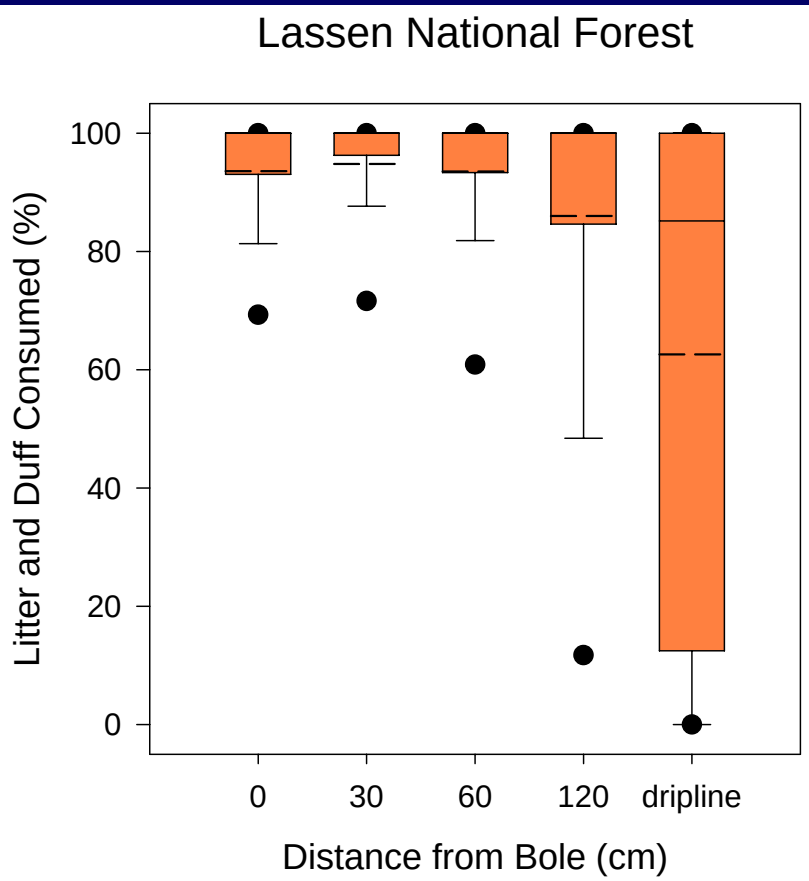


60ºC

Duff Consumption

Duff/litter Consumption





Average Duff Moisture @ base = 101%

Average Duff Moisture @ base = 24%

Cambium Injury

Number of Dead Cambium Samples

Site	Unit	Unraked	Raked	P-value
LVNP	Natural	0.2	0.06	0.1674
LNF	Mast	1.3	0.03	<0.0001
LNF	Thin	1.9	0.0	<0.0001

Crown Scorch

Site	Unit	N	Unraked	Raked	P-value
LVNP	Natural	100	31.0	26.3	0.4893
LNF	Mast	60	3.9	4.2	0.9334
LNF	Thin	60	9.0	5.5	0.1330

1 Year Post-fire Mortality

3 Dead Raked Trees

- Control: 2.5% raked ; 0% unraked (p=0.1546)
- Burned Units: 0.9% raked; 0% unraked (p=.1587)
  - 2 dead trees in LNF control
    - Mass attacked by Jeffrey pine beetle
  - 1 dead tree in LVNP burn
    - Fire scar

Conclusions and Future Plans

- Significantly greater cambium injury with greater duff consumption
- Raking alone does not cause increased tree mortality

- Too early to determine if raking reduces tree mortality after burning, continue to monitor tree vigor