Fire Behavior Assessment Team (FBAT)

Measurements from Active Wildfires

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Synopsis

Fire behavior measurements collected during active wildfires are paramount to fire behavior research (Butler *et al.* 2004). Many existing fire behavior models are based on laboratory data (i.e., Rothermel 1972; Viegas 2004), data collected during experimental burns (Alexander *et al.* 2004), or a combination of these. With advancements in technology it is possible to gather fire behavior data on actively burning wildland fires (Jimnez *et al.* 2007) to help calibrate modeling outputs. A USDA Forest Service Enterprise Team, Adaptive Management Services (AMSET), coordinates the FBAT module focused on collection of fire behavior data on active wildland fires in collaboration with land managers and research groups. The FBAT module assimilates well into incidents, due to their high level of wildland fire experience, and the rapport built with some Incident Management Teams. The FBAT data from the Clover and Lion fires was compared to modeled fire behavior and indicated further calibration is needed. Refined and updated uses for FBAT fire behavior and fuels data will enhance data collection methods and data applications.

Goals

- Directly measure fuel treatment effectiveness
- Measure fire behavior and effects and their relationship to fuels, fire history, and treatments
- Build dataset useful for calibration of consumption, emissions, and fire behavior models
- Supply data and video useful for firefighter safety and public outreach

Fuels & Vegetation

Surface and Ground Fuels

- 3 planar-intercept transects for woody material (Brown 1974)
- Litter and duff measurements
- Maximum fuel bed depth

Understory/ladder Fuels

- vegetation density photo series for understory vegetation (Burgan and Rothermel 1984)
- Height, type and density class for all shrubs, grasses, herbs and tree seedlings inside 1 ft belt transect

Crown Fuels

- Variable radius prism plots for pole-sized and overstory trees
- Species, DBH, height to crown base, total tree height, canopy class

Fuel Moisture

- 3 samples of tree foliage and shrubs
- 2 samples litter, 1-hr, and 10-hr

Fire Severity

- All fuel data is re-measured post-fire
- NPS burn severity protocol used for understory and soils
- Post-fire char, scorch, and torch for trees

Fire Behavior Instruments

Rate of Spread (ROS)

- Continuous temp. readings

Anemometer

- Wind speed (until it melts)

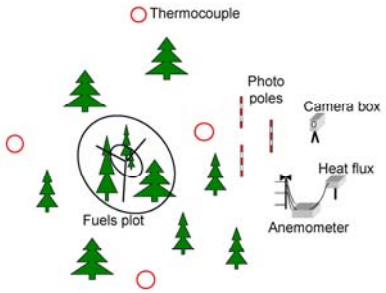
Thermocouples

- Multiple used to capture temp. at different heights

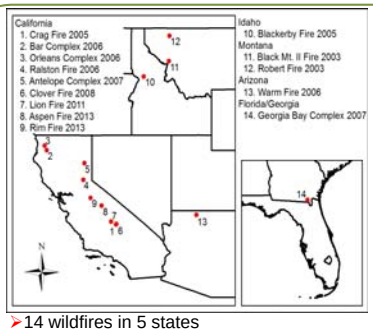
Video Cameras

- Wired thermistors trigger camera to start filming as the fire approaches
- Camera reference poles used to assess flame length and ROS

Plot Design



Fires Visited 2003 to 2013



- 14 wildfires in 5 states
  - 97 wildfire sites burned (119 attempts)
  - 32 prescribed fire sites burned (2 studies)

Products and Collaborations

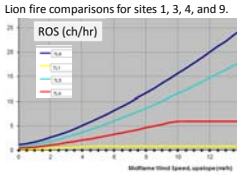
- Incident summaries on the effects of fuel treatments, interactions of past fires and recent fire behavior, and immediate fire effects on cultural and natural resources
- FBAT dataset used in calibration of FOFEM consumption model with USFS PSW Research Station, in press, *JGR – Biogeosciences*
- Highlighted in upcoming *Fire Management Today* (Crown Fire Synthesis Project, USFS PNW Res. Station, WWETAC)
- In 2013 started collaborating with the Calaveras Wildland Fire Module
- FBAT is refining data uses and practicality of calibrating models with wildfire field data

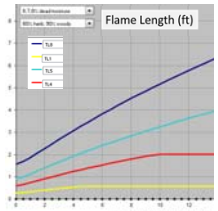
Comparison of Recorded and Modeled Fire Behavior

Rate of spread (ROS) and flame lengths measured at FBAT sites on the Clover and Lion fires were compared to outputs generated from the "Compare Model" spreadsheet (Scott 2005) which uses the Rothermel (1972) surface fire spread model. Input data was based on site characteristics (below). Site flame heights were estimated from video, and ROS was calculated from thermocouple sensors in a diamond pattern (Simard *et al.* 1982). Similarities and differences were found, indicating further need to calibrate fire models and field data.

Site	Slope %	Anemometer wind (mph)	Fuel Moisture	Standard 40 Fuel Model	ROS (ch/hr) Thermocouple Measurements	ROS (ch/hr) Rothermel calculations	Flame Length (ft) From video	Flame Length (ft) Rothermel calculations
Clover 1	15	gust 4, mean 2	10-hr 6%	TU1	1-4	4	6	2
Clover 2	40	gust 4, mean 2	10-hr 6%	TU1	0.4	5	12	2
Clover 3	14	gust 17, mean 6	10-hr 12%	TL7	3-10	8	4	3
Clover 5	25	gust 12, mean 6	10-hr 12%	TL1	(equipment failure)	1	2-3 & 6-8	1
Lion 1	16	gust 0 - 1	litter 4% 100-hr 12%	TL8	8-10	2	1	2
Lion 2	34	gust 13	litter 4% 100-hr 12%	TU1	5-6	7	(equipment failure)	3
Lion 3	20	gust 3	litter 6% 100-hr 10%	TL1	6	0-1	1-2	0.5
Lion 4	25	gust 4	litter 6% 100-hr 10%	TL5	12	3	1-4	2
Lion 6	8	gust 9	100-hr 8%	TL3	22	3	3-6	1
Lion 7	11	gust 4	100-hr 8%	TL3	3	1	1-2	1
Lion 9	20	gust 2	litter 8% 100-hr 9%	TL4	6	1	3-5 & 5-8	1
Lion 10	15	gust 3	litter 4% 100-hr 7%	TU5	2	5	1-2	6

Lion fire comparisons for sites 1, 3, 4, and 9.





Fuel moisture: For Clover used 30% herb, 60% woody. For Lion used 60% herb, 90% woody. For dead fuels we chose the closest scenario to site data.

Citations: M. Alexander *et al.*, 2004, Inf. Rep. NOR-X-393; R. Burgan and R. Rothermel, 1984, INT-GTR-167; B. Butler *et al.*, 2004, Can. J. For. Res.; D. Jimnez *et al.*, 2007, RMRS-P-46CD; R. Rothermel, 1972, Res. Pap. INT-115; J. Scott, 2006, understory calculation tool and "Compare Models Four" tool; J. Scott and R. Burgan, 2005, RMRS-GTR-153; A. Simard *et al.*, 1982, Fire Tech.; D. Viegas, 2004, IJWF.

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Feedback & Data Requests

To Order FBAT for Wildfire Incidents: Contact Carol Ewell, FBAT leader, for availability 530-559-0070. FBAT provides a personnel list to order through ROSS. Or contact Alicia Reiner 530-559-4860, alreiner@fs.fed.us.