National Park Service
Fire Ecology Annual Report
Fiscal Year 2005
Yellowstone National Park

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Fire Effects Monitoring Season Highlights

In 2005 the main focus of Fire Effects Monitoring was to allow fire-use fires to burn. Our approach was to cover tasks from the ground up, providing for Level 1 and 2 tasks (Short term weather and fire behavior monitoring) to allow for fire-use fires before Level 3 and 4 tasks (Long term vegetation and fuels monitoring).

Level 1 and 2 Priorities

- Supported wildland fire-use. Collection of fire perimeter, safety zones, and other geographic data, ArcGIS production of maps, incident planning, fire-use projections, and fuel moisture and weather monitoring. **Ten fire-use fires were monitored and supported**.
- Maintained and repaired 3 permanent RAWS stations and 1 microRAWS. Seven manual climatological weather stations and eight manual fire weather stations were maintained and staff were instructed in data collection. These stations supported fire operation safety, fire behavior predictions, aviation, weather forecasting, and research requests by internal divisions and external agencies. We collected and entered 1,240 fire weather observations into WIMS and 841 individual 1000-hour log station moistures. We installed and/or repaired fire weather equipment at 14 sites. We reviewed 72 monthly climatological weather reports and analyzed precipitation data.
- Monitored fuel moisture trends. Fuel moisture monitoring in Yellowstone is important because weather trends vary widely across the varied and extensive physiographic areas of the park and because the timing and location of fire-use ignitions is unpredictable. We collected and/or weighed, entered and analyzed 594 fuel moisture samples.
- Produced a NWCG compliant pocket card (Lead, McEldery).

• Provided daily weather observations, fire danger indices, and lightning information to Fire Management staff, the Communication Center, long-term analysts, and fire behavior analysts. Provided 122 fire weather forecasts and lightning maps for morning briefing.

• Provided 24 comprehensive weekly fire weather and fuel condition summaries to the Chief Ranger, Sub-District Rangers, and the Fire Management Staff.

• Seifert and Moss attended Handar RAWS training in Boise in May in support of Yellowstone's weather stations.

• The Mammoth weather station corral was re-built (Lead: Jackson). A 20' (6.1 m) totalizing anemometer was installed making the station NWCG compliant.

Level 3 and 4 Priorities

• Monitor new and on-going hazard fuel reduction projects. To save time and effort plots will no longer be sampled pre-treatment. We were unable to re-read the 2003 Lake, Heart Lake, and Buffalo Plateau WUI project plots.

• Monitor WFU fire effects in forests of concern: whitebark pine and Douglas-fir. One fire-use monitoring plot was installed and burned in the 90 acre Chickadee WFU in a whitebark pine forest. This plot represents a sustained underburn on the Yellowstone plateau. The current thought is that small, lower intensity fires in whitebark pine forests are needed to sustain pine nut production for grizzly bears.

• FMH plots were re-read at Stone, Sulphur, Deaf Jim, Electric, and Sylvan. We were not able to read plots at Boundary (2), Specimen (2), or Phlox. The Boundary plots represent fire effects in the large areas of the LP0 cover type resulting from the fires of 1988. Sylvan, Specimen, Phlox and Deaf Jim represent whitebark pine and Douglas-fir forests on andesitic soils.

• None of Despain's 14 fire plots (established 1977-1989) were re-read. These were last read in 2001.

• Two initial canopy bulk density (CaBD) plots were measured in the 1955 Cub Creek burn within the perimeter of the 2003 East Fire. The canopy in this 2 ha patch surrounded by black did not burn, and provides the opportunity for research into the effects of canopy fuel loading and bulk density on fire behavior.

• Fuel appraisal photoseries for andesitic forests in northern Yellowstone: This project was started in 2004 using students from the University of Idaho's Upward Bound Program. In 2005 canopy fuel measurements were improved. A web-based photoseries will be produced over the winter. The results will support BehavePlus, FLAMMAP, FARSITE, and LANDFIRE efforts.

• Legacy fire effects monitoring data migration continues from the old FMH.EXE to the new FEAT/ArcGIS software (Lead: Moss). We already have requests from NASA/USGS and the LANDFIRE-NIFTT program for data from this database

• We produced the fifth annual NPS Fire Effects Monitoring Newsletter, *Rx Effects* in June (www.nps.gov/yell/technical/fire/effects.htm). Seifert was the editor this year.

Other Accomplishments

• McEldery devoted 5 pay periods to developing a programmatic agreement for Section 106 compliance for Texas parks over the winter (Supported by Regional funds).

• McEldery proofed and corrected 23 years of fire weather records for Mammoth. This is an on-going project that affects NFDRS fire indices, FARSITE and FireFamily runs, pocket cards, and the long-term context and interpretation of current weather patterns.

• Miller presented a fire ecology program to the Montana Youth Conservation Corps in June.

• Miller was a reviewer of the IF-400 course "Fuel Assessment Techniques using LandFire Data" in Boise in September.

• Miller and Moss were part of the FEAT Conversion Working Group. This group is a liason between Spatial Dynamics (the software developers) and NPS Fire Ecology.

• Miller presented "FEAT and Fire Effects Monitoring in the Park Service" at the Forest Service's Inventory and Monitoring Meeting in Missoula in November.

• Miller attended the "Statistical Inference in Fire Effects Monitoring" workshop and presented a unit on multiple regression in Fort Collins in May.

• Moss was asked to review the GIS and spatial component of the FEAT software for one pay period in October.

• Miller is continuing with a manuscript for the International Journal of Wildland Fire, "*A Case Study of Canopy Fuels and Crown Fire Behavior in a Lodgepole Pine Forest, Yellowstone National Park, Montana, USA*" reporting results from Yellowstone's 2003 Baker's Hole Fire.

• The program contributed units of instruction for S-130/190. Jackson was the Crew Boss trainee for the line dig exercise.

Table 1. Fire Effects Plot Workload 2005

Park	Monitoring Unit	Type of Plot (FMH, photo point, other – describe)	Pre-burn	Immed. Post	Postburn (1-20 yrs)	Total Plot Reads
YELL	Mechanical Hazard Fuel Reduction	Custom	0	0	0	0
YELL	CBI	CBI	0	0	0	0
YELL	WFRB-FMH	FMH	1	0	5	6
YELL	WFRB-Despain	Custom	0	0	0	0
YELL	Canopy Bulk Density Research					2
YELL	Andesitic Forest Fuel Modelling and Photoseries	Custom				5
Total						**13**

Table 2. Fire Ecology Staffing 2005

Monitor	Starting Date	Ending Date	# of Pay Periods	Training and Development
Becky Seifert Fire Monitor	5/9/2005	10/1/2005	10	Teton Interagency Fire Effects Meeting (2/05), A-110 Aerial Observer (5/05), Handar RAWS training (5/05), DSPO (9/05)
Emily Moss Fire Monitor	5/9/2005	10/1/2005	10	Teton Interagency Fire Effects Meeting (2/05), A-110 Aerial Observer (5/05), Handar RAWS training (5/05), FFT1 (9/05)
Shawn Jackson Fire Monitor	5/29/2005	10/1/2005	9	EMT training, First Responder (6/05), Short-haul certification (9/05)
Sean McEldery Lead Fire Monitor	1/3/2005	11/14/2005	22	L-380 (5/05), S-490, S-493, Technical Fuels Management (Begins 10/05)
Eric Miller Fire Ecologist	1/3/2005	12/31/2005	26	Teton Interagency Fire Effects Meeting (2/05), L-180 (4/05), L-380 (5/05), A-110 Aerial Observer (5/05), Statistical Foundations for FEAT (course presenter & participant, 6/04)

Sampling Design and Field Methods

Changes in Protocols

In 2005 pre-treatment plots will not be required in mechanical hazard fuel reduction plots. Pre-treatment information was useful in pilot plots for evaluation of post-treatment outcomes and, at times, is useful to predict worker hours and effort. Plot re-location following treatment is nearly impossible (we can only re-locate approximately 1 out of 20 rebar/markers). Moreover, rebar has the potential to injure horses and mules, or interfere with heavy equipment operation. Outcome objectives require only post-treatment measures compared to targets.

Status of Planning Documents

Miller is working on the Fire Effects Monitoring Plan which is partially complete and needs to be updated to reflect changes to the Ten Year Hazard Fuel Reduction Plan, and the new 2005 Fire Management Plan. Burn plans are being developed for Northeast and Norris.

Monitoring Results

Completed Reports

Miller, E.A., R.J. Seifert, E.R. Moss, S.C. McEldery, S.J. Jackson. 2005. Monitoring Results for 2004 Hazard Fuel Reduction Projects: Surface and Canopy Fuel Conditions. Yellowstone National Park Fire Effects Monitoring Research Note #12. Internal report to the Fire Management Office.

In Progress:

Miller, E.A., R.J. Seifert, E.R. Moss, S.C. McEldery, S.J. Jackson, "*A Case Study of Canopy Fuels and Crown Fire Behavior in a Lodgepole Pine Forest, Yellowstone National Park,*

Montana, USA" a manuscript for the International Journal of Wildland Fire, reporting results from Yellowstone's 2003 Baker's Hole Fire.

Research Projects/Collaboration

We are collaborating with Don Despain on a fire/forest-meadow ecotone project. Despain's project addresses the question of why forest-meadow boundaries resume their former positions following fire. Despain has installed data loggers to monitor seasonal trends in soil moisture while the Fire Effects Monitors are providing the above-ground foliar, herbaceous, and log moisture information. This project will contribute to our knowledge of water usage by trees and meadow vegetation, how the forest-meadow mosaic is maintained by edaphic properties (e.g., soil moisture, composition, or chemistry) rather than by fire, and indicate how drought may be carried over in heavy fuel and soil moisture reservoirs from one year to the next.

Benson, N., Morisette, J., and B. Welch, "Using NASA's Invasive Species Forecasting System to support National Park Service decisions on fire management activities and invasive plant species control." Response to NASA Cooperative Agreement Notice: NN-H-04-Z-YO-010-C A Partnership between NPS and NASA Goddard Space Flight Center proposing an "Integrated System Solutions (of Earth science for applications of national priority)." We are providing fire effects monitoring data on exotic species as inputs to spatially predictive models of exotic locations and spread potential.

We are continuing to sample large fires for the Composite Burn Index (CBI) to improve mapping of fire severity at the landscape scale using the Normalized Burn Ratio. We had no qualifying fires in 2005. Enough field data exists at this point to predict NBR from CBI but this relationship remains to be statistically developed. Updated fire severity GIS layers will support, LANDFIRE, FRCC, research in the YCR division, and fire atlases.

We are cooperating with Mack McFarland (GRTE) in developing his four-sided prescription window concept and supporting software. This tool, given enough data, has the potential to become a custom "Hauling Chart" or to produce fire behavior prediction equations for a local fuel model. Some data were collected from the Chickadee WFU, and other fires from the Salmon-Selway Complex fires in Idaho from the Yellowstone Fire-use Module.

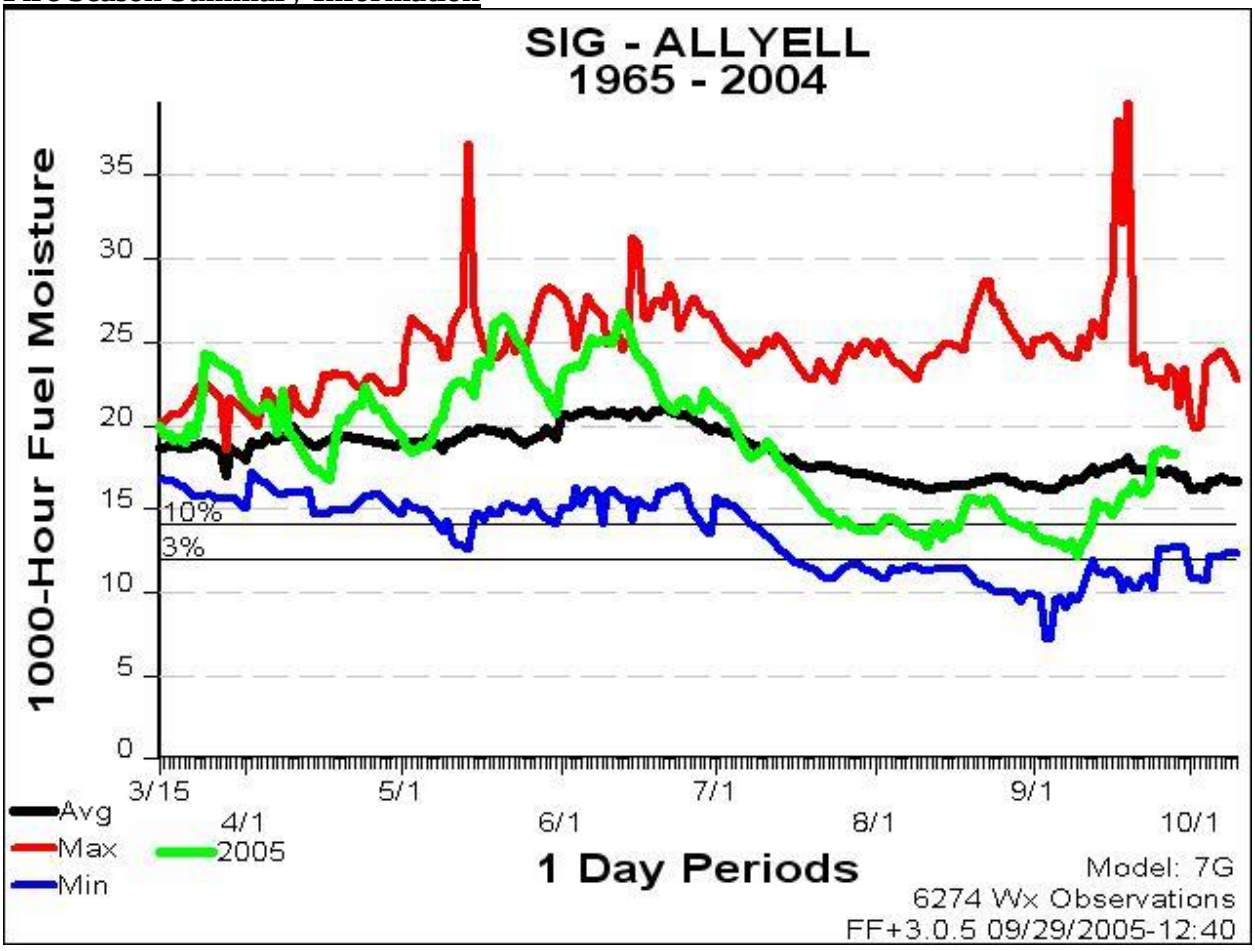
We are providing the LANDFIRE project with fire effects monitoring data to support their spatial fuel modelling and ground-truthing efforts.

Adaptive Management

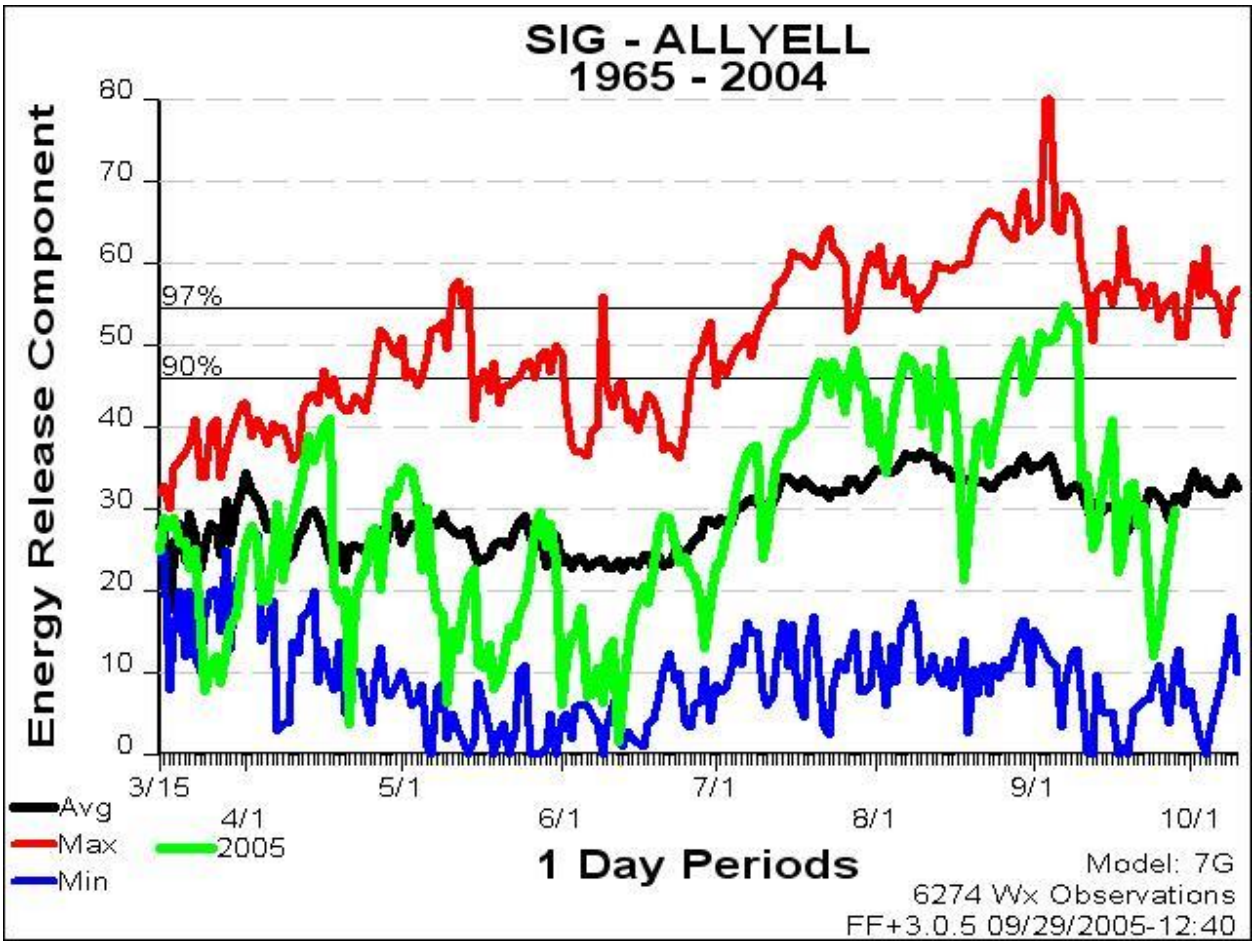
The Superintendent requested information on why Yellowstone does not utilize prescribed fire like other parks. This led to a discussion of the perception of fire behavior of lodgepole pine forests as a stand-replacement fire system. Empirical descriptions of a lodgepole underburn are lacking. We plan to use fire effects monitoring plot data as part of an internal white paper on fire behavior and effects in lodgepole pine underburns. Co-incidentally we were able to install a plot this year in front of a wildland fire-use fire that mostly burned as an underburn, reaching ~90 acres over ~2 months (Chickadee Fire). Tree mortality probability and other fire effects will be related to char and scorch height and other measures of fire intensity.

We are continuing to explore the relationships between canopy fuels and fire behavior. Results from the 2003 Baker's Hole Fire suggest that crown fire can occur at a mean canopy bulk density of 107 g/m^3. However a crown fire (2003 East Fire) burned around a ~5 acre patch (1955 Cub Creek Fire) where the mean canopy bulk density was also 107 g/m^3, suggesting a more complex relationship. The results of these projects will improve crown fire modelling and directly affect hazardous canopy fuels project planning in Yellowstone, as well as the fuel management community at large. Our research supports estimates in the literature that crown fire is unlikely where canopy bulk density <90-100 g/m^3.

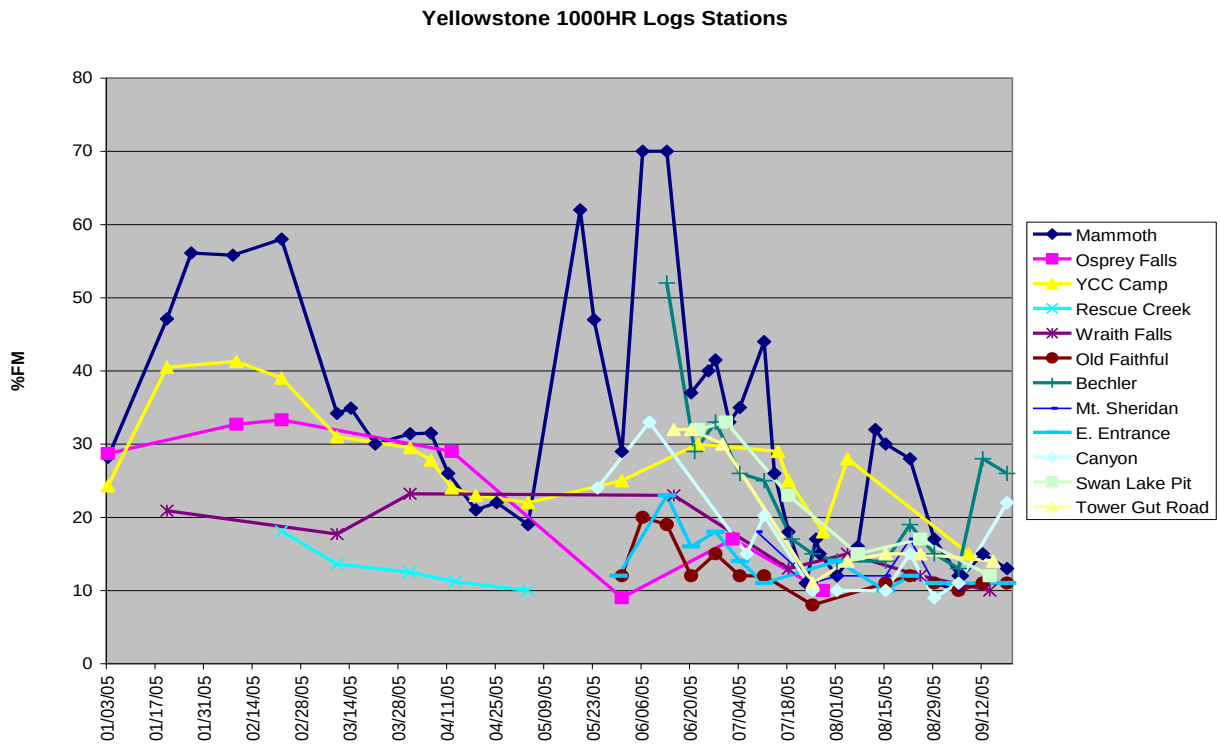
Fire Season Summary Information



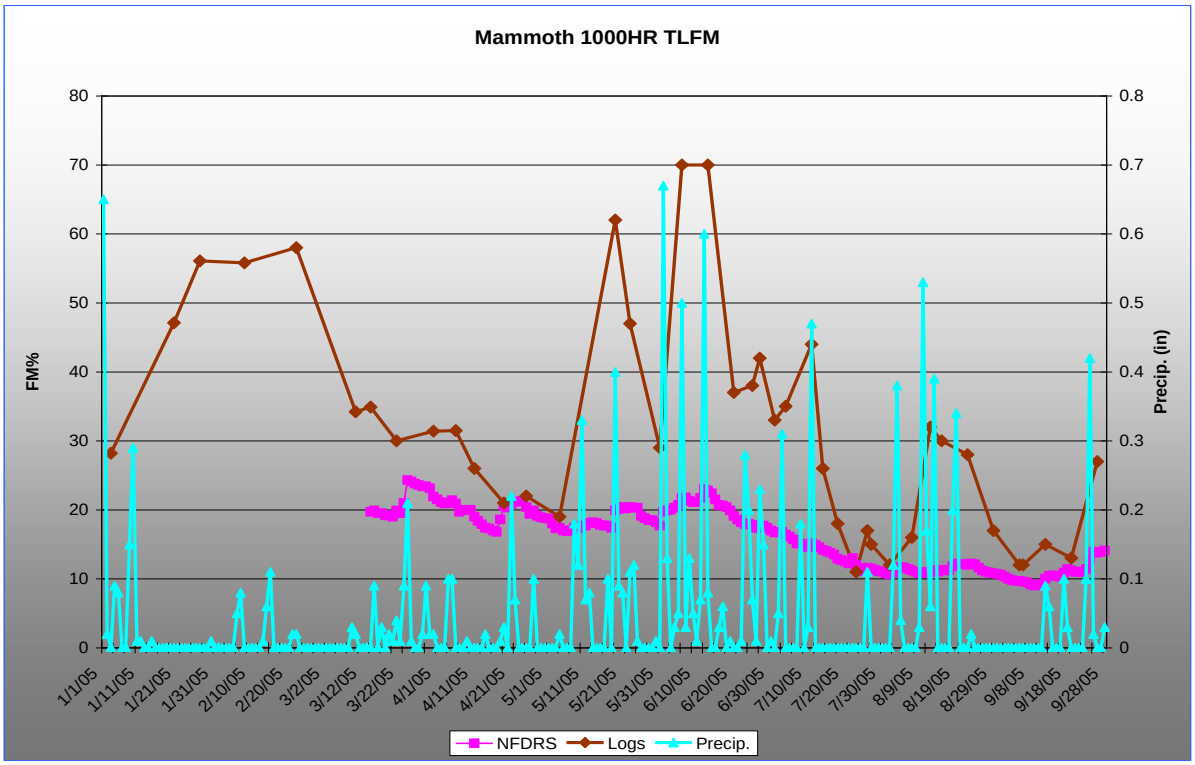
2005 Fire family seasonal 1000-hour plot.



2005 Fire family seasonal energy release component (ERC) plot.



Measurements from our 1000-hour log moisture stations throughout the park.



Mammoth precipitation, NFDRS modelled 1000-hour fuel moisture, and measured 1000-hour fuel moisture.

Yellowstone National Park

Climatological Precipitation in Inches
2005 Water Year

Precipitation at a glance 10/01/04 to 09/30/05	E. Entrance	Lake	Mammoth	Old Faithful	Snake	Tower
% of Sum of Average	92%	108%	97%	100%	83%	85%

Station	E. Entrance	2-Yr	Lake	485345	Mammoth	489905	Old Faithful	486845	Snake	488315	Tower	489025
Month/Yr	2005	Average	2005	Hist Ave	2005	Hist Ave	2005	Hist Ave	2005	Hist Ave	2005	Hist Ave
Oct-04	2.25	1.91	2.25	1.30	1.26	0.99	2.38	1.55	2.73	2.06	1.26	1.12
Nov-04	1.00	2.23	0.29	1.62	0.16	1.01	0.35	2.25	1.15	3.24	0.38	1.13
Dec-04	1.62	2.18	1.23	1.73	0.48	0.97	1.65	2.49	2.54	4.32	0.56	1.31
Jan-05	1.45	2.37	2.50	1.99	1.32	1.05	2.10	2.33	1.92	4.21	1.51	1.33
Feb-05	1.35	1.18	0.87	1.49	0.35	0.71	0.83	1.93	2.19	3.18	0.26	0.91
Mar-05	1.41	1.82	1.73	1.66	0.71	1.06	2.29	2.21	1.18	2.81	0.63	1.05
Apr-05	0.61	1.18	0.90	1.58	0.72	1.18	0.98	2.10	0.73	2.31	0.48	1.21
May-05	2.24	1.97	2.79	1.93	1.69	1.95	2.74	2.66	3.65	2.60	1.38	1.94
Jun-05	2.95	1.81	3.40	2.18	3.31	2.04	3.70	2.26	4.93	2.35	3.61	2.15
Jul-05	0.51	0.78	1.27	1.53	1.12	1.44	0.71	1.71	1.44	1.58	1.00	1.65
Aug-05	2.51	2.02	2.93	1.65	2.23	1.32	5.20	1.42	2.52	1.59	1.84	1.44
SUM	17.90	19.43	20.16	18.66	13.36	13.72	22.94	22.91	24.99	30.25	12.91	15.24

Note: Historic data obtained from the Western Regional Climate Center (WRCC) at http://www.wrcc.dri.edu/index.html
Current data obtained directly from climatological stations. Historic averages represent the total data available.

Observation Summary
Total Observations/Total Days

Station	# of Obs	# of Days	QA
E.Entrance	303	335	90%
Lake	273	304	90%
Mammoth	335	335	100%
O.F.	312	335	93%
Snake	311	335	93%
Tower	330	335	99%

Precipitation data for the hydrologic year for Yellowstone climatological stations.