National Park Service Fire Effects Monitoring Program

Rx Effects

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Spring 2004

National FEAT/Stats Workshop

Fire Ecologists and Lead Monitors from Alaska to the Southeast gathered in Fort Collins mid-May for the first truly national fire ecology workshop: "Statistical Foundations for FEAT". The week-long workshop dusted off a lot of unused brain cells and forced a lot of unpracticed fire geeks to think about statistics in new ways. Instructor Ken Gerow's conceptual approach emphasized practical statistics using computer software rather than bogging down in the underlying equations. Most participants agreed that Ken really knows his stuff!

Kim Johnson and Austin Streetman of Spatial Dynamics and the FEAT working group also presented Version 1.2 of the new FEAT software

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Inside this issue:

Monitoring Mechanical Fuel Reduction Projects in Ponderosa Pine Forests of Devils Tower National Monument and Mount Rushmore National Memorial

By Cody Wienk (Northern Great Plains)

As you all know, increases in fuel loads, ladder fuels, and tree densities have made it difficult to safely apply prescribed fire to some forested areas without first applying a mechanical fuel reduction treatment. Mechanical fuel reduction projects are currently under way in ponderosa pine stands at Devils Tower National Monument and Mount Rushmore National Memorial. The Northern Great Plains fire effects monitoring crew has installed plots in both project areas to assess stand structure and fuel loading. Two different sampling techniques were used in these projects.

Five standard FMH forest plots were installed in the 80 ha North Terrace unit of Devils Tower. This unit was mechanically thinned fall 2001. The treatment prescription called for removal of trees < 15 cm DBH. The thinning resulted in approximately 2,200 slash piles that were burned during January 2002 and February 2003. Mean pre- and post-thin tree densities are shown with standard error bars (Fig. 1). There were no significant changes in overstory or seedling tree densities. Pole tree densities were reduced from 1,077 stems/ha to 24 stems/ha. Prescribed fire is planned for this area as soon as weather conditions permit.

Total fuel load did not change significantly after the thinning and slash pile burning (Fig. 2). Ten-hour fuels increased slightly from 2.5 to 3.2 metric tons/ha while litter decreased from 10.6 to 7.4 metric tons/ha. Although not significant, it appears that there was a decreasing trend in 1000-hour fuels.

The Lafferty Gulch unit at Mount Rushmore is a 46 ha unit in the northeastern portion of the park and has been designated as Wildland/Urban Interface (WUI). Twenty

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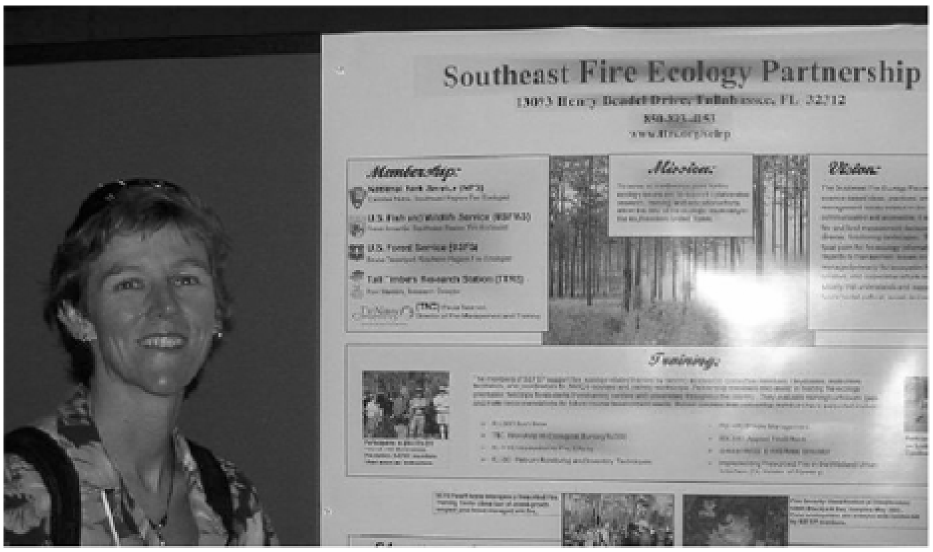
Southeast Fire Ecology Partnership

By Caroline Noble

An organization called the "The Southeast Region Fire Ecology Partnership" was formed this year and is based out of Tall Timbers Research Station in Tallahassee, Florida. Membership in the partnership includes the southeast regional fire ecologists for the federal agencies (NPS, USFS, USFWS) as well as staff from The Nature Conservancy, Global Fire Initiative, and Tall Timbers Research Station. The mission of the partnership is "To serve as a reference point for fire ecology issues and to support collaborative research, training, and education efforts within the field of fire ecology, especially in the southeastern United States." One of the first tasks the group has taken on is Fire Regime Condition Class (FRCC) reference condition development for the southeast. They will be working with the national FRCC team and the LANFIRE effort. For further information check out their new website at www.ttrs.org/sefep



Caroline Noble and the Southeast Fire Ecology Partnership presentation at the Second International Fire Congress in Orlando

An Estimate of the Threshold Canopy Bulk Density to Sustain Crown Fire in Lodgepole Pine Forests of Yellowstone National Park

Eric Miller, Rebecca Seifert, and Emily Moss (YELL)

Much recent attention has focused on hazardous fuel accumulation surrounding structures and urban areas. Managers of public forests are endeavoring to balance hazard fuel reduction with a desire to retain the forest's esthetic qualities. Removal of trees reduces the hazard of crown fire but fewer trees is often undesirable to private landowners or impinges on the ability of public land managers to maintain natural landscapes (Scott 1998). In forests such as lodgepole pine which are prone to crown fires, balancing fire hazard reduction with landscape esthetics requires an understanding of threshold canopy fuel factors below which crown fire cannot be sustained.

The continuity of canopy fuels is measured as canopy bulk density (CBD) or the mass of combustible fuel per volume of canopy space. Several recent studies suggest that crown fire behavior is reduced in stands with CBD below 100 g/m^3, however thresholds have not been empirically tested. In Yellowstone National Park estimates of CBD in natural, unmanaged conifer forests range from 100 g/m^3 for Douglas-fir forests to 260 g/m^3 for old-growth lodgepole pine and spruce-fir (Sorbel and Renkin 1998). The lower limit of canopy bulk density at which crown fire can be sustained under given weather conditions is the threshold canopy bulk density or CBD_t.

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Restoration of the Blackbelt Prairie

By Kimberly Judson, Lisa McInnis, and Andrew Ruth (NATR)

The restoration of pre-colonial landscapes and reduction of invasive species along the Natchez Trace Parkway is one of the major biological objectives of the Fire Management Program headquartered in Tupelo, Mississippi. One such restoration project occurs at the 190-acre Chickasaw Village Blackbelt Prairie site adjacent to the Natchez Trace Parkway (NATR). Prescribed burning and chemical/mechanical removal of invasive vegetation have been used in combination to facilitate the conversion of the area from a remnant grassland once used for grazing to a more representative native prairie community. In conjunction with Mississippi State University, the effects of aforementioned treatments are being evaluated by the NATR Fire Effects team.

With the exception of 2001, prescribed fire (above) has been applied annually to Chickasaw Village since 1994 to help reduce the encroachment of Eastern red cedar (*Juniperus virginiana*). Although native to northern Mississippi, fire suppression and ease of dispersal allows Eastern red cedar to invasively occupy sites in which historically it was a minor woody component.

In March 2004, a prescribed burn was conducted within Chickasaw Village using a hand-ignition method. Eastern red cedar is fire-intolerant and isolated stands of smaller cedars have been successfully reduced with the application of prescribed fire. However, clusters of large cedars do not facilitate the passage of fire due to a scarcity of fine fuels within the shaded understory. In addition, lack of foliage in the lower portions of the cedar crown and thicker bark allow larger cedars to escape lethal fire temperatures.

To further clarify the environmental conditions under which fire can effectively impact the larger stands of large Eastern red cedar, the fuels division of the Natchez Trace Fire Management Program will correlate live fuel moisture readings of Eastern red cedar with fire behavior in these larger stands. This correlation will allow for burn prescriptions to be tailored to the management objectives of Eastern red cedar reduction.

Monitoring Mechanical Fuel Reduction (Cont'd)

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circular plots with 10 m radius were randomly located within the unit. Within this circular plot, diameter at breast height (DBH) was measured and recorded for all live ponderosa pine trees with a DBH greater than or equal to 2.5 cm. Plots were randomly selected again for post-thin sampling. Two random azimuths were selected for each plot to measure downed woody fuels using Brown's lines.

This area was thinned during the summer of 2003. Pre-thin stand density was 1,488 stems/ha and fuel load was 81 metric tons/ha. The prescription called for removing trees < 15 cm DBH while leaving 48 pole-sized trees/ha throughout the unit. The thinning resulted in about 130 slash piles/ha. Approximately 600 slash piles were burned over the winter and the remainder should be burned next winter. Stand densities were reduced to 516 stems/ha following thinning. Mean pre- and post-thin tree densities by size class are shown with standard error bars (Fig. 3). Poles were reduced from 1,111 to 91 stems/ha. Downed woody fuels will be assessed after the slash piles are burned.

Thinning produced dramatic changes in the structure of this stand. Figure 4 (p. 5) illustrates pre- and post-thin stand structure. Trees smaller than 13 cm DBH composed 75% of the pre-thin stand while this size class composed only 19% of the post-thin stand. It appears that the thinning prescription was followed very well by greatly reducing, but not eliminating the pole-size trees.

Both mechanical fuel reduction projects have been successful in reducing the number of small diameter trees. Circular plots were more efficient than FMH forest plots in both installation and re-sampling. When only a few variables are of interest, we feel circular plots are much more appropriate. Four times the number of plots were sampled in less time allowing for a larger number of trees sampled, greater confidence in results, and a better distribution of sample sites.

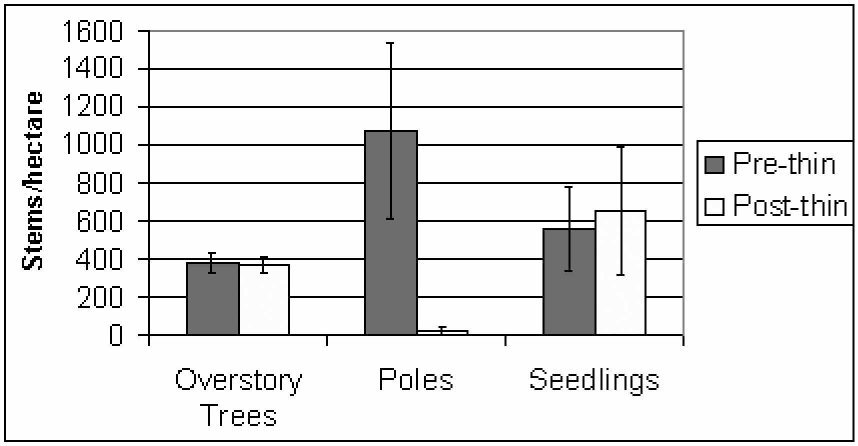

Figure 1.

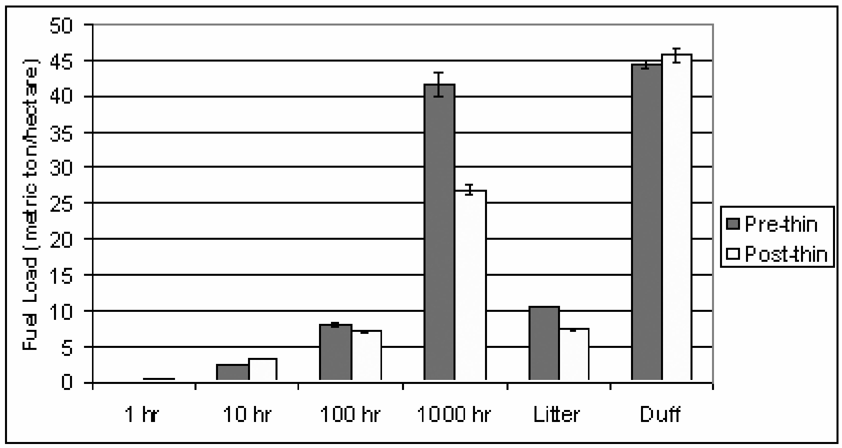

Figure 2.

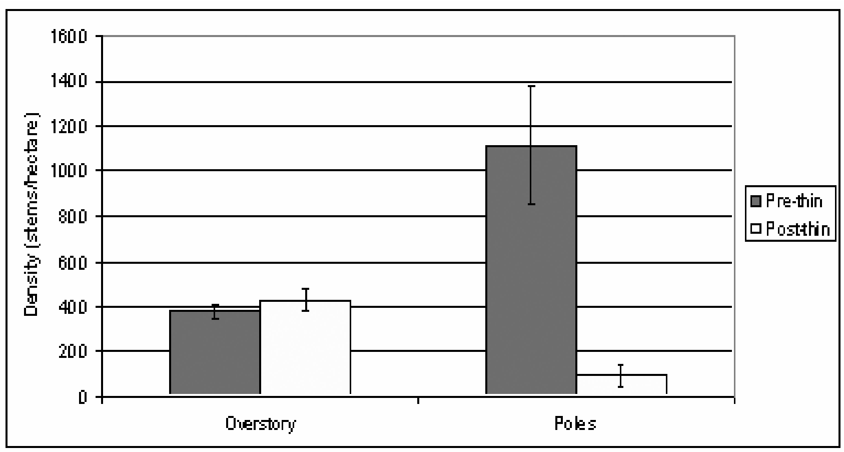

Figure 3.

Monitoring Mechanical Fuel Reduction (Cont'd)

Figure 4. Pre– and post-treatment stand condition.

FEAT/Stats (Cont'd)

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which is immediately available and workable for data entry this summer. Nate Benson asks everyone to put the software through the wringer this season to find and report the bugs and deficiencies to the FEAT working committee so they can be fixed for version 2.0.

Otherwise the workshop was an opportunity to finally meet and kick some hacky with all the fire effects people you've heard about but have never met. Hopefully more of these workshops will happen in the years to come.

Ken Gerow instructs the statistics part of the workshop.

The role of fire on tree mortality and regeneration in yellow pine (*Pinus echinata, P. rigida,* and *P. virginiana*) communities of Great Smoky Mountains National Park

By Virginia L. McDaniel and Nunally L. Benzing (GRSM)

Abstract from the 2nd International Wildland Fire Ecology

Great Smoky Mountains National Park uses prescribed fire as a management tool to maintain yellow pine (*Pinus echinata*, *P. rigida*, *P. virginiana*) communities. Specific fire management objectives include reducing the density of pole-size trees (2.5-15.0 cm diameter at breast height), reducing the total number of fire-intolerant species, and increasing yellow pine regeneration. In fourteen plots, one year post-burn data demonstrate an overall 70% reduction ($p<0.001$) in pole-size tree density. The three most common fire-intolerant species, blackgum (*Nyssa sylvatica*), white pine (*Pinus strobus*), and red maple (*Acer rubrum*) were decreased by 82% ($p<0.0001$), 71% ($p=0.003$), and 51% ($p=0.003$) respectively. Yellow pine seedlings showed an increase in density from 6 seedlings (±4; mean ±1 SE) to 134 seedlings (±32) per 100 m^2 ($p=0.003$). Overall mortality was negatively associated with tree diameter at breast height ($r=-0.419$, $p<0.001$), suggesting that small trees were more likely to be killed by fire. These preliminary results suggest that Great Smoky Mountains National Park is meeting its fire management objectives in these burn areas.

Contact info: Great Smoky Mountains National Park, Gatlinburg, TN 37738, Virginia_Mcdaniel@nps.gov Nunally_Benzing@nps.gov, Phone: 865.430.4755

Threshold Canopy Bulk Density (cont'd)

(Continued from page 2)

Examples of CBD_t in the literature are not well represented and range from guesses to estimates based on limited data.

Fire-use fires may provide a good opportunity to study the relationship between crown fire behavior and canopy fuels. Yellowstone National Park is a unique place for crown fire research because of the park's ability to allow fire-use in crown fire-prone lodgepole pine forests. Information relating crown fire behavior to canopy fuels may be gained in one of two ways: 1.) canopy fuel characteristics may be measured at the head of active fire-use fires prior to burning, or 2.) canopy fuel characteristics may be measured indirectly from post-fire measurements. Information obtained from plots prior to burning are preferable but much information may also be gained from post-burn plots. In 2003 Yellowstone National Park's Fire Effects Monitoring Program installed 4 pilot plots each in canopy burn and surface burn areas of the Baker's Hole Fire to indirectly measure the CBD_t necessary to sustain crown fire. Since canopy fuel loading cannot be measured on post-burn,

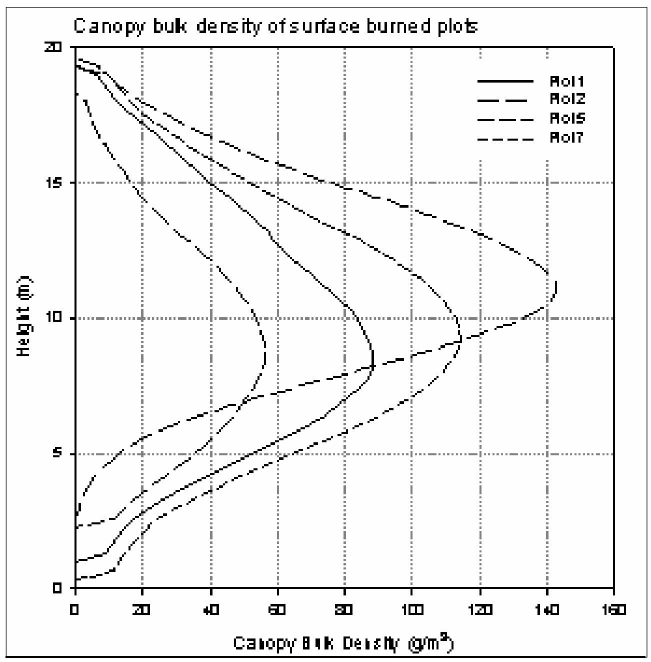

Figure 1. Canopy bulk density profiles for the four surface burn plots.

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A Fuel Appraisal Photoseries and Fuel Model for Early Post-fire Lodgepole Pine Forests in Yellowstone National Park

By Eric A. Miller[1], Rebecca J. Seifert[1], Scott A. Weyenberg[2], Sean C. McEldery[1], Andy C. Oestreich[3], Shawn J. Jackson[1], Emily R. Moss[1], Victoria A. Pecha[4], Roy A. Renkin[4], and Steve Petrick-Underwood[5]

Abstract

A fuel appraisal photoseries and several fuel models are presented on CD-ROM to represent early post-fire lodgepole pine forests in Yellowstone National Park. Fire management decisions are based, in part, on predicted fire behavior. Fire behavior prediction programs are a valuable aid in forecasting spread rates, spatial extent, and the behavior of fire across the landscape. However they require accurate input data in order for the outputs to be accurate. Inputs are typically fuel loadings based on generalized fuel models that consider the mass and spatial arrangement of fuels. The majority of the forests in Yellowstone National Park are dominated by lodgepole pine which is well modeled by standard fuel models. However, the models do not adequately describe the extensive areas of early post-fire lodgepole pine (LP0 cover type) regenerating from the fires of 1988. In each of the 2000-2003 seasons, fires in Yellowstone have unexpectedly burned through LP0, leading to uncertainty in predicting fire behavior. Consequently, fires that may have served as naturally burning wildland fire-use fires and provided valuable ecosystem benefit were suppressed. Recognizing this uncertainty the Yellowstone National Park Fire Management Office and Fire Effects Monitoring Crew began to collect information on fuel loading and fire behavior. Fuel loading information was collected in 20 photoseries sample plots and 4 less-intensively sampled transects. Fire behavior information comes from on-site observations and measurements by NPS Fire Effects Monitors and the Yellowstone Fire Use Module 2000-2003. This study improves our ability to predict fire behavior by 1.) analyzing the fuels in the early post-fire lodgepole pine forest type to determine which factors limit or promote fire spread, and 2.) providing a photoseries to aid in estimating fuel loading, and 3.) providing custom fuel models for use in fire behavior prediction software.

Fire spread in the LP0 cover type is relatively rare, to date occurring only under drought conditions and, for the most part, after mid-August. While most of Yellowstone's forests are described by timber-litter fuel models, fire spread in the LP0 cover type fuel model is mostly limited to sites with grass as the carrier fuel. Grass and other graminoids such as elk sedge allow fire spread while rotten heavy fuels sustain the fire from one burn period to the next. Where graminoids are not thick, fire spread is likely to be limited. Fire behavior observations indicate some preliminary weather and fuel moisture thresholds: herbaceous "grab sample" fuel moisture <80%, solid thousand-hour fuel moisture <12%, and relative humidity <12%.

[1]Fire Management Office, Yellowstone National Park, P.O. Box 168, Yellowstone National Park, WY 82190-0168. www.nps.gov/yell/technical/fire/ Corresponding author is Eric Miller 307-344-2474, eric_miller@nps.gov.

[2]10205 Jeffery Lane, Rogers, MN 55374

[3]Fire Management Office, Grand Teton National Park, P.O. Box 170, Moose, WY 83012-0170.

[4]Yellowstone Center for Resources, Yellowstone National Park, P.O. Box 168, Yellowstone National Park, WY 82190-0168

[5]Bureau of Land Management, Klamath Falls Resource Area, 2795 Anderson Ave, Bldg. 200, Klamath Falls, OR 97603

Interagency Fire Effects Meeting Shares Monitoring Information

By Lori Iverson (Teton Interagency Fire Management)

The third annual Interagency Fire Effects Meeting was held in Jackson, Wyoming this February, bringing together resource professionals to review data and hold discussions on research and fire effects projects in the area. Participants included representatives from Bridger- Teton National Forest, Bureau of Reclamation, Grand Teton National Park, Salmon- Challis National Forest, Teton Science School, US Fish & Wildlife Service - National Elk Refuge, Wyoming Game & Fish Department, and Yellowstone National Park. The diverse audience brought a range of skills and expertise to the meeting. In addition to fire effects technicians, the workshop was attended by fire ecologists, fuels specialists, education specialists, planners, fire managers, GIS specialists, wildlife biologists, vegetation specialists, and silviculturists. The meeting allowed participants to share information and ask questions about the research and implementation of projects throughout the Greater Yellowstone Ecosystem. Though many of the projects on the agenda had been preceded by interagency communication during the planning phase, the daylong workshop provided a format for professionals to distribute findings to a broader scope of cooperators. The Teton Interagency Fire Effects Monitoring program follows guidelines established by a larger, standardized program begun by the National Park Service in the late 1980s. Fire effects crews monitor prescribed fire and hazard fuel treatment areas to document basic information, identify trends, and ensure that fire and resource management objectives are met. Crews also map burn severity on natural ignitions, collecting data to better understand the effects of natural processes and fire regimes. The workshop demonstrated how research and management can parallel one another with a constant, ongoing improvement of knowledge base. The afternoon session ended with a key discussion of how the data will be used for direct adaptive management applications in the various programs through continued interagency coordination, management involvement, information sharing, and feedback. See www.nps.gov/grte/fire/fireeffectsmtg0204.pdf.

Threshold Canopy Bulk Density (cont'd)

crownless trees, we used an indirect, comparison approach. We assumed that if all the measurable tree features of the canopy burn plots are no different from the surface burn plots, then canopy fuel loading is also no different. The lowest canopy bulk density obtained reasonably approaches CBD_t.

A total of 314 lodgepole pine trees were sampled in the 8 plots. There were no other tree species encountered. We accepted the null hypothesis of no difference between canopy burn and surface burn tree population basal area ratio, tree density, or DBH. By extension we assume no difference in CBD either. CBD profiles for the four surface burn plots indicate a homogeneous canopy (Fig. 1). Maximum CBD values for each plot ranged between 56-143 g/m^3. The lowest CBD observed, 56 g/m^3, approaches CBD_t. Although CBD_t is unlikely to be higher than 56 g/m^3, it could be considerably lower, particularly given the relatively small sample size of four surface fire plots in this pilot study. Sample sizes will be increased during the 2004 field season.

Statistical foundations for FEAT workshop in Fort Collins, Colorado

RxFx Subscription and Submission Information

Rx Effects is the newsletter of the Fire Effects Monitoring Program in the National Park Service. It is an outlet for information on Fire Effects Monitoring, FMH, fire research, and other types of wildland fire monitoring. The newsletter is annually produced for the National Park Service but we encourage anyone with an interest in fire ecology to submit information about their program or research. Examples of submissions include: contact information for your program, summaries of your program's goals, objectives, and achievements, monitoring successes and failures, modifications to plot protocols that work for your park, hints for streamlining collection of data, data entry, and analysis, event schedules, and abstracts of papers or posters resulting from your program. Submissions will be accepted in any format (e.g., hard copy through the mail or electronic files through e-mail). The goal of the newletter is to let the Fire Effects Monitoring community know about you and your program.

Rx Effects is issued each year in the Spring. The next submission deadline is 29 April 2005. If you would like a subscription or more information please see our website **www.nps.gov/yell/technical/fire/rxfx.htm** or contact Eric Miller 307-344-2474. Fire Management Office, P.O. Box 168, Yellowstone National Park, WY 82190-0168.♦

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http://www.nps.gov/fire/fire/fir_ecology.html

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