



Ponderosa pine torched in the HCross Prescribed Fire. Personnel working for the Yellowstone National Park Fire Use Module captured the image on the evening of April 22, 2003.

Breakthrough at the Missouri River Breaks: A Quick Tool for Comparing Burned and Unburned Sites

Summary

A quantitative understanding of how forests work, both before and after (prescribed and wild) fire, is essential to management. Yet acquiring the kind of broad yet detailed information needed for many management decisions can be costly, tedious, and time-consuming. After two sweeping wildfires in the Missouri River Breaks area of eastern Montana—the Indian and Germaine wildfires—some researchers wanted to see whether it was possible to characterize both pre-fire and post-fire characteristics in a relatively inexpensive and efficient way. Specifically, they wanted to know whether prescribed fire that is then followed by wildfire, is more likely to meet management objectives.

Theresa Jain, a research forester at the Forest Service, Rocky Mountain Research Station, and her colleagues set out to do just that. After creating a careful plan, a small crew set off into the area, collected quick, but thorough data, and photographs. They were able to compare “pre burn” (untouched by fire) areas, to areas that had been exposed to wildfire, prescribed fire, or both. They created summaries and handbooks for their results. Although the data are not statistically significant, there is a *trend* in the region of this study suggesting that wildfire after a prescribed burned is more effective at meeting management objectives than either wildfire or prescribe fire alone. The handbooks offer not only specific information on the region, but also serve as a handbook for managers and planners who want to do the same thing in a different region.

Key Findings

- Basic forest characteristics and paired photographs of physiographic areas are documented for the region affected by wildfires in the Missouri Breaks.
- It is possible to acquire quick, efficient, and cost effective information on forests exposed to wildfire, prescribed burns, and areas untouched by fire; then compare them to each other for management objectives.
- Although the data are not significant, there is a *trend* in the region of this study suggesting that wildfire after a prescribed fire is more effective at meeting management objectives than either wildfire or prescribe fire alone.

Introduction

At the apex of fire management is the need for clear data on forest characterization both pre- and post-fire. A quantitative understanding of how forests work, both before and after (prescribed and wild) fire, is essential to management.

Ideally this entails extensive data collection on all sorts of forest characteristics, widespread characterization of the landscape, and the creation of objectives for the post-fire landscape. With such information managers can develop quality management practices that bring the land into alignment with management goals.

Yet, reality is often very different than the ideal world. Acquiring extensive data on a pre-fire landscape may be expensive, difficult, and unpredictable. Meanwhile, there are no guarantees that the land will burn, or not, according to specific management objectives. Even in a well-planned scenario wildfire can erupt and change everything.

This is precisely what happened in the Missouri Breaks of eastern Montana when the Indian and Germaine lightning-sparked wildfires burned more than 100,000 acres. The two wildfires burned across areas which had previously been prescribed burned. But “pre-disturbance” data had not been collected before the outbreak of the wildfires.



Test ignition for the HCross Prescribed Fire on April 22, 2003. Personnel working for the Yellowstone National Park Fire Use Module captured the image.

In response to these (not unusual) circumstances, Brad Sauer, then a fire management specialist at the Bureau of Land Management, asked a simple but powerful question: Did it make a difference in terms of management goals if the wildfire-burned land had been prescribed burned prior to the wildfire? More importantly, if so, could that difference be assessed given the lack of extensive pre-burn data?

Although the question was highly relevant to the Missouri Breaks specifically, it also speaks to a host of other land management scenarios—those that simply do not have the extensive and precise data sets needed for pre- and post-fire landscape management. So the second question gives rise to this: Is it possible to acquire useful data on creating land management objectives in a quick yet efficient fashion?

Theresa Jain, a research forester at the Forest Service, Rocky Mountain Research Station, along with a team that included Sauer, Molly Juillerat as well as Mike Ford and Robert Mitchell, set out to answer these questions.

“Since most managers will just never have the ideal world of pre-fire plot data and post-fire plot data, we wanted to figure out how to quantify given this reality. Everybody deals with it,” says Jain, “And really, how many of us have the time and the energy to deal with 1000’s of plots?”

With Joint Fire Science Program (JFSP) funding, they set out to answer Sauer’s original question while simultaneously developing tools to answer it. Further, they wanted to determine if these tools then could be applied to other landscapes with the goal of helping managers and planners deal quickly, affordably, and accurately with the abundant real world situations that involve wildfire, prescribed fire, and a dearth of costly and extensive pre- and post-fire data?

Jain’s quick summation is a resounding, “Yes.”

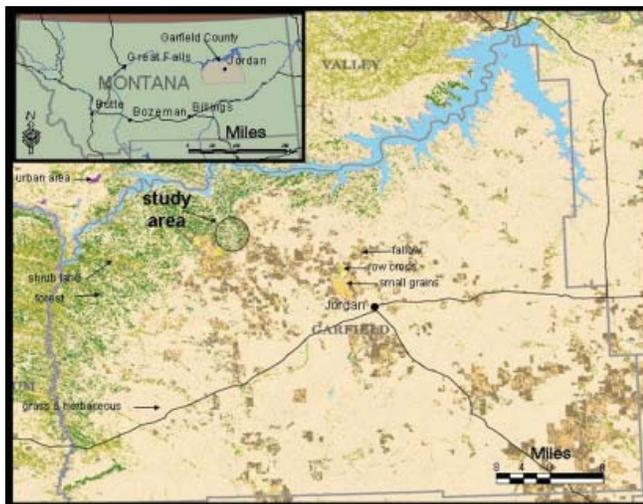
Untouched by fire

“We went into the Breaks and in six weeks, with six people, and a few two-week sessions, we had our ‘quick’ answers,” says Jain.

“We wanted to make a photo-reference guide of different aspects of the landscape that were *untouched* by fire—including relevant forest data and characteristics. Then, eventually, we wanted to be able to compare these reference conditions to the post-fire landscape, including the different fire scenarios,” explains Jain.

Maps in hand, the team went into the field with cameras and the modeling software *Forest Vegetation Simulator*. With their maps and some careful planning they ranged throughout the area after hand-picking what they called “pre-fire” reference conditions which were simply unburned sites located adjacent to burn areas.

“There was no need to be perfect here,” says Jain. “We were after trends and an ability to compare an unburned landscape to one—essentially next door—that had burned.”



Map of the study area along the breaks of the Missouri River in eastern Montana. The circle shows where the photographs and data were obtained.

“We took all sorts of information on these sites including topography, slope, aspect, soil surface characteristics, trees per acre, tree diameter, and much more,” says Jain. “We picked sites adjacent to wildfire sites (no burn, “control” plots), prescribed burned sites, and sites that had both wildfire and prescribed burns. We selected our

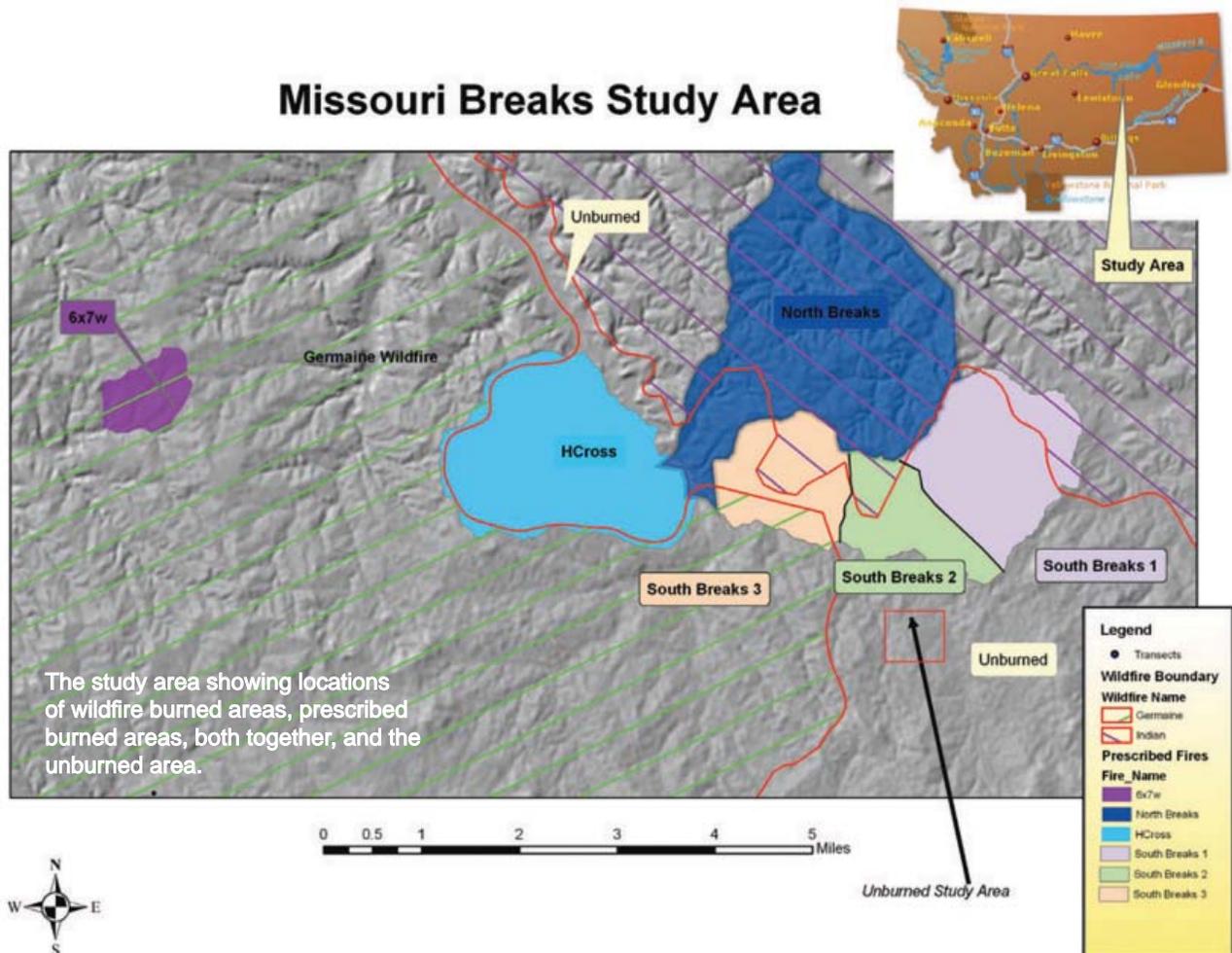
“control” sites to get the closest possible match for pre-fire reference conditions to then compare to the wildfire and prescribed burned areas.”

The team used randomly placed transects in each area to acquire photos and accompanying data. They also followed each transect in such a way as to acquire information on what they termed “low, medium, and high” tree density sites. Medium density had twice the density of trees as the low density sites, and the high density sites, likewise, had twice the density of trees as the medium density sites.

“The beauty of this,” says Jain, “is that we could pick our sites using a map of where the fire had burned, be sure we located “control” sites adjacent to both wildfire, prescribe-burned areas, and areas that had experienced both wildfire and prescribed burns, and then we could go out in the field, assign a transect and get all the data we needed very quickly.”

By the time they were done they had drafted a summary document just one week later. That document which describes the “unburned reference conditions,” is now freely available and printed on water-proof paper that fits inside a vest pocket. It is titled, *Forest Descriptions and Photographs of Forested Areas Along the Breaks of the Missoula River in Eastern Montana, USA*. It is available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr186.html.

Missouri Breaks Study Area



Says Jain, “The power of this study is that it really is extremely quick and efficient, and you can do it anywhere. Even if it’s a case of doing the best you can with what you have, you can get useful and fairly accurate data quickly, efficiently, and at very low cost.”

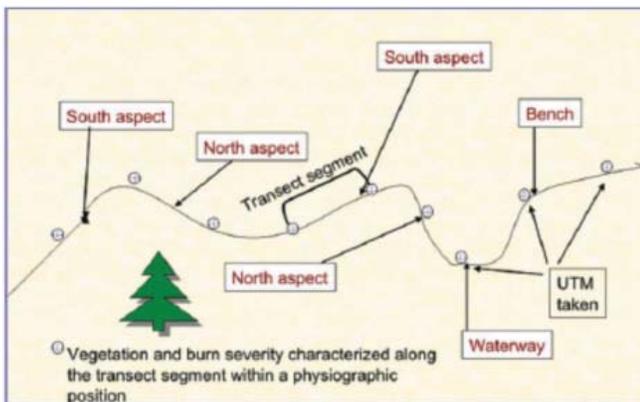
Into the burn

Meanwhile, the team also wanted to sample the actual burned landscape. Now that they had collected data on the unburned land, they needed similar data on the burned areas. The team likewise compiled the results of this portion of the work into a second handbook—also vest-pocket-sized and on waterproof paper—called *Photographic Handbook for Comparing Burned and Unburned Sites Within a Dry Forested and Grassland Mosaic: A Tool for Communication, Calibration, and Monitoring Post-Fire Effects*. It is available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr197.html.

Given their earlier work on the unburned landscape, it was straightforward to go into the burned scenarios and quickly collect data that they could then compare to their “control” plots.

Says Jain, “We created transects that intersected the different ‘treatment’ scenarios. We wanted to collect data from all three possible ‘treatments:’ prescribed burn, wildfire burned, and the two together. This would help us answer the original question, and helped us create our sampling scheme.”

The team placed transects randomly, and each transect intersected various scenarios. Then the walking began.



For each physiographic position (transect segment), forest structure (change in tree density) and the burn severity (what was left) were characterized.

“We needed to cover huge areas,” says Jain. “Each crew walked about 4-5 miles each day. We had each crew walk a transect with the photo handbook of the ‘unburned treatments’ in hand. They used this photo handbook as a pocket reference on their transect walks. When they found an area that looked similar to an ‘unburned’ area, they stopped and collected data and took pictures,” explains Jain. So, it was important to have the unburned reference conditions accounted for prior to this stage of the data collection.

That’s when the field crew collected all sorts of tree survivorship data. They recorded the percentage of dead trees based on size classes, shrub cover, the amount of mineral soil exposed, grass cover and more. They also worked to quantify crown ratios in burned versus unburned areas.

Thus they were able to get a quantitative estimate of mortality and survival in the different areas. They organized the data into four physiographic positions: (1) waterways (ravines or gullies), (2) south-facing aspects, (3) north-facing aspects, and (4) benches or ridges. Next, they ordered these estimates as photos and tables within each of these physiographic areas as either wildfire alone, prescribed fire alone, or prescribed fire followed by wildfire.

And the drumroll please...

But did it work? Did this ‘quick and efficient’ approach answer the original question: Did it make a difference in terms of management goals if the wildfire-burned land had been prescribed burned prior to the wildfire?



Photos documenting the variation in forest structure and burn severity throughout the study area; (top left) North Breaks prescribed fire and wildfire combined, (top right) South Breaks, (bottom left) HCross, and (bottom right) North Breaks prescribed fires.

“You have to be clear about what the original objectives were,” says Jain. “In our case, we wanted to see if the prescribed burned areas, followed by wildfire, helped the land move toward the desired future condition. The desired future condition was our objective.”

“Interestingly, there was no statistical significant difference according to our data and how we collected it. Still the averages were different. But the variation was very large,” explains Jain. “Even so, we thought it was very valuable information and it even gave us the beginnings of an answer to our question.”

In general, says Jain, the research showed that—in terms of meeting the original objectives for desired future

condition—the prescribed burned areas alone didn't kill enough trees. Meanwhile, the wildfire alone burned too many trees. But the prescribed burn followed by wildfire most closely met the objectives. Conclusions from the study are found on a CD on the back cover of their publication, *Vegetation and Soil Effects from Prescribed, Wild, and Combined Fire Events Along a Ponderosa Pine and Grassland Mosaic*. It can be found at: http://www.fs.fed.us/rm/pubs/rmrs_rp067.html.

“Essentially, what we saw was that the wildfire acted as a ‘second’ burn on the sites that had already been prescribed burned,” says Jain.

Specifically, according to a summary of their JFSP final report, they did not find any statistically significant effects on tree density, herbaceous cover, or crown scorch. But they *do* report on observed trends. “Depending on the physiographic position, more trees survived in places burned only by the combination of prescribed and wildfire than places burned only by wildfire. The prescribed fires tended not to fulfill prescription objectives, particularly in tree density, until the second fire occurred. However, the wildfire tended to exceed prescription objectives because it killed too many trees. Compared to unburned sites, all the fires tended to decrease litter and favor higher amounts of grass cover, thus fulfilling prescription objectives.”

Applications abound

“So, we did at least start to answer Brad’s original question, (did it make a difference in terms of management goals if the wildfire-burned land had been prescribed burned prior to the wildfire?)” says Jain, “We found that in general, forests appeared to be closer to management objectives after a wildfire if they had been prescribed burned first.”

Perhaps more important, however, the team fashioned a new ‘quick and efficient’ approach to getting a rough idea of how landscapes may be affected by prescribed burns and wildfire. With their approach, managers in other locations can go into an area, acquire data quickly, cheaply, and efficiently, and use it in creating future management objectives.

“You could do the same thing anywhere,” says Jain. “And with our handbooks, it will be straightforward for even a small team, with little money, and not very much time to go out and get these data in their particular landscape. I really see this approach emerging as an actual management tool, because once you have the first round of information, it can be used in the next round of management decisions.”

Besides the broad application of using the handbooks as a guide to implementing their techniques in other areas, the handbooks themselves have other functions. In particular, the handbook comparing burned versus unburned lands can be used as a communication tool, a calibration tool, and a monitoring tool according to Jain.

First, because the handbook offers data tables paired with two photos for each area, burned and unburned, it can serve as an easy and handy communication device. The

Management Implications

- This study shows that it is possible to get a rough estimate of forest characterizations in burned and unburned sites relatively quickly, easily, and cheaply.
- In the Missouri Breaks, there is a *trend* suggesting that wildfire after a prescribed burned is more effective at meeting management objectives than either wildfire or prescribe fire alone.
- Managers and planners can acquire the handy waterproof handbooks resulting from this work, to help implement their own similar strategies in different geographic locations.
- The handbooks can serve as communication, calibration, and monitoring tools.

visual power of absorbing such a wealth of information is important. According to the handbook itself, “Using photographs as an accompaniment to quantitative characteristics allows the user to focus on specifics in the photographs that are being described in the tables. For example, elements such as canopy height, ladder fuels, and tree density than can lead to particular severity outcomes can be visually communicated to others through the photographs.”

Also, the handbook offers information that “can be used to calibrate estimates or as a frame of reference of tree density, canopy base heights, cover for surface components, and other parameters, as well as burn severity (what is left after the fire) for different conditions within given physiographic positions,” according to the handbook.

Finally, the handbook serves as a monitoring tool, and the handbook itself suggests various ways managers and planners can use it this way. Managers who need a monitoring tool when characterizing a burned landscape or a particular fire event, may find it useful. According to the handbook, as one example, “Results that resemble those contained in the handbook can be tallied along a transect (sometimes referred to as a walk-through exam) to get an idea of how much an area resulted in various severity outcomes.”

Is there anything else Jain would like to amend to the whole process? “Yes,” she says, “I’d like in the future, to be able to use remote sensing of the burns and compare those data to the data we collected. But for now, we’re very pleased with the broad applications of this tool. It is easy, efficient, quantifiable, valid, and cheap.”

Note to Managers and Planners:

If you want free (waterproof) copies of the three handbooks referred to in this Fire Science Brief, contact: Richard Schneider – Publications; Forest Service, Rocky Mountain Research Station 240 W Prospect Road, Fort Collins, CO 80526; Phone: 970-498-1392; Fax: 970-498-1122; Email: rschneider@fs.fed.us.

Further Information: Publications and Web Resources

Fisher, William C., Bruce D. Clayton. 1983. Fire ecology of Montana habitat types east of the Continental Divide. Gen. Tech. Rep. INT-141. Ogden, UT: U.S. Department of Agriculture. Forest Service, Intermountain Forest and Range Experiment Station. 83 p.

Healy, Donna. 2005. April 10. 13 things every Montanan should know how to do [Web Page Removed].

Mackie, Richard J. 1970. Range ecology and relations of mule deer, elk, and cattle in the Missouri Breaks. Montana. Wildlife Monographs.

USDI Bureau of Land Management. 1979. Historical comparison photography: Missouri Breaks, Montana, Billings, MT. 109 p.

Scientist Profile

Theresa Jain is a Research Forester for the Forest Service, Rocky Mountain Research Station. Theresa's goal with her research is to provide alternative management strategies that address the values of society that are ecologically sound and beneficial for disturbance driven forests. Her current studies include developing fuel treatments from the site to the landscape to maintain fire adapted forest conditions. This includes adding knowledge in fire ecology, disturbance ecology, forest fuels, and forest vegetation growth and development within a given site and across landscapes.



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