2009

Reality Show: SPLATS Take a Trip from Theory to the Tahoe National Forest

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Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

Waiting for treatment or a spark. Sagehen Creek Basin, Sagehen Experimental Forest, Tahoe National Forest. Credit: Amanda Deutsch.

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Summary

Strategically Placed Landscape Treatments (SPLATS) developed by Mark Finney have successfully demonstrated their capacity to slow fire spread in computer simulations. This collaborative project combined new applications of high-tech science with local knowledge in an attempt to implement SPLATS in a real world landscape—with real world constraints. Although the SPLATS designs created for the Sagehen Creek Basin by researchers met these constraints, unforeseen complications prevented their implementation. In addition, researchers found that their technologically intensive approach is not likely to be operationally feasible for several reasons, including the limited financial and technological resources of the ranger district. Lessons learned, however, highlight the value of interdisciplinary collaboration and will help inform landscape level planning for the forests of the Sierra Nevada.

Key Findings

- Real-world SPLAT designs seemed to work as predicted. Fuel treatments that covered approximately 1/3 of Sagehen Creek Basin could be arranged in the landscape so that key aspects of the fire behavior were modified for the entire fireshed.
- There is value in examining multiple treatment plans to see which plan provides the greatest modification of fire behavior for the minimum of area treated.
- The highly detailed approach used to design SPLATS for Sagehen Creek Basin is probably not practical for management.
- The judgment of local experts is essential to obtaining models with realistic fire behavior.

Fire through a wide-angle lens

There is broad agreement that millions of acres of Sierra Nevada forests are at increasing risk for large wildfires due in part to the fuels build-up of the last century. The reality of larger, more frequent and severe fires in the region has created a shift in perspective for fire and forest managers. They're zooming out and assessing the bigger picture by taking on modification of wildfire behavior at the landscape scale.

Historically, fire behavior modification has been undertaken in relatively small pieces; at the scale of individual tree stands or small patches of forest. Although effective at reducing fire behavior within and adjacent to individual treated areas, this approach has had little protective effect across the large landscapes now threatened by contemporary wildfires.

Until very recently there has been little concrete scientific information to guide this broadened effort, but a new planning tool called *fireshed assessment* is emerging as an effective approach. Firesheds are big topographic basins similar in concept to watersheds. The idea is that fire will behave somewhat consistently within the boundaries of a given fireshed and move in an expected pattern. They range from a few hundred to many thousands of acres, identified by their common, consistent fire history, wind and vegetation patterns, and physical features.

Collaboration is the keystone of fireshed assessments, which draw on expertise and participation from every level of fire and forest science and management. The resulting wealth of information matches the scale of landscapes that managers are now charged with protecting from severe fire. But because a blanket reduction of all the fuels across an entire fireshed isn't feasible financially, operationally or ecologically—the question arises: How do we create the most effective, efficient fuel treatment program possible for a given fireshed with available resources and real-world constraints?

Wildfire traffic control

"Speed bumps," answers John Battles, Associate Professor of Forest Ecology at the University of California, Berkeley. "Patches of fuel treatments placed strategically throughout a fireshed that slow fire in the same way that speed bumps control traffic on a road. Fire hits these patches and slows down. It moves through and around the treated area, starts to speed up again and then hits another speed bump. When you place the treatments at a right angle to the major direction of fire spread you can basically re-direct it."

These strategically placed treatments known as SPLATS are the brainchild of Mark Finney, a Fire Science Researcher at the Missoula Fire Sciences Laboratory. He figured out that though we can't completely stop fires, we can strategically reduce fuels in a way that changes fire behavior across large areas. SPLATS are blocks of fuel treatments ranging from several to hundreds of acres each, placed in a way that controls the speed and intensity of fire as it moves. The pattern of placement is determined through fireshed assessments and designed to eliminate continuous pathways of untreated fuel that fire might use to race from the bottom of slopes to ridge tops. The goals are to keep fire on the ground, slow it down, and reduce its intensity so it can be modified across large landscapes.

The optimal pattern for SPLATS treatments is derived by building digital maps of how fires grow and move through a landscape. Finney's theoretical computer simulations have shown that by strategically treating as little as 30 percent of a fireshed, fire behavior can be modified throughout the entire area. This means more bang for your fuel treatment buck.

But as of 2004 no one had planned and implemented SPLATS in a real fireshed, in a real forest, with real world conditions and constraints. Along with Ph.D candidate Nicole Vaillant, Berkeley colleague Scott Stephens, and district ranger Joanne Roubique, Battles decided it was time to evaluate how this promising theory performed when applied to a real landscape—Tahoe National Forest's Sagehen Creek Basin in California's Sierra Nevada.

Collaboration nation

Sagehen Creek Basin is nestled within the Sagehen Experimental Forest in the Truckee Ranger District, where Roubique serves as district ranger. Successful SPLATS planning requires sophisticated computer power and a meeting of the minds—lots of them. It fails without collaboration. The on-the-ground experience and knowledge brought by Roubique and her staff assured that *all* the realities of Sagehen Creek Basin had a seat at the table. This productive teamwork was the hub of the project.

"This was a great opportunity to work directly with the ranger district and all the people who would ultimately be implementing the SPLATS," says Battles. "Collaboration brought in a lot more information. It was much better than us scientists going in on our own to find out all this stuff, and then having a one-day workshop where we say to managers: 'Here's how we think you should do it.' Not only was the science better because of the teamwork, but everyone's overall understanding of how fire works in the landscape was enhanced."

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Sagehen Creek Basin is the home of Sagehen Creek Field Station, which has been operated by UC-Berkeley under a special use permit since 1951. With 55 years of research history, the basin is a gold mine of historical scientific data making it exceedingly valuable as a study site. A short drive from Lake Tahoe and a hotbed for recreation, the increasingly warm, dry region is also at high risk for severe fire.

Sagehen Creek Basin is located at approximately 6,000 feet on the east slope of the northern Sierra Nevada, 20 miles north of Lake Tahoe. Credit: http://sagehen.ucnrs.org/.

"We wanted to help managers in an area where stakeholders have concerns about fire, and to inform the science of SPLATS," explains Battles. "There are lots of researchers, station managers, students, and faculty working all over the basin in very remote areas where fire risk is really high."

The idea was to combine forces and planning tools to see what could be done about the risk. The big challenge came with the use of some new techniques for obtaining meaningful data at the larger, landscape scale. Would it all be practical?

"Oftentimes we have this strategy of hope," Battles says. "We go get funding, run these projects and get answers. Then we get our papers published in academic journals and our colleagues read them. But if we haven't taken into account the realities on the ground, it's just not applicable. It doesn't have any relevance."

Tradition meets the laser

The first step in developing a SPLAT design for a specific landscape is to build proposed treatment patterns in a model: a digital version of the forest, landscape, fuel conditions and the fire that will hypothetically move through it. For this job, the researchers relied on the fire behavior simulation models FlamMap and FARSITE. But these models require continuous, full coverage data from any area being analyzed. In this case, it was the entire 8,000-acre fireshed. The new landscape level approach invited some innovation when it came to gathering minute details about large areas. So the researchers supplemented their traditional ground survey data with a high-tech tool that proved to be well suited for taking in the big picture.

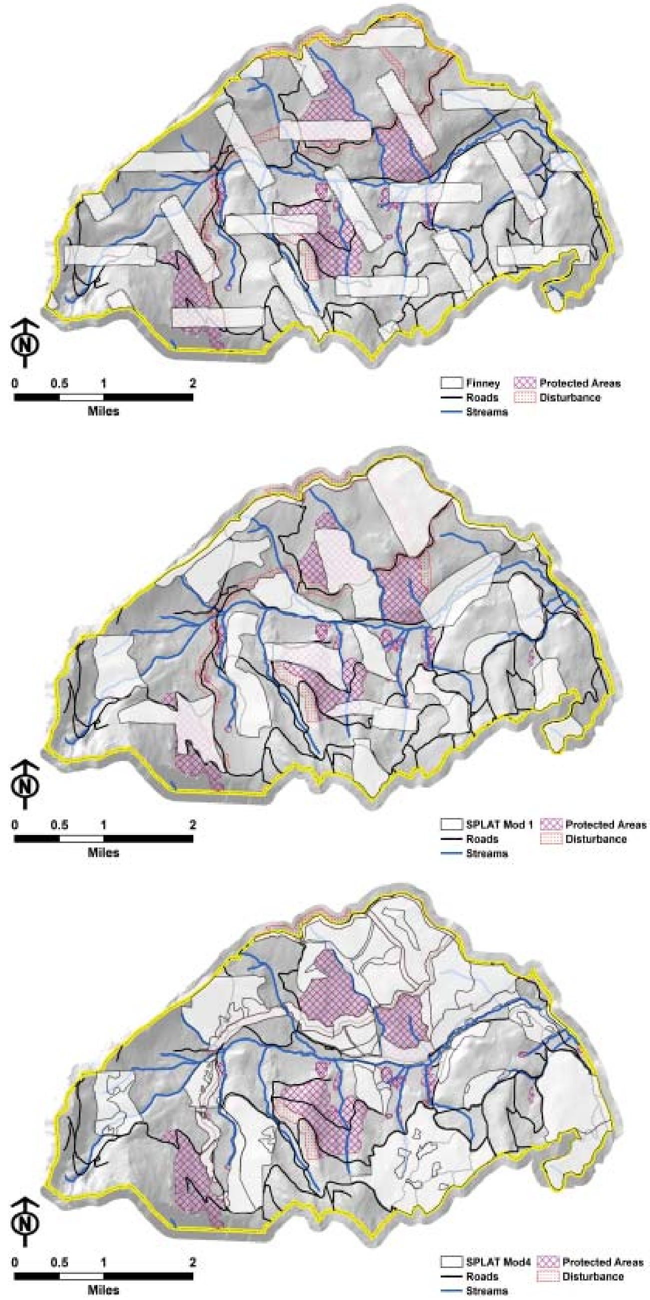
Enter LiDAR—a relatively new laser-based, remote sensing technology. LiDAR (LIght Detection and Ranging) uses plane-mounted lasers to determine the shape of the ground surface as well as natural and man-made features. It works by sending out pulses of laser light that strike the surfaces of the earth and measuring the time of pulse return. The laser scanner is mounted in the bottom of an airplane like an aerial camera, along with an airborne GPS. LiDAR generates highly-detailed, accurate, three dimensional images of the three key topographic elements that directly influence fire behavior: elevation, slope and aspect. Historically this information has been derived from topographic maps, but SPLATS planning probably requires finer detail at larger scales than these maps provide. The LiDAR technology generated the continuous high resolution detail required for the entire basin.

Because this was an early application of LiDAR to fire modeling, the team recruited David Saah from the University of San Francisco to lead the effort to incorporate the remotely sensed information. A key task was to be sure that they were really getting the accurate information they were hoping for. So the LiDAR data was tested and verified by comparing it to data from more traditional sources: good, old-fashioned, intensively surveyed plot grids of vegetation and fuels.

Local knowledge = relevance

Baseline digital models of Sagehen Creek Basin were constructed by feeding FlamMap and FARSITE with the abundant, painstakingly detailed information. The models were then used to create and test different versions of SPLAT designs. Each version allowed for input, correction and direction from the deep reserve of experience and expertise that the collaborative process brought to the project.

Sagehen Creek Basin, Tahoe National Forest. Credit: Sagehen Experimental Forest.



Three progressive SPLAT design versions reflect knowledge and experience gleaned from the collaborative process.

"We started off with the ideal SPLATS version and continually modified it to reflect input from the experts who knew how and where fire had burned in the area in the past," says Battles. "They would look at the output and say, 'Well, that doesn't make sense because we know that historically these plantations burned as active crown fire—and your model has it as a ground fire.' That's the kind of information that makes SPLATS realistic."

Truckee Ranger District staff was most concerned about a potential fire starting at Lake Tahoe, burning up over the ridge and coming down into the basin. They knew that if that happened the fire would really be roaring by the time it came over the top, so that's the scenario they simulated. SPLAT designs evolved throughout the process. Each design was evaluated based on how it changed fire behavior, and refined repeatedly to reflect reality on the ground.

Digital fires in their own back yard

In general, the SPLAT designs in the Sagehen models appeared to follow theoretical expectations. To help illustrate the impact of SPLATS on fire progress, Saah developed animations of the digital fire in motion—a process he dubbed WAKE analysis. According to Saah, the approach is "like making a little movie of what happens as the fire hits changing fuels and forest conditions. It shows how much you can affect the movement of fire across the landscape."

It's very compelling for managers to see a simulation of what fire might do in their own district—and it's a good way to judge proposed SPLAT designs against the experience of district staff who have watched fires burn there before.

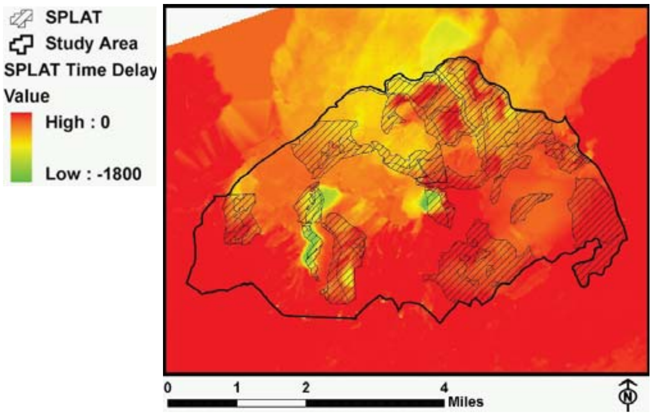
Real world detours

But along with all this relevance, reality and high-tech detail came economic, operational and ecological constraints that as of this writing have prevented the SPLATS from going in on the ground. Many of these constraints were expected and some most certainly were not. Infrastructure limitations and rough terrain challenged feasibility. Optimal treatment placement and techniques required modification to minimize disturbance of threatened and endangered species and their habitats. Treatments in sensitive riparian areas and archeological sites would have to be done with a very gentle touch if they could be done at all. Technical demands also added to the challenge. FlamMap and FARSITE depend on highly sophisticated GIS support that most local ranger districts don't have access to.

"Even though our versions of the SPLATS were able to meet the constraints," Battles says, "it ultimately might not be feasible for the ranger district for lots of reasons. They don't have unlimited resources and in the end this all has to be reasonable. The big question is—how much fire behavior reduction do I really get for what it's going to cost to go in there and treat?"

Weasel-cam road block

A recent surprise visitor added another quandary. The shocking and indisputable appearance of a wolverine, a



WAKE analysis makes it possible to view an animated simulation of the effects of SPLAT designs on the speed and direction of a hypothetical fire in a real world landscape.

Management Implications

- The specific arrangement of SPLAT treatments in terms of their size, shape, and location is important in determining the nature and magnitude of the changes in fire behavior.
- The detailed approach taken at Sagehen is not operationally practical for managers. National efforts to develop fire and fireshed assessment tools (e.g., LANDFIRE) should help provide information that is both informative and affordable for planning.
- Even in circumstances with detailed quantitative information, the judgment of local experts is essential to obtaining models with realistic fire behavior. Collaboration among expertise is key to effective fireshed assessment.

species thought to be extinct in the northern Sierra Nevada for over 30 years, brought everything to a halt. Roubique was in the middle of plotting out the final plan for the SPLATS when the animal triggered an infra-red camera meant to document the activity of martens, which are considered a sensitive species by the Forest Service.

"There it was," Battles laughs, "right on the front page of the San Francisco Chronicle. Everyone was really excited about it of course, but all of the plans for SPLATS were put on hold until they figured out whether or not there was a refugia population of wolverines in there. It eventually turned out that the animal was an itinerant individual."

Battles emphasizes however that when something unusual happens—like the sudden and extraordinary presence of a species thought to be long gone—it only adds to the importance and urgency of protecting an area from severe fire. "If this area of extreme fire risk had ended up being important habitat for wolverines—it would have been even more critical to do something to reduce that risk, because nobody wins when it comes to catastrophic fire," he says.

Intensive approach likely impractical

Battles concedes that things didn't always go as planned or as smoothly as they had hoped, but he adds that they learned a lot about what works and what doesn't. "The fact that we didn't get the SPLATS in the ground was disappointing to everybody. But who can perceive all these twists and turns? Or anticipate *wolverines*?" he says.

Towards the end of the project it became clear that their intensive research approach probably isn't a practical solution, and that it's actually possible to have *too much data*. It can reach a point of diminishing returns, burdening analysis rather than enhancing it and adding unnecessary cost.

"Operationally, this would just cost too much," Battles laments. "You have to put a plane in the air and that alone adds a lot of expense. We certainly got a tremendous amount of data for the study (Gary Roller lead field data collection)—but we had a big grant and a lot of resources. A key question is: How much better is all this than just using the baseline information data that the Forest Service uses everyday? We want to know—just how good do you need it to be in order to inform effective planning?"

But the lessons learned will certainly help inform landscape level planning for other management units in the Tahoe National Forest and other forests in the Sierra Nevada. Priorities for ongoing work include sorting out the information most critical for SPLAT design from data that might be overkill. Another priority is to improve the vital collaborative process.

"The link between scientists and managers has to get better," says Battles. "Even when you have detailed, quantitative, scientific information, the judgment of experts from *all* disciplines is essential for obtaining models with realistic fire behavior."

"Would I do it again? Absolutely," he concludes. "I'd work with any ranger district based on this experience. As scientists, we've always seen more value in basic research. But now we're realizing that in order to answer the really important questions you can't ignore the realities on the ground. The complexities of specific, real world cases certainly make it very challenging to figure out the best way to do it all."

Further Information: Publications and Web Resources

Translating SPLATs from a Theoretical to a Real World Landscape: The Implications of Fuel Management Strategies for Sagehen Creek Basin, Tahoe National Forest: http://www.firescience.gov/projects/04-2-1-84/project/04-2-1-84_final_report.pdf

Vaillant, Nicole M. 2008. Sagehen Experimental Forest Past, Present, and Future: An Evaluation of the Fireshed Assessment Process. Ph.D. Dissertation. University of California, Berkeley.

Sagehen Creek Field Station: http://sagehen.ucnrs.org

Sagehen Experimental Forest: http://www.fs.fed.us/psw/ef/sagehen/

Scientist Profiles

John Battles is a Forest Ecologist at the University of California, Berkeley. His research interest is in understanding how and why forests change. Specifically he focuses on how disturbances (e.g., pollution, fires, exotic diseases) acting alone or in concert influence the composition, structure, and dynamics of temperate forests.

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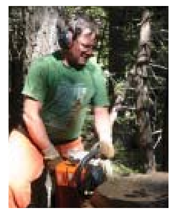

Scott Stephens is an Associate Professor of Fire Science and Co-Director of the UC Center for Fire Research and Outreach with the College of Natural Resources at University of California, Berkeley. He's interested in the interactions of wildland fire and ecosystems. This includes how prehistoric fires once interacted with ecosystems, how current wildland fires are affecting ecosystems, and how future fires, management, and climate change may change this interaction. He's also interested in wildland fire policy and how it can be improved to meet the challenges of the next decades.

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The information in this Brief is written from JFSP Project Number 04-2-1-84, which is available at www.firescience.gov.

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is published monthly.
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