8-2010

The Joint Fire Science Program's First 10 Years

Gail Wells
Gail Wells Communications

Joint Fire Science Program

Fire Science Digest

RESEARCH SUPPORTING SOUND DECISIONS

ISSUE 8 AUGUST 2010

The Joint Fire Science Program's First 10 Years

Fire scientists and managers at the 4th International Fire Ecology and Management Congress offer their thoughts about the program's accomplishments, challenges, and future direction

Introduction

Ten years ago Congress created a multiagency research and development partnership called the Joint Fire Science Program (JFSP) in response to an urgent need for science-based strategies to address fire, in all its aspects, on the nation's public lands. The new JFSP organization was directed to support land managers with credible research, develop new lines of research targeted at managers' needs, and communicate findings clearly and thoroughly. The JFSP was designed to be a single, cross-agency, "go-to" organization with the mission of streamlining the creation, synthesis, and delivery of fire science in today's changing ecological and social environment. The JFSP's competitive, peer-reviewed grant process supports projects that complement and build on other federal research.

In November and December 2009, about 650 fire scientists and managers gathered at a symposium in Savannah, GA, part of the 4th International Fire Ecology and Management Congress, to sum up the state of fire research and management after a decade of JFSP-funded science. In a series of postsymposium interviews, the Digest asked some of the participants to share their thoughts about the JFSP's role in the fire-science arena. What have been its key contributions to the body of knowledge? How have these findings changed fire science and management practices? What remains to be done?

"…when you're dealing with large-scale issues like climate change, the people who can work across disciplines are the ones who'll be making our next breakthroughs." — David Peterson


David Peterson

David Peterson has been involved with the JFSP since the very beginning; he was part of the advisory group that developed its mission and structure. A fire ecologist and climate scientist, Peterson leads the USDA Forest Service's Seattle-based Fire and Environmental Research Applications team.

The FERA team has received several competitive awards from the JFSP to conduct research on fire history, fire ecology, and characterization of fuels. Their findings are distilled into databases, software, and other tools for managers. For example, a series of JFSP-funded research projects led by Roger Ottmar, a research forester on Peterson's team, resulted in a set of illustrated guides to wildland fuels (JFSP projects 98-1-1-05, 01-1-7-02, 03-3-3-46, and 06-1-1-11). The guides feature photographs of fuels in different landscapes at different successional stages, along with data describing the condition of the fuels. They are designed to help a fuels manager accurately assess conditions in the field without having to do extensive calculations. One of the guides contains photographs that are mounted stereoscopically and includes a pair of 3-D glasses for viewing them. The images and data are also available on FERA's Web site (***http://www.fs.fed.us/pnw/fera/***).

In a current JFSP-funded project, Peterson and his team are incorporating the Fuel Characteristic Classification System (FCCS) with other fire and fuels management tools in the Interagency Fuel Treatment Decision Support System (IFT-DSS), a recent JFSP initiative. "This new system is the future of fuels management," Peterson says. "It will give users a wide range of choices and combinations of different tools, all in one framework."

Peterson's presentation in Savannah was about managing fire regimes in a changing climate. "Climate change was probably the biggest topic there," he says. "I've been doing climate-change research for over 20 years, but it wasn't much on the radar when the JFSP came into being."

He also noted that social-science findings were prominently featured at the Savannah symposium. That is a good sign, he says, but the social sciences need to be integrated even more effectively with the biological and physical sciences in both research and practice. "Integration is critical, and it doesn't happen

easily, because scientists' training is disciplinary," says Peterson. "Yet most of our problems are social and political, not biological. Especially when you're dealing with large-scale issues like climate change, the people who can work across disciplines are the ones who'll be making our next breakthroughs."

Peterson would also like to see more research emphasis on the fire dynamics of grasslands and nontimbered woodlands, which can be important habitat for threatened and endangered species. There is also a need, he says, for more work on the interactions of multiple disturbances such as fire, insects, pathogens, invasive species, and wind.

Peterson and his team remain involved with the JFSP by reviewing funding proposals and by advising the governing board on research directions. The JFSP's mission-focused approach, he says, makes it distinctive in the world of funding agencies. "It's focused, it's relevant, and it's got money behind it. These three things have been critical in helping the JFSP succeed."

"If the risk is high, and if your neighbor's actions affect your own risk, then people regard laws such as defensible-space ordinances as a reasonable way to protect public safety." — Sarah McCaffrey

Sarah McCaffrey agrees with Peterson that social science needs to be better integrated with the other fire sciences, especially at the beginning of a research effort, when the questions are being developed. "Joint Fire Science [Program] is working on that, and it's great," she says.


Sarah McCaffrey

At the symposium, McCaffrey, a research social scientist with the Forest Service's Northern Research Station, summarized social-science findings from the past decade, including those from her study comparing mandatory and voluntary measures for getting landowners to create defensible space around their homes (project 05-3-2-05).

A common perception is that ordinances are unpopular, "but we found that they weren't uniformly rejected," she says. "In the places that had ordinances, people were not upset, and they were more informed and proactive" than residents of communities where only voluntary measures were in place.

As in most questions of social acceptability, context is crucial. "If the risk is high, and if your neighbor's actions affect your own risk, then people regard laws such as defensible-space ordinances as a reasonable way to protect public safety," McCaffrey says.

Without research into the social dimensions of fire management, it would be easy for a manager to assume that public opinion is monolithic and intractable. By illuminating the "it-depends" character of people's motives, such research makes more options available to managers.

Take smoke, for example. McCaffrey says, "You hear managers say, 'The public is never going to accept smoke [from prescribed fires].' But research shows that the major issue with smoke is health, and health is an issue with about one-third of households." If the smoke hazard can somehow be mitigated for the people who are most at risk, then a prescribed fire is more likely to go forward.

The JFSP is working hard on integrating the social dimensions of land management into its research. McCaffrey and another social scientist were recently invited to a meeting of a JFSP-supported team developing fuels treatments. "When some of them started going down tracks like, 'We need to *make* the public understand why fuel treatments are a good idea.' we were there to say, 'Well, most people probably know that already, so maybe we should seek some other explanation if they seem to be resisting.' By having us there, the researchers could be sure they weren't proceeding on assumptions that weren't true."

McCaffrey has also been studying how people respond to fire management while a wildfire is burning. Her interest is prompted by Australia's evolving "stay-and-defend" policy and anecdotal evidence that more Americans are choosing to stay put when a fire strikes. "I was interested in understanding how their approach actually worked and whether there were major differences that would make such an approach more or less appropriate in the U.S." Here again, McCaffrey points out, it's important to probe common assumptions (such as the assumption that Australia's geographical and cultural differences make it a poor policy model for the U.S.) with rigorous social science. She would like to see the JFSP continue to broaden its support for this and other social-science questions.

"These studies are about more than just reducing fuels and altering fire behavior—they're looking at the whole web of things that go on [in a fire-prone landscape]."
— Jan van Wagtendonk

For **Jan van Wagtendonk**, the JFSP's key contribution is its support of longer-term ecological research. Van Wagtendonk is a fire ecologist, research forester emeritus with the U.S. Geological Survey, and member of the team that wrote the JFSP's first charter. His presentation in Savannah highlighted four such studies he's conducted with JFSP support.

One project examined the relationships among fire, truffles, mammals, and owls (project 01B-3-3-05). The others dealt with bark beetles (project 06-2-1-20), black-backed woodpeckers (project 06-3-4-15), and inference of fire history in a chaparral-covered landscape from fire scars in big-cone Douglas-fir trees (project 06-3-1-07).

"That one was particularly interesting," says van Wagtendonk, "because it looked at how fires recorded by one species can give us information about a different species." Big-cone Douglas-firs occur in islands amid landscapes dominated by chaparral. Because chaparral burns so frequently and thoroughly, fires sweeping through leave little evidence on the land. If big-cone Douglas-firs are present, their tissues collect a record of the timing, frequency, and intensity of past fires.

Van Wagtendonk mentioned these studies as examples of the sort of broad ecological research that the JFSP should be emphasizing more, in his opinion. "These studies are about more than just reducing fuels and altering fire behavior—they're looking at the whole web of things that go on [in a fire-prone landscape]."

The JFSP's primary mission is to provide managers with practical information on managing fire and making forests more fire-resilient. When the JFSP was begun, such information was urgently needed, but, says van Wagtendonk, it meant that broader ecological research took a back seat.

Two years ago, the JFSP's governing board added an initiative to fund new work in fire ecology, allowing scientists to propose their own study topics. That opened the door to research that went beyond short-term, limited-scope studies on fire and fuel-treatment effects. Van Wagtendonk says, "From that we got interesting studies on fire, carbon, climate change and fire severity, and reconstructing historical fire regimes."

It's important to continue such work, says van Wagtendonk, because successful management strategies need to be grounded in a sound ecological understanding. For example, van Wagtendonk believes that more long-term study of carbon sequestration is needed. "The simple assumption is that the more carbon retained on the land, the better. But is that sustainable in the long run? Might we be better off reintroducing fire and taking some of that carbon off, to keep the whole thing from burning down?"

Another area that needs more study is the ecological role played by smoke. "For example, smoke could affect the ratio between fungi and bacteria, which affects pH, which affects growth response. These systems evolved with smoke in them. If we take the smoke out, what effects will it have?" Other areas to target are analysis of historical fire regimes, effects of climate change on current fire regimes, and understanding of fire severity in terms of its effects on a given ecosystem (as distinct from a simple assessment of how much biomass is removed). "A 'severe' fire in Douglas-fir has very different ecological effects from a 'severe' fire in chaparral," says van Wagtendonk. "We need more work on this."

Jan van Wagtendonk

A mixed conifer forest in Yosemite National Park has been burned twice as part of the park's wilderness fire program.

"The heavy lifting needed to develop fire-effects prediction models that form the foundation of land-management software systems has lagged."
— Matthew Dickinson

As a way to better understand the complex and long-term effects of fire, **Matthew Dickinson** wants to see more research that links fire behavior with more direct, first-order fire effects such as fuel consumption, soil heating, and injury and mortality of trees and other plants. Understanding these effects, he says, is essential to predicting long-term responses of ecosystems to fires.

"The heavy lifting needed to develop fire-effects prediction models that form the foundation of land-management software systems has lagged," says Dickinson, a research ecologist with the Forest Service's Northern Research Station. "Applying these models [in the future] will require databases that either don't exist now or are inadequate."

On the whole, he says, a lot of progress has been made in the past decade. Models have become better at predicting these first-order effects as well as second-order effects such as erosion and changes in long-term forest dynamics. Likewise, there have been important improvements in the suite of software tools that use these models.

In particular, the IFT-DSS fuels-treatment support system is "a great advance," Dickinson says. "It bundles a number of models into one software system; it's one-stop shopping for the models that give you fire effects and other predictions. We're also looking toward including fire effects in the Wildland Fire Decision Support System [WFDSS] to support incident-management teams as they implement the new national fire policy."

However, Dickinson feels that the models that power systems like IFT-DSS are still hampered by inadequate understanding about how fires cause their effects. Consequently, the predictive capability of these models remains weak. For example, although duff consumption is often a driving force in soil erosion and tree mortality, there are no operational duff moisture and smoldering models.

Another example is the incomplete understanding of how fires, particularly intense ones, affect soils. Recent measurements showed a substantial flow of heated air into soils below a pile burn. The hypothesis, Dickinson says, is that pressure gradients caused by the combustion process drive the flow of air through soils. "Does this explain why soil heating is sometimes underpredicted by current models, even for fires less intense than pile burns?"

In addition, current predictions of tree mortality are made with relatively simple models that may become less useful as climate, insect populations, and stand conditions change. As an example of how little is known, Dickinson says, heat from a fire may seem to be the obvious cause of "crown scorch," but initial modeling and measurements suggest that a desiccating smoke plume may be more damaging and may have different effects in different tree species.

"I've given three examples, but I could go on all day illustrating the depth of our ignorance," Dickinson told symposium participants. "We need support for models and databases that are the foundation of software systems."

Matthew Dickinson helps with a January 2010 prescribed fire in longleaf pine-sandhill habitat at Eglin Air Force Base in Florida. Heat released by the fire was mapped by an airborne infrared camera calibrated by single-pixel infrared sensors mounted on 20-foot towers within the fire. Fuel consumption estimated from maps of total heat release will be compared with predictions from the model CONSUME.

"[Students] need experience and training in on-the-job skills, things that agencies do well. They also need education, which is what universities do best. Keeping these partnerships going is the best way to prepare fire professionals for the complex jobs they'll face in the future."
— Penelope Morgan

For **Penelope Morgan** of the University of Idaho's Department of Forest Ecology and Biogeosciences, one of the JFSP's most valuable contributions is the research partnerships it

has fostered among university and agency scientists. She credits the JFSP's competitive awards program, which makes research dollars available to both agency and university scientists, for the effectiveness of these collaborations. "The JFSP has supported research on a great breadth of topics and a diversity of ecosystems and geographic areas," she says. "As a result, many universities have expanded their fire programs in the last 10 years, and this has increased the capacity for innovative fire research."

These partnerships, which have involved more than 90 colleges and universities, have the added benefit of helping both undergraduate and graduate students become educated in fire science and management. In addition, Morgan says, JFSP-funded research has been incorporated into many academic courses, reaching students in more than 36 states. "That's innovative technology transfer, and it's an underappreciated impact of the JFSP," says Morgan. "The JFSP should do more to highlight the many ways they're contributing to the preparation of future fire professionals."

University of Idaho photo

Francisco Castro Rego, a Portuguese fire researcher who developed and taught a fire-behavior course, instructs students in the Geospatial Research and Teaching Lab at the University of Idaho.

Heather Heward and Gabriel Cortez

Heather Heward, Cody Fox, and Gabriel Cortez, students in fire ecology and management at the University of Idaho, participate in prescribed-fire training in Van Buren, MO, with The Nature Conservancy.

Morgan and JFSP communications director Tim Swedberg recently asked JFSP-funded university scientists how many students they'd involved in their research and what those students were doing now. The 82 principal investigators who responded (about 20 percent of those asked) reported that 589 students have been supported by JFSP funding and that 116 of them had received master's or doctoral degrees. Many of these students (33 percent of those with master's and 22 percent of those with doctoral degrees) subsequently went to work for federal or state agencies. Many others are in university programs doing research and helping to educate future fire professionals.

These professionals, says Morgan, constitute the core of the future generation of fire scientists and managers. She'd like to see the JFSP do even more to support them, perhaps funding student travel to other scientists' labs or to scientific conferences, funding applied undergraduate research, or directly supporting graduate-student research. "A small investment could make a large difference for these students."

The JFSP's support, she says, has encouraged agencies and universities to work together to give future fire professionals a full and rich learning environment. "They need experience and training in on-the-job skills, things that agencies do well. They also need education, which is what universities do best. Keeping these partnerships going is the best way to prepare fire professionals for the complex jobs they'll face in the future."

"These [software] packages are easy to use, so people who don't have a background in fire science apply the models with no way to verify their inferences." — Philip Omi

For **Philip Omi**, a key JFSP accomplishment has been to focus attention on the whole body of fuels-treatment research so that scientists could begin to see where the gaps were. "Before the JFSP, most of the research in this subject area was pretty helter-skelter," he says. "It was an afterthought to the research agendas of the Forest Service experiment stations and universities. We now have a much broader research infrastructure, with more subject areas and more investigators."

Omi, professor emeritus of forest fire science at Colorado State University, now teaches technical fire management classes to practitioners via Humboldt

State University. Recently, at the behest of the JFSP, he and colleagues have been holding workshops for scientists and managers, asking them to discuss what they see as the top fuel-treatment research priorities for the next 3 to 5 years. He circulated a survey at the Savannah symposium asking participants to offer their thoughts; the responses informed Omi's subsequent workshops in Charlotte and Tucson.

A consensus is emerging, says Omi, that more work needs to be done in three areas: the effectiveness of fuel treatments in reducing fire hazards, ecological effects of fuel treatments, and improvements to the accuracy and precision of fire-behavior and fire-effects models.

Initially, he says, the effectiveness of fuel treatments was assessed primarily in terms of how much they facilitated putting out a subsequent fire. In other words, reduction in future fire severity was a key measuring stick (because lower severity fires were expected to be easier to suppress). More recently, however, managers have also been concerned about how, and how much, fuel treatments affect future combustion environments and ecological conditions. "With contributions from other disciplines, notably the ecology and fire-effects communities, JFSP projects have shown that fuel treatments need to be evaluated in the context of broader ecological concerns," says Omi.

Studying the effectiveness of fuel treatments leads to the second area of need: gaining a better understanding of the ecological effects of treatments, especially in light of emerging issues like climate change and carbon sequestration. Like Dickinson, Omi is concerned that current predictive tools suffer from inadequate modeling of basic ecological processes. More ecological research is needed to power these decision-support tools and make them as useful as they need to be.

The third area concerns the accuracy of the models being used to predict fire behavior and effects. "There are some basic gaps in our understanding of the combustion of forest fuels in the presence of different types of fuel and moisture levels, with and without treatment," says Omi. The problem is exacerbated, ironically, by software that's become more user-friendly: "These packages are easy to use, so people who don't have a background in fire science apply the models with no way to verify their inferences."

Omi would like to see more real-time research on living fires—either prescribed burns or future wildfires as they occur—by scientist-manager-modeler teams for the purpose of collecting measurements to inform the next generation of fire models. "Modeling is about theoretical relationships among physical and ecological processes," Omi says. "Many of these relationships have been established in the laboratory or through computer simulations. But I know modelers who would welcome the opportunity to design experiments in anticipation of data collection on future wild or prescribed fires. I think the JFSP could provide incentives for these kinds of collaborations."

Annie Brown

Philip Omi collects sample materials for comparing live-fuel moisture estimation techniques in big sagebrush (*Artemisia tridentata* spp.) in northwestern Utah (project 05-2-1-70).

"If our goal is to help managers make particular decisions, I suggest we step back and take another look at how much detail they really need."
— Carol Miller

The JFSP has spent the past decade providing solid scientific footing for calculating the risks and benefits of fire. It has also supported ever-improving links between modeling and software tools. These elements, says **Carol Miller**, are essential to the quantitative, landscape-scale, risk-assessment frameworks that are being refined today. Such frameworks are making it possible to calculate ever more precisely the potential effects of fire, both prescribed and natural, on many of a landscape's

attributes at a range of time scales, from prefire planning to fire management to long-term postfire management.

Miller is a research ecologist with the Forest Service's Aldo Leopold Wilderness Research Institute in Missoula, MT. At the Savannah symposium she talked about risk-assessment and decision-support tools, giving as an example a quantitative risk-analysis framework being developed by Forest Service researcher Alan Ager (projects 06-4-1-04 and 03-4-1-04). "Not only does the framework help managers assess the risks of fire to multiple values," says Miller, "it also acknowledges that not all fire effects are bad. So it can support the manager's evaluation of both benefits and risks of fire."

More and more, managers need to make decisions about really complex systems. "It's logical that, to deal with all this complexity, we're building more and more complicated models that demand finer scale and more accurate data," Miller says. Yet increasing power and precision can be a mixed blessing. "Using all these different models and linking them together in a significant way—that requires some high-level skills. We can train people up, but it's not a given that every land management unit is going to have a resident expert."

Moreover, some of these models may have more horsepower than the average manager needs. "I think this is something the JFSP will want to look at in the future," Miller says. "If our goal is to help managers make particular decisions, I suggest we step back and take another look at how much detail they really need. According to Miller, some of these decisions are pretty broad-brush, and many are made with the goal of allaying (very real and valid) political or social concerns. "Often the output from our models tells the manager what he or she knows already," says Miller. "It helps justify the decision they already know they should make." Therefore it may not be worth the time and effort required to fully optimize every model.

That said, Miller believes more work is needed in assessing short- vs. long-term costs and benefits of both fire and management. For example, she says, there is still no satisfactory way to "grow" fuels data or model other ecosystem processes that happen over time in the absence of fire or management. And modelers are still struggling with calculating benefits and losses to things that don't have a market price. "How do we come up with a loss-benefit function for owl habitat, for example? We still have a lot of work to do in this area."

"What happens after the fire is out until the next fire occurs—that's the piece I work with, and I don't think we're paying enough attention to it."
— Pete Robichaud

Of all the JFSP's many accomplishments, **Pete Robichaud** most appreciates its support of what he calls "rapid response research." By that he means funding that equips a researcher like himself, interested in postfire phenomena, to prepare a study ahead of time and then be ready to jump when a suitable fire occurs. Robichaud is a research engineer with the Air, Water, and Aquatic Environments Science Program of the Forest Service's Rocky Mountain

What the Managers Say: We Like It

The JFSP's chief clients are land managers. They're the ones who need science-based strategies for managing fire and fuels, and they are pretty happy with what the JFSP has provided so far.

"I'm a believer and a fan," says Pete Lahm of the Forest Service's Fire and Aviation Management Program. "The JFSP's long-term and consistent investment in fire science and applications research has produced a host of operational tools for prescribed-fire management, wildfire response, decision support, and smoke management, as well as improved knowledge of basic fire ecology. Their work on fire and fuel-treatment effects is slowly but surely helping us understand the role of fire in carbon cycling, greenhouse-gas emissions, and the tradeoffs of different treatments with respect to climate change."

Robin Wills, Pacific West regional fire ecologist for the National Park Service, agrees. "You can see their [JFSP products] impact in a whole variety of ways. The science has helped inform management—such as the way we apply prescribed fire and mechanical fuels treatments—and has helped make it more strategic." The JFSP's synthesis work also has had a large impact, helping people in the field become familiar with the research without having to wade through hundreds of scientific papers, he says. "I'm a long-time user of products from the JFSP, and I'm a promoter. Their impact has been pervasive in the fire-management community."

Research Station. He works closely with Burned Area Emergency Response (BAER) teams across multiple agencies.

Most other funding agencies, he says, won't consider a proposal unless the researcher can name a specific fire he or she wants to study. According to Robichaud, you then have to recruit colleagues and get people on board and trained, and by the time the team is ready to go, the embers are long cold. "With fire studies you don't have that kind of time. So, the mechanism to have funds available when a fire occurs—to me that's the biggest success of the JFSP."

Thanks to this support, scientists have a much better understanding of what happens to a landscape after a fire. "We've advanced our knowledge of fire science tenfold over the past 10 years," he says. "We've made tremendous improvements in remote-sensing technology for mapping soil burn severity after a fire. We've developed a postfire erosion prediction model, the first of its kind in the world designed specifically for the postfire environment" (project 07-2-2-10).

JFSP-funded studies have also produced better ways to slow erosion after a fire, says Robichaud. For example, in the mid-1990s, it was thought that placing logs on the contour of a burned hillside would effectively trap the sediment flushed downhill by a rainstorm. This seemed reasonable but, Robichaud says, "when we did the research, we found it wasn't effective at all for moderate-sized or bigger storms."

Pete Robichaud gives a minidisk demonstration in Victoria, Australia.

Robichaud and his colleagues tried different erosion-catching strategies on many burned hillsides, finally showing that a mulch of shredded wood or some other plant material like straw reduced erosion better than log barriers. "The whole [postfire treatment] community has changed its practices as a result of JFSP-funded research."

In fact, Robichaud says, the JFSP's success has stiffened competition for research dollars. The program has attracted attention from scientists, especially at universities, who might not otherwise be drawn to fire-science research. The result, Robichaud says, is that "all of a sudden the competition for these dollars has really gone up." (The JFSP funds about 20 percent of the research proposals it receives, and university scientists must be teamed with agency scientists to be eligible for JFSP funding.)

Robichaud is concerned that long-term research on postfire dynamics, in particular, may be edged out by more immediate management needs. "What happens after the fire is out until the next fire occurs—that's the piece I work with, and I don't think we're paying enough attention to it," he says. "We need to be sure we have the knowledge to make long-term post-fire management work, both practically and ecologically."

"There's been nothing like [JFSP] before. It's made huge progress on many fronts: modeling, atmospherics, fire effects, landscapes, understanding wildfire. I don't see a lot of gaping holes in its research program."
— Jim McIver

Jim McIver's work on the ecological effects of fuel-reduction treatments is deepening the understanding of postfire and posttreatment dynamics. McIver is a scientist at Oregon State University's Eastern Oregon Agricultural Research Center in Union, OR. His Savannah presentation covered the national Fire and Fire Surrogate (FFS) study, on the ecological effects of fuel-reduction treatments (project 99-S-01). He and his colleagues did not investigate the efficacy of alternative fuel treatments—that is, how well they reduced the likelihood of severe fire—but rather the effects of these treatments on the larger ecosystem.

Jim McIver teaches a lesson on spiders to a fifth-grade class. Here he helps a student install a pitfall trap.

"These are the second-order effects, measured out 2, 3, 4, or 5 years later," says McIver. "If we make the fuel bed and stand structure less risky from a wildfire perspective, what else is happening in the system that might worry us? Will some species go away? Will we increase invasive weeds? Will we increase problems with bark beetles or soil fungi or mistletoe? We're looking for unintended consequences."

The FFS study, begun in April 2000, has yielded a lot of information—more than 100 peer-reviewed articles have been written so far (***http://www.fs.fed.us/ffs/***; click on the FRAMES address to access the site). To summarize very broadly, the researchers found that short-term effects of alternative fuel treatments are mostly subtle and transient. They also found that, while mechanical treatments can mimic fire in its effects on structural patterns, it is not a fire surrogate from an ecological standpoint because its effects on other aspects of a forest, like patchiness, invasive plants, and soils, are very different from those of fire. Finally, the researchers found that it usually takes repeated mechanical or fire treatments, or both, to return ecosystems to the way they were before the fuels built up.

"The JFSP has been extremely important to fire science in the U.S.," says McIver. "There's been nothing like it before. It's made huge progress on many fronts: modeling, atmospherics, fire effects, landscapes, understanding wildfire. I don't see a lot of gaping holes in its research program."

That said, McIver is concerned that the JFSP's commitment to long-term science may be getting eroded by the urgency of short-term management needs—the same concern expressed by Pete Robichaud. "I sense that the program has become more focused on addressing immediate management questions," he says, "rather than supporting research that builds a more comprehensive knowledge base."

"…we're coming to the point where we've picked that low-hanging fruit. The questions that are coming on now, such as ozone, will require a longer term investment in fundamental research." — Scott Goodrick

There was a time, says **Scott Goodrick**, when a manager planning a prescribed fire would lay a ruler on a map, draw a set of lines, and say, "I think the smoke will go right about *here*." Today, thanks to a host of tools developed with JFSP support,

Fire and Fruitcake: A Rich Analogy

Fire managers might sometimes regard the research in their field as a headache (if it's hard to figure out), or a snowflake (if it's inconsequential), or even an earthquake (if it alters the scientific landscape). But a fruitcake?

Dan Olsen, fire director for the Forest Service's Southern Region, drew smiles from Savannah participants when he likened the components of the forest landscape to those mysterious, vividly colored chunks of biomass in your Christmas fruitcake, held together in a matrix of butter and flour transformed by the oven's alchemy.

Driving up to Savannah for the symposium, Olsen spotted a billboard advertising Old Fashion Claxton Fruit Cake ("World Famous"), made in the south Georgia town of Claxton (***http://www.claxtonfruitcake.com/***). The similarity with fire management struck him like one of Claxton's luscious 2-pound loaves hurled at the head.

"Nobody really knows what's in a fruitcake," he told the participants in his talk.

"We know there are dates and nuts and raisins and flour, but nobody knows the whole recipe. The JFSP helps us get a better understanding of what's in that fruitcake by investigating and reporting what those components of the landscape are and how they relate to one another."

The "baking" of the "fruitcake" is analogous to the use of natural and prescribed fire in a forest, he said. "A fruitcake can be many things—an appetizer, a main dish, a dessert. It can be a doorstop, a hammer, a building block. It has many uses, and so does fire."

Olsen concedes that his analogy has a few crumbly edges. But the main point is as solid as, well, a fruitcake: today, thanks to the JFSP, people who've learned to manage fire by seat-of-the-pants experience can draw on a wealth of research describing how a forest landscape is put together and how it functions.

In other words, it's fine to bake a fruitcake the way Grandma used to—a pinch of this and a pint of that—but knowing several good recipes improves your odds.

"I think we've become fairly good bakers," Olsen says. "The JFSP helps us fine-tune our plans—our recipes—by helping us understand the effects fire has on the landscape. Their research helps us write down those recipes we've learned over time."

it's possible to predict how much smoke there will be, where it will flow from one hour to the next, how much particulate matter it will carry, and how long it will hang around.

"These tools have dramatically increased managers' ability to fine-tune their predictions," says Goodrick, research meteorologist with the Forest Service's Southern Research Station laboratory in Athens, GA. That increased power has come at a price, however: it's made decisionmaking much more complicated and data-intensive. "The level of expertise managers need to accomplish their job has grown dramatically. There are so many tools out there, and they don't always know how to assess which ones are best for their purposes."

Goodrick is one of several nationwide investigators contributing to a project called the Smoke and Emissions Model Intercomparison Project, or SEMIP (project 08-1-6-10). He and his colleagues are testing the performance of 22 smoke-modeling packages in different regions under different circumstances. The resulting case studies will allow a manager to assess the pros and cons of each package for doing a particular task. The project is led by Narasimhan K. (Sim) Larkin of the Forest Service's Pacific Northwest Research Station. Larkin is the lead developer of BlueSky, a widely used smoke-modeling package that was developed with JFSP support.


Scott Goodrick

Managing smoke is one of the trickier tasks facing fire professionals, says Goodrick, partly because people's concerns about smoke vary so much from one part of the country to another. "In the West, regional haze is one of the biggest issues," he says. "How much does the smoke impact the visibility of those grand vistas? But here in the Southeast, with its denser road network and a population that's more integrated into the wildland, the issue is how much smoke is going to go across a road or into somebody's home?"

In addition, burning contributes to ozone levels in the lower atmosphere. Ozone is a worrisome air pollutant that's coming under ever-greater federal regulation. It is a common and widespread component of dirty air, and it can be a severe respiratory hazard.

The amount of ozone contributed by a wildfire or prescribed fire varies according to type of fuel, moisture content of the fuel, and conditions of

burning. "Ozone is probably our biggest problem on the horizon, as some groups look to restrict prescribed burning because of changes in EPA ozone standards," Goodrick says. "There's a growing need for more information about how different fuel types burn under different conditions and how that influences ozone concentrations downwind."

Goodrick believes the JFSP should support more of this sort of basic research. "Their task so far has been to get tools quickly into managers' hands," he says. "But we're coming to the point where we've picked that low-hanging fruit. The questions that are coming on now, such as ozone, will require a longer term investment in fundamental research. You have to have that basic research to feed the applied research that feeds the next generation of management tools."

Summary

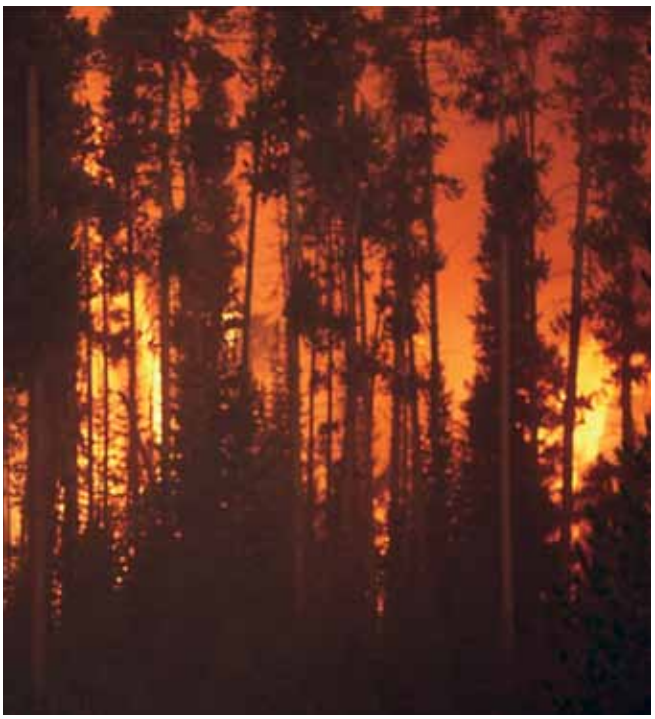
The scientists and managers who attended the Savannah symposium generally agree that the JFSP's practical, mission-oriented approach has served its clients well. "It's a big challenge trying to come up with an applied mission when dealing with [scientists] who have a longer track record in more basic research," says forest ecologist Jim Agee, who wrapped up the symposium with a short summary of presentations and panel discussions (see sidebar). "Making sure they have products that managers can use has been one of their strong points."

The JFSP's key strengths are its support for a wide range of fire-science studies, its competitive grants program, its balance between fundamental and applied research, its responsiveness to managers' needs and concerns, and its effective communication of research findings. These strengths need to be sustained and nurtured into the next decade, say participants. The JFSP's collaborative style also won praise—more than 200 organizations have partnered in JFSP-sponsored research.

Participants also generally approved of the JFSP's new idea of regional consortia—voluntary, informal associations of scientists and managers who meet regularly and discuss emerging issues. And they liked the JFSP's recent practice of funding some scientist-generated research topics as a way to encourage new thinking.

In discussions of the challenges facing the JFSP in its next 10 years, several common concerns emerged. The JFSP does not necessarily have the responsibility or the capacity to address all of them, but these challenges will shape the environment for fire research and management over the coming decade. They are:

- A growing need for **more basic ecological science** to support the next generation of decision-support



Climate change will alter the potential of western forests to sequester atmospheric carbon. Vegetation communities will contribute to the Earth's carbon cycling in different ways in the future because of altered sensitivities to future climate and fire combinations.

Agee's Wrap-up: The JFSP Is a Success, and Challenges Lie Ahead

James Agee, emeritus forestry professor at the University of Washington, had the difficult task of closing the symposium with a 20-minute summary of the proceedings.

Participants agreed, he said, that the JFSP has closed its first decade with honor—funding a good mix of projects across several disciplines, keeping a steady focus on its practical mission, supporting new science in the form of nontargeted requests for proposal, synthesizing findings of large bodies of research, and calling together regional consortia to help facilitate transfer of findings into managers' hands.

And, of course, challenges lie ahead, Agee said. They include:

- Rethinking the concept of "historic range of variability" as a changing climate complicates the understanding of historical patterns.
- Exploring the remaining uncertainty about long-term effects of fuels treatments, wildfire, and postwildfire rehabilitation.
- Understanding and communicating the policy implications of carbon storage in the nation's forests.
- Expanding research into the effects and effectiveness of different fuel-treatment strategies.
- Improving decision-support software tools by beefing up the physical and ecological modeling that underpins them, especially in the realm of fire behavior.
- Better incorporating social-science research on how people and communities deal with their fire risk and how they respond to fire management.
- Reducing the uncertainty of predicting smoke emissions.

"The JFSP has been a success," Agee concluded, "in part due to the many people attending or speaking at this symposium. I anticipate continuation of this success—and hopefully expansion—over the next decade."

Wendy Agee

Jim Agee stands next to a foxtail pine on South China Mountain in the Trinity Alps of northern California.

tools. The current crop of models can't be refined much further without a better understanding of fire behavior, biophysical effects of fire, historical fire regimes, short- and long-term ecological effects of fire and fuel treatments, and smoke emissions.

- A better understanding of both the **effectiveness and the long-term effects of fuel treatments and postwildfire rehabilitation strategies**.

- More attention to **climate change**—in particular, how a changing climate affects high- and mixed-severity fire regimes and how climate interacts with fire and other stress factors such as insects and invasive species.

- More research on **carbon sequestration**, a topic that was barely on the fire-science agenda when the JFSP got started and now is potentially "a gigantic new tail wagging the dog," in Jim Agee's words. Better understanding is needed of long-term carbon flows and of effective ways to sequester carbon in disparate landscapes.

- More research on **fire in nonforested landscapes** such as shrublands and nontimber woodlands.

- **Greater recognition of the social-science contribution** to understanding of public and community responses to wildfire-preparedness and fuel-management policies, and **better integration** of the social sciences with the other fire sciences. Also needed are better ways to calculate the worth of **landscape qualities that don't have a market value**.

- **Continuing improvement in decision-support tools**—the IFT-DSS project is a big step in the right direction.

Christina Kang

Samantha Arneberg works on a fuels reduction project at the Landmark Ranger Station in Cascade, ID. Arneberg graduated from the University of Idaho in 2009 with a double major in fire ecology and management and forest resources.

Symposium Presentations

Ten Years of JFSP Investments: A Historical Perspective. Susan Conard, USDA Forest Service (ret.).

Ten Years of Progress in Fire Science and Application: What Have We Learned? Jim Douglas, Bureau of Land Management.

Ten Years of Progress in Fire Science and Application: A University View. Penelope Morgan, University of Idaho.

Fire Ecology: What Have We Learned and What Do We Need to Know? Jan van Wagtendonk, U.S. Geological Survey (emeritus).

Joint Fire Science Program Fire Effects Research and Application: Overview, Impact, and Proposals for the Future. Matthew Dickinson, USDA Forest Service.

The Science of Wildland Fuel Treatments: Retrospectives and Future Outlook. Philip Omi, Colorado State University (emeritus).

The National Fire and Fire Surrogate Study: Lessons Learned from an Organized Multi-site Research Project. James McIver, Oregon State University and Thomas Waldrop, USDA Forest Service.

Implications and Insights from Fire History Research in the United States. Tom Swetnam, University of Arizona.

Understanding and Managing Fire Regimes in a Changing Climate. Dave Peterson, USDA Forest Service.

BAER Soil: Changes in Post-fire Erosion Mitigation. Pete Robichaud, USDA Forest Service.

Systematic Review of Post-wildfire Grass Seeding Effectiveness. Jan Beyers, USDA Forest Service and Donna Peppin, Northern Arizona University.

Public Views of Fire Management from Prescribed Fire to Suppression. Sarah McCaffrey, USDA Forest Service.

Risk Assessment and Decision Support from Prescribed Fire to Suppression. Carol Miller, USDA Forest Service.

A Summary of JFSP Fire Behavior Research Accomplishments and Some Future Directions. Mark Finney, USDA Forest Service.

Rapid Evolution of Smoke Management Tools: Ten Years of Joint Fire Science Program–sponsored Research. Scott Goodrick, USDA Forest Service.

What Are Future Fire Science Priorities? What Kinds of Changes are Needed to Address These Priorities? James Agee, University of Washington (emeritus).

Onward to another decade

In its first 10 years, the JFSP has spent about $140 million to fund more than 450 research projects. The summary of the Savannah symposium gives a small idea of the breadth and depth of the science that has come out of these projects.

"I've been amazed at what the JFSP has been able to accomplish," says Nate Benson, fire ecologist with the National Interagency Fire Center and chair of the JFSP's governing board. "The JFSP has been effective in leveraging its dollars, helping support innovative research, and cultivating the next generation of fire professionals." Board vice chair John Laurence of the Forest Service's Pacific Northwest Research Station, agrees. "It's humbling to look at the contributions of scientists and managers and realize the program played a part in those accomplishments."

"The JFSP has been effective in leveraging its dollars, helping support innovative research, and cultivating the next generation of fire professionals."
— Nate Benson

The Savannah symposium, says JFSP program manager John Cissel, made him appreciate even more the JFSP's unique role and significance as a sponsor of research to address pressing problems of today and the future. "It was impossible to attend the Fire Congress," he says, "and not come away knowing that the JFSP has reached deeply into many corners of fire science—we wouldn't be where we are today without it. But the real relevancy of this decade's summary is the foundation it laid for planning the next 10 years of JFSP investments. That's an endeavor that's already well underway."

National Interagency Fire Center
Joint Fire Science Program
3833 S. Development Ave.
Boise, ID 83705-5354

OFFICIAL BUSINESS
Penalty for Private Use, $300

JFSP *Fire Science Digest*
is published several times a year.
Our goal is to help managers
find and use the best available
fire science information.

Credits

Writer – Gail Wells
Gail Wells Communications

Managing Editor – Linda Hill
Linda_Hill@blm.gov

Design and Layout – Jennifer Kapus
Jennifer_Kapus@blm.gov

Tim Swedberg
Communication Director
Timothy_Swedberg@nifc.blm.gov
208-387-5865

AN INTERAGENCY RESEARCH, DEVELOPMENT, AND APPLICATIONS PARTNERSHIP

Learn more about the Joint Fire Science Program at

www.firescience.gov

John Cissel, Program Manager

208-387-5349

National Interagency Fire Center

3833 S. Development Ave.

Boise, ID 83705-5354