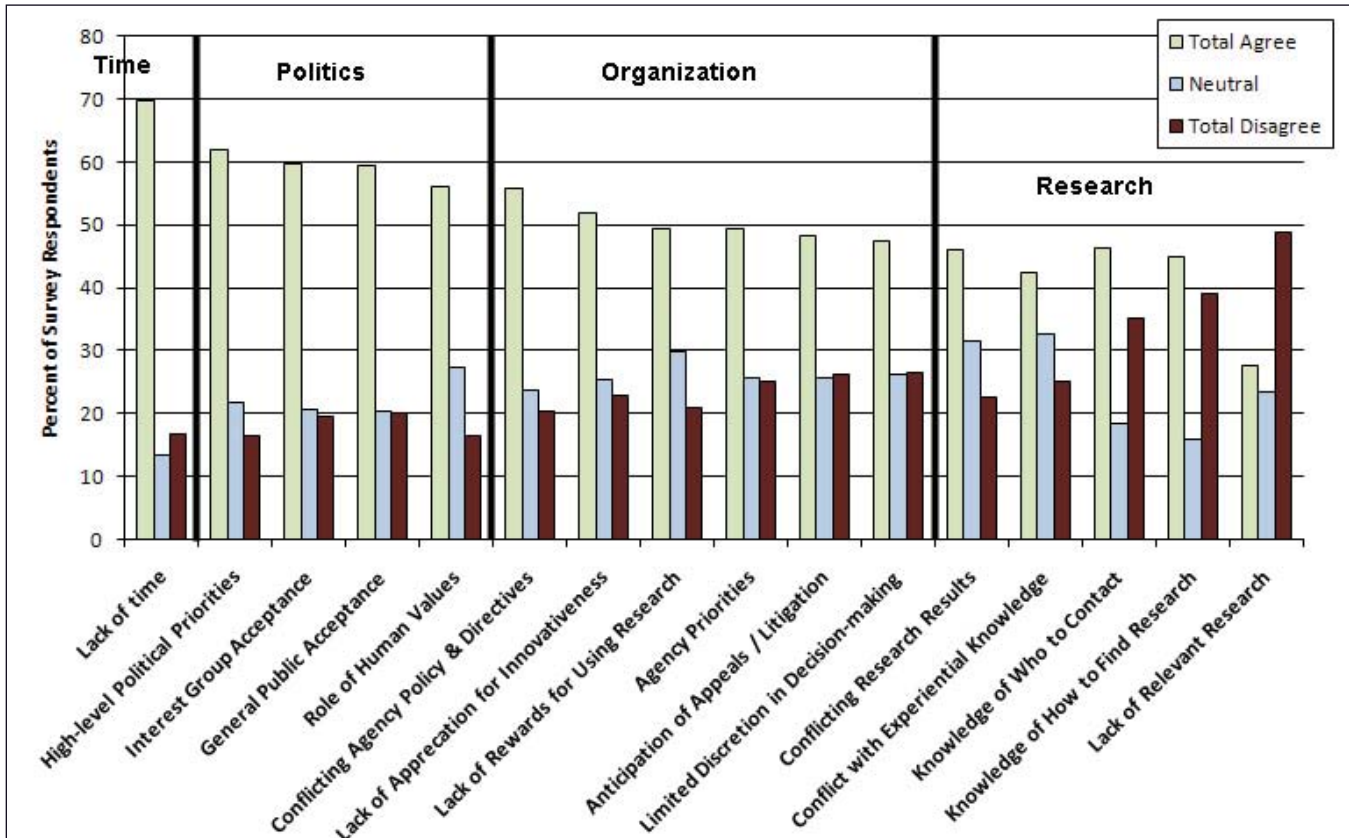


# Fire Science

RESEARCH SUPPORTING SOUND DECISIONS

## Brief



Fire manager agreement/disagreement with 16 potential barriers to using research (n=530).

## Challenges to Implementing “Best Available Science”

### Summary

Interagency wildland fire policy directs manager to apply “best available science” to management plans and activities. But what does “best available science” mean? With a vague definition of this concept and few guidelines for delivering or integrating science into management, it can be difficult for scientists to effectively provide managers with the science they need. As a result, valuable information and tools can go unused. To better understand the factors influencing research use, principal investigator Vita Wright conducted a literature review, agency meetings, in-depth interviews, and a survey of approximately 500 fire and fuels specialists and decision makers. Her study was based on social science theory, including the Diffusion of Innovations theory, which notes that there is a time lag between the introduction of a new idea and its full acceptance and adoption. By investigating social science theory and gathering perspectives from the fire management community, Wright explored the following factors that can support, or impede, research use: individual beliefs and attitudes, education and work backgrounds, current position, and organizational culture. Based on her research, Wright was able to provide tangible recommendations aimed at shortening the time to diffusion by improving the delivery, communication, and ultimately, the use of the best available scientific information.

## Key Findings

- Receptivity to research varied across the fire management community. Fire ecologists, long-term fire analysts, and individuals with graduate education had more positive beliefs and attitudes about research and said they used research more often than other groups.
- Most respondents agreed research was useful, but they were neutral when asked whether it was easy to use. Individuals with graduate-level education indicated research was easier to use.
- Respondents agreed they felt safe to introduce new ideas, yet they felt neutral about whether these new ideas would be truly appreciated or analyzed.
- Although science policy mandates have been included in interagency wildland fire policy since 1995, uncertainty exists among interagency fire managers about such mandates.
- Seventy percent of survey respondents indicated lack of time was a barrier to using research. This was substantially higher than other organizational and research-related barriers.

## “Best Available Science”

Interagency wildland fire policy mandates the use of “best available science” for fire management plans and activities. The 2003 interagency strategy for policy implementation also requires that science addressing management issues be funded, developed, and transferred to managers in a timely manner. Adherence to interagency wildland fire policy and implementation mandates is required by each of the federal fire management agencies.

However, with the exception of the 2004 interpretation of the Forest Service planning rule (36 CFR Part 219, reinstated December 19, 2009), and the National Park Service (NPS) Wildland Fire Reference Manual, fire managers have little formal guidance on what it means to apply “best available science.” And despite policy mandates, an ever-increasing warehouse of potentially beneficial research and good intentions, such ambiguity makes it difficult for managers to know when they’ve effectively located and applied the best available science to fire management plans and projects.

Vita Wright, principal investigator, said, “I was surprised to see the high level of disagreement and uncertainty when managers were asked whether they agree they are mandated by policy to use science. I was especially surprised to see any uncertainty among line and staff officers.”

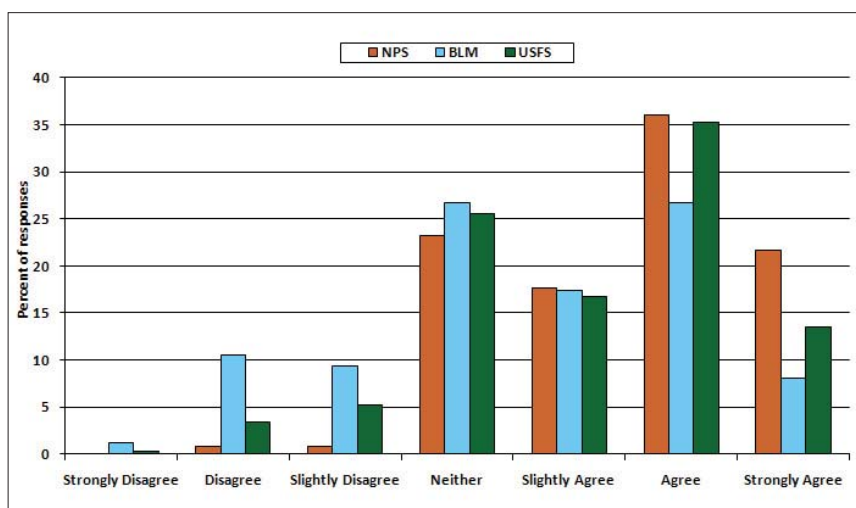
To better understand the various factors impeding this process, Vita Wright turned to social science theory and methods. Wright sought to explore behavioral and organizational factors that influence the effectiveness of science delivery and application within the fire and fuels management community.

Her study targeted professional fire and fuel specialists and decision makers in charge of fire and fuels planning and implementation within the NPS, Forest Service, and Bureau of Land Management (BLM). Wright conducted a literature review, agency meetings, interviews, and a quantitative survey, providing a blend of theory backed by empirical data. The literature review focused on the Diffusion of Innovations theory as well as other classic human behavior and organizational management theories.

Initially, four agency meetings were held to identify a range of influences to the delivery and use of science within each agency. In-depth interviews were then conducted according to agency, organizational unit, and position. And approximately 500 questionnaire-based surveys were used to gather information on respondents’ work and educational backgrounds, relationship history with scientists, beliefs about research and scientists, and organizational characteristics that contribute to learning and innovation—all within the context of different positions within fire management.

## Influences on research use

According to the Diffusion of Innovations theory, acceptance and adoption of new ideas and approaches



Agreement/Disagreement that “this agency is mandated by policy to use science,” for public land management, by agency, for the NPS (n=126), BLM (n=86), and Forest Service (n=350). Nearly one in four line and staff officers were either uncertain or disagreed.

takes time. There are multiple opportunities for active or passive rejection throughout the innovation adoption process, coupled with a number of individual and organizational influences.

Communication is a vital part of the innovation adoption process. Communication between science and management communities must occur to promote awareness of scientific knowledge and to facilitate managers' evaluation of scientific products. Research reveals, however, that there is great potential for misunderstanding during communication, which can further impede the adoption of new ideas. The Diffusion of Innovations theory suggests that people are most likely to interact with others who they most identify with, based on personal and social characteristics such as cultural beliefs and norms, work experience, and educational background. Such differences can lead to misunderstandings about each other's goals and intended messages, creating further challenges to effective communication. Wright suggests science communicators will be more successful if they tailor messages to specific audiences based on an understanding of the varying perspectives about research within the fire management community.

Individual beliefs and attitudes play a substantial role in how receptive a person is to using scientific innovations. Attitudes, which are based on beliefs, reflect positive or negative feelings about a person, object, or issue. These greatly influence individual behavior and decisions, such as whether to experiment with new approaches. In this study, Wright evaluated individual beliefs and attitudes about using research and working with scientists.

Another factor in the innovation adoption process is an individual's personality. Based on the Diffusion of Innovations theory, individuals are classified according to their willingness to adopt new ideas. Early adopters are often the opinion leaders who can jump-start diffusion among their peers. Study participants were classified into the following groups according to their willingness to try new ideas: innovators, early adopters, early majority, late majority, and diehards.

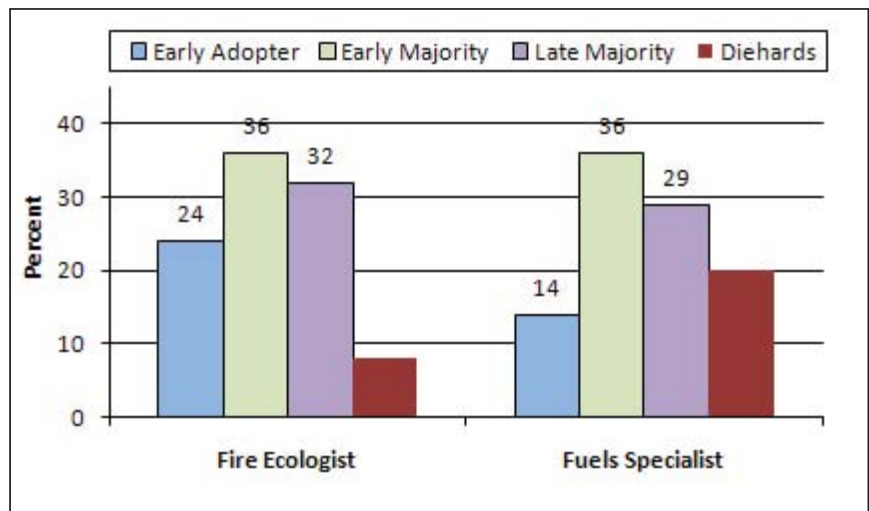
Beyond individual beliefs, attitudes, and personalities, an organization's culture can affect innovation adoption. Culture refers to shared beliefs, values, perceptions, patterns of behavior, assumptions, and norms that provide organizational members with meaning and

direction. Wright measured perceptions of organizational culture and processes related to learning as well as support for using science within the BLM, NPS, and Forest Service.

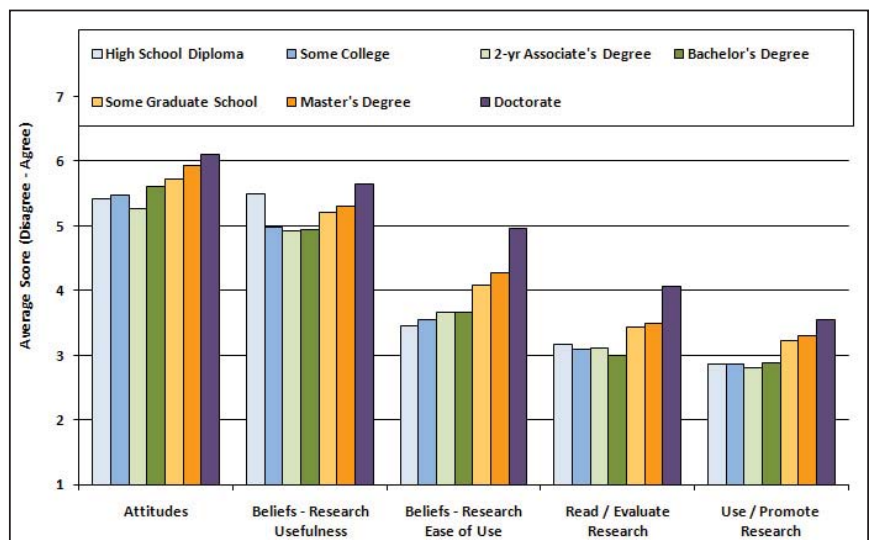
Wright commented, "When I went back to the literature to write the discussion section, I realized my results were consistent with nearly 50 years of scientific literature on human behavior, organizational communication, and innovation in organizations. It's surprising that people have been studying these issues for that long and we haven't drawn from them in addressing our questions about science delivery and application."

### One community, diverse perceptions

Study results revealed that the fire management community contains subgroups with differing levels of familiarity with and receptivity to research. Individuals working as fire ecologists or long-term fire analysts (LTANs), those in centralized positions, in the NPS, and



Percent of fire ecologists (n=25) and fuels specialists (n=140) in each adopter category.



Agreement/Disagreement, on average, for measures that differed significantly by education level. Higher numbers indicate respondents had more positive responses than lower numbers, ranging from (1) strongly disagree to (7) strongly agree (n=495).

those with graduate-level education had more positive attitudes and beliefs about research and used research more than others.

For example, fire ecologists and fuels specialists were listed as the top positions responsible for locating scientific information and tools that support fire and fuels management—yet, of the two, fire ecologists indicated they were more innovative. One-quarter of the fire ecologists were early adopters and less than one-tenth were diehards. In contrast, 14 percent of fuels specialists were early adopters and 20 percent were diehards, the last to try new ideas. Fire ecologists also had more frequent relationships with scientists than all other positions.

In another example, LTANs and fire behavior analysts (FBANs) were both innovative, but FBANs had lower beliefs and attitudes about research usefulness, used research less, and had less frequent interactions with scientists than LTANs.

Study results also revealed that individuals with graduate school background had more positive beliefs and attitudes about research and used research more than other respondents. Notably, this group found research to be easier to use than all other respondents.

Not only did individuals who worked for the NPS have more positive beliefs and attitudes about using research, but they also had more frequent relationships with scientists and had a greater awareness of science policy mandates than the other agencies.

## The role of the organization

Beyond individual perspectives, institutional environments also affect the capacity for research use. With a higher capacity for innovation, learning organizations are skilled at creating, acquiring, and transferring knowledge, as well as modifying behavior based on new knowledge.

Within the fire community, Wright measured eight characteristics associated with culture and processes of learning organizations. Of the eight measures, “time for reflection” showed the greatest opportunity for improvement. Also, when asked about barriers to using research, lack of time was seen as a barrier by 70 percent of respondents. This was substantially higher than other organizational and research-related barriers. A Forest Service Fire Management Officer explained, “I think one of the things that’s happening in the agency is burden shift. Probably one of the biggest things we face...there’s a lot of things that we do in here now, that I do as an FMO that I never would have done...admin. stuff, processing... and not that I’m above that...”

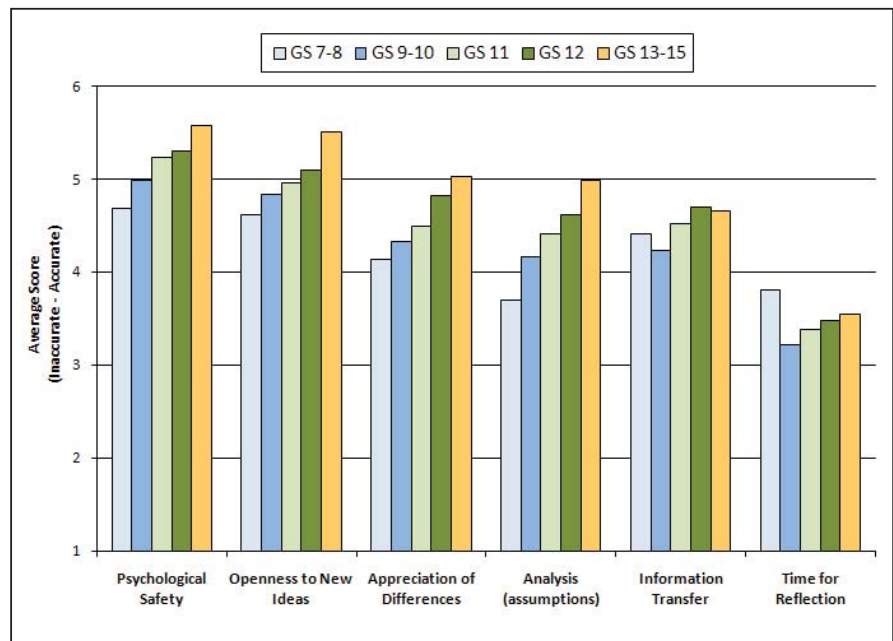
Encouraging employees to express alternative ideas and supporting them in exploring beyond established practices are vital components of an innovative work environment. In this study, respondents agreed they felt safe to present new ideas but indicated they felt neutral about whether these ideas would be analyzed or appreciated.

Interestingly, Wright found that lack of relevant research was the least prominent barrier to research use. Of 16 potential barriers, it was the only one where more respondents disagreed that it was a barrier than agreed. Pertinent, helpful information is needed. However, it’s more a matter of managers having the time and organizational support they need to find, evaluate, and plug that research into management.

“The adoption of research products is a complex process that takes time. Research relevance, while critical, is just one factor that influences whether and when research is used. By better understanding individual managers’ perspectives on using research and on working with scientists, science communicators can tailor delivery to be more effective with different groups of potential users. Additionally, by understanding work unit characteristics that contribute to learning and innovation, or that hinder it, upper level managers can increase organizational capacity for the integration of science into management,” said Wright.

## Encouraging research use step by step

This study resulted in a number of conclusions targeted at helping fire and fuels program leaders, decision makers, and scientists improve fire science communication and application.



Perceived accuracy/inaccuracy, on average, for learning organization characteristics that differed significantly by pay grade level. Higher numbers indicate respondents were more optimistic about the presence of the learning organization characteristic (n=495).

## Managers

To encourage research use, the following action items are recommended for managers:

- Cultivate a work environment where diverse ideas are respected and appreciated and productive debate is encouraged—regardless of pay grade level.
- Provide more time for reflection, consideration of alternative viewpoints, and information transfer.
- Increase awareness of science policy mandates.
- Create more boundary spanner positions that know both the management and research aspects of science and can communicate effectively across cultures.
- Supervisors: support innovation through role-modeling and direction, and by offering challenging task assignments, allowing autonomy in task execution, providing implementation resources, encouraging communication, and recognizing innovative performances.

Specific suggestions regarding fuels specialists include the following:

- Recognize and train for research-related duties in position descriptions and provide formal recognition of research use.
- Create more opportunities for employee interaction with scientists, especially for fuels specialists working at the local level. These interactions can build familiarity, trust, and credibility, thereby improving effective communication about relevant research.
- Encourage interaction with fire ecologists, who often have strong ties with scientists.
- Provide educational opportunities to increase familiarity with and navigation of the research environment.

## Scientists

To improve science delivery and application, the following action items are recommended for scientists:

- Anticipate a time lag between the introduction of a new idea or innovation and its widespread implementation. Use the following recommendations to shorten time lags.
- Strengthen trust by explicitly demonstrating that the audience's interests and needs are a priority and that research is objective.
- Help managers use research products by supporting boundary spanner positions, which can serve as a bridge between management and science cultures.
- Boost scientist-manager interaction, for example, through workshops or funding opportunities that encourage collaboration. The Joint Fire Science Program's network of regional knowledge exchange consortia is experimenting with approaches to increase interaction and communication.

## Management Implications

### For managers:

- Support the efforts of fuels specialists to deliver and apply science by formally recognizing these duties, providing educational opportunities, and fostering relationships with fire ecologists and scientists.
- Cultivate a work environment that provides adequate time for reflection and information transfer, and encourages appreciation of differences and productive debate for all pay grade levels.
- Increase awareness of science policy mandates.

### For scientists:

- Expect a time lag for the adoption and diffusion of research products.
- Build trust by demonstrating that research supports management and that it is objective.
- Deliver research products to early adopters, such as fire ecologists, LTANs, regional/state staff, and individuals with graduate-level education.
- Deliver results to those seen as responsible for communicating about research: fuels specialists, fire management officers, natural resource specialists, and silviculturists.

## A shared goal

Social science theory asserts that it takes time for communities to embrace new ideas. Different individual backgrounds and perspectives as well as work unit environments can either enhance or slow the adoption process. By addressing both individual and organizational challenges, the time to diffusion can be shortened, and capacity for research use can be increased.

In the end, both fire managers and scientists are working toward the shared goal of sound stewardship, and that includes working together to understand fire behavior, effects, and management. It also includes making a concerted effort to better understand and communicate with each other. By striving to understand each other's perspectives and actively supporting innovation and learning, the entire fire and fuels management community can move toward more effective use of best available science.

## Further Information: Publications and Web Resources

Influences to the Success of Fire Science Delivery Project:  
<http://www.leopold.wilderness.net/research/fprojects/F016.htm>

Joint Fire Science Program science delivery consortia projects:  
[http://www.firescience.gov/JFSP\\_consortia.cfm](http://www.firescience.gov/JFSP_consortia.cfm)

Interagency Wildland Fire Policy: [http://www.nwcg.gov/branches/ppm/fpc/archives/fire\\_policy/index.htm](http://www.nwcg.gov/branches/ppm/fpc/archives/fire_policy/index.htm)

Wright, V. 2004. How do land managers adopt scientific knowledge and technology? Contributions of the Diffusion of Innovations theory. In: Neil Munro, Phil Dearden, Tom B. Herman, Karen Beazley, Sorun Bondrup-Nielson, editors. Making Ecosystem-based management work. Proceedings of the Fifth International Conference on Science and Management of Protected Areas, Victoria, BC, 11-16 May 2003. Wolfville, Nova Scotia: SAMPAA: <http://leopold.wilderness.net/pubs/527.pdf>

Wright, V. 2007. Communication barriers to applying federal research in support of land management in the United States. Pages 55-62 In: Cynthia Miner, Ruth Jacobs, Dennis Dykstra, Becky Bittner, eds. 2006. General Technical Report PNW-GTR-726. Portland, OR: USDA Forest Service, Pacific Northwest Research Station: <http://leopold.wilderness.net/pubs/614.pdf>

Wright, V. 2010. Influences to the success of fire science delivery: Perspectives of potential fire/fuels science users. Final Report to the Joint Fire Science Program. Project #04-4-2-01: [www.firescience.gov/projects/04-4-2-01/project/04-4-2-01\\_vw\\_jfsp\\_final\\_report.pdf](http://www.firescience.gov/projects/04-4-2-01/project/04-4-2-01_vw_jfsp_final_report.pdf)

### Scientist Profile

A fire social science analyst, **Vita Wright** works in a shared position between the USFS Rocky Mountain Research Station (RMRS) Human Factors & Risk Management RD&A and the NPS Branch of Wildland Fire. She is currently pursuing her PhD at the University of Montana in Missoula, where she is studying individual and organizational influences to the use of fire science. Previously, Vita developed and led the Aldo Leopold Wilderness Research Institute's Research Application Program, which focused on wilderness science application.



*Vita Wright* can be reached at:  
USDA Forest Service  
RMRS Human Factors & Risk Management RD&A, Missoula, MT  
NPS Fire Science and Ecology Program, Boise, ID  
Phone: 406-758-3547 • Cell: 406-369-5374 • Email: [vwright@fs.fed.us](mailto:vwright@fs.fed.us)

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*Results presented in JFSP Final Reports may not have been peer-reviewed and should be interpreted as tentative until published in a peer-reviewed source.*

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John Cissel  
Program Manager  
208-387-5349  
National Interagency Fire Center  
3833 S. Development Ave.  
Boise, ID 83705-5354

Tim Swedberg  
Communication Director  
[Timothy\\_Swedberg@nifc.blm.gov](mailto:Timothy_Swedberg@nifc.blm.gov)  
208-387-5865

Writer  
Sheri Anstedt  
[sanstedt@comcast.net](mailto:sanstedt@comcast.net)

Design and Layout  
RED, Inc. Communications  
[red@redinc.com](mailto:red@redinc.com)  
208-528-0051

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