ASSESSMENT FINDINGS

Joint Fire Science Program: Connecting Science and Policy

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EXECUTIVE SUMMARY

The Joint Fire Science Program (JFSP) Board engaged the U.S. Institute for Environmental Conflict Resolution to provide independent third party neutral assistance to assess key stakeholder needs and interests for the integration of science into policy. Forty-five experts in fire science, land and resource management were interviewed between November 2015 and January 2016. The assessment findings are a basis for the collaborative development of specific, actionable recommendations to the JFSP Governing Board about how to provide the best process or products to improve the integration of fire science into policy discussions.

How Science is used to Inform Policy

Policy-makers generally stated that policy development and implementation is most successful and defensible when based upon current, credible science. Many interviewees suggested that science is most actively sought (and resourced) by policy makers in time of crises, and that the application of science to support policy decisions is inconsistent and not always strategic.

Consistent among nearly all interviewees was the observation that policy-makers have limited time and the pace of decision-making often doesn't allow deliberative, considered use of science.

Examples of Successful Integration of Science into Policy

Interviewees provided numerous examples of policy-making efforts that successfully integrated science. Consistently, examples included policy-making efforts that brought scientists and policy makers together to develop policy, where scientists were present to shepherd the science through the policy-development process. Despite the number of examples provided, there were some interviewees who struggled to identify a specific example of where science was successfully integrated into policy-making, and still others who said they knew of no example where that integration had occurred successfully.

How Policy-makers Access Science

Policy-makers rarely have time to access and utilize primary science (e.g. scientific papers). Instead, they rely on syntheses of relevant science, presentations at conferences and meetings, online webinars, and, most importantly, the counsel of their trusted science network. In particular, interviewees noted the key role of translators/facilitators, specific individuals who provide a bridge between science and policy, and help policy-makers understand and apply relevant science.

Mechanisms for Connecting Science to Policy

Interviewees identified several mechanisms currently in place that allow policy-makers to access and connect to science, ranging from one-on-one meetings and briefings to searchable databases to field tours. The mechanisms reflected a range of strategies depending the policy need, the scientific content, and the time available to the policy-maker.

It was clear that existing mechanisms do not fully meet the need for those seeking science information to support policy development, particularly related to synthesis of information and incorporating socio-political and economic impacts of potential courses of action. Key suggestions for new or improved mechanisms included creating a deliberative dialogue between those generating knowledge and those making decisions, potentially through annual conferences, workshops or existing meetings. Others suggested creating an independent body tasked with connecting science and policy. Still others suggested creating training sessions for scientists to better communicate with policy makers, or education programs to increase the visibility of fire science in the public eye. Finally, interviewees suggested convening task groups or teams to address high priority policy issues, including scientists, management, academia, and others across a wide span of disciplines.

Policy Issues Most in Need of Science

Interviewees identified a number of policy issues they believe need to be informed by science, but a significant number of the interviewees identified social science issues as most needing to be informed by science. Beyond socio-political issues, the majority of interviewees suggested more science is needed to support air quality, climate change, and management-related issues. Other key issues fell under topics of vegetation, restoration, fire suppression, fire fighter behavior and safety, and post-fire activities.

Identifying/Prioritizing Science Needed to Inform Policy Decisions

Interviewees were asked how science needs should be prioritized, and respondents provided a number of suggestions about how to improve the prioritization process.

- Reduce Duplication: Numerous respondents spoke about the need to better define research that is already underway when identifying and prioritizing science needs.
- Be Objective-Based/Strategic: Many respondents strongly stated the importance of prioritizing science that directly addresses a decision to be made. Interviewees also wanted to see a strategic prioritization of science priorities to reflect policy issues expected in five, ten or fifteen years.
- Need to Broaden the Conversations: Interviewees consistently identified the need to broaden the conversation about identifying and prioritizing science needs to include stakeholders and non-agency groups, as well as entities who haven't historically been involved in decision-making.
- Need for More Structure: Some interviewees expressed the need for more structure in identifying issues and establishing priorities, perhaps including a formal call for issues, an annual dialogue with a broad base of stakeholders, and application of decision criteria based on objectives identified by the fires science and policy communities. Others suggested creating an independent body to identify and prioritize emerging science needs.
- Tie to Existing Plans and Data: Interviewees pointed out that when identifying and prioritizing issues, it is critical to connect to existing science plans to validate prior efforts and agreements. Conversely, these issue-specific science plans need to be kept current and include a broad constituency in their development.
- Foster Innovation: A few interviewees recommended catalyzing and embracing innovation by creating an overall framework for priorities, but providing flexibility on developing innovative approaches to delivering answers within that framework.
- Budgets: Several interviewees pointed out that research priorities need to be relevant. They recommended allocating a portion of the research budget to specific agencies to conduct research that is a priority for them, and monitor the outcomes.

NEXT STEPS

As the next step in the process envisioned by the JFSP, these findings will be deliberated by a work group convened by the U.S. Institute and tasked with developing recommendations to the JFSP Governing Board for action.

INTRODUCTION

Wildland fire affects natural resources and the people who depend upon them, often in highly contentious ways. Managing wildland fire involves a broad community, consisting of multiple agencies and organizations across many levels of government and disciplines. In 1998, Congress directed federal land and resource science and management agencies to create a Joint Fire Science Program (JFSP), appropriating funding focused on improving the scientific understanding of wildland fire and fuels and the myriad natural resources affected by them. Science information is delivered largely to managers, practitioners and scientists through a national network of regional fire science exchanges (www.firescience.gov/JFSP_exchanges.cfm)

In parallel with those engaged in management or operational issues, a large and diverse community participates in policy formulation affecting wildland fire and fuels management. While concentrated in Washington, DC, people across the country seek information to inform, influence and interpret policy outcomes. Credible and well considered scientific studies are essential to ensure policy is well grounded and likely to achieve stated aims.

The JFSP issued a request for proposals in 2013 to create a national policy-oriented exchange. Review and evaluation of submitted proposals led the JFSP Governing Board to conclude that there was an inadequate understanding of the existing environment, and further assessment was needed to determine an effective path forward (JFSP 2015). The JFSP Board engaged the U.S. Institute for Environmental Conflict Resolution (U.S. Institute) to provide independent third party neutral assistance to assess key stakeholder needs and interests for the integration of science into policy, and to use the assessment findings as a basis for the collaborative development of specific, actionable recommendations to the JFSP Governing Board for establishing a productive policy-focused science exchange. The U.S. Institute contracted with EnviroIssues to provide services.

METHODOLOGY

Susan Hayman and Angie Thomson, Senior Associates at EnviroIssues , conducted the assessment interviews from November 2015 – January 2016. At the outset of the process, EnviroIssues established an Assessment Strategy Team (AST) comprised of four representatives from the JFSP Governing Board and staff, two representatives from the U.S. Institute, and the two EnviroIssues' interviewers. The JFSP representatives on the AST identified a pool of approximately 70 potential interviewees and a target of 50 interviews. This pool was periodically updated as interviewees provided suggestions for additional interviewees.

Ultimately, EnviroIssues interviewed 45 experts in the fire science and land and resource management policy communities, based on responsiveness to interview requests, availability, and an attempt to strike a balance among affiliations of interviewees. EnviroIssues provided interviewees guiding questions developed by the AST in advance of each 30 to 60 minute phone or in-person interview. Time spent on each question varied, depending on the interests of the interviewees, Appendix 1 contains the interview 'guiding questions' and Appendix 2 contains the list of interviewees.

The findings below are organized topically and represent the breadth of perspective shared by the interviewees. As stated in the introduction, these findings will be used to inform subsequent discussions about how to provide the best process or products to improve the integration of fire science into policy discussions.

Within the Findings section, italicized text represents verbatim responses from individual interviewees, provided to reinforce synthesized information. Non-italicized text contains information consolidated and interpreted by the preparers from multiple interviews. When specific examples are provided to illustrate a point, such examples were specifically provided by the interviewees.

Terminology: In this Assessment Report, we differentiate the "roles" that define perspectives and responses. An interviewee may act in more than one role, depending on the circumstances. For instance, a high-ranking agency official may both make decisions and advise on decisions made at levels above him/her. For the purposes of this report, we defined the following:

- Policy makers: Those with decision-authority for a policy
- Policy advisors: Those relied upon to provide scientific or policy advice to a policy maker. Policy advisors may be either staff (internal) or consultants (external)
- Translators: Those people who operate at the interface of science and policy, and are relied upon to create a bridge between the two for policy makers
- Facilitators: Those who create a bridge between science and policy by strategically bringing the "right" people into the conversation. In some (but not all) cases, these people operate as translators, too.
- Scientists: Those who operate within agency or academic institutions and conduct research

HOW SCIENCE IS USED TO INFORM POLICY

Summary of Key Findings

Policy-makers generally stated that policy development and implementation is most successful when based upon current, credible science. Most interviewees also asserted that science is most actively sought (and resourced) by policy makers in times of crisis.

A key use of science in the policy arena is to determine the practicality of and potential outcomes from a course of action (modeling). Policies that address fire prevention, firefighter safety and suppression efficacy, changing fire behavior, potential impacts to private land and public health, and enhancement, protection and restoration of ecosystem services have benefitted from significant science investment in modeling.

Policy-makers acknowledged that science isn't the only factor in effective policy making—socio-political and economic factors play an important role, too. Those we interviewed generally concurred that the appropriate application of science substantially contributes to the development of defensible, durable, and implementable policies. Interviewees also felt there is an inherent responsibility to monitor policies and adapt them as new scientific (and other) information surfaces.

In the application of science to policy considerations, people in both the science and policy arenas stated two ongoing challenges: 1) policy makers sometimes misapply scientific findings to situations outside the comfort level of the scientists; 2) scientists sometimes overly-qualify scientific findings to a point where it is difficult to discern their applicability to policy.

Specifics

Policy makers are keenly aware of the need to demonstrate the use of best available science in policy making. "Best available science" is also not limited to the science developed through agencies and academic institutions.

- *There are checks and balances to ensure that we are appropriately using science in our policy decisions -- our constituents are watching us and holding us accountable. If [our policies] are not well-informed by science, they get litigated and we lose. The agency has to rely on the best science it can.*
- *We need evidence-based science, which speaks to the quality of the science itself (e.g. credentials of scientist, number and distribution of data points).*
- *When policy is developed, we need to consider the practicality of it. We need to look at the latest science on fire in the ecosystem, fire impacts, and restoration in the basins, and think about whether it will help us in restoration of the ecosystem and whether it is practical on the ground.*
- *It is important to make a scientific assessment of where risk resides, though that risk takes different forms: what's at risk on the geography, what's at risk in terms of values that are threatened, and the social component of how people address risk.*
- *Incorporating science into policy-making helps shape good business practices. It helps us know what is effective, efficient and ecologically sound.*

Science in support of policy is usually issue-based, opportunistic (taking advantage of visibility), and driven by management agency needs. Many respondents noted that the fire science and policy community is good at reacting to most important issues, but poor at anticipating them. Others noted that the application of science to support policy decisions is inconsistent, not always strategic, and not always supportive of application in the field.

We heard that scientists and policy makers sometimes have a frustrating relationship. A challenge for scientists is that policy makers at times apply scientific findings beyond what the science supports. Synthesis documents are generally written for non-scientific audiences, and often include qualification to the findings. So while some of the scientists we spoke with feel that pronouncements from policy-makers may over reach at times, some of the policy-makers wished that scientists would be more definitive (e.g. the "on the other hand" syndrome)."

Policy advisors we spoke to generally agreed that it is hard to integrate science into decisions that are highly-politicized. There is a sense that policy-makers are hurried and harried, and that the pace of decision-making often doesn't lend itself to the deliberative, considered use of science.

- *The closer people are to the actual management, the more they are actually likely to use science.*
- *Is the science information pipeline working? It becomes narrower and more clogged as it gets to Washington. There is less ability to hear about/think about how science influences what they do.*

However, once an issue crosses a certain political threshold and becomes a crisis, a substantial array of resources can be marshalled to provide a credible, scientific basis for action (e.g. sage-grouse).

- *When a Secretary thinks [it] is a huge issue, it leads to all kinds of discussions and contacts. People reach out to me for my expertise. There are conferences designed specifically to inform policy with science (e.g. The Next Steppe Conference in November 2014), but they come about only in response to a perceived crisis level.*

Some respondents suggested there was room for improvement when integrating science into policy:

- Air quality managers are sometimes asked to weigh in on policy proposals, but not enough of this discussion is occurring.
- Science informs the ecological impacts of the fire program, but there are a host of other issues. There has not been a good scientific look at how all of those issues are integrated.

And a small number of respondents said they rely less on science than other means to inform their policy recommendations:

- *I tend not to fall back to science as much as personal experience. As an experienced manager, I've "been there, done that."*
- *I don't think science should inform policy as much as history should. Utilizing traditional, ecological knowledge and practices could have avoided situations that science complicated. Ecological systems are integrated and inter-related. "Science" tends to study small components instead of the inter-relationships.*
- *Ultimately, many of the questions we're dealing with are not scientific. They are about resolving conflicts between values, ethics, and what kinds of institutions should be in place.*

EXAMPLES OF SUCCESSFUL INTEGRATION OF SCIENCE INTO POLICY

Summary of Key Findings

Interviewees provided many examples of policy-making efforts that successfully integrated science – some interviewees provided numerous examples. Still, there were some interviewees who struggled to describe a specific example, and still others who said they knew of no example where that integration had occurred successfully. It was also challenging, at times, for interviewees to distinguish between 1) science integration into operational practices, and 2) science integration into policy. More interviewees seemed to have had experience with the former than the latter.

Consistently, successful examples included policy-making efforts that brought scientists and policy makers together to develop policy, where scientists were present to shepherd the science through the policy-development and, in some cases, implementation process.

Specifics

A sampling of the examples of successful integration of science into policy includes:

COMPLETED

Bush Fire Cooperative Research Center: Required that research proposals specifically identified how the science would affect fire policy and operational delivery. Success credited in part to the creation of an independent private research organization that sourced the science, and also to a system where scientists had a responsibility to be involved in the policy development and implementation process.

National Cohesive Wildland Fire Management Strategy: Created a connection between scientists and decision makers around an "all hands all lands" approach to fire and vegetation management. It emphasized the need for rigor and reliance on data and bringing that information to the policy body. The purpose was clearly articulated by policy makers and the strategy reflected science purposefully designed by the science community, contributing to its success.

The Efficacy of Hazardous Fuel Treatments: Utilized an evidence-based approach bringing together the best available science and scientists from different disciplines to address hazardous fuel treatments and inform related policies.

Firefighter Medical Qualification Policies: Drew upon the science of physiology and performance to learn how people adapt to firefighting stressors. Success resulted from having the experience and knowledge to ask the right questions, and from collaborating with other specialties as needed.

Fire Regime Condition Class Data: Characterized departures from historic conditions across the county. The effort was a science and management collaboration that informs fire management policy.

Fuel Characteristic Classification System: Developed a fuels classification system applied wholesale, and institutionalized across the country. The success of this system was its development through a partnership of scientists and managers.

Land-based Wildfire Risk Assessment: Assessed nationwide wildfire risk and captured the information in a comprehensive database. The primary objective was community protection from wildfire, and provided a scientific basis for funding priorities.

Landscape-scale Planning Efforts (Northwest Forest Plan, Interior Columbia Basin Ecosystem Management Project): Engaged scientists, managers, and the public in developing strategic land and resource use planning that translated into policy. These efforts were successful, in part, because scientists had to/could explain the science behind their recommendations, and managers could explain the implications of the applied science on future policies.

North Central Washington and Pacific Northwest Disturbance Ecology and Vegetation Management: Collaborated on appropriate vegetation management policies through the application of disturbance ecology principles. Success was in large part due to the close collaboration between managers and scientists.

Prescribed Fire Guide: Established federal standards for planning and implementation for prescribed fires. It was successful because the lead researcher used federal agencies as a sounding board to proof the work.

Wildland Fire Chemicals Assessment Program: Evaluated the best available science on the effects of fire chemicals likely to enter the environment and their effects, and has influenced policies regarding the use of fire chemicals. Because scientists were involved in program design, there was a built-in mechanism to evaluate success.

Wildland-Urban Interface Fire Dynamics Simulator (WFDS): Reconstructed progress of a devastating wildfire in Colorado Springs to identify how the fire spread through the forest and then into community. The resulting information influenced modifications of building codes, and placement and orientation of housing developments. It created local policy that is spreading to other areas.

2009 Fire Policy Review and Update: Developed a decision support system to assist managers with making and documenting decisions on wildland fire events. The system was developed to provide foundational knowledge and a model management system for fire policies.

ONGOING

Avoided Cost Modeling Scenarios: Informs policy decisions by clearly articulating tradeoffs in evaluating alternatives for

investment.

CHAT Model: Provides a tool for wildfire policy decisions that includes not just an operational perspective, but also futuristic thinking about how to get ahead of the issues through fire policy.

National Park Service Policy Analysis: Systematically determines if management policies are keeping up with the science of climate change and fire management. Successful due to the collaboration between managers and scientists across multiple disciplines.

HOW POLICY-MAKERS ACCESS SCIENCE

Summary of Key Findings

Science is derived from a spectrum of providers. The U.S. Forest Service research and development programs, USGS, Joint Fire Science Program, and universities were all cited by interviewees as having the ability (and track record) to deliver useful science. The challenge stated by policy-makers is having to search through this substantial body of information to find the most useful information for a specific issue.

Of all the findings from this assessment, this point was most clear: Policy-makers rarely have time to access and utilize primary science (e.g. scientific papers). Instead, they rely on syntheses of relevant science and, most importantly, the counsel of their trusted science network. For some, this may represent a relatively small circle.

There was general agreement from policy makers and advisors alike that there seems to be an accelerated "crisis mode" with policy issues requiring stronger science input, and turnaround times for this requested science are getting shorter. Policy makers do utilize mechanisms such as social media and other online tools for keeping a pulse on the latest science related to critical issues. However, the real urgency for improved mechanisms to bring science to policy seems to rest with the policy advisors. Sections 6 and 7 speak to this.

Specifics

PERSONAL INTERACTIONS

Policy makers expect their staff to be informed and to advise them appropriately. Policy-makers we interviewed generally want to receive information face-to-face, with supporting briefing materials or handouts. Requests to policy advisors often have a turnaround in terms of hours, rather than days. Some interviewees noted that policy makers often rely on the "busiest" scientists (based on professional reputation, status, "cutting edge" research) – and that this may not be a sustainable approach given the increasingly short turn-around times.

- *I expect staff will bring an options paper that includes a science component. For example, developing risk-based modeling (science) to approach how to determine funding. Science (US Geological Survey (USGS), US Forest Service (USFS), JFSP) must be is a full component of the conversation. I look for it, expect it, and see it.*
- *I prefer to have an issue paper that reviews science and sets the issues up to develop choices (pros, cons, advantages, disadvantages). I oversee development of issue papers, and then use them to develop my choices for policy.*
- *The biggest challenge is having time to get to the science information. With 50-100 emails each day, policy-makers don't have time to dive into a 200-page document for science information. I personally haven't accessed the JFSP science site for technical transfer in over two years.*
- *I don't have the time or capability to sort out all the different science. Given the time available, I can't accurately assess the right scale and application for the science, or assess operational risk science compared to strategic risk science.*
- *There is a cultural difference between scientists, practitioners and policy-makers. Most scientists would like a year or two to address a question. Policy makers need an answer "by Friday." Sometimes the result is messy, superficial, and unworthy of the time it took to prepare it.*

A significant role for consultants and policy advisors is to interact with scientists to bring information together in a way that is meaningful to policy makers – to serve as an information facilitator and/or translator. Beyond one-on-one interactions with policy makers, translators/facilitators sometimes organize teams to work in a focused way on an issue, which may lead to a scientific publication, white papers, discussion papers, and/or presentations. Work may be in person or virtual.

- *Many years ago I began a relationship with a small circle of scientists that really have been good resources for the complex issues I face.*

- *I often access science through a translator. For instance, I rely heavily on the fire lab in Missoula MT, where scientists are really good at explaining scientific research to me. If I want to make policy sense out of that science, I look to a fire professional (e.g., fire director) who understands science, how it applies to operations, and how that might influence a policy direction.*

- *To be useful, a policy exchange has to have a staff of worker bees who bridge the gap and feeds info from policy people to researchers, and from researchers to policy people. These people need to not just be well-versed in these topics – they need to do the synthetic work.*

Other face-to-face access to science for policy decisions comes through advisory and/or collaborative councils that include a science component –interviewees provide numerous examples. Bureau of Land Management (BLM) resource advisory councils (RACs), for instance, directly advise BLM state directors. The U.S. Forest Service has a history of convening advisory committees to integrate science and other stakeholder values into policy discussions. The Northwest Forest Plan is an example of policy development through an advisory body convened by the White House. Self-directed Landscape Conservation Cooperatives implement collaborative approaches to landscape-scale science and management that have positively contributed to policy development. And groups nurtured through non-profits and other conveners, like the Sustainable Rangelands Roundtable, also offer a venue for in-person science-for-policy interactions. These boards or councils sometimes have the opportunity to review unpublished drafts of reports that help participants learn about new research initiatives.

- *I review science information as I prepare for executive board meetings that I sit on. The meeting packets include background information I review prior to the meeting, and I hear about new science in that context.*

Opportunities to participate in conferences that specifically and intentionally tie science discussions to policy issues are valuable, but infrequent.

- *I find focused workshops that include science, management, and policy very helpful. They give me a download of science information, and a download of management and policy needs.*

ONLINE/SOCIAL MEDIA

Interviewees had varying levels of experience in reaching out, and being reached, through social media. While many we spoke to use Twitter and Facebook as mechanisms to alert and link them to science that may be of interest, most who access information online utilize searchable databases (such as ResearchGate, FireScience.gov, and others) Such databases generally include primary research, as well as fact sheets and short working papers.

- *I use social media to learn what's bugging people. Is my science good under the new paradigm of what I am seeing people care about? I learn about demographics and durability of the movements I observe -- is the event unique or part of a long-term social trend?*

- *Search engines help answer questions at the moment, but social media helps me know what is "out there."*

HOW POLICY ADVISORS ACCESS SCIENCE

Summary of Key Findings

Policy advisors serve as the providers, facilitator and/or translators of scientific information – sometimes to policy makers directly and sometimes to higher-level policy staff. As a group, they access and utilize scientific information differently than policy makers. Based on those we interviewed, policy advisors benefit most from "mechanisms" to find and deliver science related to policy.

They currently use their well-established network and online sources to keep tabs on the pulse of science – the emerging issues, the current findings, and the subject matter experts. They also use these same sources for detailed exploration of science related to issues of concern.

Policy advisors routinely participate in workshops, conferences, and colloquia to transfer knowledge to others and expand/deepen their own.

Because policy advisors are the most likely to utilize "mechanisms" to find and deliver science to policy makers, the table of successful existing mechanisms found in Section 7 largely speaks to this set of actors in the science and policy community.

Specifics

Policy advisors, whether they come from primarily a science or policy background, understand they play a key role in bridging the gap between science and policy. Those we interviewed take this role seriously and rigorously seek out the people and information needed to add value to policy development.

- *Policy folks don't want to go to the source of science. They are so busy in their world that is a pretty rare thing to see them dig into something. Mostly they get briefings – face time with the scientists and policy people.*
- *When facilitating the development of science-based, policy-focused reports and other publications, I work with the scientist(s) to put together an outline and structure the material. Their science information comes from them, not from me.*
- *For the most part the scientists like working with information facilitators/translators. This enables the scientists to attend fewer policy meetings, and policy-makers don't have to sort through all the scientific details.*
- *Because it is readily-available, the majority of interviewees who act in the policy advisor role utilize searchable databases and other online information sources to access and distribute science information.*
- *I look at Forest Service research (Internet), JFSP website (synthesis documents first), other science websites, professional organizations, non-profits that do synthesis, Congressional Research Service, National Institute of Standards and Technology, and weather service publications, including Department of Commerce climate change and fire weather.*
- *I use the Internet to do searches and then start networking and learn who key players are from the science perspective.*
- *When there is a specific project or policy question that needs to be addressed, staff seek out the science related to that work. The outreach is driven by management questions, not just to keep up with the science.*
- *As a science-driven organization, we work to put science into a digestible form for policy makers.*

Based on our assessment interviews, policy advisors much more actively participate in regional and national workshops, conferences, colloquia, and online webinars than policy makers, both as presenters and participants.

- *Workshops and conferences – being in that setting is really helpful for focusing on a particular subject in a concentrated timeframe. These in-person Interactions help me think things through and provide deeper understanding (rather than just reading about something).*
- *Lessons learned webinars have been a good tool, and the JFSP Friday Flash is great.*
- *Knowledge exchange consortia are useful–and we find that regional issues can be applied to other areas (e.g. California synthesis papers)*

SUCCESSFUL EXISTING MECHANISMS FOR CONNECTING SCIENCE TO POLICY

Summary of Key Findings

Interviewees, principally policy advisors (see Section 6), identified numerous mechanisms currently in place that allow the fire science and policy community to access and connect to science, ranging from one-on-one meetings and briefings to searchable databases to field tours. The table below summarizes these mechanism, which reflect a range of strategies depending upon the policy need, the scientific content, and the time available. As previously discussed in Section 5, policy makers we interviewed are much less likely to use any sort of "mechanized" information tool to access science – they rely most on one-on-one meetings and other personal communication with trusted advisors.

Specifics

Mechanism	As Described by Interviewees	Why it Works	Some Limitations…
Searchable Database (e.g. FireScience.gov, regional fire exchanges)	An ever-expanding online collection of downloadable scientific papers, synthesis documents, and other online resources.	Searchable by a wide variety of attributes. Available on-demand.	Mostly geared toward technology transfer and operational issues, rather than policy-level issues. Information can get "lost" if not properly indexed. Need better training of how to utilize search tools.
One-on-One Meetings/Briefings	Personal conversation between policy makers / elected officials (or their staff) and policy advisors (scientists, other policy staff, consultants), who serve as information facilitators and translators.	Personal contact that provides high level, synthesized and interpreted science material that is high quality and credible. Also allows for direct conversation about policy needs and research priorities and funding.	There is less diversity of thought if policy makers principally utilize a small network of advisors. There is also a shortage of "translators" who can bridge science and policy.
Testimony	A process where an agency leader and/or subject matter expert (SME) is called to address (and respond to questions about) a particular issue or question to Congress or other deliberative political bodies.	Those with a recognized level of expertise or responsibility have the opportunity to bring critical information directly and concisely, to policy makers.	The questions SMEs are often asked are not that well-framed or are politically driven. Sometimes those who testify provide black and white answers to issues that are not black and white.
Ad Hoc Work Groups	Groups of individuals who represent different interests related to an issue, who provide advice and/or recommendations to policy makers or elected officials/staff. May be convened by agencies, NGOs, political or neutral entities.	Better likelihood of understanding all sides to complex issues before developing policy around them. Increase buy-in when more people are involved.	Time-intensive and may not be nimble enough to address immediate, crisis-level issues. Need resources to support regular care and feeding of these groups. Recommendations can be highly influenced by the people participating in the group, so selection of members is critical.

Mechanism	As Described by Interviewees	Why it Works	Some Limitations…
Established Collaborations / Consortia	An association of entities who have a shared interest in the human and natural environments and collectively bring resources to the table to connect science and management. Examples include Landscape Conservation Cooperatives, Sustainable Rangelands Roundtable, Western Forestry Leadership Coalition	Seeks to directly connect operational, managerial, and policy needs with science/research. Provides a knowledge exchange that can be applied to other areas. Institutionalized relationships allow partners to help drive and financially support the research. Their investment also brings buy-in to the science.	Still principally focused on technological and operational issues. Can be difficult to retain continuity of individual participants and, therefore, relationships.
Topical Webinars / e-Notices (e.g. JFSP Friday Flash)	Online seminars and short e-notices around specific topics.	Succinct, accessible, and applicable. Focused on information transfer. Easy to access via multiple platforms, and doesn't require too many 'clicks'.	Mostly geared toward technology transfer and operational issues, rather than policy-level issues.
Science Digests	High level summary of recent science around several key topics. Provides an easy to understand summary of the work, with a link or reference for more information. Distributed weekly or monthly.	Provides an easy way for policy-makers to be aware of the most recent science. Also provides a direct link (if done electronically) to more information.	Can be too general to provide key details. Requires policy-makers to actively seek out more information on relevant articles.
Conferences / Workshops	Formal, structured information sharing through topic/thematic-based presentations, usually focused on research findings.	It works when it includes a discussion component specifically connecting science, operations, and policy (e.g. the Next Steppe Conference hosted by the BLM in November 2014). Provides opportunity to rub shoulders with researchers, managers, policy makers and promote the value and relevance of science.	Conferences and workshops still do not address much of the deliberative science/policy discussions. Too many fire conferences – need improvement in coordinating topics and reducing overall numbers of meetings.
Field Tours	Travel to a site where the issue at hand can be personally seen or experienced. Usually held in conjunction with conferences or workshops, but can be stand-alone events.	Provides an enhanced environment for creativity and problem-solving.	Place-based – may be difficult to use as a mechanism to address policy-level issues. Congressional rules can make it more difficult to get good attendance at field tours.
White Papers, Briefing Papers, Fact Sheets	Papers that synthesize the state-of-the-science addressing specific management or policy issues/ questions.	Provides a takeaway reference for one-on-ones/briefings, as well as a synthesis of key (sometimes citable) information for those seeking it. If done correctly, these papers reinforce information in a succinct and visual way.	Can over-generalize responses to complex issues. Need a way to anticipate producing these in advance of being asked for them by policy makers.

POTENTIALLY NEW/ ADAPTED MECHANISMS FOR CONNECTING SCIENCE TO POLICY

Summary of Key Findings

While many interviewees commented favorably on existing science delivery mechanisms, they made it equally clear that these mechanisms do not fully meet the need for those seeking science information to support policy development. Interviewees generally agreed that existing fire science mechanisms were principally developed to address tactical and operational issues of firefighting and management. Some interviewees specifically noted that the mechanism for integrating science into policy needs to differ from that used for operational issues. Our interpretation from the breadth of interviews is that it may not be that the mechanisms aren't helpful – rather, that the information itself is often incomplete or targets the wrong audience (i.e. not written for policy-makers who have little time to access it).

Interviewees generally conclude that policy-level science is really more about synthesis and determining applicability of a potential set of processes or procedures across a broad set of circumstances. By necessity it must factor in the socio-political and economic impacts of potential courses of action – these are factors that interviewees suggest are poorly represented in the current body of science. "Policy science" appears to be more about the picture one creates by putting puzzle pieces together, rather than focusing on the puzzle pieces themselves. The current technical, operational, and place-based science mechanisms do a good job at delivering the puzzle pieces – it's just hard to get the related pieces together in the same box.

Specifics

PERSONAL INTERACTIONS

When asked if they had specific suggestions for how to improve upon existing mechanisms, or implement new ones, numerous recommendations were provided. Again, policy makers focused mostly on personal communications, rather than online/automated "mechanisms:

DELIBERATE DIALOGUE

Most interviewees said that a more intentional, deliberate and regular dialogue between "those generating the knowledge and those making the decisions" needs to be in place. While this predictability may not seem to address the reality that crisis often drives the need to gather up science to inform policy, it may provide an opportunity for looking ahead/ anticipating emerging issues.

Providing a stronger tie between science and policy could also be undertaken more deliberately at an annual conference/ workshop specifically oriented to fire science and policy. Those proposing such an annual meeting suggested organizers would be charged with reaching out before the meeting to prioritize the issues most important to policy-makers and scientists. If it was scheduled prior to the budget process, some thought it could influence the flow of funding to science organizations. It is important to note that other interviewees cautioned about conferences requiring more time from policy-makers who are already over committed.

Other interviewees suggested creating a deliberate fire science/ policy dialogue at association meetings of often-overlooked partners. For example, attending and participating on panels at insurance association meetings, disaster management/ responder, public health, and other associations who have an overlapping interest with fire science and policy (even if they don't know it).

Better utilizing existing fire science meetings for science-policy discussions would also be fruitful, according to a number of interviewees. For example, adding a forum for interested community leaders at the annual Fire Ecology and Management Congress could help connect fire science with policy makers at state and local levels.

Another way to capitalize on existing fire science meetings would be the use of standing agenda items focused on science review and policy implications. These discussions could include presentations by scientists or translators, and help foster the connections between policy makers and people developing science. It would also help integrate science into the regular consciousness of policy makers in a way that doesn't require extra time or effort.

INDEPENDENT CONSORTIA

To specifically respond to "beltway" policy issues, some respondents suggested a mid-Atlantic science consortium established by an independent entity (e.g. the Wildland Fire Leadership Council) oriented towards policy makers. Scientists could provide in-person forums, discussions, colloquiums with decision-makers, with a focus on emerging

and long-term sticky wickets (e.g. economics and fire funding). Such a consortium could utilize agency scientists and local area academia.

The notion of an independent body playing a role in connecting science and policy was suggested by numerous interviewees. Such a consortium could also host workshops with participants from a variety of levels within a diversity of organizations, representing different disciplines and expertise.

CULTIVATING TRANSLATORS/FACILITATORS

Interviewees consistently emphasized that people who can bridge the gap between science and policy are critical. Our interpretation is that there is a need to cultivate people with this skill set – people who understand the science and also understand policy issues and needs, and know how to best present "digestible" science to policy makers. Translators can help interpret new science within the framework of existing science to help policy-makers understand if the work provides a complementary or competing framework. And facilitators can ensure that the right people are in the room for critical conversations.

ON-LINE/ON-DEMAND

As we learned from the interviewees, the primary consumer of online/on-demand information would likely be policy advisors, rather than policy makers.

Policy advisors emphasized the need to "push science out." Most felt it would be increasingly helpful to filter the kinds of materials or topical areas for updates – that is, the user would pick and choose what information was sought and at what frequency (e.g. as done through E&E Publishing codes). Another mechanism could be the establishment of community of interest "distribution groups" for topics of interest.

Search engines need to be robust and based on key characteristics of the information being sought – and that the characteristics of information needed for policy support may vary from traditional operational and tactical science search engines. Some felt that Google was an underutilized search engine, and that it might be worth investigating more specifically for fire science applications, and for its ability to adapt to both mobile and other types of displays.

It was further suggested by a small number of interviewees that JFSP and other federally sponsored databases provide hyperlinked references to download papers. There is frustration with some policy advisors searching for information that is published in journals behind firewalls (pay-for-downloads).

BUILD A BETTER NETWORK

Building trusted, personal networks is difficult to "mechanize," but there are lessons learned for how to do this successfully. Interviewees suggested building relationships with the high-level staff of key elected officials and agency leadership, as these high-ranking officials often have high turnover and too broad a span of control to focus on fire science issues.

Interviewees suggested being strategic about those who are sought to influence (governors, Office of Management and Budget, Government Accounting Office, and congressional committees), and to not overlook the associations of people impacted by fire (e.g. insurance companies, water industries).

SCIENTIST-DRIVEN COMMUNICATIONS

While policy-makers could do a better job to actively seek out science, scientists could also improve their efficacy in presenting research findings to policy-makers. Interviewees noted that getting the research done is the easy part, and it is more difficult for scientists to share it more broadly with the policy community.

Several interviewees (particularly policy advisors) suggested that it can be difficult to understand the relevance of scientific research. From these interviewee's perspective, referred articles should include a historical summary at the beginning to provide a framework for the work done to date. They should also include a synthesized version specifically geared toward managers that includes a well-written abstract with a summary or conclusion of results that would be short, to the point, and easy to understand (e.g. USFS "Rainbow Series"). The summary should also clearly describe how the research connects to and could influence policy needs (the "so what")

Some suggested that under the present framework, there is little motivation for scientists to create this type of synthesis document. This could be a role for a translator, who understands both the science and policy needs and can provide an interface between research scientists and policy-makers.

Some interviewees expressed the view that scientists have a difficult time understanding policy-makers' space. They suggested JFSP facilitate sessions on how scientists can

better communicate with policy makers, and help each other understand their respective needs.

TASK GROUPS/TEAMS

Several interviewees suggested convening task groups/teams when high priority policy issues arise, especially when they are time-critical. Such teams would include scientists, management, academia, and others across a wide span of disciplines (e.g. social science, economists) to work in a focused way. A small number of interviewees advocating for this mechanism noted the competitive nature of labs and scientists, but felt this could be overcome for the greater good. It was suggested that those providing the funding (e.g. JFSP) could mandate this approach.

Other interviewees proposed creating a group to complete fire policy reviews, including reviewing priority fire policies across geography. This effort would ensure that relevant fire policy summaries are prepared and ready to go when policy needs arise.

THINK TANK(S) / NATIONAL NODES

Interviewees spoke of the (desperate) need to provide a more deliberative space for thinking about science needs to support policy issues, and how to apply scientific findings to policy decisions. With a look to the future, a group made up of diverse disciplines and from different organizational levels and entities could get a little bit ahead of the critical issues, and identify the funding and resources needed to do the work.

In a similar vein, several interviews suggested a "national node" -- such as a Federal Fire Science Coordination Committee – would broaden multi-agency involvement in questions around fire science and policy and result in stronger, more integrated policy conversations.

PUBLIC AND EDUCATIONAL PROGRAMS

Some interviewees noted that the public has a key role in influencing policy. Some of the key issues facing fire policy include communities at high risk to fire, as well as public perceptions and reactions to fire events. Educating the public about fire science is an important part of the interface between fire science and policy.

These interviewees noted that journalists report on a variety of fire issues and are pivotal in shaping public opinions and priorities of fire. Educational programs for journalists could help them know how agencies think about fire, where it is used and where it can't be used. These programs would encourage journalists to write about fire, and influential publications could bring policy needs and issues to the forefront.

Others suggested that fire science and policy both need a greater presence in the public eye. Development and adoption of policies should include public review, at the national, regional, local and community scale. This review process, and the important dialogue that would accompany it, could start to change the public perception of fire, including its use in the landscape and interactions at the wildland urban interface.

IDENTIFYING/PRIORITIZING SCIENCE NEEDED TO INFORM POLICY DECISIONS

Summary of Key Findings

Many interviewees felt that they/their agencies were well-represented in processes used to identify and prioritize science needs. However, nearly all interviewees expressed that it would be beneficial to further broaden the participation in these discussions, including a diversity of stakeholders.

Among some interviewees, there is a feeling that responding to "issues of the day" has passed (we note that this is in contrast to those who earlier identified that "crisis" still drive the importance placed on integrating science with policy). For others, there is still a tension between strategically identifying and prioritizing policy/science needs and responding to urgent requests for information. And for some, it seems that progress on big issues is elusive – that the big issues of yesterday are much the same today.

There was agreement regarding the need to consider how the science information will be used and when it is needed when prioritizing science needs. And, as a small number of interviewees suggested, it may be that the focus should be on how science will contribute to a specific decision, rather than the current practice of tying science needs to management questions.

Specifics

REDUCE DUPLICATION

Numerous respondents spoke about the need to better define the research that is already underway when identifying and prioritizing science needs.

- *Robust collaboration at the national level would also help identify who is working on what, where there are gaps in science based on what is needed at the policy level. Put this together with field needs and then prioritize, rank and rate – including national priorities, and national perspectives. This would give a true evaluation of priority setting for field and policy science.*

- *We need more distinctions between research – to work together and share information so that there isn't duplication of research. In [a recent policy/science agenda report], all projects sounded the same.*

BE OBJECTIVE-BASED/STRATEGIC

When identifying and prioritizing issues that would benefit from additional science, many interviewees strongly stated the importance of articulating up front how the science information would be used. True integration of science and policy must begin with direct feedback as to how science information will directly affect a policy decision. Rather than focusing on science that addresses "management questions," the focus should be reoriented to science that addresses a decision to be made, and the kind of information that would influence it (e.g. uncertainties, risk – other decision criteria). Whether based on questions or decisions, interviewees want science investments tied to clearly stated objectives for the science.

- *Who is the stakeholder? How will they use the information -- how will it be used in the decision? What is the VALUE of this information to the decision? This is important to know for making science investments.*

- *We must try to assure that when we are investing money in science, the outcomes of endeavors (primary or secondary) will actually answer questions at the policy level (75% anyway). This is not the time to simply "build the body of knowledge."*

- *The strongest JFSP proposals have asked managers if these are the right questions, if this is a high value investment.*

Interviewees also wanted to see a strategic prioritization of science priorities to reflect policy issues expected in five, ten or fifteen years from now. For example, invasive plants are expected to become a significant problem in some ecosystems—science needs should be prioritized now that will ensure science is ready to inform those policy questions when they come to the forefront.

Some interviewees also suggested prioritizing science needs by looking at the current barriers to accomplishing land management objectives. A discussion of those barriers and what it would take to resolve them would reveal some policy issues and a host of research needs. Those needs could be prioritized and addressed to meet land management objectives.

NEED TO BROADEN THE CONVERSATION

While there was affirmation that the policy makers and scientists who need to be involved in identifying and prioritizing science generally are involved, interviewees consistently identified the need to broaden this conversation to stakeholders and non-agency groups.

- *One of my concerns is that [they] invite people to the prioritizing conversation and some show up, but it's sort of window dressing – stakeholders really don't have much influence in how funds are allocated. This has to be a genuine effort – this involvement needs to affect the outcomes and stakeholders need to know that it did.*

Interviewees suggested identifying critical organizations/entities who should be included and ensure they have a representative at the table. This includes those entities who haven't historically been involved, but should be now. Those identified include (but are not limited to) those who work in insurance, natural disasters, public health/air quality, tourism, economics, and state and local governance.

- *Priority-setting and designing research questions needs to involve everybody.*

- *Communities should also have a voice in prioritizing needs, in large part because they create a constituency that is of interest to policy-makers. With enough voices from the public, policy-makers will find a way to address the problem in front of them.*

- *The public helps with prioritizing needs too. Climate change—most people believe that is going on now. It's become a fertile ground for scientific research.*

NEED FOR MORE STRUCTURE

Some interviewees expressed the need for more structure in identifying issues and establishing priorities. Their vision included a formal call for issues, an annual dialogue with a broad base of stakeholders, and application of decision criteria based on objectives identified by the fires science and policy communities. These annual discussions would be documented, with the notes widely shared to bring transparency to the decision process. There could be a parallel, equally structured process to address emerging issues and opportunities.

Others suggested creating an independent body to identify and prioritize emerging science needs. This entity could talk to operational land managers, ecologists, biologists, hydrologists, and others to find out their emerging needs. The group would also consult with policy-makers nationally and in D.C. The role of this independent body would be to bring together the needs of these groups to identify a series of priority science needs.

TIE TO EXISTING PLANS AND DATA

Several interviewees pointed out that many program areas have their own science agenda (e.g. Joint Fire Science Program Smoke Science Plan). When identifying and prioritizing issues, it is critical to connect to these individual documents to validate prior efforts and agreements. Conversely, these kinds of issue-specific science plans need to be kept current and include a broad constituency in their development.

In addition, some interviewees suggested that priorities presented to policy-makers should be based on a comprehensive analysis of wildland fire reporting at federal, state and local levels. This data on fire experience will shed light on science question necessary to address wildland fire issues.

FOSTER INNOVATION

Future policy challenges will require innovation. A small set of interviewees recommended catalyzing and embracing innovation, while maintaining an overall framework for priorities. While policy-makers should set a general framework for the questions that need to be answered, there should be flexibility on developing innovative approaches to delivering answers within that framework.

- *Everything shouldn't come to the top for approval, but instead there should be a top-down framework for the science needs, but a bottom-up practice for how to deliver.*

BUDGETS

There was general acknowledgement that research budgets are declining. Some needs can be anticipated and planned, while others are relatively immediate, crisis-driven needs. This creates a challenge for strategically identifying and prioritizing science investments.

- *USFS spends 52% of the entire agency budget on fire management, with less than 1% on fire research. This is an order of magnitude less than a typical R&D budget for a private company.*

Several respondents pointed out that research priorities need to be relevant. They recommended allocating a portion of the research budget to specific agencies to conduct research that is a priority for them, and monitor the outcomes.

- *The difficulty is that those that control the funding also control the research. If management isn't willing to embrace certain research, then it doesn't get done.*
- *The Forest Service Research & Development Program has been following this approach (allocating a portion of the research budget) for some time when it comes to research that is a priority for tribes.*

Others felt that agencies should be vested in the overall research budget if they wish to be part of directing where funding goes.

- *Ask partners to play a role in financing the work if they want to be part of the prioritization conversation.*

Still others noted that research funding ultimately comes from Congress or private entities, and often that funding is spurred by large fire events. As a result, research can be focused on specific topics that may not necessarily be overall priorities for the agencies. It is important to talk directly with appropriations staff to help them understand how priorities have been determined and why science is necessary.

- *We need to have a better decision system on investment in our scientific pursuits that includes an ongoing active dialog between scientists and policy-makers. Policy-makers need to have regular visits with people who make the decisions on where the science dollars are invested.*

NEXT STEPS

Assessment Report

The JFSP Governing Board, interviewees, and selected members of the fire science and policy community will have the opportunity to review and provide feedback to this draft Assessment Report. The final Assessment Report will be presented to the JFSP Governing Board in June 2016.

Work Group

In June 2016, the U.S. Institute will begin convening a work group of fire science and policy actors to collaboratively design a process and operational protocols for developing actionable recommendations to improve fire science integration into policy decisions. This work group is expected to begin its work by mid-summer, and present recommendations to the JFSP Governing Board by early 2017. Feedback from the fire science and policy community will be iteratively incorporated into development of these recommendations. Implementation is expected to be complete by November 2017.

APPENDIX 1: GUIDING QUESTIONS

These questions are intended to solicit specific, actionable recommendations, and address 1) the inteviewee's perspective of how the current science-to-policy "system" functions overall, and 2) how the interviewee personally experiences the connection of science and policy.

1. What is your current role in the development of wildland fire policy?
2. How do you currently obtain scientific information relevant to wildland fire policy issues?
3. What forms of science exchange are most useful to you (e.g., forums, workshops, facilitated discussion groups, briefs, digests, social media, etc.)? Least useful? Why?
4. How do you integrate and interpret scientific information in the context of specific policy issues? What are some examples of success? Is there a need to improve this process?
5. What areas of wildland fire policy need to be informed by wildland fire science? What are the areas of wildland fire policy that have priority needs?
6. How do you determine and communicate science/research needs relevant to policy issues? How do you wish to exchange research needs?
7. What kind of assistance could help you/policy-makers determine their science needs and priorities?
8. There are a number of current mechanisms/entities to exchange fire science information. Do you think there is a need for a new entity to specifically serve policy-making needs? Or, should these roles be performed as new or enhanced functions of an existing entity?
    a. If you think this role should be performed as a new or enhance function of an existing entity, what should it look like or how should it function?
9. Are there other actors that participate and influence wildland fire policy that we should talk with?

APPENDIX 2: INTERVIEWEES

The authors gratefully acknowledge the contributions of the interviewees who willingly contributed time and their experience to this assessment.

Name	Affiliation	Location
Academia		
Steve Pyne	Arizona State University	Arizona
Norm Christensen	Duke University	North Carolina
Wallace Covington	Northern Arizona University, Ecological Restoration Institute	Arizona
Diane Vosick	Northern Arizona University	Arizona
Scott Stephens	University of California-Berkeley	California
Mark Brunson	Utah State University	Utah
Agencies/Departments		
Bodie Shaw	Bureau of Indian Affairs	Oregon
Mark Jackson	Bureau of Indian Affairs	Idaho
Paul Peterson	Bureau of Land Management	Nevada
Ron Dunton	Bureau of Land Management	Idaho
Steve Ellis	Bureau of Land Management	Washington, D.C.
Paul Peterson	Bureau of Land Management	Nevada
Jolie Pollet	Bureau of Land Management	Idaho
Robert Bonnie	U.S. Department of Agriculture	Washington, D.C.
Kim Thorsen	U.S. Department of the Interior	Washington, D.C.
Dick Bahr	U.S. Department of the Interior – Office of Wildland Fire	Idaho
Jim Douglas	U.S. Department of the Interior – Office of Wildland Fire	Washington, D.C.
Paul Steblein	U.S. Department of the Interior – Office of Wildland Fire	Washington, D.C.
Peter Teensma	U.S. Department of the Interior – Office of Wildland Fire	Washington, D.C.
Jeff Rupert	U.S. Fish and Wildlife Service	Virginia
Kim Van Hemelrcyk	U.S. Fish and Wildlife Service	Idaho
Becki Heath	U.S. Forest Service	Oregon
Calvin Joyner	U.S. Forest Service	New Mexico
Jim Hubbard	U.S. Forest Service	Washington, D.C.
Vicki Christiansen	U.S. Forest Service	Washington, D.C.
Elizabeth Reinhardt	U.S. Forest Service – Fire and Aviation Management	Washington, D.C.
Pete Lahm	U.S. Forest Service – Fire and Aviation Management	Washington, D.C.
Danny Lee	U.S. Forest Service – Eastern Forest Environmental Threat Assessment Center	North Carolina
Dave Peterson	U.S. Forest Service – Pacific Northwest Research Station	Washington State
Colin Hardy	U.S. Forest Service – Rocky Mountain Research Station	Montana

Dave Peterson	U.S. Forest Service – Rocky Mountain Research Station	Utah
John Phipps	U.S. Forest Service – Rocky Mountain Research Station	Colorado
Bill Kaage	U.S. National Park Service	Idaho
Dan Buckley	U.S. National Park Service	Idaho
Greg Eckert	U.S. National Park Service	Colorado
Nate Benson	U.S. National Park Service	Idaho
Consultants		
Gary Morgan	Consultant (formerly with the Bushfire Cooperative Research Centre)	Victoria, Australia
Tom Quigley	Consultant (formerly with the U.S. Forest Service, Pacific Northwest Research Station)	Utah
Ann Walker	Consultant (formerly with the Western Governors' Association)	Oregon
Non-Governmental Organizations		
Will May	International Association of Fire Chiefs	Florida
Jim Erickson	Intertribal Timber Council	Washington
Chris Topik	The Nature Conservancy	Virginia
Dan Johnson	Western States Air Resources Council	Washington
Retired		
Tom Harbour	Retired (formerly U.S. Forest Service – Fire and Aviation Management)	Washington, D.C.
Rich Lasko	Retired (formerly U.S. Forest Service)	Montana
Tom Zimmerman	Retired (formerly U.S. Forest Service)	Idaho

APPENDIX 3: SCIENCE NEEDED TO INFORM POLICY

Summary of Key Findings

We received a large number of responses to the question of "what policy issues are most in need of science" – we've included a summarized list of them below. And while this list is in alphabetical rather than priority order, without a doubt the most frequent response we received to this question revolved around the need for socio-political science to inform fire policy. Other policy issue categories identified by a large number of interviewees include air quality, climate change, and management.

As we talked with interviewees about policy issues most in need of science, several spoke to us about their overarching perspective of science priorities. Their quotes in the "Specifics" section below are included as an introduction to the list of identified policy issues in need of science.

Specifics

OVERARCHING PERSPECTIVES ON SCIENCE PRIORITIES

Many interviewees spoke to the need to have science be driven by management decisions or policy issues – that is, that foundational or basic (rather than applied) science was a luxury that could no longer be afforded. Several interviewees stressed the need for science to be more "holistic," rather than a series of individual, component parts. And some interviewees expressed the view that policy makers need to take more initiative to understand the science that has already been done, rather than asking for new research or synthesis of existing research.

- *There is always a balance needed between foundational science and policy-driven science. At top of the list is social science that helps*

us understand what people really think about the role of fire and how it affects their landscapes and communities. We focused in the past on the physical attributes of fire (how fire propagates, how structures ignite, and the fire ecology of plant communities), so we don't understand how the people who receive fire services, those who are proximate and not on fire lands, view these issues.

- *We need comprehensive, interconnected thinking about resolving fire policy matters: Air quality impacts, maintaining natural resources for future generations, preventive vegetation treatments. Social and long-term impacts, economic, intergenerational. We tend to fracture science into individual parts. The narrower the focus, the less likely the decision will be useful for "capital P" policy.*

- *I am always surprised by "we need information on this." Something is missing in our science delivery. I feel we have studied some of these issues for years – I'm a little disappointed at how little grasp some on the management side have of what's been done in the science arena. "Could you guys synthesize this for us¿" Well, it's already been done numerous times.*

AIR QUALITY

- Tradeoffs between particulates introduced in prescribed burning and those that may be generated under a wildfire scenario
- Toxic air pollutants -- carcinogens that add to downwind impact and the cancer risk to the public
- How to monitor air quality in an extremely dirty environment (high degree of smoke overpowers other constituents)
- Plume height and dynamics – we disperse plumes based on a lot of assumptions, rather than physical principles, including energy release information from the fire itself and how this interacts with the environment above it
- Emission reduction techniques for ozone and precursors, FPM 2.5, black carbon

BIOLOGY

- Biology of fire, including its origins in oxygen and exploring biological solutions to fire

CLIMATE CHANGE

- Apparent short-circuiting natural lifecycles of vegetation communities through either too much or too little fire. We need to know the new species/mutation cycles -- the breadth of acceptable outcomes with pathways yet unknown -- complex adaptive systems we've never seen before (e.g. Alaska).
- How to manage carbon (sinks and sources) - various perspectives on carbon modeling to help with tradeoffs of prescribed and wildfire to reduce biases in the models and how the information is used by policy makers
- How fire will change with climate change, including invasive species, fire behavior, fire severity, and ecosystem response to fires

ECONOMIC ISSUES

- How to inform social and ecological tradeoffs of spending funding on fire suppression versus on other resource work
- How to recover lumber mill infrastructure to support timber harvest to accommodate increasing need for fuel treatments, and to salvage/begin restoration of burned acres
- Scientific return on investment models for fire prevention and suppression, and how to make it digestible to policy makers
- How to develop budgets over a period of years using cost avoidance models
- Effectiveness and rate of return, especially at a regional and national scale. Spending billions of dollars suppressing fires, protecting communities, and addressing vegetation management issues, without an objective sense of the effectiveness of these investments.

FIREFIGHTER BEHAVIOR AND SAFETY

- Socio-political element of fire-fighter roles, responsibilities and missions
- How to address the increased risk of fatalities that occurs during initial attack
- Impacts of subjecting fire fighters to dangerous, highly uncertain situations and the implications on behavior (suicides, abuse, drinking). Research on how this PTSD-type behavior is impacting individuals, communities, and how it can be addressed.

FIRE SUPPRESSION

- For ongoing fires, type of decisions made in using resources and how those decisions are made with those entities who are responsible. How readily accessible is the information and how easily can it be understood and accessed?
- Private landowners have a long history on the land and should be tapped for their knowledge of how fire has historically spread through their lands
- Effects of night operations on fuel suppression
- The physical component of the tools and processes used in firefighting -- we are using the same fire tools as we did at the turn of the century. Is there any problem with this?
- Unwanted wildfire and effects of alternative resource investments on outcomes. Is it more effective to have more retardant drops vs ground crews? What would differing investments mean in terms of outcomes?
- Utility of FLAME ("FireLine Assessment Method") model and the currency of its science basis
- Consequences of an aggressive fire exclusion policy
- Preparedness, suppression and the effectiveness of initial attack models
- Equipment effectiveness studies to help reduce costs and reduce equipment exposure

FIRE WEATHER

- How to use technology or modeling/remote sensing platforms to take the place of fire weather from the weather service that is no longer funded – emerging issue

HYDROLOGIC ISSUES

- Is it possible to link fire management and water management? If western conifer forests are more resilient to climate change, will this positively affect water production?
- Fire science and integration with water -- How to build resilience to a loss of water over time from fires

INSECTS AND DISEASE

- Private landowners' knowledge of how insects and disease historically spread through an area.

MANAGEMENT

- Are we efficient and effective in transitioning policy and strategic planning to consistent implementation across multiple bureaus and partner agencies?
- Dealing in an all-lands concept – big questions about what you do on the restoration side to prevent catastrophic landscapes. How you prioritize?
- Differential outcomes based on differences in post-fire management
- Science that informs planning, and realizing that we are having the same discussions in the resource management world. Effectiveness directly informs how we develop processes for accountability.
- History of fire and fire management, how that does and should inform current policy
- Integrated and comprehensive study of fire policy and how it has been implemented from an economic, ecological and social perspective

- Federal government response to wildland fire, especially with regard to the threat of fire as compared to hurricanes and floods. What are the implications for mitigation work instead of incident response?
- Identifying and describing a fire culture, and determining its effectiveness

POST-FIRE ACTIVITIES

- Predictive modeling – under what circumstances will treatments be effective (seeding method, seed viability, etc.)

RARE HABITATS

- Fire impacts on rare habitats (endemic species) - how does generalized science apply in these specialized communities?

RESTORATION/RESILIENCE

- How to restore ecosystems to enable them to withstand fire (address this problem other than through fuels management). We've fundamentally changed the fire program since 2009 to address creating resilient forests – why isn't it working?
- Best management practices for how much fire can help to restore forests to a resilient framework
- Ecosystem services (e.g. drinking water system for Helena, WUI) – how do you determine tradeoffs for natural system management versus the need for ecosystem services
- Landscape conditions and how fire can change the ecology and trajectory of the landscape

RISK

- Science of risk management -- the culture of reward/consequence that a decision-maker may experience. Risk is framed within the lens of the person deciding how to move forward. More complex for policy than on-the-ground operational decisions.
- Risk of fire on the landscape: terrain, weather, preparedness and how this should dictate where to treat in advance, where to be prepared to react
- Fire science for woodlands and PJ vegetation types - risk transference is occurring from those areas we are focused on to these areas where we are not
- Risk management to identify opportunities to reduce accident rates
- Co-management of risk, including shared risk between homeowners, communities, local policy makers

SOCIO-POLITICAL ISSUES

- How people are affected by prescribed fire/wildfire -- both firefighters and landowners (risk, safety)
- Health and human performance elements (safety)
- The social realization of fire on our landscapes - how people understand fire in their environments, their expectations for service levels and fire suppression, and the willingness to take individual actions to reduce risk
- Using social and economic science to help describe fire management outcomes.
- How communities communicate and absorb information. Who really needs to know what in order to proceed with a decision?
- How to operate in the social media world (overloading people with too much information)
- How fire and aviation personnel process information – decision science, human behavioral science – to contribute to more holistic view of wildland fire
- Land use policy in fire adapted ecosystems, including barriers to local governments adopting and enforcing policy, land use codes, development regulations that address wildland fire risk
- Behavior change research to understand interface between fire and human communities, including how to protect homes and how to get communities engaged in a decision-process that would result in actions to reduce risk

VEGETATION TREATMENTS

- How do you determine where to prioritize vegetation treatments? What should they look like?
- How to address biomass generated from thinning forests when there is not enough wood volume to offset the cost of removal, and air quality issues prevent burning
- Expedited fuels reduction strategies (reforming NEPA not viable). Lesson learned from successful/unsuccessful collaborative projects
- Synthesis and science transfer regarding the efficacy of fuels treatments; specifically, prescribed burning. A lot of funding for hazardous fuels has dried up due to lack of proof of effectiveness at a policy level.
- Effectiveness of substituting logging for fire's ecological role
- Fuel treatment effectiveness/cost-benefit – the effectiveness of treatments on a programmatic level, rather than specific local level
- Vegetation and fuel management: has fuel treatment research exceeded the management capability to implement? How can fire restore landscapes?