Wildland Fire Science Needs in Oregon and Washington

Local and regional research availability, applications, and gaps

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About the Northwest Fire Science Consortium:

The Northwest Fire Science Consortium works to accelerate the awareness, understanding, and adoption of wildland fire science in Washington and Oregon (excluding the SE corner). It connects managers, practitioners, scientists, and local communities and collaboratives working on fire issues on forest and range lands. The Northwest Fire Science Consortium is one of the 15 regional exchanges established by the Joint Fire Science Program's Fire Science Exchange Network to bring fire science users together to address regional fire management needs and challenges. Each regional exchange provides current and regionally-relevant wildland fire science information to users in the region. For more information: http://www.nwfirescience.org/.

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NORTHWEST FIRE SCIENCE CONSORTIUM

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Executive summary

The Northwest Fire Science Consortium (Consortium) works to accelerate the awareness, understanding, and adoption of wildland fire science by connecting users in the Pacific Northwest with the most useful resources available. These efforts require an ongoing understanding of how users access wildland fire science, the challenges and opportunities that they experience in using different types of research, and topics where more information is needed. Previous research, including a prior assessment by the Consortium in 2011,[1] has highlighted the importance of local or regionally-relevant information among fire science users. In this assessment, conducted in 2018, we sought to update the needs assessment conducted in 2011 while investigating topics where local research was most needed. The specific objectives were to:

1. Characterize wildland fire science use among Consortium users;
2. Understand Consortium users' perspectives about applying local and nonlocal research in their work;
3. Identify the place-specific research needs of Consortium users;
4. Develop recommendations to help guide the Consortium in outreach efforts.

We conducted interviews (n=20) with key wildland fire managers and stakeholders, and surveyed a broader audience (n=167) of Consortium users. Participants in both efforts worked primarily in Washington or Oregon and represented a range of disciplines, positions, and agencies or organizations, all engaged in wildland fire.

Key findings:

Use of wildland fire research

Survey respondents identified patterns and preferences for using wildland fire research similar to those identified in the 2011 assessment. Specifically, our results indicate that:

- **Use of research publications on wildland fire is an important aspect of respondents' work positions.** Fifty-seven percent of survey respondents reported that they used scientific research at least once per week and 34 percent used it at least once per month to help inform decisions in their wildfire-related jobs.
- **Consortium users access research publications from many different sources.** Survey respondents most commonly used general internet searches, the Consortium, resources from other employees or partner organizations, and Google Scholar to access wildland fire research. Respondents indicated that they relied on a variety of sources, including formal and informal social networks, depending on the issue and the availability of information.
- **Research project summaries and syntheses continue to be valuable resources for Consortium users.** The importance of summary and synthesizing documents was noted during the 2011 assessment. Findings from this 2018 assessment suggest that the value of summary and synthesizing documents has persisted, and that these resources can have long-term utility for fire science users in the region. Seventy-eight percent of survey respondents indicated that briefs or digests that summarize the main points and implications from wildfire research projects were important or very important for their work. Participants also indicated that documents that synthesize multiple research efforts on a topic or across geographic regions were especially useful for helping them to understand trends and implications for their local context.

The importance of local and nonlocal research

The 2011 assessment found a need for more local information, and initial interviews from this assessment indicated that site-specific information needs had persisted and become even more pressing for some fire science users in Oregon and Washington in recent years. Key findings highlight the utility of both local and nonlocal research, the barriers that respondents perceived to using nonlocal research, and details of where and when local research is most needed:

- **Local research has widespread importance for nearly all wildland fire science users.** Nearly all survey respondents (96 percent) reported that research conducted in the same local area as their work was moderately or very important to their job. The degree to which respondents valued nonlocal information was more varied, but all respondents felt that research conducted in other areas had a least some degree of utility. Fifty-three percent of respondents indicated that nonlocal research was 'sometimes useful.'
- **Barriers to applying nonlocal research are based on a diverse range of site, community, and policy considerations.** Survey respondents rated environmental differences between sites (e.g., ecological characteristics like soil and vegetation type, current climate characteristics, climate projections) as significant barriers to applying nonlocal research. However, social considerations were also reported among the most significant barriers to applying research from other areas. For example, most respondents (63 percent) indicated difficulties "reaching consensus about management decisions with nonlocal research" as a moderate or significant barrier for using nonlocal research. Finally, some interviewees discussed how policy requirements for geographically-specific data influenced the applicability or usefulness of nonlocal research.
- **The value of local versus nonlocal research varies across ecosystems and across different scales of work.** Survey responses and interviewee insights alike highlighted nuances in the utility of local and nonlocal research across different geographies. Some participants described how work at larger scales (e.g., across regions or states) relied less on local conditions and therefore had less need for site-specific research. Others noted that it was easier to apply nonlocal research in certain ecoregions because the ecological conditions were similar enough to other areas where more research had been conducted. Some participants described how it was difficult to apply nonlocal research in certain areas, particularly riparian areas and historically less fire-prone areas, because there was little or no wildland fire research conducted in comparable ecosystems.

Topics where local wildland fire research is most needed

The survey asked respondents to rate the extent to which more local research was needed on 159 specific wildland fire topics in their work areas. We then ranked the top 25 local research needs by their average rating across all respondents, and grouped top needs thematically. Thus, results highlight the topics rated as the most significant local research needs across the diverse survey population. The most significant local research needs in specific landscapes, areas, or ecosystems may differ. Overall, respondents indicated the greatest local research needs for the following topics:

Communication, public involvement, and other social dimension of wildland fire. Respondents consistently ranked social aspects of fire management such as working with partners; understanding public expectations, knowledge, or attitudes; and communication with stakeholders as high needs for more local research. Nine of the 25 highest-ranked topics for local research needs concerned social aspects of wildland fire. Five of the top eight involved understanding public perceptions or communicating with the public. Specifically, respondents ranked "communicating with the public about fire impacts" as the topic with the greatest local research need out of all 159 topics on the survey, with 89 percent of respondents indicating a moderate or significant need for more local research on the topic.

Climate change and its effects. "Climate change effects on local forest conditions" was rated as the second-greatest local research need across the topics we asked about, with 87 percent of survey respondents rating it as a moderate or significant need. "Climate change impacts on local range, shrubland, or grassland conditions" was also rated as a moderate or significant need by 72 percent of participants, showing that concerns about climate change on local vegetation expanded beyond forest ecosystems. The most-needed topics also included research on climate change effects on local: fire regimes, wildland fire behavior, and fire impacts.

Fuels mitigation and prescribed fire. Survey respondents highlighted the importance of understanding the effectiveness of fuel treatments locally. The 25 topics rated as the greatest local research needs included five different topics related to fuels mitigation techniques or effectiveness. In particular, respondents indicated that more local research was needed on: the effectiveness of prescribed fire to restore natural conditions, burn windows for conducting prescribed fire, the effectiveness of prescribed fire specifically to mitigate wildland fire risk, modelling fuel treatment effectiveness, and the effectiveness of fuels mitigation techniques to reduce fuel loads or wildfire risk.

Fire effects. Survey respondents highlighted a need for more research on the effects of fire on their local landscapes. Eighty-five percent of respondents reported that "fire effects related to landscape or ecological health," was a moderate or significant local research need. Other top needs included local research on: the effects of fire across longer temporal scales, factors that affect landscape resiliency, and the effectiveness of post-fire restoration strategies.

Wildland fire in riparian areas. Throughout the survey, respondents consistently highlighted the need for more research and information on wildland fire in riparian areas at all scales. When asked to evaluate local research needs, survey respondents rated all aspects of wildland fire in riparian areas as high research needs in their local work areas. More than three-quarters of respondents considered "the role of fire in affecting fish habitat" and "understanding the role of fire in riparian areas" to be moderate to significant local research needs.

Recommendations:

We developed several recommendations based on this study's findings to help the Consortium meet the needs of fire science users in Washington and Oregon:

1. Develop and share examples or case studies of local wildland fire mitigation, management, and research efforts.
2. Facilitate and distribute localized research on the most needed wildland fire topics.
3. Focus on and encourage synthesizing documents on needed topics.
4. Consider ways that different types of unpublished data and experiential knowledge could be made more accessible.
5. Continue providing publications and information in a variety of formats.

Background

The costs and complexity of wildfire management have increased due to the effects of widespread wildfire suppression practices during the last century, increased housing density in fire-prone areas, climate change, and diverse management objectives (e.g., ecological health, property protection, public safety and health). For the most effective wildland fire management in these contexts, wildland fire managers and practitioners need to use the best available science to inform planning and decisions. Incorporating scientific research findings into fire planning, mitigation, management, and recovery is important in the development of defensible practices. Although there is a large body of existing wildland fire research and findings, key questions about the best ways to use this information persist for many managers and practitioners, particularly when research for the actions in question has been conducted in regions other than those where managers are implementing decisions.

Previous research, including a prior assessment by the Northwest Fire Science Consortium (Consortium) in 2011, has highlighted the importance of site-specific and regionally-relevant information among fire science users.[2] Many fire managers and practitioners express uncertainty about whether available research is applicable to their specific work area or region because of place-specific climatological and ecological characteristics that affect fire risk, behavior, and effects.[3] For these same reasons, reaching consensus with stakeholders and gaining public trust and support around management actions can also be more difficult without place-specific research.[4] Access to locally-relevant wildland fire information is often needed to facilitate reliable and defensible decision making.[5]

As the Consortium works to accelerate the awareness, understanding, and adoption of wildland fire science by connecting users with useful resources, a better understanding of place-specific information needs can help prioritize efforts. In this assessment, conducted in 2018, we sought to update the previous needs assessment while investigating topics where research was most needed in the Pacific Northwest. The specific objectives were to:

1. Characterize wildland fire science use among Consortium users;
2. Understand Consortium users' perspectives about applying local and nonlocal research in their work;
3. Identify the place-specific research needs of Consortium users;
4. Develop recommendations to help guide the Consortium in outreach efforts.

Approach

The following is an overview of the approach for this assessment. More detailed methods can be found in Appendix A (see page 28).

In the spring of 2018, we conducted telephone interviews with 20 key stakeholders in Washington and Oregon. Interviewees included a) Consortium advisory board members, who represented a broad range of positions and interests in wildland fire science use, and b) several additional key stakeholders recommended by advisory board members as having valuable views and comprehensive insights on wildland fire science use, data gaps, and needs in the Pacific Northwest. We asked interviewees how they accessed and used wildland fire research, their greatest research needs, how they approached using non-local research findings, and specific research topics where they felt more site-relevant research was needed.

With insight from interview findings, we created a web-based survey to further investigate wildland fire science use and science needs across a broader audience of Consortium users. The survey included questions about the respondents' job position and geographic region, their use of local and nonlocal scientific research, and their needs for locally-relevant wildland fire research. It also included opportunities for respondents to add open-ended comments or insights about wildland fire research and needs.

In the fall of 2018, we administered the survey to recent (since 2016) Consortium users based in Washington and Oregon who had participated in webinars, workshops, field tours, or signed on to the Consortium listserv. This included fire science users from government agencies, NGOs, tribal entities, community-based and collaborative organizations, and private individuals. Participants were involved in fire management, mitigation, prescribed fire, smoke management, public communication and collaboration, policy-making, and related fields. We excluded users who identified research as their profession. The survey sample size was 374 individuals. We sent each individual three emails, each approximately one week apart, describing the project and inviting them to participate. We closed the survey two weeks after the last reminder email was sent and considered those who had not taken the survey at any point as non-respondents. In total, 167 respondents completed the survey (75 from Washington and 92 from Oregon), a response rate of 45 percent (see Table 1, below).

Table 1 Survey sample size and response rates by state

	Sample size	# of respondents	Response rate	% of respondents
Oregon	225	92	41%	55%
Washington	149	75	50%	45%
Total	**374**	**167**	**45%**	**100%**

Results

The findings presented below follow the questions and results from the survey. Pertinent insights and findings from interviews are included where applicable.

Respondent characteristics

Survey respondents represented diverse ecoregions and a range of positions, professional responsibilities, experience, and agencies or organizations. Respondents worked in all areas of Oregon and Washington, and every ecoregion in the two states was represented. Eighty-two percent of survey respondents indicated that their position was directly related to land management (forest, range, or other) or wildland fire (through fuels management, prescribed fire, smoke management, or "other" directly related area). Respondents who reported that their positions were not directly related to land management or wildland fire most often indicated that they were specialists in different disciplines (e.g., botany, biology, timber, public relations, planning, air quality, soils, or emergency respondence). In terms of their specific responsibilities, most (60 percent) respondents indicated that they worked across public and private lands with different groups or networks, and nearly half indicated they planned or implemented fuels and other restoration treatments (see Table 2, page 7).

Survey respondents worked for a range of agencies and organizations (see Table 3, page 7). They most commonly worked at federal agencies (35 percent), state agencies (22 percent), NGOs (16 percent), or city or county agencies (13 percent). Several respondents listed other organizations, including conservation districts, fire protection districts, municipal hydroelectric facilities, or community colleges.

Respondents indicated that they had been at their current positions (at the time of the survey) for nine years on average, ranging between less than one year and 45 years. Most (55 percent) reported that they had been at their current position between 4 and 15 years. Nearly 30 percent reported 3 years or less, and 16 percent reported 15 or more years at their current positions (see Figure 1, page 7).

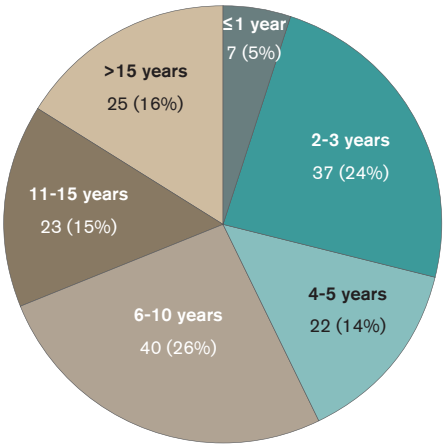
Table 2 Survey respondents' professional responsibilities

Professional responsibilities	n	%
Working across public and private lands with groups such as natural resource collaboratives, neighborhood associations, community wildfire protection planning committees, and fire learning networks	101	60
Planning or implementing fuels and other forest restoration treatments (including timber)	78	47
Developing, implementing, or analyzing policy related to wildland fire or land management	65	39
Focusing on a discipline other than wildland fire (e.g., botany, hydrology, wildlife, soils, etc.) that involves considerations of wildland fire to some degree	63	38
Wildfire operations, prescribed fire or other wildland fire management, or smoke management	62	37
Compliance with air quality rules and regulations	42	25
Other wildland fire work areas or responsibilities	41	25

Table 3 Survey respondents' agency or organization type

Agency or organization	n	%
Federal agency	58	35
State agency	37	22
Non-governmental/ NGO	27	16
City or county agency	21	13
Tribal entity	10	6
Other	10	6
Community forestry or community-based collaborative entity	9	5
Private contractor or consultant	7	4
Extension agent	7	4
Private landowner or HOA representative	5	3

Figure 1 Amount of time that survey respondents had been at their current position at time of survey



Use of wildland fire research

The 2011 assessment of wildland fire science users in Washington and Oregon highlighted the importance of using wildland fire research to inform planning and decision-making across many different agencies, organizations, disciplines, and positions within the greater wildland fire community. It also highlighted the diversity of ways that fire science users reported accessing fire research publications.[6] The present assessment echoed earlier findings about the importance of scientific research in respondents' positions, and revealed a similar level of diversity in the ways that respondents accessed this research.

Use of research publications on wildland fire is an important aspect of respondents' work positions. We asked survey respondents how often they used research findings in their jobs (see Figure 2, below). More than half (57 percent) of respondents reported they used research publications at least once per week, and another 38 percent indicated that they used them about once a month. Most (71 percent) respondents reported using wildland fire science both directly (assessing full-length research write-ups such as peer-reviewed journal articles) and indirectly (reviewing syntheses or briefs of peer-reviewed research, non-peer reviewed sources). Interviewee responses and comments throughout the survey further emphasized the importance of scientific research to a variety of work-related decision making processes.

Respondents access wildland fire research publications from many different sources, including formal and informal networks. The most common sources of research reported by interviewees and survey respondents included the internet, Consortium resources, and coworkers (see Table 4, page 9). Nearly half (49 percent) of survey respondents indicated that they also used partner organizations to help them locate relevant research publications. Direct access to peer-review literature through Google Scholar or library search engines were also commonly reported but were not as prevalent as general internet or coworker inquiries. In open-ended comments in the survey, some respondents explained that they used different sources depending on the research need, topic, and availability of information. Several interviewees described relying on coworkers and project partners for publications and findings, and some explained that they had even worked to develop relationships with researchers and extension agents specifically to help develop new scientific research when available re-

Figure 2 Survey respondents' report on how often they used research publications in their jobs

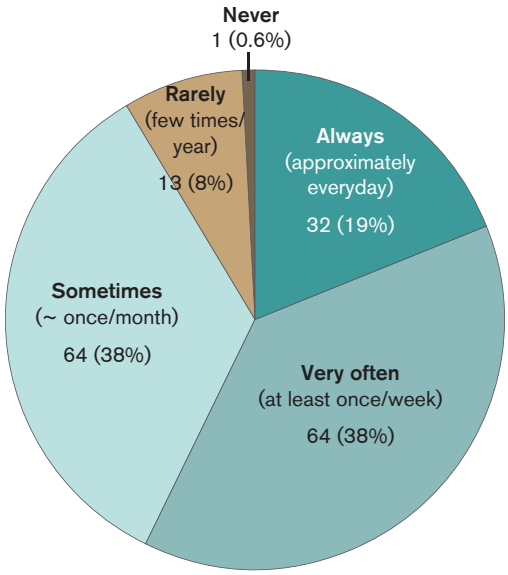


Table 4 Sources used to search for wildland fire research publications among survey respondents

Source	n	%
Internet (via a general search)	115	69
Northwest Fire Science Consortium	89	53
Coworker	83	50
Partner organizations	81	49
Google Scholar	65	39
US Forest Service Treesearch	55	33
Fire Science.gov (JFSP)	54	32
University library search engine or website	37	22
Other fire science consortia or exchanges	37	22
Fire Effects Information System (FEIS)	32	19
Other scholarly search engines (e.g., science.gov, Refseek, WorldWideScience, etc.)	30	18
Wildland Fire Library	27	16

search did not meet their needs. These results suggest that both formal venues for research and informal networks of individuals and organizations were important sources for obtaining wildland fire research publications or information.

Research project summaries and research synthesizing documents continue to be valuable resources. The importance of summary and synthesis documents was noted during the first needs assessment the Consortium conducted in 2011.[7] In that prior assessment, respondents highlighted a need for "briefs" or summarizing documents to help communicate new research to people with limited time or ability to search for new information. Respondents also indicated that syntheses, which interpret and summarize multiple sources of information about a particular topic or issue, were particularly important and useful for informing management decisions. Findings from this assessment suggest that the value of summary and synthesizing documents has persisted, and that these resources can have long-term utility for fire science users in the region.

Specifically, interviewees said they appreciated the concise nature of project and research summaries, which helped them easily access and process pertinent information quickly. Among survey respondents, 78 percent reported that briefs or digests that summarized the main points and implications from research projects were important or very important to their work.

Interviewees also indicated that documents that synthesize multiple research efforts on a topic or across geographic regions were especially useful for helping them to understand trends and consider local implications. Many noted the value of having examples or case studies from other ecologically-similar regions where more research and management actions may have been carried out. Among survey respondents, 69 percent indicated that topical syntheses that covered the main findings from multiple studies were important or very important to their work. However, 71 percent of respondents also indicated that "having research about historic or reference conditions (e.g., fire regimes, wildfire historic range of variability) for their local work area specifically" was important or very important to their work, suggesting that although syntheses can be valuable resources, place-specific information, particularly around reference conditions, is often still needed when making local decisions about wildland fire and management.

The importance and utility of local and nonlocal wildland fire research

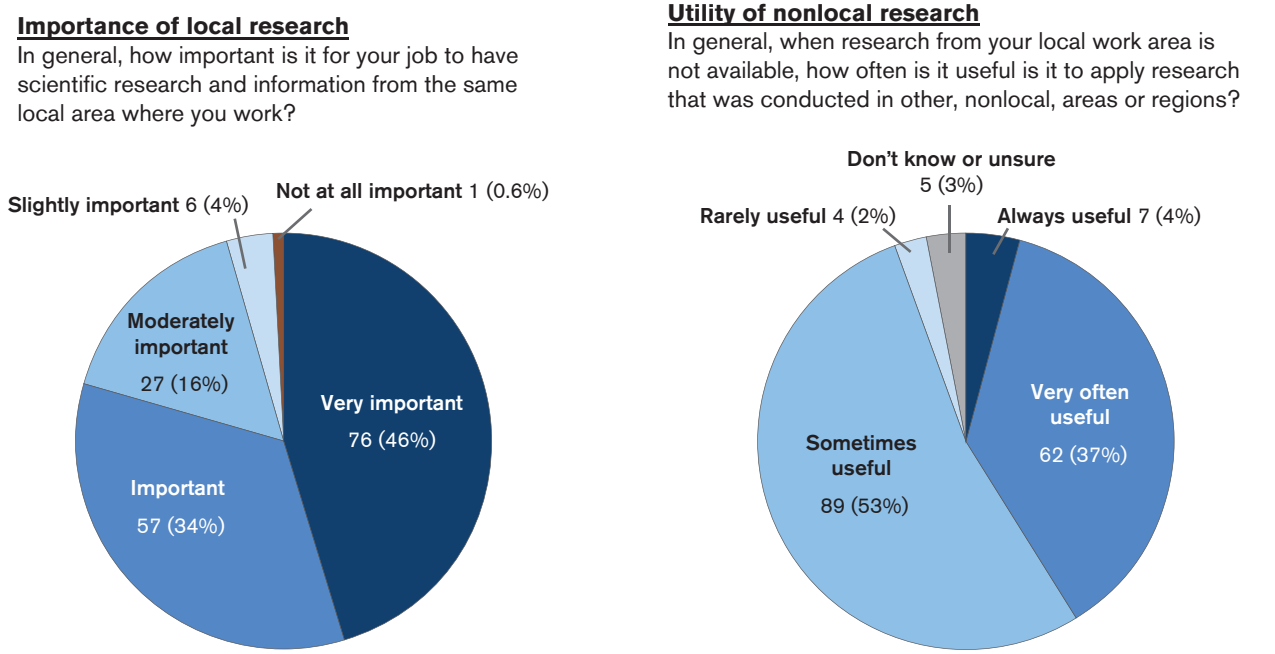
The Consortium's 2011 wildland fire science needs assessment found a need for more site-specific information that could better guide strategic planning, management decisions, and the resolution of ongoing debates in local contexts.[8] In the current assessment effort, initial interviews indicated that site-specific information needs were imperative for many wildland fire science users, and that these site-specific needs had become even more pressing for some users in recent years. Interviewees gave many examples of recent research conducted in other parts of the country that they felt investigated management questions and practices relevant to their work. However, because the research derived from locations different from their own, they were uncertain how to apply it in their local work areas.

To better understand the concerns that respondents had about applying nonlocal research, we asked them to rate the importance of local and nonlocal research, and to evaluate the degree to which specific factors acted as barriers to applying nonlocal research. We also asked participants to identify topics where locally-relevant information was most needed. We did not define "local" for survey respondents, thus individual perceptions and definitions of "local" likely varied.

Local research has widespread importance for nearly all wildland fire science users, but the value of nonlocal research is more variable. Nearly all survey respondents (96 percent) indicated that it was moderately to very important for their work to have research conducted in the same local area (see Figure 3, page 11). The other four percent indicated that it was only slightly important (three percent) or unimportant (one percent) to have local research for their work.

The degree to which respondents felt that nonlocal research was useful to their positions was more varied. All respondents felt that, when research specific to their area was not available, there was still some value in nonlocal research on the same topic. No respondent indicated that nonlocal re-

Figure 3 Survey respondents' report on the importance of having local research and the utility of nonlocal research



search was "never useful," and only four respondents (two percent) rated it as "rarely useful." The majority (53 percent) of respondents rated nonlocal research as 'sometimes' useful, while 37 percent rated it as "very often useful," and four percent rated it as "always useful." Thus, although there is widespread agreement about the importance of locally-conducted research across survey respondents, nonlocal information also had some utility and applicability for most respondents.

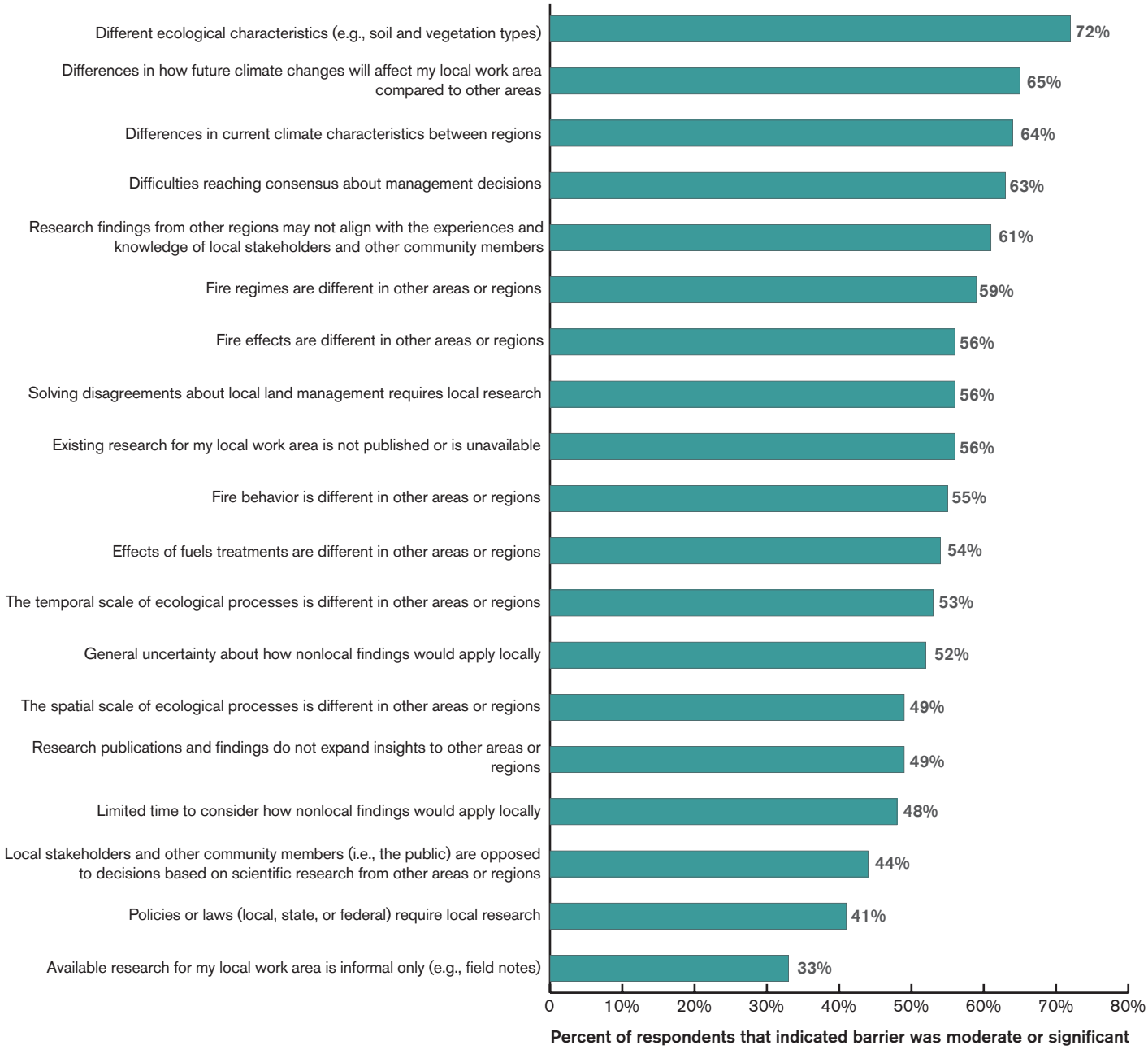
Barriers to applying nonlocal research are based on a diverse range of site, community, and policy considerations. Interviewees explained that as the body of research and findings around wildland fire has increased, they have had access to greater quantities of information. However, they said they were often uncertain of how to apply new research findings when the research was conducted in different locations. They explained that although new information was often valuable, its relevance varied because of uncertainty about transferability to their work and area. Several interviewees noted that there was uncertainty with applying wildland fire research regardless of whether it was conducted locally or elsewhere, but that uncertainty was greater with nonlocal research.

When asked about the specific barriers to applying nonlocal research, interviewees described how factors like fire behavior, fire effects, smoke patterns, fire mitigation techniques, and the effectiveness of fuels treatments depended greatly on local climate, topography, soil, and other site-specific conditions. Interviewees also stressed the importance of having credibility with the public, and the concern that nonlocal research could be viewed by stakeholders as less credible than research conducted in the local area. Finally, some interviewees discussed how policy requirements limited the applicability or usefulness of nonlocal research. For example, several interviewees described endangered species conservation or invasive species management policies that required site-specific data, limiting the utility of research from other areas.

To understand the specific barriers that Consortium users faced in applying nonlocal research, we asked survey respondents to rate the significance of 19 potential barriers (see Figure 4, below). Survey respondents indicated a diverse array of challenges that they perceived as significant to applying nonlocal research to their local work areas or region. Some respondents identified every potential barrier we asked about as significant.

Environmental differences between sites are the most significant barriers to applying nonlocal research. Specifically, respondents rated differences in: ecological characteristics (72 percent), future climate change effects (65 percent), and current climate characteristics (64 percent) as moderate or significant barriers. Most respondents also rated differences in: fire regimes, fire effects, fire behavior, fuel treatment effects, and the scale of ecologi-

Figure 4 Percent of respondents who indicated that a factor was a moderate or significant barrier to applying nonlocal research to their work region or area



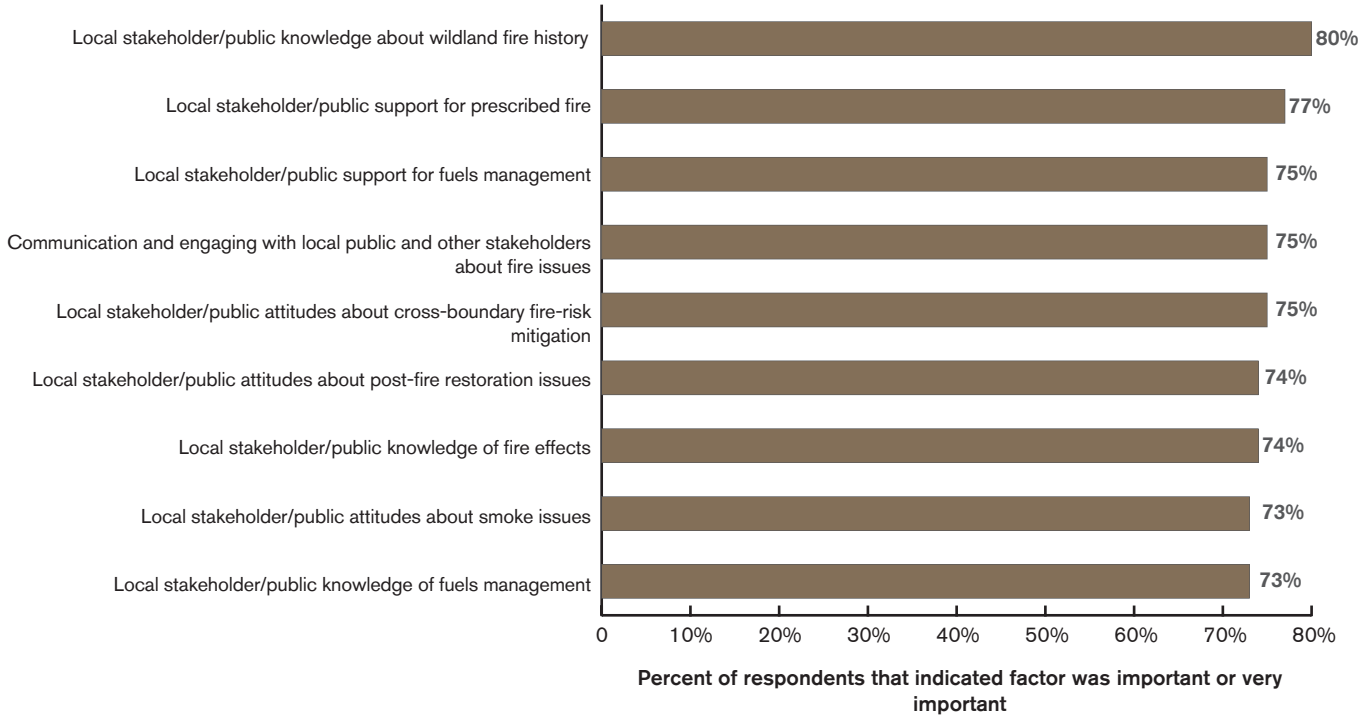
cal processes as moderate or significant barriers to applying nonlocal research.

Social considerations are also among the most significant barriers to applying nonlocal research. The majority (63 percent) of survey respondents indicated difficulties "reaching consensus about management decisions with nonlocal research" as a moderate or significant barrier for using nonlocal research. Sixty-one percent reported the significance of mismatches between nonlocal research and the local experiences and knowledge of stakeholders. Most (56 percent) also reported having land management disagreements that required local research to solve.

Both interview and survey participants identified local social contexts as significant for effective planning, management, and strategy decisions about wildland fire. Interviewees emphasized the importance of effective communication with the public, and discussed the importance of having the "social license" to perform activities such as thinning and prescribed fires. They explained that public support for wildland fire mitigation, management, and restoration projects required efforts to understand and integrate public perspectives in decisions. Some interviewees described how local research played a particularly important role in areas lacking consensus about appropriate management activities.

Survey respondents likewise highlighted the importance of understanding stakeholder perspectives. For every aspect of stakeholder knowledge, support, and attitudes included in the survey, more than 70 percent of respondents indicated it was either important or very important to their position (see Figure 5, below). Many respondents also indicated that sharing locally-relevant research with the public and other stakeholders was an important part of their jobs.

Figure 5 Percent of survey respondents who indicated that assessing and understanding different social aspects of wildland fire management was an important or very important part of the job



The value of local research varies across ecosystems and different scales of work. Survey comments and interviewee insights alike highlighted nuances in the utility of local research. For instance, some described how work at larger scales (e.g., across regions or states) relied less on local conditions and therefore had less need for site-specific research. Some participants also noted that it was easier to apply nonlocal research when ecological conditions were similar to their own (e.g., several participants described how ponderosa pine forests had similarities in ecosystems in the Cascades and Sierra Nevada Mountain Ranges). Participants explained that in areas with limited local research, having examples from other ecologically similar regions was important.

In contrast, participants in some areas explained that it was difficult to apply nonlocal research because there was little or no wildland fire research conducted in comparable ecosystems. Respondents working in some areas, particularly less historically fire-prone areas (e.g., Willamette Valley, Puget Trough, Coast Range, North Cascades), noted that limited information about local fire histories presented challenges for considering how to manage fuels and anticipate future wildland fire issues. They described how these challenges were exacerbated by changing climate conditions and increasing housing density in expanding wildland-urban interfaces.

Similarly, several survey respondents and interviewees highlighted a lack of relevant wildland fire research for riparian areas, which they explained has led to significant challenges for their understanding of fuels treatment success, fire behavior, fire effects, and the influence on climate change on fire regimes in riparian areas. These respondents described an increase in climate change-induced fire activity in riparian areas while fire-related research in riparian areas remained scarce. Thus, they had greater perceived uncertainty about how to manage riparian areas in relation to fire, and around how climate changes would further affect fuels and fire conditions in these areas in the future.

Topics where local wildland fire research is most needed

The 2011 wildland fire science assessment found a need for more site-specific information but did not identify specific research topics where this type of information was most needed. To help identify the greatest local research needs across Oregon and Washington, we asked survey respondents if ten different broad topical areas of wildland fire research were important to their work in their local area (see Figure 6, below). For each topical area indicated as important, respondents were presented with more specific topics and asked to rate the extent to which local research for that topic was needed in their work area. The survey included 159 specific topics nested within the ten broad research areas.

In the following section we focus on the specific topics for which local research was rated as most needed. The most needed topics were identified by ranking the average rating of each (see Table 5, page 17). The 25 topics that survey respondents ranked as having the greatest need for more local research were then grouped into five categories used to guide the following sections. The interviews also provided additional insights to the topics rated as most in need of local research, which are included where relevant. It is important to note that this ranking and discussion of results identifies topics rated as highly needed across the entire survey population. There may be research topics that were identified as highly needed in some locations but not others. Because the ranking is based on average ratings for local research need, the top ranked topics were ranked as needed consistently across all respondents. Future research efforts may want to investigate the greatest research needs as they correlate with specific locations.

Figure 6 The percent of survey respondents who indicated a general topic of wildland fire research as important to their work

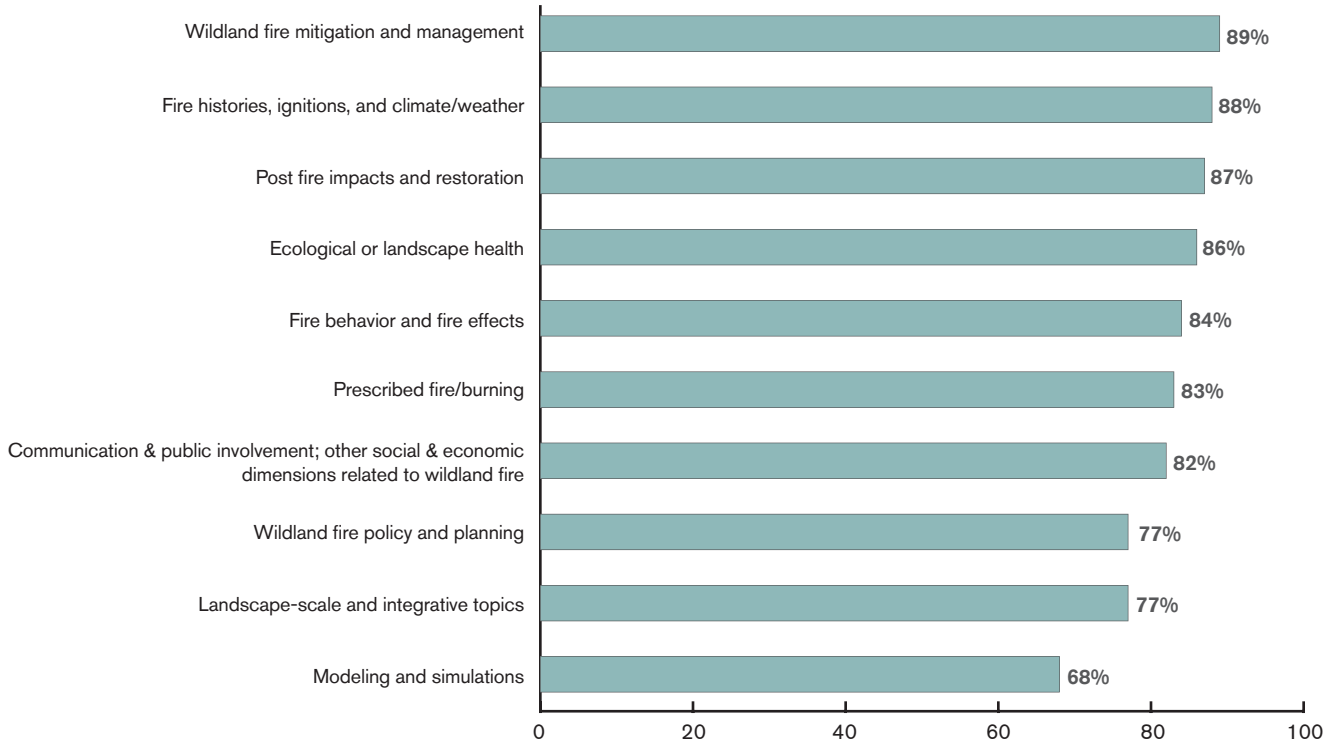


Table 5 The top 25 topics of wildland fire-related research where local research is most needed, based on average rating among survey respondents.

Rank	Subtopics of wildland fire research	Average rating*	%**
1	Communicating with the public about fire impacts	4.40	89%
2	Climate change effects on local forest conditions	4.40	87
3	Public perceptions of wildfire risk	4.35	83
4	Communicating with the public about fire risk	4.32	85
5	Climate change effects on local fire regimes	4.32	85
6	Public tolerance of smoke from prescribed burns	4.29	81
7	Fire effects related to landscape or ecological health	4.28	85
8	Public attitudes about prescribed burning	4.25	82
9	Effectiveness of fuels mitigation techniques (e.g., thinning) to reduce fuel loads or wildfire risk	4.24	83
10	Burn windows for conducting prescribed fires	4.23	81
11	How climate change may influence fire effects/impacts	4.23	80
12	Climate change effects on local wildland fire behavior	4.23	82
13	Modelling fuel treatment effectiveness	4.22	80
14	Public expectations about the fire season or fire regimes	4.22	81
15	Effectiveness of using prescribed fire to mitigate wildfire risk	4.22	80
16	Attitudes about wildfire among the local public	4.21	84
17	Public tolerance of smoke from wildfire	4.20	77
18	Long term studies about fire behavior and fire effects (more than 10 years after a fire)	4.20	82
19	Effectiveness of using prescribed fire to restore natural conditions	4.19	75
20	Fire effects (physical, biological, and ecological impacts of fire on the environment)	4.19	81
21	Developing partnerships with other landowners/organizations	4.18	81
22	Fire impacts on fish habitat	4.18	79
23	Factors that affect landscape resiliency	4.18	77
24	The role of fire in riparian areas	4.18	77
25	Effectiveness of post-fire restoration strategies and techniques	4.18	79

** Average rating used to rank subtopics. Scale: 1 = not needed, 2 = minimal need, 3 = slight need, 4 = moderate need, 5 = significant need*

*** The % column is the percentage of respondents who selected either "moderate need" or "significant" for the subtopic.*

1. Communication, public involvement, and other social dimensions of wildland fire

Throughout multiple survey questions and interviews, participants in this assessment referenced the importance of developing and fostering public support for their work. They stressed the importance of maintaining credibility, transparency, and trust; and suggested that improved strategies for outreach and communication could lead to increased collaboration and public support for management decisions. Some interviewees noted the need for applied research that could help them understand public expectations and better communicate about fire-related issues, including research-informed guides for public communication. Some identified needs for more research about networking, collaborative processes, and effective public engagement.

When asked to evaluate their local research needs in the survey, respondents consistently ranked topics about social aspects such as working with partners; understanding public expectations, knowledge, or attitudes; and communication with stakeholders as high needs for more local research. Nine of the 25 highest-ranked topics for local research needs concerned social aspects of wildland fire (see Table 6, below). Five of the top eight topics involved understanding public perceptions or communicating with the public. Specifically, out of all 159 topics on the survey, 89 percent of respondents ranked "communicating with the public about fire impacts" as the topic with the greatest research need.

Table 6 Communication, public involvement and other social dimensions of wildland fire research topics included in the top 25 topics where local research is most needed

Rank of top 25	Subtopics of wildland fire research	Average rating*	%**
1	Communicating with the public about fire impacts	4.40	89%
3	Public perceptions of wildfire risk	4.35	83
4	Communicating with the public about fire risk	4.32	85
6	Public tolerance of smoke from prescribed burns	4.29	81
8	Public attitudes about prescribed burning	4.25	82
14	Public expectations about the fire season or fire regimes	4.22	81
16	Attitudes about wildfire among the local public	4.21	84
17	Public tolerance of smoke from wildfire	4.20	77
21	Developing partnerships with other landowners/organizations	4.18	81

** Average rating used to rank subtopics. Scale: 1 = not needed, 2 = minimal need, 3 = slight need, 4 = moderate need, 5 = significant need*

*** The % column is the percentage of respondents who selected either "moderate need" or "significant" for the subtopic.*

2. Climate change effects on ecological conditions and wildland fire

Both interviews and survey responses emphasized the need to understand how climate change would affect different aspects of wildland fire at local scales. Eighty seven percent of survey respondents rated "climate change effects on forest conditions" as a moderate or significant need (see Table 7, below). Climate change impacts on local range, shrubland, or grassland conditions was also rated as a moderate or significant need by 72 percent of participants, showing that concerns about climate change on local vegetation expanded beyond forest ecosystems. The 25 most needed topics rated by respondents also included: climate change effects on local fire regimes, climate change effects on local wildland fire behavior, and an increased understanding of how climate change may influence fire impacts locally.

As discussed previously, survey respondents selected "differences in how future climate changes will affect my local areas compared to other areas" as the second-greatest barrier to applying research findings from other locations to their local work area. Accordingly, an overarching theme across interviews and survey responses was perception that climate change increased uncertainty in future wildland fire planning and management activities. Interviewees said that this uncertainty was greatest in locations where local fire histories were not established. Interviewees and survey respondents described how in these areas, communication with the public and stakeholders was difficult because conversations about future fire management challenges and opportunities inevitably required discussions about fire's historical role in a landscape. Some respondents that expressed this perspective were interested in obtaining fire history at a very local, even site-specific scale. They felt that information about fire histories at this scale could help them understand and communicate both the ecological role of fire in the past and expectation for future fire behavior and regimes.

Table 7 Climate change effects research topics included in the top 25 topics where local research is most needed

Rank of top 25	Subtopics of wildland fire research	Average rating*	%**
2	Climate change effects on local forest conditions	4.40	87
5	Climate change effects on local fire regimes	4.32	85
11	How climate change may influence fire effects/impacts	4.23	80
12	Climate change effects on local wildland fire behavior	4.23	82

** Average rating used to rank subtopics. Scale: 1 = not needed, 2 = minimal need, 3 = slight need, 4 = moderate need, 5 = significant need*

*** The % column is the percentage of respondents who selected either "moderate need" or "significant" for the subtopic.*

3. Fuels mitigation and prescribed fire

Survey respondents highlighted the importance of understanding the effectiveness of fuels treatments locally. The 25 topics rated as the greatest local research needs included five topics related to fuels mitigation techniques or effectiveness (see Table 8, below). In particular, respondents indicated that more local research was needed on: 1) effectiveness of fuels mitigation techniques to reduce fuel loads or wildfire risk, 2) burn windows for conducting prescribed fire, 3) modeling fuels treatment effectiveness, 4) effectiveness of prescribed fire specifically to mitigate wildland fire risk, and 5) the effectiveness of prescribed fire to restore natural conditions. In interviews and open-ended survey comments, participants suggested that seeing examples of different fuels treatments in similar ecoregions could also be helpful.

A related topic ranked as an important local research need among participants was smoke from prescribed fire. Eighty-one percent of respondents rated local research on public tolerance of smoke from prescribed burns as a moderate or significant need. Several respondents added comments in the survey and multiple interviewees mentioned needing more information on the health impacts from prescribed fires and wildfires, as well as smoke dispersion patterns.

Table 8 Fuels mitigation and prescribed fire research topics included in the top 25 topics where local research is most needed

Rank of top 25	Subtopics of wildland fire research	Average rating*	%**
9	Effectiveness of fuels mitigation techniques (e.g., thinning) to reduce fuel loads or wildfire risk	4.24	83
10	Burn windows for conducting prescribed fires	4.23	81
13	Modelling fuel treatment effectiveness	4.22	80
15	Effectiveness of using prescribed fire to mitigate wildfire risk	4.22	80
19	Effectiveness of using prescribed fire to restore natural conditions	4.19	75

** Average rating used to rank subtopics. Scale: 1 = not needed, 2 = minimal need, 3 = slight need, 4 = moderate need, 5 = significant need*

*** The % column is the percentage of respondents who selected either "moderate need" or "significant" for the subtopic.*

4. Fire effects on ecological health, resiliency, and post-fire restoration

Survey respondents expressed a need for more research on the effects of fire on their local landscapes. One of the top areas they felt needed more local research was "fire effects related to landscape or ecological health," with 85 percent of respondents indicating that this topic was a moderate or significant local research need (see Table 9, below). Another top-rated local research need concerned the physical, biological, and ecological effects of fire across longer temporal scales (more than 10 years post-fire). Seventy-seven percent of survey respondents felt that there was a moderate or significant need for local research on "factors that affect landscape resiliency."

Post-fire restoration was also brought up as an important research need in both interviews and the survey. Interviewees expressed interest in understanding the most effective post-fire restoration strategies and techniques to accomplish a range of goals (e.g., minimize erosion, improve regeneration, mitigate invasive species, and protect endangered species). Seventy nine percent of the survey respondents indicated that the effectiveness of post-fire restoration strategies and techniques was a moderate or significant local research need.

Table 9 Fire effects on ecological health, resiliency, and post-fire restoration research topics included in the top 25 topics where local research is most needed

Rank of top 25	Subtopics of wildland fire research	Average rating*	%**
7	Fire effects related to landscape or ecological health	4.28	85
18	Long term studies about fire behavior and fire effects (more than 10 years after a fire)	4.20	82
20	Fire effects (physical, biological, and ecological impacts of fire on the environment)	4.19	81
23	Factors that affect landscape resiliency	4.18	77
25	Effectiveness of post-fire restoration strategies and techniques	4.18	79

** Average rating used to rank subtopics. Scale: 1 = not needed, 2 = minimal need, 3 = slight need, 4 = moderate need, 5 = significant need*

*** The % column is the percentage of respondents who selected either "moderate need" or "significant" for the subtopic.*

5. Wildland fire and effects in riparian areas

The need for more information about the effects of wildland fire in riparian areas, both broadly and at local scales, emerged as a theme across interviews and multiple survey questions. Several interviewees explained that they had less empirical wildland fire literature to draw from to guide management actions in riparian areas than for non-riparian areas. They wanted more information on how wildland fires behaved and affected ecological aspects (e.g., fish and wildlife habitat and reproductivity) and biophysical processes (e.g., nutrient cycling) in riparian areas. As discussed previously, interview responses and comments from multiple survey participants described a need for more local research concerning wildland fire in riparian areas because of perceived climate change-induced changes. Participants also discussed a need for more research about the impacts of fuels mitigation and prescribed fire techniques on fire risk and ecosystem health in riparian areas.

Of the 16 topics we included under the "ecological or landscape health" research area, respondents rated the three riparian and fish habitat topics we included in the top four for most-needed local research. More than three quarters of survey respondents rated "the role of fire in affecting fish habitat" and "understanding the role of fire in riparian areas" among the top 25 most-needed research topics (see Table 10, below).

Table 10 Wildland fire and effects in riparian areas research topics included in the top 25 topics where local research is most needed

Rank of top 25	Subtopics of wildland fire research	Average rating*	%**
22	Fire impacts on fish habitat	4.18	79
24	The role of fire in riparian areas	4.18	77

** Average rating used to rank subtopics. Scale: 1 = not needed, 2 = minimal need, 3 = slight need, 4 = moderate need, 5 = significant need*

*** The % column is the percentage of respondents who selected either "moderate need" or "significant" for the subtopic.*

Integrating unpublished research and local knowledge in decision making

Multiple interviewees identified a need to consider and integrate unpublished research and practitioners' local knowledge derived from experience into planning and decision making. Although this was not included in the survey as a wildland fire research topic, some survey respondents added comments that highlighted the wealth of anecdotal and experiential knowledge that both local residents and professionals can have regarding past fire behaviors, impacts, and areas more likely to burn in the future. These respondents expressed an interest in understanding how to assess and incorporate these local perspectives into their work.

Similarly, several interviewees suggested that some aspects of agency decisions are driven more by local practitioner experience in the field than by formal scientific methods. For instance, they mentioned that unpublished research (e.g. field notes, white papers, reports) is often used to inform planning and decision-making. They saw value in having this type of evidence synthesized and made accessible to others. They felt that increased access to this type of information could improve transparency in decision making while expanding knowledge available across agencies, organizations, and landowners.

Recommendations

Findings from this assessment show key aspects of how respondents use wildland fire research and highlight the research topics that respondents felt were most needed in their local work areas in Washington and Oregon. These aspects offer a focal point for future Consortium efforts. We offer several recommendations here that the Consortium may consider in its ongoing efforts to connect fire science users with relevant information.

1. Develop and share case studies of local wildland fire mitigation, management, and research efforts

Interview and survey responses revealed a growing need for fire science users to have access to clear and concise examples of wildland fire mitigation and management projects, research efforts, and outcomes across Oregon and Washington. Respondents indicated that specific examples of research applications (e.g., case studies on issues like fuels management effectiveness, examples of how climate change can affect fire behavior in a particular area) were valuable resources. Good examples of effective public outreach, engagement, communication, and collaboration efforts (e.g., assessing public perspectives on different wildland fire issues, incorporating public perspectives with research and diverse objectives into decision making) were also noted as valuable. Conducting or sharing case study examples, particularly related to topics where local research needs were rated as most significant, may help Consortium users better understand their local landscapes and manage for desired outcomes.

2. Facilitate and distribute site-specific research on the most needed wildland fire topics

This assessment identified numerous topics of wildland fire-related research that Consortium users wanted more information on, particularly in relation to their local work areas and management decisions. These topics are broadly related to:

- Climate change impacts on fire risk, fire behavior, and fire effects;
- Communication strategies and other social science techniques to assess public knowledge, experiences, perceptions, and attitudes;
- Fire histories at local scales throughout Washington and Oregon;
- Landscape health and the interaction between various disturbances and land uses;
- Fuels management effectiveness;
- Identifying or predicting prescribed fire opportunities;
- Different aspects of smoke-related issues.

Our findings suggest that local research is especially useful and needed in situations where disputes exist or when reaching consensus is an important goal. Thus, identifying types of management decisions that are most disputed, polarized, or controversial could be an important step for identifying, producing, or sharing the most impactful research. The Consortium may consider prioritizing dissemination of the most needed research identified in our assessment, including taking inventory of the research publications and projects already available (e.g., on the website) to re-feature them in focused outreach efforts. Other efforts might focus on connecting fire science users with each other and researchers. This could include current activities like workshops, webinars, and field trips; or new approaches such as facilitating an online forum with space for users to ask questions and provide feedback about wildland fire topics.

3. Support the production of synthesizing documents on needed topics

One of our findings was that respondents in this assessment greatly valued synthesizing documents on wildland fire-related topics, especially when the documents articulated management and planning implications. Respondents also appreciated how synthesizing documents distill and organize large amounts of information on a topic with references to the research included, and felt that syntheses were valuable resources even if they did not include research from Oregon or Washington

landscapes. For instance, syntheses can highlight commonalities, consistencies, differences, or nuances on a topic across geographies and research efforts. These types of insights increase the potential applicability of nonlocal research. Thus, the topics rated as high local research needs in this assessment would be valuable to respondents, even if those syntheses included research primarily conducted outside of Oregon and Washington.

In addition to continuing its work in creating and disseminating syntheses on wildland fire research topics, the Consortium can also consider ways to enhance the capacity of researchers and practitioners to produce synthesizing documents. For example, the Consortium could focus efforts on advertising or publicizing funding opportunities for data collection, analysis, and publications – especially for topics rated as most needed in this assessment. The Consortium could also focus its efforts to connect practitioners and researchers (e.g., workshops, webinars, online forums, conference panels) in ways that encourage synthesizing documents (e.g., efforts designed to facilitate dialogue, brainstorming, and partnerships around synthesis efforts).

4. Consider ways that different types of unpublished data and local knowledge could be made more accessible.

Practitioners use many types of data, observations, and other inputs to make decisions. One theme that emerged from interviews and survey responses was the importance of considering unpublished data and practitioner experiences in wildland fire-related decisions. Multiple participants explained that a wealth of unpublished research (e.g., field notes and white papers) existed within organizations and agencies. Some noted how useful that information could be if it were systematically synthesized and made accessible to others, and some suggested that more opportunities to network and share this information would be valuable. Based on this feedback, the Consortium should take care to consider the value and dissemination of all types of wildland fire information, from experiential to peer-reviewed and published findings. In addition, the Consortium should continue efforts to connect managers, practitioners, scientists, local communities, collaboratives, and others as a means for facilitating information transfer and learning around wildland fire issues.

5. Continue providing publications and information in a variety of formats

This assessment reiterated the finding that fire science users in the region access information from many different sources and in many different formats. The Consortium currently provides publications in a variety of formats (e.g., peer-reviewed publications, research briefs, syntheses, webinars, videos). Respondents in this assessment appreciated this diversity and often highlighted publication or outreach types that they felt were the most useful. Although syntheses and research briefs were highlighted as valuable the most often, every type of product that the Consortium creates and every type of outreach that the Consortium is engaged in was noted as especially valuable by at least some respondents. Based on this reported diversity for learning about, accessing, and processing fire science information, the Consortium should continue providing a variety of resources for its users.

Discussion and considerations

As wildland fire management grows increasingly more complex and new wildland fire research is continually made available, intermediary information-exchange organizations such as Joint Fire Science Program Fire Science Exchange Networks can benefit from periodic assessments of users' research needs. This assessment examined the perspectives, preferences, and needs of fire science users in the Pacific Northwest through both interviews and an online survey. The effort reconfirmed several key findings from an earlier assessment about how wildland fire science users in the region accessed wildland fire research, as well as the formats and types of publications that users found most valuable. This assessment also expanded on earlier findings about the need for site-specific research by investigating the barriers that respondents perceived in applying nonlocal research in their own work areas, and asking about the most needed topics for local research.

In general, participants in this assessment placed a high value on research conducted locally, regardless of topic. This value is based on the premise that research conducted in the local work area could always be applied in the same area with

greater certainty than a similar study conducted elsewhere could be. While local research may thus always be more valuable that nonlocal research based on this premise, there are limitations on the amount of research that can be conducted, both locally and otherwise. It is not practical or possible to investigate every topic of wildland fire science in every location across Oregon and Washington. Efforts that help fire science users understand when and how to interpret and apply research findings that were not obtained through site-specific research are also important and may help reduce some of the uncertainty around using nonlocal research described by this research's participants.

It is important to also understand the limitations of this assessment and the findings reported here. To identify the most pressing local research needs, we asked participants to rate the extent to which local research was needed for over 150 wildland fire topics. This allowed us to rank local research needs based on the average score across respondents. Ranking at this regional level allowed us to understand the greatest needs across the survey population and all the respective areas that participants worked. However, it does not necessarily improve understanding of the greatest local research needs in any one specific area or ecosystem. Although we recognized the value of identifying and comparing local wildland fire research needs by ecoregions, relatively small sample sizes for these domains inhibited statistical inferences by state or ecoregion. Therefore, we presented all findings combined across the Consortium area (Washington and Oregon). Future research efforts may want to investigate the greatest research needs in specific locations. Further, while we report on local research needs, we did not explicitly define or bound what "local" meant beyond instructing respondents to "think about the local area where you do most of your work." The scale of the term likely differed considerably among participants in this assessment from stand-level to watershed, ecoregion, or even larger landscape levels. Thus, our findings cannot on their own direct the scale, scope, or location of potential research on topics that respondents reported as most needed.

We also did not explicitly define "scientific research." Nine of the 25 highest-ranked topics for local research needs concerned social aspects of wildland fire, and respondents consistently ranked topics such as working with partners; understanding public expectations, knowledge, or attitudes; and communication with stakeholders as high needs for more local research. We did not ask participants about the specific means for conducting the local research that they identified. In some instances, bolstered public outreach and engagement efforts compatible with local social contexts may be more appropriate than formal scientific investigations. Additional communication capacity may help meet or alleviate many of the concerns raised by participants. Multiple interviewees and survey participants emphasized the value of information gathered outside of formal scientific inquiries (e.g., local ecological knowledge, firsthand narratives, and smaller scale data collection efforts that may have transferability). Consequently, wildland fire managers and practitioners may benefit from efforts that help them effectively integrate diverse types of information with their management decision-making processes.

Appendix A: Methodology

Project development began with a review of literature related to scientific research use and needs among land managers, policy makers, and other stakeholders, with an emphasis on wildland-fire related topics. We also carefully reviewed findings from the previous needs assessment conducted in 2011 in Washington and Oregon that helped provide initial direction during the formation of the Northwest Fire Science Consortium (Consortium). We used literature and discussions with Consortium leaders to develop the project goals and methodology. A mixed-methods approach (i.e., interviews and a survey) was selected to provide depth and breadth of insights among key fire science stakeholders and across local Consortium users.

After developing methodological protocols, we received approval from the Institutional Review Boards (IRB) at the University of Oregon and Oregon State University to conduct the research. We then compiled two sample lists, one for the interviews (phase 1) and one for the survey (phase 2). The sample list for the interviews was purposive and consisted of key wildland fire science users, decision makers, and policy makers in Washington and Oregon. We drew initially from the Consortium's Advisory Board members, and expanded our list of interviewees based on discussion and recommendations with members. Interviewees were individuals who we determined had a strong understanding of the Consortium's mission and goals, and/or were identified as someone in a position that relies heavily on wildland fire science for management, policy, and other applied purposes. They included scientists, practitioners, managers, directors, fire chiefs from a wide range of disciplines (e.g., aviation, ecology, firefighting, fuels, prescribed fire, meteorology, community engagement) from local, state, and federal agencies and non-governmental organizations related to the management of natural resources and wildland fire.

The main goal of the interviews was to identify the most pressing issues and needs related to wildland fire science in terms of research content, format, and accessibility. In total, we conducted 20 telephone interviews with key fire science users in Washington (9) and Oregon (11). We first asked the participants to describe their position, their use of wildland fire science (e.g., frequency and sources or outlets), and the topics or areas of wildland fire research where they identified needs and gaps. Then, we asked them to discuss their perspectives about the importance and challenges of using local research to inform their decisions. Lastly, we asked participants to describe changes in wildland fire research in the past decade and lessons they have learned using it. Interviews were approximately one hour in duration each. Interviews were digitally recorded, summarized by the research team, and reviewed for common themes.

We presented initial findings from the interviews at the Fire Continuum Conference in Missoula, Montana in May 2018. We used feedback from the conference along with the initial findings to develop a survey for a larger sample list. The sample for the survey consisted of anyone in Washington and Oregon who signed up for a Consortium event or service (e.g., webinar, workshop, field trip, listserv) since 2016. Because our focus was on Consortium users who apply wildland fire science in the Pacific Northwest, we removed anyone who engaged primarily in research or whose work was not based in Oregon or Washington.

The main goal of the survey was to understand Consortium users' 1) perspectives about using local and nonlocal research and 2) their needs for specific topics of wildland fire research in their work area or region. In addition to integrating findings from the interviews and relevant literature to develop the survey, we carefully reviewed a wide range of wildland fire publications (academic and practitioner) and websites to ensure proper terminology and inclusion of a broad spectrum of wildland fire research topics and issues that may affect the application and utility of research among respondents.

The survey had four main sections. The first section asked respondents about their position and where they work. The second section asked about respondents' use of wildland fire research and their perspectives about barriers to using nonlocal research to inform their decision-making process. The third section asked respondents to identify the extent to which they needed more local research about a total of 159 specific subtopics. The final section asked respondents for any additional insights they had on how wildland fire research had changed over the past decade, how their use of wildland fire research had changed, and any other comments they had regarding wildland fire research. Question structure included a mix of fixed-choice (e.g., yes/no or five-point Likert-type scales) and open-ended questions.

We waited to administer the survey until fall 2018, after the main 2018 fire season. We used a modified Tailored Design to administer the survey.[9] Beginning in mid-October, we sent the sample (n=374) three emails approximately one week a part describing the project and inviting them to participate. Individuals who did not respond within two weeks of the final reminder email were considered non-respondents.

In the writeup of results, we reported basic summary statistics (e.g., means and percentage) that were revealed in data analysis conducted in the Statistical Package for the Social Sciences (SPSS). Survey findings and interview findings were integrated where thematically appropriate to address the project objectives. Although we recognized the value of identifying and comparing local wildland fire research needs by ecoregions, relatively small sample sizes for these domains inhibited statistical inferences by state or ecoregion. Therefore, we presented all findings combined across the Northwest Fire Science Consortium focal area (Washington and Oregon).

Endnotes

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Oregon State University

Oregon State University Extension Service

University of Oregon

Ecosystem Workforce Program

Joint Fire Science Program

Forest Service U.S. Department of Agriculture

Sustainable Northwest

Center for Natural Lands Management

The Nature Conservancy
Protecting nature. Preserving life.