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Northern rockies Fire Science Network Programmatic evaluation and Needs assessment

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# Executive Summary

The Northern Rockies Fire Science Network (NRFSN) is a federally funded program developed to provide a resource for managers and scientists involved in fire and fuels management in the Rocky Mountains of Idaho, Montana, Washington, and Wyoming. It facilitates knowledge exchange among managers and scientists by bringing people together to strengthen collaborations, synthesize science, and enhance science application to critical fire and fuels management issues.

This report details findings from an internal evaluation designed to gain insight into NRFSN users and producers of science in the region, specifically, their needs; concerns; and how NRFSN does and can better assist in their work, fire science delivery, and other needs. In addition, science users affiliated with tribal agencies, both individuals engaged with NRFSN and those who are not, were also surveyed to help the Bureau of Indian Affairs (BIA) and NRFSN better understand the needs of those individuals.

## Main objectives

1. Provide a programmatic evaluation of the NRFSN to determine:
   1. if the program is providing the outcomes initially developed by the NRFSN Advisory Board and principal investigators and meeting the needs of its users.
   2. strengths and weaknesses of the program
   3. if and how scientists and managers are using the NRFSN as a resource
2. Provide a needs assessment to:
   1. assist in development of the ongoing Program of Work
   2. determine which fire topics need additional focus in the Northern Rockies
   3. identify the best ways to provide information
3. Identify barriers to use of science by managers and practitioners.

## Methods

Users of the NRFSN, both science users and science producers, were invited to take an online survey asking about their experiences with NRFSN, current/future information needs related to fire topics in the Northern Rockies, preferred methods of science delivery, and barriers to using science in their work (science users only). The link to the survey was shared with members through several emails sent by the previous NRFSN PI and the lead author on this report. In addition, tribal science users were contacted by BIA partners, again via email. Data were analyzed using Statistical Package for Social Sciences (SPSS) and responses of science users and producers were compared to identify potentially different needs of these populations. Tribal science users who engaged with NRFSN were included in the larger group of NRFSN users of science for analyses; we also include results from non-NRFSN tribal science users, as understanding needs of those in the region who are not part of NRFSN can also assist NRFSN with its program and outreach.

## Major findings and recommendations

### Relationships, Networks, Communication

* Science users and science producers value networking and relationship-building opportunities. NRFSN activities have helped them with networking, relationships, and subsequent collaborations through its activities (e.g., field trips). However, given that respondents indicated a lower likelihood of attending in-person activities in the next year, NRFSN should explore other innovative approaches to foster connections between these groups.
* Science producers said they interacted with managers/practitioners on a more frequent basis than science users did with researchers. Additionally, science producers were more likely to note that workshops/field trips provided benefits in terms of relationship building. NRFSN might want to explore further both why science producers expressed more benefits of these activities and ways to increase such benefits for science users.
* Science users agreed that barriers to using research in their work included *too few opportunities for managers and researchers to communicate/network* and *a lack of communication between science and management agencies*. Therefore, even though NRFSN is addressing these concerns, it should continue to put emphasis on opportunities to mitigate these barriers.

### Use of fire/fuels products

* Science producers more frequently accessed and used fire/fuels products in their work. However, both science users and science producers more often accessed these products from any source than from NRFSN. NRFSN can further emphasize its resources, as well as the fact that individuals can search the website by keywords to locate information related to their interests/needs.
* Science users most often used information in models/decision support tools, in NEPA documents, or implementing non-prescribed burn fuels treatments. NRFSN can ensure it provides information that would assist with these endeavors, and that such information is accessible, in a useable/digestible form, and easy to locate. This can help address the obstacles that users mentioned related *to lack of time to find and use research* and *too much available to digest and integrate*.
* Science users and science producers agreed that NRFSN increased accessibility and use of fire science information in their work and/or region.

### Science delivery methods

* There was a disconnect between preferred methods of science delivery between science producers and science users. Science producers preferred to share information with managers/practitioners through in-person presentations, virtual presentations, and field trips, with journal publications being the least preferred method. However, science users most frequently visited the publications database on the NRFSN website. Science producers indicated a lower likelihood of attending NRFSN in-person events in the upcoming year (2023).
* In terms of NRFSN products that they preferred for increasing their knowledge about fire management and/or manager needs, science producers highly ranked webinars, workshops, field trips, and research briefs. Similarly, science users also ranked these methods more highly. Differences existed in their top choices, with research briefs being the top choice of science users compared to field trips, which was more often ranked as science users’ top preference.
* Although many science users and science producers visited the website on a monthly or quarterly basis, webpages they most frequently visited varied. Managers were more likely to view the publications database and upcoming events, whereas a greater proportion of science producers viewed research briefs. However, for both groups, the webinar and video archive was the most frequently visited webpage.

### Barriers and obstacles

* Science users displayed the greatest level of agreement obstacles related to communication and scientific recommendations, priorities, and directives posed the greatest challenges to including research in their work.
* Although fewer research related factors were seen as barriers, science users agreed that the following factors were obstacles: time to find and use information, too much information to digest and integrate, and research write-ups lacked clear management objectives.
* On average, non-NRFSN tribal science users faced more obstacles to using research in their work. Although this could be because of additional barriers tribal science users might face, a previous report compiled for the BIA by Grimm examined responses of all tribal respondents. Results indicated a lower level of agreement when NRFSN users and non-NRFSN users were combined. These findings support the idea that NRFSN is helping address these barriers among its users. NRFSN should continue its work to alleviate such barriers, as well as outreach to increase awareness of NRFSN, its products, and activities among the larger population.

### Topics needing greater attention

Knowing topics that respondents believe need more attention can help NRFSN with future programming and products (e.g., topics for webinars).

* Topics that were ranked highly as pressing information needs were *climate change effects on fuels and fire, post-fire recovery, ecological effects of severe fires*, and *ecological resilience*. Among tribal respondents and science producers, *fire and traditional knowledge* was also highly ranked. *Cross boundary management, fire effects on invasive species*, and *public communication* also were seen as pressing information needs among many science users.
* Many science users, producers, and non-NRFSN tribal science users believed that the following firefighter health-related topics needed more attention: *mental health, smoke effects,*  and *sleep/work patterns*. *Stress* was also mentioned by many science users and non-NRFSN tribal science users, although it was less frequently selected by science producers.
* Among all groups, there was high congruence around the firefighter safety-related topics that needed more attention: *fire behavior, human behavior and/or decision-making,* and *organizational culture and communication.*
* Science users, both NRFSN science users and non-NRFSN science users, ranked the following topics as top research needs regarding public perceptions and attitudes: *attitudes about wildfire management, attitudes about prescribed fire,* and *expectations about fire season and fire regimes*.

This NRFSN program evaluation and needs assessment provides greater understanding as to whether NRFSN is meeting the needs of its users, strengths and weaknesses of the program, how it is being used as a resource, and where to focus attention in terms of topics and science delivery methods. Additionally, by identifying barriers to use of science, NRFSN can ensure it help find ways to mitigate such barriers.

# 1. Introduction

The Northern Rockies Fire Science Network (NRFSN) is a federally funded program developed to provide a resource for managers and scientists involved in fire and fuels management in the Rocky Mountains of Idaho, Montana, Washington, and Wyoming. It facilitates knowledge exchange among managers and scientists by bringing people together to strengthen collaborations, synthesize science, and enhance science application to critical fire and fuels management issues.

To better understand NRFSN science users and science producers in the region, an internal programmatic evaluation and needs assessment was conducted. Needs assessments are a process for determining needs and gaps between current and desired outcomes. Needs assessments have been used by other Fire Science Exchanges (FSE), as well as more broadly across the entire Fire Science Exchange Network (FSEN)(e.g., Kocher et al. 2012, Maletsky et al. 2018). The evaluation conducted for NRFSN, focused on its users’ needs; concerns; and how NRFSN does and can better assist in their work, fire science delivery, and other needs. In addition, science users affiliated with tribal agencies, both individuals engaged with NRFSN and those who are not, were also surveyed to help the Bureau of Indian Affairs and NRFSN better understand the needs of those individuals.

The objectives of this study were to:

1. Provide a programmatic evaluation of the NRFSN. We hoped to determine if the program is providing the outcomes initially developed by the NRFSN Advisory Board and principal investigators and meeting the needs of its users. We hoped to determine the strengths and weaknesses of the program and how scientists and managers are using the network as a resource.
2. Provide a needs assessment for developing both the ongoing Program of Work. We planned to identify which fire topics need additional focus in the Northern Rockies and what are the best ways to provide that information.
3. Help identify barriers to use of science by managers and practitioners.

# 2. Methods

## 2.1 Data Collection

We were interested in understanding experiences and perceptions of both science users and science producers. Therefore, we conducted three ~15-minute online surveys with three separate groups: science users who work for federal agencies and were users of NRFSN, science producers who were users of NRFSN, and tribal science users in the Northern Rockies region—both those involved and not involved with NRFSN. Surveys were developed and administered using Qualtrics survey software; questions were similar although some differed to address uniqueness of those groups (see Appendix A). Federal science users were surveyed December 2021-January 2022, tribal science users were surveyed July-August 2022, and science producers were surveyed August-September 2022.

Survey questions included those (1) based on previous surveys conducted NRFSN, FSEN longitudinal surveys administered annually between 2011-2015 (Maletsky et al. 2018), and previous research conducted by Grimm and (2) created to address NRFSN goals and its logic model. Questions were primarily quantitative and close-ended (e.g., multiple choice), with few open-ended (e.g., We are interested in understanding the direct impacts of NRFSN. Can you provide a specific example of how NRFSN resources helped meet one of the above outcomes?). Questions were asked about NRFSN effectiveness, barriers to fire science communication, topics for fire research, firefighter health and safety, public communication, methods for science transfer, website/Twitter use, and demographics. Two versions of the survey were created for tribal respondents so that questions specific to NRFSN’s role were asked only of those who were engaged with NRFSN, unless the question could assist NRFSN in their work (e.g., The following fire topics have been identified as important in the Northern Rockies. Please rank your top 5 topics for future NRFSN activities). Questions and sampling methods were approved by the University of Montana’s (UM) Institutional review Board (IRB).

Samples for the first two surveys were pulled from NRFSN’s Mailchimp listserv and individuals were categorized as a science user or science producer, as well as their affiliation (e.g., NPS, BLM). The first survey was only administered to federal employees (e.g., USFS, BLM); this was available for both federal science users (N=381) and science producers (N=61), with slightly different questions for each group. However, few science producers completed this survey, so we again reached out to federal science producers when we more widely surveyed all NRFSN science producers, which included but were not limited to those from universities, non-profits, and consulting firms. They were informed that if they had previously completed the survey to not retake it, and the results described here combine all science producers into one group (including one science producer who took the survey sent to tribal science users). The tribal sample population list was provided by our BIA contact and included those in the study region (Northern Rockies and interior Northwest) involved in fire and related resource professions; the final population sample included 87 individuals. This list was then broken into two groups, NRFSN science users and non-NRFSN science users.

For all surveys, we designed and used the approach that was approved by the UM IRB (Table 1). This approach utilized a modified Dillman approach (Dillman et al. 2014). First, for the first survey, the NRFSN PI emailed all federal employees on the NRFSN Mailchimp listserv and invited them to participate in the survey. The email contained information about the study and the link to the online survey. A similar process was used for the second survey sent to the science producers, but this was sent to all science producers on the Mailchimp listserv, not just federal employees. For the third survey to tribal science users, our BIA partner sent it those on their listserv; two versions of the email were sent depending on which survey link was appropriate for the individual (NRFSN user, non-NRFSN user).

After a week, Grimm sent a personalized email using Microsoft outlook’s mail merge function to a random sample of science producers and federal science users; personalized emails can increase the chance the email is read and the survey completed. The email informed people that they were randomly selected for a personal invitation and contained the survey link. For federal science users, we aimed to reach at least 25 from each category (jurisdiction and specialization within the USFS), unless that category had less individuals (e.g. USFWS), which led to 158 personal invitations. Similarly, we sent personal invitations to 158 science producers, with half sent to federal science producers (n=79) and half to non-federal science users (n=79). We used a random sequence generator to create the random sample. A similar personalized email was sent by our BIA contact, but given the small overall sample, everyone in this sample received a personalized email.

One week later, we also called those who received the personal invitation who did not respond (respondents were asked to include their email in a separate linked survey if they did not want to be called) to see if they received the survey, would like to answer questions by the phone, and if not, encourage them to take it online. Because we did not connect with many individuals via phone (given Covid-19, many were likely working at home), we did not use phone calls to reach individuals for the other two surveys. The same week (week 3), federal users who did not receive the personalized email also received a bcc email from the NRFSN PI reminding them of the survey; all tribal science users and science producers received this reminder email. Finally, in week 4, everyone received a final reminder email noting that the survey closed in one week.

Table 1. Sampling method and timeline used to recruit individuals for the three surveys: federal employees, science producers, tribal affiliated respondents.

|  |  |  |  |
| --- | --- | --- | --- |
| **Timing** | **Population** | **Method** | **Who** |
| Week 1 | 1. All federal employees on Mailchip listserv 2. All researchers on Mailchip listserv  3. All tribal contacts on BIA listserv | 1 & 2. Email to NRFSN listserv with survey link  3. Email to BIA listserv with survey link | NRFSN PI, BIA contact |
| Week 2 | Stratified, random sample | Personal invitation with survey link | Grimm, BIA contact |
| Week 3 | Stratified, random sample (federal science users) | Phone call | Grimm & NRFSN Program Coordinator |
| Week 3 | Individuals not in random sample | 2nd Email reminder with survey link | NRFSN PI; BIA contact |
| Week 4 | Everyone on mailing list who has not completed survey | Final email reminder with survey link and closing date | NRFSN PI; BIA contact |

## 2.2. Data analysis

Data for each survey were downloaded from Qualtrics into an excel file. Three groups were created for analysis, all science users involved with NRFSN (federal and tribal respondents), all science producers, and tribal science users not engaged with NRFSN. Data were uploaded into Statistical Package for Social Sciences (SPSS). Analyses consisted of running frequencies, means, and medians. We follow recommendations that actual numbers be used to describe and compare samples of less than 25 individuals (Sandelowski, 2001); since the third data set included responses with 25 individuals or less, we use numbers throughout for consistency.

# 3. Results

In total, 113 NRFSN science users, 74 science producers, and 28 non-NRFSN tribal science users attempted the survey, although this does not represent the number of fully completed surveys. Given the value of responses to any question, we included partially completed survey in our analysis; therefore, if an individual answered half the survey, responses for that half are included. The total number of respondents for each question is indicated. All Likert-type questions (e.g., How much do you agree or disagree, how likely or unlikely are you…) are on a 5-point scale. Ranking questions asked people to rank their top 3, 5, or 7 choices, depending on the question. Questions asking about frequency included the following choices: never, less than once a year, yearly, quarterly, monthly, weekly, and daily. Specific scales and rankings are described in the text and corresponding figures. When reading figures, caution should be used comparing science user and science producer answers, as there were fewer science producers in the sample; however, comparisons can be made between the groups when comparing average responses or the most/least frequently selected responses for a group. For example, the most frequently selected choice of science users might be quarterly basis compared to the most frequently selected choice by science producers for the same question.

## 3.1 Demographics

### 3.1.1. Science users

We asked several demographic and employment questions. Of science users who shared information about their affiliation (n=113), 96 were federal employees and 17 were affiliated with a tribal resource agency. Of the federal employees, most worked with the USFS (n=65). Others worked for the NPS (n=12), BLM (n=9), BIA (n=8), or USFWS (n=2). Most respondents worked at the local office (n=85), which included park, forest, district, field, or tribe levels; less common were those working at the state/regional level (n=19) or national level (n=9). Respondents were primarily either fire specialists (n=45) or resource specialists (n=42). Fewer respondents were managers or decisionmakers (n=15); 10 indicated they were something else. Of the 45 fire specialists, 44 individuals responded to a subsequent question about their current position. Most were fuels specialists (n=14), while others were FMO/AFMOs (n=9), fire ecologists (n=6), in fire/fuels planning (n=6), in field operations (n=4), or something else (n=5). The number of years in fire and their current position were categorized into ranges of 0, 1-5, 6-10, 11-15, 16-20, and 21+ years. The majority of those involved in fire who answered the question (n=83) were involved for 21+ years (n=47), followed by 16-10 years (n=18). Of the 88 respondents who answered about their current position, a greater number indicated they have been in their current position for 1-5 years (n=39), followed by 6-10 (n=16) and 11-15 (n=13). The majority of the 89 science users indicated their highest level of education was a Bachelor’s degree (n= 40), followed by a Master’s degree (n=23) or some graduate school (n=13). Respondents (n=69) were most commonly in the following OPM series: 0401/0408 (n=16), 04760/0461 (n=16), 462 (n=15), followed by 301 (n=9). Most respondents answering about their pay grade (n=69) were a GS11 (n=22), with others fairly evenly spread among GS9/10 (n=13), GS12 (n=14), and GS13/14/15 or SES (n=11); only seven individuals were at a GS7/8 level, with no lower GS levels represented in this sample.

### 3.1.2 Producers

Of science producers who shared information about their affiliation (n=72), most were affiliated with either a federal agency (n=36) or a university (n=30), while two selected state and four indicated other (e.g., consulting, non-profit). Of these individuals, 69 provided more details about the agency/University/organization for which they worked; the greatest number worked with the USFS (n=25), followed by the University of Montana (n=7); a university other than University of Montana, University of Idaho, or Montana State University (n=11); or a federal agency other than USFS, NPS, BLM (n=8). Most respondents (n=71) described their current position as ecological (plant, wildlife) (n=33), followed by fire behavior/fuels (n=16), and other (n=12). Less commonly did positions relate to science liaison (n=5), weather/climate (n=3), and social science (n=2). Of those involved in fire who answered (n=48), most frequently selected was involvement for 21+ years (n=21), followed by 16-10 years (n=9), although 1-5 (n=7) and 6-10 (n=6) closely followed. Of the 48 respondents who answered about their current position, a greater number indicated they have been in their current position for 1-5 years (n=21), followed by 21+ (n=12) and 11-15 (n=10) years. The majority of the 49 science producers indicated that their highest level of education is a PhD (n= 32), followed by a Master’s degree (n=13); with only 4 people indicating not selecting one of those choices.

### 3.1.3 Non-NRFSN tribal users

Of non-NRFSN tribal science users who shared information about the agency with which they worked (n=28), most were affiliated with either a tribal resource agency (n=16) or the BIA (n=11). Most worked at the local level (n=23), while only five worked at the regional/state level. Most were managers/decision makers (n=14), while others were range resource specialists (n=4), timber/silviculture (n=4), fire specialists (n=4), or other (n=4). This makes sense because a greater number of tribal fire specialists are part of NRFSN (n=14) and those not specifically fire focused might be less likely to engage with NRFSN. Of the 28 respondents, 21 indicated involvement in fire, with most being involved 21+ years (n=9) or 11-15 (n=5). In their current position (n=23), most were there for 1-5 years (n=12), followed by 21+ (n=5). The majority of the 23 respondents indicating their highest level of education selected a Bachelor’s degree (n= 15), followed by a Master’s degree (n=4) or some graduate school (n=2).

## 3.2 Interactions with other actors

### 3.2.1 Science users

Respondents were asked if they worked with policy makers, agency leadership, political staffers or prepresentatives, or some other type of policy maker. In addition, tribal science users were asked about tribal leadership. Of the 111 respondents, 28 indicated they did not work with policy makers, whereas 72 worked with agency leadership; fewer worked with political staffers or representatives (n=11) or some other type of policy maker (n=9). Of the 23 tribal respondents answering this question, 16 indicated they worked with tribal leaders. All respondents who worked with some type of policy maker were asked how much they agreed these groups were knowledgable about the latest fire sicence (1= strong disagree, 5=strongly agree). On average, they somewhat agreed that agency and tribal leaders were knowledgeable (M=3.03), whereas more disagreed that policial staffers were knowledable about this topic (M=2.27).

Science users were also asked how frequently they worked with researchers. Of those responding (n=106), they most commonly reported working together on a quarterly basis (n=31), followed by yearly (n=20), monthly (n=18), or less than once a year (n=18) basis (Fig. 1).

### 3.2.2 Science producers

Science producers were also asked about their interactions with policy makers and leadership. Thirty-nine individuals responded, of which 23 indicated they worked with agency leadership, two worked with political staffers or representatives, and nine selected other. However, given an error in the survey, respondents were only able to select one choice instead multiple choices, and therefore, unless they selected other and wrote both (some did), we do not know if more would have they also would have selected political staffers or representatives. Science producers, on average, agreed more that agency leadership was knowledgeable about the latest fire sicence (M=3.65). There was greater disagreement that political staffers were knowledgable (M=2.0), but this was based on only two respondents.

Many science producers (n=57) indicated that they worked somewhat frequently with managers and practitioners, with the most common response indicating a weekly basis (n=20), followed by monthly (n=11) and quarterly (n=9) (Fig. 1). Science producers were also asked how frequently they shared fire research findings directly with policy makers or agency decisionmakers in the last two years. Majority of respondents (n=48) said three or more times, followed by one time (n=13); only four respondents said they never shared these findings.

### 3.2.3 Non-NRFSN tribal science users

Out the 28 people who responded to questions about working closely with policy makers and leadership, only four respondents reported that they did not. Most worked with tribal leadership (n=21) and/or tribal agency leadership (n=21). Fewer individuals worked with political staffers or representatives (n=5). On average, respondents somewhat agreed that tribal leadership and/or tribal agency leadership was knowledgeable about the latest fire science (M= 3.30). In contrast, no one agreed that political staffers or representatives were knowledgeable about latest fire science (M=2.0).

## 3.3 Access and use of fire/fuels science product

### 3.3.1. Science Users

Science users (n=105) answered how frequently they accessed or used fire and/or fuels science products in their work (Fig. 2). The most common selection was a monthly basis (n=40), followed by quarterly (n=23) and weekly (n=20). Less common were respondents who never, yearly, or daily accessed these types of science products. Science users most often indicated that they used NRFSN information on a quarterly (n=39) or monthly basis (n=33) (Fig. 3).

Science users (n=105) were asked how they used these science products in their work (Fig. 4). Most respondents used science information in their work in at least one way, with only two individuals not recalling if they applied science information in their work. The most common use was to inform models and decision-support tools (n=65), followed by citing this information in NEPA planning documents (n=54) and implementing other fuels treatments (i.e. not Rx burns) (n=50). Other uses included implementing wildlife management strategies (n=39), developing treatment prescriptions in burn plans (n=37), implementing prescribed burns (n=36), making wildfire management decisions (n=34), post-fire rehabilitation (n=32), delivering fire-related training/presentations (n=32), and delivering public outreach (n=25).

### 3.3.2 Science producers

Science producers (n=57) were also asked how frequently they accessed or used fire and/or fuels science products in their work (Fig. 2). More respondents reported doing so on a weekly basis (n=22), followed by a daily (n=15) or monthly (n=11) basis. Much less common were science producers who never, less than once a year, yearly, or quarterly accessed these types of science products. Respondents indicated that they accessed or used NRFSN information most commonly on a quarterly (n=20), monthly (n=14), or yearly basis (n=11) (Fig. 3).

Science producers (n=52) also shared rank their preferred methods (research briefs, journal publications, field trips, in-person presentations, virtual presentations) for sharing research results with managers (1=most preferred, 5=least preferred) (Fig.5). Field trips were most often ranked first (n=14), although in person presentations (n=11), research briefs (n=12), and virtual presentations (n=10) followed closely. Journal publications were overwhelmingly ranked last, with 29 people placing it as their least preferred method. By comparing the means (means closer to 1 are more preferred), in-person presentations were the preferred method (M=2.23), followed by research briefs (M=2.59), virtual presentations (M=2.79), and field trips (M=2.82). Journal publications had an average ranking of 3.98.

### 3.3.3 Non-NRFSN tribal science users

Non-NRFSN tribal respondents (n=26) more often accessed or used fire and/or fuels products in their work on a yearly (n=7) or monthly (n=7) basis, followed by weekly (n=4); only one reported never accessing or using this type of information. Of the respondents answering (n=24), most used science information in their work in at least one way; only one individual could not recall applying science information in their work. The most commonly reported use was for models and decision-support tools (n=15), followed by post-fire rehabilitation (n=13), implementing prescribed burns (n=12), citing in NEPA planning documents (n=11), implementing wildfire management (n=10), and implementing other fuels treatments (i.e. not Rx burns) (n=10). All other uses were selected by fewer than 10 respondents.

## 3.4 Obstacles to using fire science research

### 3.4.1 Science Users

Science users were asked on a 5-point scale how much they disagreed or agreed that they faced certain obstacles to using research in their work (1=strongly disagree, 5=strongly agree). Obstacles were asked in three groups, organized around research; communication; and scientific recommendations, priorities, and directives (Figs. 6-8). All questions had 92 respondents except for relevant research (n=91). Means above three indicated a level of agreement that these factors posed obstacles. For the first grouping, the only factors that respondents agreed, on average, were obstacles included: *lack of time to find and use research* (M=3.70), *too much research available to digest/integrate* (M=3.36), and *research write-ups lack clear management implications* (M=3.15). In contrast, fewer people, believed the following were obstacles to using research: *lack of relevant research* (M=2.70), *lack of knowledge on how to find relevant research* (M=2.54), *lack of knowledge on who to contact about research* (M=2.83), *lack of rewards for using research* (M=2.98), *lack of one convenient place to access fire research* (M=2.97), and *uncertainty about how to apply relevant science* (M=2.83).

There was, on average, greater agreement that communication factors posed obstacles: *lack of communication between science and management agencies* (M=3.25), *lack of communication within management agencies* (M= 3.43), and *too few opportunities to communicate/network with scientists* (M=3.55).

Individuals tended to agree that factors around scientific recommendations, priorities, and directives were also obstacles to using research: *scientific recommendations conflict with the management options the general public is willing to accept* (M=3.32), *scientific recommendations conflict with agency priorities* (M=3.13), *scientific recommendations conflict with high-level political priorities* (M=3.41), *different disciplines use different scientific information* (M=3.41), *conflicting agency policy and directives* (M=3.45), and *lack of funding to implement research findings* (M=3.59). The only factor that, on average, was not viewed as an obstacle was *scientific recommendations conflict with my on-the-job knowledge* (M=2.51).

### 3.4.2 Non-NRFSN tribal science users

Twenty-three non-NRFSN tribal science users responded to questions about obstacles to using research. For these respondents, many of the factors related to accessibility and applicability of research were viewed as obstacles: *lack of knowledge on who to contact about research* (M=3.13); *lack of time to find and use research* (M=3.87), *lack of rewards for using research* (M=3.17), *uncertainty about how to apply relevant science* (M= 3.26); *lack of one convenient place to access fire research* (M=3.48), *too much research available to digest/integrate* (M=3.43), and *research write-ups lack clear management implications* (M=3.65). Only two factors related to research were not, on average, seen as obstacles: *lack of relevant research* (M=2.96) and *lack of knowledge on how to find relevant research* (M=2.74).

Similar to the NRFSN science users, there was, on average, agreement that communication was an obstacle to using research: *lack of communication between science and management agencies* (M=3.65), *lack of communication within management agencies* (M= 3.87), and *too few opportunities to communicate/network with scientists* (M=3.70).

Respondents also tended to agree that factors related to scientific recommendations, priorities, and directives were obstacles: *scientific recommendations conflict with the management options the general public is willing to accept* (M=3.74), *scientific recommendations conflict with agency priorities* (M=3.39), *scientific recommendations conflict with high-level political priorities* (M=3.4), *different disciplines use different scientific information* (M=3.65), *conflicting agency policy and directives* (M=3.87), and *lack of funding to implement research findings* (M=3.74). The only barrier for which there was a level of disagreement was *scientific recommendations conflict with my on-the-job knowledge* (M=2.57).

## 3.4 Topics for future fire research

### 3.4.1 Science users

We wanted to know which topics respondents felt needed more research. Science users ranked their top five fire topics for future NRFSN activities, where 1=most pressing information need and 5=least pressing need of the top five (topics outside the top 5 were not ranked) (Fig. 9). The list comprised of fire topics identified as important in the Northern Rockies. Overall, the most pressing need among users was *climate change effects on fuels and fire*. Sixty-six people selected this as one of their top five pressing information needs, and it was overwhelmingly selected as the #1 need (n= 31). Other topics commonly selected as a top 5 need were *ecological resilience* (n=49), *ecological effects of severe fires* (n=45), *post-fire recovery* (n=36), *cross-boundary management* (n=39), *fire effects of invasive species* (n=35), *public communication* (n=31), *fire and traditional knowledge* (n=29), and *risk assessment* (n=28); all other topics were placed in the top 5 by 25 or less respondents, with *smoke* (n=15) and *wilderness fire* (n=12) mentioned most infrequently.

Respondents were then asked specifically about topics related to fire fighting. They were asked to indicate from a list of eight **firefighter health-related topics** which needed more attention (Fig. 10). Out of the 88 users who responded, *mental health* (n=63), *stress* (n=52), *sleep/work patterns* (n=40), and *smoke effects* (n=44) were most frequently selected. Following were *fatigue* (n=32) and *suicide* (n=32). Less commonly selected choices were *COVID and firefighting* (n=12) and *other physical/mental health issues* (n=12). Only one person selected *none of the topics*, indicating that almost all respondents believed at least one of these firefighting health-related topics needed more attention.

They were also asked to select which, from a list of seven, **firefighter safety-related topics** needed more attention (Fig. 10). Out of the 88 individuals who responded, most indicated more attention was needed for *fire behavior* (n=65) and *human behavior and/or decision-making* (n=65), followed by *organizational culture and/or communication* (n=54), *risk analysis* (n=37), and *crew dynamics* (n=31). Less commonly selected was *hazard trees* (n=12). Two individuals indicated that none of these safety-related topics needed more attention.

Respondents ranked the top three research needs regarding public perceptions and attitudes (Fig. 12). Overall*, Attitudes about wildfire management among the local public* had the greatest number of people indicating it is a topic needing more research (n=67), with 19 individuals indicating it the top need. However, more people ranked *public expectations about the fire season or fire regimes* as their top need (n=28), with 60 people indicating it as one of the top three topics needing more research. *Public attitudes about prescribed burning* also factored into many people’s top three (n=64) with several respondents selecting at their first (n=23) or secondchoice (n=24). *Public tolerance of smoke from Rx burns* and *Public tolerance of smoke from wildfire* were ranked lower, with the latter being the least commonly selected.

We also asked an open-ended question to science users about what fire science topics they would most like to discuss with their public stakeholders. Most commonly mentioned topics included: prescribed fire, fire as a natural process/not putting all fires out, climate change/climate science, restoration and fuels treatment, Firewise/defensible space, ecosystem resilience, timber-oriented topics (e.g., timber as a resource for rural economies), risk and uncertainty, and post-fire management. Other topics mentioned by only one person, but still important to note were: Indigenous/cultural use of fire, cross-boundary fires, increasing fire severity in built landscape, and fuels and wildlife habitat connections.

Tribal science users were also asked if their program needed assistance incorporating more traditional knowledge in their vegetation/hazardous fuels projects and treatments. Of the 22 individuals who responded to this question, nine indicated that their program needed such assistance.

### 3.4.2 Science producers

Overall, science producers indicated that *climate change effects on fuels and fire* was also the most pressing information need (Fig. 13). Forty individuals selected this as one of their top five pressing information needs, and it was overwhelmingly selected as the #1 need (n= 18). Other topics in science producers’ top five included *ecological resilience* (n=25), *ecological effects of severe fires* (n=28), *post-fire recovery* (n=31), *fire and traditional knowledge* (n=22) and *public communication* (n=18); all other information needs were selected by 15 or fewer respondents.

For **firefighter health-related** topics, out of the 47 individuals who responded, *smoke effects* (n=24), *mental health* (n=18), and *sleep/work patterns* (n=15) were most frequently selected as topics needing more attention (Fig. 10). Following those were *fatigue* (n=11), *stress* (n=11), and *suicide* (n=8). Less commonly selected topics included *COVID and firefighting* (n=5) and *other physical/mental health issues* (n=6). Four people selected none of the topics.

Out of the 37 science producers who indicated which **firefighter safety-related** topics needed more attention, most believed that *fire behavior* (n=34) and *human behavior and/or decision-making* (n=34) needed more attention, followed by *organizational culture and/or communication* (n=28) and *risk analysis* (n=21) (Fig. 11). Less commonly selected were *crew dynamics* (n=13) and *hazard trees* (n=12).

### 3.4.3 Non-NRFSN tribal users of science

Even though they were not engaged with NRFSN, we asked non-NRFSN tribal science users to also rank their top five fire topics for future NRFSN activities. Since the list comprised of fire topics identified as important in the Northern Rockies, topics could be of interest to any individual involved with or impacted by fire. Additionally, there is a chance that learning about NRFSN in this survey could lead non-NRFSN members to join (information on how to join the listserv was provided at the end of the survey), and therefore, respondents could be impacted by future NRFSN activities. Although a greater number of individuals indicated that their top information need was *climate change effects on fuels and fire* (n=8), fewer people placed this in their overall top five needs (n=13) compared to *fire and traditional knowledge* (n=15), *post-fire recovery* (n=15), and *ecological effects of severe fires* (n=14). Close behind was *ecological resilience* (n=12). Less pressing needs, selected by fewer than five respondents, were *reburns* (n=2), *social resilience* (n=4), *smoke* (n=2), *public communication* (n=2), and *risk assessment* (n=4).

As for **firefighter health-related topics** needing more attention, out of the 22 individuals who responded, *smoke effects* (n=17) and *stress* (n=16) were most frequently selected, followed by *fatigue* (n=11), *suicide* (n=8), and *sleep/work patterns* (n=8). Less commonly selected choices were *mental health* (n=6), *COVID and firefighting* (n=5) and *other physical/mental health issues* (n=1). No one indicated that none of the topics needed more attention. Out of the 21 individuals who responded to which **firefighter safety-related topics** needed more attention, most indicated that *fire behavior* (n=18), *human behavior and/or decision-making* (n=18), and *organizational culture and/or communication* (n=17) needed more attention, followed by *risk analysis* (n=10). Less common were *crew dynamics* (n=8) and *hazard trees* (n=2).

In terms of research needs on public perceptions and attitudes, *public attitudes about prescribed burning* had the greatest number of people selecting it as one of the top three needs (n=17). S*moke from prescribed burns* was the most often selected top need (n=9), and 13 individuals placed this topic in their top three. Also seen as important needs were *attitudes about wildfire management among the local public* (n=15) and *public expectations about the fire season or fire regimes* (n=13)*.*  Few people ranked *public tolerance of smoke from wildfire* in the top three needs (n=4). Many of the topics these respondents said they would most like to discuss with their public stakeholders could be grouped around in the following categories: prescribed burns, climate change impacts, smoke management, ecological benefits of wildfire, cultural fire, inevitability of fire, risk assessment, WUI responsibilities, and fuels treatments.

When asked if their program needed assistance in incorporating more traditional knowledge in their vegetation/hazardous fuels projects and treatments. Of the 24 individuals who responded to this question, 12 indicated that their program did need such assistance.

## 3.5 NRFSN’s impact and effectiveness

### 3.5.1. Science users

Science users were also asked questions specific to their involvement with NRFSN, as well as the impact NRFSN has had on their work. Members were asked how likely they would be to participate in a variety of NRFSN events in the next year (1=Very unlikely to 5=Very likely) (Fig. 14). On average, for all activities, respondents indicated a greater likeliness than unlikeness for participation. Specifically, they were most likely to participate in webinars (M=4.17, n=94), followed by virtual workshops (M=3.79, n=91), and virtual fields trips (M=3.38, n=91). Lower likelihood of participation was seen for both small, outdoor field trips (M=3.16, n=94) and in-person workshops (M=3.15, n=94).

In terms of benefits resulting from NRFSN workshops and field trips, only 39 out of the 91 science users had participated in workshops or field trips (Fig. 15). Of these, most common benefits were a better understanding of researcher needs(n=22*),* expanded network of researchers(n=24) and building a working relationship with researchers(n=24). Less common results from workshops and field trips were directly consulting with fire researchers on research project objectives more (n=12) or meeting with researchers as a management advisor *(n=8);* only 3 respondents said they were *included by a researcher as a co-investigator on a proposal.*

NFSN activities or products related to wildland fire and/or fuels management had a greater impact on respondents (n=97) (choices were yes, no, or unsure) (Fig. 16). Most commonly, respondents believed that these activities or products *contributed to* *enhancing the skills, expertise, and/or resources of an organization or group* (n=65) or *contributed to changes in managers’/practitioners’ knowledge and/or awareness of an issue* (n=61); followed by *led to new or strengthened relationships*, *partnerships and/or networks* (n=48). Less commonly perceived impacts were *contributed to changes in the public’s knowledge and/or awareness of an issue* (n=33) or *was* *instrumental in changes to plans, decisions practices, and/or policies (*n=26). Interestingly, in all instances, “unsure” was more frequently selected than “no”.

On average, respondents (n=109) agreed that NRFSN helped them access and use science in their work (Fig. 17). The highest level of agreement was that the *NRFSN helped accessibility* *in my daily work* (M=4.07). However, respondents also agreed that *NRFSN helped improve use and application of fire science information in my daily work* (M=3.78) and *helped improve communication between fire managers/practitioners and fire researchers* (M=3.76).

Respondents (n=85) were also asked to rank the usefulness of these potential NRFSN activities and products for increasing their knowledge about fire research (Fig. 18). Most people ranked research briefs as the most useful (n=21), followed by webinars (n=19) and field trips (n=18). We also compared average scores, where the closer the average was to 1, the more useful respondents perceived it: webinars (M=3.14), research briefs (M=3.20), workshops (M=3.29), field trips (M=3.60), reviews of scientific literature (M=4.2), videos (M=4.76), podcasts (M=5.80). Doing so, illustrates that overall, webinars on average were seen as slightly more useful than research briefs.

We also asked them to provide a specific example of how NRFSN resources helped meet one of NRFSN intended outcomes:

1. Scientists understand managers’ fire science needs and communicate on challenges and science to support them,
2. Fire managers and scientists collaborate to build ecosystem resilience and fire adapted communities,
3. Policy/decision makers increase their knowledge of fire science, share the information, and use it to inform policy.

The most often mentioned resource was publications, and many respondents discussed ways they have incorporated or used information from these publications in their work and planning (e.g. prescribed burns, support analysis presented in NEPA, plan reforestation efforts). Workshops and field trips were also mentioned by several respondents; beside providing scientific information, these activities were viewed as strengthening relationships and building new collaborations. As one individual stated about the field-based workshop in Yellowstone after the Maple Fire, “These relationships [have] lasted and strengthened since then.” Webinars were also seen as a useful resource by several respondents, providing scientific information in an understandable context, as well offering an opportunity for questions to be answered by scientists and in some cases, build collaborations or help managers explain information to the public. There were also several additional benefits mentioned, but it was not clear from the responses to which resources they are referring.

We also asked people to share other potential methods for delivering science that would be helpful for learning about fire science. Some people focused on current methods, but emphasized more of those methods, such as podcasts, briefs, videos, and newsletters. Interestingly, although some people mentioned podcasts in response to this question, as seen above, podcasts were ranked as the least preferred methods among the larger sample. One person mentioned having the briefs and newsletters delivered via email provided a quick overview to help them determine its relevance to their work; if relevant, they can then dig deeper.

However, other people mentioned new potential methods, which included: Zoom or Teams presentation with Q&A, short films, quarterly emails with cliff notes of new papers and links to NRFSN where they are located, GIS story maps and dashboards, structured/planned events like quarterly science/management summits, tiktok, open access to journal articles, and ignite talks. Some methods involved the public, such as media blitzes, public news articles so managers and public are on the same page, and more direct public outreach. Others answered this question by focusing on new content they would like to see delivered, such as stories from those who have lost their homes, future landscape visualizations, and long term follow up on the condition of burned landscapes. Finally, seven people focused not so much on a specific methods and content, but more on ways to build relationships between managers and scientists through methods such as field trips, one on one interactions, visiting researchers who collaborate with practitioners, brown bag webinars tailored to a specific unit, lab tours, getting scientists engaged and represented in fire training curriculums and delivery beyond fire ecology and behavior, and continued field trips and workshops.

### 3.5.2 Science producers

Respondents (n=53) were also asked questions specific to their involvement with NRFSN, as well as the impact NRFSN has had on their work. Members were asked how likely they would be to participate in a variety of NRFSN events in the next year (Fig. 14). They were most likely to participate in webinars (M=3.98) and virtual workshops (M=3.38), and less likely to participate in virtual fields trips (M=2.94), small, outdoor field trips (M=2.89), and in-person workshops (M=2.83).

In terms of benefits resulting from NRFSN workshops and field trips, 28 out of the 51 science producers had participated in workshops or field trips (Fig. 15). Of these, most common benefits were provided a better understanding of manager needs(n=25)and expanded network of managers(n=23). These activities less commonly led science producers to build a working relationship with managers (n=14), directly consult with fire managers on research project objectives more (n=12), or meet with managers as a science advisor (n=10*);* only 4 respondents said theyincluded a manager as a co-investigator on a proposal as a result of a workshop or field trip*.*

Science producers (n=54) viewed NRFSN activities or products related to wildland fire and/or fuels management as having a greater impact on them (Fig. 19). Science producers most often selected agreed that these activities or products *contributed to changes in researchers’ knowledge and/or awareness of an issue* (n=35), *led to new or strengthened relationships*, *partnerships and/or networks* (n=35), and *contributed to enhancing the skills, expertise, and/or resources of an organization or group* (n=33). Although fewer respondents selected *contributed to changes in the public’s knowledge and/or awareness of an issue* (n=20), this was still greater than the number who selected was *instrumental in changes to plans, decisions practices, and/or policies* (n=8). Science producers were also asked if these products or activities *led to changes in social and/or ecological systems*; 15 individuals out of 46 agreed it did. As with science users, in all instances, far more people selected “unsure” than “no”.

On average, respondents (n=57) agreed that NRFSN helped with access and use of science in their region (Fig. 17). The highest level of agreement was that the *NRFSN helped accessibility* in my work (M=4.32), but closely followed by *NRFSN helped improve use and application of fire science information in my region* (M=4.26) and *helped improve communication between fire managers/practitioners and fire researchers* (M=4.25).

Science producers (n=49) ranked the usefulness of these potential NRFSN activities and products for increasing their knowledge about fire management and/or manager needs (Fig. 19). Most people ranked field trips as the most useful (n=20). Eight people each ranked the following as the most useful: workshops, webinars, and research briefs. When comparing average scores, although field trips remained the most useful (M=3.12), workshops (M=3.16) closely followed. Average scores for other products were as follows: webinars (M=3.22), research briefs (M=3.39), reviews of scientific literature (M=4.63), videos (M=4.59), and podcasts (M=5.88).

When asked about useful products that have led to direct outcomes, researchers focused more on products that allowed them to interact with managers, such as field trips and workshops. As one researcher stated, “NRFSN bridged the gap between academic researchers and on-the-ground practitioners and decision-makers by engaging both groups and creating opportunities for knowledge transfer…[such as] workshops in which scientists and managers participated in identifying research questions, setting priorities, and sharing results.” Whereas science users emphasized the value of publications, this was not a product discussed by science producers who responded to this question, likely because they have other venues to locate publications. However, they did more often mention research briefs than did science users; researchers said that these products can help them better understand manager needs and disseminate study results in a digestible and concise manner. Webinars were also seen to be useful products providing similar benefits as research briefs. Like science users, some science producers just mentioned overall benefits, but the specific product was not clear.

Science producers focused more on new methods of science delivery than the ones currently used, although two people mentioned podcasts and short videos, with one noting that people are bit webinar-ed out. However, there were many new ideas people shared: weekly interviews/interview series, short videos of scientists sharing results, webinar conference, trivia contest, documentary videos, long format news stories, podcasts with publication authors, special sessions at conferences, special issues in fire journals, outreach to high school and younger classrooms, other social media platforms like Instagram, panels, radio, newspaper articles, teacher workshops, and storyboards. Like science users, a theme in these responses was relationship building. Ideas centered on this involved working closer with extension foresters; collaborating with local people; more avenues to speak with local, state, and national level policy makers; real-time engagement with fire fighters, managers, and researchers while in the field; involving more practitioners; and working with end users to develop the science.

## 3.6 NRFSN online presence

### 3.6.1 Science users

Only 3 out of the 72 respondents followed NRFSN on Twitter; the website was utilized more frequently. Out of the 94 science users responding, they most frequently visited the website either quarterly (n=35) or monthly (n=26), followed yearly (n=16) (Fig. 21). Commonly visited webpages were the webinar/video archive (n=44), publications database (n=43), and upcoming events (n=42), followed by hot topics (n=35) (Fig. 21). The least frequently visited webpage was links to research institutions (n=4). Eleven people also said they did not know or remember which webpages they had viewed, while five said they had not visited any of these webpages. We also asked respondents what content they would like to see more shared via Twitter; even though many people do not follow NRFSN on Twitter, knowing desired content can help in sharing it through other social media formats. Science users tended to focus on topics, such as fire behavior prediction and modeling information, health-related information, post-fire information, and protection of the timber base. One person mentioned reminders about upcoming presentation and webinars.

### 3.6.2 Science producers

More science producers followed NRFSN on Twitter, with 14 out of the 43 respondents indicating they did. Of the 51 individuals responding to the frequency with which they visited the NRFSN website (Fig. 21), most indicated it was quarterly (n=21) or monthly (n=12); only two people had never visited the website. Fifty people shared which NRFSN webpages they visited in the last year (Fig. 22); most frequently visited webpages were the webinar/video archive (n=30), followed by NRFSN research briefs (n=24) and past event resources (n=20). Least frequently visited were the publication database (n=1), links to research institutions (n=1), and upcoming events (n=4). Seven people did not know or remember which webpages they had viewed.

Science producers focused more broadly on formats and announcements when asked what they would like to see tweeted. Suggestions centered around ideas like: reflections from managers, starting conversations around interesting topics, sharing publications or publication announcements, research highlights with links to articles/briefs, research-management interactions, the latest research, including fire research and activity in the Northern Rockies, report of research that has management implications, and highlights of researchers and practitioners. One person mentioned posting fun facts or safety tips, mixed with pictures, stories, and/or research summaries. Some people also mentioned it could be used for event announcements and adverting NRFSN activities, such as webinars, podcasts, and workshops. One person, who felt NRFSN should connect current events to their products stated, NRFSN should “promote its own activities, in ways that are consistent with its goals and missions. That is alternatively to the site tweeting actively about current event... without a link to its own products or mission. I could see the "sweet" spot being that the site helps share resources that are relevant to ongoing / current events (e.g., There a fire in region X, and there happens to be research that helps inform that event), then share that and link it to current events.”

### 3.6.3 Non-NRFSN tribal science users

Since those not involved with NRFSN might use the group’s resources, we asked all tribal respondents how frequently they accessed the NRFSN website or followed NRFSN on Twitter. Only one out of the 26 respondents followed NRFSN on twitter. Most non-NRFSN science users had not visited the website (n=10) or had done so less than once a year (n=7). Of those who had visited the website, most common webpages visited included the publications database (n=5), webinar and video archive (n=7), traditional knowledge and fire newsletter (n=5), and NRFSN research briefs (n=5); four individuals indicated they did not know or remember.

# 4. Discussion/Main takeaways

## 4.1 Relationships, Networks, Communication

* Science users and science producers value networking and relationship-building opportunities. NRFSN activities have helped them with networking, relationships, and subsequent collaborations through its activities (e.g., field trips).
* Science producers said they interacted with managers/practitioners on a more frequent basis than did science users about researchers. Science producers were more likely to note that workshops/field trips provided benefits in terms of relationship building.
* Science users agreed that barriers to using research in their work included *too few opportunities for managers and researchers to communicate/network* and *a lack of communication between science and management agencies*.

Respondents valued opportunities to network, build relationships, and collaborate. Several questions in the survey allowed respondents to share ways that NRFSN have fostered such opportunities. For example, respondents agreed that NRFSN has helped communication between fires managers/practitioners and fire researchers. Additionally, one benefits of NRFSN activities or products were that they *led to new or strengthened relationships, partnerships, and/or networks*. However, it is important to note that although both groups reported such benefits, in most cases, science producers had a more favorable view (e.g. greater average level of agreement, more commonly selected answer). NRFSN might want to explore in greater detail why science users have a slightly different outlook, and find ways to address potential issues and broaden the benefits to more science users.

Science producers also reported working more frequently with science users than the other way around; it could be they tend to work with individuals who were not in our sample. However, if science users would like more opportunities to work with science producers, which responses seems to indicate is the case, NRFSN might want to explore additional ways to foster collaborations and partnerships between the groups. Even though science users reported many benefits, they still agreed that obstacles included *too few opportunities for managers and researchers to communicate/network* and *a lack of communication between science and management agencies*. Therefore, even though NRFSN is addressing these concerns, it should continue to put emphasis on opportunities to mitigate these barriers. In addition, as discussed in greater detail below, given the likelihood of participation in certain activities, this might necessitate exploring new and innovative approaches that can foster collaborations, but are feasible with peoples’ availability.

## 4.2 Use of fire/fuels products

* Science producers more frequently accessed and used fire/fuels products in their work. However, both science users and science producers more often accessed these products from any source than from NRFSN.
* Science users most often used information in models/decisions support tools, in NEPA documents, or implementing non-prescribed burn fuels treatments.
* Science users and science producers agreed that NRFSN increased accessibility and use of fire science information in their work and/or region.

Science producers tended to access or use fire and/or fuel science products more frequently in their work than did science users. For both groups, it was less common to access these materials from NRFSN; the most common response was on a quarterly basis. NRFSN might want to remind its users about the fire and fuels science products that it has accessible that might be of interest to users. In addition, sharing the fact that individuals can search by keyword to find information related to their interests/needs might increase usage of the website for such information. One individual mentioned it would be useful for the website to be searchable, indicating that not everyone is aware of this function.

In addition, NRFSN can ensure that it provides the information that people need to assist them in their work. Science users most often used information in models/decisions support tools, in NEPA documents, or to implement non-prescribed burn fuels treatments. NRFSN can ensure it provides information that would help with these endeavors. It should also ensure that such information is accessible, in a useable/digestible form, and easy to locate. If such information is not currently digestible and useable, NRFSN might want to share it in a more user-friendly format, such as a science brief. This can help address obstacles that users mentioned related to *lack of time to find and use research* and *too much research available to digest and integrate*.

Despite these suggestions on ways to increase the use of NRFSN products, NRFSN is meeting its goals in terms of improving accessibility and use of fire science information. Both science users and producers, overall agreed that accessibility and use/application has been facilitated by NRFSN in either their daily work or in the region.

## 4.3 Science delivery methods

* There was a disconnect between preferred methods of science delivery between science producers and science users.
* Although many science users and science producers visited the website on a monthly or quarterly basis, many of the webpages they most frequently visited varied.

In terms of NRFSN products that were viewed as most useful, the top choices for both science users and producers were research briefs, webinars, field trips, and workshops. However, whereas research briefs was highest for science users, more science producers ranked field trips as more useful. Given some of these differences, NRFSN might want to market or offer different opportunities depending on the groups.

NRFSN might have to provide different opportunities to accommodate the interests and needs of science users and producers. Whereas both groups indicated they were most likely to participate in webinars, followed by virtual workshops, science users also indicated that virtual field trips were of interest whereas science producers on average had less interest in participating in these[[1]](#footnote-1). It should be noted that all average ratings for likelihood of participation were lower for science producers, indicating they might be less likely to participate in any activity.

However, this seems to contradict other responses by science producers who indicated they preferred to share information via in-person means (e.g. presentation, field trips), as well as virtual presentations. In addition, several science producers shared qualitatively the value of in-person events for building relationships. Science producers who attended field trips and workshops indicated several benefits they received from such activities. It could be that there is a divide between researchers, where some are interested in these in-person methods of engagement and others are not; this difference also has been documented in other research examining researchers involved with a FSE (e.g., Grimm et al. 2022). Therefore, NRFSN should be careful to not lump all science producers and their needs together, instead to providing a diversity of opportunities for their different needs and interests.

Overall, benefits from field trips, workshops and more broadly NRFSN products and activities provided benefits to many science users and producers. One thing that is not clear is if virtual field trips and workshops might also provide the same benefits as did workshops and field trip because we did not specify the format in that question. Activities and products related to wildland fire and/or fuels management were seen to have a positive impact on respondents, especially *enhancing skills, expertise, or resources* and *changes in knowledge or awareness of an issue*; *led to new or strengthen relationships, partnerships, and networks* was also important, especially for many science producers. The benefits that these participants experienced should encourage NRFSN to continue such activities, even if overall respondents indicated a lower likelihood of attending some. For those who do attend, the benefits were immense.

In terms of efforts for its online presence, NRFSN should put more investment and time into its website than Twitter. In addition, given the changes to and public opinion about Twitter (now X) since these surveys were conducted, there is a chance its limited number of followers might further decrease. Instead, science users and producers most often visited the website on a quarterly or monthly basis. Although for both groups, the webinar and video archive was the most frequently visited webpage, differences could be seen for other webpages. For example, managers were more likely to view the publications database and upcoming events, whereas a greater proportion of science producers viewed research briefs. This could be a result of science producers’ ability to access other sources (e.g., publications). Knowing that some webpages are infrequently visited can help NRFSN better focus their attention and efforts, or in some instances, merge information on less visited webpages with a more visited webpage to reduce the number of webpages maintained, while also further streamlining the website to improve usability.

## 4.4 Barriers and obstacles

* Science users displayed the greatest level of agreement obstacles related to communication and scientific recommendations, priorities, and directives posed the greatest challenges to including research in their work.
* Although fewer research related factors were seen as barriers, science users agreed that the following factors were obstacles: time to find and use information, too much information to digest and integrate, and research write-ups lacked clear management objectives.
* On average, non-NRFSN tribal science users indicated greater obstacles to including research in their work.

One of the goals of NRFSN is help facilitate the use of science research, so understanding obstacles people face to using research is important; NRFSN can focus energy alleviating these barriers. For both NRFSN science users and non-NRFSN tribal science users, barriers were especially significant related to communication factors, both within and outside their agency, as well as scientific recommendations, priorities, and directives. Although some of these might be difficult for NRFSN to address, such as when *recommendations conflict with agency priorities*, there are areas where NRFSN might be able to help, such as connecting science users to funding and improving communication between disciplines. Among NRFSN science users there was overall less agreement that finding research, applying research, and locating research were obstacles and therefore, NRFSN might want to focus less time trying to address many of these factors. However, NRFSN could help with some challenges people mentioned related to there being *too much research to digest/integrate*, *not having time to find and use research*, and *research lacks clear management implications*. Given a goal of NRFSN is to assist in science delivery and use, it is likely already working to help create more useable and digestible science with clear management actions. This is an area where it should continue to place emphasis, as well as make it clear to its users where they can find these products.

Interestingly, all but two obstacles related to research were viewed as obstacles for non-NRFSN tribal users indicating that NRFSN might be helping alleviate these obstacles among its users. Although this could be because of additional barriers tribal science users might face, a previous report compiled for the BIA by Grimm examined responses of all tribal respondents. Results indicated a lower level of agreement when the NRFSN users and non-NRFSN users were combined, for example, *lack of knowledge on who to contact about research* (Mnon-NRFSN = 3.13, MNRFSN = 2.91) and *research write-ups lack clear management implications* (Mnon-NRFSN = 3.65, MNRFSN = 3.31). Although small samples, these findings bode well for illustrating and supporting the idea that NRFSN is helping address and alleviate common research obstacles. NRFSN should continue working to remove such barriers, as well as continue outreach to increase awareness of NRFSN and its products and activities so that additional individuals can experience such benefits.

## 4.5 Topics needing more attention

Knowing topics that respondents believe need more attention can help NRFSN with future programming and products (e.g., topics for webinars).

* Science information needs that were highly ranked across all groups as pressing needs were *climate change effects on fuels and fire, post-fire recovery, ecological effects of severe fires,* and *ecological resilience*.
* Many science users, producers, and non-NRFSN tribal respondents believed that the following firefighter health-related topics needed more attention: *mental health, smoke effects,* and *sleep/work patterns*. *Stress* was also mentioned by many science users and non-NRFSN tribal science users.
* Among all groups, there was high congruence around the firefighter safety-related topics that needed more attention: *fire behavior, human behavior and/or decisions-making,* and *organizational culture and communication*.
* Both NRFSN science users and non-NRFSN science users, ranked the following topics as top research needs regarding public perceptions and attitudes: *attitudes about wildfire management, attitudes about prescribed fire,* and *expectations about fire season and fire regimes.*

Knowing topics that groups feel need more attention can help NRFSN focus its attention. For science users, science producers, and non-NRFSN tribal science users, *climate change effects on fuels and fire* was viewed as a top pressing information need. Other topics that all three groups felt were pressing information needs included *ecological effects of severe fires* and *post-fire recovery;* *ecological resilience* was also ranked highly by NRFSN science users and producers. Important to note is that even though climate change was most often ranked #1, non-NRFSN tribal respondents were less likely to place this in their top five compared to *fire and traditional knowledge, ecological effects of severe fires,* and *post-fire recovery*. Another difference is that proportionately more science users also indicated that *fire effects on invasive species* and public communication were pressing information needs.

For firefighter health-related topics, there were some differences between science users and producers. Although *smoke effects*, *mental health*, and *sleep/work patterns* were commonly selected by both groups, the frequencies between these choices differed, with more science users (NRFSN and non-NRFSN) seeing some as important than did science producers and vice versa. In addition, more science users emphasized *stress* as a major topic needing more attention, compared to science producers. However, there was more congruence around safety-related topics, where for science users, science producers, and non-NRFSN tribal users, *fire behavior* and *human behavior and /or decision-making* were the most frequently selected choices, followed by *organizational culture and/or communication*. NRFSN might want to focus attention on public perceptions and attitudes around *wildfire management*, *fire season or regime*, and *prescribed burning,* which again were the most highly ranked topics by both NRFSN and non-NRFSN tribal users of science.

The overall congruence in topics that groups find need more attention is helpful for NRFSN as it can streamline attention and satisfy the needs of both science users and producers. In addition, by focusing more attention on topics important to tribal science users, especially those who are not currently involved with NRFSN, there is a greater chance that NRFSN can expand its reach and users. Knowing topics of interest can also help facilitate science delivery (e.g. webinars) as groups would be interested in accessing products or participating in activities that provide information on topics identified as pressing information needs.

# 5. Conclusion

Overall, NRFSN seems to be meeting many of the goals set out in its logic model (e.g., helping improve accessibility of scientific information). This program evaluation/needs assessment highlighted some areas where NRFSN can improve with its efforts, such as helping remove obstacles that science users face to using research in their work. Given time and resources, this needs assessment can also help NRFSN focus on research topics that of most interest to its members, as well as which products, activities, and online resources NRFSN should use to convey this and other information.

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# 7. Figures

Figure 1. Frequency that science users (n=106) and science producers (n=57) interact with researchers/ managers or practitioners (Number of respondents).

Figure 2. Frequency with which science users (n=105) and science producers (n=57) access or use fire and/or fuels science products from any source in their work (Number of respondents).

Figure 3. Frequency with which science users (n=105) and science producers (n=57) access or use fire and/or fuels science products from NRFSN in their work (Number of respondents).

Figure 4. Ways that science users (n=105) indicating use fire and/or fuels science in their work (Number of respondents).

Figure 5. Number of science producers (n=52) who ranked their preferred methods of sharing research results with managers/practitioners. Respondents ranked all in order of most preferred (1) to least preferred (5).

Figure 6. Average level of agreement/disagreement that research-related factors were obstacles for science users (n=92 for all except relevant research n=91) to use research in their work. Scale: 1=Strongly disagree, 2=Somewhat disagree, 3=Neither agree or disagree, 4=Somewhat agree, and 5=Strongly agree.

Figure 7. Average level of agreement/disagreement that communication-related factors were obstacles for science users (n=92) to use research in their work. Scale: 1=Strongly disagree, 2=Somewhat disagree, 3=Neither agree or disagree, 4=Somewhat agree, and 5=Strongly agree.

Figure 8. Average level of agreement/disagreement that factors related to scientific recommendations, priorities, and directives were obstacles for science users (n=92) to use research in their work. Scale: 1=Strongly disagree, 2=Somewhat disagree, 3=Neither agree or disagree, 4=Somewhat agree, and 5=Strongly agree.

Figure 10. Number of science users (n=88) and science producers (n=47) who indicated that the above firefighter health-related topics need more attention.

Figure 9. Number of science users who ranked each of the above fire topics identified as important in the Northern Rockies as their first, second, third, fourth, and fifth choice, where 1=most pressing need and 5=least pressing need (out of the top five); respondents did not rank topics that were not in their top five.

Figure 11. Number of science users (n=88) and science producers (n=37) who indicated that the above firefighter safety-related topics need more attention.

Figure 12. Number of science users who ranked each of the above research needs regarding public perceptions and attitude as their first, second, and third, where 1=most pressing need and 3=least pressing need (out of the top three); respondents did not rank topics that were not in their top three.

Figure 13. Number of science producers who ranked each of the above fire topics identified as important in the Northern Rockies as their first, second, third, fourth, and fifth choice, where 1=most pressing need and 5=least pressing need (out of the top five); respondents did not rank topics that were not in their top five.

Figure 14. Average level of likelihood that science users (n=94, except virtual field trips, virtual workshops n=91) and science producers (n=53) will participate in the above NRFSN activities in the next year. Scale: 1=Strongly disagree, 2=Somewhat disagree, 3=Neither agree or disagree, 4=Somewhat agree, and 5=Strongly agree.

Figure 15. Number of science users (n=91) and science producers (n=51) indicating NRFSN workshops or field trips provided the above benefits. Those who selected “have not participated” were not able to select other responses.

Figure 16. Number of science users (n=97) indicating that NRFSN activities or products related to fire and/or fuels management had the above impacts.

Figure 17. Average level of agreement/disagreement that NRFSN helped science users (n=109) and science producers (n=54); *Daily work* was only used with science users, whereas *work* was use with science producers. Use and application questions were asked differently of the two groups. Scale: 1=Strongly disagree, 2=Somewhat disagree, 3=Neither agree or disagree, 4=Somewhat agree, and 5=Strongly agree.

Figure 18. Number of science users (n=85) who ranked the usefulness of potential NRFSN activities/products for increasing their knowledge about fire research. Respondents ranked all in order of most useful (1) to least useful (7).

Figure 19. Number of science producers (n=54) indicating that NRFSN activities or products related to fire and/or fuels management had the above impacts.

Figure 20. Number of science producers (n=49) who ranked the usefulness of potential NRFSN activities/products for increasing their knowledge about fire management and/or manager needs. Respondents ranked all in order of most useful (1) to least useful (7).

Figure 21. Average frequency with which science users (n=94) and science producers (n=51) visited the NRFSN website in the past year.

Figure 22. Number of science users (n=94) and science producers (n=50) who visited each of the above NRFSN webpages in the last year.

1. It should also be noted that although this was conducted during Covid-19, which could have increased the interest in virtual events, conversations and previous research conducted by Grimm et al. (2022) indicated that for some science users it can be difficult to travel to events due to distance, time, and agency regulations around permission. [↑](#footnote-ref-1)