



Northern Rockies Fire Science Network (NRFSN) Annual Report for Fiscal Year 2020



During FY20, the Northern Rockies Fire Science Network (NRFSN) continued to gain visibility and diversify our membership, even while adapting to challenges presented by the COVID-19 pandemic. Early in FY20, we were able to emphasize partnerships, personal briefings and consultations, and co-hosting and attending in-person events. As FY20 progressed, although we had already hosted our planned workshops, we shifted to exploring the feasibility of virtual field trips and meetings.

In addition to direct engagement, we hosted webinars and facilitated access to online resources, including: written products and videos, the NRFSN searchable publication and webinar databases, “hot topic” webpages, and past event webpages. We also engaged remotely with the NRFSN membership through email updates, newsletters and Twitter. Finally, we supported JFSP by compiling regional research needs and submitting success stories for the 10-year celebration.

Activities and products predominantly focused on forest resilience, post-fire regeneration, tools and resources for fire managers, fuel treatments, traditional knowledge and fire, risk assessment and management, wilderness and long-duration fire, firefighter health and safety, and whitebark pine restoration.

Participation by Organization, FY2020

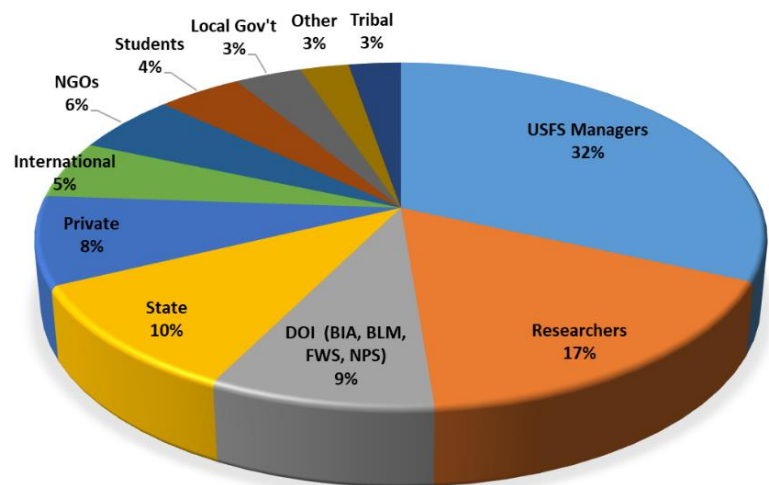
NRFSN membership grew 29% from FY19 to FY20 to 1,192 members. Reflecting high federal, tribal, and state land ownership in the Northern Rockies, the NRFSN has a high proportion of federal, tribal, and state managers (54%) and researchers (17%). Current manager membership in the United States includes 378 USFS, 124 State, 48 Tribal and BIA, 46 BLM, 33 NPS, 8 FWS, and 41 local government managers. Research membership includes 102 University, 73 USFS, 10 USGS, 10 NOAA and NWS, 6 NRCS and 1 USDA-ARS.

Ninety-three percent of NRFSN members are from the US, especially MT and ID, followed by WY, OR, WA, CO, CA, and UT.

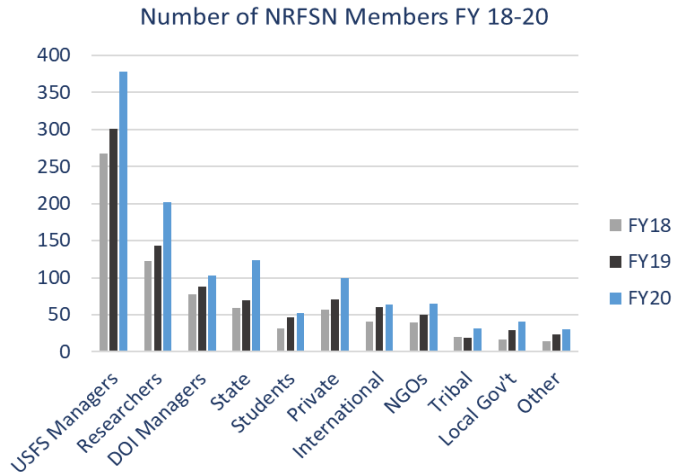
The 64 international members are mostly from Canada (primarily from British Columbia and Alberta), with additional members from Europe, Australia, and Southeast Asia.

NRFSN membership grew in FY20 in nearly all categories. In addition to continued growth by USFS managers (26%) and DOI managers (24%), notable increases in membership in FY20 included: States (77%), Tribal Nations (68%), local (city, county) governments (114%), and private companies (62%). Increases in research membership were due to an increasingly diverse set of researchers including gains in academic (31%) as well as federal researchers (48%) in the USFS, USGS, NOAA, and NWS. These areas of growth demonstrate increasing awareness of NRFSN activities and products by diverse stakeholders engaged in fire and fuels management and science across the Northern Rockies.

2020 NRFSN MEMBERSHIP BY ORGANIZATION



FY20 growth was predominantly through the following NRFSN activities: Montana Wildfire Risk Assessment Webinar, the NE Washington Tribal Focus Group, briefings at the Fire Adapted Montana workshop and the USFS Region 1 Joint Silviculture and Fuels Meeting, and webinars focused on tools for fire and fuel managers: Flammap 6.0, NFDRS and Photoload.



Participation by Activity, FY 2020

NRFSN activities in FY20 included workshops; presentations and exhibits; briefings and consultations; webinars; past event documentation; searchable publication and webinar / video databases; hot topic webpages; research briefs; e-newsletters and events flyers; social media tweets; and videos.

Direct Engagement

Direct engagement is a critical part of NRFSN work because it facilitates members building relationships and exchanging knowledge. Thus, NRFSN leadership and staff spent a substantial amount of time, energy, and resources in the first half of FY20 facilitating scientist-manager communication through workshops, delivering resources through exhibits, and conducting leadership and field briefings and consultations.

As FY20 progressed, the COVID-19 pandemic prevented us from hosting or attending planned workshops, field trips, meetings, and conferences after March 1st. As it became apparent that direct engagement through in-person events would be limited by the threat of Covid-19, the NRFSN Planning Team began exploring how to adapt field trips, workshops and meetings to a virtual format.

Workshops and Field Trips. The NRFSN planned 4 workshops and 1 field trip during FY20 to address the following topics of high interest in the Northern Rockies: landscape and forest resilience, fire and traditional knowledge, the new National Fire Danger Rating System (NFDRS), mastication, and fire ecology and management in the Crown of the Continent (Crown Fire Forum). Three of these events were hosted as planned, while the Crown Fire Forum and the mastication field trip were postponed until FY21.

Landscape and Forest Resilience

In Northern Rockies ecosystems, recent occurrence of shorter-interval, high-severity fire in landscapes with historically long-interval fire regimes has presented questions about long-term landscape resilience. To address this topic, NRFSN partnered with the University of Wisconsin and Dr. Monica Turner’s research team to host the *Learning about Resilient Futures* workshops in Missoula and Bozeman in February, 2020. These workshops were part of a JFSP-funded research project (What makes for a resilient landscape? Climate, fire and forests in the Northern Rockies), and followed workshops held at the



Workshop participants discuss findings in a break-out session in the Resilient Futures workshop, Missoula, MT.

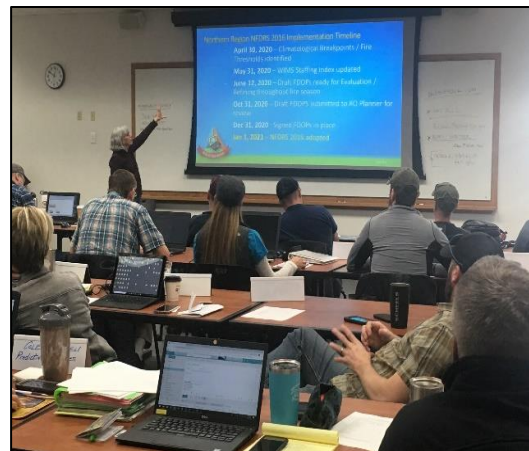
beginning of this project in 2017, *Dimensions of Resilience*. The first workshop identified pressing questions from the management community about resilience, climate, and fire; and identified characteristics of interest to be modeled.

At the second workshop, the research team shared simulation results at stand, landscape, and regional scales through the end of the 21st century. The research team and managers jointly interpreted what these projections mean for resilience; identified tradeoffs among different dimensions of resilience; determined what management interventions may resolve or inadvertently intensify tradeoffs; and reviewed limitations and appropriate use of modeling results. The workshop provided a unique opportunity to integrate research results from another JFSP-funded research project (*Identifying ecological and social resilience in fire-prone landscapes*) at the University of Montana, leading to future collaboration between the two research teams.

Including both the Missoula and Bozeman workshops, 37 people attended, representing three federal agencies, a tribal agency, several universities, and a private forester.

National Fire Danger Rating System

The Northern Rockies Fire Science Network played a central role in coordinating Fire Science Exchange Network partnership with USFS Fire and Aviation Management to hosting the regional National Fire Danger Rating System (NFDRS) Update rollout workshops. In addition, the NRFSN partnered with Julie Shea, the USDA FS Northern Region's Fire Planner to host the region's NFDRS Update workshop in Missoula, MT in February, 2020. The objective of this event was to inform managers of changes to NFDRS, including incorporating new science of moisture dynamics, weather conditions and fuel models from the past four decades. The 35 participants represented five federal agencies and one state agency.



Julie Shea, USFS R1, presents at the NFDRS roll-out workshop in Missoula, MT.

Tribal Engagement

Also in February, 2020, the NRFSN partnered with Kim Kelly, BIA Northwest Regional Fire Ecologist, and Monique Wynecoop, USFS Fire Ecologist, to host a workshop with tribes from north ID and northeast WA to gather information needs and science delivery needs across a range of fire and fuels topics on tribally-managed lands. This information was incorporated into the research needs submitted to JFSP in August 2020.

Presentations and Exhibits. In FY20, the NRFSN again partnered with the Northern Rockies Training Center (NRTC) in Missoula to offer an onsite exhibit during the training season. Materials were displayed at 17 trainings, including RX410, RX310, S482, R1 RLT, S420, and S490. This exhibit reached a diverse group of managers and scientists throughout the season. In addition, NRFSN materials were distributed at the International Association for Fire Ecology Conference (Tucson, AZ), the National Cohesive Wildland Fire Management Strategy Workshop (Plymouth, MA), and the Wyoming Prescribed



Tribal workshop participants provide feedback on fire and fuels information needs in Spokane, WA.

Fire Council and Rural Firefighters meeting (in partnership with the Southern Rockies Fire Science Network, Cody, WY). Exhibits were also displayed at all NRFSN hosted workshops. These exhibits primarily highlighted resources for fire, fuels and forest managers and practitioners.

NRFSN briefings were given and exhibits displayed at the USFS Region 1 Joint Fuels and Silviculture Meeting in Missoula, MT; the Fire and Fuels Science & Management Cross-Jurisdictional Conversation Workshop and Tribal Focus Group in Spokane WA; the Fire Adapted Montana annual meeting in Helena, MT; and the Blackfoot Prescribed Fire Working Group meeting in Greenough, MT.

Leadership Briefings and Consultations. During the first part of FY20, we continued to use opportunities for in-person briefings and consultations to increase awareness of the NRFSN, share products and services, and gather feedback on future emphases of NRFSN products and activities. In addition to leadership briefings and consultations with the NRFSN advisory board (Forest Supervisor, Salmon-Challis National Forest; Fire Management Officer, Flathead National Forest; Chief, Landscape Conservation and Climate Change, NPS Intermountain Region; Program Manager, Wildland Fire Management RD&A; and Chief, Fire & Aviation Management, Montana Department of Natural Resources and Conservation), other leadership briefings included the USFS Western Montana NEPA Strike Team Leader and the BIA Northwest region's Fire Ecologist, Fire Management Officer, Fuels Manager, and Prevention Specialist.

Webinars. NRFSN hosts 3-5 webinars per year on key topics as requested by scientists and managers. In FY20, NRFSN webinars addressed several themes of importance to Northern Rockies fire managers, including updates to resources and tools available to fire and fuel managers, risk assessment, and wilderness fire. The following webinars served 541 direct participants and 1,577 participants who viewed the recordings later on the NRFSN YouTube channel: *Flammap 6.0* (Chuck McHugh, USFS Rocky Mountain Research Station), *An introduction to the new National Fire Danger Rating System* (Matt Jolly, USFS Rocky Mountain Research Station), *Learn a new way to sample wildland fuels: the Photoload technique* (Robert Keane, USFS Rocky Mountain Research Station), and *Montana Wildfire Risk Assessment* (Montana Department of Natural Resources and Conservation and Pyrologix, LLC). With the USFS Rocky Mountain Research Station Missoula Fire Sciences Laboratory, we also co-hosted *A career of research in the Bob Marshall Wilderness: 1988-2020* (Robert Keane, USFS Rocky Mountain Research Station).

Online Resources

In FY20, the NRFSN continued to put substantial energy into making science accessible through online resources on the NRFSN website. This included past event documentation, searchable publication and webinar databases, subject matter expert reviewed resources on hot topics, and a bimonthly e-newsletter. The NRFSN's Drupal platform is in process of being updated, with completion expected in FY21.

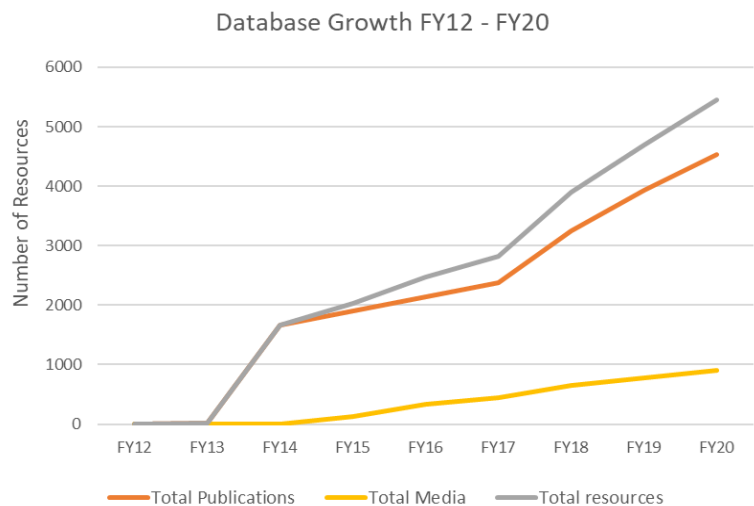
Past Event Documentation. In FY20, we developed past event webpages for one workshop and five webinars. These pages highlighted key messages and posted webinar or video recordings, related publications, and other associated resources for the events the NRFSN hosted. The materials offer learning opportunities for those who were not able to participate directly and allow participants to easily reference and revisit information presented during the event. Google Analytics shows that past event pages are widely viewed after an event; for example, in FY20 there were 261 page views of the past event page for the FY19 *Wilderness Fire Management: Easier Now or Later?* workshop.

Past event resources were posted for the following events:

- *Learning about resilient futures* workshop
- *Flammap 6.0* webinar
- *An introduction the the new National Fire Danger Rating System* webinar
- *Learn a new way to sample wildland fuels: the Photoload technique* webinar
- *Montana Wildfire Risk Assessment* webinar
- *A career of research in the Bob Marshall Wilderness: 1988-2020* webinar

Searchable Databases. The NRFSN hosts two searchable databases, including a searchable Webinar & Video Archive to help managers, scientists and others locate recorded webinars and videos on topics of interest. In FY20, we added 122 webinar and video recordings to this searchable archive. Overall, we provided access to 909 webinar recordings, seminars, videos or podcasts in 2020, which are searchable by topic and ecosystem. According to Google Analytics, there were 483 page views of the NRFSN Webinar & Video archive database in FY20.

Expanding the searchable NRFSN Research & Publications Database during FY20, we added 612 new publications, bringing the total to 4,540 documents. Based on manager interest, in FY20 we added a new subtopic to the database (BAER). According to Google Analytics, the publication database received 1,542 page views in FY20.



Hot Topics Webpages. In FY20, we continued to develop “hot topic” webpages focused on key themes important for fire and fuels management in the Northern Rockies. These topic-focused webpages feature important resources (webinar recordings, videos, scientific articles, syntheses, and upcoming and past events) relevant to specific topics of interest. While the hot topics pull resources from our searchable databases, the hot topics feature a narrower list of resources that are recommended by subject-matter experts to ensure viewers can quickly find the most current and relevant resources on a given topic. The following new hot topic webpages were created and shared with users in FY20: 1) public perspectives of fire management, which included resources to better understand the social issues that managers encounter in fire management and provide potential ways to address those issues; 2) post-fire debris flow, which included resources that address factors that influence the occurrence and severity of debris flows, potential consequences of post-fire debris flows, debris flow assessment, and mitigation efforts.

According to Google Analytics, there were 986 page views of our entire suite of Hot Topic webpages in FY20; topics with the most page views were *Wilderness Fire*, *Big Sagebrush Fire Ecology and Management*, and *Post-fire Tree Regeneration*.

Briefs and Science Reviews. In FY20, NRFSN briefs addressed the following topics: smoke impacts on firefighter health, post-fire tree regeneration, long-term fuel treatment effectiveness, and NRFSN outreach. We planned to publish a longer science review on resilience in FY20, covering results from

several JFSP-funded research projects. Based on researcher input, the review has been postponed to FY21, once project results have been published in peer-reviewed outlets.

Firefighter health and safety

Wildland firefighter health and safety has long been a topic of importance in the northern Rockies. To further address this topic, NRFSN worked with Kathleen Navarro to develop the research brief *Wildland Firefighter Smoke Exposure and Risk of Lung and Cardiovascular Disease*. The brief summarizes a study that analyzed long-term health impacts of smoke exposure for wildland firefighters. The study estimated relative risk of lung cancer and cardiovascular disease mortality across different exposure scenarios.

WILDLAND FIREFIGHTER SMOKE EXPOSURE AND RISK OF LUNG AND CARDIOVASCULAR DISEASE

Research Brief 7 | September 2020

Wildland firefighters are exposed to health hazards including inhaling hazardous pollutants from the combination of live and dead vegetation (smoke) and breathe soil dust, while working long shifts with no respiratory protection. This research brief summarizes a study analyzing long-term health impacts of smoke exposure for wildland firefighters (Duan et al. 2019). The study estimated relative risk of lung cancer and cardiovascular disease mortality from existing particulate matter (PM) exposure-response relationships using a measured PM concentration from smoke and breathing rates from previous wildland firefighter studies across different exposure scenarios.

Key Findings

- Firefighters who worked both short and long shifts (80 days and 96 days per year, respectively) were exposed to increased lifetime doses of PM_{2.5} across all career durations (1-23 years).
- Wildland firefighters were estimated to be at increased risk of lung cancer (8 to 43 percent) and cardiovascular disease (16 to 39 percent) mortality across career lengths and career durations.
- These findings suggest that wildland firefighters should reduce exposure to smoke in any way possible.

environmental exposure compared to not having the exposure, an RR of greater than 1 suggests an increased risk of an adverse health outcome. For example, an RR of 1.2 indicates a 20% increase in risk of developing a disease from an environmental exposure. Study authors used the following equations developed from Pope et al. (2011), which were developed for the American Cancer Prevention Study II, to calculate disease risk for wildland firefighters.

Relative Risk of LC = 1 + 0.3195 (Dose of PM_{2.5})^{0.95}
Relative Risk of CVD = 1 + 0.2485 (Dose of PM_{2.5})^{0.95}

Estimation of Lifetime Daily Dose of PM_{2.5}
 Study authors estimated the lifetime daily dose of wildfire smoke PM_{2.5} from measured concentrations of PM_{2.5} (PM with a diameter $\leq 2.5\ \mu\text{m}$ from smoke. Exposure-response relationships describe the strength of a health response to a disease (in this case PM_{2.5}) after a certain exposure time. Relative risk is used to understand the risk of an adverse health outcome from an environmental exposure compared to not having the exposure.

Methods

Wildfire Smoke Exposure-Response Relationship
 This study used exposure-response (ER) relationships to estimate the relative risk (RR) of lung cancer (LC) and cardiovascular disease (CVD) mortality from exposure to PM_{2.5} (PM with a diameter of $\leq 2.5\ \mu\text{m}$ from smoke. Exposure-response relationships describe the strength of a health response to a disease (in this case PM_{2.5}) after a certain exposure time. Relative risk is used to understand the risk of an adverse health outcome from an environmental exposure compared to not having the exposure.

Daily dose PM_{2.5} (mg) = Exposure Concentration ($\frac{\text{mg}}{\text{m}^3}$) \times Daily Shift Duration ($\frac{\text{hrs}}{\text{day}$) \times Breathing Rate ($\frac{\text{L}}{\text{min}}$) \times F \times CF

CF = Conversion Factors ($\frac{60 \text{ min}}{\text{hr}}$) and ($\frac{\text{m}^3}{1000 \text{ L}}$)

F = Frequency of Exposure = ($\frac{\text{shift days per year}}{365 \text{ days per year}}$) \times (years of firefighting career)
 45 years

Bringing people together, sharing knowledge
 NRFSNscience.org

Post-fire regeneration

With a changing climate and more fire on the landscape in the northern Rockies, managers are asking about the effects of fire on long-term vegetation recovery. To address this, the NRFSN partnered with Kimberley Davis on a research brief, *Climatic Controls on Post-fire Ponderosa Pine and Douglas-fir Regeneration and Growth*. The brief summarized a study that identified how seasonal climate conditions affect post-fire ponderosa pine and Douglas-fir regeneration and explored how reductions in canopy cover, through stand-replacing disturbances such as wildfire, may alter microclimate conditions needed for seedlings to survive.

Fuel Treatment Effectiveness

Fuel treatments are designed to reduce wildfire hazard, but they are rarely monitored for long-term effectiveness. Following a JFSP-funded remeasurement study, NRFSN worked with Sharon Hood to publish a research brief on the longest running fuel treatment and restoration study of ponderosa pine forests in the US northern Rockies, Lick Creek in western Montana. The study showed how fuels and vegetation changed over the 23 years since treatment and compared the effects of harvesting with and without prescribed burning.

Policy

In an effort to inform agency leaders and other policy makers about NRFSN resources, we updated a brief developed in 2018 that highlights activities, products and public outreach efforts. The brief also serves to introduce new audiences to NRFSN and the JFSP Fire Science Exchange Networks.

Newsletters. The NRFSN usually produces 5 newsletters/year, distributed outside of fire season. In FY20, we produced 4 regular newsletters, the first issue of a bi-annual Traditional Knowledge and Fire newsletter, and 3 listserv announcements of upcoming events. NRFSN newsletters are resource-focused, including short articles about new scientific resources and new publications, upcoming events, and fire or fuels-related regional highlights.

Social Media. In FY20, the NRFSN sent 138 tweets, numerous retweets and increased our number of followers by 201. This brought the NRFSN a total of 1,887 followers. NRFSN tweets highlight current research and news relevant to fire science and management in the Northern Rockies. We also use Twitter to make followers aware of NRFSN events and other relevant conferences, webinars, and opportunities that may be of interest.

Videos. The culmination of several years of work, the NRFSN worked with videographer Peri Sasnett to release the new video: *The Benefits of Hard Decisions: Lessons from Wilderness Fire*. Using interview footage that we collected from experienced fire managers and scientists, and input from subject matter experts, this video provides resources, guidance, and inspiration to line officers, especially those relatively new to managing wildland fire. This video is designed to stimulate conversation and has been widely viewed, with over 2,800 views in the first 3 months.

We also partnered with Heather Heward at the University of Idaho to sponsor the video *Landscape-scale Fire Management on the Payette National Forest*. Targeted towards an audience unfamiliar with prescribed burning, this short video outlines the process used to complete landscape-scale burns.

These videos are available through the NRFSN YouTube channel and are linked from the NRFSN website.

Highlights and Achievements, FY2020

An Established Resource in the Northern Rockies. In our eighth year, the NRFSN continued to grow its reach within the fire research and management communities in the region and beyond. Steady membership gains were made among researchers, federal managers, and most notably, among state, tribal, local (city, county) government, and private companies. This reflects growing partnerships with the state and tribes as well as participation in events that draw more diverse participants. The NRFSN continues to develop resources aimed at meeting the needs of federal, state and tribal managers while increasing awareness of NRFSN products among others interested in the science of fire and fuels management.

Governance & Staffing. NRFSN leadership continues to leverage partnerships with the USDA Forest Service's Human Performance and Innovation & Organizational Learning RD&A, the Wildland Fire Management RD&A, RMRS Fire, Fuels, and Smoke Program, and Northern Region; University of Idaho, University of Montana, Montana State University, and Salish Kootenai College. The NRFSN Planning Team and staff are especially pleased with the level of engagement of the Advisory Board. This can sometimes be challenging for organizations, but our Advisory Board demonstrates commitment to the NRFSN's success and actively engages in discussions around management needs, NRFSN priorities and capacity. Representing the USFS, NPS, BLM, BIA, Montana DNRC, and UI Extension, the NRFSN Advisory Board provides input on strategic direction, partnership opportunities, and potential activities; networks with their respective communities about NRFSN activities and products; makes suggestions to improve the effectiveness of our activities and products; and provides feedback on program effectiveness.

NRFSN staff coordinates with the NRFSN Planning Team to design and implement NRFSN activities. The NRFSN Planning Team works well together, is deeply committed to the success of the NRFSN and supports NRFSN staff in evaluating new ideas and troubleshooting challenges (for example, the exploration of virtual events). Of note, the NRFSN Planning Team was intentional in FY20 in having discussions about how to support diversity in fire and fuels science. Such open communication about challenges and lessons learned is a critical step in moving toward a more diverse workforce.

The NRFSN welcomed a new Coordinator in October 2019, Signe Leirfallom. Signe worked for several years as a fire ecology research technician at the RMRS Missoula Fire Sciences Laboratory, and most recently served as the Forestry Coordinator with a community conservation organization in western Montana working to support cross-boundary forest management, prescribed fire, and wildfire risk reduction. Also during FY20, the NRFSN bid farewell to Linda Mutch as she returned to full-time work with the National Park Service. We filled the Science Communication Specialist position with Cory Davis. Most recently, Cory has served as the Coordinator of the Southwest Crown Collaborative, a USFS CFLRP project in western Montana. Remaining in a shared position with the Rocky Mountain Research Station's Fire, Fuels, and Smoke Program, Pam Sikkink continued to serve as NRFSN's Fire and Fuels

Science Information Specialist. In FY20, Pam primarily focused on managing and updating the NRFSN searchable publication and webinar databases, developing new hot topics, exhibit preparation and staffing, and writing newsletter articles. Monique Wynecoop, Fire Ecologist with the USFS Northwest Region Fire Ecology Group continued to play a leadership role in the NRFSN's outreach to tribes, ensuring the NRFSN gathered tribal information needs and that information and resources relevant to tribal fire ecology are shared. The NRFSN is fortunate to have a skilled and dedicated staff!

FY20 Highlights

FY20 was another productive year for the NRFSN. We leveraged partnerships to host three workshops with the University of Wisconsin, the USGS Northern Rocky Mountain Science Center, the BIA Northwest Region, and the USFS Northern Region. For a second time, the Crown Managers Partnership Fire Forum was postponed; this time, rather than a government shutdown, it was the coronavirus. The repeated need to postpone this workshop illustrates some of the challenges of hosting events that are outside our control and beyond the inherent challenges of the intense fire seasons and short field seasons of this region. The Crown Fire Forum will be hosted as a virtual event in FY21. Hosting events with partners is not only synergistic, but it also provides opportunities to deepen relationships with a diverse set of scientists and managers working in the Northern Rockies. Similar to other Fire Science Exchanges, after nearly a decade of work, the Northern Rockies Fire Science Network is seen as a desirable partner for sharing knowledge about critical fire and fuels topics because we are well connected with scientists and managers in the region, we have a pulse on current management issues and the latest science, and we know how to organize events, synthesize knowledge, and deliver information through online resources. JFSP funding enables us to capitalize on these strengths by providing continuity and capacity through funding of staff and resources; however, we are continually challenged to prioritize the large workload required to meet intended outcomes in this complex region with limitations in staff and resources.

In FY20, we continued an emphasis on integrating tribal partners and traditional knowledge into NRFSN events and products. We were fortunate to continue our partnership with Monique Wynecoop of the USDA Forest Service's Northwest Region's Fire Ecology Group and Advisory Board member Kim Kelly of the BIA Northwest Region. We worked collectively to increase awareness of NRFSN resources available to serve tribal fire and fuels managers and to understand information needs on tribally managed lands. An FY20 highlight was the workshop, *A Cross-Jurisdictional Conversation with the BIA NW Regional Tribal Fire and Fuels Programs*, which brought together 35 participants representing ten tribes and the BIA NW Regional Office. As follow-up, we included research needs identified during this workshop in our Summer 2020 research needs submission to JFSP, and based on the high level of interest in invasive species, we will partner with the Fire Effects Information System (FEIS) in FY21 to develop a research brief on recent FEIS syntheses on invasive species. In a second highlight, the NRFSN partnered with Monique to release our first traditional knowledge and fire ecology newsletter to 155 subscribers.

In FY20, NRFSN products and activities continued to promote dialogue and deliver science on critical fire and fuels issues in the Northern Rockies, including forest resilience, post-fire regeneration, tools and resources for fire managers, fuel treatments, traditional knowledge and fire, risk assessment and management, wilderness and long-duration fire, firefighter health and safety, and whitebark pine restoration. We also supported JFSP by compiling regional research needs on repeated fire, and by submitting success stories for the 10-year celebration on the following topics: 1) Resilience, Reburns and Post-fire Regeneration in Mixed- and High-Severity Forests; 2) Making relevant science accessible to land managers and stakeholders through online resources; 3) Lessons from Wilderness Fire Science and Management; 4) Traditional Knowledge and Fire; and 5) Human Dimensions of Wildfire Management. In developing research needs in FY20, the NRFSN worked closely with a large group of subject matter

experts on the topic of reburns. The level of engagement demonstrated by this group of experts was outstanding and critical in narrowing down a broad topic to a tangible set of specific research questions.

Supporting fire-adapted communities through hosting the Montana Wildfire Risk Assessment webinar was another highlight. Large gains in membership resulted from this webinar as well as NRFSN exhibits at the Fire Adapted Montana Learning Network and the Blackfoot Prescribed Fire Working Group. Supporting firefighter health and safety, the NRFSN developed a research brief on the effects of smoke on firefighter lung disease and cardiovascular health. Perhaps one of the biggest highlights of the year was the production of the video: *Benefits of Hard Decisions: Applying Lessons from Wilderness Fire*. This video drew on the rich knowledge about wilderness fire in the Northern Rockies and garnered more than 2,800 views.

Positive feedback on the video included the following:

"I believe this is the single best media product I've seen in quite some time. It's clear, concise, touches on MORE topics that I would have imagined a video of this length could, and hits all the professionals needed to be incredibly convincing." – Rocky Mountain Research Station Lead Team Member

"Awesome video.... I just shared the video with the NPS fire leadership. You are making a difference!" - NPS National Fire Science and Ecology Program Staff Member

Transition to FY21

During the coming year, the NRFSN will continue to expand our membership and facilitate knowledge exchange about a variety of scientific resources that support proactive, effective management before, during, and after fire. This will provide context for the NRFSN's overarching goals of building science-manager communication networks; increasing scientist awareness of management challenges and research needs; and increasing manager awareness, understanding, and use of science.

In FY21, we will continue disseminating science around key themes that are important to fire and fuels managers in the Northern Rockies. Activities and products will address the following themes: resilience, fuel treatments, ecological effects of severe fire and repeat fire, wilderness and long-duration fire, risk management, fire and traditional knowledge, and species of special interest such as whitebark pine and invasive species. Information on priority themes will be gathered through a needs assessment survey and conversations with the NRFSN advisory board members.

With the continued impact of the coronavirus pandemic on in-person events, we will explore hosting several virtual events that provide valuable opportunities for engagement between managers and scientists. In one example, footage for a virtual workshop and field trip on mastication was collected in summer 2020 by the University of Idaho, with plans to virtually host the event in FY21. In another, we will kick off a post-fire workshop with a webinar panel to provide the background needed for the virtual workshop discussions. The third example is the Crown Fire Forum we have planned with the Crown Managers Partnership. We will also experiment with hosting the annual NRFSN in-person team and advisory board meetings virtually. We look forward to incorporating feedback on these various approaches into future event planning.

In addition to moving these workshops, field trips and meetings to virtual platforms, we will also explore the potential of hosting smaller, local field trips with covid mitigations. One exciting possibility for this is on the topic of prescribed fire in lodgepole pine forests. If successful, this approach could be repeated for the same field trip in different locations.

We will continue to strengthen relationships with tribal land managers in the Northern Rockies. In partnership with Kim Kelly of the BIA and Monique Wynecoop of the USFS Northwest Region's Fire

Ecology Group, we will expand our outreach to tribal managers to build relationships and understand the fire and fuels science needs of tribes in the region. We will also partner with Monique Wynecoop to distribute a second newsletter focused on fire ecology topics of interest to tribes; at the time of this report, 236 subscribers are awaiting the next newsletter. By fostering knowledge exchange among managers, researchers and tribal community members, we are actively building communication capacity at several levels of tribal involvement.

Also in FY21, we will continue to expand our searchable database and website to include topic-focused “hot topic” webpages, which will feature new and important resources (webinar recordings, videos, scientific articles, reviews, and briefs) that inform specific issues. Featured hot topics have been identified for smoke and populations and for risk management.

The NRFSN is fortunate to have a committed and engaged planning team, advisory board and staff who look forward to another productive year of fire science exchange on topics of critical management importance in the Northern Rockies.