United States
Department of
Agriculture

Forest Service

**Northern
Research Station**

Research Note
NRS-171

# Pine Ridge Fire Summary Report

**Hannah Brenkert-Smith**
**Sarah McCaffrey**
**Melanie Stidham**

## Abstract

In July 2012, immediately after the Pine Ridge Fire burned outside De Beque, Colorado, a team of researchers interviewed fire managers, local government officials, and residents to understand perceptions of the event itself, communication, evacuation, and pre-fire preparedness in order to identify contributors to success and areas for improvement. Although the fire had been a fast-moving event that presented significant risk to critical regional infrastructure and homes, research participants largely agreed that the fire management response prevented losses and that the actions taken before the fire among fire managers and emergency responders to plan and build relationships were a key component of the success.

## PROJECT DESCRIPTION

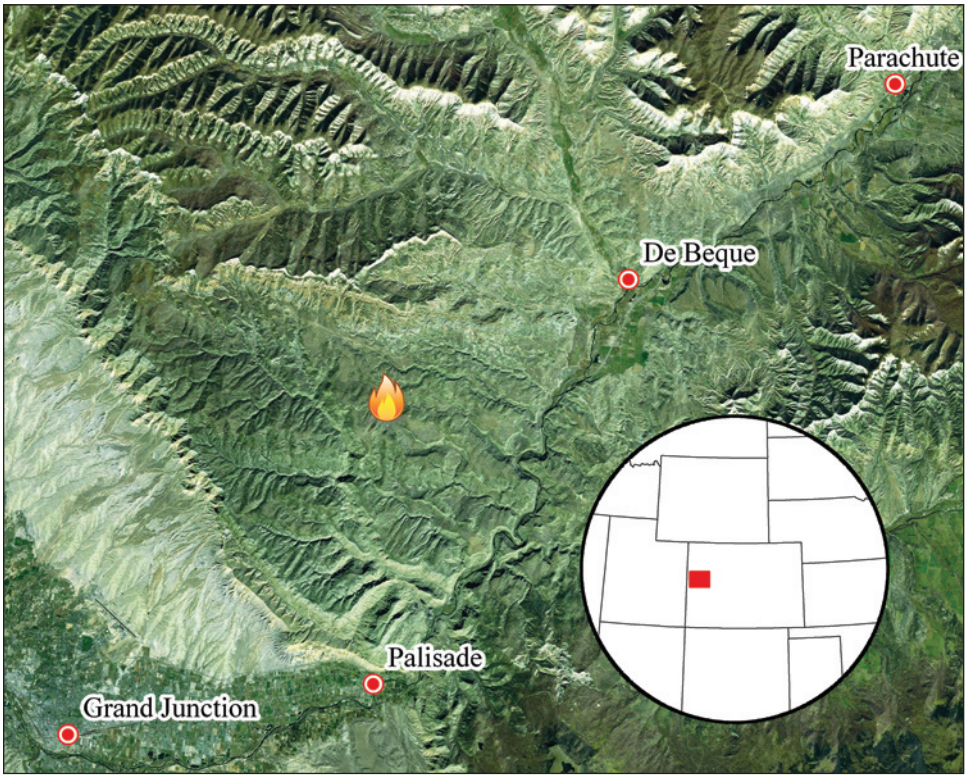
A research team of seven social scientists from North Carolina State University, the U.S. Forest Service, University of Colorado, and Ohio State University collected data from July 13 through July 17, 2012. Data were collected using structured interview protocols tailored for three stakeholder groups. Interviews were primarily conducted in person in Grand Junction and environs (including De Beque and Rifle, CO) with teams of two (interviewer and note taker) and lasted from 45 minutes to 1.5 hours. The interviews were documented through extensive notes and digital recordings for later transcription. This report was generated from notes taken during the interviews.

This research is part of a larger project to expand our understanding of social dynamics during and immediately after a wildfire event. The focus is on perceptions of the event itself, communication, evacuation, and wildfire preparedness among community members, local organizations, and federal agency personnel. To date, data collected after wildfire events primarily focus on physical aspects of wildfire behavior and impacts. This project seeks to develop a new framework for postfire research that will: (1) facilitate more consistent and rigorous collection of social data immediately after an event, and (2) improve the ability to aggregate lessons across wildfire events. Using a consistent approach to gather social data across multiple fires will help identify those processes that consistently contribute to better outcomes and can be replicated, as well as those that contribute to less positive outcomes and need to be addressed. This project was funded by the National Fire Plan.

## OVERVIEW

The lightning-ignited Pine Ridge Fire was detected on the afternoon of June 27, 2012 on Bureau of Land Management (BLM) land southwest of De Beque, Colorado (in the western part of the state, near Grand Junction). The fire burned 13,920 acres and had three structural losses, none of which were classified as residences. Primary participants in management of the Pine Ridge Fire were the Type 1 incident management team (IMT), the initial Type 3 IMT, the Upper Colorado River Interagency Fire Management Unit (UCR), the Mesa County sheriff's office (which includes the Office of Emergency Management), the State of Colorado, and De Beque Fire. Several items specific to this fire are of note:

- Federal fire management in the area is handled by the UCR (created after the South Canyon fire of 1994), an interagency unit through which the three federal land management agencies in the region (Forest Service, BLM, and the National Park Service) share firefighting resources.
- The fire threatened the Interstate 70 (I-70) corridor, which runs north-south for the portion of highway east of Grand Junction and through De Beque. A major transportation corridor, I-70 is co-located with several critical infrastructure elements including Union Pacific Railroad, gas and electric utilities, and high-voltage transmission lines that provide power to the Grand Valley. Loss of the power lines could have affected thousands of people at a time when temperatures were more than 100 °F. The area also has many gas and oil wells.



- In Colorado, the county sheriff is responsible for wildfires. In Mesa County, the sheriff's department has its own wildland fire crew, and its deputies all have red cards (Interagency Incident Qualification cards).

A total of 22 interviews were conducted with 28 people. Nine of these interviews were conducted with federal agency fire personnel, seven with local emergency personnel, and six with households affected by the fire (from evacuated and non-evacuated areas). Although the six household interviews (eight people) do not provide a comprehensive summary of resident response, given the relatively small number of residents evacuated this number is sufficient to give a sense of the range of situations and dynamics experienced by residents. Overall, a high level of consistency was found in the patterns of responses in all stakeholder groups.

## FIRE TIMELINE

The Pine Ridge Fire was ignited by lightning and was first detected on the afternoon of June 27, 2012 on BLM land outside of De Beque, Colorado. Initial attack units were sent to the fire as soon as it was spotted by patrols, followed by a helitack crew. Shortly thereafter, command of the fire was transferred from a Type 4 IMT to a Type 3 IMT.[1]

Residents learned of the fire primarily by seeing or smelling smoke. The June fires on the Front Range of Colorado (High Park and Waldo Canyon) had already heightened awareness and residents were sensitized to the high fire danger.

Given the terrain and fuels, the fire was expected to calm in the evening, but instead it was very active, doubling in size to 1,500 acres by the morning of June 28. Suppression actions included backburning, air retardant drops, and on-the-ground fire crews. As fire models predicted that the town of De Beque and I-70 might be threatened in the next 7 days, the sheriff's office and other local personnel began coordinating pre-evacuation notices, contacting stakeholders (e.g., Colorado Department of Transportation [CDOT], Union Pacific Railroad, Xcel Energy, the Ute Water Conservancy District) in anticipation of possible future needs, and staffing the emergency operations center. At 5:00 p.m., key local personnel (e.g., BLM agency administrator[2] [AA], county sheriff, county emergency manager, public

[1] There are five levels of IMTs in the United States ranging from Type 5 teams at the local level to Type 1 teams at the national level. Each successive team level has more experience, training, and available resources, thus increasing the capacity of the incident response as needed. Responses are initiated by the local team (level 5, 4, or 3, depending on the location) and are transferred to higher-level teams when the situation warrants greater response capacity.

[2] The agency administrator is the representative of the local agency, in this case the BLM, who has statutory responsibility for all personnel and actions on an incident. The IMT works on behalf of the agency administrator to manage the fire.

information officers) met in Grand Junction to plan for a 7:00 p.m. community meeting in De Beque, where they intended to share fire and pre-evacuation information with residents.

Plans changed at 5:45 p.m. when the county fire warden called to report that during the afternoon the fire had exhibited extreme fire behavior, had grown to 10,000 acres, and was imminently threatening I-70 and residences south of De Beque, days earlier than expected. High winds were threatening to carry embers across the Colorado River to the east side, where I-70, homes, and the high-voltage power lines were located. The Union Pacific rail line, on the west side of the river, was already being affected.

The sheriff immediately called an evacuation for the east side of I-70 south of De Beque and for a section west of I-70, affecting approximately 50 residences. The public was alerted about the evacuation through the reverse 911 system, National Weather Service emergency alerts, door-to-door visits by sheriff's deputies, and public news releases. An evacuation shelter was set up by the Office of Emergency Management at Palisade High School in Palisade, Colorado, although it was not used. In addition to the evacuation of residences, oil and gas wells in the area were shut in for several days.

Due to increasing complexity, the BLM had already been planning on ordering a Type 2 team to take over the fire, but given the sudden and significant threat to infrastructure it was decided to immediately order a Type 1 team. The incident commander (IC) for the Type 1 team was based in Grand Junction and could be mobilized relatively quickly. The Type 1 team assumed command of the fire at 6:00 a.m. on June 30 after receiving a delegation of authority from the BLM AA, Mesa County, and the Colorado State Forest Service. The incident command post (ICP) was set up at the main De Beque school.

The evacuation order was formally lifted by the sheriff on June 30 and the fire was contained on July 4. Management of the fire was transferred to a Type 4 team on July 5. Rain on July 6 significantly reduced fire potential.

## COMMUNICATION

During a fire there are two primary concentrations of communication: internal communication between emergency responders and external communication with the media and public. Internally, the IMT held three meetings for fire personnel each day:

- 6:00 a.m.: morning briefing for crew bosses, engine captains, logistics personnel, and line supervisors to talk about safety, leader intent, and expectations for the day.

- 12:00 noon: internal meeting for primary IMT staff.
- 7:00 p.m.: status update and planning meeting for the next operation period attended by state and local agency personnel including the sheriff and local fire chiefs.

Representatives from most of the key local organizations were consistently present at the ICP, participating in meetings and observing/listening to what was happening to keep informed and prevent miscommunication.

Externally, three public meetings were held in De Beque, starting on the evening of June 28. Attendance was generally high with ~200 attending the first meeting, ~100 at the second, and ~50 at the third. The AA, sheriff, and IC attended each of those meetings. The public was given updates on fire management and evacuations, and was offered a chance to ask questions. The AA made a point of making sure people knew where the ICP was and that they could go and ask additional questions whenever they wanted. As a way to prevent misinformation, the AA requested that when people heard something that they didn't understand or that sounded inaccurate they check with the BLM or IMT to make sure the information was correct.

Due to intense media interest, there were numerous public information officers (PIOs) working on the fire, including individuals from both IMTs (Type 1 and 3), the local BLM office, Mesa County (several offices sent PIOs), and the Grand Junction police department. They provided information through press releases (distributed to Grand Junction television, radio, newspapers, Denver media), Inciweb (www.inciweb.org), and traplines (a set of public locations where fire information is distributed every day) spanning from Rifle to Grand Junction. In addition, the IMT had a Twitter feed and multiple people called or stopped by the ICP to get up-to-date information. Several of the PIOs interviewed mentioned that their phones did not stop ringing for 2 days. People could also sign up to receive twice-daily email updates sent out by the IMT PIOs. In addition to communicating with the public, the IMT communicated regularly with other local entities that were affected by the fire (e.g., energy/utility companies, Union Pacific Railroad, local fire officials and law enforcement, local governments) through the team's liaison officer.

## Residents

Once aware of the fire, residents monitored the fire visually and sought additional information from a variety of sources including friends and family, mass media, and official sources. Overall, Inciweb was most often mentioned as a useful source of information and was highly regarded by all who said they used it. The Mesa County Web site was also a frequently cited Web-based source of information. Officers at roadblocks were a key source of information for several people. For

several individuals television or radio was the primary information source, but others found these sources less useful, citing inaccurate or sensationalized content or lack of timeliness or local specificity. Throughout the fire information was constantly being verified through friends and families. Because the community was small, these sources often were members of the local fire department.

## OUTCOMES: SUCCESSES AND CHALLENGES

Generally people spoke of management of the Pine Ridge Fire in a positive light. The clear consensus by all interviewed was that, despite some areas of concern, overall the fire was seen to have gone well. Although there were no significant problems, several areas were identified where there was room for improvement. The following section identifies elements mentioned by multiple participants as contributing to success or needing improvement.

### Overall Fire Management

Unique to this fire was the fact that state responsibility for wildfire was being transferred from the Colorado State Forest Service to the Department of Public Safety, during the middle of the fire (July 1). Most of the federal agency personnel interviewed said they had felt concerned about the transition before it took place, but found that it was handled well by both state departments and did not cause any significant problems or complications.

Several issues were reported regarding firefighting resources. One problem was that the federal resource ordering system was only intermittently available, causing delays in ordering and releasing resources (e.g., fire crews, fire equipment). Another problem was that the purchasing team was from another area and was not familiar with local purchasing protocols, leading to further delays in ordering and receiving resources. Finally, many of the resources that would normally be locally staged were already in use elsewhere because of other large fires already burning in the region. Although all of these were potentially major problems, none ended up having a significant negative impact on fire operations.

### Communication

The primary communication issues on the fire revolved around technology or equipment.

- Most frequently mentioned were the coordination and communication challenges created by the mismatch in radio equipment between local and federal systems. The county uses 800 MHz, as mandated by federal policy post-9/11. Federal agencies, on the other hand, use very high frequency (VHF, 30-300 MHz). These radio systems are incompatible. The problem had been identified as an area of concern prior to the fire season and the

sheriff's office had lent the BLM a cache of radios to put in its trucks so that local and federal responders could hear each other's communication. This arrangement functioned well during initial attack but did not work once the incident transitioned to a Type 1 team, which used only VHF. At this point the radio communication issue was addressed by use of cell phones and having representatives from each group at the ICP to maintain face-to-face communication.

- When coordination of multiple entities (e.g., evacuations) was required, the local emergency radio channel became overloaded. The Office of Emergency Management had another channel available with greater capacity that was utilized instead.
- Lack of clarity on how to reach the appropriate managers of different local infrastructure elements created initial communication challenges. For instance, the local contact for Union Pacific didn't have the authority to make decisions regarding shutting down the rail line and additional effort was required to identify a contact with the required authority. Moreover, although emergency managers were in contact with local Xcel Energy and Ute Water Conservancy District representatives, they learned later that they should also have contacted national-level energy and utility representatives[3] who could look at broader-level implications.

Overall, communication on the fire was seen as very successful despite these challenges. This success was attributed primarily to two specific things: (1) preexisting relationships that fostered trust and familiarity among local personnel at various levels of authority, and (2) the fact that many interactions occurred face-to-face at the ICP.

There has been a long-term concerted effort within the local fire management community, including the sheriff's office, to work and train together on a regular basis to build and maintain relationships outside of a fire event. Having strong professional relationships was seen to help build trust between parties and an understanding of each other's roles and intentions. Local agency personnel regularly mentioned that they had all worked with each other on fire planning prior to the fire and that this collaboration made communication easier during the fire. In addition, many members of the IMT, including the IC, were locally based, which further facilitated communication.

[3] Specifically, an ESF12 representative, whose role is to facilitate restoration of damaged energy systems during a federal emergency, as part of the Federal Emergency Management Agency's National Response Framework

*"We have very good relationships with the sheriff's office and with the county and those relationships are built over time and are nurtured over time so that when you need them they are there, so you're not trying to go and deal with people you don't know."* BLM AA

During the fire, respondents noted that having easy access to the ICP made it easier to communicate. One person put it succinctly by saying, "People made themselves available early and often." The IMT worked hard to make communication and decisionmaking transparent and open. In turn, members of the IMT mentioned the proactive response of local personnel, particularly the UCR, county Office of Emergency Management, and sheriff, in terms of coordination and cooperation during the fire as a key positive of the fire.

One specific activity that was identified as facilitating communication is the liaison officer's practice of sending an information request sheet to the local emergency manager whenever his team is deployed on a fire. The sheet introduces the team and explains what team members need in order to be successful, and then requests contact information for local fire officials, law enforcement, city council, and other local authorities. This step helps to quickly establish and maintain communication between entities during a fire.

### Residents

The level of desire for information varied amongst participants, with some finding what was available on the radio or television sufficient and others actively seeking information from multiple sources and expressing a strong desire for more frequent and accessible updates. For those with higher information needs, community meetings were a particularly reassuring information source. Higher desire for information was not necessarily tied to level of exposure. Some evacuees were content with information from the radio while one of the residents with the highest desire for information lived in a pre-alert evacuation area and was not evacuated.

Several participants indicated a desire for a more dependable mass media information source they could turn to at any point (not just during the regular news hour) when they wanted current fire information. Suggestions included a frequently updated radio channel like the National Oceanic and Atmospheric Administration (NOAA) weather report or a tickerline that local television channels could run at the bottom of the screen. The public meetings were informative for those who reported going to them. One non-evacuee said she appreciated the meetings more for reassurance that everything was going to be okay, than for specific information per se. One person expressed regret that she hadn't attended the public meetings and wished she had gone to get information on what to take when evacuating.

## Evacuation

Overall, agency personnel felt that the evacuation went smoothly. The primary logistical challenge was that many residents in the area did not have landlines; those who had not registered their cell phones with emergency services did not receive reverse 911 calls. To bridge this gap, sheriff's deputies engaged in door-to-door notification of evacuations. In addition, opportunities were provided at the ICP for residents to sign up for the county emergency alert system. There was also confusion over the exact boundary lines for evacuated areas; however, this did not end up being a major problem.

### Residents

Residents also had little issue with how the evacuation was handled. The reverse 911 process was generally seen to have worked well for those who had it. Its use to give pre-evacuation notice and information on the initial community meeting was appreciated as it provided advance warning and more time to prepare. Several people noted that they would have liked the message to be repeated so they could verify the information, and would rather have received more frequent calls with more detail on fire status. Residents shared agency personnel's concern that not all residents had landlines or had registered their cell phones and talked about calling each other to make sure everyone affected knew about the fire and the evacuation. Those who were notified of the evacuation by authorities going door-to-door indicated that the deputies who came were polite, well informed, and non-threatening.

Community members exhibited helping behavior at many levels by proactively providing updated fire information to those who were most directly threatened, sharing general information with friends and family, and helping evacuees move animals or household goods.

The eight residents interviewed for this project showed a range of behavior in response to the evacuation. One couple in the evacuation area chose not to leave. Both members had wildland fire fighter training, their property was well prepared, and they believed that their ability to protect their property allowed firefighting resources to be committed elsewhere. Several residents evacuated their key possessions, including horses, and then returned to their property, either immediately or after a day or two. Reasons for returning to the property included a sense that the fire was just not close enough to merit being away, concern about looting, and business interests on the property that needed to be looked after. One couple who lived in a pre-evacuation area exhibited two different responses to the fire. The husband felt their property was at no risk while the wife in many ways showed the most concern about evacuating of any resident interviewed and had pre-packed their car in case they needed to evacuate.

The primary impact that experiencing the fire appeared to have on residents was in terms of evacuation preparedness with discussions of making more concrete plans for what to take next time and registering cell phones for reverse 911. Only a few residents mentioned future property preparedness actions and when they did, they spoke in terms of general land maintenance such as mowing the grass.

## Road Blocks

Members of the De Beque marshal's office staffed the one active local roadblock and the sheriff's office and IMT provided support after the first day, including updating them with fire management information. The other local roadblock was not actively staffed; rather the closure was indicated by a road closed sign. Although roadblocks were seen to have been managed well, both agency respondents and residents said it was somewhat unclear as to how hard/soft the road closures were. There was one reported incident where a resident who had taken horses out was told she would not be let back in to get personal items when she thought she could, but this situation was quickly resolved and the resident was able to return to her property. Some residents reported being able to freely return to their homes without encountering any law enforcement; others reported talking with sheriff's deputies on the way in or out of the evacuation zone. Some who did not encounter law enforcement expressed concern about potential looting.

Overall, the soft nature of the road closures was seen positively by residents, for whom it simply made sense that they could go back to their property as needed if the fire threat was not imminent. As expressed by one resident, "they used common sense instead of rules." Personnel were not present at all roadblocks all the time; however, when they were, they were seen as a good information source who handled questions and issues in a thoughtful manner.

## I-70 Corridor: Critical Infrastructure Issues

The Colorado Department of Transportation had been involved in discussions at the outset of the event when closing I-70 was still hypothetical. When the fire doubled in size on June 28 and resulted in a recalibration of evacuation and road closure timelines, CDOT was initially able to provide staff to close only one end of the highway. The sheriff's office staffed the other end of the closure until CDOT was able to mobilize additional staff. Beyond its effect on interstate traffic (which was not a minor issue: one respondent indicated that within half an hour of closure tractor trailers were backed up for several miles) the closure created two challenges for the fire management team:

- The cut-off road used to bypass the interstate had limited capacity because it was narrow and curvy and had to be used for both the I-70 detour and evacuating residents, thereby posing additional safety hazards.
- The closure of the interstate limited access to the evacuation shelter established in Palisade as it was on the far side of the closure from the evacuation perimeter. It is not known whether sheltering needs were unmet as a result, but several residents commented that the shelter location did not make sense and was one reason why they didn't use it.

## OVERARCHING DYNAMICS

### Pre-fire Work

The fact that communication between fire management entities, interagency coordination, information flow to the public, and evacuations were all considered to have gone well was largely attributed to the amount of pre-fire planning the UCR and local cooperators engage in every year. Almost every agency member who participated in this study spoke of interagency planning, training, and other opportunities to work together on a regular basis and indicated that these activities prepared the agencies to respond in an efficient, coordinated manner. In addition, these preparation actions ensured that the first time the emergency responders met and worked together would not be on the fire line.

> *"My involvement [in this event] started in January with pre-loaded in-brief packet and agency admin briefing. My day job is designed around this event occurring. I have a seat at the table with Mesa County – I have worked on radio communications issues… policy, annual and operating plans so that we are not meeting each other for the first time. Everyone can do their jobs because of the relationships constructed."* BLM zone fire management officer

Activities that were mentioned in this respect included the following:

- The UCR coordinates training (for red cards and on the Incident Command System) throughout the year with local fire departments and the sheriff's wildland fire crew. The UCR also shares equipment and personal protective equipment.
- All individuals with communication responsibilities (public affairs or public relations officers within federal, state, and county agencies and some private organizations) within Mesa County meet every 3 months to share information and maintain open lines of communication.
- The Type 3 team has incorporated local cooperators into the team to build bridges and increase familiarity and understanding between different entities.

- Several cited development of an annual federal operating plan for the county as a key activity as, among other things, the plan specifies the roles of the sheriff and federal agencies (including cost shares) should a fire occur, and updates communication plans (e.g., radio frequencies, key personnel's cell phone numbers).
- During the fire season a coordination meeting is held weekly between federal fire managers and the county fire marshal.
- The AA made a point of stating that one strength of her agency's fire organization is that many of her employees are members of IMTs, providing her group with a level of experience that wouldn't otherwise be there. She and her staff also work hard to build and maintain relationships with the community; "better to make friends before you need them than when you need them." Community outreach is an ongoing goal of the local unit.

## Preparedness Gaps

In early 2012, the sheriff's office (including the Office of Emergency Management, sheriff, and wildland fire unit) had engaged in developing a county wildfire protection plan that involved public meetings to help identify values at risk (e.g., structures, infrastructure, critical wildlife habitat) in the county and to share risk mitigation information. Spring exercises followed to identify trigger points, simulate staffing up an emergency operations center, and engage with local federal agents (BLM) in order to establish coordination procedures. Wildland fire training, and specifically the red card training of the county's wildland fire team and sheriff's deputies and staff, reflected a high level of local familiarity and capacity to engage in wildfire management. Despite this work, several related concerns emerged.

- Multiple participants expressed surprise at the speed and magnitude of the Pine Ridge Fire. Even though everyone knew it was a dry year and fire risk was high in the county, most expected the "big one" to happen elsewhere in the county where there is a forested wildland-urban interface. In general participants, including residents, indicated that prior to the fire, they had seen the fire-affected area as having a relatively low fire risk compared to other areas of the county. Consequently, education and outreach efforts had tended to focus on higher-risk areas with more homes and denser vegetation to the exclusion of areas considered at lower risk. Several individuals felt this gap in attention to lower risk areas may have contributed to fewer wildfire preparedness activities by both local organizations and residents in the De Beque area.
- Organizations within De Beque had not developed any clear process for communication between local organizations or with the public for an event like the Pine Ridge Fire, perhaps because few people expected De Beque

to face such an event. As a result, poor communication between De Beque agencies, such as the fire department and Town Hall, meant that public queries about the fire could not always be quickly answered.

- The local fire department was not included in the Incident Action Plan (IAP), the plan developed before each operational period of the fire that includes all aspects of fire management. Typically the UCR relies on the county to identify the local resources that should be utilized during the fire response; in this case the local fire department was not identified in the initial response. Instead, the local fire chief had to call the IC and insert the department into the response where appropriate (mainly medical response). "Usually the local entities are not even addressed in the IAP, especially on [the] medical side of it with some of these larger fires. [Our fire department] would just be listed with a phone [number], but no real plan on how to utilize local resources. … We went to them [IMT] to get incorporated; they never came to us." This omission did not end up being a significant problem over the course of the fire but was identified as a glitch in the initial response.

## SUMMARY

The Pine Ridge Fire was a fast-moving wildfire that presented significant risk to critical regional infrastructure and homes. However, research participants largely agreed that the fire management response prevented losses and that the actions taken before the fire to plan and build relationships were a key component of the success. Although several glitches were reported, none of them resulted in major issues or controversies. In fact, from the perspective of our research participants this was a fire that went about as well as could be hoped.

## ACKNOWLEDGMENTS

We thank Dale Gormanson, U.S. Forest Service, Northern Research Station, Forest Inventory and Analysis, for graciously developing the map of the general fire area.

## AUTHORS

This report was developed by Hannah Brenkert-Smith, University of Colorado; Sarah McCaffrey, U.S. Department of Agriculture, Forest Service, Northern Research Station; and Melanie Stidham, The Ohio State University. For questions or comments please contact: Sarah McCaffrey, smccaffrey@fs.fed.us, or Hannah Brenkert-Smith, hannahb@colorado.edu.

Brenkert-Smith, Hannah; McCaffrey, Sarah; Stidham, Melanie. 2013. **Pine Ridge Fire summary report.** Res. Note NRS-171. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 12 p.

KEY WORDS: wildfire, emergency response, evacuation, wildland-urban interface, social dynamics, fire management

Manuscript received for publication January 2013

Published by:

USDA FOREST SERVICE
11 CAMPUS BLVD., SUITE 200
NEWTOWN SQUARE, PA 19073-3294

July 2013

For additional copies:

USDA Forest Service
Publications Distribution
359 Main Road
Delaware, OH 43015-8640
Fax: 740-368-0152
Email: nrspubs@fs.fed.us

Visit our homepage at: **http://www.nrs.fs.fed.us/**

Printed on recycled paper


Northern Research Station

www.nrs.fs.fed.us