# Relational Risk Assessment and Management: Investigating Capacity in Wildfire Response Networks

**Project Title**: Relational Risk Assessment and Management: Investigating Capacity in Wildfire Response Networks

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## ABSTRACT

Relational Risk Assessment and Management (RRAM) is about developing a new set of concepts and rapid assessment tools for assessing risk for problems that occur in inter-agency communication and coordination on complex fire events. Failures in effective communication and coordination within the network of responding organizations and agencies during a wildfire can lead to problematic or dangerous outcomes. Although risk assessment and management concepts are usually understood with regards to biophysical attributes in the wildfire context, these concepts can be extended to understanding risk for problematic communication and coordination embedded within social and organizational relationships. In this research, we leveraged social theory, survey methods, grounded theory,participant observation field ethnographic methods, and social network analysis to achieve four major outcomes: 1) Empirically identify, validate, and create tools for assessing both pre-incident preparedness as well as performance of wildfire incident response networks, 2) Empirically identify and validate social 'watch out' situations that cue responders to the presence of heightened risk for problems in communication and coordination, 3) develop an empirically based theory of network governance on complex wildfire incidents that can inform and expand upon the tools of ICS, and 4) document practices in network cognition and management on major wildfires to advance both theory and practice in relational risk assessment and management.

## BACKGROUND AND PURPOSE

*Relational risk* refers to the probability of problematic communication and poor coordination occurring amongst agency responders during an incident. If risks related to inter and intra organizational relationships are better understood, strategic actions can be taken to mitigate risk through both preparation and capacity building before a fire event and the employment of appropriate relational management strategies during an event. The aim of this research has been to develop an empirically-based framework for assessing relational risk. Such a framework has several components including 1) assessing the dimensions of network capacity and readiness pre-fire season, 2) understanding effective network structures for governing complex fire events, 3) understanding the social cognitive processes associated with assessing and managing social risk during incidents, and 4) being able to assess performance at whole network level of analysis. This research is an essential building block towards a set of tools that will assist host agencies, local responders, and incident management teams (IMTs) to identify appropriate relational risk management practices during an incident based on rapid assessment of local network capacity and incident complexity. To date, there has been significant empirical attention devoted to understanding risk and risk management as it relates to forest management and homeowner/landowner protection (e.g., Martin, Bender and Raish 2008, McCaffrey 2008, Steelman 2008). However, we currently lack conceptual frameworks and empirical research to assess the factors that contribute to or minimize *relational* risk in the coordination of responders during the wildfire event. Additionally, we do not fully understand how actions before the fire may impact coordination during an event.

We propose that relational risk is a function of 1) network capacity that exists before the fire; 2) the quality of the network management and governance processes during the fire, and 3) the complexity of the wildfire event itself. *Network capacity* refers to pre-fire factors that facilitate effective communication and coordination among the network of agencies responding to an event. *Network management and governance* refer to both the micro processes through which responders gain situational awareness of the network in which they are operating and become cognizant of and take action to avoid potential problems. It also refers to the macro structures and tools that shape the patterns and nature of communication networks during an incident. *Incident complexity* refers to characteristics of the event itself that increase the degree and/or difficulty of communication and coordination efforts needed among responders. While existing social theory and research from other disaster contexts offers a starting point in the development of RRAM, there is much left to understand about the factors that facilitate effective inter-agency coordination during wildfires (Drabek and McEntire, 2002, Masingo, 2009). Theoretical constructs like psychological sense of

community (PSOC), bridging capital, and bonding capital have been posited as factors associated with better communication and coordination in other disaster contexts (Pelling & High, 2005; Norris et al., 2008). However, there is a shortage of empirical research on these constructs, particularly as they relate to inter-organizational networks and wildfire and how they might be leveraged to assess and manage relational risks. Further, as fires have become more complex, a great deal of knowledge about relational risk factors and how to manage them has been gained by incident management teams, local forest leaders, and emergency managers through experience. However, for the most part, this knowledge and experience is not documented nor has it been empirically validated across incidents. Without documentation and study, much of this hard-earned wisdom is in danger of being lost in light of an aging workforce and impending retirements.

The assessment and management tools developed as a result of this project have been disseminated widely through assessment reports, presentations to both the wildland fire and academic communities, as well as published in both trade and academic publications. Our hope is these efforts have and will continue to aid local agencies in prioritizing capacity building efforts in advance of a fire, as well as help incident commanders and IMT members to gain greater situational awareness of the relational aspects of fire management and tailor their relational risk management efforts in accordance with field tested strategies.

## STUDY DESCRIPTION AND LOCATION

This project involved several phases of data collection including initial key informant interviews, identifying response networks and network structures, pre-fire surveys, field work during the fires and a post fire survey. Research focused on four states: Washington, Idaho, Oregon and Montana. These states were chosen as the focus of the study because at the time of our research climate change models predicted that long term wildfire threats would be more prevalent in these regions compared to other regions in the continental United States (Westerling et al. 2006; Running 2006; Brown et al. 2004[1]). These predictions remain valid currently.

**Incident Response Key Informant Interviews**. The objective of the key informant interviews was to document best practices and lessons learned by experienced fire personnel for assessing and managing relational risk under different risk/complexity scenarios and to ensure this knowledge was preserved beyond impending senior IMT personnel retirements. We sought out key informants that included experienced Incident Management Team members as local USFS Forest and cooperator agency representatives who had extensive experience assessing and managing relational risks in large-scale wildfire environments. Between July 2012 and February 2013, we conducted 24 key informant interviews. Key informant interviews were conducted by phone, recorded, transcribed. These key informants were identified using an information rich sampling strategy that was based on the investigators own networks, individuals were identified who had extensive experience in the field of wildfire incident response and land management, represented diverse perspectives within fire management and occupied multiple roles (e.g. a local sheriff also works as a LOFR on an IMT). Informants represented Incident Commanders, Liaison Officers, Operation Section Chiefs, Logistics Officers, Public Information Officers and Safety Officers on both Type 1 and Type 2 teams. Many people switched positions and teams over the years moving between Type 1 and 2. Outside of incident command, informants represented Forest Supervisors, Fire Chiefs/Local Fire, Retired or Current Regional USFS personnel, State Forestry,

[1] Brown, Timothy J., Beth L. Hall, Anthony L. Westerling. 2004. The Impact of Twenty-First Century Climate Change on Wildland Fire Danger in the Western United States: An Application Perspective. Climate Change 62:365-388; Running, Steven W. 2006. Is Global Warming Causing More, Larger Wildfires? Science 313:927-928; Westerling, A.L., H.G. Hidalgo, D.R. Cayan, T.W. Swetnam. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. Science 313:940-943.

National Forest/BLM Fire Staff, NIMO, Sheriff, active residents with fire experience. Total time in incident management within this sample was 646 years with experience on a total of 824 Type 1 fires.

**Identifying Local Incident Response Networks.** This phase of the project was designed to identify counties and adjacent USFS districts at risk for WUI wildfire in Oregon, Idaho, Washington and Montana. Our ultimate aim was to identify individuals in key leadership positions who would likely become engaged in the incident response networks should a large scale wildfire to occur. We focused specifically on US Forest lands in this first phase in order to simplify the networks. Within our tartget states, we identified 137 wildfire-prone forest districts using the 2012 wildfire Hazard Potential Map (http://www.arcgis.com/home/item.html?id=e03a1965082e4230b516fb9a3363b27e). We then created a geographic information system (GIS) to map the counties and population centers adjacent to each of the 137 forest districts. Our GIS specialists, Justin Shedd, used GNIS data because it was the only consistent data set for the entire four-state area in our sample. This resulted in an initial list of 136 counties. Following this, we used interviews with emergency managers and district rangers to narrow the list down to 108 'at risk' counties with population centers within 12 miles of a USFS boundary. These 108 counties were adjacent to 137 National Forest Districts associated with 33 different National Forests. Following this process, the incident response network associated with each county and its adjacent Forest Districts was created. This roster was based on an initial generic list of county, District and US Forest positions we developed specific rosters of organizations and individuals reflecting the incident response network. After extensive quality checking, this resulted in the identification of 1801 unique positions within the county, 449 positions within Districts, and 304 positions within Forest Supervisors offices. These individuals became the population of interest for the pre-fire survey.

**Capturing the Critical Network Structure.** To develop a structural model of an effective incident response network to transboundary wildfire, we engaged in a two phased effort. First, we started with a list of actors and units who have leadership responsibilities over different domains of incident response operations that must be coordinated with the rest of the network for the incident to be managed. Because this network was designed as a theory building exercise focused on an abstraction of an idealized incident response network during wildfires, the actors in this network were based on roles common to complex wildfire disasters but did not represent any one wildfire disaster network in particular. In phase two, the goal was to capture the network cognitions of highly experienced ICs. Each year, the nation's Type 1 incident and area commanders and deputy commanders attend a national workshop to prepare for the upcoming wildfire season. We were invited to present at this this meeting in April of 2012 which presented a unique opportunity to survey this elite group. This group effectively represents the population of active Type 1 qualified incident commanders trained and certified under the National Wildfire Coordinating Group in 2011. To extract this insight, each of the 25 commanders was given a social network roster based on the list described above. This roster was embedded within a square matrix with each actor appearing as both a row and a column. The worksheet contained only one question. ICs were asked to identify who should be in active communication with whom for a wildfire incident to be managed effectively. They were also provided an alternative wording to think about ties between actors who were ***not*** in communication with one another during the incident that would result in significant problems. We refer to these ties as the "critical incident response network". The aim of this data collection was to identify ideal structure of the communication network which is particularly central to decision making and governance in the network. This data collection resulted in 25 different cognitive representations of the critical network for transboundary incident response to wildfire. These data were then analyzed at the dyadic level for the degree of agreement among ICs concerning the criticality of any given relationship between any two actors. To create an aggregated model, only those ties nominated by 75% or more of respondents were included in the final network. This critical incident response network was then member-checked with the Type 1 incident commanders in 2012 at a follow up national workshop. Once validated, the network was analyzed both graphically and using social network analysis

metrics to discern its structure. Network metrics were calculated in UCINET and graphics generated in NetDraw.

**County & District Network Capacity Interviews.**
Based on the findings from our key informant interviews, we developed tools for assessing county and district capacity and readiness. We then conducted phone interviews with each District/Zone fire management officer and county emergency manager in the sample. We conducted a total of 134 FMO interview (98%) response rate and 98 OEM interviews (89% response rate).

**Pre-Fire Survey of Incident Response Network:** All individuals identified in the network identification stage received a survey which collected both social network data on their existing relationships within the potential incident response network as well as data on their background, personal and agency level involvement in preparededness activities, sense of collective efficacy, organizational culture, connection to place and trust in government, and familiarity with ICS and IMTs. A total of 706 responses from county agencies (39% response rate), 317 response from USFS District leaders (71% response rate) and 213 response from Forest Headquarters (70% response) were received.

**RRAM Participant Observation and Field Work.** Our objective was to visit a total of four Type I incidents and to select two from counties with high wildfire response capacity and two from counties with low capacity. As a result of logistics and the timing of fires, we were only able to conduct fieldwork on two incidents, with a brief visit to a third incident. The following three incidents were included in this phase of the study:

> *GC Complex*: The GC Complex Fire started one mile north of John Day in the late afternoon on August 7th, 2013, as the result of a lightning strike. GC Complex consisted of the Grouse Mountain and Starvation Fires. Response was headed by Brian Watt's Type II Incident Management Team and Oregon of Forestry, followed by Myer's Type II IMT. Malheur National Forest and the Oregon Department of Forestry acted as host agencies on this fire. At its peak, the complex threatened 100 residences, 10 commercial structures, and 290 outbuildings. One outbuilding was destroyed. Ranchers moved cattle off grazing lands ahead of the advancing fire.
> *Elk Complex*: On the night of August 8, 2013, several lightning fires burned together on the Boise National Forest resulting in the Elk Complex. The following day evacuations were put in place for the communities of Prairie, Fall Creek, and Lester Creek alongside road closures issued for roads off Highway 20, Cow Creek Road and Black Creek Road. On August 11, Rich Harvey's Type I Incident Management Team (IMT) transitioned onto the Complex. At its peak, the Elk Complex threatened over 480 structures, destroying 38 it its wake. Other values-at-risk included groups of livestock and bull trout habitat. The fire remained an imminent threat to the community through August 18, when residents were allowed back into their homes. On August 22, Redinger's Type III IMT transitioned onto the complex and 100 percent containment was achieved on August 31 with Nemore's Type IV IMT. Over 130,000 acres burned in total and, according to Inciweb, 75 percent of the burned area had high-to-moderate burn severity.
> *Beaver Creek*: On August 7, 2013, lightning ignited the Beaver Creek Fire on the Sawtooth National Forest, several miles outside of Hailey, Idaho. By August 12, Beth Lund's Type I Incident Management Team (IMT) was fully operational and began combating the extreme blaze. There were multiple host units on the Beaver Creek Fire, including Sawtooth National Forest, the Bureau of Land Management (both the Shoshone and Twin Falls Districts), Idaho Department of Lands, Ketchum Fire Department, and Wood River Fire Protection District. At its peak, the Beaver Creek Fire threatened 5,128 residences, 1,399 commercial buildings, and 3,729 outbuildings as well as greater sage grouse habitat, bull trout in Ditto Flat/Little Smokey Creek, mining structures, Forest Service campground infrastructure, Carrietown historic structures, as

well as commercial timber areas. Upon containment, the Beaver Creek had burned approximately 111,500 acres of land.

Fieldwork consisted of a participant observation protocol as well as follow up interviews. The participant observation protocol involved the principal investigators arriving on incidents shortly following the arrival of the Type 1 or 2 IMTs to 'job shadow' the incident commander and liaison officer. Our observation protocol focused on documenting the processes through which these two individuals developed a situational awareness of social risk and the actions they took to manage these risks. Each researcher shadowed their participant from the 5.30 am Ops meeting or the 6 am briefing until the final planning meeting in the evening. Researchers discreetly took notes during the day/night and wrote up notes at the end of the day or as soon as possible as events would allow. We were on site for 2-11 days on each incident (GC complex from August 08, 2013 to August 16, 2013; Elk Complex from August 16, 2013 to August 17, 2013; Beaver Creek from August 17, 2013 to August 26, 2013). Based on field observation, a sub-sample of members of the responder network were selected for in-person interviews. This sampling was made based on level of involvement. For instance,more emphasis was placed on members who were more engaged in the incident although effort was made to make the field interviews representative as possible of the entire responder network. In some cases, an individual who was not part of our roster for the incident response network was also interviewed. These were generally residents who became engaged in the incident in an intensive manner. A total of 26 interviews were conducted for Beaver Creek, 4 for Elk, and 21 for GC Complex.

**Post Fire Survey.** Over the course of the 2013 Fire Season, our team monitored all fire activity in our sample region. Type 1 and Type 2 WUI fires were flagged for follow up surveys. There were a total of 21 incidents met sample criteria during this fire season. For each of these incidents, the incident commander and liaison officer was consulted to confirm the incident response network that was activated during that event. These networks were then verified by followup consultation with the county emergency manager to ensure there were not actors involved of which the IMT was not aware. This process resulted in the identification of 885 individuals representing the incident response network. These individuals were surveyed using tools created to assess the performance of the incident response network including performance of the IMT, the host agencies, and the county cooperators. Survey responses were received from 511 individuals (58% response rate).

## KEY FINDINGS

Because of the breadth and depth of data collected as part of the project, we have organized management implications under nine major findings and implications. Additional work is being published along with continued analysis.

1) **More Work is Needed Improving Wildfire Readiness in Local Communities (Pre-fire Surveys)**:

In 2013, our sample of 108 counties at risk for a wildland urban interface fire reported widespread involvement in state and federal mitigation and defensible space programs however there are systematic differences in the popularity of programs/tools across states. States appeared to differ most significantly in terms of whether county prioritized CWPPs or Firewise programs. Further, while all counties reported participating in some wildfire risk mitigation programs, many are still in the planning stages. For example, while 100% of counties in Washington indicated they participated in Firewise, 30% of those counties had yet to develop finalized plans at the time of survey. Given this variation, findings suggest that state of implementation is an important consideration for understanding county capacity and preparedness for wildfire. In terms of preparedness related to emergency response, planning for evacuation was common but less than half of our sample counties reported plans for evacuation and accommodation of special needs populations and few counties reported plans for how to notify residents of property damage and coordinating donations. Also interesting, counties reported recent experiences

with incident management teams as largely positive. However, more work can be done by incident management teams to improve communications with local governments and responding agencies. While overall rating of past IMTs was positive, a significant number of respondents reported that past IMTs have demonstrated limited understanding of their organization's work and failed to value their organization's input. Further, many key actors including municipal and county managers, elected officials, and animal evacuation organizations lack experience with Incident Command Systems (ICS). Incident responders should be aware of this and not make assumptions that the ICS terminology and structure is equally well understood by all involved. Further, there is opportunity for greater training and education in ICS among these sectors so that they can be included in a more meaningful way during an incident.

Supporting publications and presentations:

Nowell, B. and Steelman, T. (2014) When help arrives: Is your community ready? Fire Adapted Communities Learning Network. Published July 22, 2014. http://facnetwork.org/help-arrives-community-ready/

Faas, A.J., B. Nowell, T. Steelman and L. Bradford. 2013. County Wildfire Incident Readiness Report: Fall 2013. Fire Chasers Improving Community Response to Wildfire Study. September 30. Available for download at: http://cnr.ncsu.edu/blogs/firechasers/reports/

Nowell, B. and Steelman, T. (2013) Relationship Risk Analysis and Management: Watch Outs, Capacity Areas, Management Strategies. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. March 4-8th, 2013, College Station, TX.

**2) USFS Districts Report Strong Social Capital but Have Room to Improve their Knowledge and Documentation of their Local Communities and Values at Risk (Pre-fire Survey).**

Good interagency communication is one of the most important elements of a coordinated incident response. While most districts report having established significant networks they can draw upon during a wildfire event, there is more work to be done. Nearly half of all Districts reported not having plans for how to maintain communications with other agencies in the event of power and phone outages. Further one out of every four of the 134 US Forest Service Districts in our sample did not have plans in place for how to manage inter-agency communications during an incident. Overall attention to assessing values at risk (VARs) across Forests was found to be high but not all Districts are equally prepared. When looking at the different activities involved in assessing and documenting VARs, most Districts across all regions were likely to have created some maps of values at risk (93%), completed an initial assessment of VARs (90%) and considered the resources they would be willing to commit to protect VARs (86%). Districts were more variable in whether they reported having done systematic analysis of VARs in relation to risk to responders to defend those values (74%) or whether they had actual lists detailing VAR on their Districts that could be referenced in the event of a fire (73%). These higher order types of analysis and documentation have been identified as important preparation in advance of fire season to enable Forests to adopt a risk management approach to wildfire response. Findings also suggest that one of out of every four Districts may experience challenges clearly communicating with incident management teams about VARs. Finally, results found that Districts have room for improvement in assessing and assembling information needed by out-of-area IMTs in order for them to be effective on the ground. Approximately 1 out of 5 Districts reported they did not have a packet of local information prepared to in-brief an incoming IMT. Of those who did, most existing in-brief packets contain media and cooperator contact information. However, Districts were less prepared to provide IMTs information about key local constituents such who are county commissioners, mayor, ranchers, politicians, business interests was reported absent in approximately 1 out of every 5 in-brief packets. This type of information can assist

IMTs to be more effective stewards of the relationships between the local Forest and its surrounding communities during a large scale wildfire event. For more information, see Nowell and Steelman (2014):

Supporting publications and presentations:

Nowell, B. and Steelman, T. (2014) When help arrives: Is your community ready? Fire Adapted Communities Learning Network. Published July 22, 2014. http://facnetwork.org/help-arrives-community-ready/

Faas, A.J., B. Nowell, and T. Steelman. 2013. National Forest Wildfire Capacity Report: Fall 2013. Fire Chasers Improving Community Response to Wildfire Study. October 9. Available for download at: http://cnr.ncsu.edu/blogs/firechasers/reports/

Nowell, B. and T. Steelman. 2014. Communication under Fire: Emergence, Embeddedness and Performance in Disaster Response Networks. Journal of Public Administration Theory and Planning. Published online July 1, 2014. doi: 10.1093/jopart/muu021

Nowell, B. and Steelman, T. (2013) Relationship Risk Analysis and Management: Watch Outs, Capacity Areas, Management Strategies. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. March 4-8th, 2013, College Station, TX.

**3. Twelve Key Social "Watch Out" Situations Are Indicators of Social Risk for Incident Management Teams (Key Informant Interviews)**

Greater situational awareness of the social environment can l aid responders in identifying when extra care and attention needs to be dedicated to managing relationships to avoid failures in communication and coordination. We identified 12 "Social Watchout" situations based on interview data from 24 experienced fire managers collectively representing 646 years of large wildfire incident management experience along with having tackled an estimated total of 824 Type 1 wildfires. The most common watch out situations encountered by ICs appeared to be associated with incident severity and the associated political attention that frequently accompanies significant fire events. Watch out situations related to problematic relationships such as turf battles, problematic historical relationships, and anti-outsider/government sentiments appeared to be relatively less commonly experienced by IMTs. Watch out situations associated with problematic relationships were identified as some of the most difficult to manage, but these were less commonly experienced. However, because they are less commonly experienced, IMTs may be less practiced in how to both identify and manage these types of watch out situations. In fact, their less frequent nature may actually contribute part of the explanation for why they are so difficult to manage. These findings suggest that IMTs may need to pay special heed to relationship-oriented watch outs that they encounter, appreciating that: 1) these situations can significantly undermine effective communication and coordination on incident, 2) they are notoriously difficult to manage, and 3) their team may have relatively less experience and consequently fewer tools for how to manage these situations. Being aware of these watchout situtations is critical for IMTs as survey data show that the presence of watchout situations was negatively related to all areas of network performance on an incident. This suggests that social watchouts are key indicators of social risk and early identification can help IMTs mitigate this risk.

Supporting publications and presentations:

Steelman, T. B. Nowell, C. Fitzgerald, M. Hano. (2015) Social Watch Out Situations for Incident Management Teams. Wildfire Magazine. JANUARY 26, 2015

Steelman, T. , Nowell, B., and Hano, M. (2015)/ "Social "Watch Out" Situations for Incident Management Teams. IAWF Conference, Boise, April 2015

Nowell, B. and Steelman, T. (2014) Tools for Assessing and Managing Social Risk During Complex Wildfire Incidents. Invited webinar presented to National Incident Command Public Information and Liaison Officers. April 30th, 2014.

Nowell, B. and Steelman, T. (2014). "Assessing and Managing Social Risks", Meetings with Pacific Southwest US Forest Service, Riverside, CA, December 2014.

Nowell, B. and Steelman, T. (2013) Relationship Risk Analysis and Management: Watch Outs, Capacity Areas, Management Strategies. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. March 4-8th, 2013, College Station, TX.

Nowell, B. and Steelman, T. (2013) Relationship Risk Analysis and Management: Watch Outs, Capacity Areas, Management Strategies. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. March 4-8th, 2013, College Station, TX

**4) 2013 Wildfire Season: How did we do?**

**IMTs Perform Better on ICS Related Tasks than Non ICS Related Tasks When Evaluating Incident Performance. Failures in Any Part of Performance Are Associated with Perceptions of Overall Performance Outcome (Post fire Survey).**

Results from the 21 Type 1 or 2 WUI incidents investigated in Oregon, Idaho, Montana, and Washington over the summer of 2013 indicated areas of significant strength as well as areas most frequently in need of improvement. In terms of strengths, we observed the strongest overall performance of the incident response network in the areas of fire management, inter-agency interaction, and public information. We saw the lowest performance ratings in the areas of managing cost share, evacuation & re-entry of neighborhoods, and sheltering/mass care operations. This is noteworthy in that, as a general pattern, we see stronger performance in areas of the network where ICS is prevalent and IMTs have formal control. It is also interesting to note that IMTs overall rated network performance higher than County or Host Agencies. This is important as it suggests that IMTs systematically tend have a more positive view of how things went on an incident relative to other stakeholders. Ratings in fire operations and interagency interactions were significantly correlated with ratings in other areas of emergency response. In other words, when informants felt things went poorly in one area, they were significantly more likely to perceive things to have gone less positively in all areas. This highlights the need to think about performance on incidents from a holistic perspective as failures in any part of the network can influence outcomes for all other areas of the network.

**IMTs Are Rated Well By Host Agencies, but Could Be More Responsive and Pro-Active Collaborators on Incidents.** Across the 21 incidents, IMTs ratings by their cooperators and host agencies were generally positive. However, there were areas of greater strength and areas suggesting room for improvement. In terms of strengths, IMTs were viewed positively as good team players, positive ambassadors, and accessible to other stakeholders. In areas rated as needing more room for improvement, communities and host agencies reported wanting IMTs to be more pro-active and responsive collaborators. Particular areas for improvement included: 1) appreciating and being sensitive to local context, 2) being pro-active in communications rather than waiting for everyone to come to you, 3) engaging affected or potentially affected jurisdictions early one, and 4) being flexible in adapting fire management strategy in response to local concerns.

**IMTs Rate Host Units Positively, but Could Use Better Documentation about Local Context to Inform IMTs When They Arrive on Site**

Ratings on the performance of host agencies were also obtained from our 21 incidents. Overall, host units were rated positively by IMTs in terms of 1) agency administrators being effectively engaged, 2) host

units providing up to date information on media contacts, and 3) demonstrating familiarity on how IMTs operate. IMTs saw the greatest room for improvement across host units in 1) providing up to date and detailed maps of values at risk, 2) providing contact information for local cooperators, and 3) providing locations of residential populations that could be at risk. These findings triangulate with and further support the Pre-fire Survey findings. Namely, that host units have room to improve in getting to know and documenting key information about their local community context. Further, the importance of the host unit's role in serving as a bridge between the IMT and the local community was validated – as the better the host agency performed the better the incident response outcomes were.

Nowell, B. and Steelman, T. (2015) "Network Management and Performance on Complex Fire Events", IAWF Conference, Boise, April 2015

Steelman, T. and Nowell, B. (2015) Managing Wildfire Networks: Brokering Relationships and Mission Conflict. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. Phoenix, AZ.

Nowell, B, Sarah McCaffrey, Molly Mowery (2014) Building System Awareness around Wildfire Preparedness and Response. Symposium presentation for the Annual Natural Hazards Research and Applications Workshop, Broomfield, CO. June 22-25.

Nowell, B. and Steelman, T (2014). Social Risk Assessment. Invited presentation to the Rregion 5 US Forest Service California Fire Leadership Meeting. Sacramento, CA, April 4, 2014.

Nowell, B. and Steelman, T. (2014) Responder Network Performance. A tool for systemically assessing incident response during a large scale wildfire. Available for download at www.firechasers.ncsu.edu.

Nowell, B. and Steelman, T. (2014) IMT Network Performance. A tool for assessing the performance of incident management teams in working effectively with local fire and disaster response operations. Available for download at www.firechasers.ncsu.edu.

Nowell, B. and Steelman, T. (2014) Host Unit Network Performance. A tool for assessing the performance of host agencies in brokering between incident management teams and local communities. Available for download at www.firechasers.ncsu.edu

Nowell, B. and Steelman, T (2014) Critical incident response networks. A framework for conceptualizing incident response from a whole network perspective. Available for download at www.firechasers.ncsu.edu.

**5) Pluralism is Not Measurement Error When Attempting to Understand Performance of Wildfire Response Networks (Post Fire Surveys).**

A key challenge encountered on this project which required methodological innovation and generated significant insight was the need to develop a standardized yet holistic measure of network performance that could be used across numerous wildfire incidents. In order to accomplish this, we underwent an in depth measurement development and validation process. In Nowell, Steelman, Velez, and Godette (2016), we investigated the issue of how multiple people in the network evaluate network performance across responders. In the academic literature this is known as "pluralism". Using hierarchical linear modeling techniques, we found evidence of extensive pluralism within our disaster response networks

which, in accordance with the arguments of Mandell and Keast (2008) among others, calls into question the validity of conceptualizing performance at a network level of analysis. This finding is significant,particularly in the study of wildfire response networks, as it provides a theoretical challenge to whole network based performance measures that fail to consider whose perspective on performance is being privileged in the use of such measures.

Nowell, B., Steelman, T., Velez, A. and Godette, S. (in press). Operationalizing Performance Measures in Networked Settings: Lessons from Large Scale Wildfires in the United States. AJ Faas and E. Jones (eds), Networks and Disasters

Nowell, B. and Steelman, T. (2013). The Role of Responder Networks in Promoting Community Resilience: Toward a Measurement Framework of Network Capacity. In N. Kapucu, C. Hawkins, and F. Rivera (Eds.) Disaster Resiliency: Interdisciplinary Perspectives.

Steelman, T., Nowell, B., Velez, A. and Godette, S. (2015). Operationalizing Performance Measures in Networked Settings: Lessons from Large Scale Wildfires in the United States. 2015 Public Management Research Association Conference (PMRA), Minneapolis, Minnesota, June 11-13, 2015.

Nowell, B. and Steelman, T. (2015) "Network Management and Performance on Complex Fire Events", IAWF Conference, Boise, April 2015

**6) Mission Misalignment and Potential Conflict Is More Likely among Federal and non-Federal Partners than Federal Partners on a Wildfire. (Pre-fire Survey)**

Findings from this project to date have also offered new insight into patterns of intra and intergovernmental conflict and collaboraton during large scale wildfire events. Published in *Public Administration Review* (Fleming, McCartha, and Steelman, 2015), this research suggests that perceptions of a mission alignment, or lack thereof, represent a critical component of social-organizational resilience to disasters. Findings indicate that federal actors [USFS] perceived greater ability to manage conflicts based on competing missions with other federal actors relative to actors across different levels of government (local and state). The role of multi-use versus single use policy mandates was a significant factor associated with the perceptions of alignment. Cumulatively, in addition to advancing theories of federalism, these findings empirically illuminate areas where greater mission incongruence and potential conflict is most likely on large scale wildfire events involving multi-jurisdictions across local, state and federal land agencies.

Fleming, C. J., McCartha, E. B., & Steelman, T. A. (2015). Conflict and Collaboration in Wildfire Management: The Role of Mission Alignment. Public Administration Review, 75(3), 445-454.

Nowell, B. and Steelman, T. (2015) ."Brokering Relationships and Agency Mission Misalignment", Webinar, US Forest Service, May 2015, NIFC Fire Season Communications

Steelman, T. and Nowell, B. (2015) Managing Wildfire Networks: Brokering Relationships and Mission Conflict. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. Phoenix, AZ.

Nowell, Branda and Toddi Steelman. 2015. "The Role of Network Leadership in Brokering

Between Local Communities and External Disaster Response Efforts." American Association of Behavioral and Social Sciences Conference. Las Vegas, NV. February.

Fleming, C., McCartha, E.B., & Steelman, T. (2014, March). Mission alignment and misalignment in multi-jurisdictional, multi-governmental wildfire disaster response. Paper presented at the Deil Wright Intergovernmental Relations Symposium, American Society for Public Administration, Washington, D.C.

**7) Social Capital of Key Community Brokers is Underleveraged (Post Fire Survey)**

Findings from this project to date have led to additional insights into the actors that other responders trust to play bridging roles within the network during a large scale wildfire event as well as those actors who end up playing these roles. In press with *Disasters* (Faas, Velez, Fitzgerald, Nowell, and Steelman, forthcoming), findings reveal patterns based on principals of homophily in who actors trust and prefer as liaisons/bridgers in the network. Further, findings revealed that the preferred bridgers were frequently not mobilized into these roles suggesting a disconnect between those actors who may have the greater social capital to act in liaison roles within the network and those actors generally assigned to or assuming those roles. In practice, these results suggest the need for wildfire-prone communities to build greater networks of trust in assigned liaisons as well as potentially find ways to tap into the social capital of natural bridgers.

Faas, A.J., Velez, A. FitzGerald, C., Nowell, B. and Steelman, T. (in press). Patterns of Preference and Practice: Bridging Actors in Wildfire Response Networks in the American Northwest. Manuscript in press with Disasters.

Nowell, B. and Steelman, T. (2015) ."Brokering Relationships and Agency Mission Misalignment", Webinar, US Forest Service, May 2015, NIFC Fire Season Communications

Steelman, T. and Nowell, B. (2015) Managing Wildfire Networks: Brokering Relationships and Mission Conflict. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. Phoenix, AZ

Fitzgerald, F., Velez, A., and Faas. A. (2015)/ Spanners in the Works: Bridging Actors in Wildfire Response. 75th Annual Meeting of the Society for Applied Anthropology (SfAA), Pittsburgh, Pennsylvania, March 25-28.

Nowell, Branda and Toddi Steelman. 2015. "The Role of Network Leadership in Brokering Between Local Communities and External Disaster Response Efforts." American Association of Behavioral and Social Sciences Conference. Las Vegas, NV. February.

**8. Understanding Network Cognition is Critical in Understanding How Social Risk is Assessed and Managed (Field work).** Participant observation ethnography allowed us to gain in depth insight into how incident commanders and liaison officers develop a situational awareness of the social and political environment in which they are working in order to make decisions about who and what needs to be managed and how to manage it. We refer to this as network cognition. We know very little about the cognition that accompanies leadership action in public-service oriented networks operating within dynamic and complex environments. We identified five key cognitive tasks employed by leaders during a large scale, wildland urban interface fire. These included 1) Defining network boundaries, 2) Assessing network capacity, 3) Balancing ego network needs with other network needs, 4) Clarifying roles in network, and 5) Assessing problem scope. However, these processes appear to be influenced by a series of more macro processes. First, our ICs and liaison officers were observed to grapple with balancing an

over-riding consideration of one's immediate network while maintaining a situational awareness of the incident response network as a whole. This was important because reflections from these leaders suggested that managing one's own network takes a different set of skill and tactics compared to managing problems elsewhere in the network. ICs and Liaison Officers were also observed to think about system dynamics first and networks second. In other words, our targets of study tended to focus on the changes in the bio-physical environment as cues for thinking about changes in the network environment. Last, network cognition was observed and described as heavily influenced by past experience and schemas. This is important as it highlights both the value and potential blind spots that past experience can create when working in a new situation. This research is exciting as it opens up a new frontier of inquiry that builds upon past work in understanding mental models and situational awareness to focus specifically on the unique processes that influence information processing of the social and political environment.

Nowell, B. and Steelman, T. (in preparation). Network Leadership in Complex Problem Domains: A Study of Leaders' Network Cognition during Disasters. Manuscript in preparation for submission to the Public Administration Review.

Nowell, B. and Steelman, T. (2016) Network Leadership in Complex Problem Domains: A Study of Leaders' Network Cognition during Disasters. Paper presented at the Goal Directed Networks: The State of the Art Workshop. ESADE Business School, Barcelona June 19th-21rst

**9. Understanding of Core-Periphery Network Structure Suggests New Tools for Governing Complex Wildfire Incidents. (Key informant interviews, field work)**

There is significant debate about the appropriate governance structure in incident response. Complex disasters exhibit both networked and hierarchical characteristics. One challenge in the field of disaster management is how to structure a response that reconciles the need for centralized coordination among varied responders while retaining flexibility to mutually adjust operations to quickly changing conditions. Missing from the current literature is empirical evidence and theory-building concerning what characteristics of network structure might be associated with effective incident response to complex disasters. Based on data we collected from 25 Type 1 Incident and Area Commanders, we constructed an empirically-based theoretical social network of an effective incident response. We then analyzed this model to identify a set of propositions concerning the network structure and governance of effective incident response. Our data suggested that the structure of an incident response network sits at the intersection of several models of network structure, being neither highly integrated nor rigidly centralized. Rather, it is best characterized as a moderate core-periphery structure. These findings have important implications as tools of network governance such as ICS facilitate certain communication network structures. Paradoxically, current practices in network governance on complex incidents tend to rely on models and tools of governance designed to produce either highly centralized networks OR highly decentralized, dense networks of communication. On the centralized end, the command organizational structure that is the hallmark of the incident command system is hierarchical in nature with significant attention given to chain of command, reporting structures and span of control. This model has received significant criticism in the literature for being ill-suited to the dynamic and unpredictable nature of highly complex disasters, with particular challenges levied at this structure's inability to coordinate across lateral relationships that cannot be brought under a single unified command. On the other end of the spectrum, prominently used tools for coordinating laterally such as cooperator meetings and conference calls have likewise been found problematic. These approaches generally evoke a more dense network structure that has been criticized for being cumbersome and easily overwhelmed by the number of actors seeking to

interact. In very practical terms, the present study provides a foundation for examining the structure of network interactions that are being facilitated by the governance tools we use on wildfire incidents. These network structures need to then be compared against the type of structures that can best facilitate a coordinated response across a complex and dynamic array of responders.

Nowell, B., Steelman, T., Velez, AK, and Yang. Z (revise and resubmit). The structure of effective governance of disaster response networks: Insights from the field. Manuscript under review with the American Review of Public Administration.

B Nowell, B. and Steelman, T. (under review). Beyond ICS: How Should We Govern Complex Disasters in the United States? Manuscript under review with Disasters with Disasters

Nowell, B. and Steelman T.(2016) Beyond ICS: Propositions on the Importance of Core-Periphery Networks in Managing Complex Disasters. Invited symposium for the School of Public and International Affairs, North Carolina State University April 29th, 2016.

Nowell, B. Velez, A., Yang, Z. and Steelman, T. (2016). Network Governance of Transboundary Disasters: A Comparative Study of Core-Periphery Networks. Paper presented at the International Public Management Research Conference, Aarhus, Denmark, June 22-25th

Nowell, B. , Steelman, T. and Velez, A. (2015) The structure of effective governance of disaster response networks: Insights from the field. Paper accepted for presentation at the Academy of Management Annual Meeting. Aug 7-11th; Vancouver, BC.

Nowell, B. and Steelman, T (2014) Critical incident response networks. A framework for conceptualizing incident response from a whole network perspective. Available for download at www.firechasers.ncsu.edu.

**Existing research, compatible scholarship and future work**

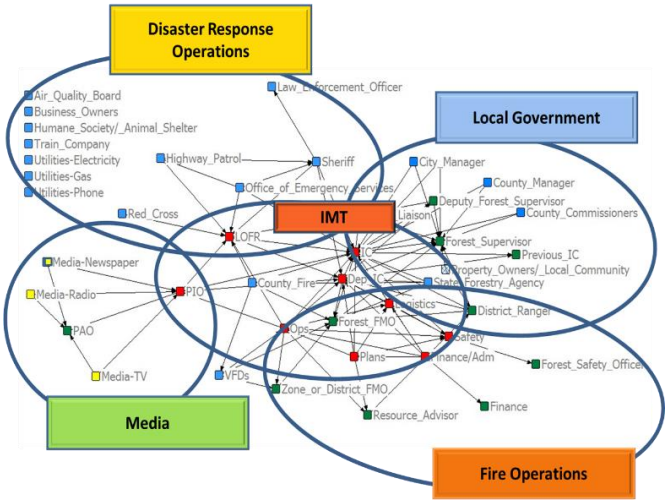
Humans need to adapt in the face of growing risks associated with wildfire (Pyne 2015; Roos et al. 2016; Fischer et al. 2016a; Moritz et al. 2015; Calkin et al. 2014). The wildland urban interface continues to be an area of focus given this is the place where more resources are expended on wildfire management in an effort to protect lives and private property (Calkin et al. 2015, Ager et al. 2015, Fischer et al. 2016a). Our research complements that of many others who are working on the complexities associated with how to prepare for, respond to and recover from wildfire disasters that affect human communities (for a small sample of work: Carroll et al. 2005; Cohn et al. 2006; Cohn et al. 2008; Dunlop et al. 2014; Jakes et al. 2007; Martin et al. 2009; McCaffrey 2015).

Our concepts of relational risk assessment and management are couched with a guiding assumption that there are rising expectations about who will be involved in a complex wildfire incident, which often spans multiple jurisdictions. Three broad goals are outlined in the National Cohesive Wildfire Management Strategy, including creating resilient landscapes, fire adapted communities, and safe and effective wildfire response (USDA and USDOI 2009). Creating fire adapted communities involves understanding community response and wildfire management (McCaffrey and Olsen 2012). Our research targets these last two goals and we seek to influence both policy and management in these areas. For us, this means taking a more holistic and system focus regarding both who is considered part of incident response and what we consider as part of incident response.

Wildfire research, especially social science research, is at a timely crossroads. While early social science work was largely typified by in-depth field work and qualitative case studies (e.g. Carroll et al. 2005; Cohen et al. 2006; Jakes et al. 2007; Martin et al. 2009; Paveglio et al. 2009; 2012) that facilitated theory generation and application (Flint and Luloff 2005; McCaffrey and Kugagai 2007), research is now transitioning into theory operationalization and testing. Our research is part of this next generation of wildfire scholarship that also includes work by Dunlop et al. (2014), Fischer et al. (2012, 2016b), Nielsen-Pincus et al. (2015), Paveglio et al. (2015, 2016). We have moved toward the operationalization of approaches that both quantify and qualify social dynamics in wildfire response. In particular, we have helped develop and move into the fire management vernacular the concept of the "response network" and how network tools can be used to create better situational awareness for Incident Management Teams on wildfires. We are not alone in using network concepts in this context (Taylor et al. 2007; Fischer et al. 2016b). A network perspective illuminates the web of interdependence that exists across functional domains and can help identify areas with greater potential for communication failure to occur. Adopting a network perspective requires moving beyond thinking about agency performance (just the USFS or IMT) and thinking about the whole network and how it is performing (see Figure 1). As incidents grow larger and more complex, the fire management community needs these tools to help them adapt to meet the needs of the National Cohesive Wildfire Management Strategy to create safe and effective wildfire response and fire adapted communities.

Next steps for our work will hopefully build on other systematic work that typologizes (Paveglio et al. 2009, 2012, 2015) and quantifies social diversity of WUI communities (Paveglio et al. 2016). For instance, Carroll and Paveglio (2016) identify four archetype communities and key pathways that are most likely to be effective in promoting fire adaption among these specific populations. These include formalized suburban WUI; high amenity, high resource WUI; rural lifestyle WUI and working landscape/resource dependent WUI. Our interest lies in how wildfire managers, including Incident Management Teams, work with different communities to more effectively prepare for and respond to complex wildfires in the WUI. In this way, we believe we are working toward articulated needs for future research related to wildfire management (McCaffrey et al. 2013).

**Figure 1: Wildfire Incident Response as a Network Response**

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| DELIVERABLES CROSSWALK TABLE | | |
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| **PROPOSED** | **DELIVERED** | **STATUS** |
| **Project website** | www.firechasers.ncsu.edu | Published |
| **Peer Reviewed Publications** | Nowell, B., Steelman, T., Velez, A. and Godette, S. (in press). Operationalizing Performance Measures in Networked Settings: Lessons from Large Scale Wildfires in the United States. AJ Faas and E. Jones (eds), *Networks and Disasters* | Published |
| | Faas, A.J., Velez, A. FitzGerald, C., Nowell, B. and Steelman, T. (in press). Patterns of Preference and Practice: Bridging Actors in Wildfire Response Networks in the American Northwest. Manuscript in press with *Disasters*. | Published |
| | Fleming, C. J., McCartha, E. B., & Steelman, T. A. (2015). Conflict and Collaboration in Wildfire Management: The Role of Mission Alignment. *Public Administration Review*, *75*(3), 445-454. | Published |
| | Nowell, B. and T. Steelman. (2012). "The Role of Responder Networks in Promoting Community Resilience: Toward a Measurement Framework of Network Capacity", in Editors: N. Kapucu, C.V. Hawkins, and F. I. Rivers *Disaster Resiliency: Interdisciplinary Perspectives*, 232-257, New York: Taylor & Francis/Routledge. | Published |
| | Nowell, B., Steelman, T., Velez, AK, and Yang. Z (revise and resubmit) The structure of effective governance of disaster response networks: Insights from the field. Manuscript under review with the *American Review of Public Administration* | Under Review |
| | Nowell, B. Bodkin, C and Bayoumi, D. (under review) Redundancy in Disaster Response Systems: A Pathway to Resilience or a Recipe for Disaster? Revise and resubmit with the *Journal of Contingencies and Crisis Management.* | Under Review |
| | Faas, AJ, Velez, AV; Nowell, B., and Steelman, T. (under review) Identifying Large Wildfire Disaster Response Networks in the Pacific Northwest: A Strategic Approach to Pre-and Post-Disaster Network Identification. Manuscript under | Under Review |

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| | review with *Connections* | |
| | Nowell, B., Velez, AK, Hano, M. Sudweeks, J. Albrecht, K., and Steelman, T. (in revision). Defining Network Boundaries in Complex Problem Domains: A Tale of Three Networks. Manuscript requested for resubmission to *Public Administration* | Under Review |
| | Nowell, B. and Steelman, T. (under review). Beyond ICS: How Should We Govern Complex Disasters in the United States? Manuscript under review with *Disasters* | Under Review |
| | Velez, AK, Diaz, J. Nowell, B. and Steelman, T. (in preparation). The intersection of human psychology and local context: Understanding engagement in disaster preparedness from a social-ecological perspective. Manuscript in preparation for submission to the I*nternational Journal of Mass Emergencies and Disasters.* | In Preparation |
| | Nowell, B., Steelman, T., Faas, AJ, and Albrecht (in preparation). Community connection as resilience: A longitudinal study of disaster response networks. Manuscript in preparation for submission to the *Journal of Public Administration Research and Theory*. | In Preparation |
| | Nowell, B. and Steelman, T. (in preparation). Network Leadership in Complex Problem Domains: A Study of Leaders' Network Cognition during Disasters. Manuscript in preparation for submission to the *Public Administration Review*. | In Preparation |
| | Nowell, B., Steelman, T., Hano, M. and Fitgerald. Operationally Engaged Residents: How residents and federal responders co-navigated their roles and relationships on a large scale wildfire. Manuscript in preparation for the *Journal of Community Psychology*. | In Preparation |
| **Manager-Oriented Trade Publications** | Steelman, T. B. Nowell, C. Fitzgerald, M. Hano. (2015) Social Watch Out Situations for Incident Management Teams. Wildfire Magazine. JANUARY 26, 2015 | Published |
| | Nowell, B. and Steelman, T. (2014) When help arrives: Is your community ready? Fire Adapted Communities Learning Network. Published July 22, 2014. http://facnetwork.org/help-arrives-community-ready/ | Published |

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| **Manager-oriented**<br><br>**Findings/Technical Reports** | Faas, A.J., B. Nowell, T. Steelman and L. Bradford. 2013. County Wildfire Incident Readiness Report: Fall 2013. Fire Chasers Improving Community Response to Wildfire Study. September 30. Available for download at www.firechasers.ncsu.edu. | Published |
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| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Lolo Creek Complex. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Gold Pan Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Eagle Fire. Available for download at www.firechasers.ncsu.edu. | Published |
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| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Beaver Creek Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Elk Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Green Ridge Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Lodgepole Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Miner Paradise Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for PineCreek Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Weiser Complex. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for West Mullen Fire. Available for download at www.firechasers.ncsu.edu. | Published |

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| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Whiskey Complex. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for West Fork Fire. Available for download at www.firechasers.ncsu.edu. | Published |
| **Manager-oriented Tools** | Nowell, B. and Steelman, T. (2014) Responder Network Performance. A tool for systemically assessing incident response during a large scale wildfire. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, B. and Steelman, T. (2014) IMT Network Performance. A tool for assessing the performance of incident management teams in working effectively with local fire and disaster response operations. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, B. and Steelman, T. (2014) Host Unit Network Performance. A tool for assessing the performance of host agencies in brokering between incident management teams and local communities. Available for download at www.firechasers.ncsu.edu. | Published |
| | Nowell, B. and Steelman, T (2014) Critical incident response networks. A framework for conceptualizing incident response from a whole network perspective. Available for download at www.firechasers.ncsu.edu. | Published |
| | Steelman, T. and Nowell, B. (2014) Social Watchout Situations. An Assessment tool. Available for download at www.firechasers.ncsu.edu. | Published |
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## X. Additional Reporting (Appendices and other inputs to JFSP)

PEER REVIEWED PUBLICATIONS


Nowell, B., Steelman, T., Velez, A. and Godette, S. (in press). Operationalizing Performance Measures in Networked Settings: Lessons from Large Scale Wildfires in the United States. AJ Faas and E. Jones (eds), *Networks and Disasters*

Faas, A.J., Velez, A. FitzGerald, C., Nowell, B. and Steelman, T. (in press). Patterns of Preference and Practice: Bridging Actors in Wildfire Response Networks in the American Northwest. Manuscript in press with *Disasters*.

Diaz, J., Steelman, T, and Nowell, B. (in press ) Local Ecological Knowledge and Fire Management: What Does the Public Understand? Manuscript in press with the *Journal of Forestry*

Nowell, B., & Steelman, T. (in press). Communication under Fire: The Role of Embeddedness in The Emergence and Efficacy of Disaster Response Communication Networks. *Journal of Public Administration Research and Theory*, muu021.

Fleming, C. J., McCartha, E. B., & Steelman, T. A. (2015). Conflict and Collaboration in Wildfire Management: The Role of Mission Alignment. *Public Administration Review*, *75*(3), 445-454.

Steelman, T. A., Nowell, B., Bayoumi, D., & McCaffrey, S. (2014). Understanding Information Exchange During Disaster Response: Methodological Insights From Infocentric Analysis. *Administration & Society*, 46(6), 707-743. First published online in 2012.

Steelman, T. A., McCaffrey, S. M., Velez, A. L. K., & Briefel, J. A. (2014). What information do people use, trust, and find useful during a disaster? Evidence from five large wildfires. *Natural Hazards*, 1-20.

Nowell, B. and Steelman, T. (2013). The Role of Responder Networks in Promoting Community Resilience: Toward a Measurement Framework of Network Capacity. In N. Kapucu, C. Hawkins, and F. Rivera (Eds.) Disaster Resiliency: Interdisciplinary Perspectives.

McCaffrey, S., A.Velez**,** and J. Briefel. (2013). Differences in Information Needs for Wildfire Evacuees and Non-Evacuees*. International Journal of Mass Emergencies and Disasters*. 31 (1). 4-24.


**Works under review**


Nowell, B., Steelman, T., Velez, AK, and Yang. Z (revise and resubmit). The structure of effective governance of disaster response networks: Insights from the field. Manuscript under review with the *American Review of Public Administration*.

Nowell, B. Bodkin, C and Bayoumi, D. (under review) Redundancy in Disaster Response Systems: A Pathway to Resilience or a Recipe for Disaster? Revise and resubmit with the *Journal of Public Administration Research and Theory.*

Faas, AJ, Velez, AV; Nowell, B., and Steelman, T. (under review). Identifying Large Wildfire Disaster Response Networks in the Pacific Northwest: A Strategic Approach to Pre-and Post-Disaster Network Identification. Manuscript under review with *Connections*

Nowell, B., Velez, AK, Hano, M. Sudweeks, J. Albrecht, K., and Steelman, T. (in revision). Defining Network Boundaries in Complex Problem Domains: A Tale of Three Networks. Manuscript requested for resubmission to *Public Administration*

B Nowell, B. and Steelman, T. (under review). Beyond ICS: How Should We Govern Complex Disasters in the United States? Manuscript under review with Disasters

Manuscripts in preparation

Velez, AK, Diaz, J. Nowell, B. and Steelman, T. (in preparation). The intersection of human psychology and local context: Understanding engagement in disaster preparedness from a social-ecological perspective. Manuscript in preparation for submission to the *International Journal of Mass Emergencies and Disasters*.

Nowell, B., Steelman, T., Faas, AJ, and K. Albrecht (in preparation). Community connection as resilience: A longitudinal study of disaster response networks. Manuscript in preparation for submission to the *Journal of Public Administration Research and Theory*.

Nowell, B. and Steelman, T. (in preparation). Network Leadership in Complex Problem Domains: A Study of Leaders' Network Cognition during Disasters. Manuscript in preparation for submission to the *Public Administration Review*.

TRADE PUBLICATIONS

Steelman, T. B. Nowell, C. Fitzgerald, M. Hano. (2015) Social Watch Out Situations for Incident Management Teams. Wildfire Magazine. JANUARY 26, 2015

Nowell, B. and Steelman, T. (2014) When help arrives: Is your community ready? Fire Adapted Communities Learning Network. Published July 22, 2014. http://facnetwork.org/help-arrives-community-ready/

INVITED PRESENTATIONS

Nowell, B. and Steelman T. (2016). Situational Awareness for Social Risks: Understanding and Managing your Network. Invited presentation for the National Meeting of Type 1 Incident and Area Commanders. Fredericksburg, PA, April 18-22nd.

Nowell, B. and Steelman T.(2016) Beyond ICS: Propositions on the Importance of Core-Periphery Networks in Managing Complex Disasters. Invited symposium for the School of Public and International Affairs, North Carolina State University April 29th, 2016.

Steelman, T. and Nowell, B. (2015). "Overview of the Fire Chasers Project". Northwest Territories Fire Workshop, Yellowknife, NWT. January 2015

Steelman, T. (2015) "Wildfire Policy as a Socio-Ecological Problem". Plenary Session. IAWF Human Dimensions of Wildfire Conference, Boise, April 2015

Nowell, B. and Steelman, T. (2015) ."Brokering Relationships and Agency Mission Misalignment", Webinar, US Forest Service, May 2015, NIFC Fire Season Communications.

Steelman, Toddi, A. 2015. Fire Policy as a Socio-Ecological Problem. DELWP/FEMD Science Symposium 2015, Science in Use. Melbourne, VIC, Australia. November 5.

Steelman, T. and Nowell, B. (2015) Managing Wildfire Networks: Brokering Relationships and Mission Conflict. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. Phoenix, AZ.

Nowell, B. and Steelman, T (2014). Social Risk Assessment. Invited presentation to the Region 5 US Forest Service California Fire Leadership Meeting . Sacramento, CA, April 4, 2014.

Nowell, B. and Steelman, T. (2014) Tools for Assessing and Managing Social Risk During Complex Wildfire Incidents. Invited webinar presented to National Incident Command Public Information and Liaison Officers. April 30th, 2014.

Steelman, T. (2014) "Wildfire as a Socio-Ecological Problem", Coupled Natural-Human Systems

in Fire-Prone Ecosystems: Interconnections and Research Needs Workshop, Bend, OR, August 2014

Nowell, B. and Steelman, T. (2014). "Assessing and Managing Social Risks", Meetings with Pacific Southwest US Forest Service, Riverside, CA, December 2014.

Nowell, B. and Steelman, T. (2013) Relationship Risk Analysis and Management: Watch Outs, Capacity Areas, Management Strategies. Invited presentation at the National Meeting of Type 1 Incident and Area Commanders. March 4-8th, 2013, College Station, TX

Nowell, B. and Steelman, T. (2012). The Role of Responder Networks in Promoting Community Resilience: Toward a Measurement Framework of Network Capacity. Invited paper presented at the USDA Disaster Resiliency Workshop, March 29-30, Orlando, FL.

Nowell, B. and Steelman T. (2012) Wildfire Research Summary. Invited presentation to the National Incident and Area Commanders Organization. March 5-9th, 2012, Denver, CO.

CONFERENCE PRESENTATIONS/PAPERS

Nowell, B. and Steelman, T. (2016) Network Leadership in Complex Problem Domains: A Study of Leaders' Network Cognition during Disasters. Paper presented at the Goal Directed Networks: The State of the Art Workshop. ESADE Business School, Barcelona June 19th-21rst

Nowell, B. Velez, A., Yang, Z. and Steelman, T. (2016). Network Governance of Transboundary Disasters: A Comparative Study of Core-Periphery Networks. Paper presented at the International Public Management Research Conference, Aarhus, Denmark, June 22-25th.

Nowell, B. and Steelman, T. (2016) Beyond ICS: Propositions on the Importance of Core-Periphery Networks in Managing Complex Fire Events. Paper presented at the International Association of Wildland Fire Fire and Fuels Conference. Portland, OR, April 12-15th.

Toddi Steelman, Branda Nowell, Zheng Yang Relational Risk Assessment and Management in Large Wildfires: Lessons from Wildfire Incident Management Teams International Symposium on Society and Resource Management (ISSRM) June 22-26, 2016 in Houghton, Michigan, USA

Steelman, T., Nowell, B., Velez, A. and Godette, S. (2015). *Operationalizing Performance Measures in Networked Settings: Lessons from Large Scale Wildfires in the United States.* 2015 Public Management Research Association Conference (PMRA), Minneapolis, Minnesota, June 11-13, 2015

Fitzgerald, C., Hano, M. Nowell, B., and Steelman, T. (2015) *Operationally engaged: Is emergent engagement of local landowners a critical piece of future wildfire management in the Western United States*? Paper accepted for presentation at the Biennial Conference for the Society of Community Research and Action. June 25-28; Lowell MA.

Nowell, B. , Steelman, T. and Velez, A. (2015) *The structure of effective governance of disaster response networks: Insights from the field*. Paper accepted for presentation at the Academy of Management Annual Meeting. Aug 7-11th; Vancouver, BC.

Fitzgerald, F., Velez, A., and Faas. A. (2015)/ *Spanners in the Works: Bridging Actors in Wildfire Response.* 75th Annual Meeting of the Society for Applied Anthropology (SfAA), Pittsburgh, Pennsylvania, March 25-28.

Faas, A.J. (2015) Metaphors, Metrics, and Ethnographic Heuristics of Social Networks in Disaster. Paper presented at the Annual Meeting of the Society for Applied Anthropology, Pittsburgh, March 23-28.

Nowell, B. ,Hano, M., Velez, A., Sudweeks, J and Albrecht, K. (2015) *Investigating Network Boundaries in Complex Problem Domains: A Tale of Three Networks.* 2015 Public Management Research Association Conference (PMRA), Minneapolis, Minnesota, June 11-13, 2015.

Steelman, T. , Nowell, B., and Hano, M. (2015)/ "Social "Watch Out" Situations for Incident Management Teams. IAWF Conference, Boise, April 2015

Nowell, B. and Steelman, T. (2015) "Network Management and Performance on Complex Fire Events", IAWF Conference, Boise, April 2015

Nowell, Branda and Toddi Steelman. 2015. "The Role of Network Leadership in Brokering Between Local Communities and External Disaster Response Efforts." American Association of Behavioral and Social Sciences Conference. Las Vegas, NV. February.

Nowell, B. and Steelman, T (2014). Promoting Socio-Organizational Resilience in Disaster: Toward a Measurement Framework of Network Capacity. Paper accepted for presentation at Resilience2014 conference. Montpellier, France. May 4-8th .

Faas, A. J., and Nowell, B. (2014) Place Identity, Sense of Community, and Engagement in Wildfire Preparedness in the American Northwest. Paper presented at the Annual Meeting of the Society for Applied Anthropology, Albuquerque, March 18-22.

Faas, A. J., Holli Starr, and Corinne Wilder (2014) Fire Chasers: How historical relationships affect coordination and cooperation in wildfire response. Paper presented at the Annual Meeting of the Society for Applied Anthropology, Albuquerque, March 18-22.

Velez, A.K. Planning for the Future Past: Assessing the Extent to Which Local Emergency Officials are planning around Built Historic Resources. Paper presented at the Annual Meeting of the Society for Applied Anthropology, Albuquerque, March 18-22.

Fleming, C., McCartha, E.B., & Steelman, T. (2014, March). Mission alignment and misalignment in multi-jurisdictional, multi-governmental wildfire disaster response. Paper presented at the Deil Wright Intergovernmental Relations Symposium, American Society for Public Administration, Washington, D.C.

Nowell, B, Sarah McCaffrey, Molly Mowery (2014) Building System Awareness around Wildfire Preparedness and Response. Symposium presentation for the Annual Natural Hazards Research and Applications Workshop, Broomfield, CO. June 22-25.

Steelman, T. (2014) "Best Practices in Public Communications on a Wildfire", Canadian Wildland Fire Conference, Halifax, October 2014

Faas, A.J., Eric C. Jones, Arthur D. Murphy, Branda L. Nowell, Toddi A. Steelman, Graham A. Tobin, and Linda M. Whiteford (2014) All the Years Combine: The expansion and contraction of time and memory in disaster response. Paper submitted to the Annual Meeting of the American Anthropological Association, Washington DC, December 3–7.

FitzGerald, C., Hano, M.C., Nowell, B., and Steelman, T. (2014). Stories from the Fire: An initial look at institutional responses to operationally engaged residents on wildfires of the Western United States. Public Administration Conference/Teaching Public Administration Conference. June 9-11, Liverpool, UK.

Velez, A.K. Disaster Recovery and Cultural Resources: Examining the Intersection of Disaster Planning and Historic Preservation. Coastal Resilience Conference 2014, Galveston, Texas, October 9, 2014

Velez, A.K. To What Extent are NEPA Resource Categories Being Included in Local Disaster Planning Efforts? Natural Hazards Conference IRCD add-on, Broomfield, Colorado, July 17, 2013.

<u>TECHNICAL REPORTS*</u>

Faas, A.J., B. Nowell, T. Steelman and L. Bradford. 2013. County Wildfire Incident Readiness Report: Fall 2013. Fire Chasers Improving Community Response to Wildfire Study. September 30.

Faas, A.J., B. Nowell, and T. Steelman. 2013. National Forest Wildfire Capacity Report: Fall 2013. Fire Chasers Improving Community Response to Wildfire Study. October 9.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for GC Complex.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Kelley Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for the Little Queens Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Pine Creek Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Vinegar Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Moose Meadow fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Rock Creek Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Rough Creek Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Lolo CReek Complex.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Gold Pan Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Eagle Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for 25 Mile Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Kelly Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Labrador Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Beaver Creek Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Elk Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Green Ridge Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Lodgepole Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Miner Paradise Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for PineCreek Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Weiser Complex.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for West Mullen Fire.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for Whiskey Complex.

Nowell, Branda, Toddi Steelman, A. J. Faas, Anne-Lise Knox Velez, Joy Davis, Clare FitzGerald, and Mary Clare Hano. 2014. Improving Community Response to Wildfire: 2013 Fire Season Findings Report for West Fork Fire.

TOOLS

Nowell, B. and Steelman, T. (2014) Responder Network Performance. A tool for systemically assessing incident response during a large scale wildfire

Nowell, B. and Steelman, T. (2014) IMT Network Performance. A tool for assessing the performance of incident management teams in working effectively with local fire and disaster response operations.

Nowell, B. and Steelman, T. (2014) Host Unit Network Performance. A tool for assessing the performance of host agencies in brokering between incident management teams and local communities

Nowell, B. and Steelman, T (2014) Critical incident response networks. A framework for conceptualizing incident response from a whole network perspective.

**DISSERTATION**

Velez, A (2014). What a Disaster: Risking the Loss of Our Historic Built Resources to Inadequate Disaster Planning. Dissertation prospectus successfully defended.

Diaz, J. (2014). Local Ecological Knowledge and Fire Management: What Does the Public Understand? Master's Thesis.