



# Managing the Market: How Procurement Practices Impact Private Sector Wildfire Response Capacity

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## I. Abstract

Effective wildfire management requires significant institutional organization, a skilled workforce, facilities, and equipment. Sustaining sufficient wildfire response capacity is critical to both agencies and communities that are affected by fire. Because fire suppression is seasonal work and demands vary considerably from year to year, it is vitally important that adequate capacity in the form of resources can be mobilized when resources are needed. As USDA Forest Service staffing has declined over the past decade, the agency more frequently contracts directly with businesses and through partnerships with state agencies to meet these episodic needs (McKinley 2008; Prestemon et al. 2008). As a “market manager,” the Forest Service’s rules and actions concerning contracting can also affect how businesses and communities garner economic benefits from wildfire response spending.

The purpose of this project was to explore the contracting market for fire suppression in the Western United States, specifically focusing on (1) how private sector fire suppression capacity compares to demand and wildfire locations, (2) business models and strategies used by fire suppression contractors to maintain their business in an unpredictable market, and (3) transitions in the fire suppression contracting industry.

Main findings from this research suggest that (1) privately contracted fire suppression equipment is unevenly distributed across the west, (2) dispatch centers share contracted resources regularly, (3) peak demand for Northwest engines may be below capacity, and (4) businesses engaged in suppression equipment contracting in the Northwest come mainly from forestry, commercial services, and fire backgrounds, and they employ a variety of diversification strategies to maintain their businesses under unpredictable fire suppression demand.

## II. Background and purpose

Federal agencies increasingly rely on contracts to respond to wildfire. Though present since the 1970s, private equipment contractors have moved into an important role following extreme fire seasons in the 1990s. Understanding how these businesses operate and provide equipment for suppression is critical to ensuring availability of sufficient and efficient wildfire suppression resources when they are needed.

As USDA Forest Service staffing has declined, the agency more frequently contracts directly with businesses and through partnerships with state agencies to meet these episodic needs (McKinley 2008; Prestemon et al. 2008). For example, of the \$155 million spent on wildfires in Trinity County, California in 2008, nearly 50 percent was paid to private sector vendors (Nielsen-Pincus et al. 2011). In many ways, market conditions affect whether land management agencies can fulfill their fire suppression procurement needs (Thai 2001), such as the type and timeframe of resources the market buyer needs.

Because of their role as a major purchaser of fire suppression services, however, the Forest Service has become a “market manager” and can use administrative strategies to create, enhance, and sustain capacity in the market (Graddy and Chen 2006; Johnston and Girth 2011; Warner and Hefetz 2008). Consequently, the Forest Service’s contracting processes, technical requirements, and dispatching protocols structure the market for these goods and services, influencing the business models, competitiveness, and profitability of the firms from which the government purchases suppression-related goods and services (Johnston and Girth 2011). As a market manager, the Forest Service’s rules and actions around contracting can also affect how businesses and communities garner economic benefits from wildfire response spending. For example, bid evaluations that rank newer equipment more highly than older equipment will benefit businesses that can easily access investment capital, while requirements for online registration and bidding give businesses that have high speed Internet access an advantage over those that do not. These decisions matter not so much because they put some businesses at a disadvantage, but because they identify opportunities for the federal government to manage the market for improved efficiency (Goldsmith 1997) and distributive equity (McCrudden 2004). Gains in efficiency are possible if local suppression resources can be competitively procured, while employing local businesses and workers can help minimize the negative economic impacts wildfires can have on local communities (Kent et al. 2003).

To date, there has been limited research on federal procurement processes and their impacts on

market efficiency, businesses, and communities (Caldwell et al. 2005), but recent research from a previous JFSP project suggests that fire suppression contracting capacity varies considerably across the American West (See Economic Impact of Large Wildfires of 2008, JFSP project ID 09-1-10-3, PIs Moseley and Nielsen-Pincus).

The purpose of this project was to explore a set of questions about the Forest Service fire suppression contracting and the contracting market, including fire suppression equipment capacity, business locations, structures, challenges, market strategies, and transitions in the industry. The specific knowledge objectives of this research were to (1) contribute to scholarly literature about federal procurement broadly as well as procurement for response and recovery from natural disasters such as wildfire, and (2) provide fire managers insight into the influence of Forest Service contracting practices on the structure and competitiveness of wildfire suppression contract market and the impacts of procurement contracting on fire-affected communities. Understanding these helps managers make effective decisions about what kinds of resources to make available to manage wildfires and where the resources are needed, which can minimize negative impacts of wildfires on local communities. We accomplished the knowledge objectives of this research through four main steps or subcomponents:

1. Developing models to understand what drives local wildfire capacity across the West.
2. Identifying and analyzing fire suppression equipment contractor capacity across the West, including how demand for contracted fire suppression equipment relates to supply.
3. Identifying and describing a set of business models of suppression contractors.
4. Exploring transitions in the wildfire suppression contracting industry, from both an agency pre-season procurement and dispatch perspective and a contractor business and industry transition perspective.

### **III. Study description and location**

At the West-wide level, we investigated local capture from fire suppression in local communities, as well as identified and analyzed fire suppression contracting equipment locations and types. We then used an in-depth case study approach to explore fire suppression capacity and demand, as well as contracting business models and strategies in the Northwest region (Washington and Oregon states), the most concentrated region of contracted fire suppression equipment and hand crews in 2015.

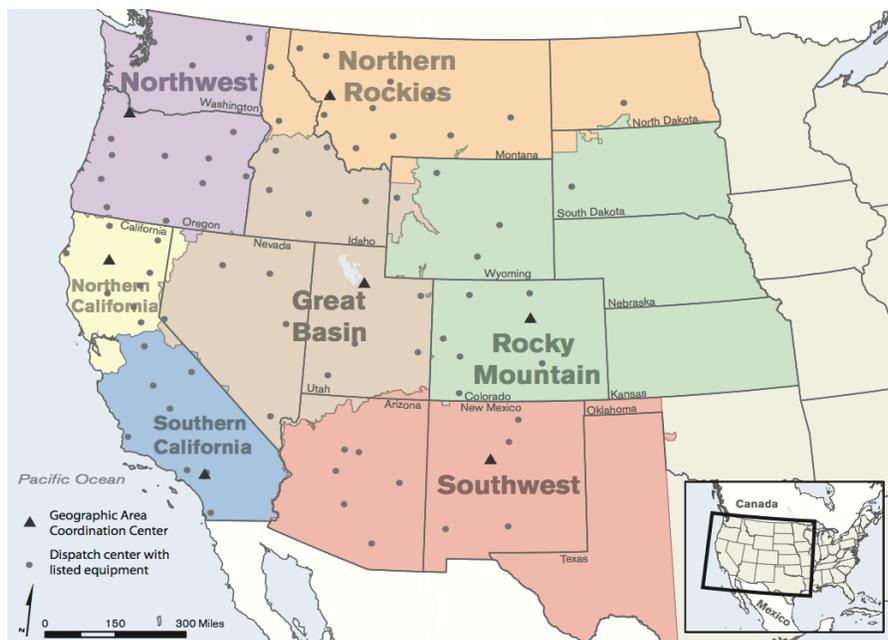
The first component of the research—developing models to understand what drives local wildfire capacity across the West—focused on understanding the extent to which community participation in federal natural resource forest management prior to a wildfire affects participation during a large wildland fire, and located private contractor capacity. Wildland fire in the western US has been increasing in size, severity, and cost. This increase has resulted in wildfire response capacity growth and centralization. At the same time, however, the National Cohesive Wildland Fire Management Strategy, developed to guide future wildland fire management on all lands in the US, emphasizes the importance of enhancing local capacity to prepare for and respond to wildfires.

First, we investigated whether communities that participated in federal forest management and restoration contracts prior to a wildfire were more likely to have businesses that captured suppression contracting opportunities during a fire. We also evaluated whether and how community economic and geographic contexts affected local participation. These connections have implications for understanding existing and potential local capacity for fire preparedness and response as fire suppression funds in a community can provide a source of income and support for building or maintaining local fire response capacity. We used a randomly selected stratified sample of 135 large wildfires and Forest Service suppression expense transaction records for each wildfire (from the Foundation Financial Information System) to analyze suppression expenditures for local capture. To evaluate the relationship between the proportion of contracting dollars awarded to local businesses (local capture) and local business capacity, urbanization, economic specialization, and other variables we used a beta regression model (Grün et al. 2009).

For our second step, we identified and analyzed fire suppression equipment contractor capacity across the West, including how demand for contracted fire suppression equipment related to supply. This allowed us to better understand the existing capacity and regional variation of contracted resources for

federal agency fire suppression needs across the western US for preseason fire planning and response. We conducted empirical research of private sector capacity in relation to basic market drivers to gain a clearer understanding of where and how contracts for resources in the preseason and positioning of agency resources during the fire season happen. First, using 2015 preseason agreement data for wildfire equipment and services from the Virtual Incident Procurement system, we examined how equipment amount and diversity varied across the West. We created a database of all vendors with preseason Incident Blanket Purchase Agreements in VIPR in December 2015 (USFS 2015a) in the western US, which includes seven different incident management geographic areas (see Figure 1). Under the current system, any piece of equipment that meets specifications in VIPR will be placed on the appropriate Dispatch Priority List (DPL) for a particular host dispatch center based on the equipment’s location (USFS 2015a).

**Figure 1.** Study area with geographic area coordination centers and dispatch centers with equipment listed on VIPR in 2015 indicated.



Next, we compared contracted equipment availability to resource orders using the Northwest Geographic Area (NWCC; Oregon and Washington) as a case study. Incident management systems around the world have been focusing on improving decision-making, support tools, and pre-positioning and planning (Pacheco et al. 2015). In the US wildfire suppression dispatch system, each dispatch center, geographic area coordination center, and the National Interagency Fire Center are responsible for both filling and requesting resources. To increase the certainty of having required equipment available in an orderly manner and to respond to issues of fire contracting efficiency, the Forest Service began using the Virtual Incident Procurement (VIPR) system in 2009 to solicit, award, and manage preseason agreements with contractors for equipment and certain types of services (USFS 2015b). We (1) examined the deployment of engines from dispatch centers in the Northwest Geographic Area from 2008 to 2015, and (2) compared the capacity to peak demand by analyzing private sector engine capacity and deployment in the Northwest GA in 2015, noted as “the most severe fire season in modern history” (USFS 2016).

For the third step—identifying and describing a set of business models of suppression contractors—we interviewed 131 businesses from Oregon and Washington with preseason agreements in VIPR in 2015. We identified 615 unique contractors in the Northwest as the region’s 2015 population of fire equipment contractors and then used simple random sampling to contact 366 contractors (210 total responses) for a combination of phone and in-person interviews. Our interview questions focused on understanding the contractors’ (1) business background (e.g. years in the fire contracting market and

reason for entering the market), and (2) their business practices (type and number of equipment and employees, fire dependency, diversity of business, and response to the current contracting market). These questions allowed us to explore the relationships between the different backgrounds and practices of businesses and how they had built and changed their contracting business practices.

Finally, we conducted our final step: exploring transitions in the wildfire suppression contracting industry from both an agency pre-season procurement and dispatch perspective and a contractor business and industry transition perspective. We interviewed state and federal agency individuals involved in fire suppression contracting, and hand crew contractors with either Type 2 IA crews on national contracts with the US Forest Service and/or Type 2 hand crews contracted with the Oregon Department of Forestry through Interagency Firefighting Crew Agreements (IFCAs). We contacted all 46 businesses (which comprised the entire population of hand crew contractors in the Pacific Northwest), and key state and federal agency staff that worked with contractors on fire suppression procurement. We conducted interviews with 24 businesses (including 89% of national crew businesses and 48% of businesses with IFCAs), two individuals representing private contractor associations, and 22 state and federal agency staff (45 total interviews). We conducted over 30 hours of participant observation between January and April 2016 at wildland fire contracting public meetings held by the Pacific Northwest Fire and Aviation Contracting Team and at the largest annual gathering of fire suppression hand crew contractors at the 25<sup>th</sup> annual National Wildfire Suppression Association (NWSA) meeting.

#### IV. Key Findings

*The findings addressed below represent some of the main findings from this research project. These findings are addressed only briefly here. In-depth findings and discussion can be found in EWP Working Paper #61, Innovative Contracting Quick Guide, and Briefing Paper #s 63, 65, 66, 67, and 68, which can be found on the project website at <http://ewp.uoregon.edu/managingthemarket>. Additional findings are located in four manuscripts that are under review at journals and two manuscripts that are in advanced preparation.*

##### **A. Local capture during a fire was higher in places where more vendors were involved in forest and watershed restoration prior to fire activity**

Counties with more diversified economies were more likely to capture suppression contracting opportunities than those with less diverse economies. We found variation in the amount of suppression funds captured by local businesses during large fires that occurred between 2004 and 2008 as well as in the factors that influence the amount of local capture. The results suggest that the odds of local vendors receiving US wildfire suppression contracts increased when a local restoration-related economy was already present, but that use of local contractors varied by county economic specialization and proximity of the fire to an urban area. The effect of local capacity increases at a decreasing rate, suggesting that the number of businesses with past experience in federal contracting is relatively more important in communities with little existing business capacity compared to places with large numbers of existing businesses. Counties with large numbers of local businesses had more variable local capture rates than those counties with fewer businesses. Isolated rural counties were also more variable in their ability to capture wildfire suppression contracts. We found that larger social and economic dynamics constrain the number of vendors and local capture of suppression contract spending. Capacity is higher in counties with larger populations, and counties with less specialized economies are more likely to capture contracted suppression spending than those specialized in a single sector.

Despite the significant relationship between natural resource management contracting capacity and local fire suppression capture rates, our model leaves a lot of variation unexplained. Given the lack of previous research in this field, we can only speculate about potential causes for the unexplained variability.

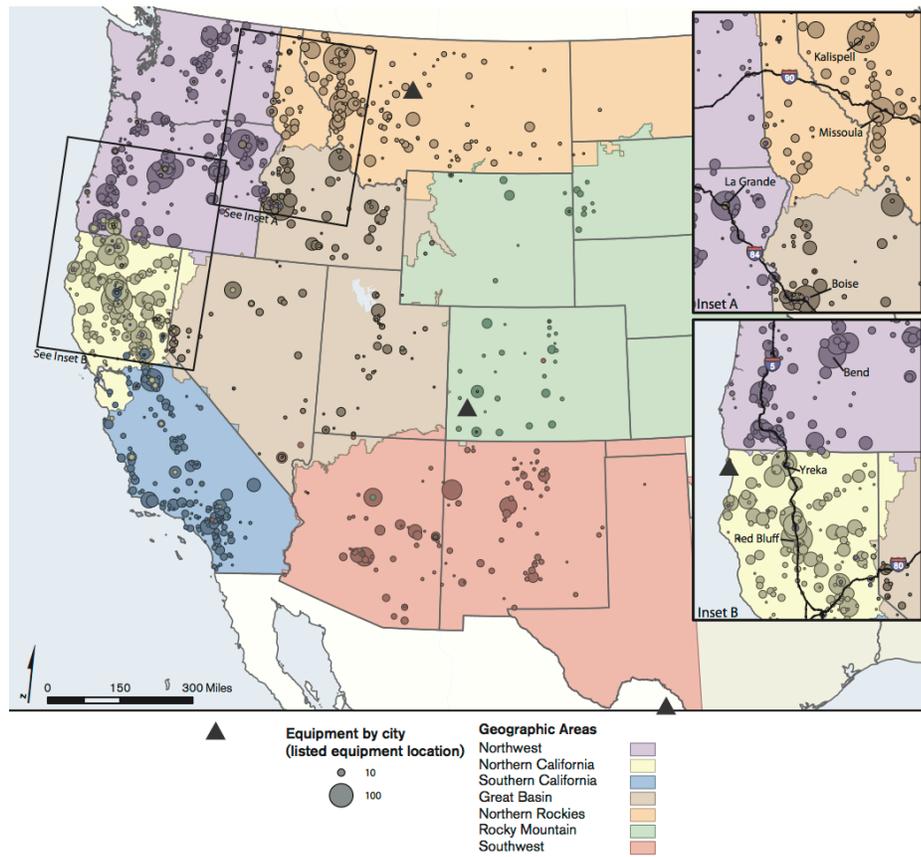
##### **B. Contracted wildfire suppression resources are unevenly distributed**

There was wide variation in the location, categories, and number of pre-season equipment agreements across the western geographic areas (GAs). The seven western GAs (our study region)

contained 2,040 unique vendors that owned 9,396 different pieces of equipment with preseason equipment agreements in 2015. There was clear concentration of resources in particular GAs: on average, GAs contained 1,342 pieces of equipment, with a maximum of 2,437 in the Northwest GA and a minimum of 254 in the Rocky Mountain GA. In addition to holding the most agreements, the Northwest also had the greatest number of vendors (n = 630), followed by Northern California (n = 414), and the Northern Rockies (n = 336). The categories of equipment available in each GA varied; no one area contained all 40 equipment categories. Although there were 40 categories, 70% of the total equipment in the study area was included in just ten categories: dozers, water tenders, fallers, engines, transport, excavators, pickups, tents and canopies, crew carrier buses, and potable water trucks.

Analyzing the distribution of the amount and type of equipment across the GAs as well as the specific equipment locations indicates that the types of contractor equipment available are quite uneven across the West. One possible explanation for this unevenness could be that GAs with more fires may solicit more types of equipment, while contractors seeking work opportunities may place their equipment where they believe there is more likely to be work. To test this hypothesis, we linked preseason agreements with historical wildfire data for the West to see if the history of fire impacts would influence how equipment was distributed between and then within GAs. When we explored these connections further through statistical analysis of equipment locations and wildfire locations we found **that cities located closer to previous fires did not contain more vendors or resources than those located farther away** (Figure 2).

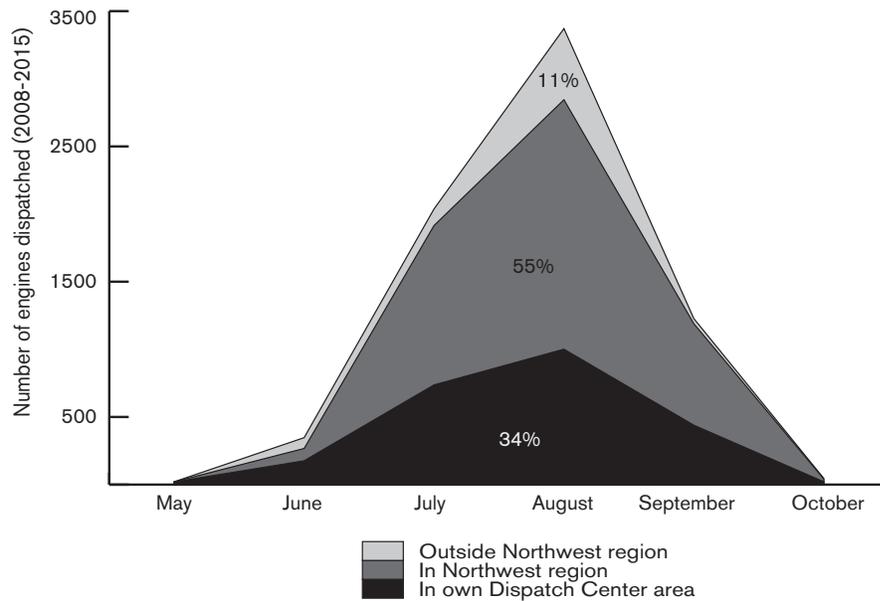
**Figure 2.** Location of equipment under preseason agreements by location (city or town where equipment is based) in 2015. Colors of circles correspond to the host Geographic Area of the equipment. Size of circles correspond to the amount of equipment available in each location.



### C. Dispatch centers share resources regularly.

Given the distribution of resources across the West, efficient resource sharing is vital. Looking at engine contracting in the Northwest GA, we found that equipment sharing both within the GA and with other GAs was common. Of the engines ordered in 2015, 56% went from one dispatch center to another within the GA and 9% of orders went out of the GA. Some dispatch centers had many engines and tended to consistently lend to dispatch centers with few engines, while others tended to lend and borrow resources at about the same rate (Figure 3).

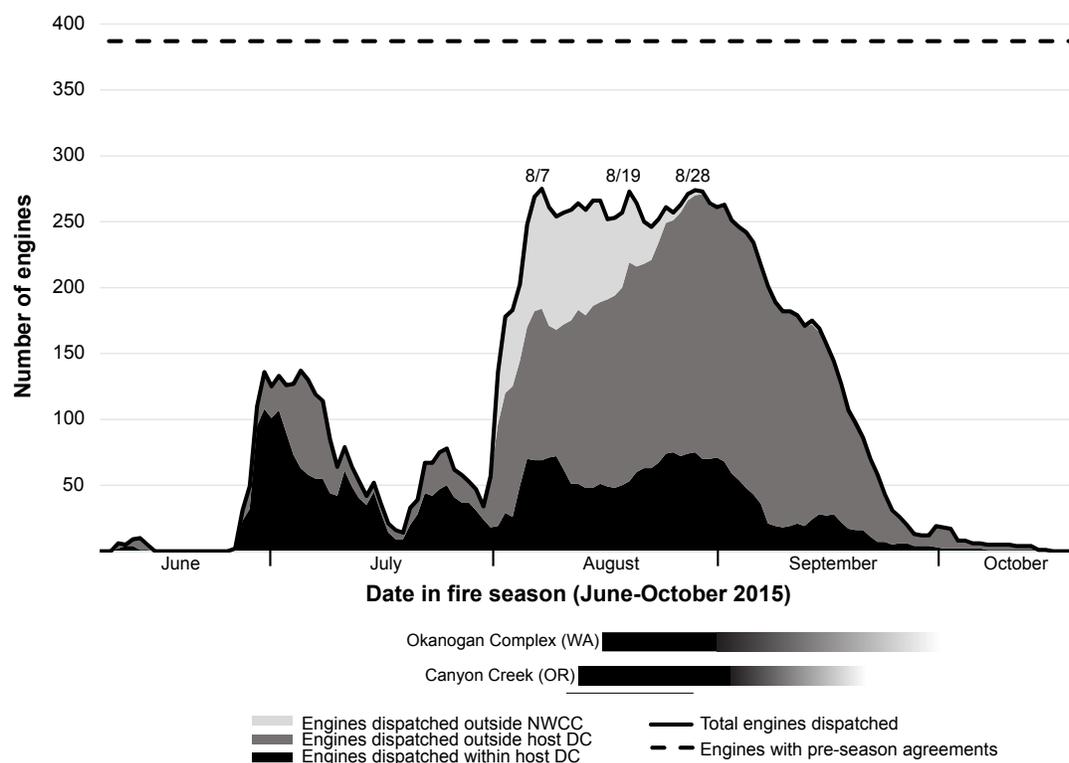
**Figure 3.** Engines dispatched by the Northwest Coordinating Center by month, 2008-2015



### Peak demand for Northwest engines was apparently below capacity in 2015.

In the current system, all equipment that meets specifications is placed on dispatch priority lists in a particular dispatch center. In 2015, a large fire season in the Northwest, this analysis shows that 11% of engines never went out on a fire. We do not know if these resources were never requested, or if they were unavailable for other reasons. During the peak days of the season in mid-August, only 71% engines were on fires (Figure 4). We know there are considerations not reflected in the available data, in particular that “fill by agreement” orders (selected by dispatch and state orders) do not appear in ROSS, which shows resources as available even when they are out on a fire. Furthermore, in busy seasons businesses may not have enough engine bosses to staff their engines, for these employees often work for multiple companies and move around frequently in a fire season.

**Figure 4.** Northwest Coordination Center engine availability and dispatch during the 2015 fire season



**D. We identified four distinct types of businesses that provided equipment services to the fire suppression market:**

**Forestry equipment contractors** tended to have a background in forest work and to use suppression contracts to supplement and extend the forest work season with their existing equipment and staff. Fire suppression provided employment for these contractors at a time of year when they generally could not conduct other forestry work due to high fire danger. Forestry contractors owned a greater amount and variety of fire equipment, had more trained employees, and contained more suppression hand crews (which in most cases were made up of a subset of the existing forestry crews) than other businesses we interviewed.

**Commercial services equipment contractors** were typically in the construction and transportation businesses and had equipment such as hand washing stations and crew carriers or buses, which they often already owned prior to contracting for fire suppression. Although these contractors had less variety of equipment than forestry businesses, they more overall equipment. Employees of these businesses generally worked in fire camps versus on active fire suppression.

**Fire-focused equipment contractors** purchased equipment specifically for fire suppression and had less equipment variety and numbers than commercial services or forestry contractors. They often also hired fire suppression hand crews, generally all as seasonal employees for the fire season only. After starting in fire suppression, most of these businesses found other work outside of fire season to increase their work year and increase security. This work was mainly forestry-related to use existing equipment and staff training. These businesses were the most dependent on fire suppression income, often depending on fire season income to support them year round.

**Micro-business contractors** came from backgrounds unrelated to forestry, fire, or fire equipment, and were primarily retired individuals or people looking for summer employment to supplement existing jobs such as educators with summers off. They generally owned just one or two pieces of equipment that were primarily operated by the owner of that equipment (e.g. a retired individual with a water tender or a truck). These contractors often had other sources of income such as a pension or unrelated job.

**Contractors across all business types cited common challenges in maintaining their businesses,** including growing competition in the market, equipment requirement changes, and, in particular, unpredictable demand for their equipment. Contractors were most concerned with the variability between contract seasons and resulting planning challenges.

**Businesses used a variety of strategies to adapt to contracting challenges,** including listing equipment at multiple dispatch locations, increasing the amount of equipment they contract, and diversifying the types of contracts they seek, particularly between fire suppression and forestry work.

#### **E. Transitions in fire suppression contracting have created an increasingly professionalized industry and strengthened connections between agency staff and contractors.**

Our interviews and participant observation yielded a more nuanced story of the transition to and progression of fire contracting in the Northwest Region, where it originated in the 1970s with forest contractors. Most hand crew operators began their work through forestry operations, informally assisting on fires as needed using existing crews and equipment, often during periods that the forest was otherwise closed to them due to high fire danger. Issues in worker safety, questions about dispatch and ordering processes, and audits on the cost-effectiveness of contracting all led to changes in contracting businesses (creation of associations, standardized requirements and trainings), and agency changes (creation of a nationalized interagency wildfire management approach, including new standardized contracting processes, templates and resource ordering, and dispatch systems). Throughout these transitions for both contractors and agencies, fire intensity increased, federal budgets declined, and communication and standardization increased between agencies and contractors in the preseason contracting process.

Our research also found that *history still has a large influence on the origin, workload and culture of fire suppression contracting*. Many contractors and agency interviewees noted differences in how contracted hand crews and agency hand crews were treated on a fire, much of it stemming from historical interactions between fire incident management and original hand crews. In addition, cultural differences were noted between hand crew businesses, most notably interviews identified a difference between those businesses that focused exclusively on fire suppression versus those who conducted forest restoration (thinning, tree planting) and did fire suppression on the side.

Finally, we found that **in many cases the contractors we interviewed would take on jobs in the non-fire season to address one of their largest challenges: employee retention issues.** Hand crew contractors in particular emphasized the challenges they faced in keeping well trained workforces available from season to season for fire suppression work. Often employees would move on to more full-time or stable work, disrupting businesses' abilities to retain trained staff. Several contractors talked about the various other projects they would find to keep their staff working more months of the year, such as forest restoration work, construction, and emergency response services. In some cases businesses would take these jobs at a rate where they broke even or took a small loss in order to keep their employees working. **Many of these non-fire jobs were dependent on contractors' ability to bid competitively on projects, which highlights the continued connection between fire suppression and forest restoration workers.**

## **V. Management implications**

Taken together, these findings underscore the importance of local response capacity, communication, and sharing of resources, particularly given the unequal distribution of resources. As demands for wildfire response resources grow across the nation and agency budgets continue to decline, reliance on private contracting resources for fire suppression will continue. The capacity to provide such resources when and where they are needed depends not only on public sector contracting and dispatching processes but also on private sector interest in participating in this system.

**In a time of increased focus on collaborative fire management and local capacity development, finding that suppression capacity is shaped by participation in federal contracting prior to a fire can help guide policy and practice to develop more fire adapted communities.** Similar to evidence about wildfire hazard mitigation (Moseley and Toth 2004), our findings suggest that counties with

diversified urban economic centers may be better prepared to participate in the wildfire suppression market, while smaller, less diversified, and moderately isolated counties capture fewer suppression dollars.

**There are important open questions about the amount of capacity needed for key resources, such as engines, that require additional research.** Our research suggestions that there may have been more-than-adequate capacity in the Northwest in a record fire season in 2015 leads to questions whether the agencies may want to conduct additional analysis and planning both to ensure a sustainable supply resources and to provide a better indicator to the contracting market about what resources are needed. This would need to be balanced by analyzing the amount of resources that could be needed in the most demanding fire years after government and cooperator resources are exhausted.

**The uneven geographic distribution of contracted resources makes clear the importance of advanced planning and efficient sharing of resources to ensure resources are in the right place at the right time.** This includes a critical role for effective coordination. If fire contracting resources are driven by historic and current forest management market dynamics, then resources may not be located in the most efficient areas from a fire response perspective. The mobile nature of contracted fire suppression resources is intended for quick transport of resources over long distances, but fire managers also depend on rapid deployment of close resources.

**The erratic nature of wildfire suppression needs may drive companies to locate their resources where work is available in the off-season.** One might expect contractors to locate their resources primarily based on where fires have tended to occur. However, the erratic nature of wildfire work may instead drive companies to locate where work is available during the non-fire season. The Forest Service could create incentives for contractors to move closer to common fire locations to reduce travel costs, but significant analysis would be needed to understand the possible effects on costs and resource availability if businesses were to move further from sources of off-season work.

**Hand crew contractors depend on off-season forest management and restoration work to retain their workforce.** The ability of contractors to retain their skilled and typically local workforces is often directly tied to their ability to bid competitively on other federal agency contracts. Fire suppression contractors are linked to federal and state agency contracting more broadly, which contracting officers should consider when awarding contracts. The ability of fire suppression contractors to competitively compete for and win bids on other federal contracts has direct implications on their ability to maintain and build a trained workforce both in isolated rural communities and elsewhere across the region.

**The largest purchaser of services (the US Forest Service) has a direct impact on shaping the fire suppression market through changes in preseason contracting requirements, online forms and systems, and other requirements they have enacted.** At the same time, agencies increasingly depend on private contractors to be available when and where they are needed to fill unpredictable resource gaps. This creates an unpredictable market for private contractors, who invest in equipment and who train and equip staff on the chance that they will be called on a fire.

**Contractors depend on federal agency needs for fire suppression services, and lack of agency clarity or articulation of resource needs creates confusion for private contractors on what services they should provide.** Contractors often face large upfront investments of equipment and trained staff, decisions they must make from a fire suppression perspective in the face of uncertainty about the need for their services. This uncertainty, combined with dependence on the income for worker livelihood, makes fire suppression contracting a risky market with potentially high payoffs for contractors. **Agencies are faced with the challenge of planning for the extreme fire days—the one in a thousand fire days of unprecedented need—while still balancing contractor expectations for use of the services they provide.** The structured processes and procedures agencies engage for preseason contracting and dispatch at times clash with the deeply personal nature of businesses making ends meet, and the ability to

consistently retain a workforce for the men and women who own and operate the over 600 businesses within Oregon and Washington alone.

Our policy review of the shifting role of communities in wildfire policy (prompted in part by the National Cohesive Wildland Fire Management Strategy completed in 2014) **shows that federal wildland fire policy has, over the past 15 to 20 years, evolved to have a different focus on the role of communities than it has historically had in federal fire protection efforts as well as community collaboration in planning, risk reduction, and increasingly in fire suppression.** This evolution in focus, while in many ways new, has clear roots in previous policy. We identified three important shifts that point to a change in the role of communities in federal wildland fire policy since 2000:

1. A shift in objectives from protection of natural resources to protection of human lives and property, particularly in the wildland-urban interface (Vaughn and Cortner 2005, Moseley 2007).
2. The rise of community-based wildfire planning, preparation, and risk reduction. One of the goals of the Healthy Forests Restoration Act of 2003, to encourage communities to develop Community Wildfire Protection Plans, is a prominent example of this shift (Jakes et al. 2011).
3. A vision of increased community involvement in the process of suppressing wildfires, as opposed to merely expecting communities to step aside for federal suppression efforts.

This third shift involves the most uncertainty going forward, as it is not yet clear whether federal policymaking or budget priorities in particular will actually foster greater community involvement in suppression efforts on the ground, or where the financial support for these efforts will ultimately come from.

## **VI. Relationship to other recent findings and ongoing work**

This was the first project to examine the private contracting market for fire suppression services. This work builds on previous research projects, most notably:

### **1) Economic impacts of large wildfires**

The study of the economic impact of large wildfires (2008, JFSP project ID 09-1-10-3, PIs Moseley and Nielsen-Pincus) explored how fire suppression and recovery efforts may provide economic opportunities for areas where large wildfires disrupt the lives of workers, families, and employers. However, unlike with other natural hazards, there has been little research about how wildfires affect local economies. The purpose of this project was to analyze the effects of large wildfires on labor markets and examine how fire suppression spending may mediate these effects. Main findings from this research suggest that (1) in the short term, labor market impacts from large wildfires are positive during the course of a fire, (2) in the long-term, large wildfires lead to greater economic instability by amplifying seasonal variation in employment, (3) local capture of suppression spending helps mediate negative labor market impacts, and (4) local business capacity to capture suppression contracts varies and can be measured by the number of suppression-related vendors active in the county.

### **2) Understanding the roles of socioeconomic vulnerability, adaptive capacity, and mitigation in determining economic impacts of wildfire**

This study examined how socioeconomic status, wildfire planning and adaptive capacity in communities interact and influence community resilience to large wildfires when they occur. The study considered the identified economic impacts in the myriad of large wildfire effects to communities, and considered community capacity for planning by examining 130+ Community Wildfire Protection Plans (CWPPs) across western states. This project also builds onto the 2004-2008 data set of Forest Service suppression spending on large wildfires, extending the set of large wildfires with detailed spending information to 2011.

### **3) Economic impacts of forest and watershed restoration**

This project expanded a study on the economic impacts of restoration in Oregon (Nielsen-Pincus and Moseley 2010) to a national level. This has included analysis of federal and state investments in

restoration, a profile of the restoration industry, and tools to help practitioners better estimate and understand the economic impacts of their work. Through this study on wildfire suppression markets, we have gained valuable knowledge about the impacts of fire suppression work and the connections between suppression and restoration work in sustaining capacity, creating a more complete picture of both the business and community capacity to manage natural resources and wildfires.

In addition, our research in this project builds on a few bodies of related research, including:

### **1) Incident management systems and teams**

To date there has been limited research on federal procurement practices and related impacts on market efficiencies or businesses (Caldwell et al. 2005), or incident command systems more broadly (Jensen and Thompson 2016). Some previous research has focused on both incident management systems, as well as on the inter-team dynamics that make up the incident management teams. Research on incident management systems has focused on improving decision-making, support tools, and pre-positioning and planning (Pacheco et al. 2015 and others). As an increasing number of non-federal resources are used for fire suppression in the US, other reports and research has explored incident management primarily related to contracting efficiencies (Booz Allen Hamilton 2012 and NIFC 2015), with limited research on the economic background and organization of wildfire suppression systems (Lueck 2012). In addition, some recent research has focused on the social networks of Incident Management teams, such as the work of Steelman, Nowell, and others.

### **2) Wildfire suppression expenditures**

Previous research on wildfire suppression costs, such as that by Prestemon, Gebert, and others, has focused on the trend of growing costs and increasingly severe fire seasons, often at the national scale (Prestemon et al. 2008, Calkin et al. 2009, and Thompson et al. 2013). Little attention has been given to local impacts, business capture, and the resulting fire suppression industry that has arisen. Our work adds to this research by better documenting how suppression money reaches private contractors, who provide local employment opportunities and are a key source of training for the development of local, skilled workforces for community preparedness and response to wildfire.

### **3) Local business capacity for natural resource work**

Our research explored community capacity in relation to wildfires. First, we contributed new work on understanding how fire suppression contractors are based in other areas of contracting such as forest restoration. Although there is existing literature on natural resource management businesses and their ability to capture local work from federal land management agencies (e.g. Moseley and Shankle 2001, Moseley and Toth 2004), this focus had not yet been applied to wildfire-related activities, including the variety of support services that are contracted. Second, we also have contributed to the broader literature and discussion of community capacity for wildfire response and preparedness, related to work by Williams and others, and the recently developed National Cohesive Wildland Fire Management Strategy (Paveglio et al. 2015, Smith et al. 2016, Williams et al. 2012, and The National Strategy 2014). Both our policy review of community roles and interview data on contractors' local employee retention strategies provide more detail about the specific issues facing communities and local businesses in building skilled local workforces for community fire preparedness.

*In addition to contributing to the bodies of research noted above, members of the research team have been involved in a number of related ongoing projects that build from and supplement the findings from this project:*

### **Northwest Fire Science Consortium**

We are part of the leadership team of the JFSP-funded Northwest Fire Science Consortium that began providing science and knowledge dissemination in 2012. We help bring social and economic research such as this study forward through this venue, ensuring that community capacity and economic development findings are shared with diverse manager and practitioner audiences across this region. In particular, the consortium has provided a channel to better and more broadly communicate the findings of

this study with these audiences.

### **Developing cross-trained local workforce capacity for wildfire suppression community preparedness and response**

This project uses the framing of the National Cohesive Wildland Fire Management Strategy to improve multi-jurisdictional coordination of wildfire management by expanding local preparedness and response capacity to identify local workforce development opportunities. Local workforces that are trained to prepare for and respond to wildfire risks in their communities could play vital roles in bringing together planning, risk reduction, and fire response. However, unpredictable work, limited state and federal budgets, diverse landowner objectives, and complicated contracting practices can create challenges for sustaining place-based workforces. We are examining cases where organizations in the Fire Adapted Community Learning Network, and their partners have developed local, cross-trained workforces through integrating fires suppression, hazardous fuels reduction work, and identifying the authorities used in these cases to facilitate local workforce development.

## **VII. Future work needed**

The ongoing and recent research reflects some of the anticipated future research of this and other teams. In particular, this project raises questions about (1) contracting capacity as compared to agency need and (2) local workforce development and community capacity for wildfire preparedness and response.

First, this study finds that available contracting equipment is unevenly distributed, and for a variety unknown reasons, contracted engine availability appears to have been greater than agency need even during an extreme fire year. Further inquiry into linking capacity to demand would improve understanding of how the public sectors has used private contracting resources in a range of fire seasons. This type of analysis should include other data to tell a more complete picture, including:

1. Forest Service “Unable to Fill” (UTF) reports. These show how many of a specific resource a dispatch/GACC was unable to fill on a given day, which would explain some of the “unused” resources even in an extreme fire year.
2. Multiple years of VIPR data to identify trends in resource availability to compare to multiple years of resources dispatching (from ROSS) to better show trends over time, particularly since no one year is a typical fire year.
3. In future years, there would be opportunity to use the recently (as of Spring 2016) linked VIPR-ROSS database to track resource use and availability in far more simplified manner, rather than the analysis we conducted, linking different databases together and tracking individual engines line by line. This provides opportunities to track multiple types of equipment over different time periods, providing a more detailed understanding of how different regions request resources and of local access to available resources in a given fire season.

Other potential areas of inquiry related to contracting capacity and agency fire suppression resource use include:

1. Exploring the unused contracted resources in an in-depth case study. By identifying the unused resources through VIPR and ROSS, research could then focus on the business owners of the unused resources, including an exploration of why resources were not used, from both contractors’ and local dispatch centers’ perspective to identify main causes of unused resources. This would help managers understand if changes to the preseason contracting process would improve the efficiency and/or effectiveness of their processes.
2. Exploring trends and changes in how agencies depend on private contracting resources. By using resource ordering data for federal, cooperator, and private contractor resources would provide a more comprehensive picture of what resources are used on fires, including the types and timing of resources dispatched. This research would allow the tracking of resources fire by fire, specific to region and season, to identify the variations in where, how, and when fire suppression resources are solicited. This type of research could answer questions about if and how agency dependence on outside (cooperator and contractor) resources is changing over time.

3. Compare contracted vs. agency and cooperator resources to understand where and how agencies are deploying resources and its effects on capacity and business models.

Future research related to local workforce development and community capacity for wildfire preparedness and response is a timely and relevant topic, as contractors and communities alike struggle with training and maintaining sufficient workforce capacity for wildfire suppression and preparedness. The considerations raised by hand crew contractors in this research about their dependence on other federal contracting opportunities warrants further exploration to better understand how intertwined fire contracting businesses are with other federal contracting. If the health and stability of these businesses is heavily dependent on federal contracting processes, managers will need to understand the points of impact: where and how contracting decisions and changes impacts businesses, particularly those in multiple contracting arenas (e.g. fire and forest restoration), and areas where local workforce building could contribute significantly to community wildfire capacity and preparedness. Our finding that areas with preexisting restoration businesses tended to capture more wildfire suppression funds during and after a fire than other areas reinforces the importance of understanding local capacity and challenges to further developing it.

To create effective policy and management options, particularly in a time of intensifying wildfires, increasing reliance on contracted resources, and high uncertainty in future wildfire needs, we need to know more about how available suppliers of fire suppression resources match demand, know where and how different types of fires suppression resources are used by agencies, and identify where local communities could link to improved wildfire preparedness capacity development.

## VIII. Deliverables Cross-Walk Table

See deliverables list for full citations of all deliverables listed below.

Proposed deliverables	Delivered	Status
<b>From original proposal:</b>		
1 conference presentation	Moseley, 2015. International Wildland Fire Safety Summit and Human Dimensions of Wildland Fire Conference	Completed
2 working papers	1. EWP Working Paper #61, 2015 2. Quick guide: "Innovative Contracting: A Guide for Collaborative Groups and Community Partners."	Completed
2 refereed journal articles	1. Moseley et al., in review. Submitted to <i>Forest Science</i> 2. Lyon et al., in review. Submitted to <i>International Journal of Wildland Fire</i>	Completed, revise and resubmit as needed
1 policy briefing paper	EWP Briefing Paper #63, 2015	Completed
Briefings with policymakers in Washington, DC	May 31-June 2, 2016: 11 meetings with policymakers and congressional staff to distribute research findings	Completed
Dissemination of deliverables	1. Announcement of results via the NW Fire Science Consortium 2. Email announcing final publications to research participants 3. Email announcing results to EWP network of partners and collaborators	Completed
<b>From extension request:</b>		
3, two-page fact sheets	1. EWP Briefing Paper #65, 2016 2. EWP Briefing Paper #67, 2016 3. EWP Briefing Paper #68, 2015	Completed
1, two-page briefing paper that provides key lessons for policy makers	EWP Briefing Paper #66: Drivers of Wildfire Suppression Costs: A Review. 2016.	Completed
1-2 additional refereed journal articles	1. Munger, et al., in review. Submitted to <i>International Journal of Wildland Fire</i> 2. Huber-Stearns et al., in review. Submitted to <i>Journal of Forestry</i>	Completed, revise and resubmit as needed
<b>Additional deliverables created:</b>		
Conference presentation	Bixler, 2015. International Wildland Fire Safety Summit and Human Dimensions of Wildland Fire Conference.	Completed
Conference presentation	Huber-Stearns, 2016. University of Oregon Climate Change Symposium.	Completed
Refereed journal article	Moseley, et al., in prep for <i>Administration and Society</i>	Drafted
Refereed journal article	Huber-Stearns, et al., in prep for <i>Policy Studies</i>	Drafted
Poster	Rural Voices for Conservation Coalition Annual Meeting, poster presentation	Completed
Invited presentation	Huber-Stearns, 2016. Presentation at the National Wildfire Suppression Association Meeting, Reno, NV, February 22, 2016	Completed
Invited presentation	Rural Voices for Conservation Coalition Annual Meeting, Huber-Stearns was an invited discussant for 3 "Fire-Adapted Communities and Resilient Landscapes" discussion panels, 12/15.	Completed
Fact Sheet	Northwest Fire Science Consortium, "What is? The National Cohesive Strategy"	Completed
Video	"Private Contracting on National Forest Lands: Pre-season Contracting and Fire Response Procedures" YouTube video.	Completed
Project website	<a href="http://ewp.uoregon.edu/managingthemarket">http://ewp.uoregon.edu/managingthemarket</a>	Completed

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## X. Deliverables

### Final report:

Huber-Stearns, Heidi, Cassandra Moseley, and Autumn Ellison. "Managing the Market: How Procurement Practices Impact Private Sector Wildfire Response Capacity." Final Project Report (JFSP Project Number: 12-2-01-10). Submitted August 10, 2016. University of Oregon. Eugene, OR.

### Website:

Ecosystem Workforce Program. "Managing the Market: How Procurement Practices Impact Private Sector Wildfire Response Capacity." University of Oregon. <http://ewp.uoregon.edu/managingthemarket>.

### Conference Presentations/Workshops

Cassandra Moseley. "Wildland Fire Governance: Strategies of Effective Suppression Firms." Presentation at the International Wildland Fire Safety Summit and Human Dimensions of Wildland Fire Conference: Managing Fire, Understanding Ourselves: Human Dimensions in Safety and Wildland Fire, Boise, ID, April 20, 2015.

Huber-Stearns, Heidi. "Managing the Market: Unpredictable Wildfire Suppression Needs in a Changing Climate." Presentation at the 5th Annual University of Oregon Climate Change Research Symposium, Eugene, OR, Feb 17, 2016.

R. Patrick Bixler. "Fire Manager or Market Manager? Administrative Practices for Large Fire Suppression." Presentation at the International Wildland Fire Safety Summit and Human Dimensions of

Wildland Fire Conference: Managing Fire, Understanding Ourselves: Human Dimensions in Safety and Wildland Fire, Boise, ID, April 20, 2015.

### **Invited Papers/Presentations**

Redmond, Oregon presentation (pending):

Presentation of findings to US Forest Service Region 6 Fire and Aviation Contracting Team, and Fire and Aviation Management Leadership. Scheduling meeting time for fall 2016 (post-fire season).

Washington, DC presentations:

PI, Cassandra Moseley, and Research Associate Heidi Huber-Stearns traveled to Washington, D.C. the week of May 30th to present findings to land management officials and policy makers. They had 11 meetings with US Forest Service, Office of Management and Budget, USDA, Council of Environmental Quality, and Hill staff. They met with congressional staff from the Oregon delegation, as well as the House and Senate natural resource committees and the senate ag committee. During all meetings, Moseley and Huber-Stearns disseminated research briefs summarizing research findings to meeting participants. These meetings included in-person and phone presentations to Fire, Aviation, Contracting and Acquisition Management staff at the US Forest Service.

Huber-Stearns, Heidi. "Managing the Market: How Procurement Practices Impact Private Sector Wildfire Response Capacity. Presentation at the National Wildfire Suppression Association Meeting, Reno, NV, February 22, 2016.

Moseley, Cassandra and Heidi Huber-Stearns. "Managing the Market: Procurement Practices and Private Sector Wildfire Response Capacity." Poster presentation at the Annual Meeting of the Rural Voices for Conservation Coalition, Hood River, OR, December 8, 2015.

Rural Voices for Conservation Coalition Annual Meeting, Huber-Stearns was an invited discussant for 3 "Fire-Adapted Communities and Resilient Landscapes" discussion panels, and PI Moseley co-facilitated the panels. Hood River, OR. December 9, 2015.

### **Publications in Print/in Press**

#### ***Working papers:***

Huber-Stearns, Heidi, R. Patrick Bixler, and Cassandra Moseley. "Private Contracting on National Forest Lands: Pre-season Contracting and Fire Response." Ecosystem Workforce Program Working Paper 61, Summer 2015.

#### ***Briefing papers:***

Ellison, Autumn and Cassandra Moseley. "Drivers of Wildfire Suppression Costs: A Review." Ecosystem Workforce Program Briefing Paper 66, Spring 2016.

Huber-Stearns, Heidi, Autumn Ellison, and Cassandra Moseley. "Cross-trained Local Capacity for Integrated Wildfire Management." Ecosystem Workforce Program Briefing Paper 65, Spring 2016.

Huber-Stearns, Heidi, Autumn Ellison, Olivia Molden, Jessica Neafie, and Cassandra Moseley. "Profiles of Fire Suppression Contracting Businesses." Ecosystem Workforce Program Briefing Paper 68, Spring 2016.

Huber-Stearns, Heidi, R. Patrick Bixler, Autumn Ellison, and Cassandra Moseley. "Call When Needed: Private Contracting for Wildfire Suppression in an Unpredictable Work Environment." Ecosystem Workforce Program Briefing Paper 63, Summer 2015.

Moseley, Cassandra and Heidi Huber-Stearns. "The Right Resources at the Right Time: Private Fire Suppression Contracting Capacity in the West." Ecosystem Workforce Program Briefing Paper 67, Spring 2016.

**Other:**

Ecosystem Workforce Program. "Private Contracting on National Forest Lands: Pre-season Contracting and Fire Response Procedures." Video, September 30, 2015, <http://ewp.uoregon.edu/managingthemarket>

Moseley, Cassandra, E.J. Davis, and R. Patrick Bixler. "Innovative Contracting: A Guide for Collaborative Groups and Community Partners." Ecosystem Workforce Program Quick Guide, Summer 2015.

Northwest Fire Science Consortium. "What is? The National Cohesive Strategy." *Northwest Fire Science Consortium Fire Facts*, 2016. Available at: <http://www.nwfirescience.org/biblio/nwfsc-fire-facts-national-cohesive-strategy>.

**Publications under Review (refereed)**

Huber-Stearns, Heidi, Cassandra Moseley, Christopher Boone, Nathan Mosurinjohn, and Katie Lyon. "Contracted Wildfire Response Capacity in the American West." Submitted to *Journal of Forestry* on May 27, 2016.

Moseley, Cassandra, Cody Evers, Max Nielson-Pincus, Heidi Huber-Stearns, and R. Patrick Bixler. "What Drives Local Wildfire Response Capacity?" Submitted to *Forest Science* on April 17, 2016.

Munger, Sean, Cassandra Moseley, Heidi Huber-Stearns. "Devolution and Continuity: The Changing Roles Communities in Federal Wildfire Policy in the USA." Submitted to *International Journal of Wildland Fire* on May 30, 2016.

Lyon, Katie, Heidi Huber-Stearns, Cassandra Moseley, Christopher Bone, and Nathan Mosurinjohn. "Sharing Contracted Resources for Fire Suppression: Engine Dispatch in the Northwestern United States." Submitted to *International Journal of Wildland Fire* on May 30, 2016.

**Publications in Preparation (refereed)**

Moseley et al. "Business strategies in a managed market: fire suppression equipment contracting in the Northwest." In prep for *Administration and Society*.

Huber-Stearns, et al. "Transformation and evolution of the fire suppression contracting industry in the Pacific Northwest." In prep for *Policy Studies*.