Technical Management in an Age of Openness:

The Political, Public, and Environmental Forest Ranger

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Abstract:

The modern bureaucracy faces tradeoffs between public and congressional input and agency expertise. The US Forest Service offers an opportunity to quantitatively analyze whether an agency that is required to be more open to the public and congressional input will be forced to ignore its technical expertise in managing resources. This study uses data on 83,000 hazardous fuels reduction activities conducted by the Forest Service from 2001 to 2011. Although the results show that managers are responsive to public and congressional considerations, this has not prevented them from utilizing their technical knowledge to restore lands most deviated from natural conditions. This suggests that managers can balance responsiveness to public and political principals with technically sound management.

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In recent decades, advancements in science have required management agencies to incorporate increasingly technical factors into their management decisions. One way to manage these technical problems would be to hire homogenous managers (Kaufman 1960) and insulate the agency from political control (Bawn 1995; Epstein and O'Halloran 1994). However, management agencies have also faced an increasing imperative to be more open to public input. Openness to public and political input means that agencies may face conflicting political, public, and technical imperatives. The policy question agencies face, therefore, is how to respond to input from the public and Congress while taking advantage of technical expertise, when these two imperatives could trade off.

The organization of the U.S. Forest Service and its implementation of forest fire policy offer a compelling empirical test that allows us to understand whether openness comes at the price of neglect of technical implementation of policy. Forest fires have ecological benefits (Agee 1998), but because they can destroy lives, property, and livelihoods, managers face pressure from the public and from Congress to avoid losses. The consequences of wildland fire are immense. For example, the Bastrop County Complex wildfire in Texas in 2011 burned over 34,000 acres, destroyed about 1,600 homes, killed two people, and resulted in losses of $400 million (Badger 2012).

Since Kaufman's 1960 publication of *The Forest Ranger,* which argued that the organizational culture of the Forest Service could encourage dispersed front-line managers to advance the centralized goals of the agency,[1] the political, economic, and technical environments have changed considerably (Tipple and Wellman 1991). Scholars have pointed out that the Forest Service has undergone three main changes: an increased focus on ecological concerns (e.g. Brown and Harris 2000), more openness to citizen and interest group input via such laws as the National Environmental Policy Act (e.g. Halvorsen 2001), and less insulation from congressional and public control (e.g. Vandlik 1995; Sabatier, Loomis and McCarthy 1995).

Structural changes are common among agencies (Whitford 2010), and the specific changes to increase public openness are also common. Beyond the broad openness engendered by the Freedom of Information Act of 1966, agencies have implemented their own procedures to increase public input. For example, the EPA has developed Community Advisory Groups (Daley 2007), public participation is common in other environmental planning venues (e.g., Beierle and Konisky 2000), and collaborative management has become a frequent strategy and subject of study (e.g., Koehler and Koontz 2008, Hardy and Koontz 2008). In addition, there have been calls for increased public participation (NRC 1996) and legislation requiring it (e.g. NEPA). These changes are intended to increase bureaucratic responsiveness, but they may also reduce bureaucratic autonomy.

As opposed to relying on indirect indicators of agency activity to understand whether the increased openness to the public results in policies that no longer reflect the technical imperatives of environmental management, we analyze detailed data on almost 83,000 Forest Service activities pertaining to fuels management to prevent or control wildland fires and restore

[1] Similar arguments have been made by McCurdy (1992) about NASA, by Scholz and Wood (1998) about the IRS, and by Koontz (2007) about state forest agencies.

ecological health.[2] The analysis presented here shows that ecological factors, along with political and economic factors, are indeed reflected in Forest Service decisions. The preferences of the public are reflected in policy implementation with more fuels management near housing and smaller mechanical thinning projects where there are more members of environmental groups. On the political front, Forest Service activities are influenced by congressional oversight (Weingast and Moran 1983; McCubbins and Schwartz 1984), with larger projects in areas with less competitive districts where the incumbent can expect to win reelection. Yet, the Forest Service still finds a way to prioritize fuels management in areas where the forest is most deviated from its historic state, areas where ecological criteria would prescribe treatment.

The paper proceeds as follows. The first section explores the changes in the Forest Service, developing theoretical expectations regarding how openness and technical management will be reflected in the economic, political, and ecological determinants of fuels management. The second describes the data, collected from a database tracking all activities undertaken by the Forest Service. The third section reports results from the empirical analysis, followed by a concluding section with a discussion of the implications for organizing governmental agencies and for further research opportunities.

ECOLOGY, PUBLIC PARTICIPATION, AND POLITICS IN FLUX

Decades of excessive fire prevention and suppression on public lands have made it impossible to ignore the important role of fire in forest ecology (Sedjo and MacCleery 2008) and led to a change in how the Forest Service approaches fire management (Davis 2006). Nonetheless, forest fires still have great destructive potential, especially in and around the

[2] Fuels management refers to any activity that reduces the amount of fuels (these can include prescribed burns, mechanical thinning, burning brush piles, and other actions).

wildland urban interface (WUI). There are several stages at which wildland fire management can occur:

- fire prevention—encouraging people to follow Smoky the Bear's adage that "Only you can prevent wildfires";
- fire suppression—putting the fire out;
- fire preparedness—being ready to fight fire when it occurs; and
- fuels management—decreasing vegetation to reduce the likelihood and severity of fire.

Fire suppression receives much attention because a fire with its accompanying devastation is like a war that must be won regardless of cost; there are almost no limits on expenditures.

But before a fire starts, land managers have more discretion as well as more financial limits on how they can allocate fuels management activities (Noss, et al. 2006).[3] There are a number of motivating factors that are likely to influence how they allocate activities. By appropriately investing in fuels management, an agency can reduce the probability that a fire with large negative impacts occurs, protect or improve the capital stock of buildings and roads, increase the future flow of timber, forage, or wildlife, maintain or improve water quality, preserve viewsheds, reduce electoral risk, or reduce its liability—political or economic—for damage to private property (Yoder et al. 2003; Epstein 2012).

With a better understanding of the ecological benefits of fire on forest health, the Forest Service has adjusted traditional management objectives to take into account ecological considerations including, forest type, fire regime patterns, and critical habitat. However, national forest managers also cannot ignore the economic impact of fire and fuels management on

[3] Fire management has come to include multiple agencies and multiple scales of government (Davis 2001). Here we focus on activities recorded by the Forest Service, but we recognize the cooperative nature of some fire management.

property and jobs, especially with increased openness to public and interest group input. Finally, although the Forest Service arguably maintains greater autonomy from political control than other agencies due to their technical knowledge (Wilson 1989; Clarke and McCool 1985; Kunioka and Rothenberg 1993), Congress still influences management through oversight and budgets. Structurally, the decentralized (or deconcentrated) nature of the Forest Service makes it more likely to be subject to local influence at the expense of technically sound management that conforms to national priorities (Whitford 2002). The question addressed here is how the public, political, and ecological factors affect variation in the size and geographic distribution of fuels management projects. Using spatially explicit data enables us to contrast the degree to which the Forest Service is responsive to public demands and congressional principals with their ability to implemental technically sound ecological management.

Forest Ecology and the Technical Management of Fuels

Although public land managers, especially those of the Forest Service, historically have focused on their original mandate to ensure a sustainable flow of timber from the public lands and to maintain watershed health, changes in the political landscape and in our understanding of forest ecology have changed management priorities. The "Big Burn" of 1910,[4] which destroyed approximately three million acres throughout Washington, Idaho, and Montana, and killed nearly ninety people over a two-day period, led to decades of fire prevention at any cost. Over time, however, not only have suppression costs increased exponentially, but the science and understanding of fire have changed (Schoennagel et al. 2004). Once the ecological benefits of fire were recognized, the agency faced a balancing act between the potential positive ecological

[4] See *The Big Blowup: The Northwest's Great Fire,* by Betty Goodwin Spencer (1956) for a historical portrayal of the event.

effects and the social costs of fire.[5] The increased emphasis on ecology came from laws such as the National Environmental Policy Act (NEPA) enacted in 1970, and more recently from the Healthy Forests Restoration Act of 2003, which specifies the goal

> To improve the capacity of the Secretary of Agriculture and the Secretary of the Interior to plan and conduct hazardous fuels reduction projects…aimed at protecting communities, watersheds, and certain other at-risk lands from catastrophic wildfire, [and] to enhance efforts to protect watersheds and address threats to forest and rangeland health, including catastrophic wildfire, across the landscape … (H.R. 1904 2003).

Additionally, internal as well as cross-agency documents support the focus on fuels management, in part for the purposes of ecosystem health. The National Fire Plan 10-year Comprehensive Strategy dictates that the Forest Service should "prioritize hazardous fuels reduction where the negative impacts of wildland fire are greatest" (Forest Service 2001). Furthermore, a USDA Audit report for 2009 and 2010 specified the strategic goal to "restore ecosystems on a landscape scale, build fire adapted communities, and respond appropriately to wildfire" (USDA 2010). Adjustments to legal changes and to attitudinal shifts among Forest Service employees have not been smooth (see Butler and Koontz 2005 and Koontz and Bodine 2008), but the stated aims of the Forest Service in fuels management have increasingly reflected an environmental emphasis that requires technical expertise to implement.

This increased emphasis on ecosystem health was reflected in interviews conducted with district rangers from Region 1 during the summer of 2011.[6] Rangers stated that they make

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[5] They may even have to consider the negative budgetary and employment implications that could result if "the big burn" occurs in a manager's district. For example, after the Yellowstone Park fires in 1988, the park superintendent was transferred from what is consider a "crown jewel" of the national park system to the remote Gates of the Arctic National Park in Alaska.

[6] Each ranger is associated with a different National Forest, thereby increasing variation in responses. The interviews were approximately ten minutes long. The focus was on what factors influence decision-making. Rangers were asked, for example, "At what scale are the decisions regarding fuels reduction spending made?; What does the flow of allocations look like?; and What types of considerations are included in this decision-making process?" There was a

recommendations based on local characteristics such as fire regime, vegetation type, and extent of wildland urban interface to regional managers. According to one ranger, fuels reduction projects are based on a multitude of factors, including the probability of multiple ecological benefits as well as the presence of threatened and endangered species. For example, a ranger in Idaho shared one of his project reports, which specified that it would "[p]rioritize those stands in the … watershed most at risk for insect and disease infestation. Restore species and age class diversity on the landscape. Identify watershed restoration opportunities. Complete a watershed wide transportation analysis. Complete weed treatments."

To be effective, fuels management must be conducted with technical precision in places where it will reduce the likelihood or severity of future fires. Due to significant variation in vegetation types and historical fire regimes (Brown et al. 2004), the effect of fuels reduction differs geographically. One consistent measure that rangers use to evaluate projects from the perspective of fire risk is the degree to which forest conditions are deviated from their historical norm (Interagency Fire Regime Condition Class (FRCC) Guidebook, 2010). From a technical perspective, the Forest Service should act to restore the historical fire regime and vegetation in those areas that have deviated the most from their historical state, likely due to long-term suppression (Hann and Strohm 2003). For example, if a particular forest type depends on fire for its health, as is the case with ponderosa pine, and has had fires consistent with its historical fire regime, less treatment is likely. On the other hand, in cases where fire suppression has transformed a ponderosa forest so that it no longer reflects the historical norm, more treatment will be necessary. For this reason, particular locations within an ecosystem should have different

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possibility to administer additional interviews, but because the answers were fairly similar, it was unnecessary to do so.

levels of treatment depending on physical conditions of the land and trees.[7] To assess whether more deviated areas receive larger treatments, our analysis makes use of the Forest Service assessment of the percentage of the treatment area in Condition Class I, II, and III, where I pertains to ecosystems with low (less than 33%) departure, whereas III pertains to ecosystems with high (greater than 66%) departure. We code each treatment as to whether the plurality of the acreage treated falls into Condition Class I, II, or III. There should also be more and larger treatments where threatened and endangered species will be negatively affected by fire because improving endangered species habitat is regularly given as an ecological reason for fuels management activities (see Cashore and Howlett 2007 for a discussion of how endangered species preservation affected Forest Service forestry practices in the Pacific Northwest).

If the Forest Service shift to ecological concerns is reflected in fuels management, as it is in timber harvesting (Farnham and Mohai 1995) and in non-commodity management (Farnham, Taylor, and Callaway 1995), discretionary fuels management activities should vary with environmental and ecological factors, especially given the increased demand for ecosystem services from public lands.

The technical management of fuels to improve forest ecology would imply the following hypotheses:

- the Forest Service will prioritize those locations identified to be most deviated from their historical state, and
- those areas with threatened and endangered species will be prioritized over others in an effort to restore ecological health.

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[7] There continues to be debate concerning the historical or "natural" fire regime of certain ecosystems and landscapes (Williams and Baker 2012).

The Political Economy of Public and Interest Group Influence

Kaufman characterized the Forest Service as having one-way communication with the public to inform and educate citizens, but now communication flows from the public to the agency as well (Tipple and Wellman 1989). Such participation has been shown in other contexts to affect the decision making of agencies (e.g., Daley 2007) and "as the preferences of the constituencies enfranchised in the agency's structure and procedure change, so too will the agency…" (McCubbins, Noll, and Weingast 1989, pg. 444). For example, Clark and Whitford (2011) find that federal environmental funds "end up where they are wanted and not where they are not demanded." Sabatier et al. (1995) even conclude that the Forest Service attends to the needs of the localized public rather than prioritizing the policy targets developed in Washington.

Statutory requirements and litigation have forced the Forest Service to be more responsive to public input, including environmental groups (Halvorsen 2001; Brown, Squirrell and Harris 2010) and homeowners. The new flow of communication is promoted by NEPA, which requires a public comment period on Environmental Impact Statements. Similarly, the National Forest Management Act of 1976 requires public involvement in forest planning (Hoberg 2004; Wondolleck 1988), even if the procedures used by the Forest Service are rather limited in the amount of public access they offer to the agency planning process (Blahna and Yonts-Spehard 1989). At the same time litigation has become a tool for interest groups (Jones and Taylor 1995), forcing the Forest Service to contend with the opinions of potential litigants.

Increased openness to public input has increased the incentives for forest managers to consider the value of what might be destroyed by a fire. California exemplifies the importance of housing in fuels management decisions in the wildland urban interface. Although only seven percent of California's land is in the wildland urban interface, that area includes five million houses. Property losses from fires amounted to $1.4 billion in 2008 (www.nfpa.org). The link between housing and fuels management is strengthened by insurance programs that subsidize building in fire prone areas, thus creating a moral hazard problem. Such policies put pressure on land management agencies such as the Forest Service to reduce the risk of wildfire, especially near the wildland urban interface where homes are at risk. At least in the cases of California (Anderson and Anderson 2012) and New Mexico (Shepherd, Grimsrud, and Berrens 2009), hazardous fuels reduction spending is concentrated in areas with greater housing density.

A major cultural change toward a more diverse workforce in the Forest Service also has changed management procedures and objectives (Brown, Squirrell, and Harris 2010). Two aspects of the more diverse workforce within the Forest Service have translated into more openness to the views of interest groups. First, the Forest Service has become more diverse with respect to race and gender (Thomas and Mohai 1995; Brown, Harris, and Squirrell 2010). Second, new recruits to the Forest Service have more varied professional backgrounds. Less than a third of front line workers identified themselves as foresters in 1996. Instead they have expertise in wildlife and fisheries biology, recreation, ecology, and fire management (Brown and Harris 2000). Each of these changes to the makeup of the Forest Service has resulted in more attention paid to environmental groups than traditional commodity users such as logging and has therefore driven shifts away from timber management toward more amenity production (Halvorsen 2001). These changes have implications for the balance between traditional commodity uses and the amenity values of the public (Brown and Harris 1993; Burnett and Davis 2002; Farnham and Mohai 1995).

Some rangers who were interviewed stated that they consider timber interests in their decision calculus, but a ranger in Montana confirms that certain treatment "techniques" are not considered “appropriate” by the public around his district, emphasizing that they are in general suspicious of large scale mechanical thinning operations that are contracted out to logging firms. The Forest Service history of logging has resulted in concern that fuels reduction is simply an excuse to allow logging where it otherwise would not be allowed, a controversy that played out in the passage of the Hazardous Fuels Reduction Act. The rangers’ sense of the public’s concerns is confirmed by evidence that the public is aware of the potential threat posed by fire. Although wildfire receives relatively little public attention compared to other societal risks (Daniel et al. 2003), public perception has gradually moved away from treating fire as a tool and toward treating fire as danger (Dellasala et al. 2004; Dale 2006).[8]

With this increased openness to public and interest group input, the Forest Service must balance the preferences of logging interests and environmental groups, which may be at odds regarding fuels management activities. Logging interests will demand a sustainable flow of timber while environmental interests may demand more natural management and therefore less fuels management.[9] Additionally, homeowners can exert influence.

Three hypotheses follow from the openness to public input:

- more logging employment will be associated with more fuels management activities,
- more environmental interest group pressure will yield smaller fuels management projects, and
- more housing will be associated with more fuels management activities.

[8] There is substantial variability in the concerns of the public (Kneeshaw et al. 2004), their views on the role of government in reducing wildfire risk (Kruger et al. 2003; Nelson et al. 2003), and their attitudes toward controlled burns (Vogt, Winter, and Fried 2003; Winter,and Fried 2000).
[9] The expected direction of this relationship is contentious. There is diversity in the stances of environmental groups with respect to fire and fire management, particularly with respect to the appropriate use of prescribed burns, so we explore this in the analysis.

Political Control

With time, the Forest Service itself has become more politicized and less insulated. Congress has increasingly exercised its oversight (Moe 1987, 1997; Weingast and Moran 1983; Weingast 1984) of the Forest Service with more hearings, more proposed legislation governing the Forest Service, and more bills passed (Jones and Callaway 1995). For example, the Healthy Forests Restoration Act sought to reduce fire risk through hazardous fuels reduction, but generated controversy over whether it would allow more logging. Moreover, under the Clinton administration, the Chief of the Forest Service was, for the first time, not a career employee, but was appointed from outside the Forest Service (Vandlik 1995). There is some evidence that this politicization has changed the behavior of the Forest Service. For example, patterns of congressional appropriations to non-commodity uses suggest that Congress changed its view of how the Forest Service should manage its land and that these changes in congressional priorities drove changes in the activities of the Forest Service itself (Farnham 1995) and the president and Congress appear to be exercising more control over wildlife management (Davis 2007).

As a result of reduced insulation, members of Congress may be able to channel more fuels management to their own districts based on their electoral needs.[10] In other words, fuels management projects can be used as pork barrel spending (Ferejohn 1974; Stein 1981; Bickers and Stein 1996, 2000), driven directly by "single minded seekers of reelection" (Mayhew 1974). Members of Congress can exert control by targeting competitive districts or rewarding their

[10]Although most fire prevention appropriations are allocated in a lump sum to the agency, earmarks in appropriations bills are common and can also increase spending and projects for particular districts. In the case of fuels management budgets, there were, for example, six earmarks--one for Minnesota, one for Arizona, one for New Mexico, and one for California--in the appropriations bills for FY 2001, 2002, and 2003. They ranged in size from $263,000 to $19,900,000. These direct earmarks are in addition to the indirect targeting of projects.

supporters (Cox and McCubbins 1986; Ansolabehere and Snyder 2003). In this case, we expect safer districts to receive more funding because their members are better able to direct spending. The awareness of the public with respect to the threat of wildfires (Dellasala et al. 2004; Dale 2006) may further motivate members of Congress to influence fuels management spending. Interestingly, the NFPORS database we use includes the congressional district and the name of the congressional representative, suggesting that the Forest Service is aware of the need to appeal to its political principals.

Political influence over the Forest Service suggests that:

- there will be more fuels management activities in electorally safer districts and
- the effect of competitiveness on fuels management will be greater in the wildland urban interface where the activities are more easily observable.

EMPIRICAL STRATEGY AND DATA

In order to evaluate whether the increased openness to public and political concerns has undermined technical policy implementation, we use fuels management projects from the National Fire Plan Operations and Reporting System (NFPORS) in the Western U.S (Forest Service regions 1-6) over the period from 2001-2011. Treatments range in size from 1 acre to 105,000 acres and are in four categories: controlled burns (5,279,190 acres), mechanical thinning (4,520,872 acres), preparation for treatment (952,236 acres), and other (92,031 acres). Although we control for the type of treatment, we focus on controlled burns and mechanical thinning as the most prevalent in the analysis.

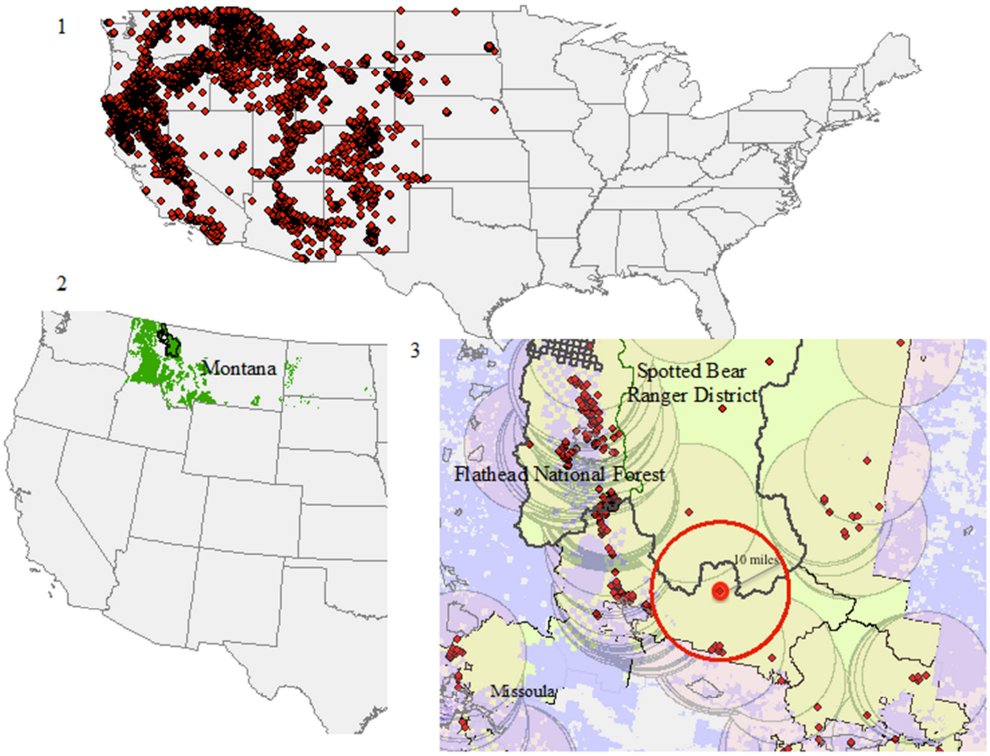
The dependent variable is the number of acres in a treatment. Thus, controlling for attributes of the treated area, such as if there was a Community Wildfire Protection Plan, if the location was identified as a community at risk, and whether the treatment was targeted for biomass energy production, the analysis uses public, political, and ecological attributes to predict the size of the treatment. One way to think about this is that the number of acres in a treatment serves as a proxy for the allocation of resources to fuels management (or for spending on fuels reduction).

The simplified version of the regression model is:

$$Treatment_i \text{ (ln } acres) = \alpha + \beta_a * public_i + \beta_b * political_i + \beta_c * ecological_i + \beta_d * controls_i + \varepsilon_i$$

Housing, logging companies, environmental group membership, and competitiveness of the congressional district operationalize potential public and political influence on fuels management. The NFPORS data provide a location (latitude and longitude) for each treatment, enabling matching of each treatment to its geographic location, whether county, congressional district, or ranger district. Housing "near" treated lands is estimated by using Arc GIS to create circles the size of the treatment area around each location and adding ten-mile buffers around the circles. Then housing data from the Integrated Climate and Land Use Scenarios Project (Bierwagen 2010, EPA 2009) at the hectare scale is summed within the buffer to give us an estimate of housing units within ten miles of each treatment. Figure 1 illustrates this process.

Figure 1: NFPORS Treatments and Housing Calculation



Note: Item 1 shows treatments conducted in Regions 1-6 from 2010-2011. The dots represent the center of the treatment, but not its size. Item 2 is a map of Forest Service land in Region 1 with the black outline showing Flathead National Forest. Item 3 zooms in on this Forest, specifically to one treatment, a prescribed burn of about 2,000 acres in the Spotted Bear Ranger District, conducted in 2010. In this item the shading outside of the Forest boundaries denotes low housing density from the housing data used for this project. The bold circle shows how housing was calculated: first the treatment location was transformed into a circular area the size of the number of acres treated; then a buffer with a ten mile radius was created; ArcGIS then calculated the number of housing units that lay within the buffer. As is shown by the figure, those treatments closest to the Forest and Ranger District boundaries tend to come into contact with housing. The logic of the 10 mile buffer is that these are houses most likely to be affected by a forest fire at the treatment location. The specific example highlighted included approximately six housing units within the "buffer" region. It should be noted that the buffers look similar in size due to the fact that the acres treated are considerably smaller than the ten mile buffer placed around them.

The 2007 County Business Patterns data can be matched to each treatment to determine the number of logging establishments in the county containing the treatment (U.S. Census 2009). Similarly, each treatment is matched to its zip code and the number of members of the Natural Resources Defense Council (NRDC) in each zip code in 2006. NRDC's membership numbers are highly correlated with those of other environmental groups, such as the Nature Conservancy, the National Wildlife Federation, and the Sierra Club (Anderson 2011). Each treatment also is matched to its congressional district and the percentage of the two party vote received by the winner of the prior election is used to operationalize the competitiveness of the prior election.[11] This serves to assess whether larger treatments are allocated to safer districts.

The ecological need for treatment is operationalized using Condition Class and the existence of species that must be managed. The NFPORS data give an estimate of the proportion of each treatment that is in each Condition Class, which is transformed into a set of dummy variables. These dummies indicate whether the plurality of the treatment acreage is in Condition Class I (least deviated from historical state), Condition Class II, or Condition Class III (most deviated from historical state). In addition, we account for the presence or absence of a threatened or endangered species under the federal Endangered Species Act with a dummy variable.

Finally, the NFPORS data provide a rich set of control variables for each treatment, including the potential for biomass,[12] whether the treatment falls within the Wildland Urban

[11] Electoral data were graciously provided by Jason Holt (Holt unpublished 2011).
[12] Biomass is residual vegetative or biological material that can be recovered and used for renewable energy production. The Forest Service recently has emphasized biomass utilization as an economic benefit of fuels management. Both in interviews and in guiding documents (Patton-Mallory 2008), managers have indicated that biomass potential should also be included when foresters decide where to prioritize activities. Specifically, Executive Order 13134, "Developing and Promoting Biobased Products and Bioenergy," directs agencies to conduct economic feasibility analyses of increased biomass utilization. The document "Protecting People and Sustaining Resources in Fire-Adapted Ecosystems: A Cohesive Strategy," a Forest Service Management Response to GAO Report 99-65 (2000), states that the Forest Service intends to take a leadership role in developing a market for biomass, given its alignment with hazardous fuels reduction priorities. In interviews, a number of rangers expressed that they make note of projects that may have the potential to generate biomass. For a good summary of see the "Woody Biomass Utilization Desk Guide" (Forest Service 2007).

Interface, and whether it is associated with a Community Wildfire Protection Plan (CWPP),[13] a community at risk,[14] or a community of interest.[15] A substantial number of observations for CWPP (21,949) and biomass (14,481) were missing because these were not recorded before Fiscal Year 2006. For this analysis, we assign observations before FY 2006 a value of zero for CWPP, because the CWPPs only came about statutorily in the Healthy Forest Restoration Act of 1993 and therefore did not exist before FY 2006. Similarly, biomass utilization became a policy priority in 2003 (Forest Service 2007) and was first recorded in FY 2006. Prior to this, we code it as zero.[16] Nonetheless, the appendix offers results with the smaller dataset where values for CWPP and biomass were available and results are substantially the same. Table 1 summarizes these variables, their source and level of aggregation, and their mean and standard deviation.

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[13] CWPPs are intended to enhance cooperation between the public and the Forest Service. Furthermore, agency documents suggest that managers prioritize areas having approved CWPPs (USDA 2010).

[14] A community at risk is a national list of communities at risk from wildland fire developed pursuant to Congressional direction and published in the Federal Register.

[15] A community of interest is a community not listed in the Federal Register under community at risk but impacted by or within the management plan area. These are identified by managers.

[16] Projects may have been used as biomass before this, so we repeat the analysis on the subset where biomass utilization was reported in the appendix.

Table 1: Variables in Analysis of Fuels Reduction

Variable	Measure	Source	Geographic Level	Mean	Standard Deviation
Dependent	ln(acres treated)	NFPORS	Treatment	3.25	1.54
Environmental CC3	Largest portion of treatment in Condition Class III	NFPORS	Treatment	55% of projects	
CC2	Largest portion of treatment in Condition Class II	NFPORS	Treatment	34% of projects	
Species	T&E Species	NFPORS	Treatment	0.029	0.17
Public Housing	Houses (000s)	ICLUS Project	Treatment Buffer	3.87	17.94
Environmental Group	NRDC members	Anderson (2011)	Zip Code	25.12	62.87
Logging	Logging companies	2009 County Business Patterns	County	13.2	17.62
Political Vote share	Congressional vote percentage	Jason Holt	Congressional District	63.33	10.18
Controls WUI	WUI	NFPORS	Treatment	0.53	
Biomass	Biomass	NFPORS	Treatment	0.14	0.35
CWPP	Community Wildfire Protection Plan	NFPORS	Treatment	0.49	0.50
Comm at Risk	Community at Risk	NFPORS	Treatment	0.41	0.49
Comm of Int	Community of Interest	NFPORS	Treatment	0.21	0.40
	Activity type:	NFPORS	Treatment		
Burn	Prescribed burn			22.48%	
Mechanical	Mechanical thinning			75.32%	
Prep	Preparation for treatment			0.84%	
Other	Other			0.36%	

In the regression analysis we control for activity type (prescribed burn, mechanical thinning, preparation, or other), because prescribed burns tend to be larger than mechanical thinning. In addition, each specification includes dummy variables for each year and for Forest Service Region. The coefficients for year and region are available in the appendix.

RESULTS

Results from a regression of the natural log of acreage in each project on the public, political, and ecological variables are presented in Table 2. The coefficients indicate whether a given factor is associated with larger projects. The third column shows the size of the effect. For continuous variables, the size of the effect is given for a one standard deviation change; for dichotomous variables, it is given for the change from zero to one. The data broadly show that forest managers allocate hazardous fuels reduction in a way that is responsive to the public and to their political principals. Yet they still allocate larger projects to areas where the technical demands are higher (where the forest is more deviated from its historic state).

Public and Interest Group Influence

If forest managers are responsive to public interests, we would expect to see larger projects where housing is denser, where there are fewer members of environmental groups, and where there are more logging interests. Indeed more housing is associated with larger projects; risk averse managers reduce hazardous fuels in and around housing to reduce the likelihood of damage. A project with an additional 18,000 houses (one standard deviation) within 10 miles is 1.6% larger than one without those houses. The size of this effect is small and for most treatments proximity to housing may not play much of a role. However, for those treatments near urban areas (which can be close to 500,000 houses), proximity to housing can have a substantial effect.

In this specification, members of environmental groups are not associated with smaller projects, but more logging establishments are. Those counties with more logging firms, and therefore greater employment from logging, are associated with smaller projects. These relationships are not in the expected direction and we consider them in more detail below.

Political Factors

The data show that forest managers as agents take into consideration the desires of their political principals. Safer districts have, on average, larger projects. A one standard deviation increase in the vote margin of the incumbent, which translates into a 10% increase in votes for the incumbent, is associated with a project that is 4% larger. This may be consistent with a strategy on the part of members of Congress to reward their supporters. However, the safety of a district is likely also correlated with the seniority of the representative, since incumbents can more easily get reelected in safer districts. Thus, it is also possible that, rather than members of Congress rewarding supporters, the Forest Service is targeting fuels reduction to more senior members, with whom it has a relationship and who may have more oversight power.

Ecological Factors

Although the Forest Service responds to public and political demands, the technical aspects of fuels management remain visible in the size of projects. Given that a number of GAO Reports specify that hazardous fuels reduction serve to restore ecological health, we expect forest managers to prioritize hazardous fuels reduction where the condition of the forest deviates most from its natural state. In fact, projects are 24 percent larger when the bulk of the project area is in Condition Class III (most deviated from historical state) than when the majority of the project area is in Condition Class I (least deviated from historical state). Projects where the majority of the acreage is in Condition Class II are 28 percent larger than those in Condition Class I.[17] The presence of threatened or endangered species is associated with projects that are 6 percent larger. Larger projects do occur in areas where the ecological conditions would prescribe fuels management activities.

Most of the control variables demonstrate the expected relationship with the size of treatments. Because guiding documents and interviews suggest increasing biomass utilization we expect treatment size to be greater when the project can be utilized for biomass and it is 14 percent larger. It is also 8 percent larger in those areas with a Community Wildfire Protection Plan (CWPP), communities that have shown a willingness to cooperate with forest managers in an effort to reduce the risk of wildfire to economic assets. Treatment acreage is 3 percent smaller where the Forest Service has indicated to Congress the presence of a community at risk but 9 percent larger in communities of interest. Treatment size is smaller in the wildland urban interface and we consider this in detail below.

[17] The difference in the size of projects in Condition Class II and Condition Class III is statistically distinguishable from zero but small (4%) relative to the difference between those in the more deviated classes and those in Condition Class I.

Table 2: Predictors of the Logged Number of Acres for Each Project; No interactions

		Estimate	Std. Error	Substantive Size of Effect (Change of 1 s.d. or from 0 to 1)
Public	**Housing**	0.0009***	0.0003	1.61%
	Environmental Group	-0.0001	0.0001	-0.63%
	Logging	-0.0056***	0.0003	-9.87%
Political	**Vote Share**	0.0041***	0.0006	4.17%
Environmental	**CC2**	0.2762***	0.0171	27.62%
	CC3	0.2416***	0.0164	24.16%
	Species	0.0632**	0.0303	6.32%
Controls	**Biomass**	0.1366***	0.0143	13.66%
	CWPP	0.0763***	0.0126	7.63%
	Comm at Risk	-0.0339**	0.0142	-3.39%
	Comm of Int	0.0938***	0.0149	9.38%
	WUI	-0.1115***	0.0149	-11.15%
	Mechanical	-0.3165***	0.0122	-31.65%
	Other	0.4728***	0.0859	47.28%
	Preparation	1.2714***	0.1657	127.14%
	Intercept	4.4075***	0.0677	
	N	82769		
	R-squared	0.15		

Note: The dependent variable is the log of the size of the treatment. This specification includes controls for the year of the treatment and for the Forest Service Region that are reported in the appendix. ***: p<0.01, **p<0.05

A Closer Look

We might expect housing, logging, environmental membership, and the location of a project in the wildland urban interface to have different effects on mechanical thinning and prescribed fire projects. Logging companies likely prefer larger mechanical thinning projects but smaller prescribed fires, since they reduce harvestable timber. There is considerable disagreement within the environmental community about fuels management and, in particular, the role of prescribed burns, so membership in environmental groups may be more likely to have a negative effect on mechanical thinning where there is more agreement. Similarly, we might expect homeowners to fear prescribed fire but welcome mechanical thinning. When the effect each of these variables capturing the role of the public is allowed to vary by project type, it becomes clear that there are very different dynamics at play.

Table 3 presents the effect of each variable on prescribed burns and mechanical thinning derived from a regression that includes an interaction of the type of fuels management activity with the housing, logging, and environmental membership variables. Full regression results are available in the appendix. More housing is associated with smaller prescribed burns, but with larger mechanical thinning operations. Similarly, prescribed burns are smaller inside the wildland urban interface than they are outside it and mechanical thinning is larger in the wildland urban interface than outside it. Taken together, these findings are exactly what we'd expect if homeowners demand fuels management in a form (mechanical thinning) that is less risky to their houses than prescribed burns. More logging establishments are associated with smaller prescribed fires but have a much smaller effect on the size of mechanical thinning treatments. The negative correlation remains counter to expectations, except to the extent that it is reflective of a shift toward ecological management. Finally, more environmental group membership has no effect on prescribed burns but significantly decreases the size of mechanical thinning projects. This is likely because members of environmental groups are skeptical about the role that hazardous fuels reduction plays in ecosystem management, particularly where large-scale mechanical thinning operations have been proposed.

Table 3: Effects of Public Concerns on Types of Treatment

	Prescribed Burn	Mechanical
Housing	-0.0031*** (0.0009)	0.0013*** (0.00029)
Logging	-0.015*** (0.0007)	-0.0034*** (0.00034)
Environmental Group	0.000041 (0.0002)	-0.00020*** (0.000091)
In WUI	-0.86*** (0.066)	0.48*** (0.029)

Note: The dependent variable is the log of the size of the treatment. Full results are available in the appendix. The effect of each variable on mechanical thinning is the sum of the coefficients on the main effect and the interaction of the variable with dummy for mechanical thinning. The standard deviation is the sum of the standard deviations of the coefficients and two times the covariance between the main effect and the interaction. ***: p<0.01, **p<0.05

Table 4 shows that the political effects only operate within the wildland urban interface. That is, just as we might expect if members of Congress are claiming credit (Mayhew 1974) for fuels management projects, the effect of vote share on the size of projects is zero away from the wildland urban interface and positive within it where projects are more visible to constituents.

Table 4: The Effect of Congressional Vote Share In and Out of the Wildland Urban Interface

	Outside WUI	In WUI
Vote Share	-0.00057 (0.00075)	0.0084*** (0.00072)

Note: The dependent variable is the log of the size of the treatment. Full results are available in the appendix. The effect of vote share in the WUI is the sum of the coefficients on the main effect and the interaction of the variable with dummy location inside the WUI. The standard deviation is the sum of the standard deviations of the coefficients and two times the covariance between the main effect and the interaction. ***: p<0.01, **p<0.05

CONCLUSION

In his landmark piece, *The Forest Ranger,* Kaufman asked how the Forest Service, given its immense and diverse territory, was able to maintain uniform decision-making, ultimately carrying out the mission of the agency in an "efficient" manner. Kaufman argues that it is the personnel of the Forest Service, specifically the forest rangers, who are responsible for the outcomes. His findings are in line with arguments made by Wilson, emphasizing the importance of organizational structure, leadership, and incentives in motivating "agents" to carry out the goals and mission statement of the agency in a consistent and systematic fashion. These agents were professionals who were insulated from congressional and public control. But modern natural resource management requires public input and has increasingly faced congressional oversight. This raises the question of how managers address these various, and perhaps competing, tradeoffs.

The Forest Service has changed in a multitude of ways since 1960. Not only has the personnel changed in terms of expertise, gender, and race, but the science, and thus goals of the agency have also altered significantly. It is now widely recognized that fire serves many ecological benefits for flora and fauna. Additionally, suppression has become exceedingly expensive and inappropriate in many cases. Nonetheless, a number of acres, especially in the west, are at high risk of catastrophic wildfire due to fuels loads. This poses a risk to the health of the ecosystem as well as to neighboring communities. Hazardous fuels reduction, through mechanical thinning, prescribed burns, or other treatment types, has the potential to promote ecological and economic benefits and has been promoted by congressional action and interagency guiding documents. However, extensive technical expertise is required in order to achieve the ecological benefits of fuels management, since its appropriate application depends on the forest type and condition.

This paper uses fuels management as a prime example of where the insulation from the public and Congress has been reduced, but where the agency must still consider highly technical policy implementation. It finds that, to a perhaps surprising degree, fuels management decisions are responsive to public and interest group concerns and political incentives, yet still succeed in integrating the ecological imperatives that have more recently become priorities. In fact, the size of the effect of the ecological considerations is generally much larger than the effect of the public and political considerations.

In the current managerial environment, where agencies are asked to consider the voice of the public in their decisions and face oversight from their congressional principals, there is a risk that technical implementation of policy will suffer. This analysis shows that the Forest Service is facing this challenge by being responsive to public and congressional concerns while meeting ecological demands. This suggests that the tradeoff between public and political input and technical imperatives can be managed. Since the Forest Service is highly decentralized and therefore, an agency that is, perhaps, most likely to allow technical considerations to be outweighed by local constituencies, these findings emphasize the need to understand the agency characteristics and political conditions that enable such balancing to occur.

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Appendix

Table A1: Year and Region Dummies Omitted from Table 2

Variable	Coefficient	Standard Error
FY 2002	-0.9002***	0.0680
FY 2003	-1.0426***	0.0614
FY 2004	-0.9674***	0.0580
FY 2005	-1.0517***	0.0579
FY 2006	-1.0029***	0.0579
FY 2007	-1.7677***	0.0568
FY 2008	-1.7700***	0.0568
FY 2009	-1.8996***	0.0564
FY 2010	-1.9760***	0.0563
FY 2011	-1.7641***	0.0572
FS REGION 2	0.4313***	0.0186
FS REGION 3	1.5879***	0.0267
FS REGION 4	0.4874***	0.0213
FS REGION 5	0.0693***	0.0176
FS REGION 6	0.1343***	0.0163

Note: These controls were omitted from Table 2, but are presented here for the interested reader. The dependent variable is the log of the size of the treatment. ***: p<0.01, **p<0.05

Table A2: Table 2 Specification with Missing Values, FY 2006-2011

	Variable	Estimate	Std. Error
Public	**Housing**	0.0008***	0.0003
	Environmental Group	-0.0001	0.0001
	Logging	-0.0059***	0.0003
Political	**Vote Share**	0.0032***	0.0006
Environmental	**CC2**	0.2767***	0.0192
	CC3	0.2088***	0.0181
	Species	0.2001***	0.0468
Controls	**Biomass**	0.1271***	0.0150
	CWPP	0.0676***	0.0133
	Comm at Risk	-0.0487***	0.0159
	Comm of Int	0.0981***	0.0165
	WUI	-0.0532***	0.0167
	Mechanical	-0.3659***	0.0148
	Other	1.2226***	0.1389
	Preparation	1.2934***	0.1627
	FY 2007	-0.7262***	0.0264
	FY 2008	-0.7362***	0.0262
	FY 2009	-0.8332***	0.0251
	FY 2010	-0.9338***	0.0248
	FY 2011	-0.7707***	0.0280
	FS Region 2	0.4378***	0.0201
	FS Region 3	1.6880***	0.0327
	FS Region 4	0.4706***	0.0232
	FS Region 5	-0.0028	0.0196
	FS Region 6	0.2893***	0.0185
	Intercept	3.4936***	0.0506
	N	64388	
	R-squared	0.11	

Note: The dependent variable is the log of the size of the treatment. Because CWPP and biomass were not reported before FY 2006, this specification uses only data from FY2006-2011. Table 2 in the model assumes that the values for CWPP and biomass were zero before FY 2006. Results here are substantially the same. ***: $p<0.01$, **$p<0.05$

Table A3: Fully Interactive Specification

		Estimate	Std. Error
Public	**Housing**	-0.0031***	0.0009
	Environmental Group	0.000037	0.0002
	Logging	-0.0150***	0.0007
Political	**Vote Share**	-0.0006	0.0007
Environmental	**CC2**	0.2706***	0.0171
	CC3	0.2404***	0.0164
	Species	0.0676**	0.0302
Interactions	**Housing*Mechanical**	0.0044***	0.0009
	Housing*Other	0.0043	0.0068
	Housing*Preparation	-0.1003	0.0864
	Mechanical*NRDC	-0.0002	0.0002
	Other*NRDC	-0.0008	0.0025
	Preparation for Treatment*NRDC	0.0572***	0.0218
	Mechanical*Logging	0.0116***	0.0008
	Other*Logging	0.0119	0.0108
	Preparation for Treatment*Logging	-0.0071	0.0069
	Vote Share*WUI	0.0090***	0.0010
	Mechanical*WUI	0.2404***	0.0238
	Other*WUI	0.8814***	0.1880
	Preparation for Treatment*WUI	-0.2546	0.3314
Controls	**Biomass**	0.1381***	0.0143
	CWPP	0.0650***	0.0126
	Comm at Risk	-0.0261*	0.0141
	Comm of Int	0.0904***	0.0148
	WUI	-0.8614***	0.0657
	Mechanical	-0.5958***	0.0209
	Other	-0.0218	0.1320
	Preparation	0.9641***	0.3213
	FY 2002	-0.9411***	0.0675
	FY 2003	-1.0654***	0.0610
	FY 2004	-0.9407***	0.0576
	FY 2005	-1.0274***	0.0576
	FY 2006	-0.9562***	0.0575
	FY 2007	-1.6934***	0.0565
	FY 2008	-1.7058***	0.0565
	FY 2009	-1.8114***	0.0560
	FY 2010	-1.8919***	0.0559
	FY 2011	-1.7150***	0.0568
	FS Region 2	0.4510***	0.0186
	FS Region 3	1.5308***	0.0268

FS Region 4	0.4916***	0.0211
FS Region 5	0.0527***	0.0175
FS Region 6	0.1450***	0.0162
Intercept	4.9198***	0.0758
N	82769	
R-squared	0.16	

Note: The dependent variable is the log of the size of the treatment. ***: p<0.01, **p<0.05

Table A4: Interactions with Missing Values

		Estimate	Std. Error
Public	Housing	-0.0046***	0.0012
	Environmental Group	0.0005***	0.0002
	Logging	-0.0142***	0.0009
Political	Vote Share	-0.0027***	0.0008
Environmental	CC2	0.2688***	0.0191
	CC3	0.2042***	0.0180
	Species	0.2160***	0.0468
Interactions	Housing* Mechanical	0.0057***	0.0012
	Housing*Other	-0.0055	0.0071
	Housing*Preparation	-0.1001	0.0844
	Mechanical*NRDC	-0.0009***	0.0002
	Other*NRDC	-0.0024	0.0034
	Preparation for Treatment*NRDC	0.0577***	0.0214
	Mechanical*Logging	0.0098***	0.0009
	Other*Logging	0.1074***	0.0288
	Preparation for Treatment*Logging	-0.0103	0.0072
	Vote Share*WUI	0.0114***	0.0010
	Mechanical*WUI	0.2251***	0.0293
	Other*WUI	0.8597***	0.2970
	Preparation for Treatment* WUI	-0.3020	0.3262
Controls	Biomass	0.1270***	0.0150
	CWPP	0.0537***	0.0133
	Comm at Risk	-0.0377**	0.0159
	Comm of Int	0.0940***	0.0164
	WUI	-0.9507***	0.0715
	Mechanical	-0.6052***	0.0258
	Other	0.5881***	0.2034
	Preparation	1.0236***	0.3135
	FY 2007	-0.7268***	0.0263
	FY 2008	-0.7353***	0.0261
	FY 2009	-0.8252***	0.0250
	FY 2010	-0.9244***	0.0247
	FY 2011	-0.7577***	0.0280
	FS Region 2	0.4333***	0.0201
	FS Region 3	1.6773***	0.0328
	FS Region 4	0.4704***	0.0232

FS Region 5	-0.0111	0.0196
FS Region 6	0.2953***	0.0185
Intercept	4.0731***	0.0634
N	63625	
R-squared	0.11	

Note: The dependent variable is the log of the size of the treatment. ***: p<0.01, **p<0.05