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KUNGL. VETENSKAPS-AKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

Disturbance shapes the US forest governance frontier: A review and conceptual framework for understanding governance change

Courtney A. Schultz, Jesse B. Abrams, Emily Jane Davis, Antony S. Cheng, Heidi R. Huber-Stearns, Cassandra Moseley

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Abstract Conflict in US forest management for decades centered around balancing demands from forested ecosystems, with a rise in place-based collaborative governance at the end of the twentieth century. By the early 2000s, it was becoming apparent that not only had the mix of players involved in forest management changed, but so had the playing field, as climate-driven disturbances such as wildfire and insect and disease outbreaks were becoming more extensive and severe. In this conceptual review paper, we argue that disturbance has become the most prominent driver of governance change on US national forests, but we also recognize that the governance responses to disturbance are shaped by variables such as discourses, institutional history and path dependence, and institutional innovation operating at different system levels. We review the governance changes in response to disturbance that constitute a new frontier in US federal forest governance and offer a conceptual framework to examine how these governance responses are shaped by multi-level factors.

Keywords Fire management · Forest policy · Institutional theory · Multi-level governance · Policy change

INTRODUCTION

US forest governance has evolved over time as the result of multi-level social and ecological factors that influence governance change. In the twenty-first century, forest ecosystem disturbances have increased in frequency, extent, and severity, such that today we are in a so-called era of "mega-disturbances" (Millar and Stephenson 2015). Particularly in the western US, where the majority of public forest lands (i.e., national forests) are located, large-scale forest mortality from wildfires and insect outbreaks have reshaped the structure, function, and ecosystem services of the region's forests with unprecedented pace and scale (Hicke et al. 2016; Stevens-Rumann et al. 2018). This extensive pattern of ecological disturbance is a powerful force shaping today's federal forest governance frontier, constituting a departure from past approaches towards a future that is unique and to some extent unknown.

Forests and woodlands in the United States (US) occupy approximately 333 million hectares, of which 31 percent is controlled by the federal government (Oswalt et al. 2019); most of the federal land is in the western US. The USDA Forest Service ("Forest Service") has direct management authority for the largest proportion of federal forest land—over 78 million hectares of US national forests nationwide—making it the principal forest and wildfire management organization in the nation (Schultz et al. 2019). The National Forest System is organized through a hierarchical framework of local and regional units under a national structure; it also has long-standing cooperative arrangements with Tribal, state, and local government forestry agencies at various scales to fund and administer programs that affect both federal and non-federal forests. The Forest Service is thus central to forest governance in the US.

In this conceptual paper, we provide an overview of recent changes in US federal forest governance that were designed to address increased disturbance. We discuss scholarship across multiple disciplines that has examined institutional changes in US federal forest governance as produced through a mix of environmental and socio-political variables working at multiple system levels. Previous work, however, has not been integrated into a framework that would allow us to understand how multi-level factors

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together affect governance changes in response to disturbance. Therefore, while we propose that much of the governance change we see in the US is driven by increased disturbance, we also present a conceptual framework that allows us to explore how governance change in response to disturbance is shaped and constrained by factors such as institutional history, discourses, and institutional innovation processes operating at macro-, meso-, and micro-levels.

THE INCREASING ROLE OF ECOLOGICAL DISTURBANCE ON US PUBLIC FORESTLANDS

Scientific understanding of healthy forest ecosystems has changed over time from a focus on suppressing and controlling disturbance events to accepting disturbances as key characteristics of forest ecosystem integrity. Millar and Stephenson (2015) write, "Through the mid to late twentieth century, evolving understanding of ecological dynamics, as well as increasing focus on forests as including organisms beyond the trees, led to recognition that natural disturbances—including fires, insects, and diseases—were essential ingredients of ecosystem functioning" (p. 823). Yet, despite an understanding of disturbance as a natural process, there is now growing concern and dialogue about the increased extent, severity, and frequency of disturbance due to several factors, including climate change, increased anthropogenic stressors, and increased demands on forested ecosystems. Together these factors threaten to push forests around the world past thresholds that will lead to new types of forest ecosystems or conversion of areas to non-forest, which would result in extensive and enduring changes in dominant species, life forms, or functions (Millar and Stephenson 2015). Persistent conversion to non-forest could change habitat suitability for many wildlife species, shift plant community composition, alter watershed hydrologic processes, and decrease carbon storage capacity (Coop et al. 2020).

Starting in the early 1990s, US forest ecosystems began to experience disturbances outside the range of what was observed historically (Covington and Moore 1994; Sampson and Adams 1994; Swetnam et al. 1999). In the east this was due to increased harvesting, but in the western US this was due to increases in natural disturbances, notably insect outbreaks and fires (Masek et al. 2013). Since 1990, continuous outbreaks of native pine bark beetles have resulted in significant overstory tree mortality across nearly 47 million hectares of forests in western North America (Morris et al. 2018). Insect outbreaks have been particularly active in the central Rocky Mountains where insect-driven disturbance events, exacerbated by drought and warmer winters, went from close to zero to nearly 4% of the entire landscape over the first decade of the century (Raffa et al. 2008; Birdsey et al. 2019).

Since 2000, western forests also have experienced increases in the frequency, duration, severity, and extent of fires (Westerling 2016; Singleton et al. 2019; Mueller et al. 2020; Fig. 1); there has been an estimated eight-fold increase of high-severity fire from 1985 to 2017 (Parks and Abatzoglou 1985). The science indicates that longer and more intense fire seasons have occurred and will continue to occur due to climate change (Abatzoglou and Williams 2016; Westerling 2016). Human ignitions also have increased the geographic and seasonal niche of fires (Balch et al. 2017). The last two decades have witnessed many record-setting fire years, and again in 2020, over 4 million hectares burned in the US, making it the second largest year in terms of acres burned, with totals that were 50% higher than the 10-year average (Department of Interior 2021; National Interagency Fire Center 2021). As we write this, the summer months of 2021 have again been characterized by extensive fires, on par with and even outpacing previous years.[1]

Although both fire and insect outbreaks are endogenous to western forest systems, the scale and impacts of both disturbance agents in recent decades deviate sharply from recent and even historic patterns (Raffa et al. 2008; Higuera et al. 2021) The unprecedented geographic scale and severity of forest disturbances and mortality events are the result of climate change-driven interactions among increasing temperatures, longer and hotter droughts, the effects of native insects and pathogens, and uncharacteristically severe wildfires (Millar and Stephenson 2015). Past management practices also helped set the stage for current disturbance patterns. Increases in fire extent and severity, for instance, results from a combination of altered forest conditions after a century or more of fire suppression and climate change (Millar et al. 2007; Jolly et al. 2015; Hurteau et al. 2019). In frequent-fire forests, fire suppression has led to an accumulation of small trees and fine fuels that contribute to increased fire hazard; federal forest restoration in many places therefore involves thinning trees to restore more natural structure and composition and returning fire as a critical ecological process to the land, either through human-applied prescribed fire or the management of natural fire starts (North et al. 2021). There has been some debate as to whether restoration is necessary and whether calls for forest restoration are simply a thinly veiled effort to return to more active forest management; there is broad scientific consensus, however, that forest thinning, which focuses on the removal of small, low-to-no value trees, followed by prescribed fire, is an effective approach for reducing the impacts of uncharacteristic

[1] https://www.nifc.gov/fire-information/nfn

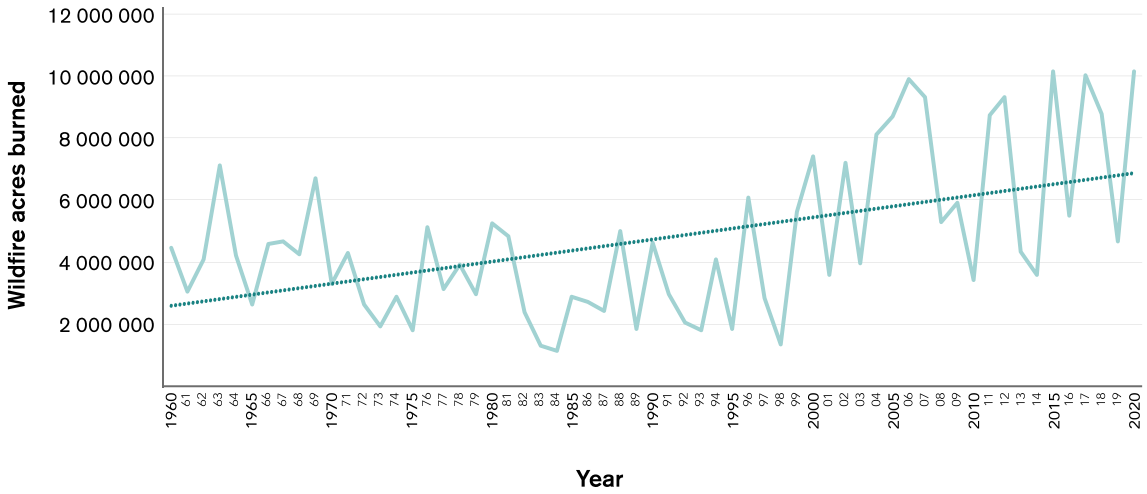

Fig. 1 Wildfire acres burned, 1960–2020. *Source* National Interagency Coordination Center, https://www.nifc.gov/fire-information/statistics/wildfires, last accessed on Aug. 26, 2021. Data collection methods changed in 1983, and, while we had previously accessed the earlier data, those data are no longer available at this site. One acre is equivalent to 0.4047 hectare

wildfire and supporting the adaptation of forest ecosystems to climate change (Prichard et al. 2021). For the US Forest Service, restoration of ecological integrity to promote ecosystem resilience is currently the primary land management objective in the face of climate change (Wurtzebach and Schultz 2016).

Disturbances have had significant effects on ecosystem services and forest management. From a human and community perspective, disturbance-altered landscapes may provide different or diminished ecosystem services, loss of economic value, and altered cultural values (Millar and Stephenson 2015; Lake et al. 2017). For instance, concerns about post-wildfire water quality have prompted changes to drinking water infrastructure preparation and planning across the western United States (Huber-Stearns and Cheng 2017; Huber-Stearns et al. 2019). Fires have led to extensive losses of homes and numerous fatalities (Schoennagel et al. 2017). Disturbances also are taxing government agencies. The Forest Service estimates that the costs of firefighting, which have primarily been drawn from the agency's existing budget, have resulted in a loss of almost half of its non-fire personnel capacity; today, nearly two-thirds of the agency's budget is devoted to fighting fire, compared to about a quarter of the budget just twenty years ago. This forced reallocation of resources has had dramatic, negative impacts on the other mission areas of the Forest Service, including work to restore forest conditions that would be more resilient to fire (USFS 2015).

A BRIEF HISTORY OF US FEDERAL FOREST GOVERNANCE

With these trends in mind, we can consider how governance is changing to address increased ecosystem disturbance, but first we provide an overview of the history of US federal forest governance.

The US Congress established the Forest Service in 1905 within the US Department of Agriculture to manage public forestlands with a mission to prevent further resource exploitation, maintain a steady supply of timber, and protect water supplies (Nie 2008). The imposition of federal managerial control over public forestlands aligned with values of the Progressive Era of early twentieth century US politics to reduce political and economic influence over government officials and to use the power of the federal government to implement and model scientific forestry. The first Chief of the Forest Service, Gifford Pinchot, was a staunch advocate of Progressive Era values and envisioned an agency staffed by trained forestry professionals, acting in service to a broad public interest but largely insulated from potentially corrupting political and local financial considerations (Clary 1986; Sabatier et al. 1995; Sedjo 2000). For the first several decades of the Forest Service's history, the agency established a substantial amount of bureaucratic autonomy in light of its extensive networks of public support and the charisma of Pinchot himself (Carpenter 2001). This was bolstered by the Forest Service's development of wildfire prevention and control as an

organizational *raison d'etre*, which in turn allowed it to secure social, political, and financial support (Pyne 1997; Stephens and Ruth 2005; Steen 2013).

This relative insulation from commercial and political pressures, however, did not endure, as tension between timber production and other non-production values (e.g., aesthetics, biodiversity, recreation, water quality), intensified after World War II when Forest Service timber production increased rapidly (Clary 1986; Hirt 1994). From the 1940s until the early 1990s, in response to growing market demand, the Forest Service increased annual timber harvest from about one billion to over 12 billion board feet, harvesting at rates that were unsustainable and predicated on optimistic projections of future productivity (Hirt 1994). During this time, the politics of agency capture dominated the Forest Service and other US federal land management agencies as a result of interest group politics, financial incentives for agencies to prioritize commodity production, and the lack of substantive policy tools focused on ecosystem sustainability (Wilkinson 1992; Nie 2008).

Beginning in the 1960s, a series of public laws enacted by the US Congress reshaped forest management for four subsequent decades. In 1960, Congress passed the Multiple-Use Sustained Yield Act, broadening the mandate of the Forest Service to manage for long-term water, soil, and wildlife health, as well as recreation and wilderness protection, in addition to its traditional timber emphasis. The National Environmental Policy Act of 1969 (NEPA) required the federal agencies to analyze the environmental impacts of their actions and diversify the scientific expertise of their workforces to do so. This was followed in 1973 with the Endangered Species Act (ESA), which prohibited federal agencies from jeopardizing species listed as threatened or endangered under the Act's provisions. In 1976, Congress passed the National Forest Management Act (NFMA), which maintained the agency's multiple use mandate, while also providing enforceable standards for soil, water, and biodiversity protection and expanding requirements for interdisciplinary land-use planning with public involvement.

These changes diversified the professional culture within the Forest Service and, in concert with US administrative law, allowed citizens to hold agencies accountable to new substantive and procedural legal standards via public involvement and litigation in the federal court system (Hoberg 1992, 2004). They were also part of what Klyza and Sousa (2008) refer to as the "green state," a bevy of environmental laws grounded in tenets of synoptic planning and regulation established over the course of the twentieth century, thick with procedural and substantive legal requirements to promote accountability and limit flexibility. Additionally, laws such as NEPA and NFMA reflect an underlying assumption of stability in social and ecological systems that allows predictive planning processes to allocate the multiple uses allowed on national forests in a model of decision-making grounded in post-pluralist politics (Shapiro 1988). These policies are less well-suited for rapidly changing systems or for grappling with uncertainty through approaches that require monitoring and adaptive management (Nie and Schultz 2012).

The conflict between timber production and preservation of noncommercial uses on federal lands—and between the organized social groups that advocated for each of these priorities—was one of the key tensions animating forest policy developments of the latter half of the twentieth century. The provisions of laws such as NEPA, ESA, and NFMA allowed the use of administrative appeals and litigation aimed at slowing the pace of resource use (Keele et al. 2006). These conflicts culminated in court rulings and policy shifts in the early 1990s that contributed to an 80 percent decline in national forest timber production between the high-water mark of the 1980s and 1994; this decline was driven primarily by harvest level reductions in the traditional timber stronghold of the Pacific Northwest (Yaffee 1994). Throughout this transformational period of the 1990s, Congress was largely on the sidelines, either unwilling or unable to revise or pass substantive legislation to address the forest governance crisis. Instead, the federal courts played an increasingly prominent role in reshaping forest governance by setting the boundaries of legally permissible USFS planning processes and management, as did the executive branch via directives such as the Northwest Forest Plan and Roadless Area Conservation Rule (Mortimer 2002). Local- to regional-level nonfederal actors also played key roles in evolving national forest management direction through a combination of aggressive use of litigation and collaborative efforts to identify and promote socially acceptable management strategies (Schultz et al. 2012).

By the 1990s, environmental non-government organizations (NGOs) and place-based collaborative groups emerged as powerful new forces (Cortner and Moote 1999; Cheng et al. 2003; Miner et al. 2014), working together, yet often at odds with the Forest Service, to steer federal forest management toward consideration of ecological integrity, economic sustainability, and social values (Cortner and Moote 1999; MacCleery 2008; Hays 2009). Local collaborative groups and supportive community-based organizations began to emerge in communities where the decline in the timber industry led environmentalists, industry representatives, and other local and regional actors to come together to address their common interests of community economic benefits and forest restoration (Cheng et al. 2003, 2016; Abrams et al. 2015). Over time, an emphasis on dialogue and collaborative processes grew with a goal of identifying agreements around the acceptable scope of

management, such as identifying places and parameters for vegetation management to restore lands and waters degraded after years of intensive timber harvesting, protect older trees, improve habitat for rare and sensitive species, and provide wood fiber to local timber processors (Hjerpe et al. 2009; Abrams 2011). These efforts were largely informal and unmandated, although some groups sought to formalize agreements in law (Nie and Fiebig 2010). Some others, such as smaller environmental NGOs, expressed initial skepticism and later rejected participation in these efforts (Kenney 2000; Burke 2013; Davis et al. 2018). A looming question was whether there was a need for substantial policy changes to increase flexibility to pursue collaborative, place-based agreements. This question gained added urgency in the face of an increased pace and extent of disturbance events, as we discuss in the next section.

RESPONDING TO FOREST DISTURBANCES AND THE GOVERNANCE FRONTIER

While the 1990s represented something of a sweeping victory for advocates of noncommercial uses of federal forestlands, the prevailing policy discourse that pitted timber production against protection of ecosystem values was soon destabilized by the growing visibility and impact of disturbance events. These developments put federal forest managers and stakeholders in a more reactive and defensive position, with an apparent imperative to work quickly and collaboratively in the face of change and uncertainty. At the same time, many environmental activists pushed back against the characterization of disturbance as something that should be prevented or minimized. This position was grounded, at least in part, in controversy surrounding policy language passed through Congress in 1995 that exempted many public land timber sales from environmental review under the guise of "salvaging" fire-killed trees (Bevington 2009). Many of these same advocates likewise believed that emerging collaborative governance approaches threatened to undo recent policy victories through local-scale compromises (Hibbard and Madsen 2003).

The framing of disturbance as a problem in need of a political solution created an opening to shift both discourse and policy direction away from the approaches set in motion by the laws of the 1970s (Vaughn and Cortner 2005). Governance responses to disturbance reflect the constant tension in US environmental politics balancing flexibility and accountability via enforceable legal standards (Klyza and Sousa 2008). While this tension has largely been reflective of a pluralist system and balancing among competing political interests, it has taken on a new hue considering the need to respond quickly to rapidly changing conditions. Indeed, given the importance of addressing uncertainty through monitoring, responding quickly to change, engaging collaborative partners, and working quickly at a sufficient pace and scale to potentially forestall uncharacteristically severe disturbances, one might question whether the "command-and-control" and synoptic planning statutes of the 1970s are still tenable (Benson and Garmestani 2011). At the same time, there is also present the risk that interest groups may utilize disturbance as a surrogate for decreasing regulatory accountability more generally (Klyza and Sousa 2008).

In the early 2000s, some used the prevalence of disturbance to emphasize the need for legal flexibility, blaming environmental advocates for using the environmental analysis process as a mechanism to delay or halt projects that might reduce potential fuels or respond to insect and disease events, even though no evidence was found to support this argument (Vaughn and Cortner 2005). The argument continues to be made to this day, despite an ongoing lack of evidence that environmental analysis processes are a bottleneck (Fleischman et al. 2020). High-profile wildfires and other disturbances created an opening for the Bush administration of 2001–2009 to reorient forest policy discourses to emphasize expediency and flexibility as antidotes to the "process predicament" generated by prior forest policies. The Bush administration advanced several policies targeted at addressing growing forest ecosystem disturbances such as wildfire, insects, and disease. These included the Healthy Forests Initiative (2002) and Healthy Forest Restoration Act of 2003 (HFRA), intended to support community wildfire protection planning and reduce NEPA requirements in favor of more rapid action. These policy changes had limited impact and were controversial because they bypassed typical environmental planning requirements; they also failed to support collaborative work in contiguous landscapes to have a meaningful ecological effect on disturbance patterns (Schultz et al. 2012). They may have helped, nonetheless, to solidify an emerging discourse that continues to surface in legislative proposals today emphasizing expediency over protracted deliberation, and active management over preservation, all in the name of reducing the scale and impact of disturbances.

Community-based forestry advocates, along with national non-governmental organizations working in public forest management, advanced a somewhat different type of policy change to respond to the threats of fire to their communities (Schultz et al. 2012). Their emphasis was on building capacity to work at a quicker pace and more coherent spatial extent based on broad social agreement and new strategies to engage potential partners, including industry partners that might be able to offset some of the

costs of restoration work by creating wood byproducts from small diameter trees (Schultz and Moseley 2019). The most significant innovation reflective of this policy paradigm took shape via the 2009 Collaborative Forest Landscape Restoration Program, a policy tool that competitively allocates 10 years of funding for collaborative planning, implementation, and monitoring of forest restoration projects.

The Collaborative Forest Landscape Restoration Program is unique among US national public land governance tools. The program requires proposals be written by collaborative groups in partnership with the Forest Service to compete for money that is allocated based on recommendations from a federal advisory committee, made up of non-government representatives. The law does not reduce environmental protections, although many projects have realized environmental planning efficiencies by working over larger spatial extents and longer time frames; it instead includes several substantive sideboards pertaining to historically contentious activities like old-growth logging and road building (Butler and Schultz 2019). Once projects are selected, they are awarded funding for 10 years with requirements to collaborate throughout the life of projects, including through planning, implementation, and project monitoring. The requirements for collaboration and monitoring, 10-year financial investment in a landscape over a decade, and competitive funding allocation process are all unique aspects of the policy compared to existing US public land law. In 2013, another similar program emerged: the Joint Chiefs Restoration Partnership, which allocates money for relatively smaller projects on 3-year timelines, but across public and private lands (Charnley et al. 2020; Cyphers and Schultz 2019). Recent legislative proposals have explored this type of policy tool for prescribed fire and community protection as well. Notably, these policy tools layer upon, but do not replace, existing policies and are used by groups and land management units that apply for the funding. They do not, however, mandate broad requirements across the whole system and, therefore, are optional.

Another innovation, driven largely by local, collaborative groups with support from higher-level policy makers, has been the emergence of watershed partnerships that leverage funding from municipal water providers to pay for fuels reduction on federal lands to reduce risks to water quantity and quality. This governance innovation was a place-based response to highly visible and damaging fires, which caused hugely expensive damage to water infrastructure because of post-fire soil movement; these fires served as focusing events and allowed collaborative groups and high-level policy entrepreneurs to pursue and institutionalize public–private partnerships as a policy solution (Huber-Stearns et al. 2019). More recently, the Trump administration advanced a "Shared Stewardship Strategy" (USFS 2018), which focused on federal agencies entering into agreements with state governments to promote increased prioritization and capacity for work across federal, state, and private land.

Collectively, such policies represent a policy paradigm that emerged and grew after the timber wars of the 1990s, focused on the federal government working in partnership with both communities of place and non-federal governmental entities to plan and implement projects that simultaneously meet hazard reduction and rural economic development objectives. Importantly, these are somewhat optional policy tools but have in common an emphasis on partnership, working at scale, and focusing investment in areas that have been identified as priorities based on social and economic capacity to support important ecological work.

Despite these innovations, many of these partnerships are limited by existing agency capacity and funding. For instance, limited agency capacity to plan and implement projects and a lack of external wood products markets and industry partners to help fund land management work are the primary barriers to progress under the Collaborative Forest Landscape Restoration Program and similar programs (Schultz et al. 2018). Another effect of limited agency capacity has emerged in small, forest-based communities within the Northwest Forest Plan region, where many stakeholders perceive a deteriorating relationship between the Forest Service and their local communities, often attributed to agency staffing declines, turnover, and long-distance commuting (Santo et al. 2021). Agency turnover and lack of local presence in the community can challenge agency staff's ability to understand community dynamics and build relationships, thus negative impacting the baseline level of trust between the agency and community (Davis et al. 2019; Santo et al. 2021). Watershed partnerships and other restoration efforts on federal public lands also have cited limited agency capacity as a primary barrier to progress; often non-governmental partners work to identify creative solutions to staff teams to complete restoration work (Schultz and Moseley 2019). Overall, the Forest Service estimates it is completing annually about 5% of the restoration work needed. Some of this is the result of budget declines over the last two decades; as we noted above, the increasing scale and severity of forest disturbances caused massive increases in firefighting expenditures, exacting a heavy toll on already-diminished Forest Service budgets (USFS 2015).

All told, the US federal forest governance response to increased disturbance can be characterized first and foremost by an increased reliance on partnerships, building upon, but also going beyond, collaborative governance, in ways that result in a networked governance system

(Abrams 2019). This involves the public–private partnerships to restore forested watersheds, increased partnerships with state governments under the Shared Stewardship Strategy, and increased place-based partnerships under the Collaborative Forest Landscape Restoration Program and similar programs. A second characteristic of disturbance-driven policy change is the creation of new, somewhat optional policy tools, often originating from community-based groups working to respond to disturbance at a meaningful scale (e.g., policies like Collaborative Forest Landscape Restoration Program direct investment for multiple years to particular landscapes and partnerships). A third characteristic is that policy changes nest within the existing governance system, without substantial changes to existing institutions. We have not seen fundamental changes to laws from the 1960s and 1970s, although some policy changes include expedited environmental planning requirements that can be used in special cases. Finally, while this is not an affirmative policy change in response to disturbance, an important underlying characteristic of the current governance system is decreased agency capacity and funding, products of historical trajectories of the Forest Service along with the increased presence of fire (USFS 2015). This issue has not been addressed by Congress, which means that forest restoration efforts are under-resourced and rely on leveraging partner capacity and funding (Schultz and Moseley 2019); we note, however, that this dynamic may change in 2021 with the passage of several major spending bills by the US Congress.

A MULTI-LEVEL PERSPECTIVE ON CHANGE AT THE US FOREST GOVERNANCE FRONTIER

We propose that unprecedented disturbance is a primary driver of much contemporary governance change, considering the recent history of widespread ecological disturbance and the subsequent changes in US forest governance. Yet we also recognize an interplay of micro-, meso-, and macro-level social and political factors that produce and constrain governance change. While there has been extensive literature on policy change in US forest management and public administration more generally, there is not a common, integrative framework for looking at multi-level drivers of governance change. We offer such a framework in this section, drawing up several public policy and administration theories to help explain the primary factors that predominate at each level in shaping governance change. Our contribution here is not to advance a new theory, but rather to suggest that without attention to these many levels, developments may be characterized as response to unidimensional dynamics (e.g. declining federal capacity or increased disturbance), while in fact the changes that emerge and endure are often those that result from the confluence of multi-level dynamics. In this section we explore these dynamics in more detail, with our objective being to understand how forest governance changes in response to disturbance while also being shaped and constrained by variables, such as discourses and framing, path dependence, and institutional innovation, operating at different governance levels. This framework offers a starting point for further empirical work on drivers of governance change to determine whether and in what circumstances the propositions offered in this paper hold across time and different environmental governance contexts.

We first observe that multi-level drivers have been in play throughout the history of governance change in US forest management, although not always explicitly acknowledged. For example, the transition away from timber production in the 1980s and 1990s is often depicted as a story of litigation that halted that logging in places that held the last old-growth forest stands in the nation, leading to a concomitant decline of the timber industry and general gridlock that necessitated the creation of place-based collaboratives to find a path forward (Yaffee 1998). This story relies on the importance of meso and micro-level drivers but elides the importance of macro-level factors such as the effects of globalization policies and consequent changes to timber industry viability in the United States (Power 1996; Wear and Murray 2004). The movement towards collaborative governance on national forests also must be understood in the context of the proliferation globally of ecosystem-based and community-scaled management approaches, with attendant changes to the roles of non-state actors (Imperial 1999; Campbell and Godfrey 2010). An important question is whether there are factors that predominate at different governance levels that shape governance change.

At the highest level, we can consider the influence of macro-level drivers that are international in scope (Howlett 2009; Steelman 2010). Policy design and associated selection for policy tools are shaped by both national and international discourses and policy design preferences (Howlett 2009). International trends towards neoliberal governance approaches, for example, have influenced domestic policy design toward a focus on market-based tools, incentives, and the engagement of non-state actors in governance as sources of capacity (Bartley 2003, 2007; Goldsmith and Eggers 2005). Thus, trends framed as national-level drivers (e.g., a loss of federal capacity leads governments to look for non-governmental capacity) are often in fact also reflective of global trends that shape governance. For the Forest Service, the search for new ways to augment agency funding and capacity, coming in the context of broader neoliberal scripts, has led to the

partnership-based and marketized approaches described previously (e.g., watershed partnership with utilities and increased engagement of non-government actors without any increase in federal funding). Thus, global discourses, along with and in response to macroeconomic trends and global environmental change, are important macro-level dynamics that shape and influence meso-level policy changes. This dynamic has not been explored extensively in the context of US forest governance, although it is a dynamic that is recognized in the international forest governance literature (De Jong et al. 2017).

Meso- or national- level factors also constrain the scope of change. Indeed, a common thread tying together theories of environmental governance change is a focus on meso-level structures, processes, and factors operating at the scale of the nation-state or region and over multi-decadal time periods. Advocacy coalition theory, for instance, emphasizes the continuous interplay between learning and action among key actor coalitions within national-level policy subsystems that can produce change over time (Sabatier and Jenkins-Smith 1993; Mintrom and Vergari 1996). Kingdon's (1984) multiple streams heuristic seeks to explain national legislative change, recognizing the importance of convergence among focusing events, broader socio-political trends, and the actions of policy entrepreneurs in promoting change. Other theories of policy change and learning focused on meso-level factors eschew mechanistic processes in favor of examining eras of environmental policy design, tracking the evolving discourses about political-distributional struggles at the national level and favored planning paradigms that shape policy institutions (Shapiro 1988; Fiorino 2001). Together, these meso-level theories emphasize the importance of coalitions and policy entrepreneurs in agenda setting, framing, and conflict containment and expansion to achieve their goals within the constraints of historical institutions (Schattschneider 1959; Pralle 2006). In short, discourses and their use by coalitions are primary factors at the meso-level that shape policy design.

But there are also several other important meso-level variables to consider. As Winkel (2014) explains, at this meso-level "social and physical events are 'discursively mobilized' by means of narratives that are produced against the background of major natural resources paradigms " (p. 84). These other major paradigms are shaped by both macro- and meso-level discourses (discussed above) and meso-level institutional histories that contribute to path dependence. Public administration theory emphasizes the predominance of incremental change that builds upon existing structures (Lindblom 1959; Cashore and Howlett 2006, 2007), while scholars of institutional change describe the path dependency that constrains the realm of future possibilities (Pierson 2004). Accordingly, major shifts in governance institutions in general, and within bureaucracies, are constrained by established institutional structures and processes, ranging from policy frameworks, to entrenched political interests, to agency habits and cultures, to the interdependence within governance networks on the stability and actions of other actors (Mahoney 2000). All told, discourses, institutional history, and path dependence are important meso-level determinants of and constraints upon change.

The imperative to address disturbance, combined with meso-level rigidities and path dependencies, makes the local or micro-level the most significant locus of change. Much of our work and that of others studying federal forest governance change reveals the importance of institutional innovation at the micro-level, drawing on decades of theory development around policy implementation and institutional innovation (Moseley and Charnley 2014; Abrams et al. 2015; Butler and Schultz 2019; Steelman 2010). Individual disturbance events greatly affect individual communities via changes to various ecosystem goods and services including drinking water provision, soil stabilization, recreational opportunities, economically valuable timber, viewsheds, effects on human infrastructure (homes, roads, powerlines, etc.), and—in some cases—direct threats to human life. This creates strong motivations for organizations and elected officials at local to regional scales to contribute resources to forest stewardship initiatives and to innovate practical solutions to entrenched forest governance dilemmas. Many of the most important forest policy changes that have emerged through legislative action since 2000 are those that effectively codify practices innovated and piloted at the micro-level in individual communities. Examples of the latter include unique contracting approaches, community wildfire protection planning, and collaborative decision-making more broadly (Schultz et al. 2012; Moseley and Charnley 2014). Under conditions where top-down institutional reform becomes difficult, these bottom-up processes of innovation and experimentation, which interact with meso-level factors, represent examples of institutional change—including changes that may later be diffused more broadly through adoption within the formal policy making process (Moseley and Charnley 2014; Abrams 2019).

In summary, understanding changes in US federal forest governance requires a multi-level perspective. We and other US forest policy scholars collectively acknowledge that disturbances have acted as focusing events, compelling policy changes like the Healthy Forests Restoration Act, Collaborative Forest Landscape Restoration Program, watershed partnerships, and the Shared Stewardship Strategy with its emphasis on state-level engagement (Vaughn and Cortner 2005; Schultz et al. 2012; Huber-Stearns et al. 2019); indeed, the visibility of fires over the last several

years, combined with a renewed appetite for robust federal spending may now lead to an increased investment in forest restoration. Yet, our observation and argument are that factors at multiple system levels also shape which governance changes take hold, proliferate, and succeed. Efforts like the Collaborative Forest Landscape Restoration Program and watershed partnerships align with global trends by focusing on increased government and non-government partnerships to work at landscape scales (Arts et al. 2017). By contrast, there have been few governance innovations to address disturbance that rely on increased long-term capacity embedded within the federal government (except for fire suppression capacity drawn from other parts of the Forest Service's budget) or a renewed federal mandate that fundamentally refocuses the US Forest Service's efforts (Abrams et al. 2018). Institutional analyses conclude that despite the ongoing vesting of formal authority in the Forest Service, the agency is increasingly dependent upon entities outside of the federal government to provide social consent to operate, contribute implementation resources, and develop institutional innovations for more efficient and effective management (Abrams 2019). Thus, while disturbance may catalyze governance change, the nature of these changes will be strongly shaped by predominant multi-level drivers.

Examining these multi-level drivers of governance change allows us to posit the frontier of US forest governance as the cumulative effect of both ecological and social-political influences operating and intersecting at multiple levels, with disturbance as an increasingly prominent force. Our primary observations have been of institutional change shaped by micro-processes of institutional innovation, with policy changes that track with macro-level discourses that shape policy design preferences, and meso-level discourses, coalitions, political dynamics, and path dependence that constrain the range of possibilities. The combined effect is that in response to disturbance, we see policy change in the form of somewhat optional policy tools that work around existing institutions, a general trend towards devolution, an increased reliance on non-state actors and lower levels of government, and ongoing constraints driven by agency institutions and resource scarcity. Capturing the complexity of factors affecting the US forest governance frontier requires a framework that incorporates the multiple factors in play as governance shifts at multiple levels and across social and political dimensions (Fig. 2).

CONCLUSIONS

In the three decades since the national forest management "crisis" that began with Northern Spotted Owls in the Pacific Northwest, federal forest policy and governance have been reshaped. Of the various influences on governance change, perhaps none is more centrally important than disturbance—particularly wildfire and forest insect outbreaks. Where disturbance emerged as politically salient in prior periods of national forest management, it was largely met with legislative and budgetary solutions that increased the authority and capacity of federal agencies. In the contemporary period, it has been addressed through the informal expansion of multi-actor governance networks, devolution of authority to states, NGOs, and communities, and new policy tools to support resource-sharing and capacity-building across ownerships. This outcome reflects the interplay of influences operating at multiple governance levels that shape and constrain the range of governance responses as disturbance drives the US federal forest governance frontier.

While the frontier in US national forest governance is shifting in response to disturbance, legislative change has been limited to new, somewhat optional policies with a focus primarily on increasing non-government capacity, with limited changes to bureaucratic institutions, stagnation in resource availability, a lack of change to foundational laws, and intermittent but limited policy developments to create space for new directions. Local communities and regions have been the locus for much of the institutional experimentation and innovation in forest management since the 1990s, and a prime focus for place-based groups and networks has been confronting the challenges of managing disturbance-prone landscapes. Local and regional governance networks increasingly draw upon a suite of largely optional tools that include incentives for collaborative landscape-scale restoration, more efficient engagement with NEPA and contracting processes, and authorities that allow non-U.S. Forest Service entities to participate more actively in the management of federal forestlands. Taken as a whole, this new more networked mode of federal forest governance is broadly informed by neoliberal "scripts" (Bartley 2007) that elevate the role of NGOs, private firms, and state/local governments vis-à-vis the federal government in the management of federal forestlands and introduce limited elements of marketization in a system that nevertheless remains formally owned and controlled by the nation-state. This, along with national-level political dynamics have hampered more profound governance change, particularly as actors in this networked governance system still must contend with historical institutional forces of the bureaucracy's laws, regulations, policies, and culture. This may be changing at present with the current bipartisan emphasis on the need to invest in the nation's infrastructure and address the growing impacts of fire with increased federal investments. Changes in meso-level leadership and political dynamics appear to be

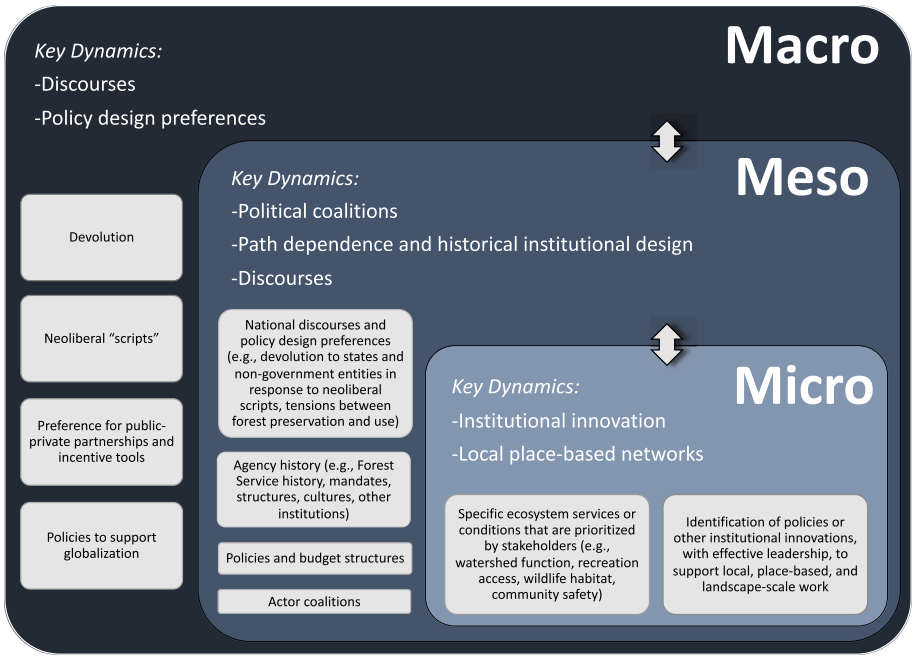

Fig. 2 Social and political factors affecting national forest governance change across macro-, meso-, and micro-levels

opening a pathway for increased spending and potentially an expansion of programs, like the Collaborative Forest Landscape Restoration Program, that allow for focused investment of spending in places where government and non-government entities are committed to collaborating towards shared goals. It remains to be seen whether this represents an enduring change or a momentary aberration.

The frontier, then, is characterized by movement away from some of the enduring institutions of twentieth century national forest administration (such as agency autonomy and congressional control over national forest policy direction) and toward a still-evolving set of governance networks that, at least in some geographies, have been able to crystallize around a vision of reducing the human and ecological toll of forest disturbance events. Recent years have seen a slow but steady shift in the scale of network governance away from communities and place-based organizations and toward higher-level entities such as states and well-capitalized national NGOs. The growing importance of these networks raises important questions regarding, among other things, authority, accountability, and legitimacy that may have been less salient when the Forest Service held a practical monopoly on national forest administration. Even though the agency continues to possess formal authority over national forest decision-making, in practice this authority is often circumscribed by the need to establish social consent among various external actors (considering their continued veto power) and the increasing dependence on external actors to provide funding, capacity, innovations, or connections to those that can provide these resources.

As this process continues, practitioners will be confronted with the challenge of maintaining the legitimacy of new forest governance institutions and the capacity of those institutions to deliver tangible results in the face of both historical institutions and ongoing multilevel social and ecological change. One question is whether the system can deliver meaningful outputs without adequate resources. Unless planning and oversight authority on public lands are handed over to other entities, the agency still needs adequate staff capacity to utilize partner funds to do work on public lands. Another important question is whether entities providing such resources will gain a measure of informal authority regarding national forest administration and, if so, whose interests will be represented. This question may become particularly important if states, counties, utility providers, and large NGOs come to play more prominent roles as envisioned in the recent "shared stewardship" policy direction, potentially displacing some of the community-based entities that have been prominent in collaborative and partnership-oriented management to date. A robust debate emerged earlier regarding the accountability of local collaborative efforts on federal forestlands (McCloskey 1999; Coggins 2001; Bryan 2004), but the rise of well-capitalized governmental and nongovernmental entities as key partners in national forest administration raises somewhat different questions regarding accountability and the representation of diverse national interests

in local- to regional-scale planning and management. Ultimately, these are more than academic questions given that the legitimacy of forest administration is an indispensable ingredient to its continued success.

It is important to acknowledge the continued dynamism at macro-, meso-, and micro-scales and implications for the dynamics described here. Both global and domestic U.S. political discourses have shown some evidence of a turn away from the austerity model that was central to the neoliberal era from the 1980s onward, and this trend could influence forest policy design going forward. There is also an increasing focus on the carbon sequestration and storage function of forestlands. This has led to some calls to prioritize preservation in forests with high carbon stocks and low susceptibility to fires and insect outbreaks (Buotte et al. 2020) or to restore more natural conditions in frequent fire forests as a carbon stabilization measure (Hurteau et al. 2019). We suspect that, in the past few decades, the lack of a clear forest advocacy coalition, along with a general decrease in bipartisan action in the United States, has led to stagnation at the meso-level, resulting in an inability to significantly change policy, address resource constraints, or attend to bureaucratic limitations and policy inconsistency via congressional action. If, however, forest management is increasingly packaged as part of government's climate response, this, along with increased funding, could broaden the coalition interested in forest management and lead to more substantial policy change; indeed, these dynamics are shifting under our feet as we publish this. The upward trajectory of Indigenous natural resource management capacity and influence on public lands within traditional Native American territories presents an emerging opportunity to transform past conflicts, practices, and discourses that have been dominated by Western conceptions of resource management (Lake et al. 2017; Long and Lake 2018). Together, these factors will lead to ongoing change at multiple system levels.

We offer our framework as a starting point for understanding and comparing governance responses to climate-driven disturbances in the US and globally across different contexts. For those who may utilize this framework, we suggest there may be several opportunities for research. First, international comparative studies of the governance responses to similar disturbance events would allow for insights into how meso- and micro-level dynamics may lead to different approaches, and in what situations macro-level discourses and policy preferences predominately shape governance changes. Through process-tracing methodologies, scholars could undertake investigation of policy changes and determine whether multi-level dynamics indeed constrain the realm of governance changes, perhaps comparing across different government agencies or resource contexts (e.g., for flood and fire response, grasslands and forests). We also note that, at the macro-level, the context of climate change and increased uncertainty about ecological trajectories will constitute a profound driver. If this is not accompanied by a specific global discourse and associated policy design approach, how might meso-level dynamics shape forest governance changes in respond to climate change? For example, how are forest policies shifting in parliamentary democracies in comparison to the more inherently conservative and slow-moving U.S. presidential democracy? How might existing meso-level institutions shape paths forward? It would also be valuable to consider the range of micro-level innovations observed in various places and determine how these are shaped by multi-level dynamics. We contend that they respond to place-specific imperatives for action, constrained by multi-level factors, but there may be more to the picture, with place-based groups around the globe identifying similar solutions. We offer these as options for future research, while also recognizing that our framework is largely an analytical heuristic that is useful for analyzing why particular governance changes may or may not occur, but also limited in a rapidly changing world with powerful drivers of change at all levels of governance.

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AUTHOR BIOGRAPHIES

Courtney A. Schultz (✉) is an Associate Professor of forest and natural resource policy and Director of the Public Lands Policy Group at Colorado State University. She studies policy and governance change in US public land management, specifically forest restoration and fire management.
Address: Colorado State University, Fort Collins, CO 80523-1472, USA.
e-mail: Courtney.schultz@colostate.edu

Jesse B. Abrams is an Associate Professor of natural resource policy and sustainability at the University of Georgia. His research on natural resource governance and policy spans diverse forest and rangeland environments from the United States to Argentina, focusing on the participation of local communities and local- to regional-scale organizations in environmental governance, policy implementation, and institutional change.
Address: University of Georgia, Athens, GA 30602-2152, USA.
e-mail: jabrams@uga.edu

Emily Jane Davis is an Associate Professor at Oregon State University studying natural resource social science, environmental governance, collaboration, community organization and development, wildfire response, science delivery, and social learning.
Address: Oregon State University, Corvallis, OR 97331, USA.
e-mail: emilyjane.davis@oregonstate.edu

Antony S. Cheng is the Director of the Colorado Forest Restoration Institute and a Professor at Colorado State University, with decades of experience and expertise in conducting outreach and studying forest policy and collaborative governance.
Address: Colorado State University, Fort Collins, CO 80523-1472, USA.
e-mail: tony.cheng@colostate.edu

Heidi R. Huber-Stearns is the Director of the Ecosystem Workforce Program and an Associate Research Professor at the University of Oregon, where she leads research and outreach on US forest management, with expertise in forest governance.
Address: University of Oregon, Eugene, OR 97403-5247, USA.
e-mail: hhuber@uoregon.edu

Cassandra Moseley is a Research Professor in the Institute for a Sustainable Environment at the University of Oregon, where she studies collaborative natural resource governance and rural development, with decades of experience in the US west.
Address: University of Oregon, Eugene, OR 97403-5247, USA.
e-mail: cmoseley@uoregon.edu