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Perspective

Re-Envisioning Wildland Fire Governance: Addressing the Transboundary, Uncertain, and Contested Aspects of Wildfire

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Abstract: Wildfire is a complex problem because of the diverse mix of actors and landowners involved, uncertainty about outcomes and future conditions, and unavoidable trade-offs that require ongoing negotiation. In this perspective, we argue that addressing the complex challenge of wildfire requires governance approaches designed to fit the nature of the wildfire problem. For instance, while wildfire is often described as a cross-boundary problem, understanding wildfire risk as transboundary highlights important political and institutional challenges that complicate collaboration across jurisdictions and shared stewardship. Transboundary risk requires collaborative governance that attends to the distribution of power, authority, and capacity across the range of actors relevant to particular fire-prone landscapes. Wildfire is also changing in unprecedented ways and multiple, interacting uncertainties make predicting future wildfires difficult. Anticipatory governance can build our capacity to integrate uncertainty into wildfire decision-making and manage risk in proactive ways. Finally, competing interests and values mean that trade-offs are inherent to the wildfire problem. Risk governance links science and society through deliberative, participatory processes that explicitly navigate tradeoffs and build legitimacy for actions to address wildfire risk. Governance approaches that better target the nature of the wildfire problem will improve our ability to coexist with fire today and in the future.

Keywords: wildfire risk; governance; transboundary; collaborative governance; anticipatory governance; risk governance

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1. Introduction

Massive wildfires in 2020 and 2021 served as a yet another reminder that contending with the ever-increasing severity and duration of the wildfire season is a pressing global challenge [1]. Wildfire is a complex problem because of the diverse mix of actors and landowners involved, uncertainty about outcomes and future conditions, and unavoidable trade-offs that require ongoing negotiation [2]. While collaborative and adaptive governance have been advanced as ways to promote flexibility and to engage a broader range of actors and landowners [3], these approaches do not adequately attend to all of the specific challenges of wildfire. In this perspective, we argue that scientists and managers need to consider emerging approaches to governance that can better address the transboundary, uncertain, and contested aspects of wildfire. More specifically, we recommend a more robust form of collaborative governance and the use of anticipatory and risk governance approaches, which are being advanced in other fields [4]. We provide examples from the

United States of America (U.S.), Australia, and the Mediterranean to illustrate the need to rethink wildfire governance.

2. Collaborative Governance: Managing Transboundary Wildfire Risk

Burning across jurisdictional boundaries, wildfire is often described as a cross-boundary problem [5]. For instance, Ager et al. [6] estimate that in the western United States more than 1800 wildland-urban interface (WUI) communities are at risk from wildfires originating on National Forest land. These WUI communities are growing faster than any other land category in the U.S. WUI development increases the number and types of private landowners [7,8] and exacerbates landscape parcelization and fragmentation in fire-prone landscapes. This is not unique to the U.S.; landscape parcelization and fragmentation also increases wildfire risk in the Mediterranean region, where wildfires frequently cross thousands of parcels managed by actors with divergent views, resources, and authorities [9]. Fire-prone landscapes are also managed by different public agencies from national to local-levels, indigenous groups with varying levels of authority, and communities with differential access to resources and political power. While recognizing that wildfire risk is cross-boundary focuses our attention on the need for collaboration across jurisdictional boundaries, it does not emphasize the importance of attending to the political and institutional differences between the actors on either side of those boundaries.

Describing wildfire risk as a transboundary problem rather than a cross-boundary one highlights the need for governance that addresses critical differences in power, authority, and capacity within and between relevant institutions and actors, which is needed to effectively contend with wildfire risk that transcends ownership boundaries [10]. Referring to management issues as transboundary specifically acknowledges that collaboration is needed between actors who do not normally collaborate because of these differences [10]. For example, in Greece, lack of wildfire management on agricultural lands in close proximity to populated areas and lack of engagement between wildfire managers and agricultural landowners are the primary drivers of transboundary wildfire risk [9]. Transboundary dynamics also change over time. For example, increased recognition of indigenous sovereignty and treaty rights makes fire-prone landscapes even more transboundary insofar as it forces more consideration of indigenous interests across multiple landownerships. Although the problem of landscape parcelization and the need for cross-boundary collaboration are increasingly recognized in wildfire research and policy, governance solutions rarely account for differences in power and authority [11].

Although there are programs in the U.S. intended to facilitate conversations between public land management agencies, communities, and other stakeholders designed to advance the national Cohesive Wildfire Management Strategy and the Toward Shared Stewardship Across Landscapes investment strategy [12], these programs often fall short of true collaborative governance. For instance, in the U.S., programs aimed at promoting community resilience, Community Wildfire Protection Plans and Community Planning Assistance for Wildfire, require communities to find most of the resources to translate their interests and concerns into the systems management agencies have already created, which means that communities with limited resources may not be able to participate [13]. The U.S. Congress also established the Collaborative Forest Landscape Restoration Program (CFLRP) to promote a collaborative restoration of forest landscapes by funding large-scale, long-term projects [14]. However, because the CFLRP has limited funds, benefits only accrue to collaborative groups that can successfully compete for funding [15,16]. As a result, the CFLRP program does not proactively target communities with fewer resources.

Similarly, while the Good Neighbor Authority and expansions to the Indian Self-Determination Act in the U.S., such as the Reserved Treaty Rights Lands program, provide formal mechanisms for state agencies and tribes, respectively, to perform fuel reduction work on federal lands, they often perpetuate the management priorities of federal agencies rather than the interests of states and tribes [17]. In Australia, where there is increasing interest in and support for indigenous cultural burning, even promising examples of inte-

grating indigenous practices into public sector management face challenges due to policy instruments that do not cede power to, nor provide payment for, Traditional Custodians to perform fire management activities [18].

Thus, many existing programs do not achieve true collaborative governance [19] because they neglect to address power imbalances between different actors and do not fundamentally change management priorities. If the transboundary nature of wildfire risk is not addressed, the trust and collaboration required to enact management actions at landscape scales can be undermined [20]. In other words, if WUI communities, indigenous groups, and local governments with less financial or political power are not given more consideration and authority in decision-making processes, it could undermine the legitimacy of management actions. Therefore, achieving collaborative governance in transboundary landscapes requires contending with power imbalances, and establishing formal mechanisms for power sharing. For example, the Be Ready Warrandyte program in Australia illustrates the importance of negotiating context-specific governance arrangements that share authority and responsibility between community and government actors [21]. True collaborative governance would also help public land management agencies better fulfill their legal obligations to indigenous groups.

3. Anticipatory Governance: Preparing for an Uncertain Future

In addition to contending with differences in power and authority through improved collaborative governance, addressing wildfire risk requires more deliberate attention to uncertainty. In the western United States, "unprecedented rates of burning" are expected by 2050 and subalpine forests are already burning more they have in the last 2000 years [22]. Fire seasons in this part of the world are getting longer and drier, and annual burned area is increasing [1]. In response to similar changes, Australia is dedicating more resources to develop tools that predict the behavior, impacts, and occurrence of future fires, but agencies are under pressure to maintain a semblance of certainty [23]. However, predictive models that rely on historic trends and patterns will be "of limited use" in the future, especially in the context of climate change [24]. Thus, while we know that wildfire is changing in unprecedented ways, multiple interacting uncertainties, including but not limited to the scale of future WUI development [7], the efficacy of fuel treatment, and the magnitude of climate change-driven drought, make predicting future wildfires even more difficult. Therefore, governance solutions need to promote resilience across multiple possible futures.

To effectively mitigate future wildfire risk and build resilience, governance needs to be anticipatory to build our capacity to envision and act before catastrophic events, and to acknowledge rather than minimize uncertainty. For example, Steelman [24] has called for "an anticipatory wildfire governance system" and Fischer et al. [25] recommend scenario planning to "test" various interventions for wildfire. Wildfire research and practice have been more focused on adaptive governance, which emphasizes flexibility and learning [3], while neglecting anticipatory governance, which integrates future uncertainty in a more proactive and forward-looking way by engaging explicitly and directly with multiple possible futures. More specifically, while wildfire work is often future-oriented, it typically fails to integrate future uncertainty in meaningful and structured ways that account for shifting baselines and non-stationarity within and across systems [26].

There is a growing toolbox of anticipatory methods that enable decision-makers to consider multiple futures and guide the development of policy and practice in the context of complexity and uncertainty, such as scenario planning, backcasting, horizon scanning, and visioning [4,27]. In the context of anticipatory governance, scenarios are used to represent a range of plausible futures based on key uncertainties and to enable decision-makers to explicitly engage with uncertainty about future conditions, helping to identify future threats and actions that are robust to uncertainty [4]. Scenario planning can integrate quantitative modeling with other scientific and local knowledge to develop a range of futures based on historic trends, current conditions, and projections about the future [4]. Although "scenarios" are sometimes used in fire modeling [26], these scenarios rarely

represent a range of futures and thus do not explicitly engage with uncertainty about the future. Rather than ignoring or reducing uncertainty, anticipatory governance builds the capacity to integrate uncertainty into decisions and foster new types of decisions as well as new criteria for evaluating decisions, such as reversibility or flexibility [28].

Anticipatory governance is primarily being advanced in the realm of climate change adaptation. For example, in southwest Montana, scenario planning tools were used to build community capacity for anticipating future fire risk and other climate-driven landscape-scale changes. These scenarios enabled community members to prepare for a range of futures in the context of uncertainty while considering how future decisions could impact both private landowners and public land management agencies [29].

Importantly, anticipatory governance helps counteract what is often termed a "presentist bias", where decisions are made on the assumption that the future is knowable and will be similar to the past [30]. This presentist bias is often built into wildfire programs that emphasize restoration, such as the aims of the CWPP program described above and the US 2003 Healthy Forests Restoration Act, which aim to reduce fuel loads and restore natural processes based on historic baselines. Similarly, in Spain and southern Europe, private landowners are engaged in community action programs that set municipal ordinances to reduce future wildfire risk [31]. These ordinances use risk assessments that are based on historic baselines rather than changing conditions. These examples are anchored in the assumption that we can return forests to historic conditions, which is an assumption that anticipatory governance is designed to counter.

Finally, anticipatory governance focuses on how today's decisions influence future outcomes and options, with the goal of minimizing harm in both the short- and long-term [27,30]. In Grand County Colorado, community members used scenarios and a pathways approach to identify the ways in which decisions made about forest management today could either open up future options or foreclose opportunities [32]. Using scenarios that represent a range of futures can reveal how particular pathways (e.g., more prescribed fire or more fire suppression in a particular landscape) structure future options. For example, fire suppression today could increase the need for fire suppression in the future by increasing fuel loads [33]. Conflicts between current management needs and future management options are often acknowledged in wildfire literature but processes to address these conflicts are not typically employed in wildfire governance [34].

4. Risk Governance: Navigating Trade-Offs

In addition to questions of power and uncertainty, addressing wildfire risk involves unavoidable trade-offs between competing values and interests [35]. For instance, there are trade-offs between protecting structures and restoring fire to ecosystems [35]. Removing trees in the WUI can reduce risk to homeowners but compromise amenity values. Also, the risk of health impacts from smoke must be weighed against the risk of not reducing fuel loads. In some places, prescribed fire can also negatively impact biodiversity. For example, Bradshaw et al. [36] found that the required frequency (six-year intervals) of prescribed burning to provide effective risk reduction would be catastrophic to biodiversity in South Western Australia. Fire suppression risks firefighter safety in order to reduce risks to communities during an active wildfire, but this presents a temporal risk-risk trade-off as effective fire suppression can maintain high fuel loads, which exacerbates future fire risk.

Risk is more than the probability of incurring harm, in part because risk is embedded in culture and politics and has different meanings to different groups of people [37]. Also, the possibility of wildfire offers potential benefits [38], whereas the term "risk" typically suggests negative outcomes. Because risk has different meanings to different people, the broad suite of actors involved in a transboundary context need to navigate trade-offs across different perceptions of wildfire risk. Changing conditions can exacerbate these differences, as seen in Australia, in 2020, when novel fire dynamics and uncertainty about the efficacy of prescribed fire led to intense political conflict [39]. In the U.S., land management agencies primarily use probabilistic wildfire risk modeling [38,40–42] to assess wildfire risk (see [43]).

However, this approach privileges certain definitions of risk over others. When model outputs based on certain definitions of risk identify some locations as more at risk than others this can result in conflict over the limited resources available for mitigation. Also, these models often consider a limited number of resources and/or values, which limits consideration of trade-offs, see [38,40–42].

While collaborative governance emphasizes win-win solutions [19], the trade-offs inherent to the wildfire problem limit the potential for solutions that meet everyone's needs. This means that addressing wildfire risk requires processes that explicitly and effectively tackle trade-offs [35,44]. Risk governance emphasizes the sorts of deliberative, participatory processes that are designed to engage diverse groups of stakeholders or the public more broadly in navigating trade-offs [45]. While the term "risk governance" is sometimes used in the context of wildfire, here we are referring to the theory and practice of risk governance primarily developed to address emerging technology (see [46–48]), which we believe has important lessons for wildfire. For example, in Australia, the nanotechnology developers engaged with multiple stakeholders across disciplines to assess physical, social, and ethical risks, which helped to bridge across the concerns and interests of scientists, policymakers, and the public to build solutions with broad support [48]. Risk governance has also been used in synthetic biology, carbon capture and storage, solar radiation management, and biotechnology to engage stakeholders and the public in early assessment of emerging risks in ways that integrate across different perceptions of risk to produce outcomes that explicitly consider trade-offs [46–48].

This kind of risk governance requires inclusive, iterative processes that help people build a collective understanding of risk and enable a dialogue across science and society about which risks are acceptable [45]. Leaning into democratic processes helps build legitimacy and thus public support for actions taken to address risk [21]. Such processes can also help participants identify trade-offs that were not initially apparent and increase the chances that decisions avoid unintended consequences [35]. Importantly, although many wildfire models implicitly consider trade-offs to determine optimal management for multiple objectives, because these models include a limited number of resources it limits the utility of these models to spur dialogue about the full range of trade-offs that are relevant to such decisions.

But risk governance is not simply about inclusive and democratic deliberation. Where collaborative governance emphasizes the interaction of stakeholders, risk governance is about the interaction between science and society and how we understand and build knowledge about risk [45], because even technical risk assessments are inherently social and political [37]. Wildfire risk should thus be viewed as negotiated rather than simply determined by quantitative models [49]. At the same time, scientific risk assessment is a critical component of the deliberative process. Through processes that integrate the technical (e.g., quantitative wildfire risk assessments) and the political (e.g., different or conflicting perceptions of wildfire risk), risk governance can bring wildfire science into a dialogue with social values to explicitly address trade-offs.

5. Conclusions

Addressing the complex challenge of wildfire requires governance approaches designed to fit the nature of the wildfire problem such as power imbalances across boundaries, uncertainties about future conditions, and unavoidable risk tradeoffs (see Figure 1). In this perspective we argue that wildfire needs to integrate more robust collaborative governance, anticipatory governance, and risk governance to better address these challenges. We draw on examples from the western U.S., Australia, and the Mediterranean to illustrate the need for new forms of wildfire governance, and to highlight some nascent examples of programs aimed at promoting collaboration and addressing uncertainty and trade-offs. While governance needs to be tailored to the specific contexts within which wildfire occurs, these examples illustrate the need for improved governance across different social-ecological contexts.

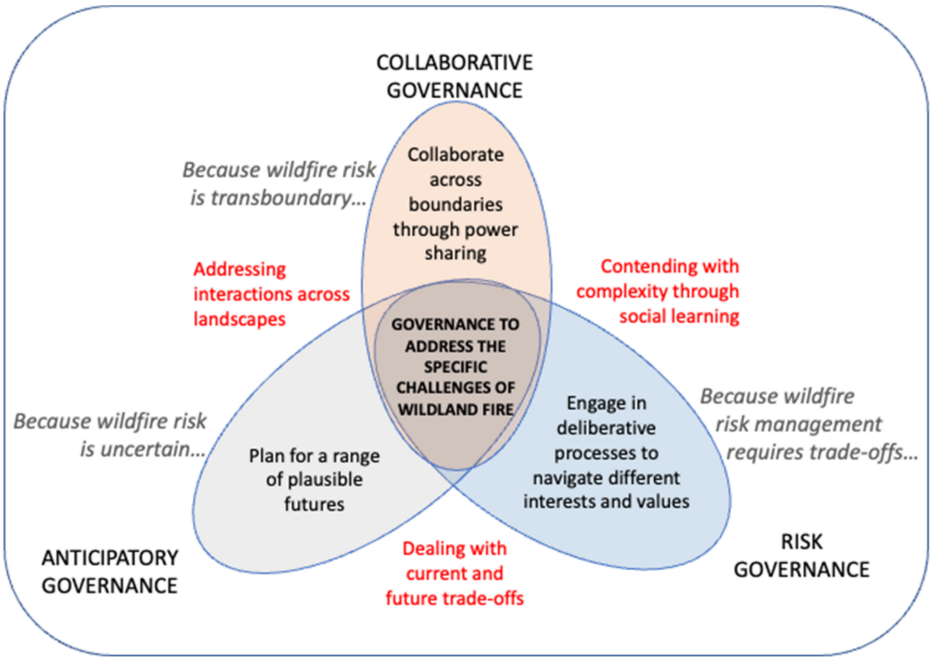

Figure 1. Designing Wildfire Governance to Address Specific Challenges.

More specifically, understanding wildfire risk as transboundary ensures that we attend to important differences across actors and institutions, especially differences in power and authority. Acknowledging that wildfire is changing in unprecedented and uncertain ways requires anticipatory approaches that enable us to integrate uncertainty into decision-making and consider a range of plausible futures that may unfold. And accepting the unavoidable trade-offs inherent in decisions about wildfire calls for the deliberative processes that are the hallmark of risk governance.

Collaborative, anticipatory, and risk governance are also complementary and synergistic. For instance, the increasingly transboundary quality of fire-prone landscapes intensifies trade-offs by expanding the competing values and interests that need to be negotiated across different actors. Anticipatory governance reveals additional temporal trade-offs, including the future consequences of present-day fire management. Being explicit about trade-offs and uncertainty in collaborative processes increases the legitimacy of actions designed to address wildfire risk, building important political capital for power-sharing. Furthermore, an anticipatory governance approach pushes collaborative processes to be more proactive and nimbler in the face of uncertainty. And finally, risk governance provides mechanisms to integrate the different perspectives that are critical to both collaborative and anticipatory governance.

Designing governance to better target the specific challenges posed by wildfire will improve outcomes today and in the future. Although many policies and programs are beginning to acknowledge the challenges described above, we need to go beyond policy language and build capacity to expand our wildfire governance toolbox, drawing on insights from collaborative, anticipatory, and risk governance. Relatedly, we need additional research to better understand the efficacy of new governance approaches to wildfire.

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