Counteracting wildfire misinformation

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Recent intense fire seasons in Australia, Borneo, South America, Africa, Siberia, and western North America have displaced large numbers of people, burned tens of millions of hectares, and generated societal urgency to address the wildfire problem (Bowman *et al*. 2020). Nearly all terrestrial ecosystems, however, burn with some degree of regularity, timing, and intensity; fire is a natural process. Wildfires are strongly influenced by climate and weather, which in turn shape the availability and flammability of fuels (Abatzoglou and Williams 2016). Yet rapid climate change is interacting with land-use legacies (eg fire suppression), transforming both wildfire and ecosystems (Coop *et al*. 2020; Hagmann *et al*. 2021). Like misinformation about climate, misinformation about wildfire has flourished in the media and in political discourse.

Misinformation is incorrect or misleading evidence or discourse that counters best available science or expert consensus on a topic (Vraga and Bode 2020). Vulnerability to misinformation is often driven by distrust in media and institutions, and exacerbated by rapid spread over social media. By obstructing solutions to public health (eg COVID-19, childhood immunizations, tobacco use) and environmental issues (eg climate change), misinformation deters effective policy responses to societal threats.

Wildfire mitigation requires accurate information about drivers of wildfire change, the impacts to society and ecosystems, and actions that alter trends. Misinformation confuses people about the causes, contexts, and impacts of wildfire and substantially hinders society's ability to proactively adapt to and plan for inevitable future fires. With limited workforces and budgets, public land managers face hard choices about implementing strategies to reduce fire risk. With strong public support and investment, rapid progress toward improving ecological and social resilience to wildfire is possible (Stephens *et al*. 2020). Yet public support is undercut by apprehension over management actions due to misinformation campaigns or past actions that led to broken trust.

Science is an imperfect, self-correcting process, relying on continuous hypothesis, method, and data development. Given imperfection and associated uncertainties, how should science inform policy and management? As knowledge accrues, facts align and holistic understanding improves, allowing for robust frameworks of evidence when more studies confirm, and fewer refute, findings over time. These robust frameworks provide vital nuance and more accurately inform management or policy debates. In active research areas with high rates of knowledge generation and exchange, some architects of misinformation might use a cloak of scientific credentials to advance their agendas via less well-supported science (Pielke 2007).

Misinformation often includes partial truths, which are central to its successful spread. An illusion of legitimacy omits critical contextual information, which is strengthened when the misinformation permeates high-profile popular press outlets. Misinformation's wide reach can mislead policy makers, further eroding public support for broad-based fire policies.

The scientific literature is not immune to misinformation (West and Bergstrom 2021), which creates a quagmire when used in litigation. Wildfire misinformation in the courts can slow or halt efforts to implement management actions, such as restoring ecologically appropriate fire activity, even when they are based on robust scientific frameworks. Creating perceptions of uncertain wildfire science imitates a misinformation tactic employed by climate-change deniers and tobacco-industry proponents, helping "false experts" sow uncertainty (Cook 2020; Lewandowsky and van der Linden 2021).

Some wildfire misinformation originates from distilling complex wildfire science into generalizations that rarely apply everywhere. Appropriate management interventions differ widely across ecosystems, but wildfire misinformation often blurs these lines too. Wildfire communication best practices include appropriate recognition of natural variability and complexity within and among ecosystems. Oversimplification of complex wildfire causes and consequences, particularly when perpetuated by public figures or scientist-advocates, muddies public perceptions of appropriate management. Yet even well-intentioned scientists, managers, or policy makers can unwittingly spread this form of wildfire misinformation.

The cyclical nature of wildfire misinformation presents opportunities to anticipate and prepare "prebunking" strategies, which can combat wildfire misinformation before it spreads. Prebunking warns of the potential for misinformation and explains why it is false. It can help the public, policy makers, and land managers prepare for common forms of wildfire misinformation, and "debunk", or deftly respond to misinformation when it begins spreading.

Prebunking is most effective when it occurs *before* misinformation gains traction and the framing of the discourse is set (Lewandowsky and van der Linden 2021). We present and prebunk several examples of wildfire misinformation (WebTable 1) that, based on our collective experience in wildfire science, can lead to social and political inaction, increased distrust, and/or misinformed reactions – all of which can aggravate wildfire risks. These examples focus on wildfire misinformation primarily (but not exclusively) related to dry forests of western North America. Additional references can be found in WebPanel 1.

Prebunking and debunking misinformation are first steps toward ensuring that policy makers, journalists, judges, members of the public, and elected officials are skeptical of weakly supported scientific information, which can hinder effective wildfire management.

Pre- and debunking also require identifying reliable messengers. Scientific credentials are not always an indicator of neutrality. Some scientists use their credentials to advocate for specific policy outcomes that they support personally, which may or may not be driven by robust frameworks of evidence. When considering policy options, information consumers must carefully distinguish recommendations by "issue advocates" (Pielke 2007) from those derived from robust portfolios of evidence.

Reliable sources have relevant "domain expertise" (specialist knowledge) as well as the trust of many subject-matter experts *and* their audience. Predetermining trusted sources who can anticipate misinformation and relate clear messages to journalists and news media (prebunking), or activate in response to misinformation (debunking), requires partnerships between scientists, land managers, and journalists.

A continually changing media ecosystem presents challenges and opportunities to mitigating the spread of misinformation. Here, journalists and news organizations have a weighty responsibility, playing a critical and often insufficient role in reducing misinformation. During the scientific publication process, journal editors and reviewers who assess manuscripts undergoing peer review must be vigilant of wildfire misinformation, the identification of which requires adequate domain expertise; prospective authors must provide sufficient scholarly context and caveats; and all participants need to engage in respectful dialogue when corrections are necessary.

Common misinformation techniques undermine well-established scientific consensus by promoting false experts and false narratives, while often creating impossible expectations about needed evidence (Cook 2020). Journalists and editors can employ "weight-of-evidence" approaches when offering competing perspectives about the causes or consequences of wildfires, ensuring that outlying perspectives are not given equal weight to robust well-established frameworks. For example, misinformation about climate change spreads by repeated overexposure of "climate contrarians" whose media visibility far outweighs the quality of their science or scientific credentials (Petersen *et al*. 2019). Overexposure of "wildfire contrarians" in media can similarly result in public confusion and weakened support for appropriate interventions.

Social media can disseminate wildfire misinformation, but can also be employed to mitigate its influence. Journalists, scientists, and policy makers must be wary of pressures to overstate or oversimplify complicated wildfire issues to garner attention in a competitive media ecosystem (West and Bergstrom 2021). Experts and members of the public can reduce misperceptions by correcting wildfire misinformation when encountered. Social media platforms can label or demote wildfire misinformation or promote accurate information, echoing recent efforts to address public health misinformation during the COVID-19 pandemic.

Changing our relationship with fire and the risks we face in the 21st century requires understanding human behavior as much as it does managing ecosystems. We must learn to deal with misinformation about wildfire and develop strategies for limiting its impact on our ability to implement effective wildfire policies.

The findings and conclusions in this publication are those of the authors and do not necessarily represent any official USDA or US Government determination or policy.

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WebPanel 1. Additional references that add context to the arguments made in the main text. Note that references provided are examples; we do not provide an exhaustive list of possible references.

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GM Jones *et al*. – Supporting Information

WebTable 1. Prebunking prominent examples of wildfire misinformation[1] related to in western North American forests.

Misinformation	Description	Consequence of misinformation	Information from more robust knowledge frameworks	Key evidence
Contemporary wildfires are normal	Current wildfires, in terms of size and severity, are within the natural range of variation and therefore not a cause for concern.	Social and political inaction; reinforces status quo.	Contemporary wildfires are abnormal in many ecosystems; those burning in seasonally dry forests are far outside the historical range of variation because of >100 years of fire suppression (leading to buildup and increased landscape continuity of fuels) and climate change, generally burning at a higher severity, in larger patches, and over larger areas.	Hessburg *et al.* 2005, 2019; Falk *et al.* 2011; Safford and Stevens 2017; Singleton *et al.* 2019; Parks and Abatzoglou 2020; Hagmann *et al.* 2021
Forests are resilient and will naturally recover	Forests have always experienced fire and have recovered on their own without human intervention. There is no need for humans to intervene through active management.	Social and political inaction; reinforces status quo; perception that active management is unnecessary and potentially harmful.	Without intervention, many forests will convert to non-forest due to disturbances and climatic warming, unable to naturally recover after high-intensity fires due to inadequate conifer seed availability, failed conifer regeneration, worsening site climate, elevated fuel loads and connectivity from fire exclusion, cyclic reburning, and post-fire dominance of shrubs and grasses. Under rapid climate change, natural recovery processes cannot maintain natural fire and ecosystem processes; appropriate interventions can make many forests more resilient to the effects of climate change or incrementally facilitate some inevitable transitions to non-forest.	Hurteau *et al.* 2014; Stevens-Rumann *et al.* 2018; Davis *et al.* 2019; Young *et al.* 2019; Coop *et al.* 2020; Prichard *et al.* 2021; Rammer *et al.* 2021
Fuel reduction treatments are ineffective	Management efforts (“treatments”) to reduce forest fuels, such as thinning, do not reduce fire hazard; they increase fire hazard. Moreover, to the extent that treatments do work, they are ineffective under extreme fire weather.	Social and political inaction; perception that agencies are wasting money and personnel on ineffective strategy.	There is abundant evidence that forest fuel treatments work, particularly those using fire itself, whether prescribed or managed. Such treatments moderate the behaviors of wildfires, even under extreme weather, slowing their spread, lowering fireline intensity, and reducing severity and smoke production in treated areas. Fuel treatments are appropriate in systems that were historically fuel-limited, and in those high severity systems that currently lack typical burned and recovering patchworks of forest and non-forest.	Safford *et al.* 2012; Stephens *et al.* 2012; Prichard and Kennedy 2014; Lydersen *et al.* 2017; Hessburg *et al.* 2019; Prichard *et al.* 2020, 2021; Jones *et al.* 2022; North *et al.* 2021

Fuels reduction is a Trojan horse for commercial logging	Pre-fire fuels reduction is motivated by timber outputs, not fire hazard reduction; the result is serious harm to the land from practices similar to commodity-driven logging.	Distrust[2] in land management agencies.	Mechanical fuels reduction focuses on *retaining* medium and large-sized fire-tolerant trees, to foster their survival of the next fire. Fuels reduction treatments restructure and remove woody material and fuel ladders that built up during fire exclusion, and are often of limited economic value. In other cases, removal of medium-, or large-sized fire-intolerant trees that recruited during fire exclusion is essential to improve fire-tolerant tree survival. The catchphrase "fuels reduction logging" deceptively conflates two very different types of forest management.	Agee and Skinner 2005; Schwilk *et al.* 2009; Stephens *et al.* 2009, 2020, 2021; Collins *et al.* 2014; Prichard *et al.* 2021; Hessburg *et al.* 2022
Contemporary wildfires are beneficial to wildlife	Forest wildlife have developed adaptive behaviors to benefit from wildfire, and since contemporary fires are normal (see above misinformation) it follows that in general they will benefit wildlife and their habitat.	Social and political inaction; reinforces status quo.	Changing fire regimes pose serious threats to the persistence of numerous native wildlife populations. The massive scale of stand-replacing patches typifying contemporary "megafires" homogenizes landscapes, reduces overall faunal species richness, and eliminates critical habitat for even fire-dependent forest species. Forest wildlife require the long-term persistence of a substantially forested landscape mosaic, as it adapts to climate change and the variability of the fire regime that emerges.	White *et al.* 2019; Kelly *et al.* 2020; Jones and Tingley 2022; Steel *et al.* 2022; Stillman *et al.* 2021

[1]Misinformation statements can be true in certain times or places, but are not generalizable; this is one harm of such statements.

[2]Distrust is not just a consequence of misinformation; misinformation is also a consequence of distrust that can be shaped by past management and policy mistakes. To reduce distrust, it is essential to own past mistakes, seek input, act in good faith, and minimize future mistakes.

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