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Wildfire trends in the US and adaptation strategies to increasing wildfire

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It's now mid-summer, and likely an active fire season is underway, yet I am writing this back in April amidst stay-at-home orders in numerous states across the US. While I don't yet know the future trajectory of COVID-19, I do know that if it is a hot and dry summer, the West will be experiencing an active fire season. As smokejumpers work heroically to extinguish remote wildland fire starts, we all search -yet again- for answers to ***why is so much area burning, and how can we better manage the growing threat of wildfires***?

I am a fire ecologist at the University of Colorado, and I have spent 25 years researching wildfires and their effects across the West. I also examine trends in US wildfires and evaluate efforts to manage them, and have testified in Congress and the Colorado legislature on these issues. Through my research and that of many colleagues, and from listening to firefighters, land managers and varied stakeholders, I have grappled a lot with these issues, and I have some answers to these burning questions.

Is climate change affecting wildfires?

Yes, a large body of research shows us that warmer drier conditions are associated with increased area burned in the US in recent decades, primarily in the West. Since the late 1970s, the US annual average temperature has risen almost 2 degrees Fahrenheit[1]. In the western U.S., this warming has led to more aridity, earlier snowmelt[2] making higher-elevation forests more flammable, and fire seasons three months longer on average[3]. As a consequence of this warming, annual area burned in the US has risen significantly, with a big uptick since 2000[4]. The ten largest fire years since 1960 have all occurred in the last 20 years. In the western U.S. area burned by wildfires larger than 1000 acres has grown by over 350% across all ecoregions and by an astounding 1300% in forests (1984-2017)[5-7]. A careful study revealed that human-caused climate change was responsible for almost doubling the area burned in western US forests from 1984 to 2015[8]. Of the total area burned in US since 2002, 55% was in the conterminous western states (80% including Alaska)[4]. So the rise in area burned in the US in response to warming largely reflects increased burning in the fire-prone West.

Are human-caused ignitions a big deal?

Yes, human-caused ignitions (campfires, powerlines, fireworks, equipment use, etc.) now play a big role in starting wildfires, accounting for 84% of all wildfire starts and 44% of area burned across the US 1992-2012[9]. Within the wildland-urban interface (WUI), where homes abut or intermix with fire-prone vegetation, almost all fires are started by humans. Warmer, drier conditions are making human-ignited wildfires more common throughout the US. Only in the interior West is lightning still the predominant ignition source of the largest 10% of fires; elsewhere in the US human-caused ignitions have become the dominant source of wildfires[10].

So what actually burns?

In the conterminous West in an average year, some two-thirds of what burns is shrublands and grasslands, not forest[11]. This comes a big surprise to many people, as the topic of better wildfire management is often couched in terms better forest management. However, most of what burns in the West is non-forest. If we look at the total area burned across the US, about 55% burns in the conterminous West, and only about 40% of what burns in the West is forests. Taken together, that means forests in the western lower 48 states account for less than a quarter of what burns across the US in an average year (55% x 40% = 22%). Our western wildfire problem is not predominantly a forest fire problem, and therefore forest management alone cannot effectively solve it.

How severe are wildfires these days?

While area burned in the US has increased significantly in recent decades, wildfire severity has not. It comes as a surprise to many to learn that the majority (65%) of what burns across the US is low-severity fire. Only about one-third (35%) is moderate or high-severity fire, with no significant change over the past 30 years (1984-2014)[12]. In western forests, burn severity tends to be higher in larger fires and during extreme burning conditions, but these trends are not beating out the noise, and overall forest fire severity has not changed significantly over the past 30 years[13, 14]. Where is forest fire severity high? In moister, more productive, higher elevation, and more northern forests, reflecting geographic patterns that promote higher fuel loads. Generally, these moister, cooler forests don't burn very often so remain a small slice of the wildfire pie, although that is changing as snowpack is melting earlier due to warming.

What is the role of fuels build-up?

I often hear people point to fuels build-up as the main reason for our big and growing wildfire problem. Indeed, fuels buildup has played role. Forest fuels have accumulated due to decades of suppression of frequent low-severity fires characteristic of dry forests (for example, low-elevation ponderosa pine forests). Historically, frequent low-severity fires kept these forests of thick-barked, fire-resistant trees relatively open (forests that clearly fall in this category are roughly 1/3rd of western forests in the lower 48[15,16]). Effective suppression of frequent fires has allowed smaller trees to fill in formerly open stands, increasing their density and making uncharacteristic high-severity fires more likely now.

But importantly, fuels have not increased in all forests. Many forests have not become denser over the previous century (roughly 1/3rd of western forests in the lower 48[16]). For example, high fuel-load forests described above, where you might ski or hike in the high country, typically experience infrequent, high-severity fires. These moister, cooler forests are as dense today as they were prior to fire suppression, and haven't experienced significant fuel accumulation. High-severity fires, while scary to us, are business as usual for those forests and not a consequence of past fire suppression and fuels build up[17].

In sum, most of what burns each year is shrubland and grasslands, and only a portion of the forests that burn suffer from fuels build-up due to past fire suppression. Therefore, reducing uncharacteristic fuel loads can restore dry forests to pre-fire suppression conditions, but this alone will not significantly address the increasing wildfire problem in the West triggered in large part by climate change.

Can fuels management significantly reduce area burned?

Let's look beyond the issue of forest fuels build up, and simply ask whether fuels reduction aka 'wildfire mitigation' treatments in a variety of ecosystems could help reduce area burned in the US. The answer to this question may surprise you, which is an issue of both scale and odds of burning.

Wildfire mitigation treatments remove ladder fuels primarily through thinning and prescribed fire with the aim of reducing subsequent wildfire severity and spread. Treatments are not fire prevention tools, but rather are designed to mitigate subsequent fire behavior. Therefore, in order for wildfire mitigation treatments to work, they need to burn by wildfire during their period of efficacy, which may last roughly 10-20 years depending on site conditions.

Two studies have specifically looked at how often federal wildfire mitigation treatments encounter subsequent wildfire, as a high-level indicator of treatment effectiveness. The first, led by a team at the University of Montana, looked at federal wildfire mitigation treatments in all ecosystem types across the US from 1992-2012[18]. The second, led by my team at the University of Colorado, looked only at federal wildfire mitigation treatments in western forests from 2004-2014[11]. Both studies found essentially the same answer: on average each year <u>less than 1% of wildfire mitigation treatments encountered subsequent wildfire</u>, meaning the vast majority of treatments miss the chance to do their job.

Forest treatments essentially burn at the rate that the forest itself burns, which is about 1% per year in western forests, and it's really hard to beat those odds. Treatments that had relatively high rates of subsequent burning (>2%) occurred in only three ecoregions across the US, all of which experience relatively high fire frequencies[18]. These are all in West, but only one of them is forested: the ponderosa pine woodlands in the Mogollon Rim Ecoregion of Arizona.

So wildfires burning fire mitigation treatments is a game of low odds, and the vast majority of treatments never get the opportunity to modify wildfire behavior because most never burn during their period of efficacy. As a consequence, treatments have very little leverage in changing wildfire behavior. In fact, only about 1% of the area burned each year burns in fire mitigation treatments. Even doubling or tripling our efforts will still yield fairly low treatment-wildfire encounter rates, and therefore, low impact on wildfire trends. More forest management, especially if occurs in moister more productive forests that generally burn less frequently, will not slow increasing wildfire. Therefore, we need to be strategic about where and how we manage forests to have any measurable impacts on wildfire.

Prescribed fire

The National Cohesive Wildland Fire Management Strategy considers prescribed fire as the most cost-effective approach over the largest potential area of the US for reducing fire risk. Indeed, federal agencies implemented about 2.8 million acres per year of prescribed burns from 1998 to 2018, and about half of the federal area treated for fire mitigation is prescribed fire. However, most prescribed fire in the US (70%) is implemented in the Southeast by non-federal agencies[19]. Meanwhile, prescribed fire has declined during the last 20 years in the West. There are important safety concerns with fires escaping prescriptions (although such occurrences are rare relative to the amount of prescribed fire safely burned), and in the arid West there are narrower windows for burning and challenges burning in mountainous terrain. Yet such challenges are not insurmountable. Implementing more prescribed burns safely in the West is the cheapest and most effective means of removing smaller fuels that spread fires, better controls smoke production relative to uncontrolled wildfire, providing untapped benefits to both ecosystems and society.

What are wildfire impacts on people and homes?

Forests today are very different from the forests that Smokey Bear used to roam. The wildland-urban interface (WUI), where houses and wildland vegetation meet or intermingle, now accounts for about 10% of lower 48 states[20]. From 1990 to 2010 the number of homes in the conterminous WUI grew 41% to 43.4 million, and the land area grew 33% to 770,000 km^2. Over 100 million people and about every third house is in the WUI, which is the fastest growing land-use category in the US. About 1.7 million homes in the WUI have a high to extreme risk of wildfire[21], and efforts to contain wildfires that threaten homes and communities are costly and dangerous. Continued expansion of the WUI will further increase human exposure to wildfires and human-related ignitions.

Extensive research on wildfires in the WUI indicates that home ignition and subsequent loss is a mostly function of home construction and vegetation directly around the home, and is largely independent of fuels and forest management on distant federal lands[22]. Ember showers during extreme wind and burning conditions are a primary source of home loss, and homes that can withstand ignition from embers are generally the ones that survive. Furthermore, about 70% of the WUI is private land[23], making homeowner and community fuels mitigation efforts paramount where federal land-management agencies have little jurisdiction. Wildfire home loss research does not support the notion that damages to people and property will significantly decline if we manage federal forests better. Home wildfire protection and federal forest management are largely independent issues, which require distinctly different solutions.

Strategies for Adaptation

Adaptation is when people and ecosystems adjust and reorganize in response to changing climate and wildfire trends to reduce future vulnerability. ***How can we better manage and adapt to the growing threat of wildfire?*** First off, we need to continue to safely and effectively suppress wildfire where it protects people, communities and vulnerable ecosystems. Smokejumpers will lead the way by snuffing out fire starts before they threaten communities and choke our skies with smoke. But despite valiant and ever-larger suppression efforts, we still are witnessing a continued growth in area burned. How can we better cope with this more fiery world? We can thin better, burn better, and build better. Here's how.

Thin better

Unfortunately, more forest management cannot significantly alter regional increases in area burned in the West where non-forest lands burn the most, and few fire mitigation treatments encounter subsequent wildfire due to the large area of fire-prone forests and the low odds of treatments burning. More treatments will encounter more wildfire if prioritized in ecosystems that have a high likelihood of burning in grasslands, shrublands, warm-dry forests. Bigger treatments will also increase the odds of subsequent burning if implemented in areas most likely to burn such as lower elevations, south facing slopes, lower latitudes in the arid West and parts of the southeastern US.

Federal thinning projects are not well-suited to reducing home loss on distant private lands, where building construction and fuels directly around the home matter most, but can be valuable in restoring forests that are adapted to frequent fire. Thinning better means thinning areas that burn frequently to reduce fire severity, help ecosystems adapt to warming, and reduce carbon losses from wildfire. Thinning better means thinning on private land in and around communities to help firefighters directly defend homes and neighborhoods where ignitions are highest.

Burn better

Burning better means implementing more prescribed fires in the West, and allowing more remote wildfires to burn in ecosystems that have evolved with frequent fire, to help minimize the severity and size of future fires. Implementing more prescribed fire in places with a high likelihood of wildfires encountering those prescriptions will reduce subsequent wildfire smoke, spread, and severity, and help firefighters more safely do their job. Furthermore, reintroducing prescribed burns in areas where historically frequent fire has been suppressed will help those ecosystems adapt to more frequent burning in response to climate change. Burning better also means reducing the number of human-related ignitions, especially in the WUI, where people and property are at high risk.

Build Better

National Institute of Building Sciences estimates that every $1 spent on wildfire mitigation saves $4 in wildfire disaster recovery costs. Retrofitting existing homes and building new homes to strict wildfire codes will save homes and lives making homes able to defend themselves without the aid of firefighters. Integrating wildfire planning into regulations, codes and ordinances will help communities better adapt to likely wildfire. Examples are requiring defensible space around homes, evacuation routes and community perimeters; restricting development on steep, remote and high fire-prone lands; ensuring ample egress and evacuation routes and community shelter-in-place options. Promoting public awareness and preparation for the inevitability of wildfire is a key feature of community adaptation to increasing fire in the West.

Summary

New adaptive approaches are needed to manage increasing wildfire risk and costs. Better thinning, burning and building will help communities and ecosystems adapt to wildfire as climate continues to change. But over the long term, the most critical means of countering rising wildfire impacts is to mitigate climate change by transitioning to a low-carbon economy sooner rather than later.

As I look out my window at eerily empty streets while we shelter in place against the COVID-19 storm, I realize that like protecting ourselves from novel coronavirus, we need to keep wildfire from spreading to where it matters most, our homes and communities. While we can effectively manage forests for many uses, we can’t vaccinate the forests against wildfire. Instead, we need to better defend our homes and communities, become better adapted, and fight climate change by pivoting to a low-carbon economy. Coronavirus showed us how well we can change our behavior for the greater good, we need to do the same to save ourselves from an increasingly dangerous, costly and fiery future.

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