

**Putting the Fire Out: Mitigating the Wildfire Threat Through Climate Awareness and
Policy Change**

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A wildfire is an uncontrolled fire that burns in wildland vegetation. They are not limited to a particular continent or environment and have been a natural occurrence for hundreds of years. While they can start from either a natural occurrence, like a lightning strike, or a human-made spark, weather conditions will often determine how much a wildfire grows (National Geographic Society 2022). Thus, as the planet is experiencing record-breaking heatwaves and historic droughts, it is unsurprising that a recent United Nations report has described the predicted global surge in wildfires as a ‘global wildfire crisis’ (Canon 2021 and Zhong 2022). While governments are already spending billions of dollars each year to manage these fires, these destructive blazes continue to grow more intense and more frequent each year. Without corrective action, the threats posed by wildfires will continue to grow and put millions of lives and livelihoods at risk. Though the risk is clear, long-standing ineffective fire management policies held in place by cognitive biases have facilitated the escalation of this issue amidst environmental pressures from climate change. Dismantling these naive fire management conventions will pave the way for optimized, climate change-aware wildfire solutions which can mitigate this catastrophic risk to the human race.

Pathway to Extinction - Existential Risks Posed by Wildfires

As temperatures continue to rise, so do the risks posed by wildfires; these fires threaten land, buildings, water supplies, and, arguably most concerning, general public health. Every year, as wildfire risk increases, so does the severity and urgency of the dangers it poses, and current predictions show that the effects will become much worse. In 2021, a normal wildfire in California burned upwards of 100,000 acres of land. Once considered a megablaze, fires of this

size have become increasingly commonplace, occurring on a weekly basis during the summer months (Canon 2021).

Before the anthropogenic influence of the industrial revolution, fire activity on a global scale was mostly climate-driven; however, once fossil fuel burning led to the onset of global warming, fire activity soon began to rise. Over the 19th century, both model- and charcoal-based records show sharp increases in biomass burning which can be strongly connected to human influence (Pechony and Shindell 2010). Today, rising temperatures continue to have significant causal effects on the wildfire problem. Drier, warmer conditions dry out forests and underbrush, increasing their flammability, and as temperature conditions worsen due to climate change, these conditions will follow suit leading to more frequent and more severe wildfires (Cleatus and Mulik, 2014). Furthermore, not only have fires become more intense, but the western wildfire season has also grown from an average of 5 months in the 1970s to an average of 7 months today. This increase has made the overall fire season more destructive and also gives less time each year to implement prevention strategies.

The effects of these blazes extend far past the immediate site, damaging downstream water sources as well as spreading harmful pollutants into the air. Studies have found significantly higher levels of phosphorus and carbon downstream of severely burned sites posing serious barriers to the treatability of water reservoirs and contaminating drinking water. Additionally, higher erosion rates in burned watersheds have increased their sedimentation levels, reducing the storage capacity and lifespan of these drinking water reservoirs (Robinne et al. 2018). Regarding air pollution, the large amounts of particulate matter released by wildfires pose a serious health risk to surrounding populations. A global study published in 2021 found that across the 43 countries looked at in the study, an average of 33,150 deaths a year could be

attributed to short-term exposure to fine particulate matter in wildfire smoke (Gribkoff 2021). The effects of wildfires are directly harming public health outcomes, and the size of affected populations is set to increase.

Currently, 50 million US homes are in the wildland-urban interface – areas in or near wildland vegetation where wildfires pose the greatest risk – and this number is increasing by a million homes every 3 years (Burke et al. 2021). Another analysis showed that nearly 80 million properties in the US face a significant chance of exposure to fire (Mutskens et al. 2022). In a landmark United Nations report released in February of 2022, the outlook for a global trajectory revealed a chilling prediction that “in a moderate scenario for global warming, the likelihood of extreme, catastrophic fires could increase by up to a third by 2050 and up to 52 percent by 2100” (Zhong 2022). Millions are already being dramatically affected. Globally, the harm caused by wildfires will be catastrophic.

Obstacles to Engagement

While wildfires pose a serious existential threat, effectively managing them requires a dramatic engagement with a complex climate system as well as both political and psychological precedents which have exacerbated their proliferation. Low-intensity wildfires have been shown to contribute to the healthy maintenance of forests and are even considered a crucial component of many ecological systems (Busenberg 2004). However, the more intense fires seen today are not natural to these systems and cause a great deal of damage to thriving ecosystems. Thus, the ways in which human activities have dramatically increased wildfire severity must be analyzed and understood in order to effectively engage with the wildfire problem.

Complex Adaptive Systems - Climate Change and Feedback Loops

Climate change can likely most accurately be described as a complex adaptive system.

There are many individual agents in these systems, for example, carbon-emitting companies, individual consumers, and government agencies. While these agents seem to operate independently, their behaviors can cause emergent outcomes which can not be understood separately from each other. Climate change, defined by the United Nations as “long-term shifts in temperatures and weather patterns,” has had immense measurable effects on a global scale, most notably concerning temperature rises. However, while ecological processes including land systems, biogeochemical, freshwater, and climate change can all be understood as self-contained cycles, their immense degree of interconnectedness is clearly illustrated as they come to reach certain planetary boundaries that they would not have while operating independently of each other. Changes in one can have significant effects on another, eventually disrupting processes within all of them (Lade et al. 2020).

Thus, engaging with wildfires requires understanding that they are not occurring as an isolated event, but instead are a component of a larger system of climate change; they are both the result of processes like greenhouse gas-caused warming as well as the catalyst for freshwater loss and emission release (Cleetus and Mulik 2014). As wildfires burn, they release light-absorbing CO₂ emissions which settle in the atmosphere and actively contribute to climate change, creating a dangerous feedback loop. For wildfires to start, three conditions are needed: fuel, oxygen, and an ignition source, and climate change makes it more likely that all of these conditions will be present in wilderness areas (Xu et al. 2020). For example, rising temperatures increase the likelihood of drought, drying soil and vegetation, and creating fuel. Additionally, the effects of climate change have lengthened the fire season, and the more fires, the more trees and vegetation are lost. Since trees operate as carbon sinks, absorbing excess carbon dioxide from the air, this loss makes it more difficult to remove carbon dioxide from the atmosphere, worsening

climate change, and making fires more likely (Cleetus and Mulik 2014). This feedback loop makes engaging with wildfires especially difficult as the problem can exacerbate itself despite direct human interventions.

Policy Legacy - Ineffective Fire Management Strategies

The lack of understanding of the true complexity of the wildfire problem has allowed for the long-term development of ineffective fire management policies that will be difficult to change. In many countries, wildfire management has long been rooted in fire suppression techniques; a lack of resources devoted to fuel reduction has allowed for fuel accumulation and has made decreasing fire frequency increasingly difficult. In Australia, general misconceptions that prescribed burning is an environmental threat have heavily influenced fire management policy for decades (Jurskis et al., 2003). The US has experienced a similar hesitation due to light burning being the only viable fuel reduction strategy when in fact, many ecosystems can survive low-intensity fires just fine but suffer extremely difficult to recover from damages from high-intensity fires. For clarity, fire intensity is defined as the energy released from a fire. The rate of this intensity is often linked to measures of tree mortality, the ability of an ecosystem to recover, and other characteristics (Keeley 2008). Low-intensity fires help reduce the accumulated vegetation on the forest floor, reducing fuel, and keeping the forest healthy. Early programs, which focused primarily on suppressing all fires, failed to account for the accumulation of flammable materials from the fires being suppressed (Busenberg, 2004). Thus, a naive self-defeating fire suppression policy that was established in the early 1900s has managed to be reinforced for decades and now heavily influences the way fires are managed in many countries.

Why Has this Policy Prevailed?

While it is clear that resources need to be reallocated to fuel reduction strategies, heavy social and financial investments into current policies have stagnated change. One study attributes the endurance of this failing policy to a self-reinforcing mechanism. Because this focus on suppression was critical to the initial policy structure, upon reassessment, the error became incorporated into the actual definition of the problem. To policymakers, it seemed that the effectiveness of suppression was critical to the effectiveness of fire management policy. Thus, the issue is caused by a failure to define the problem properly and can persist over long periods. The continuation of the policy demonstrates an instance of bounded rationality. Usage of bounded rationality refers to decision making with selective, rather than comprehensive, attention to relevant information (Busenberg 2004). Current policies were made to only address the suppression of unacceptably destructive fires. Until a new fire management policy is understood enough to be implemented on a large scale, a major shift is unlikely.

Status Quo Bias - The Limiting Nature of Path Dependency

While it is now recognized that fuel reduction is key to resolving wildfires, status quo bias from both civilians and policymakers as well as the psychological constraints from path dependency have made change difficult. Path dependent solutions are constrained by the innovations that have already been made. Due to the historical domination of fire suppression strategies, both policymakers and civilians believe that fire suppression is the most effective fire management strategy, rather than the most understood (Levin et al., 2012). Further, the immense accumulation of fuels over the last century makes it difficult to begin things like prescribed burns as there is a greater risk that they will escape control as well as concerns that the smoke generated will further contribute to climate change. Without reflection on why current policy

functions in the way that it does, change will be met with heavy apprehension. Additionally, a vast amount of resources would be needed to shift policy focus in this way. A 1999 US General Accounting Office estimate predicted fuel reduction would cost the US \$12 billion by 2015 (Busenberg 2004). These costs only exist because fuel reduction was not prioritized initially, however they will have to be accepted now in order to ignite meaningful change.

The hesitation to adopt stronger fuel reduction strategies is also a result of status quo bias. People operate under a status quo bias when persisting in certain actions because the uncertainty of change seems more dangerous than continuing as usual (Weber 2015). There is a persistence to continue with fire suppression policies because they are well understood. This idea permeates many climate risks, and in this particular area, such a comparable fuel reduction solution has never been implemented before, making it rampant with uncertainty (Busenberg 2004). Not only do policymakers hold this apprehension, but the public also expects protection from wildfires. General perceptions of fire suppression being the only positive solution makes fuel reduction strategies, which require controlled setting of fires, very unappealing to the voting public (Cleatus and Mulik 2014). Cognitive biases toward fire suppression must be effectively recognized and appeased before a new strategy can be found.

Risk Mitigation

Taking a Systems Approach - Finding Solutions Based on Climate Change Awareness

While engaging with wildfires seems daunting, one potential solution includes a consideration of the positive correlation between climate change and wildfires, recognizing that efforts to slow temperature rise will ease the rate at which governments must develop comprehensive solutions. Particularly, tree restoration is a highly effective carbon drawdown solution. Since trees are globally a significant carbon sink, restoration of trees lost not only to

wildfires but also to logging and agricultural development could be enormously helpful in decreasing the effects of climate change and likewise the severity of wildfires.

One study found that, globally, there is room for an extra 0.9 billion hectares of forest which could store 205 gigatonnes of carbon (Bastin et al. 2019). While debate exists over the plausibility of reforestation efforts on this scale, a combination of reforestation with the stopping of further deforestation could be an effective mitigation strategy (Buis 2019). Understanding the role of climate change in the proliferation of wildfires elucidates solutions in seemingly unrelated sectors.

Policy Change - Sustainable Fire Management

Significantly reprioritizing fire management policy using researched practices as well as traditional knowledge can be critical in reducing the damage and physical harm that wildfires are currently causing. It seems abundantly clear that fire management reform must include reducing the levels of accumulated vegetation and fuel in dry forests. The most efficient solution would likely be prescribed burns which are intentionally set fires that, in moderate weather conditions, will lower the chances of more intense wildfires. However, due to the lack of confidence in fuel reduction strategies, fear of liability risks and minimal dedicated budget funds hinder implementation (North et al. 2015). One solution involves testing prescribed burning in more remote sites before extending the practice to the areas closer to homes. This kind of solution has already been successful in Western Australia where prescribed burning has been widely practiced since the 1950s with a great deal of success (AFAC 2015).

Australia's success also demonstrates the great deal of traditional knowledge to be learned from communities that have been practicing prescribed burning and wildfire management for centuries. For example, many African communities intentionally set fires to

clear away vegetation and prevent wildfires that would be far more severe. The United Nations has made calls for this kind of traditional knowledge to be integrated into fire policies (Zhong 2022). By looking to communities that have an extensive understanding of what kind of fire management strategies will be most effective, policymakers and company leaders can have confidence in their implementation and greatly reduce the threat posed by wildfires.

Facing the Status Quo - Challenging Historical Precedent

Finally, any large-scale change to policy, climate change-aware or otherwise, will require acceptance of the costs of fuel reduction as well as a shift in citizens' expectations of fire management policy that prioritizes long-term improvement. Since status quo bias has made it difficult to imagine a new fire management strategy, it can be useful to reflect on instances where the status quo was successfully challenged. For example, bans on smoking in indoor spaces were met with heavy backlash at the time of their introduction. However, due to the work of courageous politicians who implemented these policies, today the health hazards of cigarette smoking are almost universally understood and defended (Weber 2015). Similarly, there is a fair amount of evidence in support of new practices, however, backlash from established institutions has stood in the way of true implementation (North et al. 2015). If a few organizations can demonstrate the necessity of the change, new wildfire mitigation strategies can likely be integrated into firefighting procedures.

In regards to the limits created by path dependency, many propose limiting the risks posed by wildfires by putting pressure on insurance companies to incentivize fireproofing homes and developing new buildings in areas less at risk of wildfire eruption (Cleatus and Mulik 2014). This approach, however, assumes that wildfires must continue to worsen at the same rate they currently are. If steps are taken to decrease wildfire frequency and intensity, it would not be

necessary to build further and further away from potentially hazardous zones. This is especially relevant as the number of areas vulnerable to wildfires continues to increase (Muyskens et al. 2022). Incorporating fuel reduction strategies requires challenging the current structure of wildfire management to prioritize long-term reduction rather than short-term protection from threats. While this change will force many agencies and institutions to restructure and reprioritize their operation models, it is necessary to recognize that current wildfire mitigation techniques are inherently flawed. Thus, the solution will inevitably be at odds with current structures. However, as seen in the instance of social infrastructure surrounding cigarette smoking, it is more than possible to restructure the fire management process to have long-term effectiveness.

Conclusion

The existential risks presented by wildfires are dangerously misunderstood, but not entirely unsolvable. A comprehensive understanding of the role wildfires play in the climate change cycle illuminates solutions that both deter the acceleration of climate change and lower the threat of wildfires. The application of more effective fire management strategies will also provide long-term risk mitigation, giving more time to find climate solutions that naturally reduce wildfire risk. Thus, with greater research and a general understanding of the complex processes causing wildfires, effective change can be brought about. While the legacy of misguided policy and public expectations will make any transition difficult, extensive reorganization of priorities can clear the way for meaningful engagement with the wildfire problem.

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