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THREAT OF MEGAFIRE TO SANTA FE, NEW MEXICO COMMUNITY HEALTH

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## **Application Paper**

### **I**

Is Santa Fe, New Mexico destined for a fate like those recently seen in Malibu, Santa Rosa, or Paradise, California? The unfortunate answer, according to researchers, is yes (Margolis & Balmat, 2009). How bad, and when a wildfire affects Santa Fe will be determined by three main factors: future moisture patterns, insect devastation, and fire mitigation techniques. Human costs associated with wildfires for which local officials are preparing include direct threats of flames, smoke, and floods. Less understood are indirect health effects of urbanized wildfires, such as benzene poisoning in groundwater from melting infrastructure and other concerns from chemicals (Carratt et al., 2017). These wide-ranging effects of wildfire can destroy a community, which is why it is crucial to review this threat to Santa Fe in detail.

It is often thought, based on past studies, that New Mexico is guaranteed endless drought in the face of climate change. Newer models, acknowledging an increase in atmospheric water vapor, are in fact predicting equal chances of drought or increase. Future precipitation is not easily predicted in such a rapidly warming climate. If the state sees increased overall precipitation, it *is* certain that New Mexico will see less snow, which is a primary defense for forests against wildfire (Bennet et al., 2020). Rain at the wrong time of year can mean taller grass, while drought at another can cause it to become an explosive new fuel for the area, leading to California-like wildfire conditions. No matter what the future forecast may be, we are currently seeing lower moisture in the early part of this century, leading to a looming threat of wildfires.

According to the US Forest Service, New Mexico's forests have experienced an unprecedented spike in temperatures, and with them a devastating wave of insects. As these insects have proliferated since the early 1990s, researchers have correlated devastated stands of forest with increasing occurrence of higher-intensity fires (Allen, 2007., p. 802). Elliot Margolis of the Santa Fe Watershed Association wrote in 2009: "The upper Santa Fe River

watershed, New Mexico is arguably the most at risk, high-profile municipal watershed in the southwestern U.S” (Margolis & Balmat, 2009).

Anthropogenically caused climate change poses both an immediate and long-term threat to Santa Fe. Increased fire activity is being shown to “push low-elevation forests across a critical climate threshold for tree regeneration” (Davis et al., 2019), especially threatened are Ponderosa Pine and Douglas Fir- the two main tree species surrounding Santa Fe (p. 6194). Recent studies ominously predict a scenario in which the mountains above Santa Fe will be inundated with bush-like deciduous trees instead of verdant conifers if there is high-intensity fire activity (Guiderman et al., 2018).

## II

Researchers at the University of California-Davis assembled a collaboration between public health officials, epidemiologists, engineers, and environmental scientists to help expand understanding of human health and fires. The group recently published a study that discovered cats treated after the Tubbs Fire in Santa Rosa had a highly elevated rate of heart muscle thickening and blood clot formation. The study asserts that cats may be the “canary in the coal mine” that indicate a risk of heart disease in humans that are also exposed to the smoke (*Are Cats the “Canary in the Coal Mine” for Wildfire Effects on Human Health?*, 2020). Further research will be required to identify the relevance to human health.

The cost of wildfires often overlooks indirect health effects. Health officials in Los Angeles have sounded the warning on this matter to colleagues around the nation. In 2016, it was estimated that in California’s most destructive blaze, the Camp Fire, Los Angeles County’s cost of health effects was \$9.50 per resident, with a population of over 10 million people (Carratt et al, 2017, p. 2.). Costs for any fire will increase in proximity to a population center, largely due to unforeseen indirect health effects.

Wildfires have long-lasting effects on human health in the form of water pollution. As the fire season grows due to climate change and expands into the spring, it can start to be concurrent with times of maximum pesticide application: “An underappreciated aspect of wildfires is the effect of pesticides and wildfire suppression chemicals present in the environment prior to burning or that were added to the fires in the firefighting process (p. 2)”. Recently, cities in California have reported contamination to water supplies of many chemicals, including many

reports of benzene. This is often driven largely by PVC pipes in housing as a fire enters developed areas (“Hidden Damage” 2019).

A direct and indirect hazard to public health during wildfires is the toxins in chemicals that are used during suppression. Many fires are combatted with foams or slurries that can have long-lasting effects on public health and water ways. These impacts vary depending on their intended use and methods of application. Foam products, for example, are used for short-term firefighting applications and can historically have contained perfluoroalkyl acids (PFAAs), which can accumulate in surface waters and firefighters that are exposed to the substance. Although PFAAs are largely phased out currently, replacement foams have also been shown to transfer dangerous compounds to humans consuming fish near past firefighting efforts (Carratt et al., 2017, p. 9).

Wildfires have been documented to have over 150 chemicals in their smoke column (Youssouf et al, 2014). The amount of smoke to which a population is exposed is affected by environmental factors as well as mitigation techniques. The use of retardant, for example, can cause a fire to smolder and significantly increase the amount of chemicals that transfer into an enlarged smoke plume (Carratt et al., 2017, p. 4). When a wildfire enters an urban area, these hazards expand to include “pulverized glass, cement, dust, asbestos, plaster, or other chemical compounds,” including radioactive materials (Youssouf et al, 2014). Globally, wildfires contribute 41% of Carbon Monoxide, and 15 % of annual Nitrogen oxides per year to our atmosphere (Youssouf et al, 2014). As fires increasingly intermix with urban infrastructure, these figures are expected to increase.

Forest officials acknowledge risks of these chemicals, which are often used for corrosion inhibition in delicate aircraft, or to prevent the evaporation of water, and repeated misapplication of the retardants. Officials point to extensive partnerships with US Fish and Wildlife and other organizations, as well as extensive oversight, in their efforts to minimize impacts. Exposure to toxins from a wildfire can cause eye or respiratory distress, heart failure, and premature death (*Wildland Fire Research: Health Effects Research*, 2020). It would be an intuitive preventative public health policy to recognize imminent wildfires as a significant hazard to Santa Fe’s security and take measures to prevent the need for chemical firefighting through other common mitigation methods.

Another study out of UC-Davis from 2017 was detailed in its explanation of the disparity between public health awareness and the threat of wildfire. It found that the risk will continue to grow as wildfire increasingly intermixes with anthropogenic materials pose many of the above short-term risks mentioned and expressed alarm at

the effect repeated fires are having on wildland fire crews. The study suggested that repeated damage will become cumulative in the general public as well, with exposure beginning in infancy for most people and “developing lung and other long-term health considerations for specific populations” (Black et al., 2017). The report, considered to be one of the most comprehensive ever performed on the subject, concluded that: “A high degree of collaboration between experts in air quality monitoring, smoke exposure modeling, toxicology, physiology, and epidemiology, will be needed to fully understand the true health impacts of wildfire smoke” (Black et al., 2017).

Health officials are well aware of the possibility of a catastrophic mass-casualty event related to wildfire in the form of a major flood. After the Conchas Fire in the Jemez Mountains, the watershed above the Santa Clara Pueblo, which is a similar size to the Santa Fe watershed, began to flood the community below with dangerous floods (*Disaster Declaration Clears Way for Aid to Santa Clara Pueblo*, 2013). This is owing to the fact burn scars cannot hold water. Authorities will be unable to stop such a flood from overtaking our meager dams upstream and flooding a large section of Santa Fe (*Santa Fe Uses New Technology to Better Prepare for Potential Flood Damage*, 2020). To better understand what mitigation measures will be required for implementation, the city has invested \$200,000 to create a highly detailed map of areas at risk of flooding (*Santa Fe Uses New Technology to Better Prepare for Potential Flood Damage*, 2020). Santa Fe’s downtown area, with a relatively high population density, may not have time to be evacuated in such an event.

Not everything about a wildfire is dangerous and detrimental to human health; modern landscapes are dependent on cycles of wildfire. Ponderosa pines are well-known for releasing their seeds, like many other plants, in the heat of a fire. A positive benefit of wildfires is the increase of bee populations, which take advantage of abundant wildfires following a fire. (Mola et al., 2020) In a time when bees are dying off, this is certainly important and positive for greater human health and food security. These positive impacts are severely limited, however, because of the elevated risks caused by climate change. At some point after a megafire, the fire threat will be significantly lessened due to the reduced biomass, leading to accelerated erosion and snowmelt. This new level of climate-caused destruction will provide a new threat to local health by destroying much the already limited local water supply.

### III

Although the scenario of a large fire event is nearly inevitable for Santa Fe, the devastating health effects do not have to be. Public health officials have the chance to listen to their counterparts in other fire-ravaged communities and continue to evolve their response plans. Studies show that the economic benefits of mitigating community exposure to smoke and chemicals are high, so it is important that leadership take this into account with any fire safety plan. This applies especially to the application of any chemically based preventative fire retardant, which is often heavily laden with chemicals that can last long after any application (Carratt et al, 2017, p. 9). Santa Fe has one of two fire departments in the state that have permanent positions dedicated to Wildland Urban Interface and Wildfire Prevention, as well as two seasonal hand crews that focus on fuel management. In efforts to prevent the necessity of chemical firefighting, local forests are being extensively treated with manual thinning and other techniques. Public health officials and forestry officials hope to save money related to health impacts and property loss by implementing a complex attack plan (*Wildland Fire Preparedness*, 2020).

There are many safety measures that need to be communicated to Santa Fe residents. First and foremost, it is crucial that all at-risk residents have access to a safe and swift evacuation plan. Santa Fe residents should understand the danger and prepare with preventative health measures. The entire town is close enough to a potential fire zone to necessitate an evacuation plan, as well as an emergency food and water supply. Any members of the community with livestock or pets need to assure the safety of these members of the more-than-human community. During the COVID-19 crisis, residents should assure that any plans ideally enable them to stay away from evacuation centers to avoid spreading or contracting the virus. The Santa Fe Fireshed Coalition ([santafefireshed.org](http://santafefireshed.org)) offers free HEPA filters to at-risk residents. Residents should seek to secure any windows or vents in the event of a dense toxic smoke cloud, to have a safe place to shelter and protect property. Every house should be ‘firescaped,’ or landscaped to the recommendations of local fire officials, and houses near the forests should have sprinkler systems attached to douse any possible ember that touches the structure.

Finally, it is crucial for local officials to focus on increased education. A study in Italy about wildfires and climate surrendered to increased fire events and said that the most important mitigation measure that can be employed is education (Michetti & Pinar, 2020). Studies around the world are showing that higher temperatures are leading to increased frequency and intensity of fires during longer seasons (Bennet et al., 2020). It will be crucial to

minimize the inevitable increase of these fire events that there is an endless campaign educating the public of the looming threat. One example of a tool for increasing public awareness could be a study that examined only New Mexico and Arizona from 1984 to 2015 found that there appears to be an acceleration of the threat: “The relationship between climate and fire activity appears to be strengthening since 2000” (Bennet et al., 2020). Our region will experience an eventual sustained decline of wildfires due to the biomass limitations. Another example could be an artistic campaign in which artists paint New Mexico’s mountains without trees.

#### IV

The Forest Service is always quick to remind us that it is vital to envision what type of landscape is left after urban areas and wildfires mix. Shortsighted approaches of the past often leave burnt areas polluted by poisonous smoke and fire retardant. A study published late last year went so far as to propose dousing large parts of the state of California in a “long term fire retardant” (Yu et al., 2019). On the other end of the spectrum, opponents of the use of chemicals in fire management point to the fact that there is no proven beneficial effect in fire outcomes, health issues for humans. They also cite the ability for a single air drop to kill all life in miles of streams as they become ammoniated (Parks, 2011).

There are no easy answers, only questions, in an unprecedented age. When Santa Rosa and other cities in California burned with such ferocity, many residents wondered if the area was fit for human habitation. In a 2009 report published in *Forest Ecology and Management*, Margolis describes his vision of a large wildfire event; “This type of event in the Santa Fe watershed could destroy the water supply infrastructure and flood the historic heart of the city” (Margolis & Balmat, 2009).

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