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State of Emergency: Examining the Impact of Growing Wildfire Risk on the Insurance Market

House Committee on Financial Services
Subcommittee on Housing, Community Development and Insurance

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Good morning, Chairman Cleaver, Ranking Member Hill and members of the Subcommittee. I am Matthew Auer, Dean of the School of Public and International Affairs at the University of Georgia's School of Public and International Affairs. I began a career in forestry and environmental policy in the 1990s. Back then, policy experts predicted that climate change would challenge how insurance companies typically model and price risk when they underwrite insurance policies. According to the National Oceanic and Atmospheric Administration, "Climate change, including increased heat, extended drought, and a thirsty atmosphere, has been a key driver in increasing the risk and extent of wildfires in the western United States during the last two decades" (NOAA, 2022; Zhuang, 2021). As predicted, these environmental changes are playing havoc with insurance markets and this affects everyday policy holders, including lower income homeowners.

I became especially interested in the problem of wildfire risk and insurance nonrenewal in 2018 after learning about policyholders in wildfire-prone areas of California who were receiving letters from insurance companies declaring the termination of their coverage. My own mom received a letter like this. But she was lucky. She could find replacement insurance, and it was insurance she could afford. As committee members know, when homeowners cannot find regular, replacement insurance, they can opt for insurance of last resort which is called FAIR Plan insurance. This is bare bones insurance that will cover losses due to fire or smoke. But typically, a homeowner must obtain a difference in conditions policy to make up the gap between FAIR Plan and regular homeowners insurance so as to cover claims like water damage, theft, and liability. Even when a homeowner is able to find regular replacement insurance, they can typically expect to pay more for the same or less coverage (United Policyholders, 2022). In many markets, these trends are particularly disadvantageous for lower income homeowners.

Benjamin Hexamer, a University of Georgia graduate student, and I, wanted to gain a clearer sense of which homeowners are at particular risk in the most wildfire-prone states. Research we authored on the subject of wildfire, income, and insurance is attached to this testimony. We found that, among the 14 states with the highest total acreage burned by wildfires between 2016 and 2020, 98 counties had a moderate to high wildfire hazard potential or WHP, which the U.S. Forest Service developed to measure wildfire risk. We found that 60 percent of these counties had a poverty rate exceeding the official

national poverty rate (Auer and Hexamer, 2022). Hence, the majority of homes in the most at-risk counties in the American West and in Florida are in areas with comparatively higher poverty rates.

We were also struck by how different data sources provide different estimates of risk. Hence, when considering counties that have high concentrations of homes with significant wildfire risk, combined with higher poverty rates, it matters a great deal whether you use data from the Forest Service or from organizations with more up-to-date, higher resolution data. This has implications for how Congress and the federal government understand the problem of wildfire and risks to homeowners. Technology companies that help insurance carriers estimate risk – or insurtech companies – tend to have more powerful tools and methods for estimating risk than do federal agencies, but algorithms they use are generally proprietary.

Our research also pointed to a potential red flag for wildfire prone states when it comes to the concentration of insurance underwriting. We were interested in market share or the proportion of net premiums held by the largest insurance companies. There are nine states where the cumulative market share of the top-10 property and casualty insurers is 60 percent or more of the market. Seven of those states are among the 14 most wildfire-prone states in the lower-48. There is research showing that higher market concentration is associated with lower financial stability of insurance firms (Shim, 2017). Even in the seven states with comparatively highly concentrated markets for underwriting, the carriers tend to be large, name-brand companies with strong balance sheets and high credit ratings. So, most of these firms are financially stable. Yet, we have observed even major underwriters leaving natural disaster-prone markets due to losses from wildfire and hurricanes (Florida Chamber of Commerce, 2022). One bad fire season or handful of major natural disasters can rapidly change market share composition in different states. Going forward, it would be prudent for Congress and for insurance regulators in these states to consider whether a dwindling set of insurance companies are making risk decisions for large numbers of policyholders – regardless of whether those companies are admitted or approved surplus line insurers.

Increasingly, insurance companies as well as state and local authorities require homeowners to adopt fire safety measures. For some homeowners, this is a condition for a new policy or for renewal of coverage. Property owners can and should play a significant role in protecting their own homes from wildfire. However, we must do a better job of helping disadvantaged homeowners help themselves.

For lower income homeowners, the financial burdens of home hardening and creating defensible space can be considerable. Consider, for example, the situation in some wildfire-prone counties in New Mexico that have median household incomes of \$35,000 or less. Lower income residents are already burdened by relatively high rates for homeowners insurance in that state. New Mexico ranks among the top-15 in the nation (Vitu, 2022). If an insurance company were to require a homeowner to implement wildfire safety measures, those costs will add up. The premium for \$250,000 worth of dwelling coverage in New Mexico is around \$1,900. That represents over six percent of median household income in a county like Mora, New Mexico. Mora was one of the counties hit by this year's Hermit's Peak-Calf Canyon fire – the largest wildfire ever recorded in New Mexico.

Some strategies for reducing the cost of insurance are impractical for lower income homeowners. When we urge policy holders to increase the deductible on dwelling coverage instead of lowering the actual dwelling coverage limit on the home, that's good advice in general, but it is unreasonable to expect lower income homeowners to rebuild on a high deductible policy. We also tell homeowners to shop

around for their policy. Again, that is good advice. However, underserved communities may be the least likely to shop around. Many property owners may not even be aware of the services of independent insurance agents.

Underserved communities may not be the loudest or best organized voices reaching the ears of state insurance commissioners. In fact, there are a great many stakeholders, not limited to homeowners, who are pressuring insurance commissioners about wildfire. These voices are not always in concert. On the one hand, commissioners are watchdogs for consumers. On the other hand, they must be fair-minded as they regulate and respond to demands for rate increases by insurance companies who incur higher costs and losses. If a state commissioner's decisions are arbitrary, unfair, or simply deemed harsh by insurance companies, those firms can decide to close shop and leave the market.

Increasingly, insurance commissioners are hearing and responding to the wildfire-related concerns of homeowners, in particular. Yet, the present context in many states resembles a game of whack a mole with commissioners responding to complaints that insurance companies are placing limits on fire-related coverage, denying claims, or failing to recognize and reward the fire safety measures taken by homeowners. Since coming into office, California Insurance Commissioner Ricardo Lara has been especially proactive at addressing these concerns. His efforts include ordering California's FAIR Plan to offer comprehensive or HO-3 coverage and to raise the ceiling on coverage limits (California Department of Insurance, 2019). The California Fair Plan Association has resisted the call for comprehensive coverage, specifically, and has lost a relevant case in court, yet, as of Monday of this week, the FAIR Plan continued to advertise only HO-1 coverage for fire and lightning, smoke, and internal explosions while directing customers needing additional insurance to consider difference in conditions coverage (California FAIR Plan, 2022).

The problem of protecting homeowners from losing their insurance or having to replace it with expensive or bare-bones FAIR Plan insurance is not exclusively the responsibility of insurance companies nor of state insurance commissioners. Federal assistance will continue to loom large for the most at-risk communities. Consider, for example, the \$100 million in FEMA Hazard Mitigation Grant funds that are flowing to California to help homeowners make their homes safer from wildfire. The Office of Emergency Services and CAL FIRE are distributing these funds in a pilot project called the California Wildfire Mitigation Program. Communities selected for assistance have higher concentrations of people over the age of 65, residents with disabilities, people living in poverty, and populations with limited English or lack of access to a car. This is a cost-share program. FEMA pays up to 75 percent of the cost of eligible mitigation projects. The California state legislature has enabled California's Office of Emergency Services to make a 25 percent match at the local level. The local communities in this case are fortunate insofar as the state is making this match possible. Sometimes the match simply is not on the table. Consider that FEMA's Building Resilient Infrastructure and Communities program requires a 30 percent match. There are communities that cannot find the match nor have the staffing to manage the grant. A stronger, consultative role by states in the allocation of these funds could help address these problems.

FEMA-supported programs like the California Wildfire Mitigation Program and the Safer from Wildfires initiative spearheaded by California's Insurance Commissioner are designed not only to directly help homeowners make their homes safer but also to inspire insurance companies to re-enter the market as homeowners and communities become more resilient to wildfire. These strategies and others could shift the insurance industry's thinking, transforming risk into opportunity (Sidoti, 2022). Nevertheless,

even as insurance and reinsurance companies become more proficient at estimating risk, lower income homeowners and lower income renters will not be the primary beneficiaries, particularly if better risk forecasting leads to higher premiums and lower coverage limits.

When it comes to protecting the most vulnerable communities in harm's way, present and future funds authorized by Congress are essential. Indeed, FEMA, with support from Congress, has made strategies like the California Wildfire Mitigation Program possible. All the relevant trends indicate that today's pilot programs to harden homes and create defensible space, supported by federal agencies, will need to evolve into longer-term, sustained programs that help underserved communities with fire safety measures in multiple states.

I wish to thank the Committee for their attention to this important matter and for inviting me to join today's hearing.

Selected References

Auer MR, Hexamer BE. 2022. Income and Insurability as Factors in Wildfire Risk. *Forests* 13(7): 1130. <https://doi.org/10.3390/f13071130>.

California Department of Insurance. 2019. Department Issues Revised Plan of Operation for FAIR Plan in Response to Commissioner's Order to Modernize Coverage for California Consumers. <http://www.insurance.ca.gov/0400-news/0100-press-releases/2019/release099-19.cfm>

California FAIR Plan. 2022. Dwelling. <https://www.cfpnet.com/policies/dwelling/>.

Florida Chamber of Commerce. 2002. Breaking News: State Insurer of Last Resort Hits 1 Million Policies. <https://www.flchamber.com/breaking-news-state-insurer-of-last-resort-hits-1-million-policies/>

Headwaters Economics. 2022. Capacity-limited States Still Struggle to Access FEMA BRIC Grants. <https://headwaterseconomics.org/equity/capacity-limited-fema-bric-grants/>

NOAA. 2022. Wildfire Climate Connection. <https://www.noaa.gov/noaa-wildfire/wildfire-climate-connection>.

San Diego Fire/Fire Protection District. 2022. California Wildfire Mitigation Program – Home Hardening Initiative. <https://www.sandiegocounty.gov/content/sdc/sdcfa/crr/ca-wildfire-mitigation-program/faqs.html>

Shim, J. 2017. An Investigation of Market Concentration and Financial Stability in Property–Liability Insurance Industry. *Journal of Risk and Insurance* 84(1): 567-597.

Sidoti, C. 2022. Running toward Climate Risk. Insurance Thought Leadership. <https://www.insurancethoughtleadership.com/resilience-sustainability/running-toward-climate-risk>

State of California. 2022. Governor's Office of Emergency Services. *Budget Change Proposal. California Wildfire Mitigation Program*. Budget Request 0690-132-BCP-2022-MR.

- United Policyholders. 2022. Dropped by Your Home Insurer? Information for Colorado Residents. <https://uphelp.org/buying-tips/dropped-by-your-home-insurer-information-for-colorado-residents/>.
- Vitu, T. 2022. Wildfire Risk Pushes up Home Insurance Rates. https://www.santafenewmexican.com/news/wildfires/wildfire-risk-pushes-up-n-m-home-insurance-rates/article_a3cd8678-06db-11ed-816a-cfa3f37115ee.html.
- Zhuang, Y. et al. 2021. Quantifying Contributions of Natural Variability and Anthropogenic Forcings on Increased Fire Weather Risk over the Western United States. *Proceedings of the National Academy of Sciences*. <https://doi.org/10.1073/pnas.211187511>

Article

Income and Insurability as Factors in Wildfire Risk

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Abstract: The increasing frequency of destructive wildfire incidents in the United States, particularly in the West, is well-documented, and the key causal variables are increasingly well understood. Among stakeholders with heightened concerns about risks from destructive wildfire are insurance companies and the homeowners they insure. The cancellation and nonrenewal of insurance due to wildfire risk has received media attention in the wake of major wildfire seasons, particularly in California. However, less attention has been directed to wildfire-related risks borne by lower-income policy holders, specifically. For example, the probability of maintaining or replacing an at-risk policy increases when a homeowner invests in fire protection measures. However, these investments are comparatively costly for lower-income homeowners. The present research aims to identify regions in the lower 48 states where moderate and high wildfire risk, lower income, and insurability are coterminous risks. The concentration of at-risk homes in counties with comparatively high wildfire hazard potential and comparatively higher poverty rates are considered. This paper also considers how the concentrated market share of insurance underwriting may pose a risk to lower income homeowners, considering the overlap between highly concentrated insurance markets and states with high wildfire risk and higher poverty rates.

Keywords: wildfire; wildfire hazard potential; poverty rate; homeowners insurance



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1. Introduction

Numerous destructive and deadly wildfires, particularly in the American West, have garnered national attention over several years. In the ten-year period ending 2021, undesirable and erratic wildfire (as opposed to fire managed intentionally for forest health and for the safety of nearby communities) burned an average of 7.36 million acres per annum in the United States, representing a 37.4 percent increase in acres burned annually over the prior 20-year period [1]. Memorably, cataclysmic fires are often associated with California including the deadly 2018 Camp Fire that largely destroyed the town of Paradise and the massive 2021 Dixie and Caldor Fires. However, in the early months of 2022, destructive blazes beyond the Pacific coastal region received national attention, including in Arizona, Colorado, and Texas. New Mexico confronted the largest wildfire in that state's modern recorded history.

Climate change is an overarching driver of increased wildfire activity, magnifying the effects of other variables, including persistent drought, mild winters, increased days of scorching summertime temperatures, earlier snowmelt timing, increased vapor pressure deficit and wind speeds, increased length of rain-free intervals, the geographical expansion of forest-killing pests and pathogens, and the build-up of forest fuels—the latter partly resulting from a prior era of faulty forest management practices [2–5]. Communities' capacities to plan for, endure, and recover from wildfire differ across wildfire-prone regions of the country. Increasingly urgent is the need for stakeholders, including federal, state, and local officials, to support communities that are most at-risk, including lower-income and minoritized communities—many of which are outside of California [6,7].

One manifestation of disproportionate, wildfire-related risk for lower-income people is the problem of property insurance nonrenewal and cancellation. Discontinuance of homeowners' policies due to wildfire risk increased substantially in California in 2018 and 2019 as insurance companies incurred major losses on policies in wildfire-prone regions. Many homeowners were resigned to adopt "last resort" insurance through California's FAIR Plan which generally entails expensive premiums and more limited coverage. For homeowners whose policies are suspended, securing replacement insurance, including FAIR Plan insurance, may require homeowners to retrofit homes with fire-resistant technologies and/or create defensible space in and around insured properties. Adopting these measures, out of pocket, poses comparatively higher economic burdens on lower-income households ([7,8]). The present article triangulates data on poverty, wildfire risk, and insurability risk to identify the most at-risk counties in the coterminous U.S. We consider county-level data, recognizing that counties, in collaboration with states, are especially important in mustering resources to prepare for, withstand, and recover from wildfire.

2. Income and Insurability as Factors in Wildfire

Over the past several years, multiple studies have documented disadvantages for lower-income or minority communities in their abilities to prepare for, respond to, and recover from destructive wildfire including in California [9], Florida [10], and Oregon [11]. Nationwide, Davies et al. [6] found that the vulnerability to wildfire increased as the proportion of Native Americans and Black individuals increased in a given community. Using census tract data, the authors estimate that majority Native American, Black, or Hispanic communities experienced around 50 percent greater vulnerability to wildfire compared to other census tracts. More recently, using wildfire risk data generated by the First Street Foundation, the *Washington Post* predicted that by 2052, around 44 percent of all Native Americans and one in four Hispanic people will live in areas with significant probability of wildfire [8].

Ability to recover from destructive fires is affected by the reliability of property insurance [8]. Insurance insecurity is of particular interest in the present research, inspired by a recent surge in wildfire-related insurance claims as well as insurance nonrenewal and cancellation in California [12,13]. In that state, a major increase in claims by policy owners in 2017 and 2018 led to large numbers of nonrenewed or suspended policies. Coverage by California's FAIR Plan—last-resort insurance for properties deemed high-risk—jumped from 140,000 in 2018 to 200,000 in 2019. Since 2018, multiple moratoria have been issued in California, prohibiting the cancellation or nonrenewal of policies in or adjacent to areas that have been subject to fire-related state-of-emergency orders.

In 2021, California unveiled the "Safer from Wildfires" framework that aims to attract insurers back to wildfire-prone areas as homeowners undertake fire safety measures. The latter include interventions such as installing fire-resistant vents and eaves, upgrading windows, creating defensible space around the home, and coordinating with neighbors to establish wildfire evacuation routes. Safer from Wildfires responds to complaints that insurance companies too often fail to account for out-of-pocket fire-protection measures taken by homeowners. The new program requires insurance carriers to recognize fire safety efforts through "wildfire risk scores" that rate individual and commercial properties. Safer from Wildfires includes a partnership with the Federal Emergency Management Agency to make USD 100 million available to qualifying property owners in wildfire-prone areas who adopt home-hardening and defensible-space measures.

Safer from Wildfires or comparable programs could be models for wildfire-prone areas outside of California. We assume that direct, governmental aid programs—comparable to Safer from Wildfires—will be needed to assist lower-income homeowners, considering the intersection of areas with high wildfire hazard potential and higher poverty rates. We examine data on wildfire risk and poverty at the county level, recognizing that counties are major participants in wildfire planning, response, and recovery efforts. In addition,

counties are vital service-providers for rural and unincorporated areas, including sparsely populated, lower-income areas that receive few or no municipal services.

3. Materials and Methods

Wildfire risk data are derived from the Wildfire Risk to Communities datasets of the U.S. Forest Service [14] and from the First Street Foundation Wildfire Model [15]. Wildfire Risk to Communities features multiple raster geospatial data sets on wildfire risk, depicting relative risk for communities at 270 m horizontal resolution. We adopted the Wildfire Hazard Potential (WHP) dataset—an index that quantifies the relative potential for wildfire that may be difficult to control [16]. WHP is derived from Large Fire Simulator (FSim) data developed by the US Forest Service Missoula Fire Sciences Laboratory, and includes modules for weather generation, wildfire occurrence, fire growth, and fire suppression, in addition to weather data from the National Weather Service and demographic data from the U.S. Census Bureau. FSim models the probability of the occurrence and growth of wildfire under tens of thousands of hypothetical contemporary fire seasons so as to estimate the probability of uncontrolled wildfire in a given area [17]. WHP is also informed by point locations of past fires (circa 1992–2005), and data on spatial fuels and vegetation provided by the public–private collaborative, LANDFIRE [18]. We adopted Mean WHP which is the housing-unit weighted mean of the WHP raster within each summary polygon [19].

The Forest Service notes that WHP “is not a forecast or wildfire outlook for any particular season, as it does not include any information on current or forecasted weather or fuel moisture conditions [19]”. Other recently developed data sets offer more refined predictions of wildfire risk at the neighborhood and individual-property level [20]. The First Street Foundation Wildfire Model (FSFWM), released in May 2022, uses a 30 m spatial resolution approach to predict wildfire exposure for any location in the United States. The great strength of FSFWM over the Forest Service’s Wildfire Risk to Communities’ model is the ability to compare risk within communities, rather than across sets of communities [15] (p. 6). FSFWM incorporates data from the Forest Service on wildfire fuels, probable ignition location based on historic fires, data from the National Oceanic and Atmospheric Administration on past weather patterns that impact fuels, and data on the probabilistic spread of fires [21]. In addition, FSFWM includes a 10-point (and elsewhere, 5-point) “Fire Factor” (or “Risk Factor”) scale that measures the cumulative likelihood of a specific property being affected by wildfire over a 30-year period [21]. First Street Foundation catalogued properties by triangulating public real estate and tax assessor records, data from the U.S. Geological Survey, and data from the U.S. Department of Agriculture. We compared FSFWM and the Forest Service’s Wildfire Risk to Communities model to identify discrepancies in the designation of counties with moderate-to-high wildfire risk.

The 14 states among the lower 48 with highest wildfire risk were identified by comparing the average annual acres burned by wildfire, by state, across the coterminous U.S. between 2016 and 2020, according to data from the National Interagency Fire Center [1]. Those states are Arizona, California, Colorado, Florida, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. Among the 14 states with high wildfire risk, we isolated counties with moderate-to-high WHP combined with a poverty rate at or above the national average. WHP is a continuous variable with five categories: very low (1), low (2), moderate (3), high (4), and very high (5). After Davies et al. [6], we adopted $WHP \geq 3$ as the lower boundary for identifying counties with comparatively higher risk of destructive wildfire. From First Street Foundation’s 10-point Fire Factor scale, we identified all counties with Fire Factor scores of moderate or higher in the 14 states with the highest wildfire risk. The goal of the comparison of the Forest Service and First Street Foundation data was to identify differences in the two models’ designation of counties combining comparatively high wildfire risk and higher poverty rates. Poverty rate data are derived from the American Community Survey data of the U.S. Census Bureau [22]. In 2019, the national poverty rate was 12.3 percent. We propose that among counties with WHP of 3 or greater, it is counties with comparatively higher poverty rates, i.e., equal to or

greater than 12.3 percent, that are especially vulnerable to the safety and economic risks posed by destructive wildfire.

Other materials include archival research on reportage of nonrenewal and cancellation of homeowners' insurance in the United States due to wildfire risk. More so than in any other state, homeowners in California have grappled with the suspension of policies, as insurance companies attempt to contain wildfire-related losses and avoid future liabilities. In the absence of moratoria, it is fair to expect increased incidence of insurance discontinuance in other states with elevated wildfire risk [23]. We consider which counties in the top wildfire-prone states are especially vulnerable considering the prevalence of lower-income households.

4. Results

4.1. Geography of Wildfire Hazard and Poverty

In the coterminous United States, among the 14 states with the highest total acreage burned by wildfire between 2016 and 2020, 98 counties had a WHP of 3 or greater. Of those 14 states, Oklahoma and Wyoming had no counties with a $WHP \geq 3$. In the remaining 12 states, counties combining moderate-to-high WHP and higher poverty rates ($WHP \geq 3$ and $PR \geq 12.3$ percent) outnumbered counties combining moderate-to-high WHP and lower poverty rates. Sixty percent of counties with $WHP \geq 3$ had a poverty rate ≥ 12.3 (shaded red in Figure 1). Forty percent of counties with $WHP \geq 3$ had a poverty rate of < 12.3 (shaded pink).

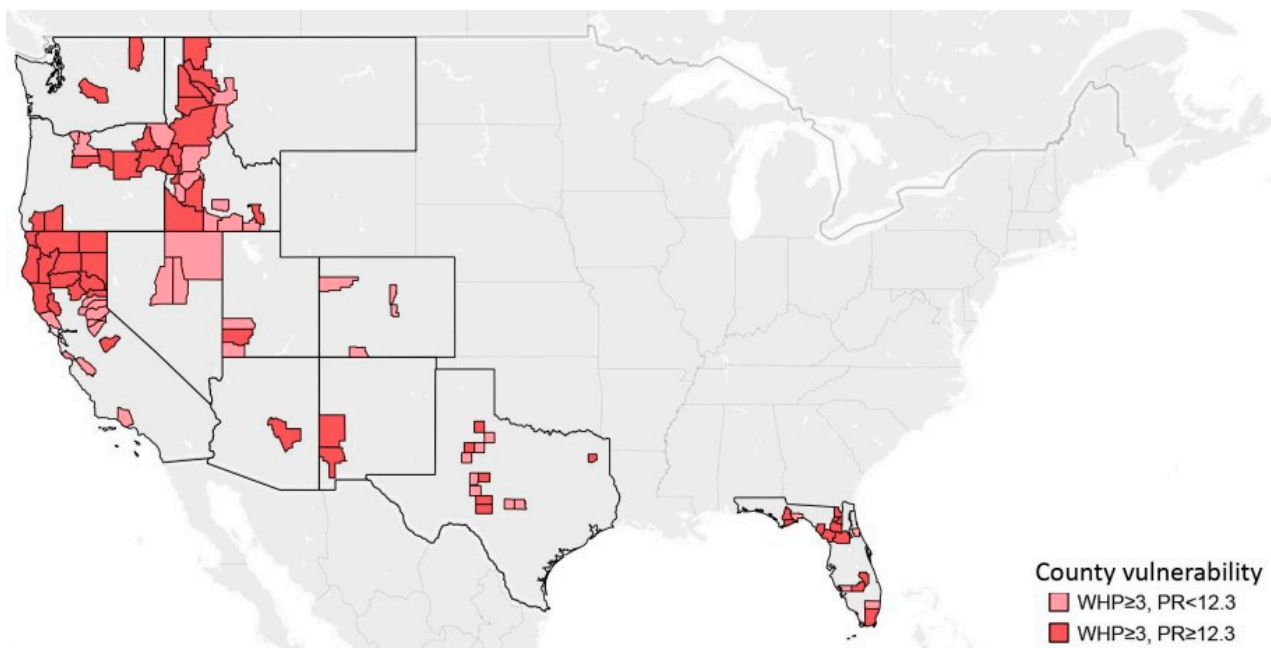


Figure 1. Higher wildfire hazard potential and poverty rates in high wildfire risk states.

The geographical distribution of areas in the high-wildfire-risk states, which combine moderate-to-high WHP and higher poverty rates and take the form of clusters of adjoining counties. For example, several at-risk northern California counties are adjoining, and the cluster is contiguous with two counties in southwest Oregon. Elsewhere in Oregon, a cluster of moderate-to-high WHP and higher poverty rate counties are in the state's north-central and northeast regions. An unbroken set of coterminous counties running along the western axis of Idaho and adjacent to counties in Nevada combine elevated wildfire hazard potential and higher poverty. In contrast, one dozen counties in Florida combine moderate-to-high WHP and higher poverty, but there is comparatively greater geographical dispersion of these regions in different parts of the state.

Figure 2 exhibits the 59 counties with moderate-to-high wildfire hazard potential that are comparatively lower-income (red), and 39 moderate-to-high WHP counties with poverty

rates below the 2019 national poverty rate of 12.3 percent (blue). Not only are there more higher-poverty-rate counties among the 98 counties, there is also greater variance in the poverty rate in the higher-poverty-rate vs. lower-poverty-rate counties ($\sigma^2 = 8.68$ vs. 2.38). The variance is greatest in the poorest subset of counties (steeper-sloping, far-right-hand portion of the red distribution in Figure 2).

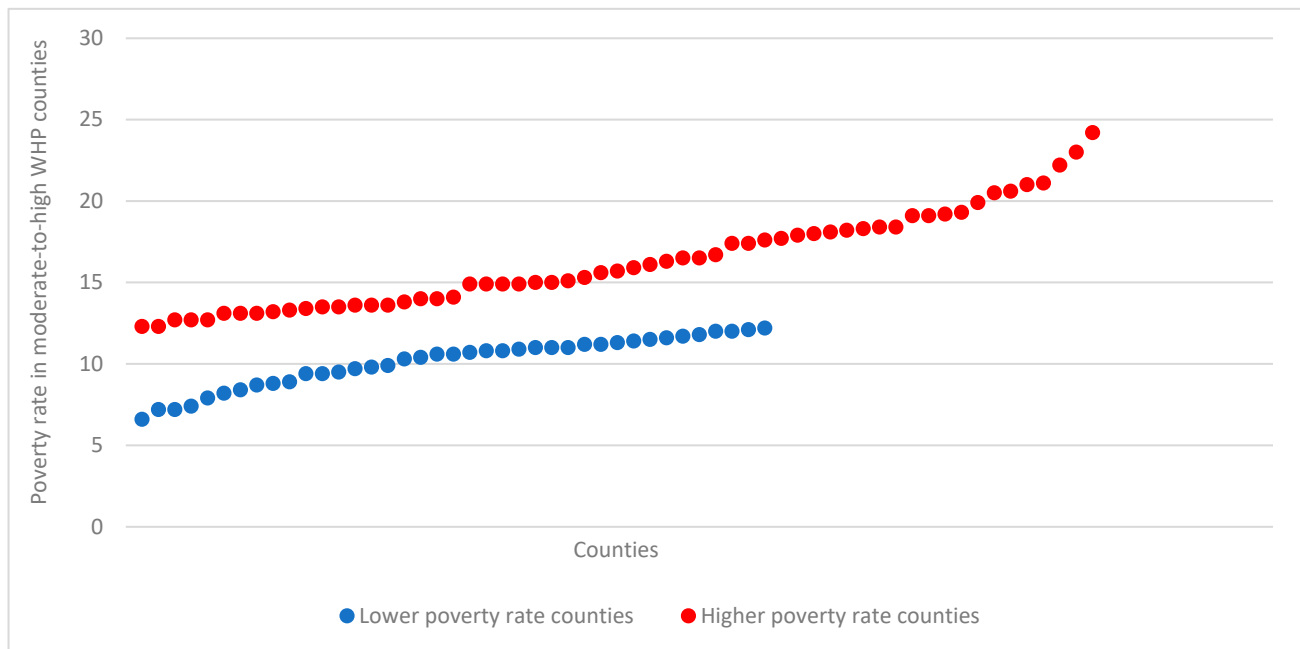


Figure 2. Poverty rate range in counties with moderate-to-high wildfire hazard potential.

Figure 3 combines three datasets: counties with moderate, major, severe, or extreme wildfire risk among the 14 highest wildfire risk states, per First Street Foundation's Fire Factor scale; all WHP ≥ 3 at the county-level per the Forest Service's Wildfire Risk to Communities data; and county-level poverty rate data from the U.S. Census Bureau. With the exception of Lincoln County, Montana, all higher-poverty-rate counties that the Forest Service model designates as having moderate-to-high wildfire risk are identical to at-risk counties identified by the First Street Foundation's Fire Factor (all red-shaded counties in Figure 3). Similarly, lower-poverty-rate counties that the Forest Service recognizes as having moderate-to-high wildfire risk are matched by Fire Factor data (pink-shaded counties). The major differences between the Forest Service and First Street Foundation model outputs are instances of lower-poverty-rate counties that the Forest Service categorizes as lower wildfire risk (WHP < 3) but that First Street Foundation labels moderate or higher wildfire risk. The latter counties are shaded yellow in Figure 3.

It is important to consider that the Forest Service's WHP and the First Street Foundation's Fire Factor are not directly comparable metrics. WHP is an index that quantifies the relative potential for wildfire that may be difficult to suppress. In contrast, First Street Foundation's 1-to-10 (and alternately, 1-to-5) scale for measuring Fire Factor considers the cumulative likelihood of a property being affected by wildfire over a 30-year period. Notwithstanding these differences, the two models rely on comparable data: WHP and Fire Factor both incorporate data on spatially derived estimates of burn probability. Second, Fire Factor incorporates the Forest Service's LANDFIRE fuels dataset as a baseline for fuel type and fuel behavior [24]. Third, the metric adopted by the two models is a continuous integer value that depicts probabilistic risk.

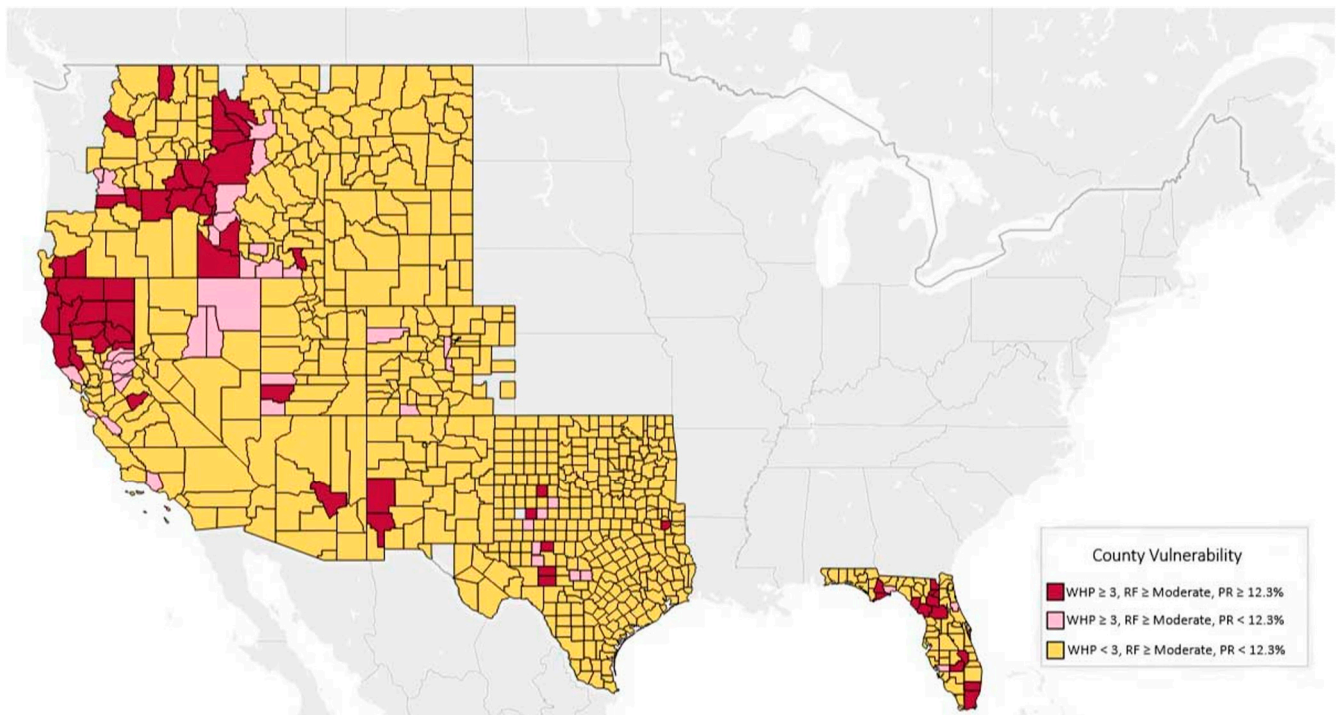


Figure 3. Higher wildfire hazard potential in combined Forest Service/First Street Foundation/U.S. Census Bureau datasets.

4.2. Wildfire, Housing Concentration, and Insurance Risk

From an insurance perspective, concentration of housing units in wildfire-prone areas is another important variable to consider, whether relying on Forest Service WHP or First Street Foundation Fire Factor data as an indicator of wildfire risk. We are particularly interested in the intersection of concentrated housing, poverty, and insurance insecurity. Data on housing concentration in wildfire-prone areas was provided by Verisk, a data analytics firm that models wildfire risk for the insurance industry. Verisk's FireLine risk management tool combines remote-sensing imagery, data on fuel abundance and fuel regrowth in previously burned areas, slope of terrain, access (i.e., road access for fire containment), and U.S. Census Bureau data on housing unit density. Data for Florida were unavailable. We matched counties in each of 12 states that combine Verisk's 2020 data on the concentration of housing units in counties with high and extreme wildfire risk (where "high and extreme" is the top tier of Verisk's three categories of wildfire risk) combined with our 2020 data set of 59 moderate-to-high WHP and higher-poverty-rate counties (red-shaded counties in Figure 1). These triangulated data are shown in Figure 4.

The overlay of housing unit concentration data in Figure 4 serves to highlight the particular vulnerability of communities in central and northeast Oregon and the adjacent counties of Idaho's panhandle. In contrast, northern California counties are fewer in Figure 4 vs. Figures 1 and 3, underlining the comparatively lower concentration of at-risk housing units in California.

Compared to the Forest Service's WHP, First Street Foundation's Fire Factor yields more counties with moderate-to-high wildfire risk. Figure 5 replaces WHP with Fire Factor data, with an overlay of Verisk housing concentration data.

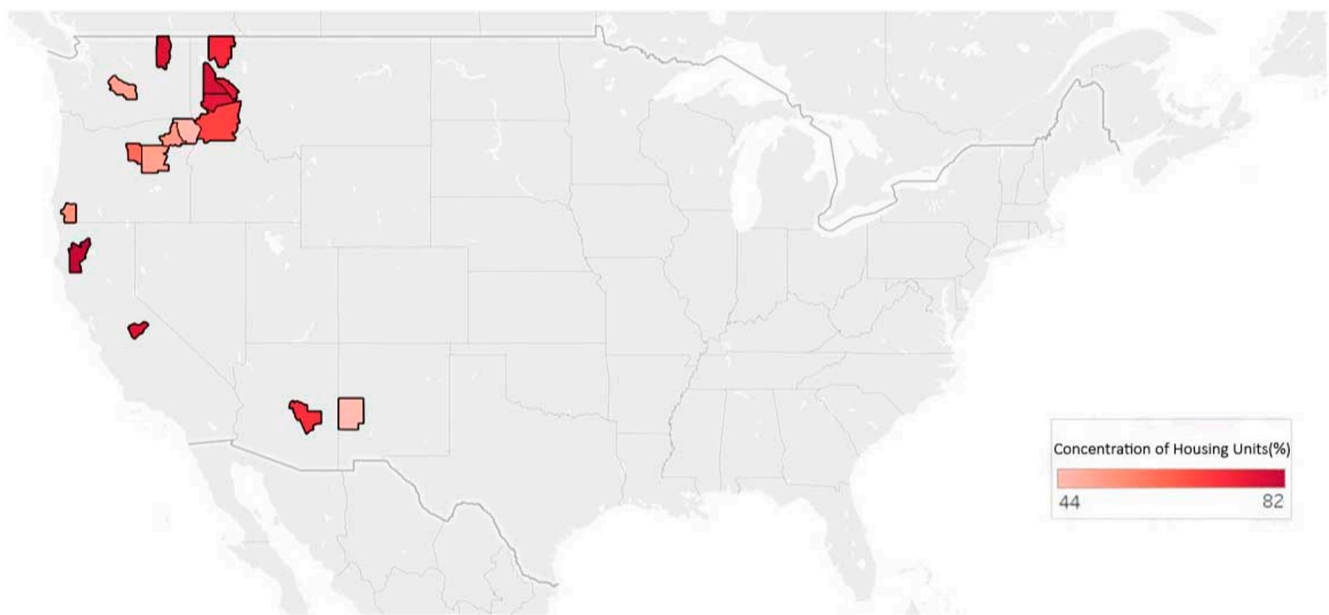


Figure 4. Higher-poverty-rate counties with the greatest concentration of housing units in Forest-Service-designated moderate-to-high risk areas.

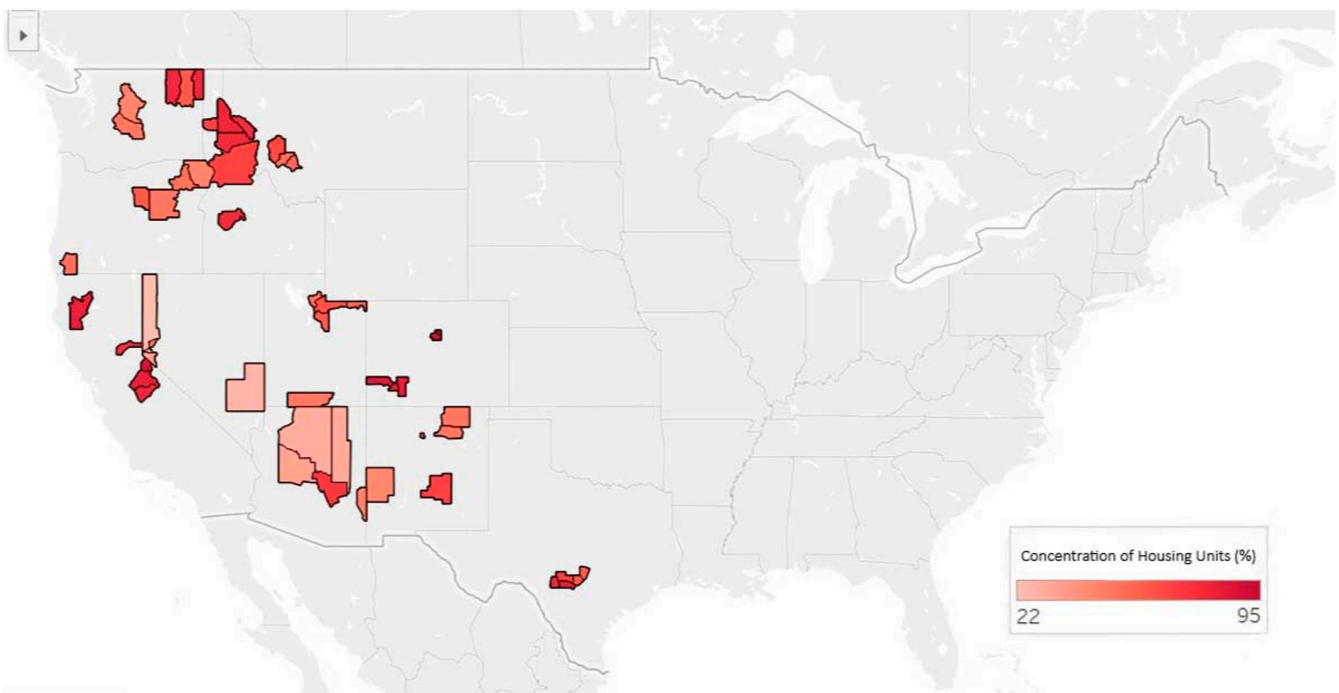


Figure 5. Higher poverty rate counties with the greatest concentration of housing units in Fire Factor moderate-to-high risk areas.

The Fire Factor overlay on Verisk data in Figure 5 shows comparatively more counties with high concentrations of housing units at high or extreme risk from wildfire. Whereas WHP + Verisk data (Figure 4) implicate seven states with very high concentrations of housing units in high- and extreme-wildfire-risk counties, Fire Factor + Verisk data (Figure 5) reveal 11 states with this combination of elevated risks. The concentration of housing units with high to extreme wildfire risk in at least two counties in Figure 5 reaches or exceeds 90 percent.

4.3. Wildfire-Prone States and Market Share of Insurance Companies

California's comparatively more sparsely populated, at-risk homeowners are beneficiaries of the 2021 Safer from Wildfires program, with 2022 marking the first year of implementation. In terms of design and scope, Safer from Wildfires, which aims to improve protection of properties in wildfire-prone areas and restore confidence among insurance companies, has no direct equivalent among the other, major wildfire-prone states in this study.

One measure of risk is access to replacement insurance. Although there are hundreds or even thousands of licensed primary and out-of-state insurers operating in every U.S. state [25], our research reveals that in many of the most wildfire-prone states, homeowner policy underwriting is comparatively highly concentrated. We examined the total number of premiums sold to insured entities (excluding premiums destined for reinsurance) in each of the lower 48 states. Data are published by the National Association of Insurance Commissioners [26]. There are nine states where the cumulative market share of the top 10 property and casualty insurers is 60 percent or more of the market. Seven of those states are among this study's fourteen most wildfire-prone states: Arizona, Colorado, Montana, New Mexico, Oregon, Washington, and Wyoming. The abundance of licensed insurers in these states does not imply that policies are underwritten by a large and varied set of insurers. New Mexico led all U.S. states with 2604 licensed out-of-state insurers in 2020. Yet, that same year, the market share of the state's top 10 property insurance underwriters was 60.6 percent, placing it among the states with most concentrated insurance markets. A relatively high percentage of homeowners in at least seven major wildfire-prone states are subject to the risk determination decisions of a comparatively small group of policy underwriters.

5. Discussion

5.1. Results and Policy Considerations

The results in the present study underscore the geographical distribution of homeowners in major wildfire-prone states whose risk factors include not just wildfire exposure risk, but also socioeconomic risk. The data reveal that many of the affected regions are outside of California, and yet California is a leader nationwide in developing moratoria on insurance nonrenewal and cancellation due to wildfire-related risks, in providing subsidies to homeowners to protect properties, and in enticing risk-averse insurers back to the market. Lower-income homeowners as a proportion of all homeowners in areas of high wildfire risk are prominent not only in northern California, but in 12 of the 14 major wildfire-prone states in the coterminous U.S., including the majority of counties in Idaho and significant portions of Oregon and Texas. This paper points to the need for additional research on socioeconomic variables, such as income and insurability risk, as overall determinants of wildfire risk. In the process, we expect more studies to bring attention to at-risk homeowners in geographical areas beyond wildfire-plagued parts of California. Consider that the deadly 2018 Camp Fire which destroyed Paradise, California affected homeowners who by California income standards are comparatively less wealthy. Butte County, California, where Paradise resides, had a 2019 median household income of USD 52,537. In comparison, the median household income of counties most directly affected by the massive 2022 Hermits Peak–Calf Canyon wildfires in New Mexico ranged from USD 28,446 to USD 30,946.

An open question this research highlights is how stakeholders such as insurance companies and insurance commissioners outside of California will respond to the intertwined problems of climate-driven, destructive wildfire, insurance risk in high- and extreme-wildfire-risk areas, and the plight of low-income homeowners in these areas. California's moratoria, which are meant to be time-limited, and its recent efforts to enable homeowners to harden homes and create defensible space, offer potential models for other at-risk regions of the country. Federal-level programs such as Firewise USA, which channels congressionally authorized funds for wildfire education and risk reduction to communities, are also part of the solution [7]. However, like California's Safer from Wildfires program

which, to date, is the most well-resourced program for wildfire prevention and protection of any state, Firewise USA does not earmark assistance for lower-income households. Since aid is unlikely to flow to all or even most individual homeowners, the community-scale assistance provided by programs such as Firewise USA and Safer from Wildfires may prove particularly important for lower-income homeowners who simultaneously confront natural disaster risk and severe economic risk. Safer from Wildfires makes resources available to engage whole neighborhoods in fuel reduction efforts in common areas and in creating evacuation routes and emergency communication plans. Presently, in poorer, rural precincts in high-wildfire-risk areas of the American Southwest and in the western mountain states, these efforts are piecemeal. More intentional and more generously resourced programs will become increasingly urgent as the risks from major, destructive wildfires continue to mount.

5.2. Further Research Needs

This article considers the combination of wildfire risk and insurance risk for lower-income households in wildfire-prone states. Additional research is required to explore the full range of wildfire-related risks that affect vulnerable populations in and near wildfire-prone areas. A broad set of environmental, public health, and economic risks from wildfire extends far beyond the factors considered in conventional homeowners' policies and in commercial-fire-insurance policies.

An important challenge for stakeholders to consider is the complexity of public and private property regimes in wildfire-prone areas. To illustrate, there are federally designated wilderness areas in some at-risk counties in this analysis, and these public lands are often contiguous with private land holdings. Fire management efforts in these areas have been complicated historically and continue to pose challenges. Beginning in the 1970s, federal agencies managing public lands in the West began adopting "let burn" policies to enable forest regeneration in fire-adapted ecosystems, including in wilderness areas. However, in practice, fire suppression continued (and currently continues) in these areas due to the abundant presence of homes and other structures in and near federally designated wilderness [27]. More broadly, wildfire-prone areas of the West include complex mosaics of public and private lands, with private property "inholdings" inside of the National Forest and National Park systems—legacies of the 1862 Homestead Act. There is also "stranded land"—parcels of public property landlocked by private land holdings. These lands are not easily accessed by fire crews (considering trespassing norms on private land), creating obstacles for fire suppression. Across 11 western states, there are approximately 6 million acres of stranded land, and research indicates that fires originating on stranded land are more likely to escape containment and increase in size versus comparable fires originating on accessible land [28,29]. Land swaps are one potential solution to this challenge: federal agencies can arrange to exchange stranded land for comparable private property, thereby reducing the patchiness of property types and improving fire safety on public lands.

Wildfire, including in the wildfire-prone/higher-poverty-rate counties examined in this article, poses risks to a variety of environmental assets and services neither covered in insurance policies nor properly valued in state or national income accounting. By way of illustration, Ferry County, Washington, a higher-WHP/higher-poverty-rate county, is home to the Colville Indian Reservation where timber extraction and recreation are key economic activities. Along a stretch of the Columbia River running through the county, a salmon hatchery was established nearly a decade ago to aid restoration of a salmon run. Considering wildfire risks, a major wildfire in this area could affect water quality, wildlife habitat, other environmental service values, and livelihood values, but these assets are not addressed in conventional insurance policies. It is unrealistic to expect households in and around the underserved Colville Indian Reservation to bear the costs of insuring larger, landscape- and societal-scale environmental, health, and economic risks posed by wildfire.

Future research is needed to properly assess the full suite of values threatened by wildfire, particularly in underserved areas where local economies and livelihoods tend to

be more natural-resource-dependent. Were “non-market” values to become incorporated into private insurance contracts, a “carrot” approach for homeowners is more likely to be accepted by policyholders. Incentives might include discounted premiums in return for reducing hazardous fuels and adoption of other fire safety measures on insured property or in wildfire-prone communal areas such as neighborhood woodlots or right of ways. As part of the U.S. Department of Agriculture’s Conservation Reserve Enhancement Program, farmers and landowners are incentivized to set aside or manage land to protect water quality, reduce soil erosion, secure critical wildlife habitat, and protect areas with high recreation value [30]. A comparable program could aim to prompt property owners to reduce wildfire risks on their own lands and adjacent lands by, for example, cost sharing of fuel reduction activities, creating fuel breaks in vegetated landscapes, protecting water sources for firefighters, and comparable risk reduction measures.

6. Conclusions

Improved methods, models, and refined datasets are enabling more precision in the arena of wildfire science. In contrast, policy responses to protect vulnerable communities from erratic, destructive wildfire lag behind. This article triangulates data on wildfire risk, income, and insurability, with the goal of understanding the vulnerability of lower-income homeowners—homeowners that are more likely to experience property insurance nonrenewal or cancellation due to wildfire risk. Using data from the U.S. Forest Service, we find that counties with moderate to high wildfire risk are more likely to be counties with higher poverty rates (59 out of a total of 98 counties in 12 high-wildfire-risk states). A more refined dataset from the risk-modeling organization, First Street Foundation, finds many additional counties, beyond those identified by the Forest Service, that are at moderate, major, severe, or extreme risk of wildfire, although both the Forest Service and First Street Foundation datasets are in close agreement regarding the set of wildfire-prone, high-poverty-rate counties. Differences in these datasets have implications for agencies and organizations tasked with managing wildfire risk, with First Street Foundation’s data proving more granular and comprehensive.

California homeowners, who experienced a surge of insurance nonrenewal and cancellation decisions by insurance carriers in 2018 and 2019, are experiencing regulatory relief in 2022. The Safer from Wildfires program adopted in late 2021 aims to incentivize homeowners and neighborhoods to adopt fire safety measures and to oblige insurers to recognize and reward these interventions. California is ahead of other states in the wildfire-prone West in addressing the challenges of wildfire-related property insurance risk. In the absence of comparable policies, lower-income homeowners in nearby states may be at higher risk of insurance termination. The concentration of insurance underwriting in wildfire-prone states elevates these risks, limiting opportunities for homeowners to find replacement insurance. More research is needed to determine risks to the most vulnerable communities on a location-by-location basis. No less urgent is the identification of resources to support wildfire planning, response, and recovery efforts among underserved communities. New initiatives such as Safer from Wildfires and older established programs such as Firewise USA will prove important for community-based wildfire management, as will widespread adoption at the local level of multistakeholder Community Wildfire Protection Plans [7]. The high probability of continued, destructive wildfires across the American West and beyond, and the varied stakeholders affected by wildfire, point to the urgent need for planning and response strategies involving multiple interests—from federal, state, local, and tribal governments to businesses, nonprofits, homeowner associations, neighborhoods, and individual homeowners. Insurance companies are among the interested parties in this urgent work, as are vigilant state insurance commissioners.

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References

1. NIFC. National Interagency Fire Center Online Database. Available online: <https://www.nifc.gov/fire-information/statistics/wildfires> (accessed on 23 April 2022).
2. Parks, S.A.; Abatzoglou, J.T. Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985 to 2017. *Geophys. Res. Lett.* **2020**, *47*, e2020GL089858. [CrossRef]
3. Abatzoglou, J.T.; Williams, A.P. Impact of anthropogenic climate change on wildfire across western US forests. *Proc. Natl. Acad. Sci. USA* **2016**, *113*, 11770–11775. [CrossRef] [PubMed]
4. Jolly, W.M.; Cochrane, M.A.; Freeborn, P.H.; Holden, Z.A.; Brown, T.J.; Williamson, G.J.; Bowman, D.M.J.S. Climate-induced variations in global wildfire danger from 1979 to 2013. *Nat. Commun.* **2015**, *6*, 7537. [CrossRef] [PubMed]
5. Williams, A.P.; Abatzoglou, J.T.; Gershunov, A.; Guzman-Morales, J.; Bishop, D.A.; Balch, J.K.; Lettenmaier, D.P. Observed impacts of anthropogenic climate change on wildfire in California. *Earth's Future* **2019**, *7*, 892–910. [CrossRef]
6. Davies, I.P.; Haugo, R.D.; Robertson, J.C.; Levin, P.S. The unequal vulnerability of communities of color to wildfire. *PLoS ONE* **2018**, *13*, e0205825. [CrossRef] [PubMed]
7. Auer, M.R. Considering equity in wildfire protection. *Sustain. Sci.* **2021**, *16*, 2163–2169. [CrossRef] [PubMed]
8. Muyskens, J.; Tran, A.B.; Ahmed, N.; Phillips, A. One in Six Americans Live in Areas with Significant Wildfire Risk. *Washington Post*. 2022. Available online: <https://www.washingtonpost.com/climate-environment/interactive/2022/wildfire-risk-map-us/> (accessed on 17 May 2022).
9. Adams, M.D.O.; Charnley, S. The environmental justice implications of managing hazardous fuels on federal forest lands. *Ann. Am. Assoc. Geogr.* **2020**, *110*, 1907–1935. [CrossRef]
10. Mercer, D.E.; Prestemon, J.P. Production function models for wildfire risk analysis in the wildland–urban interface. *For. Policy Econ.* **2005**, *7*, 782–795. [CrossRef]
11. Lynn, K.; Gerlitz, W. Mapping the relationship between wildfire and poverty. In *US Forest Service Proceedings*; RMRS-P-41; University of Oregon: Eugene, OR, USA, 2006.
12. RAND. The impact of changing wildfire risks on California's residential insurance market. In *California's Fourth Climate Change Assessment*; California Natural Resources Agency: Sacramento, CA, USA, 2018.
13. Governor's Office of Planning and Research. Appendix III: Homeowners Insurance and Mitigation Working Group Report. 2019. Available online: https://opr.ca.gov/meetings/wildfire-commission/2019-06-07/docs/20190607-Item_7_Appendix_III_Insurance_Workgroup_Report_Draft_for_Discussion.pdf (accessed on 7 May 2022).
14. US Forest Service. Wildfire Risks to Communities. Online Database. Available online: <https://wildfirerisk.org/download/> (accessed on 11 April 2022).
15. First Street Foundation. The Fifth National Risk Assessment: Fueling the Flames. 2022. Available by Request to Fifth Street Foundation. Available online: <https://report.firststreet.org/> (accessed on 17 May 2022).
16. Dillon, G.K.; Gilbertson-Day, J.W. Wildfire Hazard Potential for the United States (270-m), Version 2020 (3rd Edition). Available online: <https://www.fs.usda.gov/rmrs/datasets/wildfire-hazard-potential-united-states-270-m-version-2020-3rd-edition#:~:text=WHP%20is%20an%20index%20that,fuel%20treatments%20may%20be%20needed> (accessed on 21 May 2022).
17. US Forest Service. Spatial Dataset of Probabilistic Wildfire Risk Components for the Conterminous United States. Available online: https://www.fs.usda.gov/rds/archive/products/RDS-2016-0034/_metadata_RDS-2016-0034.html/ (accessed on 2 May 2022).
18. US Forest Service; U.S. Department of Interior. LANDFIRE. Online Database. Available online: <https://landfire.gov/> (accessed on 5 May 2022).
19. Dillon, G. Wildfire Hazard Potential (WHP) for the Conterminous United States (270-m GRID), Version 2014 Continuous. 3rd Edition. Fort Collins, CO: Forest Service Research Data Archive. 2020; Online Database. Available online: <https://www.fs.usda.gov/rds/archive/Catalog/RDS-2015-0047-3> (accessed on 23 April 2022).
20. First Street Foundation. Defining America's Past, Present, and Future Wildfire Risk. 2022. Available online: <https://firststreet.org/risk-factor/fire-factor/> (accessed on 8 July 2022).
21. First Street Foundation. The Data behind Fire Factor™. Available online: <https://riskfactor.com/methodology/fire> (accessed on 8 July 2022).

22. United States Census Bureau. Poverty Data Tables. Available online: <https://www.census.gov/topics/income-poverty/poverty/data/tables.html> (accessed on 18 October 2021).
23. Quinton, S. As Wildfire Risk Increases, Home Insurance is Harder to Find. Available online: <https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2019/01/03/as-wildfire-risk-increases-home-insurance-is-harder-to-find> (accessed on 17 December 2021).
24. First Street Foundation. Highlights from “Fueling the Flame”. 2022. Available online: <https://firststreet.org/research-lab/published-research/article-highlights-from-fueling-the-flames/> (accessed on 10 July 2022).
25. Insurance Information Institute. A Firm Foundation: How Insurance Supports the Economy. 2022. Available online: <https://www.iii.org/publications/a-firm-foundation-how-insurance-supports-the-economy/a-50-state-commitment/insurance-companies-by-state> (accessed on 8 May 2022).
26. National Association of Insurance Commissioners. 2020 Market Share Reports for Property/Casualty Groups and Companies by State and Countrywide. 2021 Edition. Available online: <https://content.naic.org/sites/default/files/publication-msr-pb-property-casualty.pdf> (accessed on 20 April 2022).
27. Van Wagtendonk, J.W. The history and evolution of wildland fire use. *Fire Ecol.* **2007**, *3*, 3–17. [CrossRef]
28. Leonard, B.; Plantinga, A.J.; Wibbenmeyer, M. Stranded land constrains public land management and contributes to larger fires. *Environ. Res. Lett.* **2021**, *16*, 114014. [CrossRef]
29. Leonard, B. Stranded. *PERC Rep.* **2022**, *39*, 9–11.
30. U.S. Department of Agriculture. Conservation Reserve Enhancement Program. 2021. Available online: https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Conservation/PDF/fsa_crep_factsheet_22.pdf (accessed on 10 July 2022).