

# WILDFIRE RESILIENCE INSURANCE:

Quantifying the Risk Reduction of  
Ecological Forestry with Insurance

*Summary of Insights*

This project and paper were funded in part through an Innovative Finance in National Forests Grant (IFNF) from the United States Endowment for Forestry and Communities, with funding from the United States Forest Service (USFS). The United States Endowment for Forestry and Communities, Inc. (the “Endowment”) is a not-for-profit corporation that works collaboratively with partners in the public and private sectors to advance systemic, transformative and sustainable change for the health and vitality of the nation’s working forests and forest-reliant communities.

We want to thank and acknowledge Placer County and the Placer County Water Agency (PCWA) for their leadership and partnership with The Nature Conservancy and the US Forest Service on the French Meadows ecological forest project and their assistance with the Wildfire Resilience Insurance Project and this paper. We would like in particular to acknowledge the assistance of Peter Cheney, Risk and Safety Manager, PCWA and Marie L.E. Davis, PG, Consultant to PCWA.

## **Authors**

### ***Willis Towers Watson***

Nidia Martínez  
Simon Young  
Desmond Carroll  
David Williams  
Jamie Pollard  
Martin Christopher  
Felicity Carus

### ***The Nature Conservancy***

Dave Jones  
Sarah Heard  
Bradley Franklin  
Ed Smith  
Dan Porter

# Introduction

The Climate Emergency is clear and present for California's 39 million residents, and is a particular danger for the more than 2.7 million of whom live in very high wildfire hazard severity zones. In 2018, the Camp Fire burned nearly 19,000 structures, killed at least 85 people, and resulted in insured losses of \$12 billion. Six of the 20 largest California wildfires occurred in 2020<sup>1</sup>, burning 4.3 million acres and claiming 33 lives. At the time of writing, in June 2021, a new fire season is well under way, and the rate of wildfires already exceeds that of 2020 by almost 40%.<sup>2</sup>

In California, insured losses for the 2020 fire season were estimated at \$5bn-\$9bn, but the cost of damage to property is only one measure of the catastrophic and sometimes fatal impacts of wildfires. Even when they do not cause fatalities, the disruption to lives and communities is devastating and long-lasting. The Camp Fire alone was the costliest natural disaster for the insurance industry globally in

2018, and the deadliest fire in the U.S. in 100 years. Most of this destruction happened in 4 hours.

Viewed through a risk management lens, wildfire risk in California and throughout the western United States is becoming uninsurable. Risk is the product of hazard (the combination of the probability of wildfire and its characteristic intensity), exposure (where the item at risk is located and its value), and vulnerability (how damaging wildfire is to the item at risk).

In the case of insurance availability and pricing, for a given exposure (e.g., an office building or home in a location within the Wildland-Urban Interface, (WUI), the hazard is growing due both to climate change and overgrown forests, while the ability to increase the wildfire resilience of the building (i.e., reduce the level of damage endured for a given intensity of wildfire impact) is limited. The WUI is



In 2018 California wildfires took 103 lives, destroyed 24,000 structures, and cost \$26 Billion in property damage and fire suppression costs. © Ben Jiang /TNC Photo Contest 2019

1 CalFire top 20 largest fires report, April 2021.

2 National Interagency Fire Center, June 2021.

the area where houses are in or adjacent to wildland vegetation. If either the hazard becomes high enough<sup>3</sup>, or vulnerability cannot be reduced sufficiently, insurance will be increasingly unaffordable and/or unobtainable.

A substantial and growing body of evidence suggests that increasing temperatures and shifting precipitation patterns associated with climate change is resulting in larger and more severe wildfires.

Additionally, warm, dry winters and drought can create other potentially hazardous conditions in California's forests, including tree disease and outbreaks of insects such as the Western and Mountain Pine Beetles<sup>4</sup>, all of which make forests more flammable and fires more intense.

However, another factor is also at play: the amount of fuel in our forests, which have become overgrown due to the active suppression of wildfires over many decades. It turns out that suppressing all fires to protect forest values and the properties and communities encroaching on our wildlands has resulted in a higher risk of severe wildfires as forests have become overgrown. The more we suppress all fires to protect lives and livelihoods, the harder it is becoming to protect lives and livelihoods; dense understory is the tinder and climate change the spark. Instead, there is a new approach which involves reducing severe wildfire risk by managing forests ecologically.

### Accounting for the Wildfire Risk Reduction Benefit of Ecological Forestry in Insurance Modeling and Pricing

The objective of the Wildfire Resilience Insurance project was to determine whether the wildfire risk reduction associated with an ecologically-based approach to forest management, or "ecological forestry", could be captured in insurance risk modelling and policy structuring, and to quantify the insurance benefits of ecological forestry, including any reduction in expected losses and consequential technical and actual premium savings.

Ecological forestry includes practices such as strategic thinning, controlled or prescribed burning, and managed wildfire. Ecological forestry practices mimic the way that



Fire crews conducting controlled burns at the Independence Lake Preserve which provides water for Reno and western Nevada. © Ed Smith/TNC

nature and indigenous peoples historically managed forests. In fire-adapted conifer forests strategic thinning involves the removal of trees and shrubs in targeted areas to reduce surface and ladder fuels while also increasing the health and diversity of the forest. Controlled or prescribed burning involves igniting small, controlled burns in targeted areas to reduce undergrowth and smaller trees while increasing nutrients for the remaining vegetation<sup>5</sup>. Managed wildfires are non-planned fires that are allowed to burn without being extinguished under certain circumstances and conditions.

The full project report "Wildfire Resilience Insurance: Quantifying the Risk Reduction of Ecological Forestry with Insurance" sets out how the reduction in the risk of severe wildfire resulting from ecological forestry, can be accounted for within insurance modelling and pricing frameworks. In fire-adapted conifer forests, ecological forestry results in forests that are healthier, more resilient to drought and other negative impacts of a warming climate, and which are at a reduced risk of generating and sustaining high-severity wildfires, as described in The Nature Conservancy's (TNC's) report, "Wildfires and Forest Resilience: The Case for Ecological Forestry in the Sierra Nevada"<sup>6</sup>.

3 Munich Re. 2019. New hazard and risk level for wildfires in California and worldwide. [https://www.munichre.com/content/dam/munichre/global/content-pieces/documents/Whitepaper%20wildfires%20and%20climate%20change\\_2019\\_04\\_02.pdf](https://www.munichre.com/content/dam/munichre/global/content-pieces/documents/Whitepaper%20wildfires%20and%20climate%20change_2019_04_02.pdf)

4 United States Department of Agriculture. 2006. Bark Beetles in California Conifers, are your Trees Vulnerable? Washington, DC, USDA.

5 Clark, S.A., Miller, A., and Hankins, D.L. 2021. Good Fire: Current Barriers to the Expansion of Cultural Burning and Prescribed Fire in California and Recommended Solutions. Karuk Tribe, California. [https://karuktribeclimatechangeprojects.files.wordpress.com/2021/03/karuk-prescribed-fire-rpt\\_final-1.pdf](https://karuktribeclimatechangeprojects.files.wordpress.com/2021/03/karuk-prescribed-fire-rpt_final-1.pdf)

6 <https://www.scienceforconservation.org/products/wildfires-and-forest-resilience>

## Fire-suppressed Forest



## Ecologically managed Forest



Ecological Managed Forests. By thinning the forest understory, we can safely reintroduce fire as a restorative process. Fire suppressed forest on the left. Ecologically thinned forest on the right. © Erica Simek Sloniker/TNC.<sup>7</sup>

<sup>7</sup> Kelsey, R. 2019. Wildfires and Forest Resilience: the case for ecological forestry in the Sierra Nevada. Sacramento, California: Unpublished report of The Nature Conservancy. <https://www.scienceforconservation.org/products/wildfires-and-forest-resilience>

In our work discussed in the full project report, we:

1. Determine whether it is possible to account for the risk reduction benefits of ecological forestry in insurance modelling of property within the forest and the WUI;
2. Quantify the reduction in expected losses and associated reduction in premium costs resulting from ecological forest treatment for indemnity and parametric insurance; and
3. Consider how insurance premium savings might be used to fund or finance additional investments in ecological forestry in national and other forest lands.

We examine an innovative solution for wildfire risk, called parametric wildfire resilience insurance, and demonstrate how it can account for the risk reduction benefit of ecological forestry. Unlike traditional indemnity insurance, parametric insurance pays out when a previously defined “parameter” is met or exceeded. For example, parametric insurance for wildfire risk could pay out when a certain threshold of “acres burned” or “acres severely burned” is exceeded, as opposed to the insured having to prove that it suffered damage and loss to insured assets from a wildfire as is the case with a traditional indemnity insurance product.



Ecologically thinned forest. © David Edelson/TNC

Our findings indicate significant potential insurance premium savings as a result of ecological forestry practices. We find that ecological forestry results in insurance savings to varying degrees for parametric insurance which could cover various wildfire related costs for a water and power agency or for a timber company, for example, as well as reducing the cost of traditional indemnity insurance for commercial and residential structures vulnerable to wildfire.

We explore how community-based catastrophe insurance which accounts for ecological forestry might be provided to insure homes at a lower aggregate cost compared to individual residential home insurance. Community-based catastrophe insurance is a new insurance product under development which would be purchased by a local government for homes in the community. The local government could purchase the community-based insurance directly to cover homes in that community and then collect a proportionate fee from those homeowners to pay for the community-based insurance premium. We also explore how the insurance savings could be captured with an additional fee on homes which in turn could be used to pay debt service on bonds issued by the local government to fund ecological forestry.

These solutions have the compound benefits of reducing the risk of damage to property, increasing the resilience of communities to avoid fires or help them recover when they do strike, lowering the costs of protecting property for homeowners, businesses, and insurers.

The full project paper also examines how insurance premium savings might be used to fund or finance additional investments in ecological forestry in national and other forest lands – therefore maximizing the potential of California’s extensive forests to help mitigate climate change. The situation is critical; our inability to slow the rise in wildfire risk now is making us even less able to adequately manage the risk in the future.

Policymakers, regulators, forestry agencies, commercial entities, communities, insurance companies and risk modelers should use these findings to drive and support more public and private investment in ecological forest treatment in national and other forests, to pilot wildfire resilience insurance products linked to risk mitigation associated with ecological forest treatment, and to unlock the availability of and lower pricing for insurance where ecological forest treatment reduces the risk of severe wildfire.

## **Wildfire Resilience Insurance Case Study: French Meadows Forest Project and Placer County Water Agency**

The French Meadows Forest Project is a landscape scale ecological forestry project in largely national forest lands in Placer County, California, on the western slope of the Sierra Nevada. The total project area consists of 28,000 acres, mostly within the Tahoe National Forest. The project is within the North Fork American River sub-basin, a watershed managed in part by the Placer County Water Agency (PCWA), which is a water supply and hydro power generating agency. The project is a partnership between TNC, the U.S. Forest Service (USFS), PCWA, the County of Placer, the Sierra Nevada Research Institute of the University of California Merced, and the American River Conservancy.

We used the French Meadows project as the “test bed” to analyze and quantify the insurance benefits of ecological forestry. The French Meadows project<sup>8</sup> was catalyzed by

the devastating 2014 King Fire that burned almost 100,000 acres of the Eldorado National Forest and private timberlands. The King Fire required about 8,000 personnel and \$117 million dollars and a full month to extinguish<sup>9</sup>.

We incorporated fire behavior modeling results conducted for ecological forestry as part of the French Meadows project into an insurance wildfire risk model to determine and quantify the insurance benefits of ecological forestry. PCWA and its assets and operations were used to analyze the extent to which accounting for ecological forestry in indemnity and parametric insurance products for a water and power agency would lower expected losses and provide insurance premium savings. We also analyzed how ecological forestry would reduce the premium for a parametric insurance product for a hypothetical timber company with timber assets and analyzed how ecological forestry would reduce expected residential losses and estimated residential insurance premiums for homes in and adjacent to the PCWA’s watershed.



TNC is working with partners on the French Meadows Restoration Project to carry out ecological forestry at scale. © David Edelson/TNC

8 Smith, E. 2018. Tahoe National Forest, American River Ranger District French Meadows Project. Fire & Fuels Specialist Report. Sacramento, California, The Nature Conservancy.

9 USDA King Fire BAER fact sheet. [https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/fseprd566026.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd566026.pdf)

# Key Findings

## **Finding 1: The wildfire risk reduction benefits of ecological forestry for insurance are quantifiable, significant, and far-reaching.**

Ecological forestry reduces the intensity at which forests burn, which in turn reduces both the average area burned by fires (all else being equal) and the average severity of the burned area. These benefits extend substantially beyond the area of ecological forestry itself, as fires spreading out of or through an area of ecological forestry are less frequent and less intense. We demonstrate that these significant risk reduction benefits can be quantified and captured in wildfire models used to assess insurance risk and price insurance coverage. This capturing of risk reduction benefits includes the fact that the reduction in severe (high flame length) wildfires eliminates many of the wildfires that are the most difficult to suppress, which in turn are those that cause most insured loss.

## **Finding 2: Ecological forestry at landscape scale can significantly reduce expected residential home losses from wildfires and consequently reduce residential insurance premiums.**

We investigated the impact of ecological forestry treatment at sufficient scale to bring the risk reduction values to the entire North Fork American River sub-basin, using two “virtual” portfolios of property insurance coverage; one comprising all residential properties within the sub-basin or in the WUI around it (captured via a five kilometer (~three mile) buffer) and the other comprising residential properties in the community of Foresthill, situated on forest lands in the central western area of Placer County.

We found that for the large “Watershed” residential portfolio, aggregate premiums could be expected to reduce, on average, by 41% (over \$21 million a year). For the smaller but more exposed Foresthill community, the aggregate premium saving was estimated at 52%.



There are an estimated 4 million homes in California in the Wildland Urban Interface with moderate or high risk of wildfire. © Robert Couse-Baker/Creative Commons



## Aggregate Residential Insurance Premium Reduction with Ecological Forestry

Area Impacted	Premium, no ecological forestry	Number of residential structures	Average Premium	Premium with ecological forestry treatment	
				Value	% reduction
<b>Watershed</b>	\$51,094,726	81,620	\$626	\$29,965,430	<b>41%</b>
<b>Foresthill</b>	\$870,470	533	\$1,633	\$416,495	<b>52%</b>

### **Finding 3: As a result of the current ecological forestry investment in the French Meadows project, the reduction in expected annual loss due to wildfire for Placer County Water Agency's buildings is 44%.**

PCWA's large industrial assets (e.g., dams, reservoirs, tunnels, etc.) make up most of their insured assets but have very low vulnerability to wildfire because they are largely hardened. As a result, those assets see no measurable benefit from ecological forestry in loss reduction or associated insurance premium. However, there was a significant reduction in estimated indemnity insurance premium associated with ecological forestry for those PCWA buildings that are vulnerable to damage by wildfire.

On average, the reduction of expected loss for the 13 PCWA buildings vulnerable to wildfire is 44%, with a minimum reduction of 10% and a maximum reduction of 84%, for a total of \$22.7 million of value at risk. The properties that pay a higher premium relative to their value at risk benefit from the greatest reductions.

### **Finding 4: Wildfire resilience parametric insurance premium estimates decrease with ecological forestry, with 20% to 40% reductions for case study scenarios consistent with the scale of the French Meadows project.**

With a parametric insurance product, a pay-out is made in the event of a fire that exceeds certain characteristics. As such, parametric insurance can provide instant access to funds to pay for costs not covered by indemnity insurance, such as heavy debris removal, sediment removal, and/or erosion and sediment mitigation expenses.

Parametric insurance premium estimates (based on expected loss) decrease with the application of ecological forestry, with 20% to 40% reductions for case study scenarios consistent with the scale of the French Meadows ecological forestry project. The premiums decrease because ecological forestry reduces both the total burned area and the areas of high severity burn.<sup>10</sup>

### **Finding 5: Residential insurance premium savings from ecological forestry compare favorably to ecological forestry costs.**

Based on the "Watershed" portfolio described above, residential insurance premium savings from ecological forestry, when aggregated across communities at risk to wildfire, compare favorably to the costs of implementing ecological forestry. The net savings increase with the duration of the program, ranging from approximately \$15.57 million for 10 years to \$120.57 million over 15 years. The annualized treatment costs are less than the annual premium savings for all time periods, and the benefit-cost ratio increases as the effective duration of the treatment is extended, as tabulated below. In other words, the insurance benefits accrued increase the longer the ecological forestry program and wildfire resilience insurance is in place.

<sup>10</sup> We note that the impact of ecological forestry on individual wildfires varies, particularly with prevailing meteorological conditions. While the wildfire modeling on which we rely covers a range of conditions around the average, it does not cover wildfires burning under extreme meteorological conditions, particularly very strong winds, where the positive impacts of ecological forestry are likely to be significantly diminished.

## Ecological Forestry Costs and Aggregate Residential Insurance Premium Savings: Benefit Cost Ratio

Duration (years)	Ecological forest treatment costs (\$M)	Total Premium Savings (\$M)	Net Savings (\$M)	Benefit-Cost Ratio
10	194.43	210	15.57	1.08
15	194.43	315	120.57	1.62

**Finding 6: Premium savings on parametric wildfire resilience “umbrella” cover resulting from ecological forestry can be substantial and could service bond financing that provides funding for such ecological forest treatment for the benefit of commercial enterprises and communities at risk.**

The premium savings from a parametric wildfire resilience insurance product that accounts for both the severity of burned area and the benefits of ecological forestry are substantial, particularly when the area insured is expansive, includes multiple parties benefiting from the services provided by forest lands, and where the benefits can be reaped for 10 years or more.

Bond financing might be coupled with parametric wildfire resilience insurance savings, where the insurance premium savings are used to contribute to the debt service on bonds issued to fund or finance ecological forestry. Co-financing of such a bond could be derived directly or indirectly from the co-benefits of reduced risk to conventional property insurance portfolios (or, indeed, the maintenance of availability of such insurance), as well as from the substantial health and welfare benefits of healthy forests.

**Finding 7: Community Based Wildfire Resilience Insurance is an innovative approach which could capture the risk reduction of ecological forestry and produce insurance price savings which could be used to fund or finance ecological forestry.**

One way in which residential insurance premium savings resulting from ecological forestry might be captured, and then applied toward the funding of ecological forest treatment projects, is through a new insurance product that several insurers are exploring – “community based catastrophe insurance” or “community based insurance”.<sup>11</sup> This concept is being driven in part by the increasing unavailability of private home insurance for homes facing moderate or high wildfire risk in California. Insurers are exploring whether something akin to a “group insurance policy” might be written for a community. The local government would purchase the community-based insurance directly to cover homes in that community and then collect a proportionate fee from homeowners, whose homes are covered, to pay for the community-based insurance

Based on the results of this study, the price for a community-based insurance product that accounts for ecological forestry should be lower than the aggregate cost of individual residential home insurance within the community where ecological forestry has not been undertaken. The price savings could be passed on in their entirety to the homeowners through a lower charge for each respective share of the community-based coverage. Alternatively, some portion of the price savings could be captured or retained by the local government purchasing the insurance and used to finance investments in ecological forestry, while homeowners would still see lower prices for community-based insurance relative to individual homeowners insurance.

<sup>11</sup> Bernhardt A., Kousky, C., Read, A., and Sykes, C. 2021. Community-Based Catastrophe Insurance: a Model for Closing the Disaster Protection Gap. New York City, New York, Marsh & McLennan Companies.

# Recommendations

1. **Federal, state and local policymakers** should increase substantially funding for ecological forestry in national and other forest lands. New fire scenario modeling from the US Forest Service suggests that targeted treatments on approximately 51 million acres of federal, state, tribal and private lands nationally in the next 10 years will significantly reduce exposure in the highest risk areas<sup>12</sup>. A recently released report found that a minimum investment of approximately \$5-6 billion per year over the next 10 years is needed for the highest priority work to reduce wildfire risks across federal, tribal, state and private lands, and for community and infrastructure investments<sup>13</sup>.
2. **Insurance regulators** should encourage insurers and insurance risk modelers to consider the results of this study and to incorporate its results in their underwriting and pricing of insurance. If not currently permitted by state law or regulation, insurance regulators or policymakers should consider modifying rate approval regulations to allow insurers to account for ecological forestry in rate development.
3. **Insurers and risk modelers** should consider incorporating the findings and methodology presented in this study in their wildfire risk score models, so that homes and businesses for whom ecological forestry reduces wildfire risk see the benefit of that risk reduction in the risk score assigned to them, which is used to determine whether or not to renew or write insurance for the asset.
4. **Private home insurers and the California FAIR Plan**<sup>14</sup> should consider incorporating the findings of this study in their rate development and modeling, so that where ecological forestry is occurring at landscape scale, rates for both the FAIR Plan and private home insurance will take into account the risk and expected loss reduction benefits of ecological forestry.
5. **Businesses and agencies with assets or property** in or adjacent to forests should pilot wildfire resilience insurance. Water and power agencies with facilities in forests should consider piloting wildfire resilience insurance. Private timber companies whose lands are or will be ecologically managed or whose assets are in or adjacent to national or other forests where ecological forestry is occurring are another potential for a pilot wildfire resilience insurance project. Ski resorts with commercial and/or residential structures vulnerable to wildfire may also present an opportunity to pilot wildfire resilience insurance while contributing insurance premium savings to fund or finance ecological forest treatment in adjacent national or other forests.
6. **Residential communities** adjacent to or in national or other forest lands undergoing ecological forestry also present an opportunity to pilot a community based wildfire resilience insurance product, and to use insurance savings captured through a property fee or assessment on homeowners to pay debt service on bonds issued to finance ecological forest treatment.
7. **Public owners of forest lands such as USFS, the Bureau of Land Management, National Park Service and the California State Parks Department** should use the findings in this report to encourage federal, state and local policymakers to provide more funding for ecological forestry projects.

---

12 House Appropriations Subcommittee on Interior, Environment, and Related Agencies Hearing on U.S. Forest Service FY2022 Budget Request, response by USDA Forest Service Chief Victoria Christiansen, April 15, 2021.

13 "Wildfire Resilience Funding: Building Blocks for a Paradigm Shift" May 2021, The Nature Conservancy.

14 <https://www.cfpnet.com/>. "The California FAIR Plan Association was established in 1968 to meet the needs of California homeowners unable to find insurance in the traditional marketplace".

