Fire, Fuel, and Forests

Reducing Fire Severity in the Southern Sierra Nevada Mountains

Authors: Justin Heyerdahl, Chris Hughes, Tess Morgridge, Craig O'Neill, Jason White
Advisors: C. Naomi Tague, Christopher Heckman

BREN SCHOOL
ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

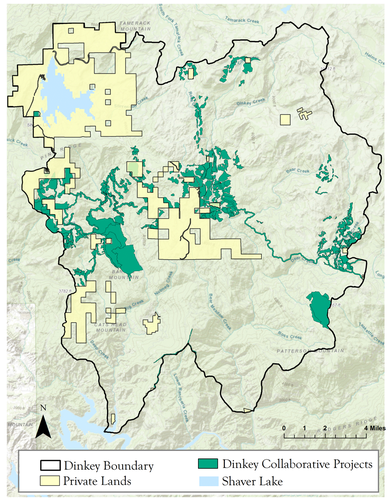
RESOURCE CONSERVATION DISTRICTS

I BACKGROUND

Area of Interest

The Dinkey Landscape is part of a federal program that encourages the collaboration of local public and private entities with the U.S. Forest Service to improve the restoration of the landscape and management of the forest.

- 154,000 acres within Sierra National Forest
- 24,000 acres under private ownership
- Facilitated by our client, the Sierra Resource Conservation District (SRCD)

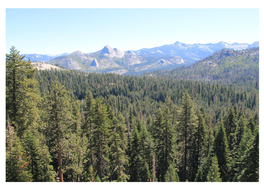


Fire and Forest Ecology

Frequent, low-severity fires are a natural component of sierra mixed conifer and ponderosa pine forests, which encompass the majority of private lands on the Dinkey Landscape. Spreading across the forest floor, these fires remove excess understory growth and provide space for larger trees to dominate. This helps relieve resource competiton for soil nutrients and water, improves resilience to environmental stress, and allows more fire-resistant species, such as oaks and pines, to thrive.

Problem

Decades of fire suppression have led to unnaturally dense forest stands, which increase the amount of combustible fuel on the landscape and vulnerability to high-severity, stand-replacing fires. These catastrophic fires pose health, safety, and economic risks to communities in the wildland-urban interface on the fringes of national forest land, and may cause drastic environmental damage to the landscape. While the U.S. Forest Service (USFS) has begun to change its forestry practices, its budget still prioritizes fire suppression over pre-emptive management. When fuel thinning is performed, private lands are mostly excluded.



II PROJECT STRATEGY

Goal

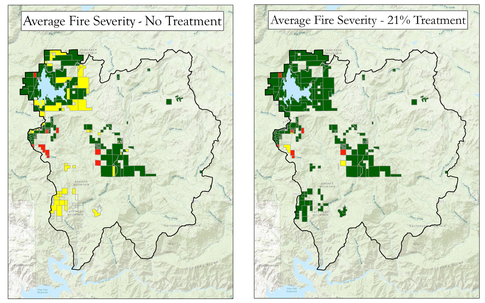
This project aimed to motivate action to reduce fire severity on private lands in southern Sierra Nevada wildland-urban interface communities. Three objectives were devised to achieve this goal.

- Define and quantify fire severity under different forest conditions
- Identify costs and benefits of performing fuel treatments
- Determine the implementation feasibility for private lands

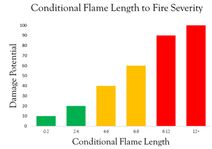
III OUR APPROACH

Modeling Fire Severity

In this study, fire severity is defined by a wildland fire's flame length, or the distance between the flame tip and the ground surface at the wildfire's front. Fuel and fire models developed and used by the USFS and Cal Fire were used to simulate forest growth, fuel treatments of varying intensity and scope, and subsequent wildfire behavior.

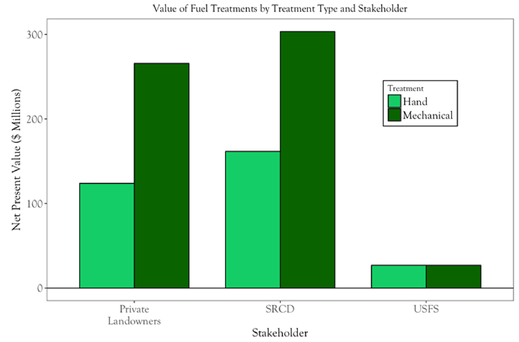


- Treating only 15 - 21% of the landscape achieved reductions in fire severity similar to those produced by a full landscape treatment.
- Leaving piles of woody debris on the landscape post-treatment resulted in higher fire severities that significantly reduce the efficacy of treatment.



Quantifying Costs and Benefits

Three separate cost-benefit analyses were performed to examine the financial impacts of overall fire risk reduction (fire severity and fire frequency through 2050) for this project's three stakeholders: private landowners, the SRCD, and the USFS.



Upfront costs of fuel treatments were assessed against the following benefits:

- revenue from merchantable timber (when using a timber contractor)
- avoided cost of fuel treatments (when using a timber contractor)
- avoided cost of private parcel value loss through fire damage
- avoided cost of higher PM_{10} emissions due to wildfire smoke
- value added through improved carbon sequestration
- avoided cost of insect damage
- avoided cost of fire suppression

Assessing Capacity and Feasibility

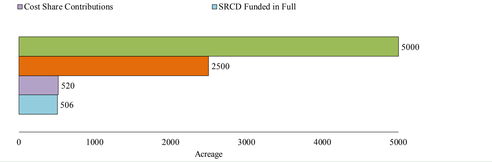
Three grant packages were identified that the SRCD is eligible for and whose funds can be used to implement fuel treatments on private lands. Additionally, three programs, that are currently under-utilized in the area, were identified which provide private landowners with direct partial reimbursement for the costs of fuel treatments on private lands.

Theoretical Funding Scenario	
Grant Packages Acquired	Assumed Funds ($)
A + B + C	1,350,000

SRCD Covers Entire Cost of Treatment	
Mechanical Thinning (Acres)	Hand Thinning (Acres)
506	165

SRCD Covers Portion of Costs of Treatment	
NRCS Cost Share (Acres)	Cal Fire Cost Share (Acres)
519	522

Funds used for mechanical thinning allow for treatment of a larger proportion of the private landscape, and can be stretched further when utilized through government cost-sharing programs. However, even under an optimal funding scenario, total treatable acreage falls short of an ideal treatment scenario, which would encompass 21% of the landscape.



IV FINDINGS & RECOMMENDATIONS

- A large data gap exists for private lands, which reduces the capability to model fire behavior using public agency modeling tools. Alternative models which use remotely sensed satellite data may help improve modeling on private lands without the need to enter landowner property and thus maintain privacy.
- The effects of climate change on forest growth should be included in future modeling efforts to assess how changes in vegetation composition and total biomass may impact potential fire severity and fire risk.
- Fuel treatments, even when only treating a fraction of the landscape, help reduce fire severity significantly and should be implemented on private lands.
- Hand-thinning was found to be less efficient than mechanical thinning from a time and financial perspective. Funds garnered for fuel treatments would be best utilized by investing in physical and labor capital for mechanical treatment.
- Large woody debris piles were found to increase fire severity even relative to a no-treatment scenario. Removal of piles within the first year is necessary in order to maximize the benefits of fuel treatments.
- Large financial, physical, and labor capacity gaps exist that preclude private landowners from investing in fuel treatments without external assistance.
- Enhanced public-private collaboration through financial, physical, and technical capacity building is essential to achieve significant reductions in fire severity for potentially at-risk private lands.

V EXPLORE ONLINE

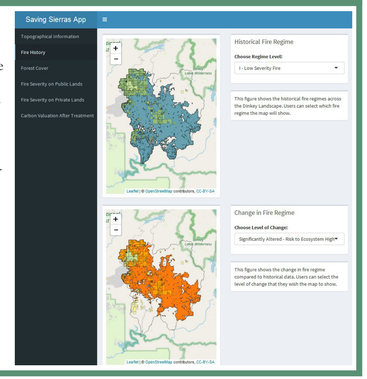
We developed an online interactive tool through ShinyApp to help better connect private landowners to information and findings from this report, landscape data from various public agencies, and a calculator for estimating the costs and benefits to individual private landowners when treatments are performed across the landscape through community collaboration to reduce fire severity.

Please feel free to explore our web app to deepen your knowledge of the Dinkey Landscape and how proactive management strategies can help reduce fire severity, create healthier forests, and improve community resilience.

This online tool will be hosted on the SRCD website.

Additional Resources:
For copies of the poster, brief, or paper, please use one of the following.

- SRCD Website: https://www.sierrarcd.com
- UCSB Bren School's Master's Group Project: https://www.bren.ucsb.edu/research/masters_gp.htm
- E-mail: gp-savingsierras@bren.uscb.edu



ACKNOWLEDGMENTS & REFERENCES

This project would not have been possible without the dedicated support and guidance that we received from our advisors, collaborators, client, and donor. We would specifically like to thank the following people and organizations for their advice and support in working with us to bring this project to fruition: C. Naomi Tague, PhD; Steve Haze, John Heywood, and the Sierra Resource Conservation District; Chubb; Christopher Heckman; John Jostes; Max Moritz; Allison Horst, PhD; James Frew PhD; Sarah Campe; Charles Ashley; Olivia Roe, Lauren Pile, and additional U.S. Forest Service personnel who provided insight on this project.

Basemaps: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, and the GIS User Community; Flame Length Damage Graph: Thompson, Matthew P., Phil Bowden, April Brough, Joe H. Scott, Julie Gilbertson-Day, Alan Taylor, Jennifer Anderson, and Jessica R. Haas. 2016. "Application of wildfire risk assessment results to wildfire response planning in the Southern Sierra Nevada, California, USA." Forests 7(3): 64; Icons: Flaticon, Freepik, Pixel perfect, Smashicons, mynamepong, Nikita Golubev, Darius Dan. Photos: "Sierra National Forest", Day 16, Gskinorth 2011; "Rim Fire", NASA Earth Observatory August 2013; "Rim Fire Aftermath" USDA - Water in the West 2013.