

Science You Can Use *in 5 minutes*

Wildfire Speed Bumps: The latest science on fuel breaks

What do fuel breaks do?

Fuel breaks are linear strips of land along which vegetation is cleared or thinned—constructed along ridgelines, roads, and other strategic places—to give firefighters a safer, higher chance to slow or steer a fire. Often described as “speed bumps” for wildfires, fuel breaks rarely stop fire spread on their own, but they do give crews critical anchor points for building fireline, setting backfires, or safely applying water and retardant. They have been used since the 1960s across many landscapes.

How effective are they?

Mathematical modeling techniques such as simulation (modeling what-if scenarios) and optimization (determining the best decision based upon specific priorities) help managers make informed decisions on fire management approaches and determine the places to construct fuel breaks that are most likely to slow a wildfire. These types of models are used by Forest Service Research and Development’s [Wildfire Risk Management Science Team](#) to conduct applied research in risk analysis, landscape ecology, and decision science, thereby contributing to the scientific foundation

used for making wildfire management decisions.

Forest Service research forester, Erin Belval, leads a research project funded by the Joint Fire Science Program that examines the effectiveness of fuel breaks. Erin and her team, including Forest Service research ecologist Kit O’Connor and research economist Jesse Young, analyzed region-specific fuel break spatial layouts and associated tradeoffs to develop tools which help managers prioritize

fuel break maintenance. The project is designed to support local decision making and is customizable for use in other fire-prone landscapes.

The team’s research expanded upon earlier work that shed light on when and where fuel breaks are most effective. Weather conditions play a major role: under moderate conditions, fuel breaks can significantly aid containment when suppression personnel are present. When the



A fuel break winds across a ridgeline in the Angeles National Forest in southern California. Weather during fires plays heavily into whether fuel breaks are helpful to fire operations. Tradeoffs, especially ecological impacts and long-term upkeep, should be part of planning. Forest Service photo by Erin Belval.

team considered grass- and shrub-dominated systems in Southern California, their research supported management expectations that wider, well-maintained fuel breaks are more effective than narrower, or poorly maintained ones. Effectiveness may also increase when combined with other fuels-reduction treatments, like mechanical thinning and mastication. Simulations in the Great Basin also suggested that incorporating fuel breaks into management strategies could reduce losses of core plant and animal habitat as compared to no-treatment scenarios. Finally, optimization modeling showed that recommended maintenance strategies can shift substantially depending on assumptions about whether a fuel break is likely to successfully contain a fire.

The catch

Fuel breaks are not without tradeoffs. Creating and maintaining them disturbs soils, potentially fragments wildlife and plant habitat, and may encourage the growth of invasive grasses that, when unmanaged, can increase fire risk. Fuel breaks also require ongoing maintenance; overgrown fuel breaks can give a false sense of security.

Bottom line for land managers

Belval observed, “While fuel breaks are not silver bullets, they do provide important options for managers that might otherwise be infeasible.” When placed and maintained wisely and when combined with active fire management, they can make large, costly fires easier—and safer—to contain.

As fire seasons grow longer and suppression costs rise, fuel breaks remain one of the few tools that can tilt the odds back in our favor.

Because fuel breaks have been shown to be effective under moderate fire conditions, they may offer more than just tactical value during suppression efforts. They could also be leveraged

Management Implications

- Weather conditions during fires determine the effectiveness of fuel breaks.
- Wider, well-maintained fuel breaks yield the best results and are worth prioritizing. Maintaining other fuel breaks offers limited benefits, as studies show returns drop significantly once half of the breaks are maintained.
- Ecological effects and maintenance of fuel breaks are important considerations.

in the development of proactive fire management strategies, providing opportunities for crews to manage or introduce prescribed fire at the landscape scale. In this sense they could serve not just as speedbumps to fire, but as gateways for managing a healthier fire regime.

Featured Scientists

[Erin Belval](#), [Jesse Young](#), and [Kit O'Connor](#) are research scientists who work with the Wildfire Risk Management Science Team at the Rocky Mountain Research Station

[Olga Helmy](#) is the author of this Science You Can Use.

Further Reading

Gannon, B.; et al. 2023. [A quantitative analysis of fuel break effectiveness drivers in Southern California national forests](#). Fire. 6(3):104.

Nguyen, D.; et al. 2025. [Optimizing fuel break management for core habitat protection against wildfires in the northern Great Basin](#). Ecological Informatics. 90: 103357.

Nguyen, D.; et al. 2024. [An optimization model to prioritize fuel treatments within a landscape fuel break network](#). PLoS ONE. 19(12): e0313591.

Young, J.D.; et al. 2024. [The cost of operational complexity: A causal assessment of pre-fire mitigation and wildfire suppression](#). Forest Policy and Economics. 169: 103351.



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