Three-decade record of contiguous-U.S. national forest wildfires

indicates increased density of ignitions near roads

Background: Roads play an important role in managing fire on the national forests. But roads also are known to increase ignition frequency and damage ecosystems. Roads may also influence the size of wildfires, which are viewed as undesirable if they endanger human life and property or desirable if they allow more land to experience the ecological benefits of fire. In this study, we examined a large, nationwide dataset to determine whether roads on the national forests are associated with higher fire frequency, and we examined patterns of fire size to see whether wilderness and roadless areas are associated with larger fires.

Results: From 1992 to 2024, in all 8 contiguous-US Forest Service regions combined, wildfire-ignition density was lowest in designated wilderness areas (1.7 fires/1,000 hectares), followed closely by that in Inventoried Roadless Areas (1.9 fires/1,000 ha). The highest wildfire-ignition density was in lands within 50 meters of roads (7.4 fires/1,000 ha), and the second highest wildfire-ignition density was in lands outside of the 100-m road buffers, but not in wilderness or roadless areas (3.5 fires/1,000 ha).

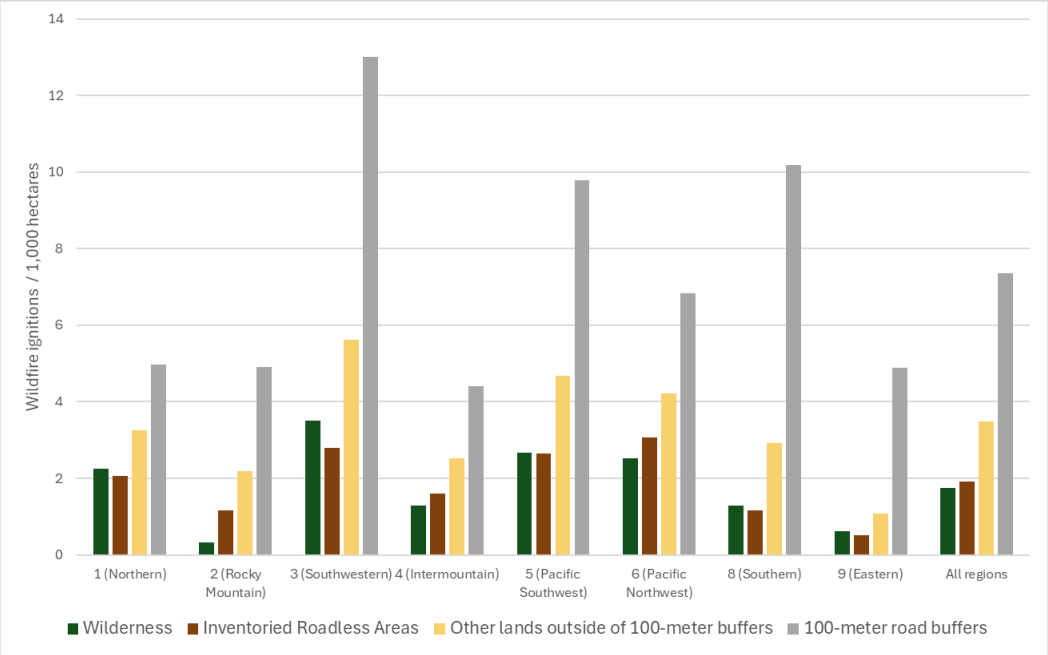

Figure 1: Wildfire-ignition density across U.S. Forest Service regions by wilderness, Inventoried Roadless Areas, other lands outside of 100-meter road buffers, and lands inside 100-meter road buffers.

For human-caused, natural, and undetermined fires, wildfire-ignition density decreased as distance to road increased, irrespective of designation categories such as “wilderness” or “roadless.” In lands between 0 and 250 m from roads, 6 fires ignited per 1,000 ha, whereas fewer than 2 fires ignited per 1,000 ha at a distance-class of over 2,000 m from roads.

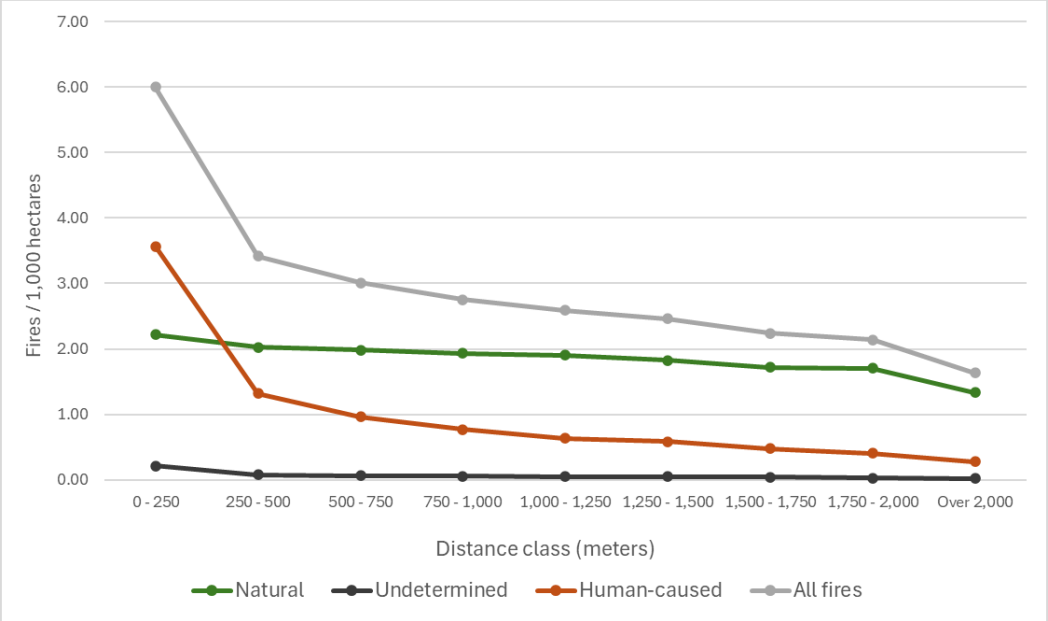

Figure 2: Wildfire ignition density with distance from roads for all national forests in the contiguous US.

Mean fire size varied by where the fire started: it was greatest in wilderness areas (238 ha), followed by roaded lands outside the 100-m buffer (180 ha), Inventoried Roadless Areas (135 ha), and lands within the 100-m road buffer (49 ha). However, it is important to note that most wildfires are less than 1/20th of a hectare when extinguished with only a few fires driving these differences. Looking only at the largest 2% of fires (those that escape "initial attack"), we found fires to be of similar size regardless of where they started (Table 1).

Land use category	Mean fire size (hectares)	Median fire size (hectares)	Standard deviation (hectares)
100-meter road buffers	4,464	728	19,715
Areas outside of 100-m buffer, IRAs, wilderness	3,811	728	12,236
Inventoried Roadless Areas	4,318	934	11,994
Wilderness	4,471	985	12,801

Table 1: Size of the largest 2% of wildfires, by ignition location, on national forests in the contiguous US.

Conclusions: Our results suggest that building roads into roadless areas is likely to result in more fires. These fires will, on average, be smaller than fires farther from roads, but there will be more of them, and some of them will grow to become large fires. Nevertheless, both roads and roadless areas can contribute to strategic, landscape-scale fire management. Recent advances in risk-based wildfire management propose using existing roads and natural fuel breaks to delineate Potential Operational Delineations or "PODs," polygons of land that can be managed specifically for community protection, ecological restoration, or wildfire maintenance where it is safe to do so. Roadless areas remaining within the existing road network, now protected by the Roadless Rule, can contribute to this risk-based strategy by providing areas of low ignition density where fire can reduce fuels without endangering homes or firefighters.