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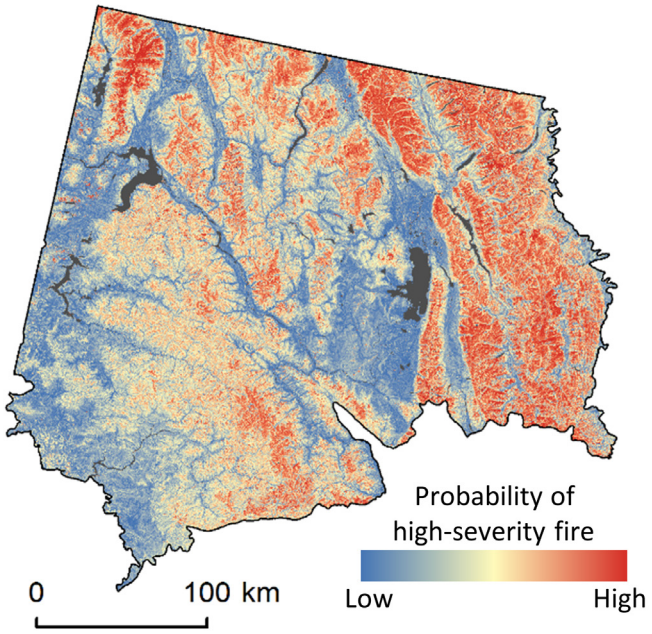
A Double Whammy: Climate Change and Stand-Replacing Wildfires

In the Intermountain region of the Western United States, most forested landscapes are fire prone and adapted to a semiarid climate. With the severity of wildfires increasing as a result of excessive fuels, land managers are concerned about forest converting to non-forest types such as shrubland or grassland. "And then when you throw climate change into the mix, the wildfire conversion risk goes even higher," said Sean Parks, a research ecologist with the USDA Forest Service Aldo Leopold Wilderness Research Institute (ALWRI), Rocky Mountain Research Station (RMRS).



Stand-replacing fires and climate change have the potential to convert trailing edge forests to grassland or shrubland. When a map depicting the probability of stand-replacing fire, such as this one for the Canadian Rockies ecoregion, is combined with a map of trailing edge forests, land managers can determine which areas are vulnerable to conversion (map by S. Parks, RMRS).

Since it was unknown as to the extent of forests within the Intermountain region that were vulnerable to conversion through the combination of climate change and stand-replacing wildfire, Parks led a team to calculate that answer.

Calculating Trailing Edge Forest Loss

Stand inventory data from the Forest Inventory and Analysis (FIA) program from eight Intermountain region states, spanning from Montana to New Mexico, were combined with climate models to create a map that identified areas that Parks calls "trailing edge forests."

"These areas are currently forested, but we think they will be climatically stressed by mid-century and potentially unsuitable for forest," he explained.

These trailing edge forests may experience climatic stress because although adult trees have extensive root systems that allow them to persist under drier conditions, seedlings don't have such root systems and are unlikely to survive under the warmer and drier conditions expected by mid-21st century.

When the trailing edge forest map was combined with a stand-replacing wildfire map, the areas of overlap identified forests with the highest risk of conversion to non-forest. Across the Intermountain region, 6.6 percent of all forest and 18 percent of trailing edge forest are susceptible to conversion to non-forest as a result of wildfires. In some ecoregions, that percentage is higher; for example, in the Utah-Wyoming Rockies, it's 15.1 percent.

These percentages are calculated under the assumption that wildfires burn under normal conditions. For the Southwest region, Parks revised the model to include wildfire severity predictions under extreme fire weather, which is a realistic scenario because of climate change. The result: 30 percent of all forests and 61 percent of trailing edge forest are at risk of conversion to non-forest.

What the Future Holds

Forests are vital for clean water, timber, recreation, and wildfire habitat, and their loss would have lasting consequences. According to Parks, there are management actions that forest managers can undertake to reduce non-forest conversion. "They can't affect the climate, but they can influence the manner in which fires burn," he said. "For example, they can reduce the probability of stand-replacing fire with fuel treatments, prescribed fire, and allowing lightning-ignited fire to burn when weather conditions are not extreme."

"Most likely, however, we're going to lose some forests, and we need to be prepared for this," cautioned Parks. "We've been managing forests based upon past climate conditions, but perhaps we should consider future climate and disturbance patterns as we move forward. This study helps frame this line of thinking in terms of potential management paradigms."

KEY FINDINGS

- There are management actions that forest managers can undertake to reduce non-forest conversion. They cannot affect the climate, but they can influence the manner in which fires burn. Managers can reduce the probability of stand-replacing fire with fuel treatments, prescribed fire, and allowing lightning-ignited fire to burn when weather conditions are not extreme.
- Understanding the interaction between climate and disturbance is necessary to understand how the distribution of forests, in particular trailing edge forests, will respond to climate change.
- Across the Intermountain region of the Western United States, 6.6 percent of forest is susceptible to conversion to non-forest resulting from wildfire by mid-21st century. This conversion is of particular concern in semiarid, fire-prone areas where many communities rely on forests for clean water, timber, and recreation.
- In the Southwestern United States, 30 percent of the forest is at elevated risk of fire-facilitated conversion to non-forest when it is assumed that fire burns under extreme weather conditions.

Trailing edge forests will be vulnerable to conversion to non-forest because seedlings are less likely to survive in the warmer and drier conditions expected by mid-21st century (photo by S. Parks, RMRS).

Sean Parks is a Research Ecologist with the USDA Forest Service, Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station in Missoula, Montana. His research focuses include the relationship between climate and fire regimes and fire-facilitated conversion from forest to non-forest. Parks can be contacted at sean.parks@usda.gov or connect with him at https://www.fs.usda.gov/rmrs/people/sean_parks.

FURTHER READING

Parks, Sean A.; Dobrowski, Solomon Z.; Shaw, John D.; Miller, Carol. 2019. Living on the edge: Trailing edge forests at risk of fire-facilitated conversion to non-forest. Ecosphere. 10(3): Article e02651. https://www.fs.usda.gov/rmrs/publications/living-edge-trailing-edge-forests-risk-fire-facilitated-conversion-non-forest.

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