# Yosemite forest fire example of possible things to come

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Conducting fieldwork in a severely burned area of Big Oak Flat, Yosemite National Park, the summer after the 2013 Rim Fire. Credit: Reed Crane, U.S. Forest Service

Forest composition, ground cover and topography are the best predictors

of forest fire severity in the Western U.S., according to Penn State physical geographers who also see that the long history of fire exclusion on federal lands leads to uncharacteristically severe burns and potentially changes the dynamics of forests and their recovery.

A hunter's illegal campfire in Stanislaus National Forest adjacent to Yosemite National Park started what would become the Rim fire, the third largest fire in California history, that burned from August through October 2013. The fire burned about 400 square miles inside and outside Yosemite, with 78 square miles burned on the worst day.

"We would never be able to do an experiment on this, never be able to burn the forest in this way, so this natural experiment is a perfect opportunity to see what happens," said Alan H. Taylor, professor of geography.

Taylor and Lucas Harris, graduate student in geography, studied the forest's recovery in the aftermath of the Rim fire. They report their results in the current issue of *Ecosystems*.

"This area burned at uncharacteristically high severity and did so even though fire weather was not particularly extreme," said Taylor. "The fire does not appear to have restored the forest to before fire suppression, but altered it."

Forest fires occur naturally, usually initiated by lightning strikes. Native Americans also started fires accidently or deliberately to improve plant growth and hunting.

"If a forest burns every ten years, ponderosa pine is pretty fire resistant," said Harris. "But after 100 years of fire suppression, there are a lot of pine needles on the forest floor and they are highly flammable. We found areas of ponderosa pine burned more severely than areas with

other trees."

An area burned at low severity in the Rim Fire, as photographed in the summer of 2014. Credit: Reed Crane, U.S. Forest Service

The U.S. Forest Service in the early 1900s instituted a policy of total fire suppression or fire exclusion in the forests they managed. Taylor and Harris looked at fire severity from 1899 in Yosemite, the last year a fire burned in the study area, for a baseline of forest composition and fire's effects on the forest. They sought to determine the factors influencing the severity of the Rim fire and whether the Rim fire's patterns were outside those of historic variability.

"Fuels and terrain were the major factors contributing to the severity of the forest fire," said Harris. "The only one of these that can be controlled is the fuel."

In some areas that have not burned for 100 years, workers go in and remove underbrush—herbaceous plants, shrubs and small trees—to reduce fuel load, but this is very labor intensive. Also, controlled burning is sometimes used to reduce the fuel load on the ground and the underbrush. Big Oak Flat, the area under study, is a never-logged wilderness area, so burning is the only possibility, but sometimes there is too much fuel to control the burns.

"In pine forests where fires naturally occur every five to 10 years, 100 years of fire exclusion creates an understory with abundant surface fuel and small trees that allow fires to move into the tree canopies," said Taylor. "Normally, with frequent fires, only the understory burns with some burn scarring of tree trunks, but the trees survive. However, in Big Oak Flat during the Rim fire, there was an unusually high proportion of

moderate and high severity fires compared to 1899."

The California Army National Guard's 1-140th Aviation Brigade (Air Assault) battles the Rim fire in a UH-60 Black Hawk near Yosemite, Aug. 23, 2013. Credit: U.S. Air National Guard photo by Master Sgt. Julie Avey/Released

Once the fires move into the canopy, they can kill the forest. Fire suppression also changes the types of trees in the forest. Since the 1899 fire, a lot more white fir populated the forests, according to the researchers.

"When you have severe fires, there is a potential for the vegetation to switch to shrubs," said Taylor. "If these shrubs burn again before the

trees can re-establish, the forest won't recover and you are left with shrub lands."

An area burned at high severity in the Rim Fire, as photographed in the summer of 2014. Credit: Reed Crane, U.S. Forest Service

To mitigate the situation, the researchers suggest that it might take multiple low to moderate severity controlled burns to restore the forest to one that self-regulates through natural periodic fires in small areas.

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