New fire containment research addresses risk and safety

September 29 2020, by Karina Puikkonen

A look at the Cameron Peak Fire plume, taken in Rocky Mountain National Park on Sept. 5, 2020. Credit: Karina Puikkonen

As 2020 has shown, wildfire frequency, size and severity is threatening communities and natural resources across the western U.S. As a result, there is a high demand for decision-making to mitigate risk, improve firefighter safety and increase fire containment efficiency.

The Colorado Forest Restoration Institute (CFRI) at Colorado State

University has been working with the USDA Forest Service Rocky Mountain Research Station (RMRS) to address these interrelated needs in fire and land management. Three recent publications from the research team address new ways to assess risks and evaluate firefighting effectiveness.

"Managers are making tough decisions about how to contain and control fires with limited time and information," said Ben Gannon, CFRI researcher and lead author on two of the studies. "This research is focused on supporting the development of risk-informed fire management strategies with a better understanding of fire effects and opportunities for firefighters to safely and effectively suppress fire."

The three publications cover topics ranging from what happens before and during a fire to after-incident review of the effectiveness of containment. Researchers said they hope this growing partnership will open up new areas of study in fire management.

Defining potential operational delineations

Potential fire Operational Delineations, or PODs, are spatial fire management units bounded by control features such as roads, rivers and fuel types. Containing wildfires with pre-existing control features is a long-standing practice in fire management but identifying these units for pre-fire planning is a relatively new concept.

Firefighters monitor the Cameron Peak Fire in Rocky Mountain National Park, Sept. 5, 2020. Credit: Karina Puikkonen

Matt Thompson with the RMRS Wildfire Risk Management Science Team is the lead author of the study that introduces a decision support prototype to help fire and land managers quickly gather a wide variety of information to guide suppression strategy development at the POD scale. He said the tools his team created should help managers tailor fire suppression responses to local conditions.

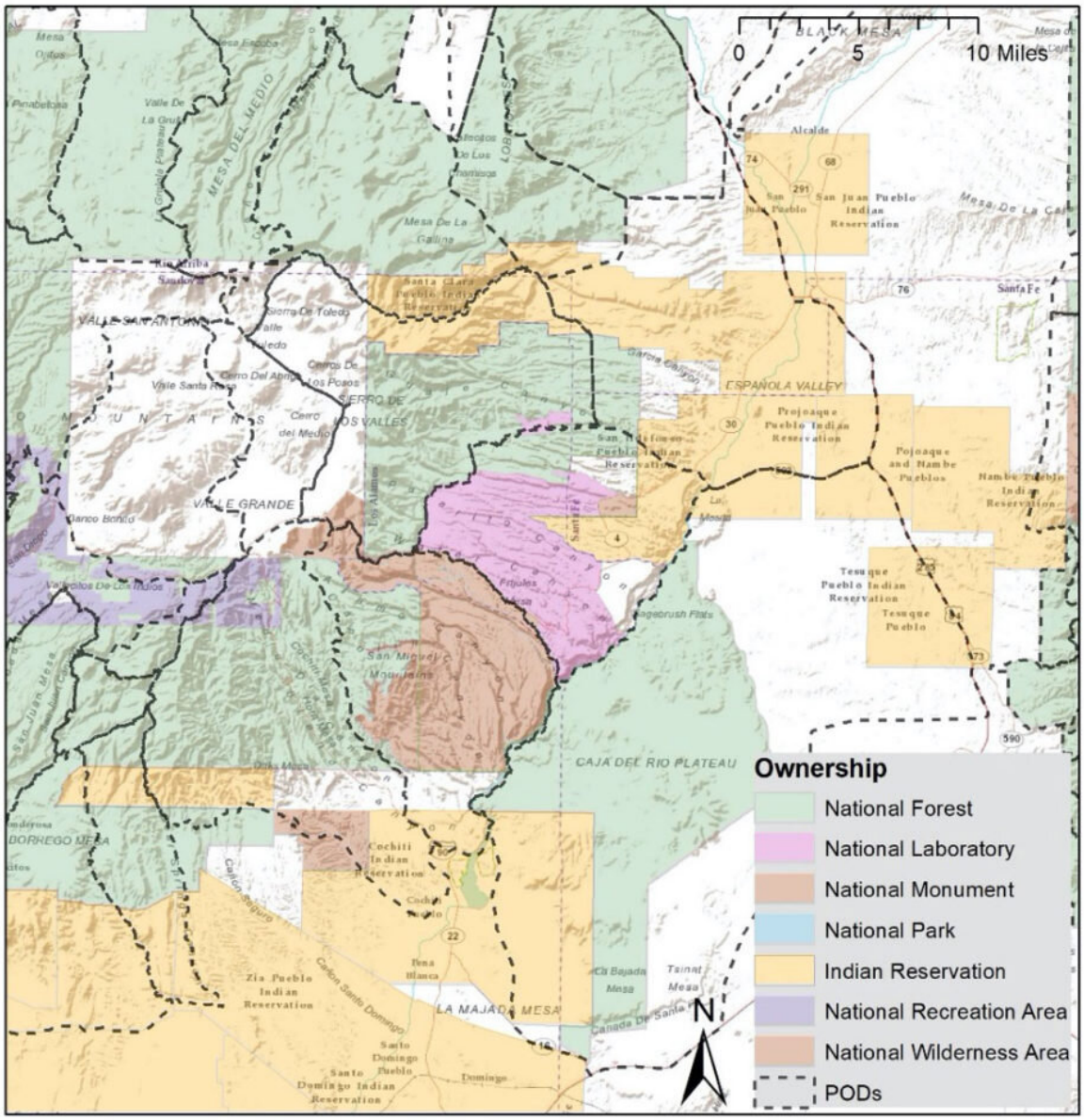
"The POD summary and atlas really gets at the preparatory stage, or the idea of engaging the fire before it starts," Thompson said. "The

intentions are to reduce time pressures and uncertainties, and expand options for incident response decisions."

The decision support tools will help organize information on ecological and social factors that managers need to be aware of, such as water supplies, wildlife habitat, cultural resources, fuel loads and land features. The team engineered the atlas to be visual and map-based so that fire managers can quickly adapt on the ground. Contributing author Mike Caggiano said the power in the tool is found in its ability to address complexities.

"The ecological, social and policy layers we consider aren't exclusive to each other," said Caggiano, also a CFRI researcher. "Fire is such a complex management issue and we are getting traction with this tool and planning framework because we are addressing the problem with the right amount of complexity."

Early adopters of the POD framework include national forests in California and Arizona. CFRI and RMRS are working to bring the POD process and related decision support products to several landscapes in Colorado and the Intermountain West.



POD boundaries in the Four Corners area. Graphic courtesy of Benjamin Gannon

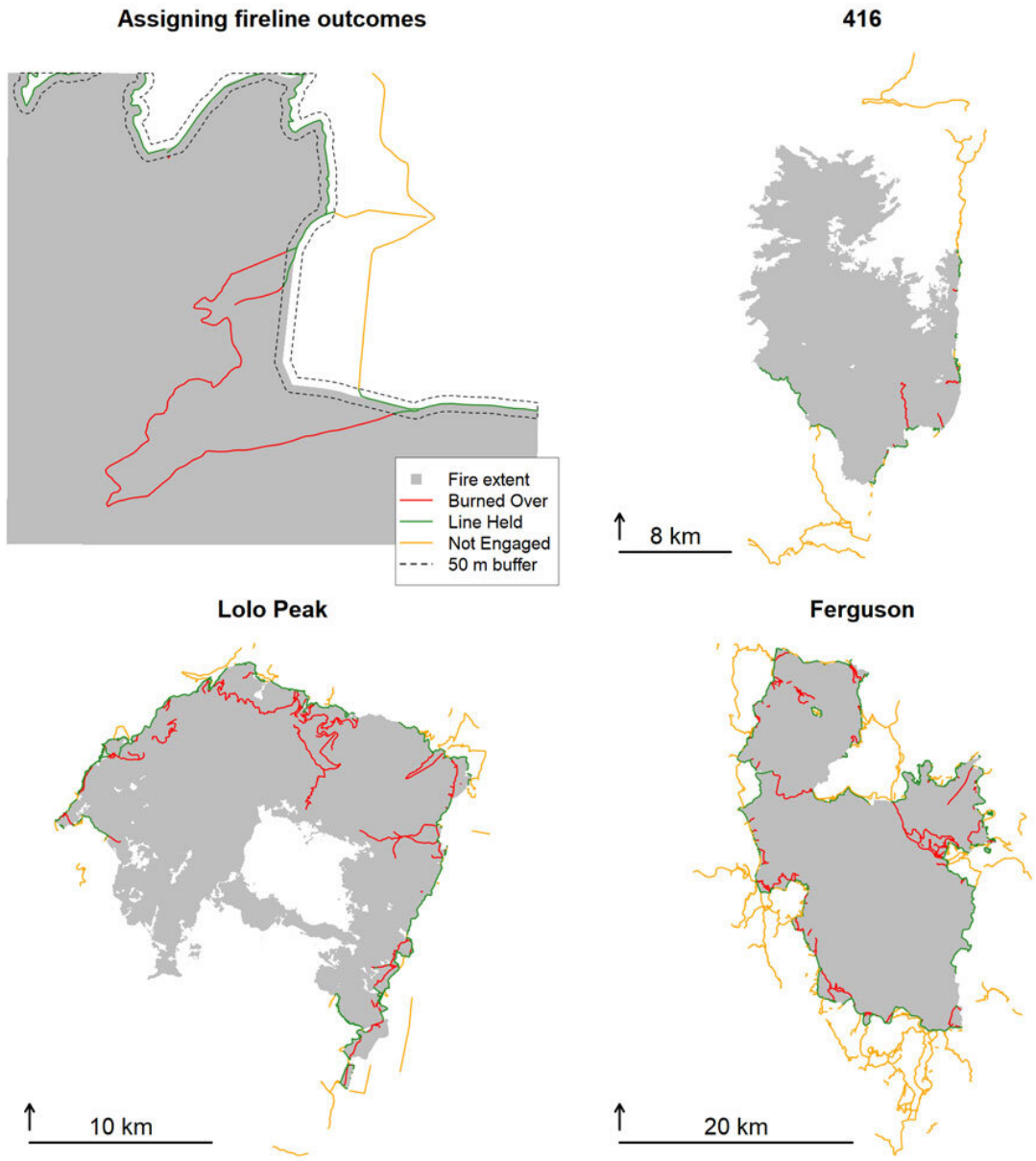
POD size could protect water quality

Erosion from large and severe wildfires can harm water supplies, a finite resource in the west. In the second publication, Gannon led an effort to model the potential for an established Potential fire Operational Delineation network in Colorado to mitigate wildfire impacts on water quality by limiting fire sizes.

"We know fire size affects the severity of impacts for many resources, but we have only recently started to address it in wildfire risk assessment," Gannon said. "Understanding how fire size affects water quality in different parts of the landscape can help managers tailor POD sizes to mitigate impacts."

Gannon modeled how early wildfire containment within PODs could affect water quality at a municipal diversion in Colorado. The team's results suggest that limiting fires to the POD of origin could reduce area burned by up to 59 percent and sediment loads from post-fire erosion by up to 55 percent. In contrast, limiting fire sizes with the current POD network is predicted to reduce the frequency of exceeding water quality thresholds for municipal water treatment by only 13 to 34 percent, depending on post-fire rainfall. Some PODs are not small enough to limit fire sizes below harmful levels.

This suggests that efforts to strategically divide high-risk PODs into smaller units are needed to achieve greater levels of protection.



Fireline analysis for two wildfires. Graphic courtesy of Benjamin Gannon

Fire line effectiveness

Recent archiving of wildfire operations data provides the opportunity to examine how much fire line is constructed and how it contributes to fire

containment. In the third publication, the team analyzed fire lines from 33 large wildfires that occurred in the western U.S. between 2017-2018 to quantify how much fire line burned over, held or did not engage with fires.

The proportion of fire line that engaged with fire and held averaged only 33 percent across the incidents studied. In some cases, fire burned over lines, but many incidents had large sections of fire line that did not engage with the fire.

Fire line performance varied widely across incidents due to an individual fire's unanticipated growth or fire break placement. Fire line construction stood out in more populated areas. At times two to three times more fire line was constructed compared to final fire perimeters. In contrast, fire line production was only a small portion of the perimeter length for many fires in remote locations. This suggests that managers are adapting their strategies based on values at risk.

Gannon said the major value of the study is demonstrating how existing data can be used to monitor and rate fire suppression effectiveness to promote adaptive management in fire management organizations.

"This fire line performance evaluation framework provides a coarse filter to identify high and low performing fires," he added. "A deeper dive is needed to diagnose the causes of inefficiencies and how to improve management strategies."

As more detailed fire progression, behavior and suppression records become available, Gannon and other researchers will explore this topic to understand what fire line and environmental characteristics influence the probability of successful containment.

Researchers will use new data from the 2020 fire season in

Colorado—which is proving to be severe and ongoing—to develop applied lines of research on wildfire risk and safety factors. The research team hopes to advance both fire science and its application in fire and land management to help with response preparations for future wildfires.

More information: Matthew P. Thompson et al, Prototyping a Geospatial Atlas for Wildfire Planning and Management, *Forests* (2020). DOI: 10.3390/f11090909

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