2019 Wildfire Season: An Overview

Southwestern US

JUNE 2020

NAU NORTHERN ARIZONA UNIVERSITY
Ecological Restoration Institute

SOUTHWEST FIRE SCIENCE CONSORTIUM

Intermountain West Frequent-fire Forest Restoration

Ecological restoration is a practice that seeks to heal degraded ecosystems by reestablishing native species, structural characteristics, and ecological processes. The Society for Ecological Restoration International defines ecological restoration as "an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability….Restoration attempts to return an ecosystem to its historic trajectory" (Society for Ecological Restoration International Science & Policy Working Group 2004).

Most frequent-fire forests throughout the Intermountain West have been degraded during the last 150 years. Many of these forests are now dominated by unnaturally dense thickets of small trees, and lack their once diverse understory of grasses, sedges, and forbs. Forests in this condition are highly susceptible to damaging, stand-replacing fires and increased insect and disease epidemics. Restoration of these forests centers on reintroducing frequent, low-severity surface fires—often after thinning dense stands—and reestablishing productive understory plant communities.

The Ecological Restoration Institute at Northern Arizona University is a pioneer in researching, implementing, and monitoring ecological restoration of frequent-fire forests of the Intermountain West. By allowing natural processes, such as low-severity fire, to resume self-sustaining patterns, we hope to reestablish healthy forests that provide ecosystem services, wildlife habitat, and recreational opportunities.

The Southwest Fire Science Consortium (SWFSC) is a way for managers, scientists, and policy makers to interact and share science. SWFSC's goal is to see the best available science used to make management decisions and scientists working on the questions managers need answered. The SWFSC tries to bring together localized efforts to develop scientific information and to disseminate that to practitioners on the ground through an inclusive and open process.

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Cover photo: The Woodbury Fire ignited on June 8, 2019, in the Superstition Wilderness on the Tonto National Forest near the Woodbury Trailhead. The fire burned in rugged terrain for the next 28 days, eventually growing to a total of 123,875 acres. This was the largest fire in Arizona or New Mexico during the 2019 season and the sixth-largest wildfire in Arizona history.

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Introduction

Wildfire is part of the landscape in the Southwest. It can be a threat to lives and property, but it is also crucial to maintaining healthy ecosystems. Forests in the Southwest are adapted to fire and many trees can easily survive low-intensity fires burning along the forest floor. For example, ponderosa pine forests need regular, low-severity fires to remain healthy. Over decades without fire on the landscape, fuel loads accumulated and facilitated more intense, high-severity fire. Each fire is different, and while some burn in ways that increase ecosystem resilience, others burn with greater severity than forests are adapted to, killing even the toughest trees and threatening lives and homes. Weather, climate, vegetation type, fuel conditions, and topography all influence how an individual wildfire burns on the landscape and whether it has beneficial effects. Some fires will leave many unburned patches, creating a mosaic burn pattern, whereas others will burn more contiguously.

This report is the seventh in a series of annual overviews available from the Southwest Fire Science Consortium and the Ecological Restoration Institute. The goal of this overview is to provide a concise summary of the fire season and to facilitate comparison with past fires. It follows the format of past years' overviews[1] and describes the impacts of the 12 largest fires by acreage in Arizona and New Mexico in 2019 (all fires greater than 8,000 acres in the Southwest region). As in previous overviews, this report covers when each fire burned, fire management costs, vegetation types, previous burn footprints, and burn severity, where available. The conclusion section summarizes these same measures for the large wildfires in the region and touches on how these fires burned in proximity to human communities.

Wildfire Management

Managers can approach each wildfire with multiple objectives that range from managing the wildfire for public safety to managing the fire to benefit natural resources. Federal wildland fire management policy states:
"Response to wildland fires is based on ecological, social and legal consequences of the fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and, values to be protected, dictate the appropriate response to the fire."[2]

A full range of wildland fire response strategies may be employed to meet these objectives, including containing, confining, or suppressing the wildfire. The national Incident Management Situation Report identifies the percentage of each fire managed with a monitor, confine, point zone protection, or suppression strategy. This report compiles these figures to better explain how fires were managed in 2019.

Wildland fire management strategies are based on a thoughtful and systematic risk-based approach that considers firefighter and public safety, cause of the wildfire, location, existing land management plans, availability of resources, values at risk, and social and economic factors. Federal policy dictates that "initial action on human-caused wildfire will be to suppress the fire."[3] The same federal policy allows naturally ignited wildfires (or parts of wildfires) to be managed for resource benefits, such as mitigating fuel loads to reduce the risk of high-severity fire, enhancing wildlife habitat, improving watershed health, and reducing risk to neighboring communities. Though multiple strategies are used to manage wildfires, it is important to note that federal agencies only recognize two types of fires: prescribed fire (planned) and wildfire (unplanned).

The 2019 Fire Season

In 2019, wildfire burned 459,864 acres in the Southwest (Arizona and New Mexico), which is only 73 percent of the average number of acres burned in the two states over the previous ten years. Arizona had more wildfire (379,979 acres) than its ten-year average, while New Mexico had less (79,885 acres) than its ten-year average. Unplanned human ignitions made up 47 percent and 29 percent of wildfire in Arizona and New Mexico respectively. Arizona conducted more than double the number of acres of prescribed fire (207,059 acres) than the previous ten-year average, while New Mexico had only 62,734 acres or 85 percent of the ten-year average of prescribed fire acres (Figure 1).

In 2019, wildfires over 100 acres represented 96 percent of the total acreage burned by wildfire in Arizona and New Mexico. The Southwest Coordination Center recorded the strategies managers employed for these fires. Of the 440,064 acres of wildfire for which a strategy is recorded in the Southwest

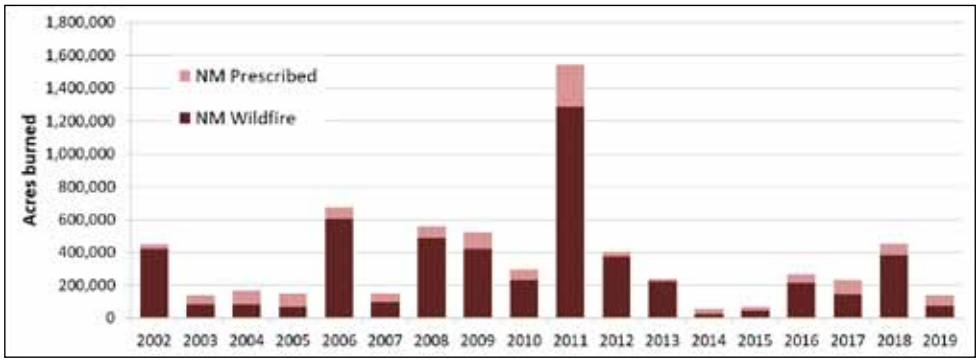

Figure 1. Wildfires and prescribed fires acres burned in Arizona and New Mexico, 2002 to 2019.[3]

1 2018, *2017, 2016, 2015, 2014,* and *2013 Wildfire Season: An Overview, Southwestern U.S.* https://cdm17192.contentdm.oclc.org/digital/search/searchterm/wildfire%20season%20overview/field/type/mode/exact/conn/and/order/date/ad/asc

2 *Guidance for Implementation of Federal Wildland Fire Management Policy* www.nifc.gov/policies/policies_documents/GIFWFMP.pdf

3 National Interagency Coordination Center Wildland Fire Annual Reports www.predictiveservices.nifc.gov/intelligence/intelligence.htm

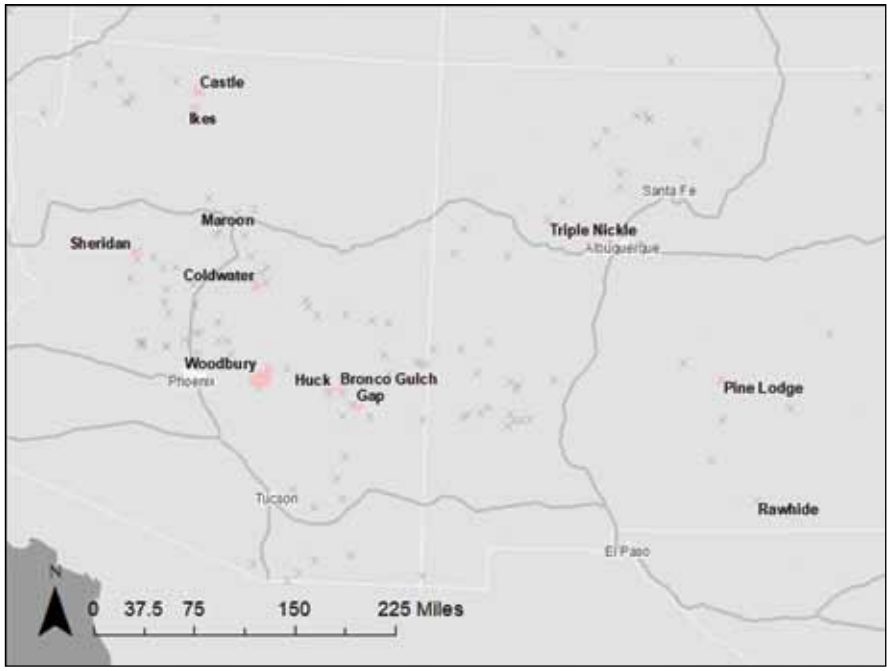

Figure 2. Map indicating the location of the 12 large fires in 2019 analyzed in this report.

Coordination Center's data, 51 percent were managed primarily with a fire suppression strategy, while a combination of monitor, confine, and point zone protection strategies were used on the other 49 percent (215,096 acres).

This overview focuses on the 12 largest fires, which include nine Arizona fires: Woodbury, Sheridan, Castle, Coldwater, Gap, Ikes, Huck, Bronco Gulch, and Maroon; and three New Mexico fires: Pine Lodge, Rawhide, and, Triple Nickle. The 12 largest fires in this report represent 61 percent of the acres burned by wildfire in 2019 (Figure 2).

Regional Context

Most of the Southwest experienced above normal precipitation during the 2018 to 2019 winter. Weak El Niño conditions led to an ample snowpack. Drought conditions covered the Southwest at the end of 2018 with a large area of exceptional drought in the Four Corners region. By the end of March 2019, much of the region had escaped from drought conditions and the Four Corners area had improved two levels, from extreme to severe drought. For the rest of the season, only small parts of the region were in drought conditions.

Even with a relatively wet winter, warm and dry conditions in the spring allowed fine fuels to begin to dry out. The composite statewide Energy Release Component (ERC) was below average for the first half of the year and then increased to near or slightly above normal values which rose concerns about a potentially active fire season due to above normal fine fuel loading (especially in the lower elevations). The ERC is an index that estimates potential available energy released per unit area in the flaming front of a fire based on the fuel model and live and dead fuel moistures. The ERC is often used to track seasonal fire danger focused on fuel loading, woody fuel moistures, and larger fuel moistures. (Lighter fuels have less influence and wind speed has no influence on ERC.) A graph of ERC shows the 2019 fire season (blue line) in comparison to the ten-year average (gray line) and ten-year maximums (red line) (Figure 3).[4] In much of the Southwest, ERCs were below ten-year average for much of the fire season.

The 2019 monsoon season was one of the hottest and driest on record because of waning influences of El Niño, a decrease in tropical storm activity, lack of northward moisture intrusions, and the likely influence of wetter and cooler periods extending well through May. Moreover, 2019 was the third-warmest monsoon season since 1895. The dry and hot monsoon season brought drought conditions back to much of the region by the fall.

Data Sources

Management, Objectives, and Cost

The InciWeb website (inciweb.nwcg.gov) provides background information on most large fires such as location and start date. InciWeb is an interagency information management system designed to provide the public with a single source of incident-related information. Because InciWeb only sporadically reports costs, Incident Status Summary (ICS-209) reports were collected to document suppression or management costs. These costs do not reflect any post-fire costs such as rehabilitation or soil stabilization. The cost data from each fire is collected in a final table at the end of the document. Incident Status Summaries also provide "strategic objectives," which briefly describe the desired outcome for the incident, high-level objectives, and in some cases strategic benefits. Though strategic objectives often change during a fire, review of the most common or persistent strategic objectives for each fire provides some insight into the overarching management goals.

Perimeters

Boundaries for each fire were taken from the Geospatial Multi-Agency Coordination (GeoMAC) archive of fire perimeter

4 Graphs produced by Charles Maxwell and Jay Ellington, Predictive Services Meteorologist, Southwest Coordination Center. For more information see http://gacc.nifc.gov/swcc//predictive/fuels_fire-danger/nfdrs_charts/Areawide.htm

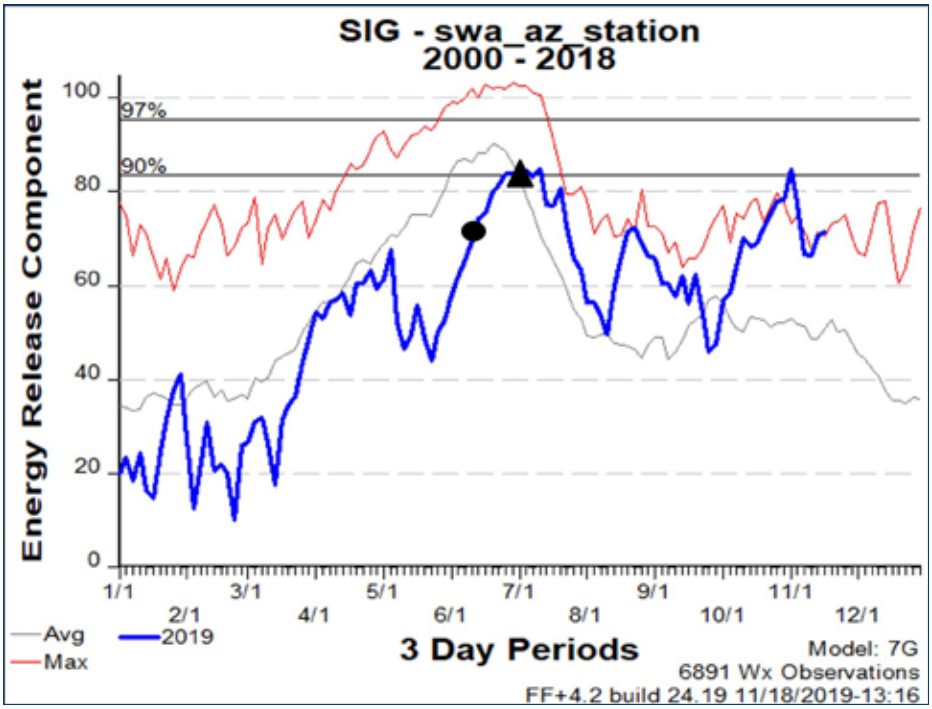

Figure 3. Energy release component (ERC) index for the 2019 fire season in Arizona New Mexico. Note the elevated ERCs at the start of the Woodbury (black circle) and around the time of the Castle and Bronco Gulch Fires (black triangle).

maps (rmgsc.cr.usgs.gov/outgoing/GeoMAC/). GeoMAC also provides perimeters of fires dating back to 2000, which provided a historic context for 2019 fires.

Vegetation

Basic information about vegetation and topography of burned areas was available from LANDFIRE (www.landfire.gov). LANDFIRE provides nationally consistent, scientifically based maps of existing vegetation as well as Vegetation Condition Class (VCC). Vegetation Condition Class was formerly referred to as Fire Regime Condition Class (FRCC). Vegetation Condition Class displays how existing vegetation has departed from estimated natural or historic condition. In the Southwest, this departure is generally due to fire exclusion, past logging and grazing and results in greater density of trees and less healthy conditions. Vegetation Condition Class is a useful metric because it integrates information on existing vegetation, historic vegetation, and fire regimes into one variable and has been used to help determine where to focus restoration efforts. The most current VCC maps (2014) were used in this report.

Soil Burn Severity

Soil burn severity maps provide Burned Area Emergency Response (BAER) teams a tool to quantify soil impacts and assess potential for post-fire erosion (https://fsapps.nwcg.gov/baer/baer-imagery-support-data-download). In the immediate aftermath of a fire, BAER teams perform an emergency assessment of post-fire soil conditions based on a combination of field observations and remote sensing change detection products derived from the differenced Normalized Burn Ratio (dNBR). The dNBR measures change in the ratio of near infrared reflected by healthy green vegetation to the shortwave infrared reflected by bare soil and rock. Most soil burn severity maps have four classes: high, moderate, low, and unburned; however, some maps combine the last two categories into a "low/unchanged" category. The distribution of soil burn severity is included in the individual fire discussions (where available) as well as in the final summary table.

Rapid Assessment of Vegetation Condition after Wildfire

Rapid Assessment of Vegetation Condition after Wildfire (RAVG) maps estimate canopy mortality (https://fsapps.nwcg.gov/ravg/). The USDA Forest Service Remote Sensing Applications Center provides RAVG analysis as a first approximation of areas that may require reforestation treatments because of canopy killed by high-severity fire. RAVG maps are created for wildfires that burn greater than 1,000 acres of wooded Forest Service land or fires for which it is requested. The maps are produced by measuring the change between a satellite image before and immediately after a wildfire using an algorithm called relative differenced Normalized Burn Ratio (RdNBR), which is sensitive to vegetation mortality resulting from the wildfire event. The RdNBR is derived directly from the dNBR but is more sensitive to vegetation mortality than the dNBR.

While soil burn severity maps and RAVG canopy mortality maps use similar satellite change detection methods, they measure fundamentally different forest attributes. In many areas, canopy mortality and soil burn severity patterns are similar. However, in some vegetation types, such as chaparral or grass, it is possible for a fire to cause complete canopy mortality with little effect on soils.

Caveats

There are important caveats for all data used in this summary. First, the fire information presented here was taken from official sources between December 2019 and February 2020 and may not include updates or revisions. Second, the geospatial data used to generate the maps and tables are also based on the best available information, however these data contain errors and uncertainties. For example, the remote sensing data used in all these datasets can include errors introduced during collection, processing, and interpretation.

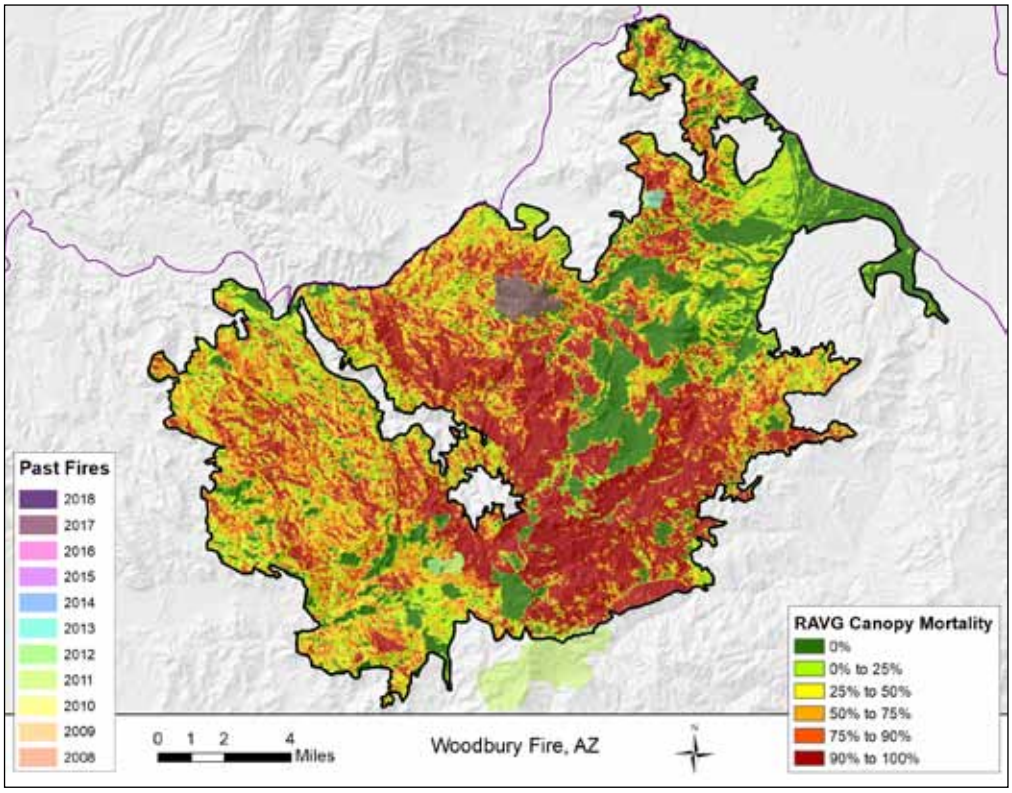

Figure 4. RAVG canopy mortality in the Woodbury Fire burn area.

Woodbury Fire, Arizona

The Woodbury Fire ignited on June 8, 2019, in the Superstition Wilderness on the Tonto National Forest near the Woodbury Trailhead. The fire burned in rugged terrain for the next 28 days, eventually growing to a total of 123,875 acres. This was the largest fire in Arizona or New Mexico during the 2019 season and the sixth-largest wildfire in Arizona history. The Woodbury Fire accounted for 33 percent of the wildfire acres in Arizona in 2019. Managers working on the fire opted to use a combination of suppression (70 percent) and monitor/point zone protection (30 percent) strategies. This approach was chosen for firefighter and public safety while protecting values, including the Pinto Valley and Carlotta mining infrastructure, Roosevelt and Horse Mesa Hydropower Dams, Silver King Substation, 500kv and 115kv power lines that supply electricity to metropolitan Phoenix, the Top of the World subdivision, commercial structures, ranches, riparian waterways, and threatened and endangered species in the Sonoran Desert ecosystem. Other protection priorities included the Tonto National Monument. During the fire, National Park Service archeologists and firefighters were able to cover the Upper and Lower Cliff Dwellings with fire retardant wrapping, which successfully protected the 700-year-old wood within.

Twelve responders were treated for illness or injury while working on the Woodbury Fire. No structures were lost but 440 citizens were asked to evacuate their homes, and closures were issued at several locations including the Tonto National Forest and Tonto National Monument. Arizona State Highways 88 and 188 were closed during the fire in addition to several smaller roads. Wildfire management cost $25 million, or about $202 per acre.

Vegetation and Past Fires

The primary vegetation types included chaparral (44 percent), scrub (25 percent) and piñon-juniper (18 percent). Although LANDFIRE classified only three percent of the burned area as grass, the Incident Status Summary and several other resources cited that a primary factor which led to the immense size of this fire was abundant, fully-cured, invasive, and native grasses present at all elevations in nearly all habitat types. These resources also cited extreme temperatures over 100 degrees Fahrenheit and a delayed monsoon season as contributing factors to its size.

The Woodbury Fire reburned all 1,150 acres of the 2017 Davis Fire in addition to the 2013 Pinion Fire (174 acres) and the 2012 Woodbury Fire (300 acres). It shared a two-mile perimeter with the 650 Fire (2011). Arizona State Highway 188 served as a 12.25-mile perimeter to the north while State Highway 88 served as an 8.5-mile edge to the west.

All the vegetation within the Woodbury Fire had low (78 percent) or moderate (20 percent) departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis. The other two percent of the burn area were water or barren lands to which vegetation departure cannot be measured.

Fire Severity

The RAVG analysis indicates that roughly one-third of the area had less than 25 percent canopy mortality, roughly another third had 25 to 90 percent mortality, and nearly another third had more than 90 percent mortality (Figure 4). The soil burn severity analysis revealed a slightly different result. More than 75 percent of the area was classified as low-severity (53 percent) or unburned/undetected (22 percent) and none of the area was classified as high soil burn severity.

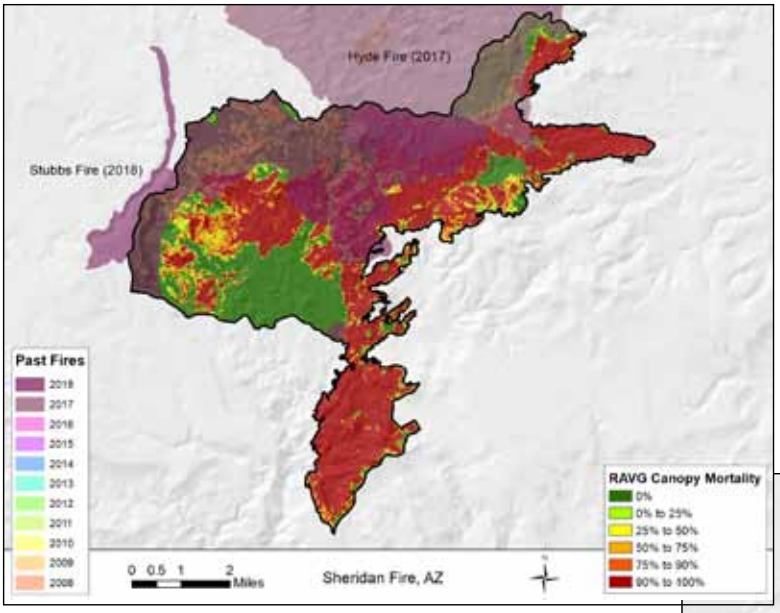

Figure 5. Canopy mortality map for the Sheridan Fire.

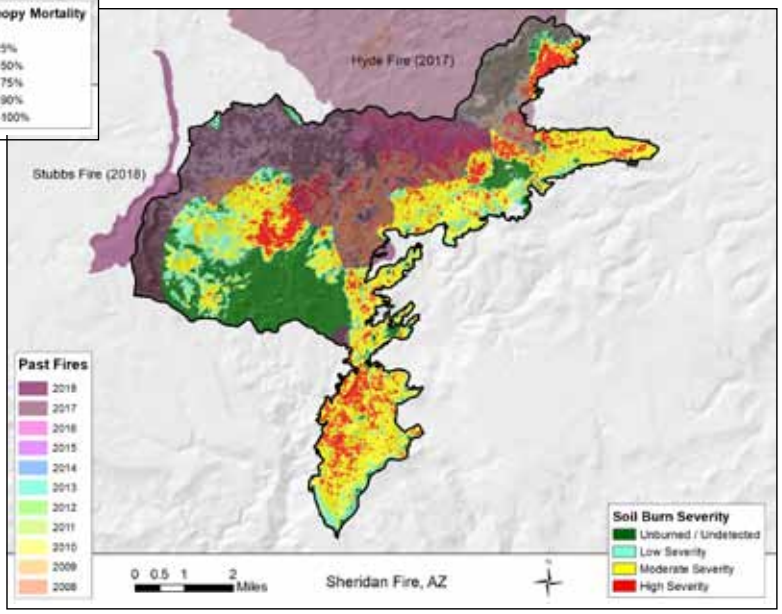

Figure 6. Soil Burn Severity map of the Sheridan Fire.

Sheridan Fire, Arizona

The 21,500-acre Sheridan Fire was reported on August 5 on the Prescott National Forest 20 miles northwest of Prescott, Arizona. Some point zone protection strategies were used early in the fire but management chose to use a monitor approach as the primary strategy on this naturally ignited fire to provide for firefighter and public safety and restore fire to its natural role in piñon-juniper, ponderosa pine, and chaparral vegetation types. This created areas of moderate- to high-severity fire on mesa tops and hillsides and low-severity fire within drainage bottoms. Success of this approach was defined as reducing future risk to the ecosystem. No injuries or structures were reportedly damaged as part of the Sheridan Fire; however, fire related area closures were in effect around the Chino Valley Ranger District. The fire burned for 73 days into mid-October and cost $4.2 million to manage, or about $195 per acre.

Vegetation and Past Fires

Roughly 40 percent (8,200 acres) of the area burned in the Sheridan Fire had been burned in the preceding two fire seasons. Nearly 1,400 of these acres were burned in three consecutive years as parts of the 2017 Hyde Fire, 2018 Stubbs Fire, and the 2019 Sheridan Fire. Despite three consecutive years of fire, no other fires occurred in this area over the last ten years. The Sheridan Fire mainly burned through piñon-juniper (56 percent), ponderosa pine (17 percent), chaparral (13 percent), and conifer-oak (8 percent) but also affected small areas of riparian forest, grass, and scrub. The Incident Status Summary indicated areas that had not burned in recent fires were characterized by decadent brush, which likely enhanced the fire's size and intensity. The majority (87 percent) of the Sheridan Fire was identified as low departure from historic conditions but almost 2,500 acres (11 percent) was identified as high departure, according to LANDFIRE Vegetation Condition Class analysis.

Fire Severity

Nearly 50 percent (10,001 acres) of the Sheridan Fire experienced greater than 90 percent canopy mortality, according to the RAVG analysis (Figure 5). This included nearly all the southern and western spurs of the fire. Other areas had a mosaic of canopy mortality and 35 percent (7,500 acres) exhibited no canopy mortality. The soil burn severity analysis showed a similar spatial distribution of severity areas (Figure 6). However, many of the areas that showed moderate soil burn severity had very high (greater than 90 percent) canopy mortality.

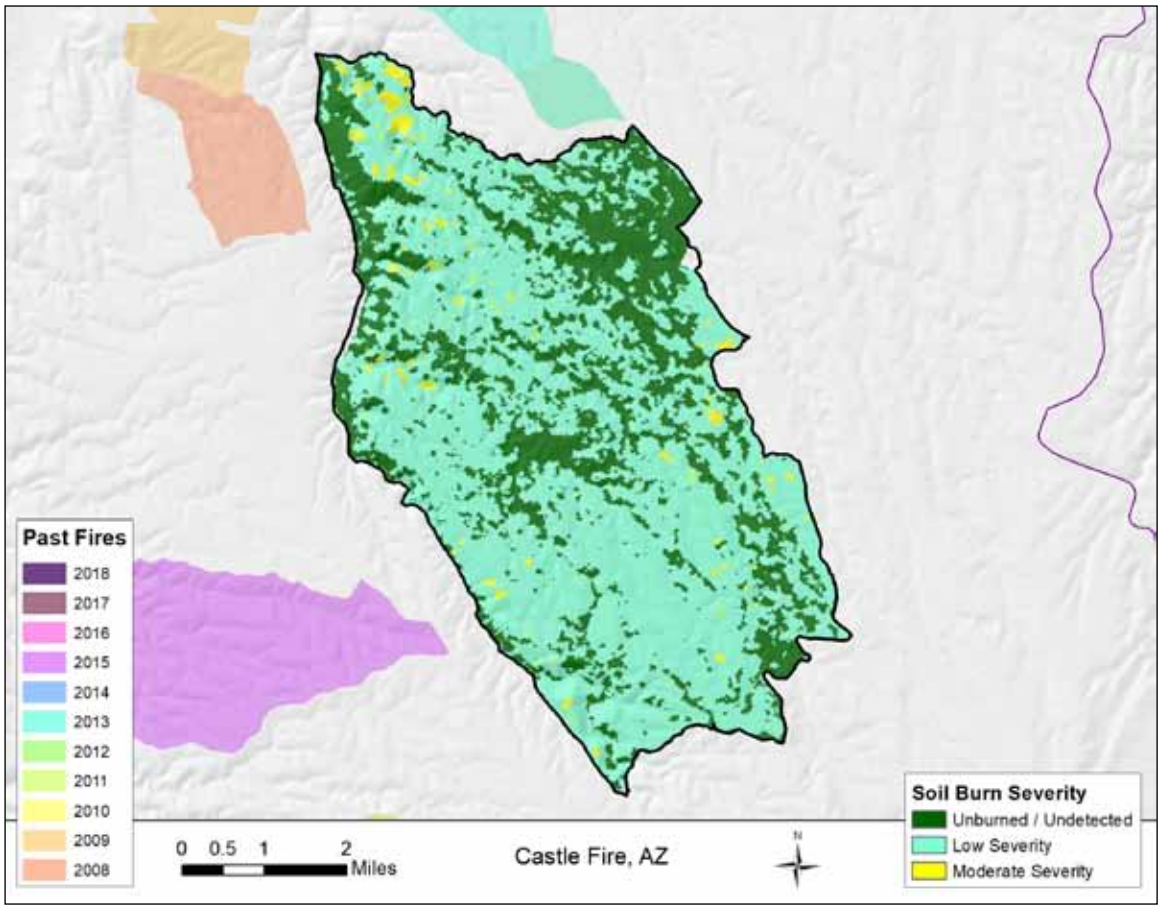

Figure 7. Soil burn severity map of the Castle Fire.

Castle Fire, Arizona

The Castle Fire burned for 62 days, from July 12 to September 12, and covered 19,368 acres in Coconino County, Arizona. This fire was located 11 miles south of Jacob Lake and three miles west of Arizona State Highway 67 near Oquer Canyon on the Kaibab National Forest. Fire managers chose to use a combination of confine (80 percent), monitor (10 percent), and point zone protection (ten percent) strategies to allow this naturally ignited fire to burn across the landscape. The fire intensity was mostly low to moderate, with occasional flare-ups in dense pockets of fuel. The Incident Status Summary indicated one injured responder with no further detail. There were no reported civilian injuries, evacuations, or damaged structures. The cost for managing the Castle Fire was $5.95 million, or about $307 per acre.

Vegetation and Past Fires

The Castle Fire burned primarily through ponderosa pine (38 percent), mixed conifer (33 percent), and conifer oak (18 percent). Fifty-four percent of the Castle Fire was classified as high departure from historic vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis. The area affected by the Castle Fire had not burned in any of the previous ten fire seasons, nor did it share any perimeters with previous fires. Past fires near the Castle Fire include the 2015 Burnt Complex Fire which burned approximately 4,000 acres a few miles to the west.

Fire Severity

Ninety-eight percent of the area was in low (68 percent) or unburned/undetected (30 percent) soil burn severity categories (Figure 7). None of the Castle Fire was classified as high soil burn severity. RAVG data were not available.

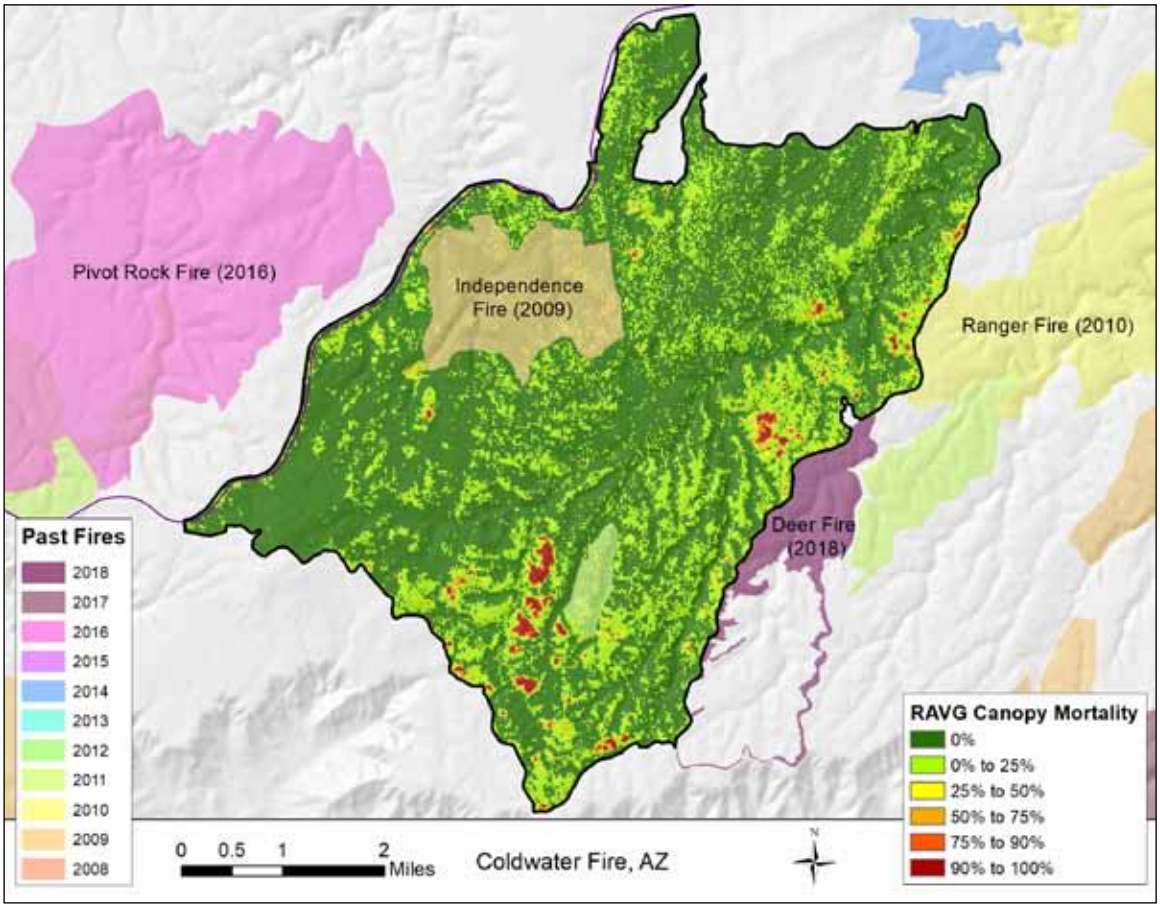

Figure 8. RAVG canopy mortality in the Coldwater Fire. Note that Arizona State Highway 87 served as the western boundary for the Coldwater Fire

Coldwater Fire, Arizona

Lighting started the Coldwater Fire on May 30 and it burned for the next 35 days, encompassing 16,790 acres south of Happy Jack, Arizona on the Coconino National Forest. Fire managers started with a monitor approach and transitioned to a 50/50 split of point zone protection and full suppression as the fire expanded toward Arizona State Highway 87. State Highway 87 eventually served as the western boundary for about 8.5 miles of the fire. Fire managers eventually chose to use a 100 percent suppression approach to protect the identified values and infrastructure from adverse fire effects while ensuring public and firefighter safety. The planned end state was to have fire along all control lines with mixed severity areas in the interior. They also sought to maintain low to moderate fire severity in any Mexican spotted owl habitat and to protect the City of Payson's watershed. Fourteen structures were threatened but none were damaged or destroyed by the Coldwater Fire. Three minor injuries were reported for responders during the fire. Management of the wildfire cost $1.5 million, or $89 per acre.

Vegetation and Past Fires

The area affected by the Coldwater Fire was predominantly ponderosa pine (88 percent) with some mixed conifer (5 percent) and riparian forest (4 percent). Several other fires have burned in this area over the last ten years. The 2011 Kehi Fire (187 acres) and the 2009 Independence Fire (1,372 acres) perimeters lie entirely within the Coldwater Fire. The 2018 Deer Fire (765 acres) served as a 4.25-mile boundary in the southeastern part of the fire while the 2010 Ranger Fire (6,400 acres) created a 1.4-mile edge farther north. Other area fires that did not overlap or share a boundary included the 2016 Pivot Rock Fire (5,968 acres) and the 2011 Scout Fire (809 acres). Thirty-four percent of the Coldwater Fire had a high departure from historic vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

Fire severity was generally low in the Coldwater Fire. RAVG maps identified nearly all the area as zero (71 percent) or less than 25 percent canopy mortality (26 percent). Less than one percent (142 acres) experienced greater than 90 percent mortality (Figure 8). These canopy mortality rates are far lower than many of the other fires in 2019 but nearly all of the area affected was ponderosa pine or mixed conifer, which tend to require a much more intense fire to induce canopy mortality than fires in grass, chaparral, and other vegetation types. This difference is highlighted in a comparison to the soil burn severity analysis. This analysis also showed most of the fire had low-severity; 76 percent low and 20 percent undetected. While some fires show a discrepancy between the canopy mortality and the soil burn severity it is worth noting that the majority of this fire had low soil severity and zero canopy mortality.

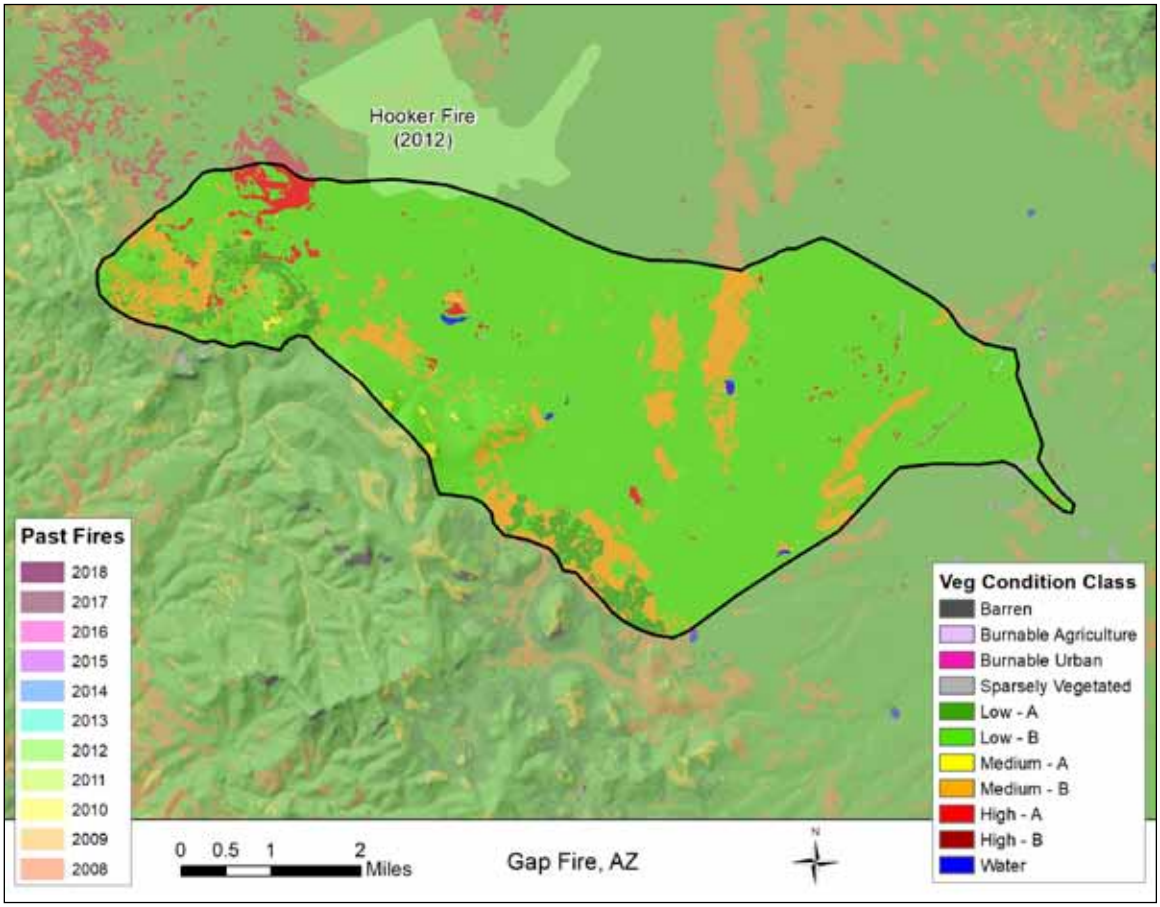

Figure 9. Vegetation Condition Class in the Gap Fire which is a LANDFIRE metric that gives a departure from historic vegetation conditions ranging from low to high. Most of the Gap Fire was low departure.

Gap Fire, Arizona

The Gap Fire was reported on June 25 about ten miles northeast of Bylas, Arizona on the San Carlos Apache Reservation near Point of Pines and Hooker Gap. Fire managers chose to use a full suppression approach and go as directly as possible at the fire given the extreme fire weather conditions and the amount of arson fires, which posed a threat to the communities and surrounding values at risk in the area of Bylas and San Carlos/Peridot. Managers used Minimum Impact Suppression Tactics (MIST) in the Bureau of Land Management (BLM) Fishhooks Wilderness, which called for the minimum amount of forces necessary to effectively achieve the fire management protection objectives. Due to the extreme fire conditions and wind-driven runs, the fire grew to nearly 13,000 acres in the first day and covered more than 16,000 acres in the nine days it burned in late-June and early-July. No injuries or damaged structures were reported. The wildfire cost $1.25 million to manage, or about $75 per acre.

Vegetation and Past Fires

The Gap Fire shared a 1.4-mile boundary with the 2012 Hooker Fire (1,981 acres). Otherwise the area affected by the Gap Fire had not burned in the previous ten years, nor had any of the surrounding landscape. Most of the Gap Fire was scrub (72 percent) with lesser components of chaparral (11 percent) and grass (9 percent). Eighty-six percent of the Gap Fire showed low departure from historic vegetation conditions according to LANDFIRE Vegetation Condition Class analysis (Figure 9).

Fire Severity

No fire severity data were available for the Gap Fire.

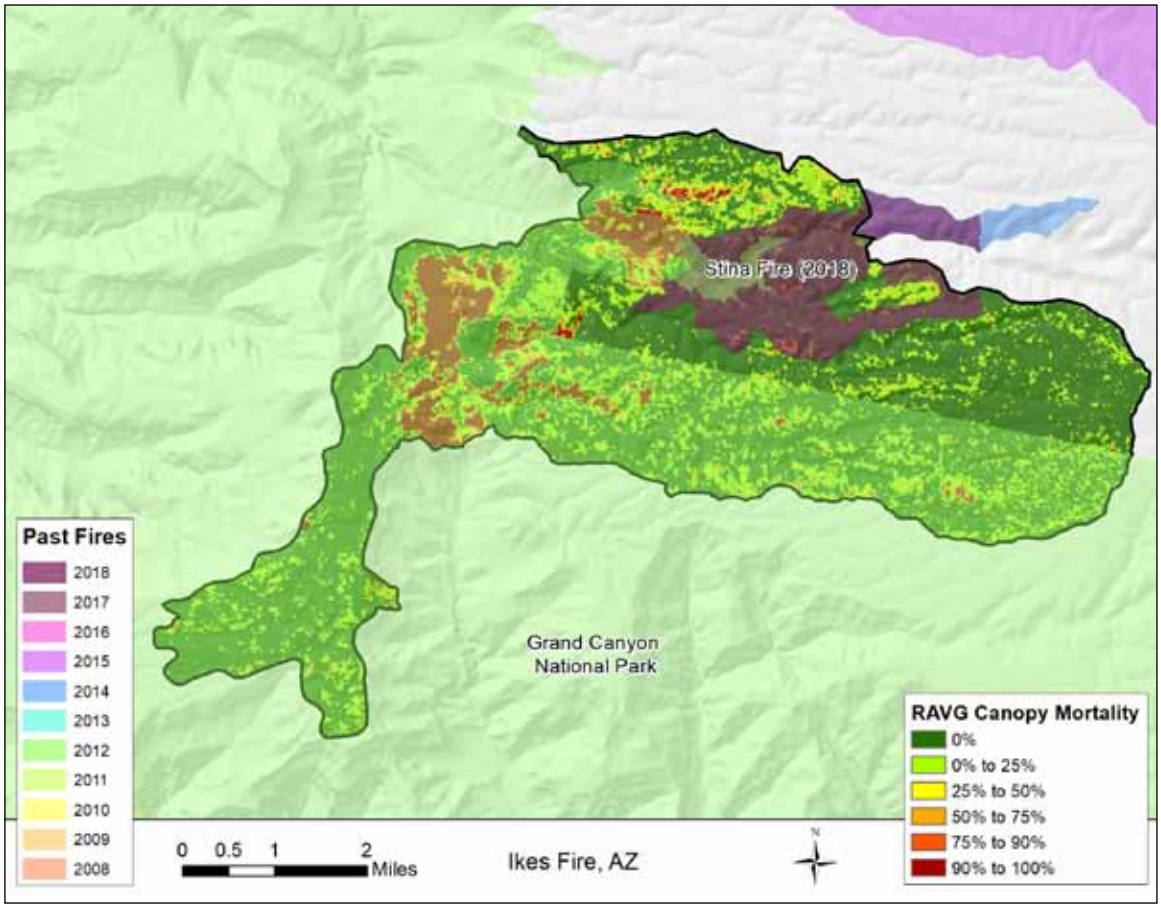

Figure 10. RAVG Canopy Mortality within the Ikes Fire perimeter. Grand Canyon National Park is shown in light green.

Ikes Fire, Arizona

The Ikes Fire burned for 84 days, from July 25 to October 17, and covered 16,400 acres in Coconino County, Arizona. Fire managers chose to use a combination of confine (80 percent) and monitor (20 percent) strategies to allow this naturally ignited fire to burn across the planning area from where it started near Swamp Point in the Kaibab National Forest and into the northern part of Grand Canyon National Park. No structures were damaged or destroyed in this remote fire. Most services to the North Rim of the Grand Canyon remained open throughout this period with only local closures and occasional smoke issues on Arizona State Highway 67. The Ikes Fire cost $4.5 million to manage, or $274 per acre.

Vegetation and Past Fires

The Ikes Fire burned through primarily ponderosa pine (56 percent), mixed conifer (21 percent), and piñon-juniper (7 percent) with lesser components of several other vegetation types. Sixty-one percent of the Ikes Fire had a high departure from historic vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis. The Ikes Fire reburned 1,770 acres of the 2018 Stina Fire (2,100 acres) and shared three quarters of a mile perimeter with the 2014 Quaking Fire.

Fire Severity

Nearly 90 percent (14,500 acres) of the Ikes Fire displayed zero (68 percent) or less than 25 percent (21 percent) canopy mortality according to the RAVG analysis (Figure 10). The roughly 1,000 acres that experienced more than 90 percent canopy mortality were concentrated in the piñon-juniper and other short-stature vegetation types. Soil burn severity data were only available for a 6,989-acre section of the Ikes Fire. This was represented in the southeastern portion of the Ikes Fire primarily south of the 2018 Stina Fire. Soil burn severity data in this section indicated primarily low (45 percent) or undetected (45 percent) severity.

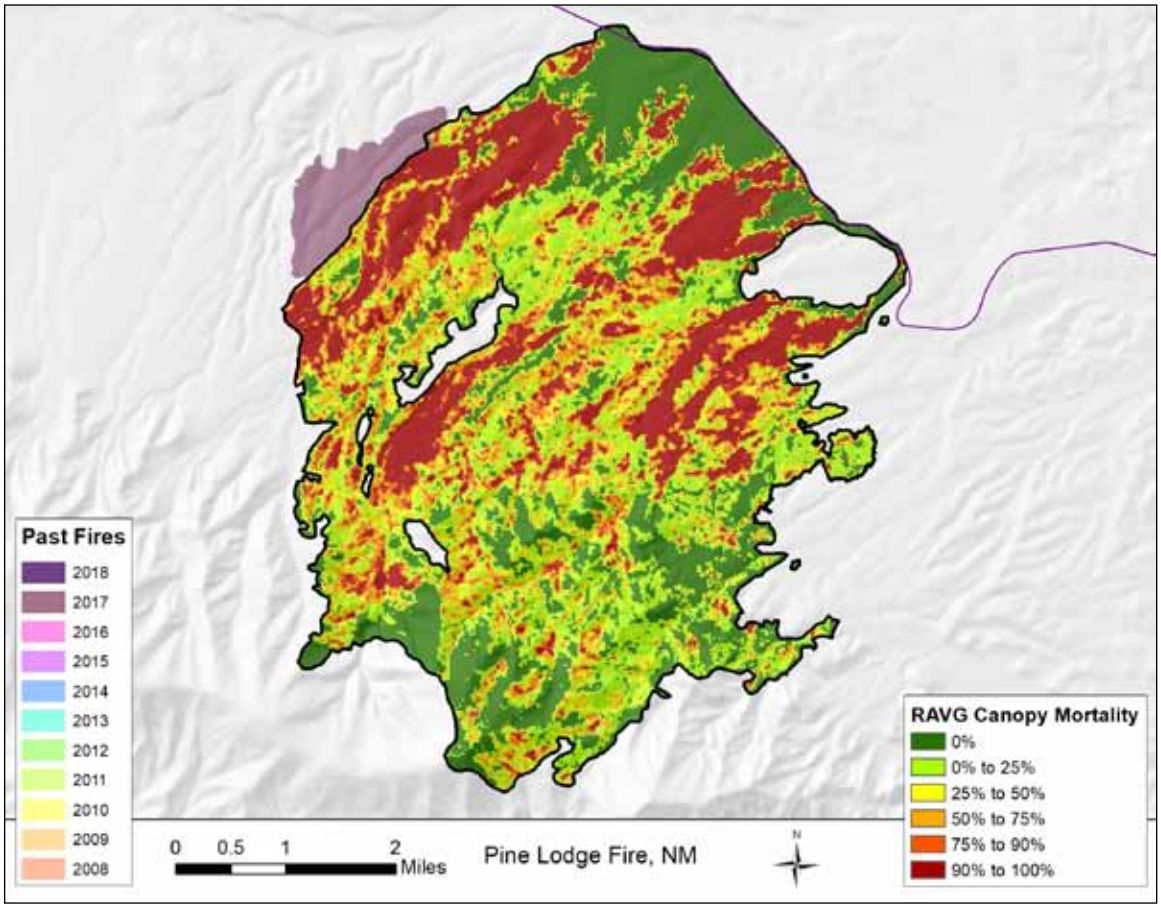

Figure 11. RAVG canopy mortality in the Pine Lodge Fire.

Pine Lodge Fire, New Mexico

The Pine Lodge Fire started from an unknown cause on June 19, 2019 in the Smokey Bear Ranger District of the Lincoln National Forest approximately five miles northwest of Arabella, New Mexico. The fire burned for 30 days across roughly 15,000 acres. The Pine Lodge Fire burned in rugged terrain within the Capitan Mountains Wilderness Area, which created a series of operational challenges around access for firefighters and long travel times. Managers used a values-driven strategy that incorporated a mix of tactics (direct and indirect) when and where the probability of success was high and the risk was acceptable in relationship to the values. This meant that while the management strategy for this fire was designated as full suppression, it was implemented in different ways across the fire. Suppression efforts were more active outside the wilderness with a full suppression strategy using direct and indirect tactics while confine/contain and MIST were used inside the designated wilderness area. The Pine Lodge Fire destroyed three residences and four responders reported injuries or illness. The cost to manage the fire was $8 million, or about $532 per acre.

Vegetation and Past Fires

The Pine Lodge Fire burned through a mix of piñon-juniper (39 percent), ponderosa pine (29 percent), mixed conifer (15 percent), and riparian forest (10 percent). The area affected by the Pine Lodge Fire had not burned in the last ten years; however, the Incident Status Summary identified significant fire management challenges due to heavy dead-and-down fuels at all elevations and in all fuel types resulting from the 2004 Peppin Fire. The Pine Lodge Fire did share a nearly two-mile boundary with the 2017 Seven Cabins Fire. Ninety-four percent of the vegetation within the Pine Lodge Fire had high (58 percent) or moderate (36 percent) departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

A quarter of the Pine Lodge Fire experienced no canopy mortality with an additional 24 percent analyzed as less than 25 percent canopy mortality (Figure 11). There were also areas of very high canopy mortality with more than 3,100 acres (21 percent) experiencing greater than 90 percent canopy mortality. Unlike some other fires in this report where the highest level of canopy mortality is concentrated in the lower statured vegetation, nearly 900 acres of the highest canopy mortality class was ponderosa pine in the Pine Lodge Fire. The soil burn severity data underscored the RAVG data showing more than 6,500 acres of the Pine Lodge Fire had a moderate soil burn severity. Although only 290 acres were designated as high-severity.

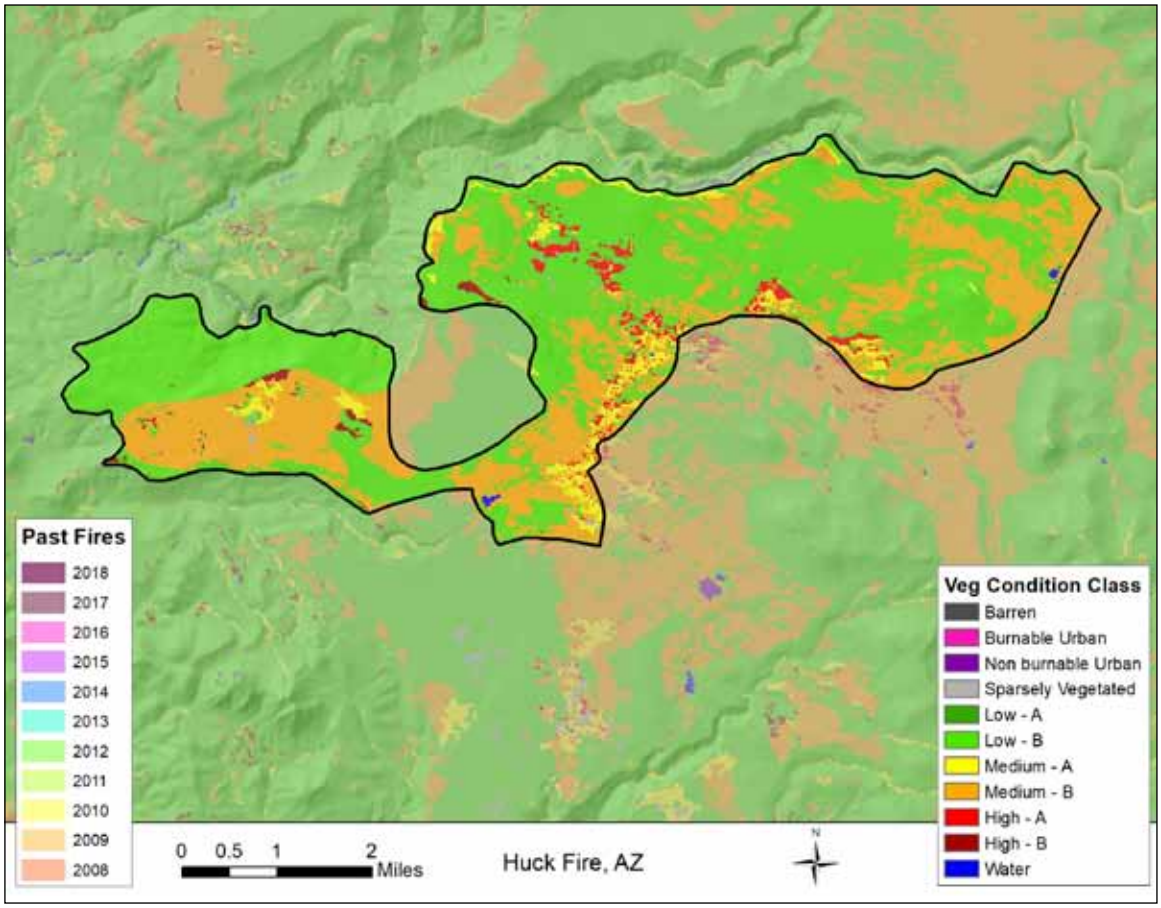

Figure 12. Vegetation Condition Class in the Huck Fire which is a LANDFIRE metric that gives a departure from historic vegetation conditions ranging from low to high.

Huck Fire, Arizona

The Huck Fire burned for sixteen days, from July 23 to August 8, about five miles northeast of San Carlos on the San Carlos Apache Indian Reservation in Gila County, Arizona. This naturally ignited fire burned approximately 11,750 acres of scrub/chaparral. Fire managers primarily chose a confine approach to keep the fire South of the San Carlos River Drainage and North of Huckberry Creek and Gila County Road 8 utilizing existing roads and natural features to allow the fire to achieve multiple resource benefits. No injuries, structural damage, or evacuations were reported for this fire. Management of the Huck Fire cost $500,000, or about $42 per acre.

Vegetation and Past Fires

The majority of the Huck Fire burned through scrub (55 percent), chaparral (31 percent), and grass (12 percent). Nearly 60 percent of the vegetation within the Huck Fire was classified as low departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis (Figure 12). The area affected by the Huck Fire had not burned in the last ten years, but the area saw two large fires in 2019 with the Bronco Gulch Fire burning nearby. The final perimeters of the Bronco Gulch and Huck Fires were separated by less than a mile.

Fire Severity

No fire severity data were available for the Huck Fire.

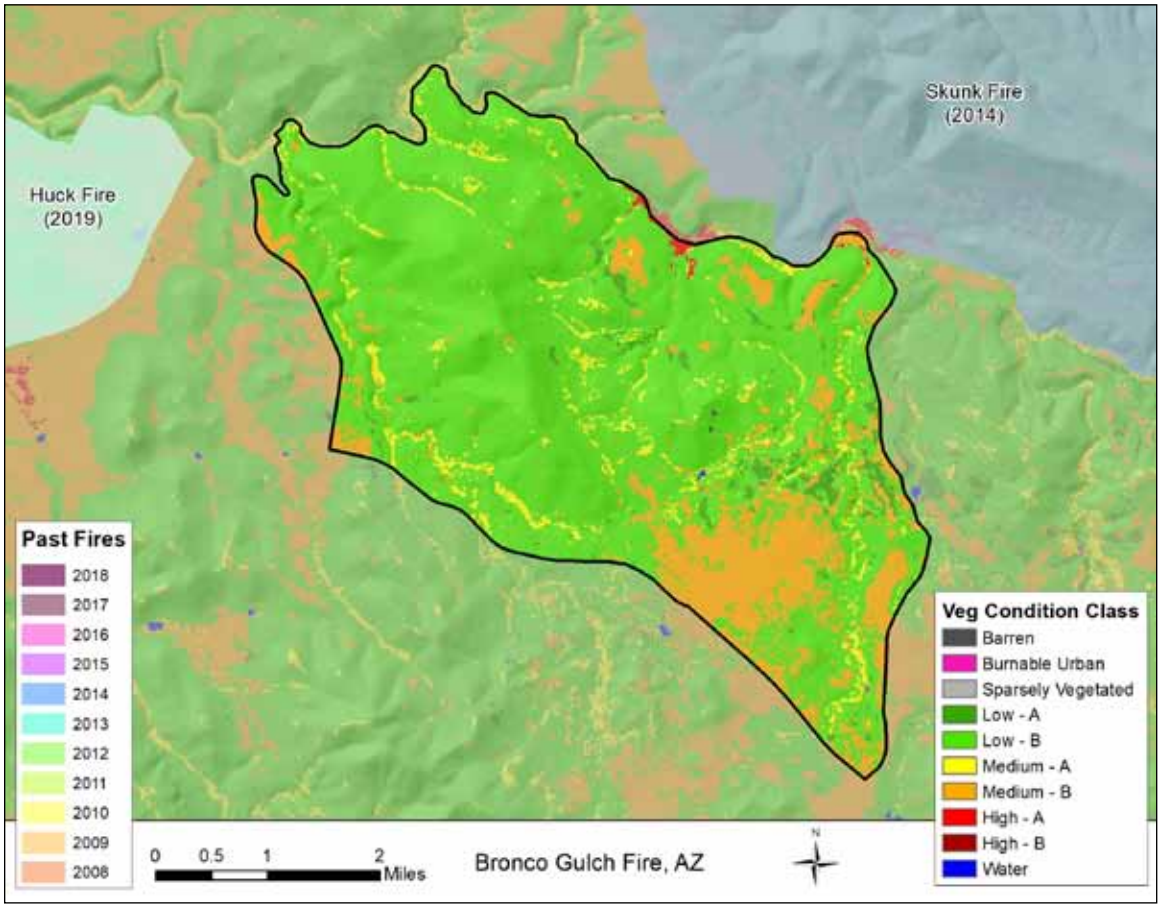

Figure 13. Vegetation Condition Class in the Bronco Gulch Fire which is a LANDFIRE metric that gives a departure from historic vegetation conditions ranging from low to high. Most of the Bronco Gulch Fire was low departure.

Bronco Gulch, Arizona

The Bronco Gulch Fire burned 10,760 acres during a 13-day stretch (July 15–28), approximately sixteen miles northeast of San Carlos on the San Carlos Apache Indian Reservation in Graham County, Arizona. Fire managers chose a point zone protection approach on this lightning-caused fire using naturally occurring features such as roads, and washes. In addition to firefighter and public safety, the fire managers hoped to restore natural fire regimes to the area to control cholla cactus and promote endemic grasses used for livestock grazing. No injuries, structural damage, or evacuations were reported for this fire. Management of the Bronco Gulch Fire cost $380,000, or $35 per acre.

Vegetation and Past Fires

The Bronco Gulch Fire burned primarily through scrub (42 percent), chaparral (38 percent), and piñon-juniper (13 percent), with small amounts of grass, riparian, and non-vegetated areas. The area affected by the Bronco Gulch Fire had not been burned in the last ten years, although there were several other fires in the area including a 1.5-mile shared perimeter with the 2014 Skunk Fire (73,600 acres). Around the time the Bronco Gulch Fire was wrapping up, another large fire (Huck) was starting nearby. The final perimeters of the Bronco Gulch and Huck Fires were separated by less than a mile. Eighty percent of the vegetation within the Bronco Gulch Fire perimeter had low departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis (Figure 13). None of the area was classified as high departure.

Fire Severity

No fire severity data were available for the Bronco Gulch Fire.

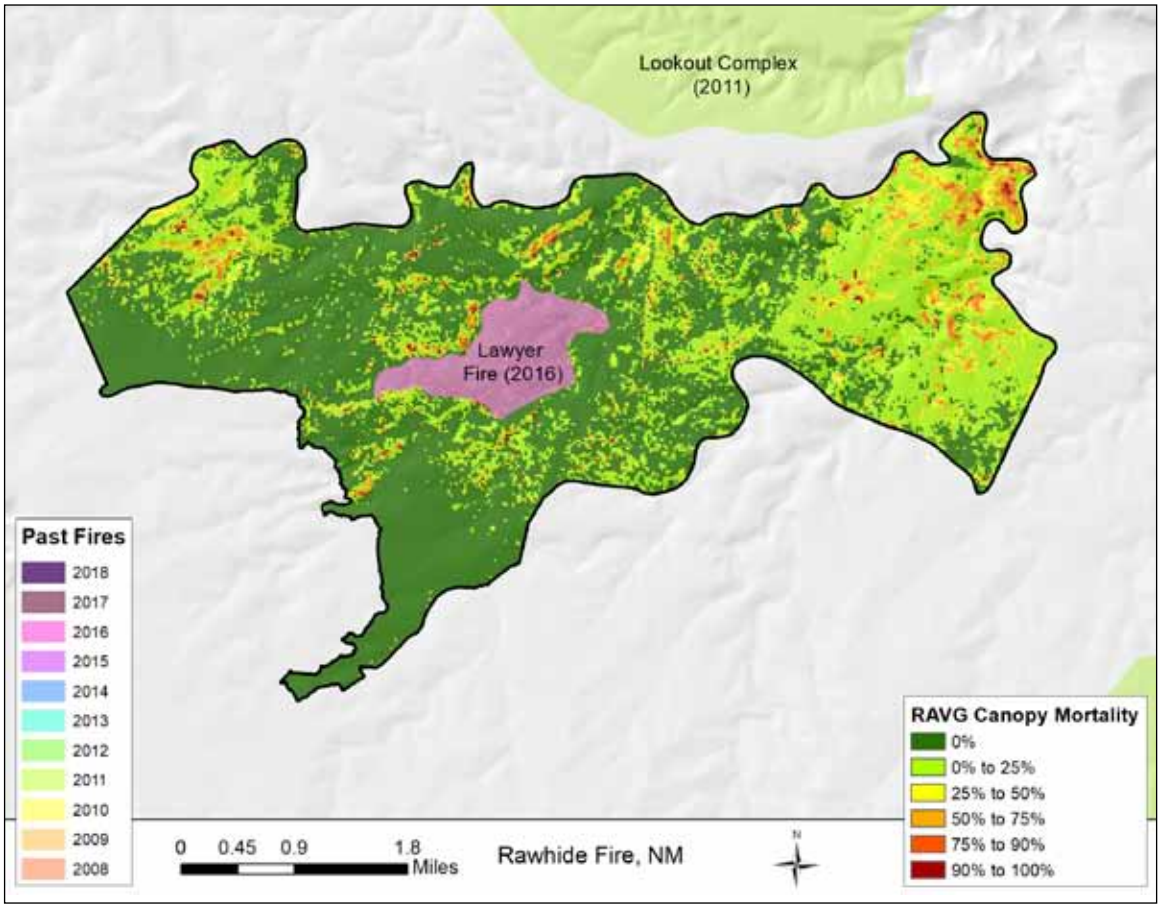

Figure 14. RAVG canopy mortality in the Rawhide Fire.

Rawhide Fire, New Mexico

The Rawhide Fire was reported on August 8 in the Guadalupe Ranger District of the Lincoln National Forest. The fire burned nearly 10,000 acres over the next 20 days around the Rawhide Canyon near the unincorporated community of Queen in Eddy County, New Mexico. Fire managers used a monitor and confine strategy to keep the fire within a designated area. No injuries, structural damage, or evacuations were reported for this fire. The Rawhide Fire cost $500,000 to manage, or about $50 per acre.

Vegetation and Past Fires

Most of the area affected by the Rawhide Fire was grass (53 percent), scrub (22 percent) or piñon-juniper (19 percent) with small amounts of chaparral and riparian vegetation. The Rawhide Fire reburned all the 2016 Lawyer Fire (587 acres) footprint. Several other large-scale fires burned in the vicinity of the Rawhide Fire including the 2011 Lookout Complex (18,820 acres) to the north and the 2011 Last Chance Fire (53,342 acres) to the south. The Kellar Fire burned 5,750 acres 4.5 miles south of the Rawhide Fire in 2018. Seventy-one percent of the vegetation within the Rawhide Fire was classified as medium departure from historic conditions in the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

Nearly 60 percent (5,900 acres) of the Rawhide Fire displayed zero canopy mortality in the RAVG analysis (Figure 14). This is surprising given the amount of grass and other low-stature vegetation types within the Rawhide perimeter. In fact, nearly 60 percent (3,080 acres) of the grass vegetation type was reported as no canopy mortality. Only 175 acres across all vegetation types were identified as having greater than 75 percent canopy mortality. Soil burn severity data were not available for the Rawhide Fire.

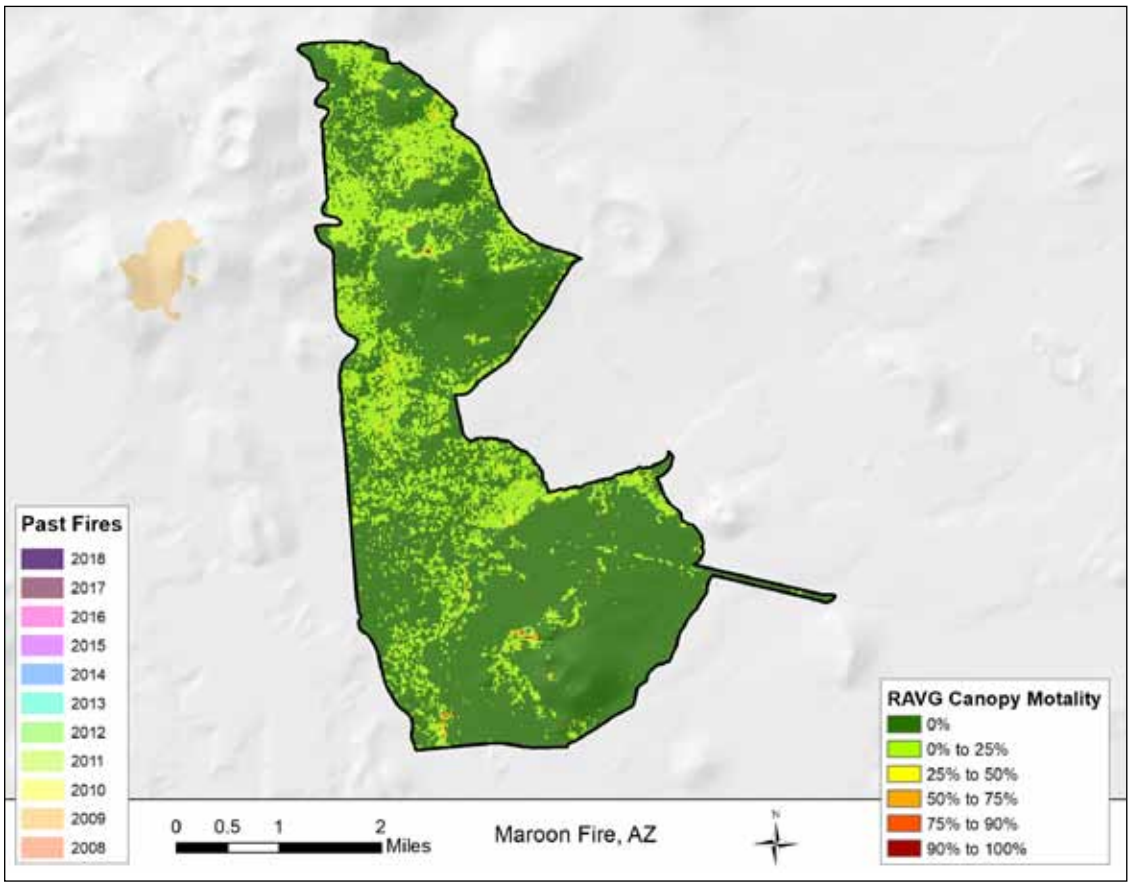

Figure 15. RAVG canopy mortality in the Maroon Fire burn area.

Maroon Fire, Arizona

Lightning ignited the Maroon Fire in the Maroon Crater approximately 13 miles northeast of Flagstaff and seven miles east of US Highway 89. The fire started on May 16 and burned for the next 38 days in an area consisting of cinders, pine, juniper, grass, and brush. The Maroon Fire required a unique approach as the area surrounding the Maroon Crater included a World War II artillery training zone with the potential for unexploded ordnance, as well as public utilities infrastructure and homes several miles northeast of the fire. Management of the Maroon Fire was described as a full suppression strategy but was unique due to the unexploded ordnance and the fire was allowed to spread naturally through most of the planning area. Coconino National Forest officials kept heavy equipment and personnel out of the 565-acre area of Maroon Crater with unexploded ordnance, which prevented them from conducting ignitions by hand. Instead, managers dropped small detonation devices from a drone over the former range. It is thought to be the first-ever use of an unmanned aircraft over an active wildfire in Region 3. Fire managers did not find any unexploded ordnance, but live weapons could still be in the area and the US Army Corps of Engineers plans to remove unexploded ordnance from Maroon Crater in 2020. This operation is projected to be greatly aided by the burn, as ordnance that would have otherwise not been visible below the grass and forest fuels should now be exposed.

In addition to the unexploded ordnance issue, the nature of the cinder hills area is unique and far different from all other areas of the Coconino National Forest in relation to conditions and fire behavior. Due to the porous soil (small-diameter cinders) and extremely windy conditions, large amounts of combustible material were buried by wind-blown cinders. This created an environment that fire managers monitored for weeks before it finally consumed all the buried combustible material.

No injuries, structural damage, or evacuations were reported for this fire. Management of the Maroon Fire cost $1.75 million, or $203 per acre.

Vegetation and Past Fires

The Maroon Fire mainly burned through piñon-juniper (68 percent) and ponderosa pine (18 percent) with scattered grass, scrub, and non-vegetated areas. Vegetated areas within the Maroon Fire were identified as moderate (59 percent) or low (38 percent) departure from historic conditions, according to the Vegetation Condition Class analysis. The other four percent of the burn area was classified as barren land on which vegetation departure cannot be measured. The area affected by the Maroon Fire had not burned in the preceding ten fire seasons.

Fire Severity

Nearly 100 percent (8,530 acres) of the Maroon Fire showed no (6,400 acres) or limited (2,130 acres) canopy mortality according to the RAVG analysis (Figure 15). Soil burn severity data were not available for the Maroon Fire.

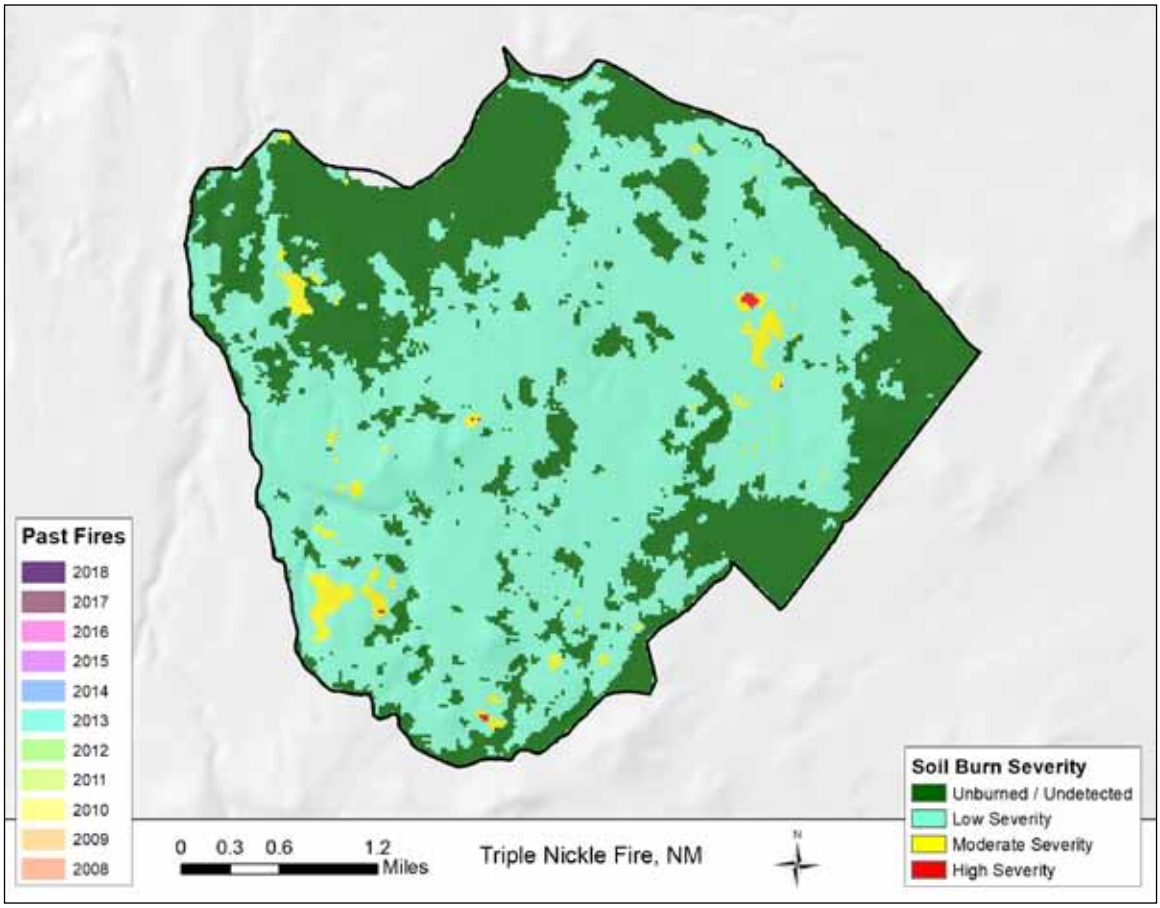

Figure 16. Soil Burn Severity data for the Triple Nickle Fire.

Triple Nickle Fire, New Mexico

The Triple Nickle Fire burned 8,063 acres northeast of Grants in the San Mateo Mountains near Mount Taylor in McKinley County, New Mexico. This naturally ignited fire started on August 8 and burned for the next 33 days on the Mt. Taylor Ranger District of the Cibola National Forest. Fire managers used a confine strategy on the fire, with goals of increasing wildlife benefits and reducing the threat of future catastrophic fires while continuing to protect the public, historical and cultural resource, threatened and endangered species, and range infrastructure. No injuries, structural damage, or evacuations were reported for this fire. The Triple Nickle Fire cost $2 million to manage, or $248 per acre.

Vegetation and Past Fires

The Triple Nickle Fire primarily burned in ponderosa pine (75 percent) and piñon-juniper (16 percent) with small amounts of riparian and scrub vegetation. There were no documented fires in the area over the last ten years. One hundred percent of the vegetation within the Triple Nickle Fire had moderate departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

The RAVG analysis showed relatively little canopy mortality across the Triple Nickle Fire, with 54 percent (4,350 acres) having no detectible canopy mortality and another 41 percent (3,300 acres) having less than 25 percent mortality. Only about 100 acres of ponderosa pine experienced canopy mortality greater than 75 percent. The soil burn severity data supported the RAVG data that the Triple Nickle Fire was predominately a low-severity fire with 98 percent designated low (64 percent) or unburned/undetected (34 percent). Only six acres were designated high-severity (Figure 16).

Conclusion

This report covers the 12 largest wildfires in Arizona and New Mexico. These 12 wildfires represented sixty percent of all acres burned in 2019. Chaparral was the most commonly burned vegetation type in the 12 fires covered in this report, however, more than 81 percent of the chaparral was in the Woodbury Fire (Figure 17). Far more acres of chaparral, scrub, and piñon-juniper were burned in the largest wildfires of 2019 than 2018, while fewer acres of grassland, ponderosa pine, and mixed conifer burned. The large fires in the 2018 analysis burned 41,000 more acres of ponderosa pine than the fires included in the 2019 analysis.

Soil burn severity data were available for seven of the 12 large fires analzyed in this report, covering nearly 220,000 acres (84 percent of acres in report). Seventy-eight percent of this area was classified as low or undetectable soil burn severity (Figure 18). Only one percent of the acres for which soil burn severity data were available displayed high soil burn severity. Nearly all of these high-severity acres were in the Sheridan Fire.

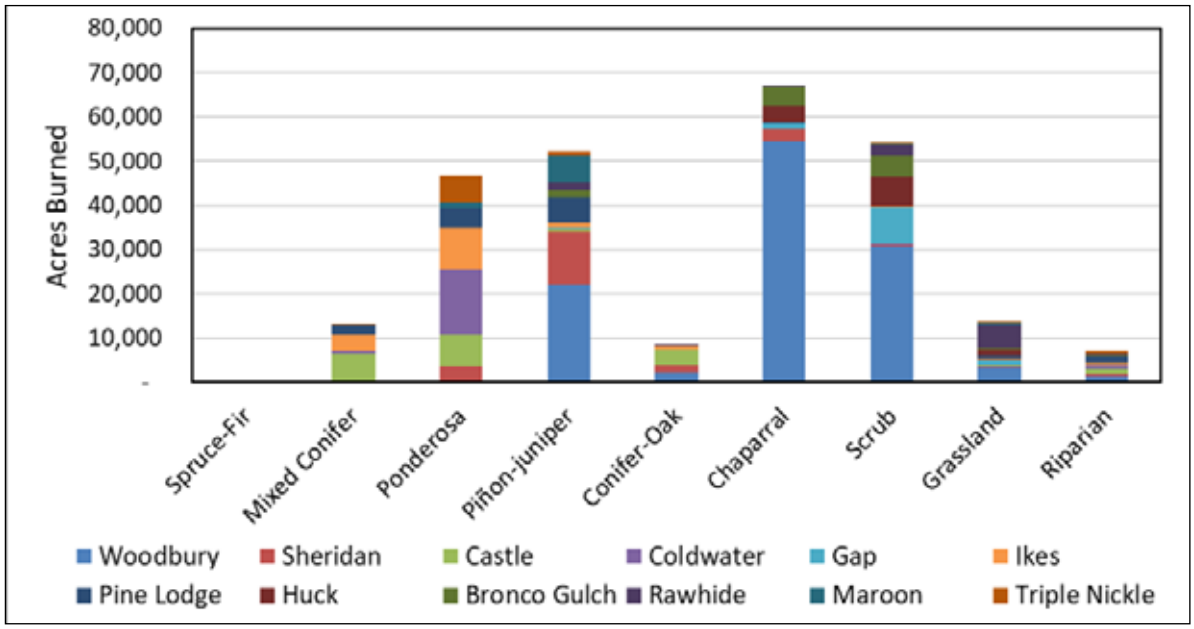

Figure 17. Summary of acres burned in the largest fires by vegetation type.

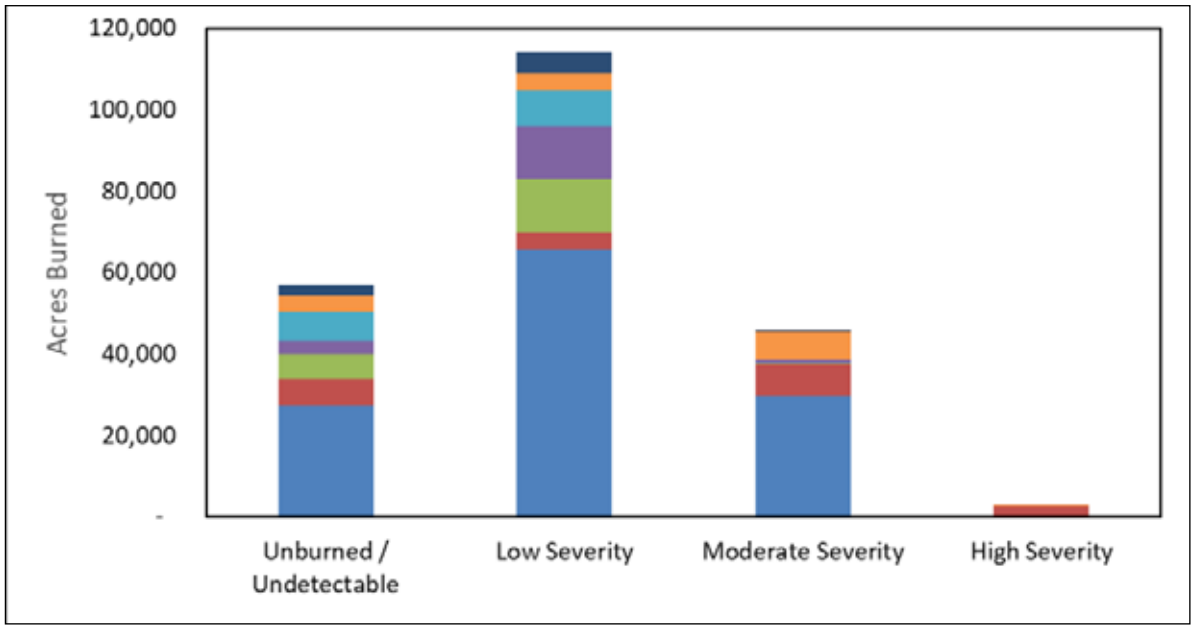

Figure 18. Summary of acres burned by soil burn severity class.

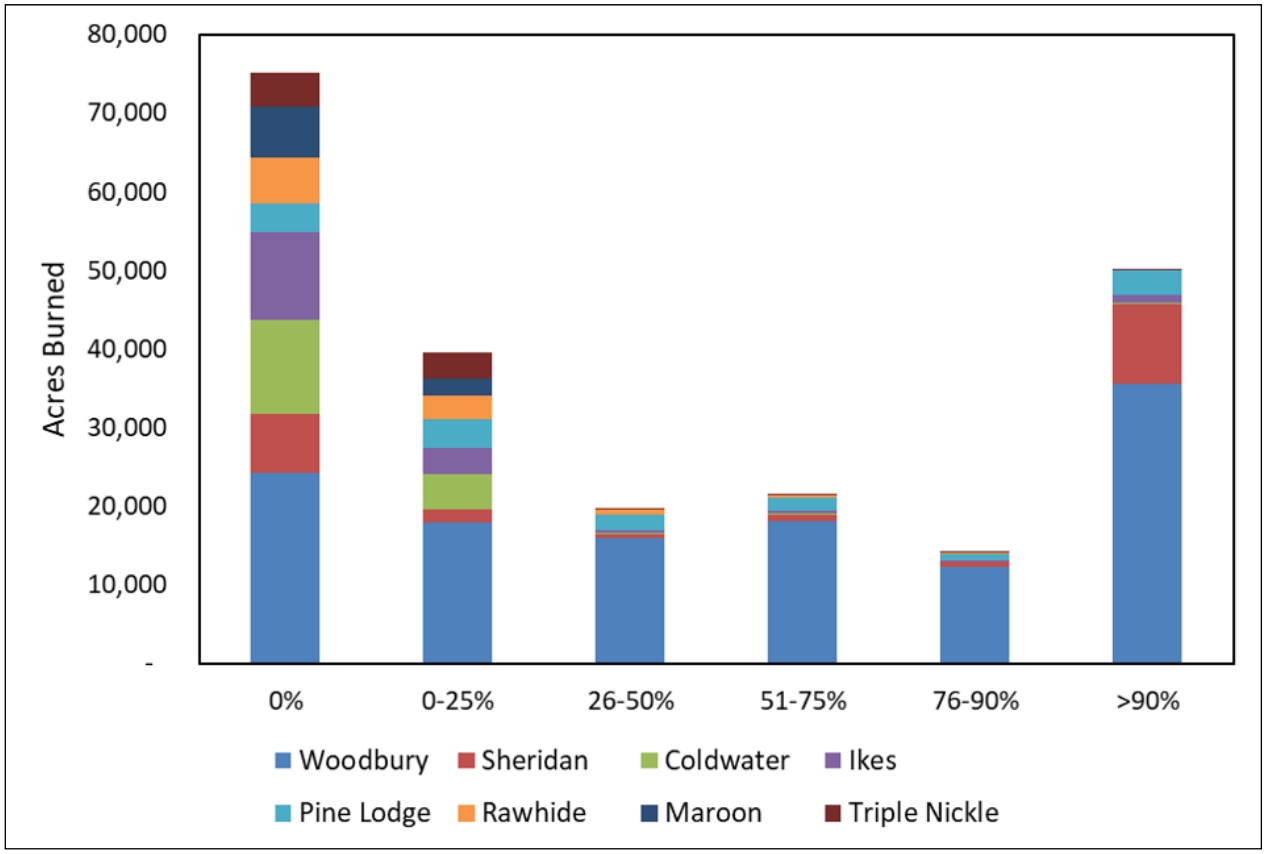

Figure 19. Summary of acres burned by canopy mortality class.

Rapid Assessment of Vegetation Condition after Wildfire (RAVG) data were available for eight of the 12 large fires covered in this report (Figure 19). Of these 220,000 acres, nearly 35 percent (75,000 acres) showed no detectable canopy mortality while more than 50,000 acres (23 percent) showed greater than 90 percent mortality. The Woodbury and Sheridan fires account for more than 90 percent of the highest canopy mortality areas. In the Woodbury Fire, this highest canopy mortality class was primarily in chaparral and piñon-juniper with relatively low associated soil burn severity classifications. Much of the high canopy mortality in the Sheridan Fire was also found in piñon-juniper but included much more ponderosa pine and had a much higher soil burn severity classification. Canopy mortality in these ponderosa pine communities can be more ecologically significant than fires that mainly burn in vegetation such as grass, scrub, and chaparral.

Only 14 percent of the area in this analysis was highly departed from historic conditions based on the LANDFIRE Vegetation Condition Class analysis (Figure 20). It is reasonable to assume that the high proportions of wildfire burning with low-severity and the high portion of the area burned close to the historic condition are related. Most of the 39,500 high-departure acres were isolated to four fires: Castle (26 percent), Ikes (25 percent), Pine Lodge (22 percent) and Coldwater (16 percent).

Human communities were not significantly affected by any of the largest fires of 2019. There certainly were localized impacts that should not be minimized, but only three structures were lost in these 12 fires and there were very few reported evacuations. In comparison, the 2018 Tinder Fire threatened more than 1,700 residences and required the evacuation of 300 civilians. It eventually destroyed 33 residences and 63 minor structures. The 2018 Ute Park Fire led to the evacuation of nearly 3,500 civilians, consumed 14 buildings, and damaged critical power infrastructure. None of the 2019 fires listed in this report caused impacts of this scale.

The cause of most fires in this report was lightning (naturally ignited) while three of the fires' causes were undetermined at the time of this writing.

The role of past fires was highly variable in the fires summarized in this report. Past fires played a role in most fires

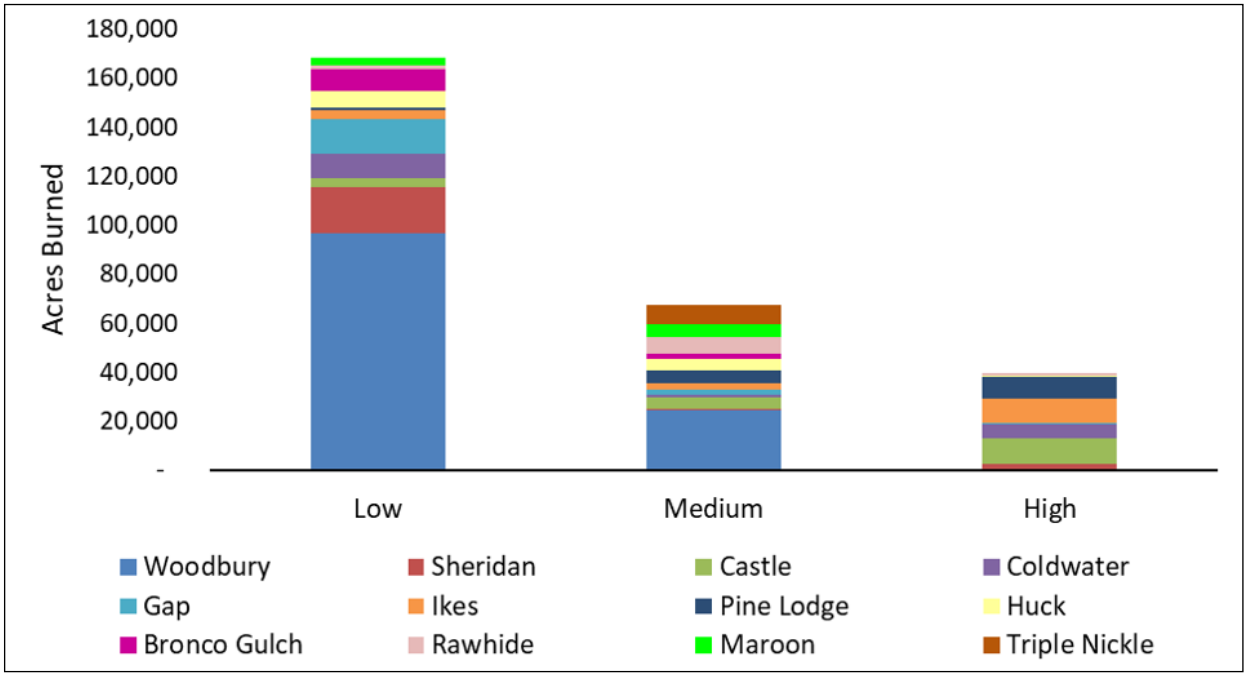

Figure 20. Summary of acres burned by vegetation condition class.

in this analysis and in many cases the edges of these ten-year-old or less fire scars served as fire breaks with only limited overlap. Meanwhile the Sheridan Fire had areas that were burned in each of the preceding fire seasons.

The 12 fires in this analysis cost nearly $56 million dollars to manage (with a range of strategies) for an average of $199 per acre. This was more than the average cost in our 2018 analysis but nearly half of the cost in the 2017 report. As noted above, managers identify the most appropriate strategy for each part of a wildfire to minimize threats and maximize positive outcomes. In 2019, managers used full suppression strategies on 49 percent of the acres burned in the large fires summarized in this report. This matches well with the percentage for all wildfires over 100 acres for which strategy is recorded in the Southwest Coordination Center's data: 51 percent were managed with a fire suppression strategy, while 49 percent were managed with other strategies. This suggests that managers were able to take advantage of relatively mild fire weather conditions throughout the 2019 fire season and naturally ignited wildfires in areas with low-to-moderate departure from historic conditions to benefit resources and increase community safety across the Southwest. While not every acre of wildfire managed with strategies other than full suppression burned at an ecologically appropriate severity, it is likely that a significant portion of the 215,096 acres provided some benefit.

Appendix 1. Fire Statistics

General				Vegetation Departure		
Name	Acres	Cost	cost/ac	Low	Medium	High
Woodbury	123,875	$25,000,000	$201.82	78%	20%	0%
Sheridan	21,510	$4,200,000	$195.26	87%	2%	11%
Castle	19,368	$5,950,000	$307.21	21%	25%	54%
Coldwater	16,790	$1,500,000	$89.34	58%	4%	37%
Gap	16,711	$1,250,000	$74.80	86%	12%	2%
Ikes	16,400	$4,500,000	$274.39	21%	17%	61%
Pine Lodge	15,044	$8,000,000	$531.77	6%	36%	58%
Huck	11,784	$500,000	$42.43	59%	37%	3%
Bronco Gulch	10,760	$380,000	$35.32	80%	20%	0%
Rawhide	9,951	$500,000	$50.25	18%	71%	11%
Maroon	8,602	$1,750,000	$203.44	38%	59%	0%
Triple Nickle	8,063	$2,000,000	$248.05	0%	100%	0%

	Soil Burn Severity				RAVG Canopy Mortality					
Name	Unburned	Low	Moderate	High	0%	0-25%	26-50%	51-75%	76-90%	>90%
Woodbury	22%	53%	24%	0%	20%	14%	13%	15%	10%	29%
Sheridan	31%	20%	36%	13%	35%	8%	3%	4%	3%	47%
Castle	30%	68%	2%	0%	-	-	-	-	-	-
Coldwater	20%	76%	4%	0%	71%	26%	1%	1%	0%	1%
Gap	-	-	-	-	-	-	-	-	-	-
Ikes	45%	54%	1%	0%	68%	21%	2%	2%	1%	6%
Pine Lodge	25%	28%	45%	2%	25%	24%	13%	11%	6%	21%
Huck	-	-	-	-	-	-	-	-	-	-
Bronco Gulch	-	-	-	-	-	-	-	-	-	-
Rawhide	-	-	-	-	59%	30%	6%	3%	1%	1%
Maroon	-	-	-	-	74%	25%	1%	0%	0%	0%
Triple Nickle	34%	64%	2%	0%	54%	41%	2%	1%	0%	1%

Woodbury Fire, Arizona

Woodbury Fire, Arizona

Sheridan Fire, Arizona

Sheridan Fire, Arizona

Castle Fire, Arizona

Castle Fire, Arizona

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