2020 Wildfire Season: An Overview

Southwestern US

JULY 2021

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 Mangum Fire burned for 46 days and covered 71,450 acres on the Kaibab Plateau near the North Rim of Grand Canyon National Park. Fire managers used a full suppression approach, which allowed for some point protection of infrastructure like the historic Jacob Lake Ranger Station featured in this photo. *Photo courtesy of the Kaibab National Forest, USDA Forest Service*

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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. Plant communities in the Southwest are adapted to fire. 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 eighth 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 and fire seasons. It follows the format of past years' overviews[1] and describes the impacts of the nine wildfires over 25,000 acres in Arizona and New Mexico in 2020. Also included are two wildfires in New Mexico worthy of note. As described in the main report, the Medio Fire provides a useful example of fuel reduction efficacy in a high-value watershed. The Luna Fire is notable because of its late start date, October 17. 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 2020.

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."[2] 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 2020 Fire Season

In 2020, wildfire burned 1,068,373 acres in the Southwest (Arizona and New Mexico), which is greater than the average number of acres burned annually in these two states over the previous ten-year period." Arizona had significantly more wildfire (929,522 acres) than its ten-year average (305,623 acres), while New Mexico had fewer acres of wildfire (138,851 acres) than its ten-year average (299,773 acres). Unplanned human ignitions made up 28 percent and 12 percent of wildfire acres in Arizona and New Mexico respectively (though these estimates excluded wildfires with an unknown cause) (Figure 1).

In 2020, wildfires over 100 acres represented 98 percent of the total acreage burned by wildfire in Arizona and New Mexico. In 2019, the Southwest Coordination Center recorded the strategies managers employed for wildfires, but that data was not available in 2020. During the fall and winter of 2019, managers were on track for a successful prescribed fire season. For example, the US Forest Service had completed 60,396 acres of prescribed burning in Arizona and New Mexico between October and end of December 2019. Then, during 2020, the COVID-19 pandemic hit and made prescribed fire and all fire management more difficult. COVID-19 caused the temporary suspension of prescribed fires on many jurisdictions to reduce smoke impacts on people at risk from COVID-19 and to reduce transmission among fire personnel. Fire management strategies focused on rapid suppression to avoid extended exposure to smoke or spread of COVID-19. In an April 3, 2020 letter, the Chief of the US Forest Service identified objectives to respond to wildfires during the pandemic including:

- Minimize to the extent feasible COVID-19 exposure and transmission and smoke exposure to firefighters and communities;
- Prioritize the use of local suppression resources with the predominant strategy being rapid containment; and
- Commit resources only when there is a reasonable expectation of success in protecting life and critical property and infrastructure.

The COVID-19 pandemic led to significant changes to fire management that are beyond the scope of this report. The Wildland Fire Lessons Learned Center compiled many of the pandemic impacts in a *Coronavirus Lessons Summary*.[3]

1 *2019, 2018, 2017, 2016, 2015, 2014,* and *2013 Wildfire Season: An Overview, Southwestern U.S.* https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/877/rec/3

2 *Guidance for Implementation of Federal Wildland Fire Management Policy, 2009* https://www.doi.gov/sites/doi.gov/files/uploads/2009-wfm-guidance-for-implementation.pdf

3 Lessons Learned Center https://www.wildfirelessons.net/orphans/view-incident?DocumentKey=1d838a70-f78c-4c47-a949-bde579427760

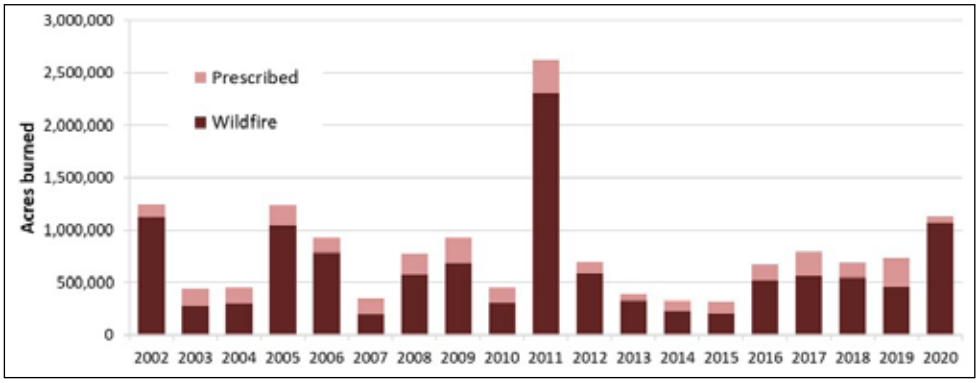

Figure 1. Wildfire and prescribed fire acres burned in Arizona and New Mexico, 2002 to 2020.[4]

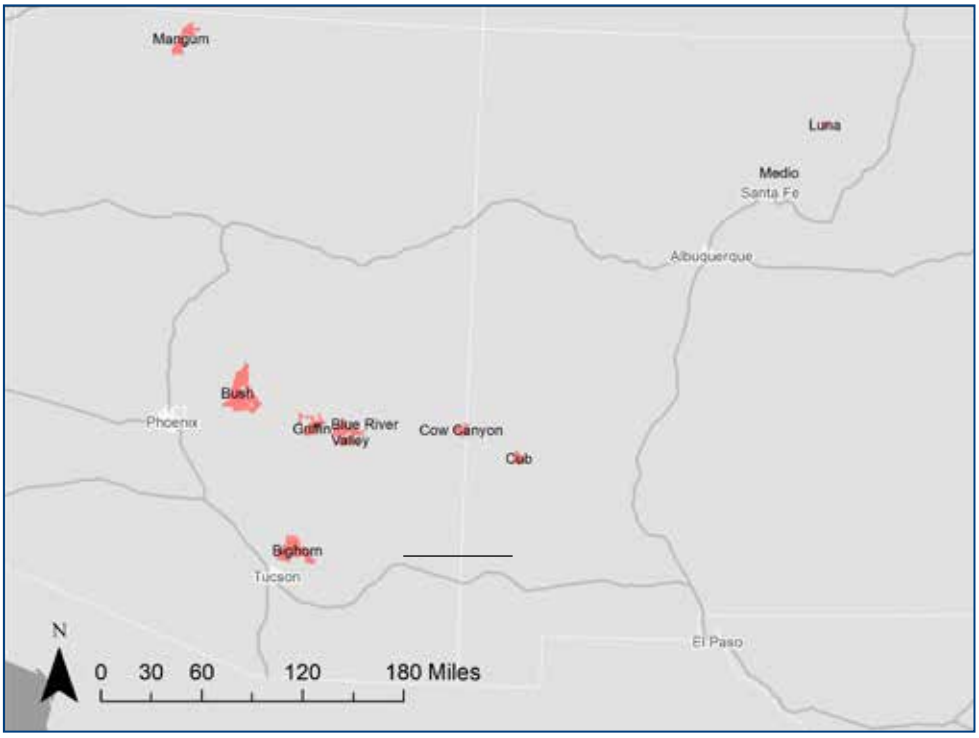

Figure 2. Map indicating the location of the 11 large fires in 2020 analyzed in this report. Note the Blue River 2 Fire is not labeled on the map but is located adjacent to the Blue River Fire.

This overview focuses on the 11 large fires, which include eight Arizona fires: Bush, Bighorn, Mangum, Griffin, Cow Canyon, Blue River, Valley, and Blue River 2; and three New Mexico fires: Cub, Luna, and Medio. The 11 large fires in this report represent 57 percent of the acres burned by wildfire in 2020 (Figure 2).

Regional Context

Northeast Arizona and northwest New Mexico were in severe drought in early 2020. The Southwest had well below average precipitation through the winter and spring. Poor precipitation in the second half of 2019 led to reduced fine fuel growth and below normal carryover of warm-season fine fuels.[5] However, the 2019–2020 winter was wetter than average in the southern part of the region and facilitated above normal growth of fine fuels. Snowpack was less than 50 percent of the long-term median. Spring 2020 precipitation was sufficient to encourage growth of fine fuels toward average levels. Fuel moistures for 100-hour fuels were below five percent in the southern half of the region and less than ten percent in the northern half at the beginning of fire season in May. Even 1,000-hour fuels had less than ten percent moisture in June. Strong wind events combined with these low fuel moistures and persistent hot and dry conditions facilitated large fires across the Southwest. Monsoons started later than usual across the Southwest. Due to the late onset and lack of significant precipitation in Arizona, much of the state remained at below normal precipitation with above normal temperatures through the summer. Persistent circulation anomalies during summer caused an abnormally inactive monsoon season with notable northerly component winds in the low-mid levels of the atmosphere. In fact, the wider Southwest (including California) had the warmest and driest July–September period on record.[6]

4 National Interagency Coordination Center Wildland Fire Annual Reports www.predictiveservices.nifc.gov/intelligence/intelligence.htm
5 https://www.drought.gov/news/2020-us-fire-outlook
6 Center for Western Weather and Water Extremes https://cw3e.ucsd.edu/2020-north-american-monsoon-recap/

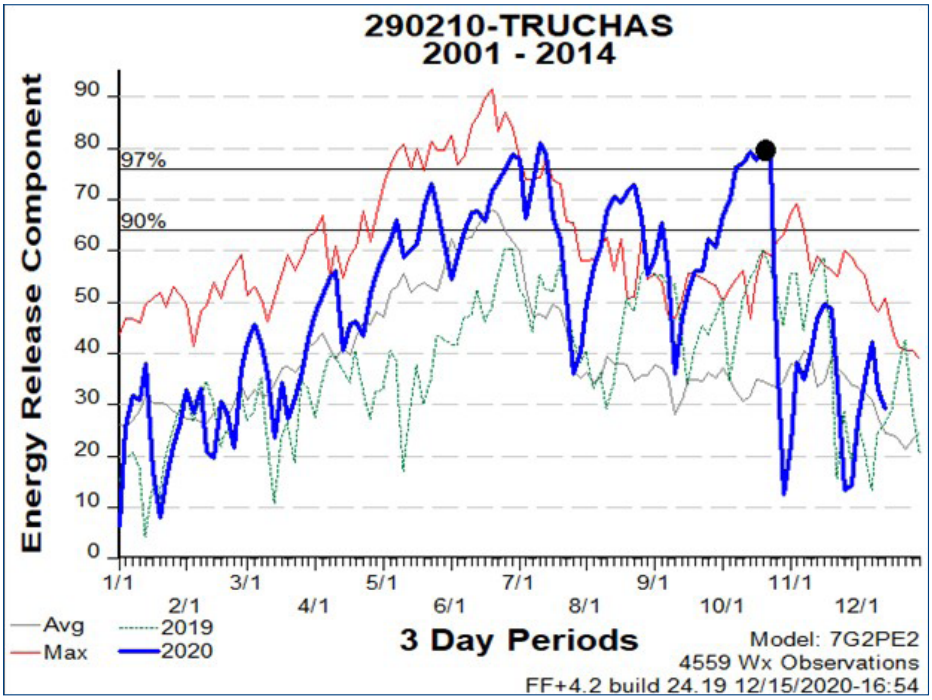

Figure 3. Energy release component (ERC) index for the 2020 fire season in northern New Mexico. Note the elevated ERCs at the start of the Luna Fire (black circle).

This unusually warm and dry summer exacerbated existing drought conditions. Upper-level ridging over California and the Southwest led to well below normal precipitation and above normal temperatures during October.

The composite statewide Energy Release Component (ERC) was about average until August when it increased to the observed maximum. In October, the region-wide ERC spiked well above the previous maximum. 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. A graph of ERC from northern New Mexico shows the 2020 fire season (blue line) in comparison to the ten-year average (gray line) and ten-year maximums (red line) (Figure 3).[7]

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 maps (rmgsc.cr.usgs.gov/outgoing/GeoMAC/). GeoMAC also provides perimeters of fires dating back to 2000, which provided a historic context for 2020 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 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 (2016) 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 fire on federal lands, 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

7 http://gacc.nifc.gov/swcc//predictive/fuels_fire-danger/nfdrs_charts/Areawide.htm

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 November 2020 and January 2021 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. As noted for specific fires in this report, soil burn severity and RAVG maps are not available for every wildfire.

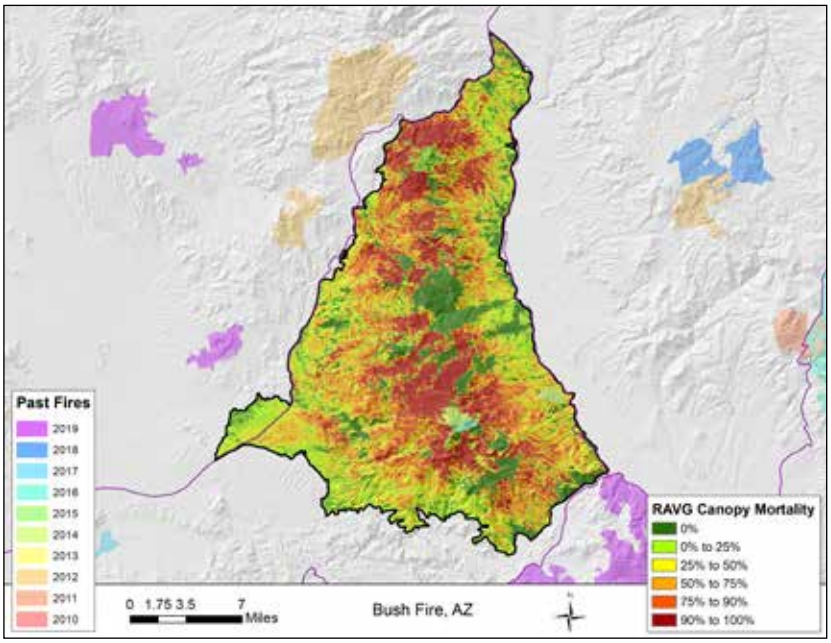

Figure 4. RAVG canopy mortality in the Bush Fire burn area.

Bush Fire, Arizona

The Bush Fire was a human-caused wildfire that started in the Tonto National Forest northeast of Phoenix, Arizona. The fire started on June 13, 2020 near the intersection of Bush Highway and SR 87 and burned 193,455 acres before it was fully contained on July 6, 2020. This was the largest fire in Arizona or New Mexico during the 2020 season and the fifth-largest wildfire in Arizona history. The Bush Fire presented numerous challenges with rugged terrain, extreme weather, and an abundance of dry invasive grasses coupled with the operational challenges around COVID-19 concerns. The fire was approached by fire managers with a full suppression approach according to the 209 report, using a values-driven strategy, incorporating 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. Suppression tactics were more active outside the designated wilderness areas with confine and monitor tactics utilized inside the wilderness.

Nearly 2,000 civilians were evacuated from their homes in response to the Bush Fire. Despite these evacuations and the fire's proximity to metropolitan Phoenix only one non-residential commercial property was damaged and no structures were lost. Arizona State Highways 87 and 188 were closed during the fire in addition to several smaller roads. No injuries or illnesses to responders were reported during on the Bush Fire. Wildfire management costs associated with the Bush Fire were estimated at $11.6 million, or about $60 per acre.

Vegetation and Past Fires

The primary vegetation types included scrub (25 percent), grass (23 percent), chaparral (19 percent), and piñon-juniper (12 percent). The scrub type often includes the iconic saguaro cactus, which is not fire adapted. Notably, there were also small patches of ponderosa pine on high elevation north-facing slopes and drainages. Nineteen percent of the area within the Bush Fire perimeter was classified as non-vegetated. Although LANDFIRE only classified 23 percent of the burned area as grass, the Incident Status Summary and several other resources cited that a primary factor that 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.

Most of the area affected by the Bush Fire had not burned in the past ten fire seasons, however fire return intervals of most vegetation types within the fire perimeter are significantly longer than ten years. There were only three relatively small fires in this area over this period: 2014 Browns (900 acres), 2015 Peters (650 acres), and 2016 Peaks (850 acres). The 124,000-acre Woodbury Fire of 2019 was just a few miles southeast of the Bush Fire. Arizona State Highway 188 served as the primary boundary along the fires 30-mile eastern edge while State Highway 87 served the same function on its 35-mile western boundary.

All but a few scattered acres within the Bush Fire perimeter were classified as low (88 percent) or moderate (11 percent) departure from historic vegetation conditions according to the LANDFIRE Vegetation Condition Class analysis. Per Tonto National Forest staff, LANDFIRE data for the area within the fire perimeter greatly underestimated the presence of invasive grasses, therefore departure from historic vegetation conditions percentages are likely inaccurate.

Fire Severity

The RAVG analysis indicated a relatively even distribution of acres across the canopy mortality categories with 19 percent showing more than 90 percent mortality and 18 percent showing zero percent canopy mortality (Figure 4). The Bush Fire primarily burned through vegetation types with relatively low canopy heights, and canopy mortality in these vegetation types can be less informative on fire severity than other vegetation types but can provide information on the variability across the burn area. The Sonoran Desert and semi-desert grassland ecosystem types in the Bush Fire footprint exhibited poor soil conditions before the fire. This made the soil burn severity analysis, which is based on change in condition, more challenging to interpret. The soil burn severity analysis showed 48% of the burn area with moderate severity and five percent with high burn severity.

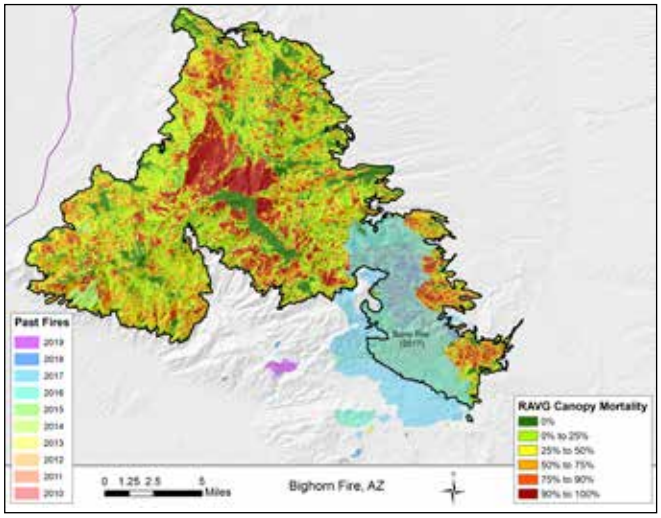

Figure 5. Canopy mortality map for the Bighorn Fire.

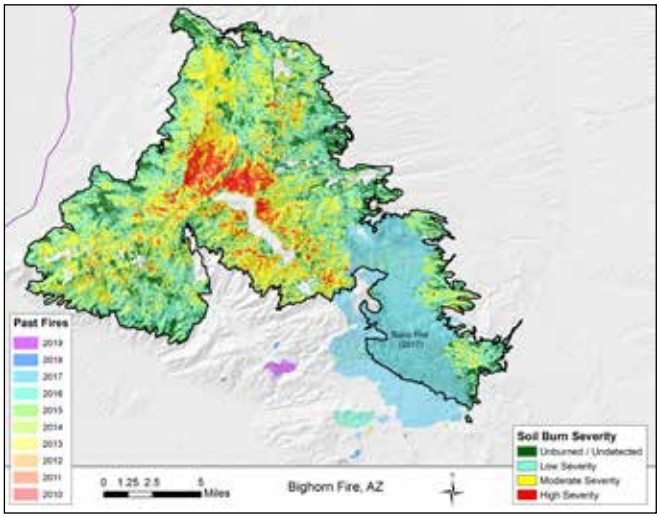

Figure 6. Soil burn severity in the Bighorn Fire.

Bighorn Fire, Arizona

Lightning started the Bighorn Fire on June 5 in the Catalina Mountains northwest of Tucson, Arizona. The Bighorn Fire burned for the next 54 days, eventually encompassing nearly 120,000 acres making it the seventh-largest wildfire in Arizona history. The fire burned in and around the Coronado National Forest, including well-known areas like Mt. Lemmon and the upper Sabino Canyon watershed. The fire burned in the steep and rugged terrain of the Pusch Ridge Wilderness and extended out toward the Catalina Foothills making it visible throughout Tucson. In some areas, invasive grasses impacted the fire at low elevations, carrying it through stands of saguaro cactus, which are not fire adapted.

Land managers chose to utilize a full suppression approach to minimize the threat and impacts to communities and private infrastructure, but also sought to minimize the impacts of suppression activities where feasible in consideration of the natural and cultural values at risk. Consideration was also taken to allow for social distancing to reduce and prevent the potential exposure and transmission of COVID-19.

The area affected by the Bighorn Fire contained numerous cultural, biological, and recreational values, including numerous archeological and cultural resources, waterways, riparian areas, wildlife, and watersheds. The area also provides habitat for rare and threatened species such as the Gila chub, Gila top minnow, lesser long-nosed bat, lowland leopard frog, and Mexican spotted owl.

The Incident Status Summary indicated 10 responders lost time to injuries/illnesses on the Bighorn Fire and that 744 residences had been evacuated during the blaze. Despite its proximity to Tucson and the number of evacuations, only two minor structures were reported destroyed in the fire. The cost for managing the Bighorn Fire was estimated at $50 million, or about $417 per acre.

Vegetation and Past Fires

The Bighorn Fire burned through a mix of conifer-oak (42 percent), piñon-juniper (20 percent), grass (15 percent), scrub (10 percent), and ponderosa pine (8 percent) and small areas of riparian forest, chaparral, mixed conifer, and non-vegetated areas. The majority of the Bighorn Fire was identified as low (44 percent) or medium (44 percent) departure from historic conditions but nearly 14,000 acres (11 percent) was identified as high departure, according to LANDFIRE Vegetation Condition Class analysis, which may underestimate the presence of invasive grasses, especially at low elevations. Most of the area affected by the Bighorn Fire had not burned in the previous ten fire seasons. It did however reburn approximately two-thirds of the 27,000-acre Burro Fire from 2017. A review of the Burro Fire was provided in the 2017 Fire Season Overview. The Bighorn Fire also reburned a few fires from 2015 including the 750-acre Finger Rock and the 205-acre Buster Mountain Fire, as well as a portion of the Woods Tank Fire. A small area inside the fire perimeter was included in 2015, 2017, and 2020 fires.

Fire Severity

Canopy mortality, as depicted in the RAVG analysis, varied across the fire (Figure 5). More than 21,000 acres (17 percent) of the burn area experienced zero percent mortality. These areas of low canopy mortality were scattered around the burn area with the largest concentration lying in a 2,400-acre block of ponderosa pine and conifer-oak along the Mt. Lemmon Highway. There were also areas of near complete canopy mortality with over 20,000 acres (16 percent) exhibiting greater than 90 percent mortality. Areas of high canopy mortality were also scattered throughout the burn area with the largest concentration in a 7,200-acre block on the north slope of Mt. Lemmon. The soil burn severity analysis showed a similar spatial distribution of severity areas (Figure 6). The five percent (6,100 acres) of the burn area that showed high soil burn severity was primarily concentrated in the area on the north slope of Mt. Lemmon that had very high (greater than 90 percent) canopy mortality.

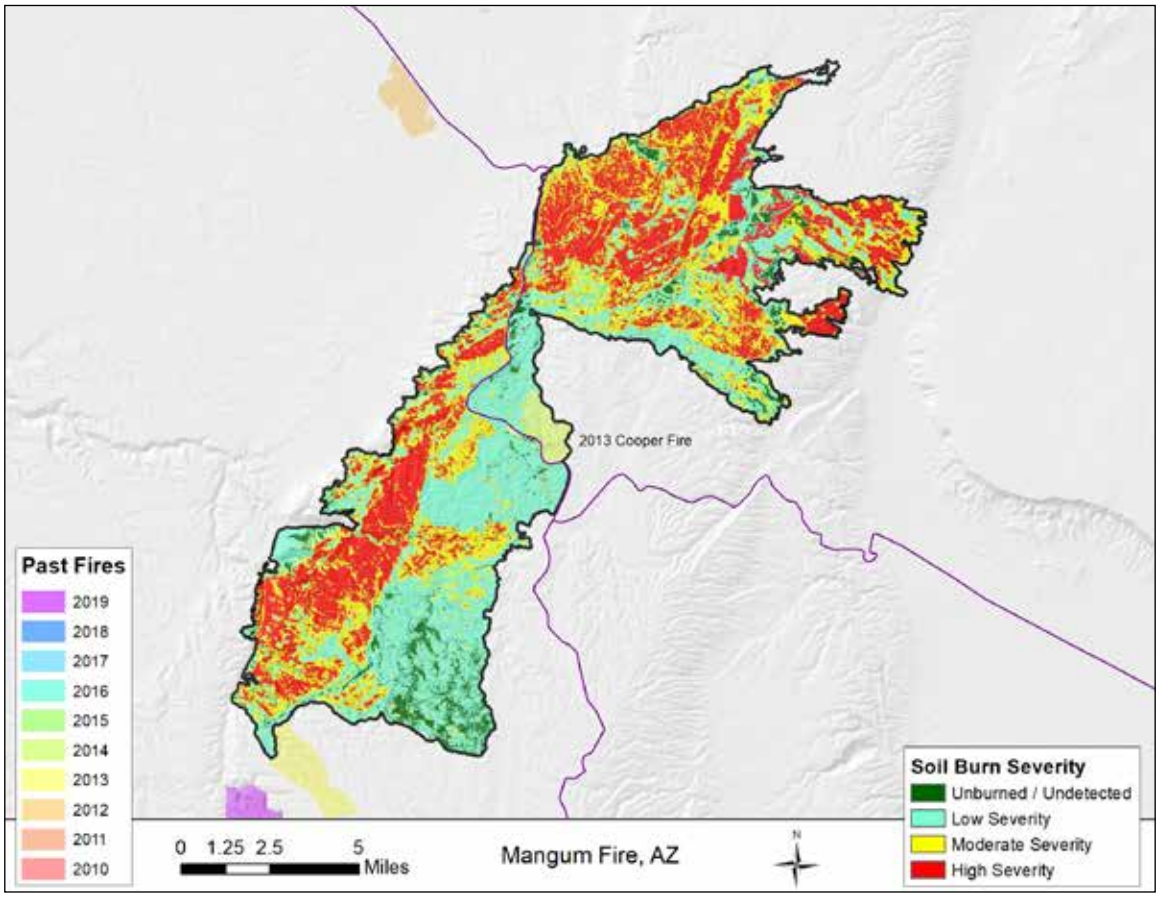

Figure 7. Soil burn severity in the Mangum Fire.

Mangum Fire, Arizona

The Mangum Fire was reported on June 8 in the Kaibab National Forest near Mangum Camp, approximately two miles north of Big Springs, Arizona in Coconino County. The fire burned for 46 days and covered 71,450 acres on the Kaibab Plateau near the North Rim of Grand Canyon National Park. Fire managers used a full suppression approach on the Mangum Fire. This approach allowed for some point protection of infrastructure (buildings, transport routes, and power utility lines) and placed a concerted effort on limiting the size and acreage of the fire with a focus on limiting smoke impacts on the Navajo Nation and surrounding communities to not further complicate COVID-19 impacts. Gusty winds, warm temperatures, low humidity, and rugged topography led to challenges controlling the Mangum Fire. Non-motorized characteristics and values were maintained within the wilderness areas.

The Mangum Fire threatened the community of Jacob Lake, Arizona and resulted in area closures and evacuations. The fire remained in the Kaibab National Forest and did not enter Grand Canyon National Park, however, several highways were closed, including US Highway 89A and AZ 67, which resulted in closure of the North Rim of Grand Canyon NP. Additionally, areas of the Paria Canyon-Vermilion Cliffs Wilderness were inaccessible due to closures.

The Incident Status Summary indicated 15 responders lost time to injuries/illnesses on the Mangum Fire. The fire destroyed two cabins and two outbuildings at Mangum Camp, a facility managed by the Grand Canyon Trust. The exact cause of the fire remains under investigation; however, fire officials confirmed it was human caused. The cost for managing the Mangum Fire was estimated at $25 million, or about $350 per acre.

Vegetation and Past Fires

The Mangum Fire burned primarily through ponderosa pine (51 percent) and piñon-juniper (31 percent) with several other vegetation types, each representing less than 10 percent of the area. Thirty-nine percent of the Mangum Fire was classified as high departure from historic vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis. Most of the area affected by the Mangum Fire had not burned in any of the previous ten fire seasons. The exception being 970 acres that burned as part of the Cooper Fire in 2013. The Mangum Fire did share a 1.7-mile perimeter with the 2013 Castle Fire and was only about one mile north of the 2019 Castle Fire, which was reviewed in last year's Southwest Fire Season Overview.

Fire Severity

Fifty-six percent of the area was in high (28 percent) or moderate (28 percent) soil burn severity categories (Figure 7) and very little was classified as unburned or undetected (6 percent). The RAVG analysis showed a similar pattern of high-severity fire with nearly 50 percent of the burn area (35,000 acres) classified as greater than 90 percent canopy mortality. This included nearly 75 percent of the piñon-juniper and 37 percent of the ponderosa pine communities with near complete canopy mortality.

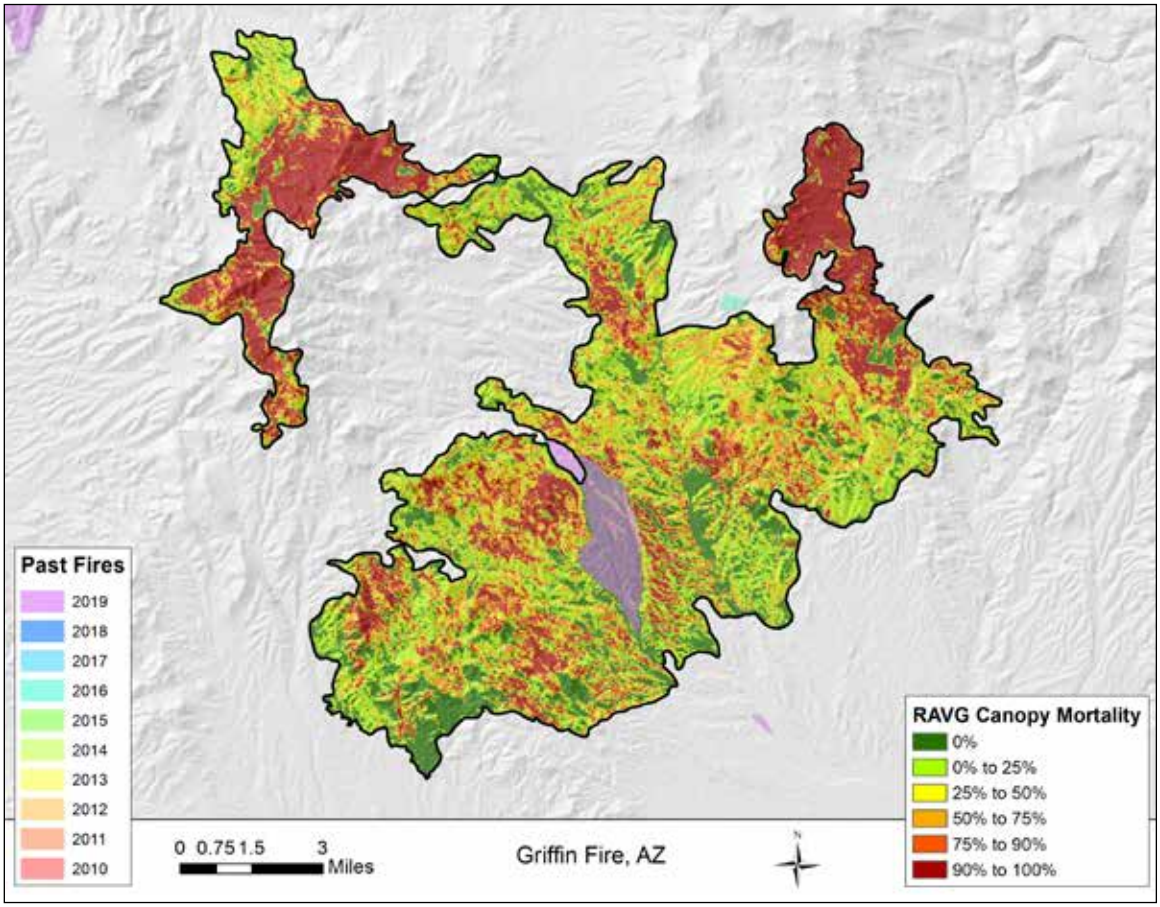

Figure 8. RAVG canopy mortality in the Griffin Fire.

Griffin Fire, Arizona

The Griffin Fire resulted from three lightning fires in the Apache Mountains north-northeast of Globe, Arizona that merged into a 61,821-acre fire over a 20-day span in late August. The Griffin and Gin Fires started on August 17 with the Gin Fire burning into the Griffin Fire on August 22. The Champion Fire was discovered on August 23, was located directly adjacent to the Griffin Fire, and burned into the Griffin Fire. All three fires were managed as the Griffin Fire. Fire managers chose to use a full suppression approach on the Griffin Fire with a values-driven strategy that used a mix of tactics (direct, indirect, and point protection) when and where the probability of success was high, and the risk was commensurate to the identified values.

Nearly 200 structures were threatened in communities that were elevated to either "Set" or "Go" status on the Ready, Set, GO model for evacuation; however, no structures were reported damaged or destroyed by the Griffin Fire. There were also several area and road closures, including shutting down US Highway 60 in both directions north of Globe due to threats to public safety. Two minor injuries were reported for responders during the fire. Management of the wildfire was estimated at $6 million, or $97 per acre.

Vegetation and Past Fires

The area affected by the Griffin Fire was predominantly chaparral (65 percent) with lesser components of piñon-juniper (20 percent) and scrub (11 percent). The greater area around the Griffin Fire has burned several times in the last ten fire seasons, including the 33,800-acre Hilltop Fire—reviewed in the 2017 Fire Season Overview—and several fires in the summer of 2020 that are reviewed in this report such as the Blue River, Blue River 2, Valley, and Cassadore Springs fires. The area directly affected by the Griffin Fire, however, had not burned in the last ten fire seasons, except for 1,960 acres in the southern portion of the fire that burned in the summer of 2019 as the Champion Fire. Ninety-five percent of the Griffin Fire had a low departure from historic vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

Fire severity in the Griffin Fire was patchy. There were more than 12,500 acres (21 percent) that experienced greater than 90 percent canopy mortality, according to the RAVG analysis. The areas of highest canopy mortality were concentrated in the two northern spurs of the Griffin Fire (Figure 8). These spurs were dominated by piñon-juniper.

The soil burn severity analysis was only available for approximately 16,000 acres (26 percent) of the total burn area that extended up toward the Tonto National Forest. Most of the area was identified as low (56 percent) or moderate (31 percent) severity in this analysis. The area of highest soil burn severity correlated with the areas with the highest canopy mortality in the RAVG analysis.

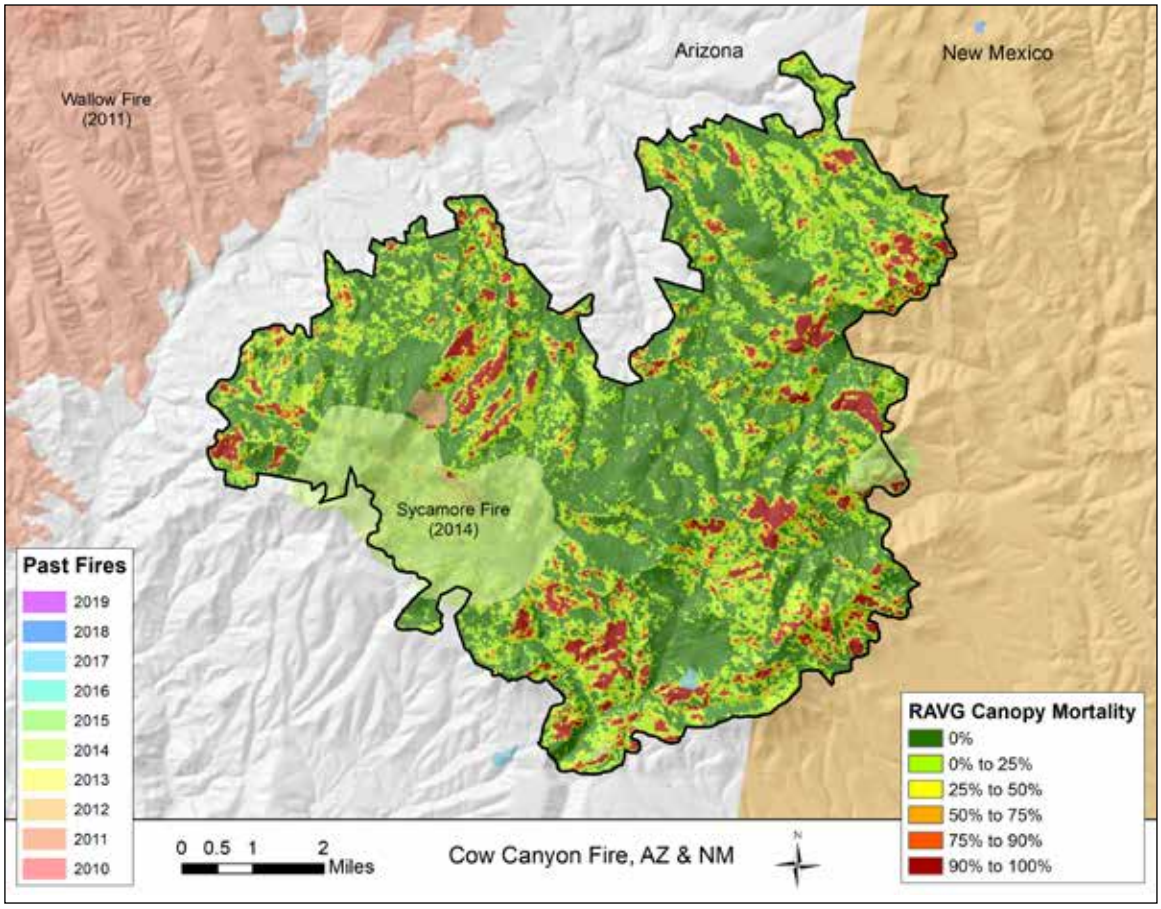

Figure 9. RAVG canopy mortality in the Cow Canyon Fire. Note that the fire crosses the Arizona and New Mexico state line.

Cow Canyon Fire, Arizona

The Cow Canyon Fire was ignited by lightning on August 18 in the Alpine Ranger District on the Apache-Sitgreaves National Forests about four miles southeast of Blue, Arizona. It burned in steep, rugged terrain with limited access, on the Arizona and New Mexico border. The fire eventually burned over 35,000 acres, with approximately 28,000 acres in the Apache-Sitgreaves National Forests and 7,000 acres in Gila National Forest. Due to the steep and hazardous terrain with no roads, fire managers chose to use a full suppression approach utilizing point protection when needed. The fire was continually monitored as it burned through the Blue Range Primitive Area in Arizona and Blue Range Wilderness in New Mexico toward the desired holding features and structures along the Blue River.

One non-specified injury to a responder was reported. No damaged structures were reported. The wildfire cost an estimated $3 million to manage, or about $85 per acre.

Vegetation and Past Fires

The Cow Canyon Fire encompassed nearly all 3,800 acres burned in the 2014 Sycamore and 345-acre Tige (2014) fires along with a few other minor fires. The rest of the area had not burned in over ten years but was located only about 0.5 miles southeast of the 538,000-acre 2011 Wallow Fire. The Cow Canyon Fire burned primarily in ponderosa pine (59 percent) with lesser components of conifer-oak (16 percent), mixed conifer (14 percent), and piñon-juniper (8 percent). The Cow Canyon burn area had the second highest percentage of high departure from historic vegetation conditions (56 percent) of any of the fires in this report according to the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

The Cow Canyon Fire had a relatively wide range of severity, according to the RAVG analysis (Figure 9). Nearly 18,000 acres (53 percent) of the Cow Canyon Fire experienced no canopy mortality while there were pockets of canopy mortality greater than 90 percent scattered throughout the burn area totaling over 2,300 acres (7 percent). The soil burn severity analysis showed a similar spatial distribution of severity areas. Eighty-seven percent of the burn area was documented as low (15,000 acres) or unburned/undetected (13,900 acres) and only 430 acres (1 percent) showed high soil burn severity.

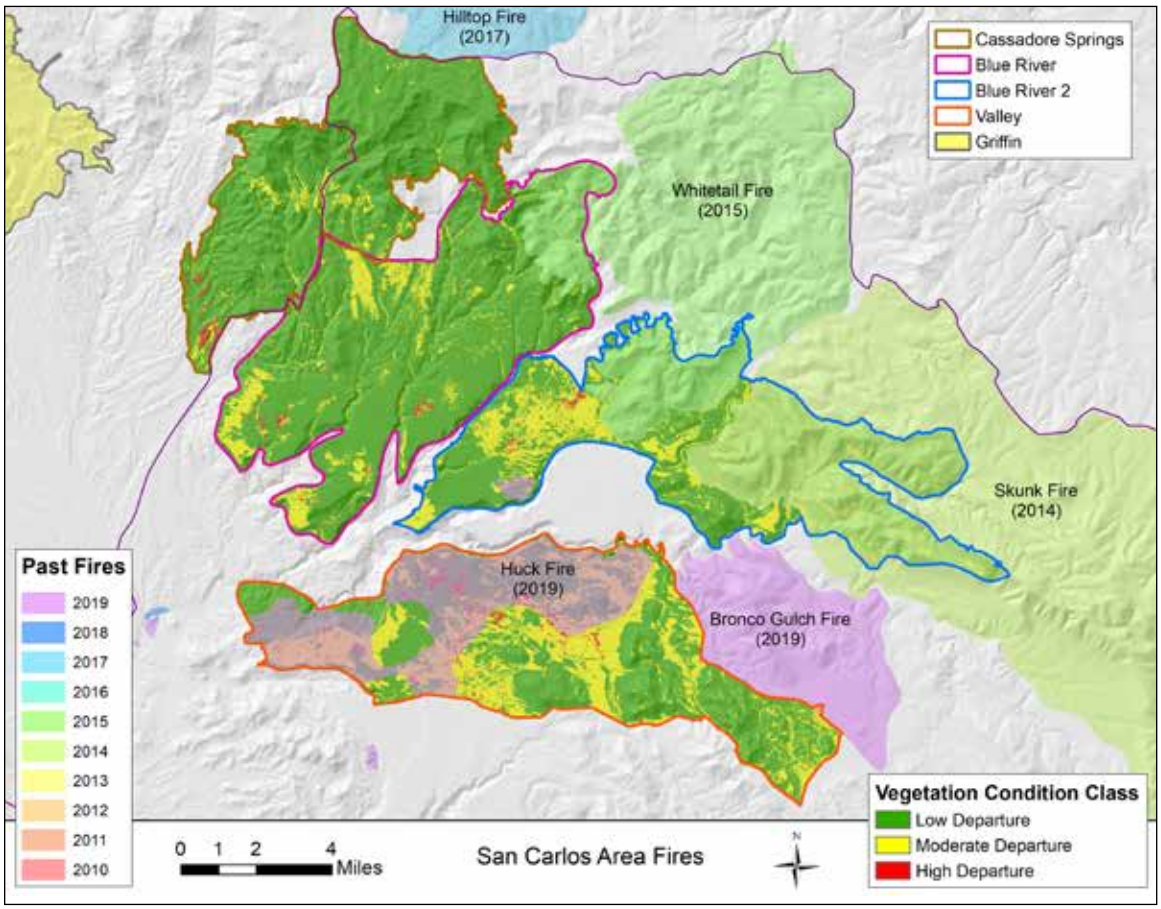

Figure 10. Vegetation departure from historic conditions based on the LANDFIRE Vegetation Condition Class analysis for the four large fires that burned near San Carlos, Arizona in 2020. The Griffin Fire (yellow) was also in the San Carlos area.

Blue River Fire, Arizona

Lightning ignited the Blue River Fire on June 5 approximately seven miles southeast of Alpine and 10 miles northeast of San Carlos on the San Carlos Apache Indian Reservation in Gila County, Arizona. Very heavy, continuous fine fuels coupled with low daytime humidity and gusty and erratic winds rapidly pushed the fire north and east to a total burn area of just over 30,000 acres. Fire managers chose to use a full suppression approach with the strategic objective of containing the fire within the existing road system to prevent it from getting into more complex terrain and heavier fuels. This approach was chosen to protect cultural sites, dance grounds, and holy grounds from damage as well as provide protection for a commercial ponderosa pine forest, threatened and endangered fish habitat, and livestock/range improvements.

The Blue River Fire Incident Status Report identified operational challenges, including a shortage of type 1 hand crews, firefighter and community health and safety issues related to COVID-19, and the logistics of supporting multiple camps that made implementing appropriate strategies and tactics more challenging. These additional logistical challenges included temperature testing all firefighters and team members before entering tribal lands and having all firefighters spike camping in designated remote areas safely adjacent to the fires while team members assisting with incident support were working remotely from Globe, 22 air miles to the west-southwest. Firefighters were fed and supported at their remote spike camps by local drivers that met the tribal COVID-19 testing requirements, delivering food and supplies several times a day.

No injuries, structural damage, or evacuations were reported for this fire. Management of the Blue River Fire was estimated at $100,000, or about $3.30 per acre.

Vegetation and Past Fires

The Blue River Fire burned through chaparral (42 percent), scrub (22 percent), grass (17 percent), and piñon-juniper (16 percent). Eighty-seven percent of the vegetation within the Blue River Fire was classified as low departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis (Figure 10). The Blue River Fire reburned approximately 3,000 acres of the 2015 Whitetail Fire but the remaining 27,000 acres had not burned in the last ten years. The Blue River was one of four large fires to burn in the San Carlos area in 2020. The others were Blue River 2, Valley, and Cassadore Springs. The Griffin Fire, summarized above, was not far to the northwest of these fires.

Fire Severity

No fire severity data were available for the Blue River Fire.

Valley Fire, Arizona

Lightning ignited two more fires on July 13 in the San Carlos Apache Indian Reservation a month after the Blue River Fire was contained. These two fires are the Blue River 2 and Valley fires. The Valley Fire consumed nearly 30,000 acres in twelve days approximately six miles northeast of San Carlos. Fire managers chose to use a full suppression approach with a direct attack to secure the fire's edge and minimize burned acreage using existing control features. Within a couple days, the Valley Fire was contained to burning within the interior of identified containment lines through available fuel. One residence was reported destroyed in this fire. Management of the Valley Fire was estimated at $2 million, or about $67 per acre.

Vegetation and Past Fires

The Valley Fire burned through a mix of scrub (55 percent), chaparral (30 percent), grass (8 percent), non-vegetated (4 percent), and piñon-juniper (3 percent). Over one-third of the Valley Fire had burned just 12 months earlier as the Huck Fire. The Valley and Huck fires shared several of the same fire lines. On its eastern side the Valley Fire shared a nearly seven-mile perimeter with the 2019 Bronco Gulch Fire. Ninety-eight percent of the vegetation within the Valley Fire had low (63 percent) or moderate (35 percent) departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis (Figure 10). The Valley Fire was one of four large fires to burn in the San Carlos area in 2020. The others were Blue River, Blue River 2, and Cassadore Springs.

Fire Severity

No fire severity data were available for the Valley Fire.

Blue River 2 Fire, Arizona

The Blue River 2 Fire was one of four large acreage fires to burn on the San Carlos Apache Indian Reservation in Gila County, Arizona during 2020. The Blue River 2 Fire was ignited by lightning on July 13 and grew to over 28,000 acres about a month after the 30,000-acre Blue River Fire was contained immediately to the north. The Blue River 2 Fire posed a threat to ancestral oak groves for acorn gathering and commercial timber harvest areas. Fire managers chose to use full suppression tactics as much as safety allowed. COVID-19 concerns played a role in fire responses with the use of additional aerial resources to assist hand crews in suppression efforts and line spiking crews to reduce travel and minimize COVID-19 exposure. Precipitation eventually slowed fire growth and aided in direct attack suppression tactics. The Incident Status Summary indicated that no structures were lost to the Blue River 2 Fire and that one responder lost time to injuries/illnesses while working the fire. Management of the Blue River 2 Fire was estimated at $4 million, or about $143 per acre.

Vegetation and Past Fires

The Blue River 2 Fire burned through a mix of piñon-juniper (29 percent), grass (27 percent), chaparral (20 percent), scrub (17 percent), and non-vegetated (5 percent) areas. Over half of the Blue River 2 Fire had burned in the last ten fire seasons. Nearly 12,000 acres burned in the 2014 Skunk Fire and an additional 4,400 acres in the 2015 Whitetail Fire. The Blue River 2 Fire shared a roughly eight-mile boundary with the Blue River Fire from June 2020. Ninety-nine percent of the vegetation within the Blue River 2 Fire had low (79 percent) or moderate (20 percent) departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis (Figure 10).

Fire Severity

No fire severity data were available for the Blue River 2 Fire.

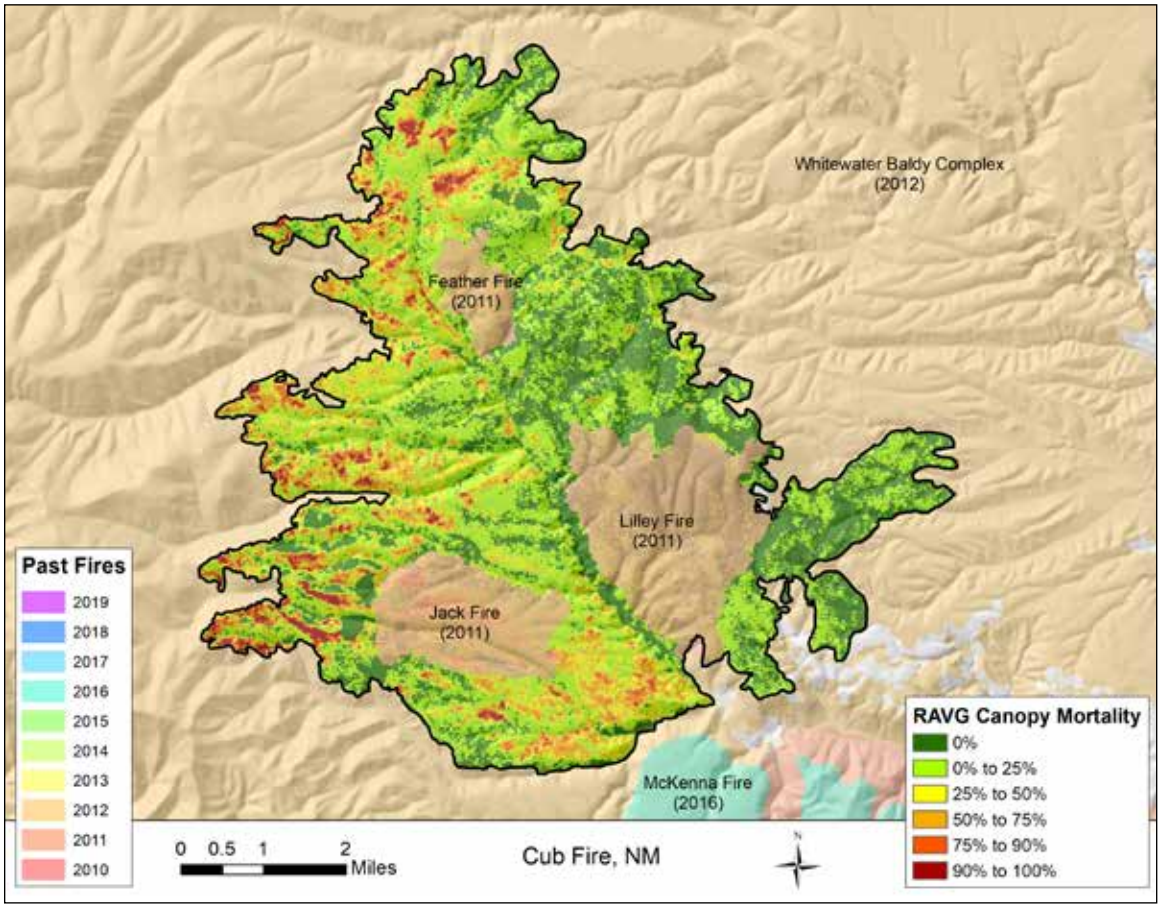

Figure 11. RAVG canopy mortality in the Cub Fire. Note the Cub Fire was completely within the 2012 burn area of the 298,000-acre Whitewater-Baldy Complex Fire.

Cub Fire, New Mexico

The Cub Fire burned 25,950 acres during a 27-day stretch from late June into July, approximately three miles northeast of the Mogollon Baldy Lookout on the Gila National Forest in Catron County, New Mexico. The Cub Fire was entirely within the perimeter of the 2012 Whitewater-Baldy Complex Fire and fire managers noted minimal to no opportunity to engage the fire with direct handline due to a high volume of snags in the old burn scar. Fire managers chose to classify the approach as full suppression but utilized a variety of direct and indirect tactics on this lightning-caused fire due to the danger to fire personnel posed by the inaccessible terrain and numerous snags, its remote wilderness location, and limited threat to life, property, and communities.

Two injuries to responders were reported, including a chemical burn to a sawyer from leaking gasoline. No damaged structures were reported. Management of the Cub Fire was estimated at $442,500 or $17 per acre.

Vegetation and Past Fires

The Cub Fire burned primarily through ponderosa pine (61 percent), mixed conifer (22 percent), and piñon-juniper (9 percent), with smaller amounts of conifer-oak, grass, and riparian areas. The Cub Fire lies entirely within the perimeter of the 298,000-acre Whitewater-Baldy Complex Fire (2012). Many of these areas also burned in 2011 as the Lilley, Jack, and Feather fires that were part of the Jack Complex. There have been no recorded fires within the Cub Fire perimeter since 2012. The perimeter was located only about 0.2 miles from the 2016 McKenna Fire (10,200 acres). Sixty-three percent of the vegetation within the Cub Fire perimeter had high departure from historic conditions according to the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

Only two percent (400 acres) of the Cub Fire was identified as having greater than 90 percent canopy mortality according to the RAVG analysis and over 75 percent of the burn area was identified as no canopy mortality (7,500 acres) or less than 25 percent (10,600 acres) mortality (Figure 11). This pattern is consistent with the primary land cover in this area as the fire burned primarily through ponderosa pine and mixed conifer. There was a preliminary soil burn severity analysis, but these data were never finalized into a format usable for this report.

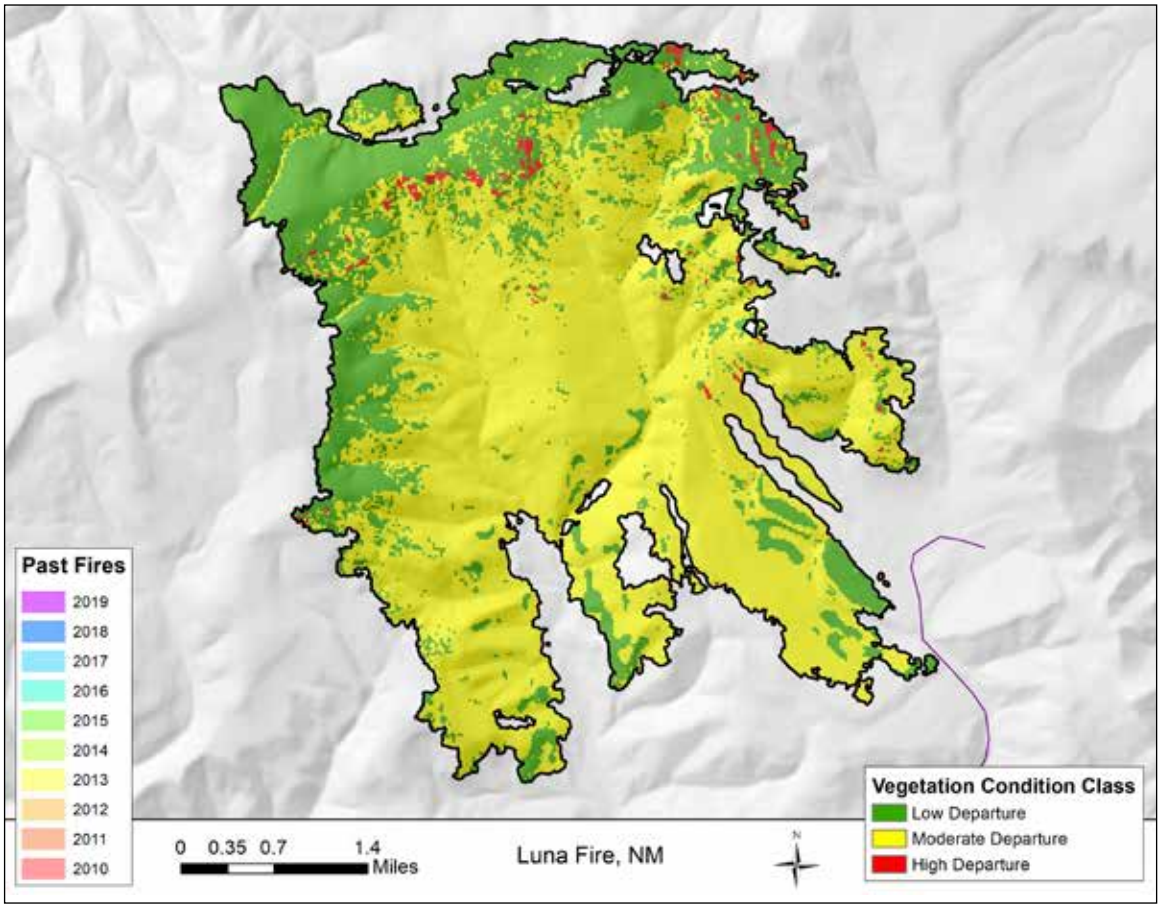

Figure 12. Vegetation departure from historic conditions based on the LANDFIRE Vegetation Condition Class analysis in the Luna Fire.

Luna Fire, New Mexico

The Luna Fire was reported on October 17 approximately 2 miles north of the community of Chacon, New Mexico. This October fire burned more than 10,000 acres at elevations ranging from 9,000 to 11,000 feet. Despite being outside the traditional fire season, this fire burned through dry timber and brush with high winds leading to extreme fire behavior with crowning, running, and long-range spotting. Fire managers used a full suppression approach with a focus on opportunities to stop fire spread toward the communities of Black Lake, Sierra Bonita, Angel Fire, Chacon, Guadalupita, Valle Escondido, and Coyote Creek State Park, as well as working on point protection activities for outlying private residences and the Forest Service's Cerro Vista Repeater. The Luna Fire threatened multiple critical watersheds supporting communities, ranching, and agriculture, along with acequias and irrigation infrastructure, and traditional tribal cultural places and religious sites. The fire also threated critical habitat for threatened, endangered, or sensitive species including the New Mexico meadow jumping mouse, Southwest willow flycatcher, Mexican spotted owl, Canada lynx, and aboriginal Rio Grande cutthroat trout.

No injuries were reported. Several roads were closed, or restricted access, and the Luna Canyon area was voluntarily evacuated, but there were no mandatory evacuation orders. The Luna Fire cost $6,120,000 to manage, or about $600 per acre.

Vegetation and Past Fires

The Luna Fire was a high-elevation fire with most of the vegetation classified as mixed conifer (71 percent) or spruce-fir (24 percent). The area affected by the Luna Fire had not burned in any of the previous ten fire seasons. The 2018 Sardinas Canyon Fire (2,300 acres), about three miles west, is the only fire during that timeframe to burn in the vicinity of the Luna Fire. Sixty-nine percent of the vegetation within the Luna Fire was classified as moderate departure from historic conditions in the LANDFIRE Vegetation Condition Class analysis (Figure 12). Only one percent, or approximately 100 acres, was classified as a high departure from historic conditions.

Fire Severity

No fire severity data were available for the Luna Fire.

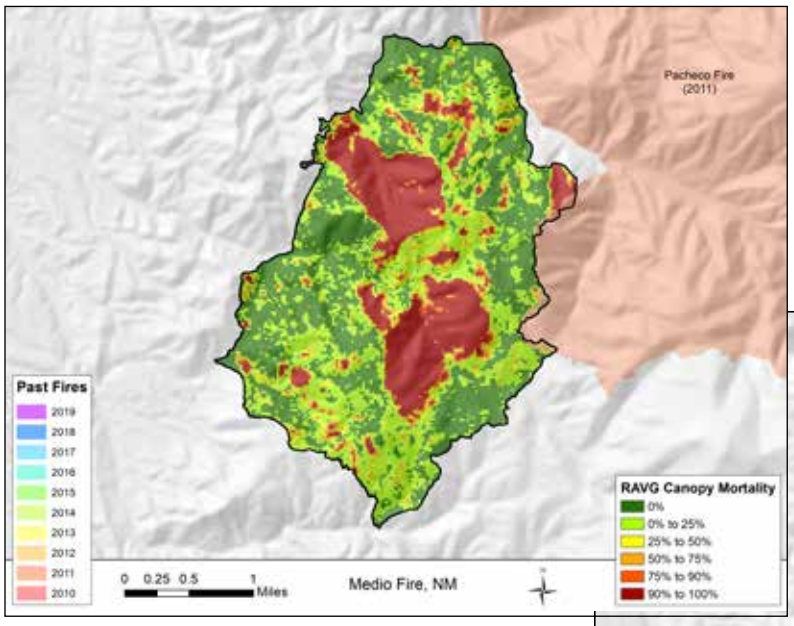

Figure 13. RAVG canopy mortality in the Medio Fire.

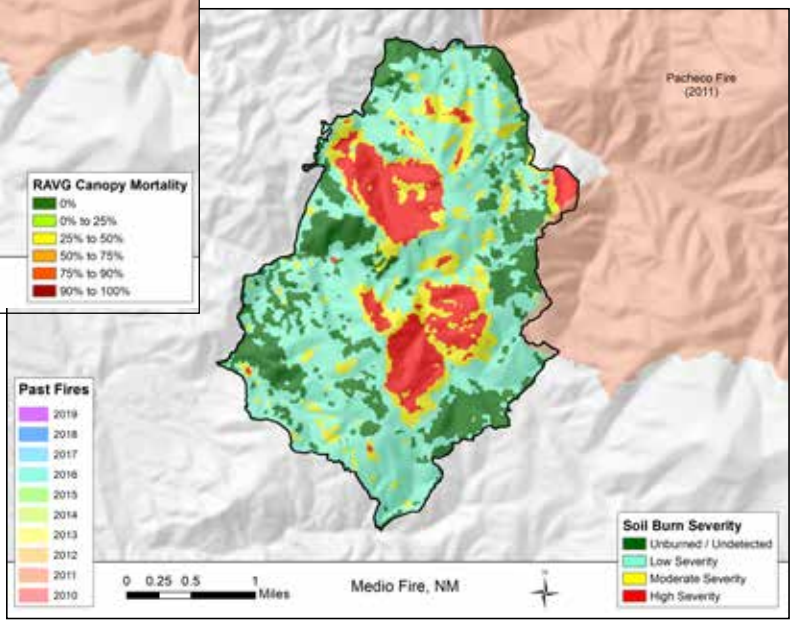

Figure 14. Soil burn severity in the Medio Fire.

Medio Fire, New Mexico

The Medio Fire was a lightning-caused wildfire reported on August 17, 2020 in the Española Ranger District of the Santa Fe National Forest. Conditions were unseasonably dry for August and resembled conditions typically observed in June. The fire burned for the next 27 days and had a final perimeter of 4,010 acres. There were numerous values at risk, including homes within Pacheco Canyon and the villages of Chupadero and En Medio, culturally sensitive sites, watersheds that provide water to communities downstream, recreational sites including the Santa Fe ski area, Aspen Vista, Big Tesuque, Hyde Park, a network of forest trails, and power and communication infrastructure. Fire managers chose to use a confine approach utilizing a variety of strategies, including burnouts and structure protection. Strong north winds increased the size of the fire but also pushed it toward the 2011 Pacheco Fire scar and toward a significant fuel change of green quaking aspen, which greatly reduced fire behavior and movement.

These reports historically have provided a summary of only the largest fires in the region based on acres. The Medio Fire was included in this analysis due to its proximity to Santa Fe, New Mexico and the reported effectiveness of a long-term fire treatment plan for the area. Fire managers noted the effectiveness of fire lines from a previous prescribed burn that held the wildfire from racing up the mountain toward the Santa Fe Ski Basin. This highlighted the ability of prescribed fire to prevent wildfires from becoming uncharacteristically high intensity, causing widespread damage.

Seven injuries or illnesses were reported on this fire. There were no reports of structural damage or mandated evacuations for the Medio Fire. Management of the Medio Fire was estimated at $5.5 million, or $1,370 per acre.

Vegetation and Past Fires

The Medio Fire mainly burned through mixed conifer (92 percent) with small areas of ponderosa pine (7 percent) and piñon-juniper (1 percent). Ninety-nine percent of the Medio Fire was identified as moderate departure from historic conditions according to the Vegetation Condition Class analysis. The area affected by the Medio Fire had not burned in the preceding ten fire seasons but roughly three-miles of the Medio's eastern boundary was shared with the 10,000-acre Pacheco Fire from 2011.

Fire Severity

The majority of the Medio Fire showed no canopy mortality (38 percent) or canopy mortality limited to less than 25 percent (30 percent), according to the RAVG analysis (Figure 13). There were, however, pockets of higher mortality with over 20 percent of the burn area displaying greater than 90 percent mortality. Canopy mortality is more ecologically significant in a predominantly mixed conifer area than in some of the earlier fires described in this report that are dominated by grasses and low shrubs. Soil burn severity data indicated 28 percent of the fire had high (14 percent) or moderate (14 percent) severity (Figure 14).

Conclusion

This report covers the nine largest wildfires in Arizona and New Mexico, an unusual late season wildfire, and a wildfire that burned near a metropolitan area. These 11 wildfires represented 57 percent of all acres in the Southwest burned by wildfire in 2020. The most widespread vegetation types affected by these fires were scrub, piñon-juniper, and chaparral, with more than 100,000 acres burned of each type (Figure 15). The largest fires reviewed in this report covered an additional 150,000 acres compared to the 12 largest fires covered in our 2019 report. As a result, more acres of all vegetation categories other than mixed conifer were burned in 2020. The starkest increase was in the conifer-oak type with a seven-fold increase. Much of the conifer-oak increase was in the Bighorn Fire. The large fires in 2020 burned nearly 40,000 more acres of ponderosa pine than the largest fires in 2019 and about the same number of acres included in the 2018 analysis.

Full soil burn severity data were available for five of the 11 fires analzyed in this report, covering nearly 250,000 acres (40 percent of acres in report). Additional limited data were available for the Bush Fire. Sixty-two percent of the area covered by these five fires was classified as low or undetectable soil burn severity (Figure 16). Eleven percent of the acres for which soil burn severity data were available displayed high soil burn severity. Three-quarters of these high-severity acres were in the Mangum Fire and most of the rest were in the Bighorn Fire. Note that Soil Burn Severity data were only available for the northern 16,000 acres of the Griffin Fire.

Rapid Assessment of Vegetation Condition after Wildfire (RAVG) data were available for seven of the eleven large fires covered in this report (Figure 17). Of these 512,000 acres, 21 percent (106,000 acres) showed no detectable canopy mortality,

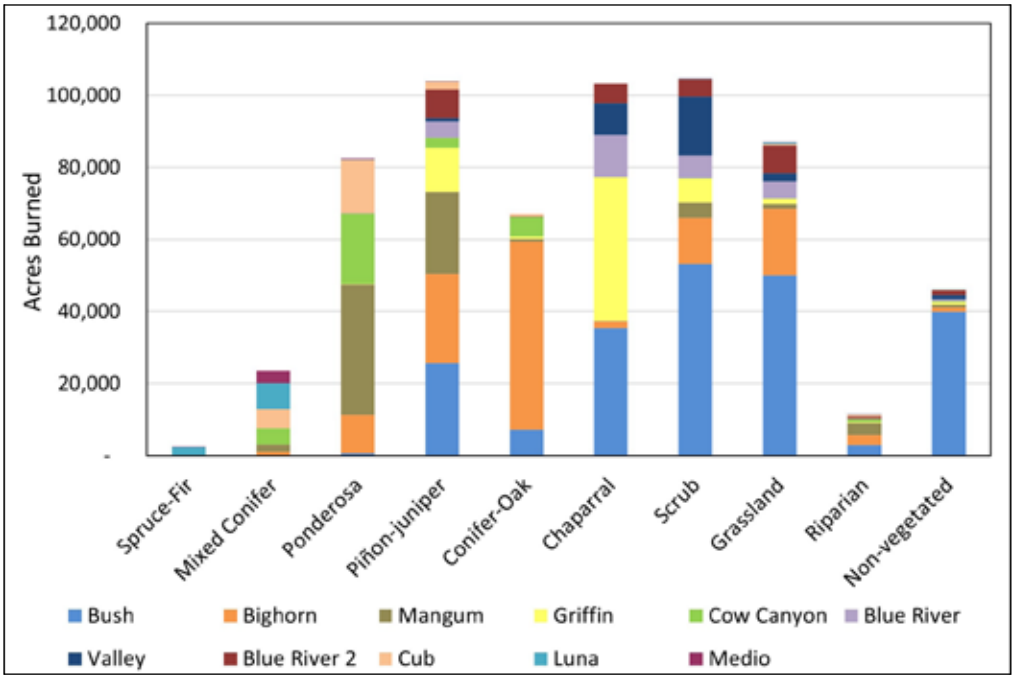

Figure 15. Summary of acres burned in the largest fires by vegetation type.

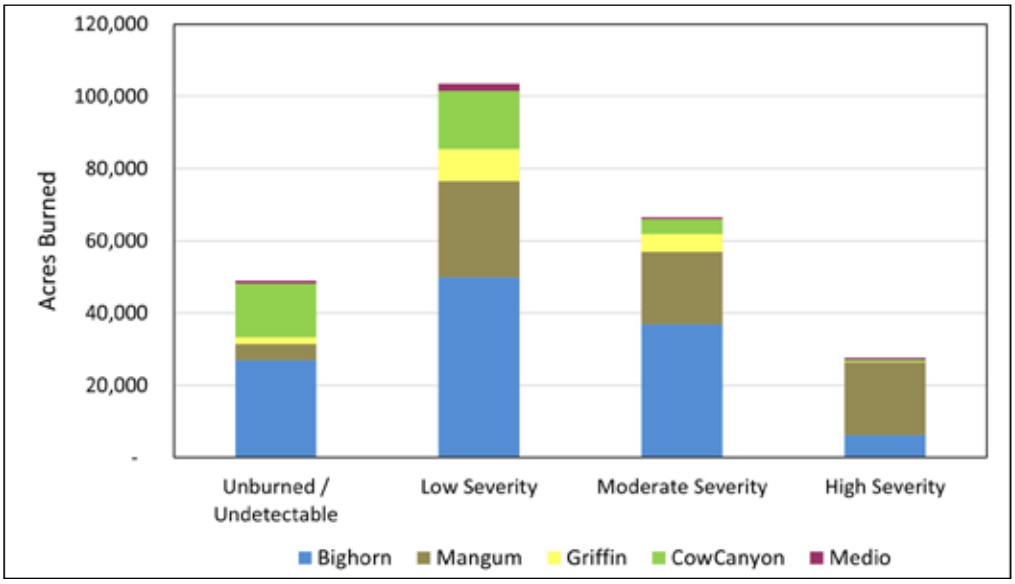

Figure 16. Summary of acres burned by soil burn severity class.

while nearly 107,000 acres (21 percent) showed greater than 90 percent mortality. The Bush and Mangum fires account for two-thirds of the highest canopy mortality areas. In the Bush Fire, this highest canopy mortality class was primarily in chaparral, piñon-juniper, and grass with relatively low associated soil burn severity classifications. Much of the high canopy mortality in the Mangum Fire was also found in piñon-juniper but also included 13,500 acres of 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 13 percent of the area in this analysis was highly departed from historic conditions based on the LANDFIRE Vegetation Condition Class analysis (Figure 18). 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. Nearly all the 79,000 high-departure acres were isolated to four fires: Mangum (35 percent), Cow Canyon (25 percent), Cub (21 percent), and Bighorn (17 percent). The Mangum Fire had the highest percentage of high soil burn severity, canopy mortality, and vegetation that departed from historic conditions. Reports on several of these fires indicated that the LANDFIRE data for the area greatly underestimated the presence of invasive grasses, therefore some of the departure from historic vegetation conditions percentages are likely inaccurate.

The fires reviewed in this report led to some evacuation and smoke-related impacts, but despite the large numbers of acres burned, human communities were not significantly

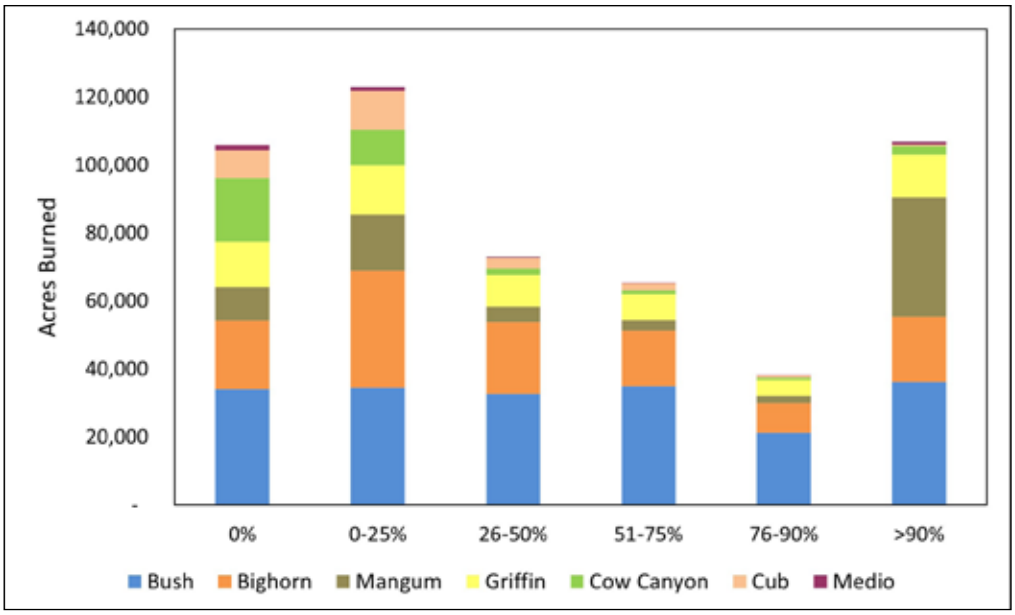

Figure 17. Summary of acres burned by canopy mortality class.

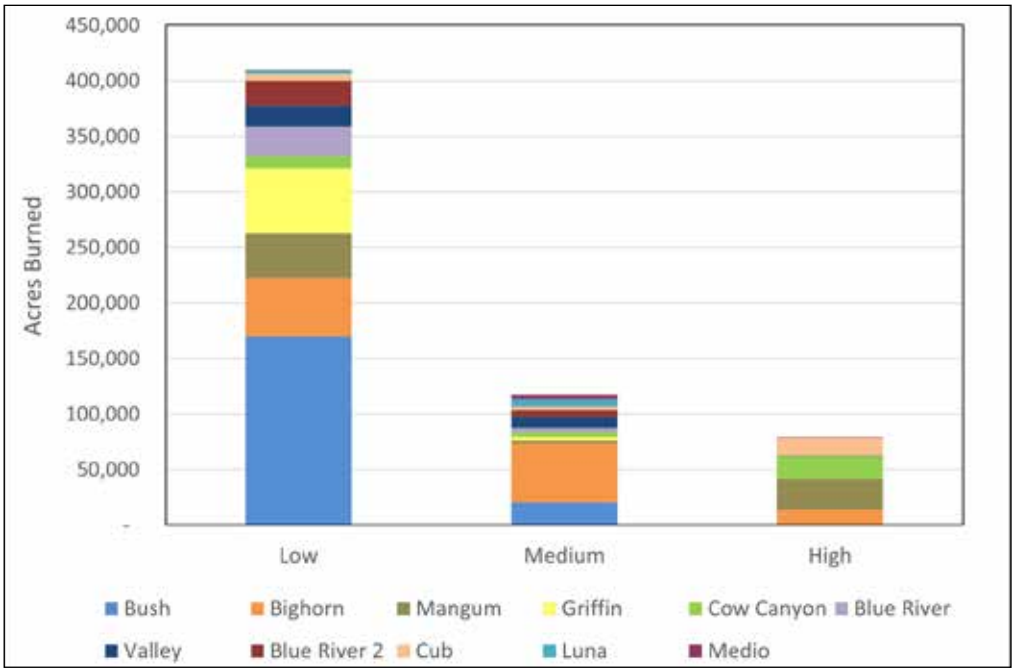

Figure 18. Summary of acres burned by vegetation condition class.

affected by any of the largest fires of 2020. There certainly were localized impacts that should not be minimized, but only one residence and a few non-residential structures were lost in these 11 fires; there were relatively few reported evacuations for most of the fires. In comparison, the 2018 Tinder Fire destroyed 33 residences and 63 minor structures while 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 2020 fires listed in this report caused structure loss at this scale even though three of the fires burned near some of the Southwest's largest metropolitan areas, such as the Phoenix (Bush), Tucson (Bighorn), and Santa Fe (Medio).

Past reports noted that the majority of the large fires in the Southwest are caused by lightning (naturally ignited). Only three of the eleven fires reviewed in this report were identified as naturally caused, while four were listed as human caused and another four were listed as 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 many fires in this analysis, and in some cases, the edges of these past burn areas may have served as fire breaks with only limited overlap. There were also several fires in areas that had not burned in many years such as the Bush, Mangum, Griffin, and notably the Luna, which was a high-altitude fire. Other fires, such as the Cub Fire, fell completely within a past fire perimeter. The Valley Fire included several areas that were burned as recently as the 2019 fire season. It should be noted that fire regimes vary significantly across vegetation types and time since fire may be less or more meaningful depending on type.

The 11 fires in this analysis were managed at an estimated cost of nearly $114 million dollars, for an average of $186 per acre. This average cost was similar to the costs reported in the 2018 and 2019 analyses, but roughly 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 2020, managers classified their strategy as full suppression on all ten of the largest fires, with only the Medio Fire reported as a confine strategy. This differs from reported strategies in past fire season overviews, which had approximately 50 percent of the acres approached with full suppression. The human or unknown ignitions of the 2020 fires likely factored into these approaches in addition to the variety of challenges that COVID-19 presented responders. It should also be noted that while the overall strategy may have been full suppression, the implementation of specific wildland fire strategies includes a variety of factors that often leads to a variety of approaches. While there was a wide variety of vegetation types and burn severity across these fires, it is likely that a significant portion of the 215,096 acres provided some ecological benefit.

Appendix I. Fire Statistics

General				Vegetation Departure		
Name	**Acres**	**Cost**	**cost/ac**	**Low**	**Medium**	**High**
Bush	193,455	$11,642,634	$60.18	88%	11%	0%
Bighorn	119,978	$50,000,000	$416.74	44%	44%	11%
Mangum	71,450	$25,000,000	$349.90	56%	4%	39%
Griffin	61,821	$6,000,000	$97.05	95%	5%	0%
Cow Canyon	35,371	$3,000,000	$84.82	32%	12%	56%
Blue River	30,408	$100,000	$3.29	87%	12%	0%
Valley	29,639	$2,000,000	$67.48	63%	35%	2%
Blue River 2	28,051	$4,000,000	$142.60	79%	20%	0%
Cub	25,950	$442,500	$17.05	24%	12%	63%
Luna	10,142	$6,120,000	$603.43	30%	69%	1%
Medio	4,010	$5,500,000	$1,371.57	1%	99%	0%
Sum	**610,275**	**$113,805,134**	**$186.48**			

	Soil Burn Severity				RAVG Canopy Mortality					
Name	**Unburned**	**Low**	**Moderate**	**High**	**0%**	**0-25%**	**26-50%**	**51-75%**	**76-90%**	**>90%**
Bush	7%	40%	48%	5%	18%	18%	17%	18%	11%	19%
Bighorn	22%	42%	31%	5%	17%	29%	18%	14%	7%	16%
Mangum	6%	37%	28%	28%	14%	23%	6%	5%	3%	49%
Griffin	12%	56%	31%	1%	21%	23%	15%	12%	7%	21%
Cow Canyon	42%	46%	11%	1%	53%	29%	5%	3%	2%	7%
Blue River	-	-	-	-	-	-	-	-	-	-
Valley	-	-	-	-	-	-	-	-	-	-
Blue River 2	-	-	-	-	-	-	-	-	-	-
Cub	-	-	-	-	31%	44%	12%	8%	3%	2%
Luna	-	-	-	-	-	-	-	-	-	-
Medio	22%	50%	14%	14%	38%	30%	6%	3%	2%	20%

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