2021 Wildfire Season: An Overview

Southwestern US

JULY 2022

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: Aerial view of the Doagy Fire, looking northwest, on May 19, 2021. The Doagy Fire was ignited by lightning on May 14 near Doagy Well in Doagy Canyon of the Gila National Forest. The fire burned nearly 13,000 acres. *Photo courtesy of InciWeb*

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Table of Contents

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 nineth 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 twelve wildfires, each more than 10,000 acres, in Arizona and New Mexico in 2021. 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. These fire season overview reports provide a unique opportunity to compare fires and fire seasons, which highlight trends and changes as managers and communities adapt to climate change.

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 2021.

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 (also called managed wildfires), 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. These fires are often referred to as "managed wildfires." 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 2021 Fire Season

In 2021, wildfire burned 648,220 acres in the Southwest (Arizona and New Mexico), which is a little lower than the average number of acres burned annually in these two states over the previous ten-year period (681,296 acres). As has been the case in recent years, Arizona had significantly more wildfire (524,428 acres) than New Mexico. Arizona had more wildfire acres than its ten-year average (390,944 acres) while New Mexico had fewer acres of wildfire than its ten-year averages (290,352 acres). Unplanned human ignitions made up 36 percent and 10 percent of wildfire acres in Arizona and New Mexico respectively (though these estimates excluded wildfires with an unknown cause). Managers were able to use prescribed fire on three times more acres in 2021 than in 2020. Prescribed fire covered 174,210 acres across the Southwest (Figure 1).

Data on management strategy was difficult to acquire for 2021, however the US Forest Service Budget Justification for fiscal year 2023 reports 642,867 acres of managed wildfire in 2021 (in other words, acres of accomplishments resulting from naturally occurring wildfires).[3] This lack of transparency prevents some comparisons with previous years, but since the Southwest has a long history of managing wildfire for ecological and community benefit, it is likely that a significant portion of the acres occurred in the Southwest. It is also worth noting that in August, the chief of the US Forest Service sent direction that "managing fires for resource benefit is a strategy we will not use. In addition, until further notice, ignited prescribed fire operations will be considered only in geographic areas at or below PL 2." This direction likely significantly reduced managed wildfire and prescribed fire in the autumn.

This overview focuses on the 12 largest fires by acreage in the region, which include ten Arizona fires: Telegraph, Rafael, Mescal, Backbone, Pinnacle, Bear, Tiger, Horton, Slate, and Walnut; and two New Mexico fires: Johnson and Doagy. The twelve large fires in this report represent 90 percent of the acres burned by wildfire in 2021 (Figure 2).

1 2020, 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 USDA Forest Service. 2022. Fiscal Year 2023 Budget Justification. *https://www.fs.usda.gov/about-agency/budget-performance*

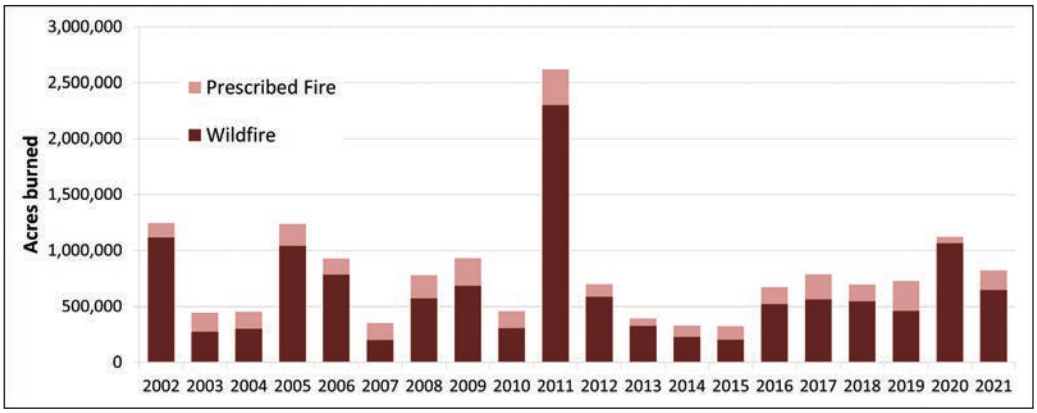

Figure 1. Wildfire and prescribed fire acres burned in Arizona and New Mexico, 2002 to 2021.[4] Wildfire burned 648,220 acres in the Southwest (Arizona and New Mexico), which is a little lower than the average number of acres burned annually in these two states over the previous ten-year period (681,296 acres).

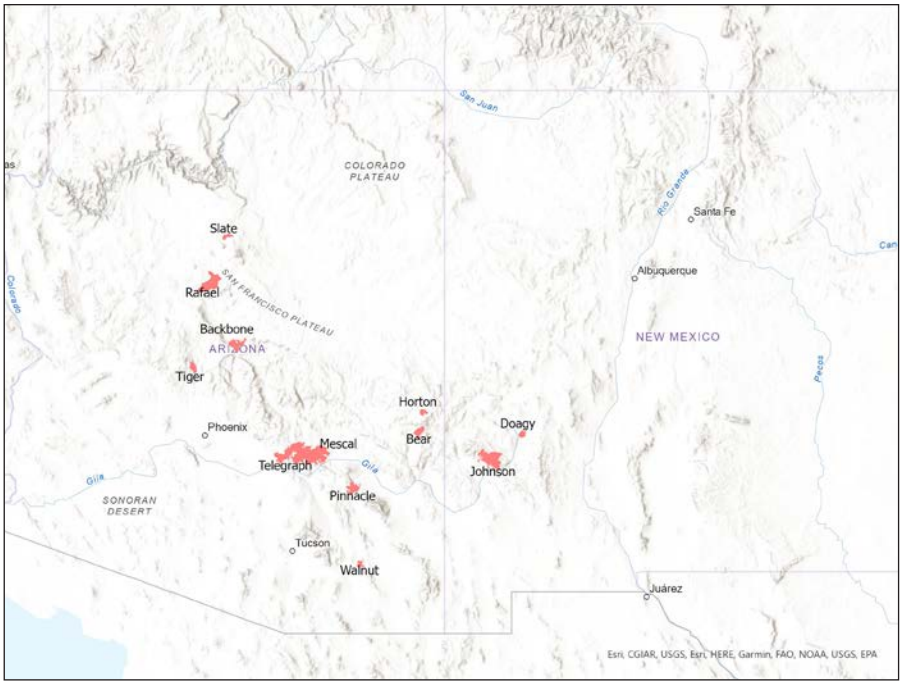

Figure 2. Map indicating the location of the 12 large fires in 2021 analyzed in this report.

Regional Context

Snowpack in the Southwest was well below normal leading into the 2021 season because of the La Niña system. The weak winter precipitation resulted in below normal carry-over of fine fuels. This was compounded by drought conditions continuing into 2021. In fact, the period from 2000 to 2021 was the driest 22-year period since at least 800.[5] More than 90 percent of the western US was in drought by July and the national preparedness level increased to five on July 14.

Monsoon precipitation was at or above normal for most of the Southwest, which helped end the large fire season. Though the monsoon season started favorably with a wet late June through July, it came to a dry halt for many areas during August and September. Many areas reached or surpassed their climatological averages for rainfall during the summer. However, abnormally high temperatures meant no real relief from drought.

The Energy Release Component (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 Arizona shows the 2021 fire season (blue line) in comparison to the ten-year average (gray line) and ten-year maximums (red line) (Figure 3).[6] Note ERCs in Arizona approached the historical maximum in April, May, and June. ERCs in New Mexico were closer to the average for this period, which may explain why fewer acres burned in New Mexico than in Arizona during 2021.

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

5 Williams et al., 2022. Rapid intensification of the emerging southwestern North American megadrought in 2020–2021. *https://doi.org/10.1038/s41558-022-01290-z*

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

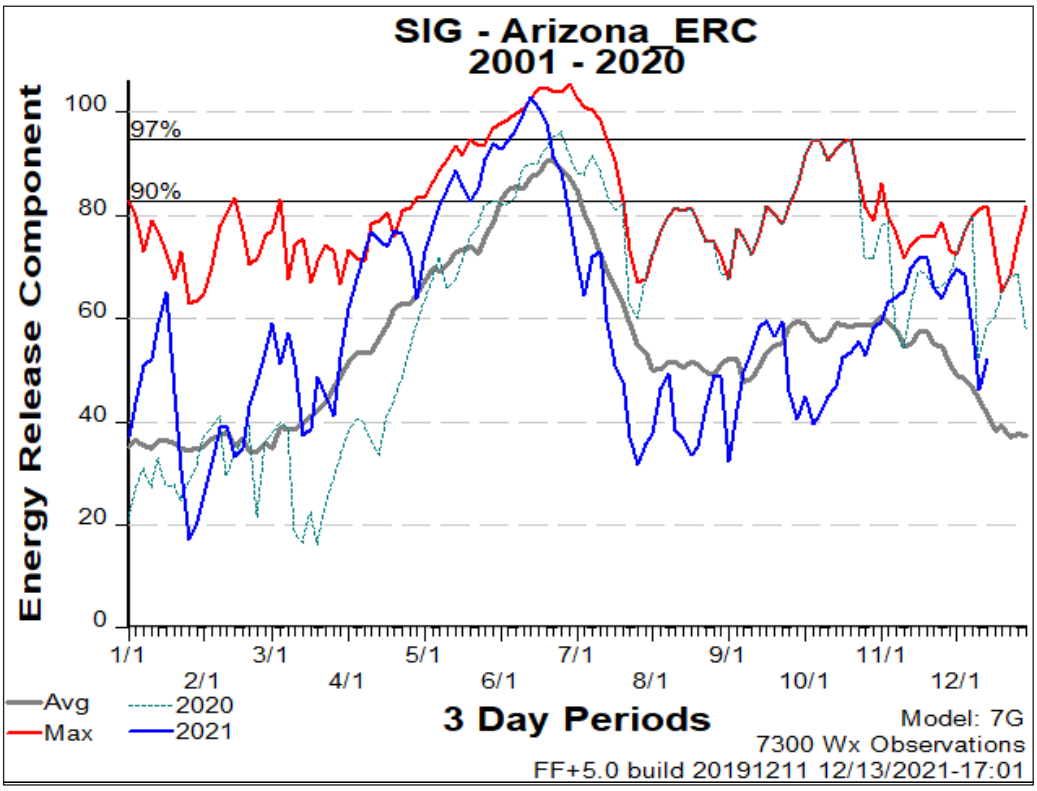

Figure 3. Energy release component (ERC) index for 2021 in Arizona. Note ERCs approached the historical maximum in April, May, and June.

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. Strategic objectives often change during a fire, and a review of the most common or persistent strategic objectives for each fire provides insight into the overarching management goals.

Perimeters
Boundaries for each fire were taken from the National Interagency Fire Center Open Data Site archive of fire perimeter maps (https://data-nifc.opendata.arcgis.com/). NIFC Open Data Site also provides historical perimeters of wildfires, which provided a historical context for 2021 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 historical 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, historical 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://burnseverity.cr.usgs.gov). 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 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://burnseverity.cr.usgs.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 2021 and January 2022 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.

Individual Fire Summaries

This section describes the impacts of the twelve wildfires over 10,000 acres in Arizona (ten fires) and New Mexico (two fires) in 2021. This report covers when each fire burned, fire management costs, vegetation types, previous burn footprints, and burn severity, where available. The fires are ordered based on the total acres burned and represent 90 percent of the acres burned by wildfire in 2021.

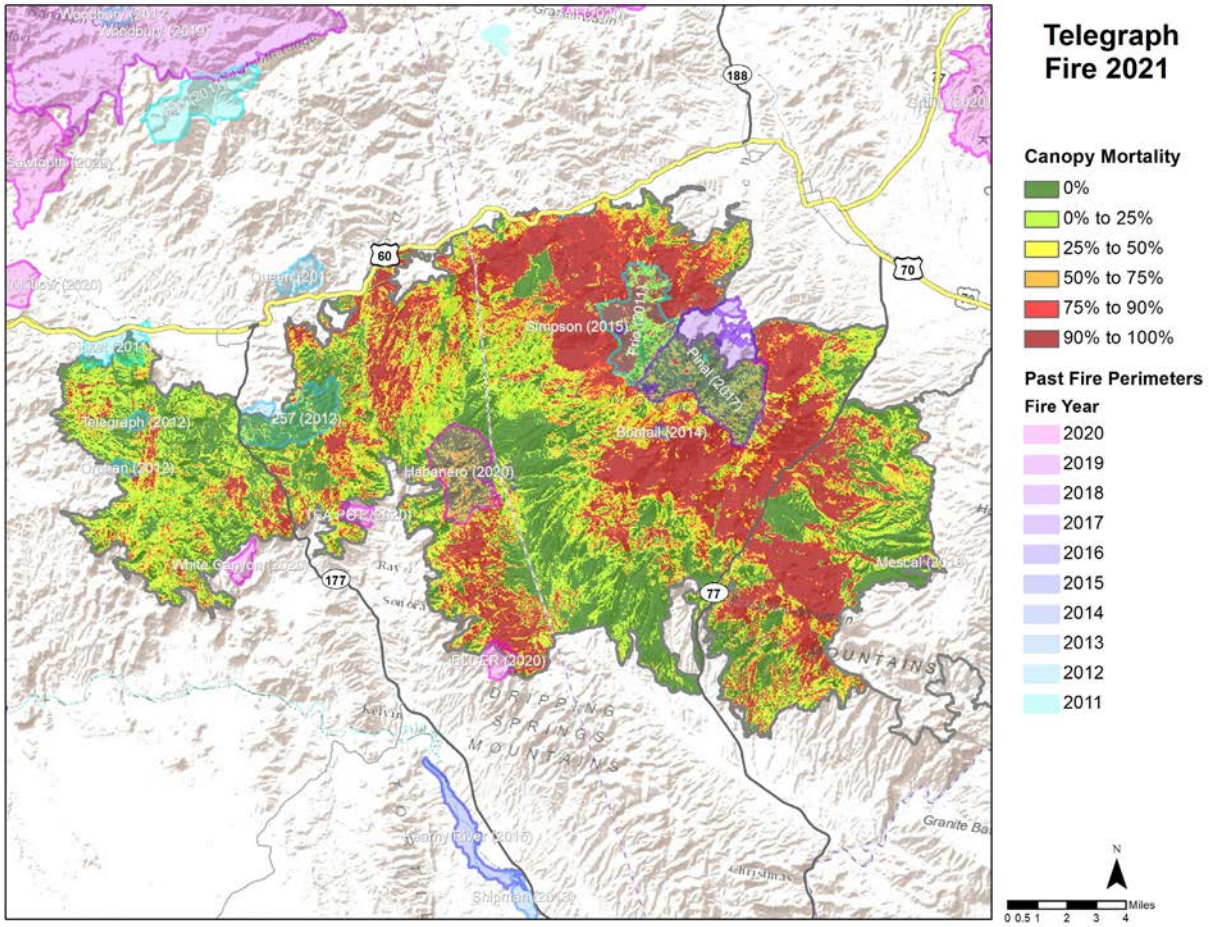

Figure 4. RAVG canopy mortality in the Telegraph Fire burn area.

Telegraph Fire, Arizona

The Telegraph Fire was a human-caused wildfire that started in the Tonto National Forest near Superior, Arizona. The fire started on June 4, 2021 and burned more than 180,000 acres before it was fully contained on July 3, 2021. This was the largest fire in Arizona or New Mexico during the 2021 season and the sixth-largest wildfire in Arizona history. The area had experienced sustained and extreme drought conditions which resulted in very low fuel moistures. The low fuel moisture coupled with high heat and strong winds facilitated the rapid expansion of the Telegraph Fire.

Fire managers applied a full suppression approach, according to the 209 reports, 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. The fire burned in steep, rugged terrain with flashy fuels, which often made direct attack challenging and/or not viable. The Telegraph Fire was eventually stopped from moving farther east when it came upon the area recently burned in the Mescal Fire (reviewed later in this report). The roughly 8,000 acres that burned after June 23 were interior burnouts near Government Ranch that had nowhere to go as they were surrounded by burned area. Monsoonal rains also helped extinguish the Telegraph Fire, but also created erosion issues that caused some roads to be washed out and/or experience post-fire debris flows.

The Telegraph Fire quickly expanded northeast from its starting point and threatened 4,900 residences, leading to the evacuation of 4,230 civilians and shelter-in-place orders for an additional 4,181 citizens. The fire destroyed 13 homes and 28 non-residential structures and damaged several others. Arizona State Highways 77 and 177 along with U.S. Highway 60 were closed during the fire in addition to several smaller roads. U.S. 60 was used as a fire break for 11 miles on the northern fire boundary. Twenty-one injuries or illnesses to responders were reported during on the Telegraph Fire. Wildfire management costs associated with the Telegraph Fire were estimated at $40 million, or about $220 per acre.

Vegetation and Past Fires

The primary vegetation types included piñon-juniper (44 percent), scrub (23 percent), chaparral (15 percent), and conifer-oak (14 percent). Although LANDFIRE only classified one percent of the burned area as grass, the Incident Status Summary and several other resources indicated that Sonoran Desert grass, cacti, scattered short brush were present in many of these communities and these fully cured grasses helped carry the fire quickly across the large burn area.

Most of the area affected by the Telegraph Fire had not burned in the past ten fire seasons, however, there were several fires that had burned portions of the Telegraph burn area. These included

the 2011 Frio (3,900 acres), 2012 257 (2,860 acres), 2017 Pinal (7,100 acres) and 2020 Habanero (3,200 acres) fires.

Portions of three 2020 fires served as burn perimeters for the Telegraph Fire. These included the Elder, Teapot, and White Canyon fires. The largest shared fire perimeter was with the 2021 Mescal Fire. These fires shared a 16-mile fire perimeter. If these fires had been combined into one large fire, they would have covered more than 253,000 acres, potentially making it the third largest fire in Arizona history.

Most of the area within the Telegraph Fire perimeter was classified as low (66 percent) or moderate (28 percent) departure from historical vegetation conditions according to the LANDFIRE Vegetation Condition Class analysis. This metric does not capture all changes from historical conditions and land managers indicated that changes in patch size was one of the primary reasons the Telegraph Fire got so big once it moved up into the chaparral.

Fire Severity

The RAVG analysis indicated a range of canopy mortality across the Telegraph Fire. Over half of the burn area showed zero (30 percent) or 0-25 percent (21 percent) canopy mortality, yet 25 percent of the burn area showed more than 90 percent mortality (Figure 4). Areas of high canopy mortality were scattered throughout the burn area with the highest density in the piñon-juniper and conifer-oak communities on the eastern half of the burn area. It is important to note in this and other fires that the RAVG analysis shows canopy mortality across all vegetation types, yet the impact of this mortality differs from vegetation type to vegetation type. For example, there were about 42,000 acres of semi-desert grassland within the perimeter of Telegraph; 13 percent burned with high severity; 29 percent burned with moderate severity, according to the RAVG data. High-severity fire is a necessary component of healthy grasslands and—if the patch size is right—shrublands, as well. Careful interpretation needs to be taken to not equate all canopy mortality with negative ecological effects.

Soil Burn Severity analysis was not available for the Telegraph Fire, however, the Sonoran Desert and semi-desert ecosystem types in the Telegraph Fire footprint exhibited poor soil conditions before the fire.

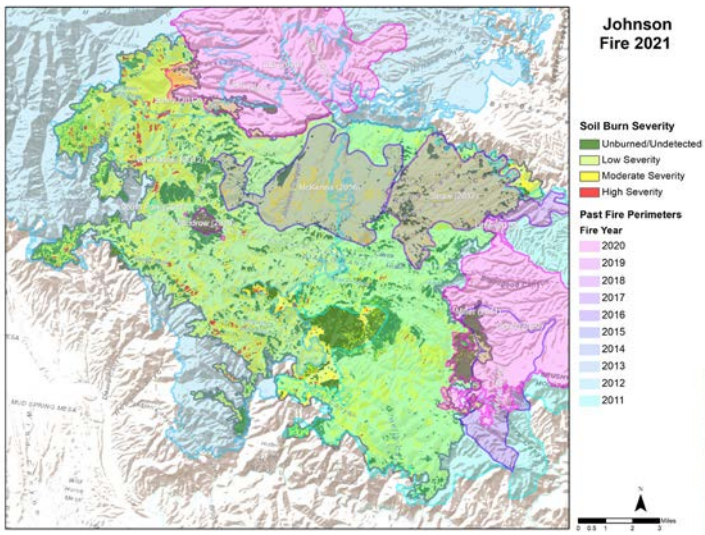

Figure 5. Canopy mortality map for the Johnson Fire.

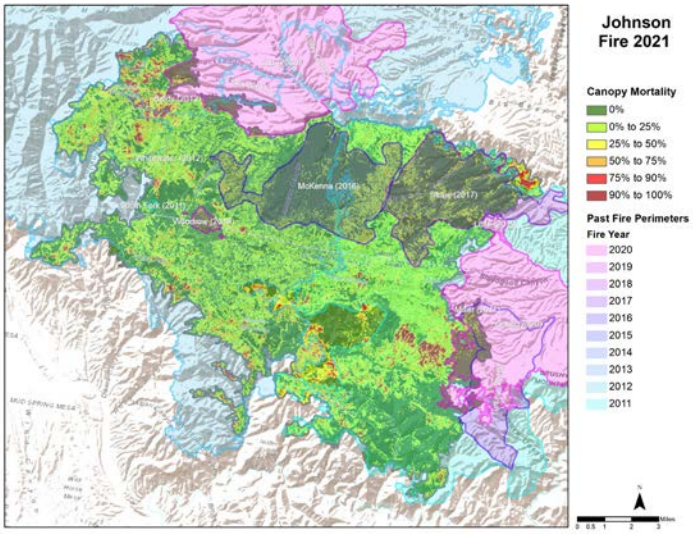

Figure 6. Soil burn severity in the Johnson Fire.

Johnson Fire, New Mexico

Lightning started the Johnson Fire on May 20 in the Gila National Forest near Gila Cliff Dwellings National Monument north of the town of Silver City, New Mexico. The Johnson Fire burned for the next 63 days, eventually encompassing nearly 89,000 acres, making it the largest New Mexico wildfire of the 2021 season.

The fire suppression strategy described in the 209 reports focused on a full suppression approach with confine/contain strategies used on the northern flank to let fire play its natural role and limit overall firefighter exposure in remote country. Operational challenges on the Johnson Fire included medical response time, wilderness intrusions, remote, rugged country, and aviation dependence. Fire managers were also considering smoke impacts to human communities, protecting the Gila Cliff Dwellings, Mexican spotted owl habitat, Threatened and Endangered aquatic species, and the mixed-conifer ecosystem.

The Incident Status Summary indicated one responder lost time due to injuries/illnesses on the Johnson Fire and that no evacuations were issued, or structures lost. The cost for managing the Johnson Fire was estimated at $10.5 million, or about $111 per acre.

Vegetation and Past Fires

The Johnson Fire burned through a mix of ponderosa pine (46 percent), piñon-juniper (25 percent), conifer-oak (16 percent), and small areas of scrub, mixed conifer, chaparral, grass, and non-vegetated areas. Vegetation departure from historical conditions in the Johnson Fire burn area was split relatively evenly between low (38 percent), medium (26 percent), and high (33 percent) departure, according to LANDFIRE Vegetation Condition Class analysis. Only about 5,750 acres of the 94,730-acre Johnson Fire (6 percent) had not burned in the previous ten years. This overlap includes nearly 50,000 acres of the 2012 Whitewater Fire and more than 41,000 acres of the 2011 Miller Fire. Other overlapping fires include the 2012 Baldy (8,600 acres), 2016 McKenna (10,200 acres), and the 2017 Straw (8,300 acres) fires. The burn area of the 2020 Cub Fire served as a 10-mile perimeter on the northern edge of the Johnson Fire while the 2020 Good Fire served as a 7-mile break on the eastern edge. A review of the Cub Fire was provided in the 2020 Fire Season Overview.

Fire Severity

Canopy mortality, as depicted in the RAVG analysis, varied across the fire but was primarily (87 percent) under 25 percent mortality (Figure 5). Nearly 46,000 acres (49 percent) of the burn area experienced zero percent mortality. Scattered pockets of near-complete canopy mortality were found throughout the burn area but only accounted for 1,100 acres (1 percent) of the fire. These high mortality areas were split evenly across the vegetation community types. The soil burn severity analysis showed a similar spatial distribution of severity levels (Figure 6). Sixty-five percent of the Johnson Fire was identified as low severity. The one percent (780 acres) of the burn area that showed high soil burn severity was primarily in the northwestern portion of the burn area.

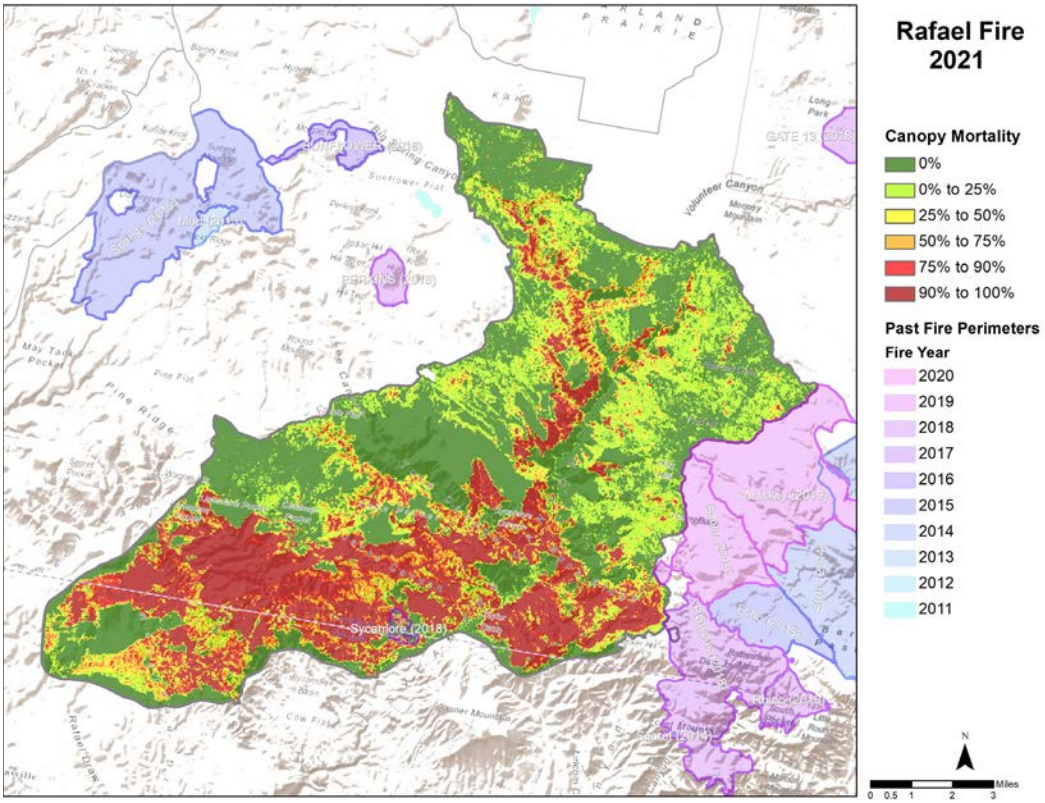

Figure 7. Canopy mortality in the Rafael Fire.

Rafael Fire, Arizona

The Rafael Fire was reported on June 18 in a remote area approximately 4 miles north of Perkinsville on the Prescott National Forest. Strong winds, dry fuels, and uphill topography led to an 9.5-mile expansion to the northeast (18,000 additional acres) on June 20 and moved the fire into the Sycamore Canyon Wilderness Area and Kaibab National Forest. The fire continued to move east over the next couple days and crossed into the Coconino National Forest adding several thousand acres per day. The fire burned for 27 days and covered more than 78,000 acres.

Fire managers used a full suppression approach on the Rafael Fire. This approach allowed for some point protection of infrastructure (buildings, transport routes, and power utility lines). Gusty winds, warm temperatures, low humidity, and rugged topography led to challenges controlling the Rafael Fire, however, burnout operations along planned holding lines were successfully implemented backing slowly through pine litter.

Fire managers estimated a population of 70,025 may be affected by the Rafael Fire. Only 50 were evacuated but another 4,907 structures were placed in the "Ready" to evacuate and 6,075 in the "Set" to evacuate level of Arizona's "Ready, Set, Go!" evacuation planning zones. The Rafael Fire did not destroy any permeant residences but did destroy two historic cabins and damaged several other cultural heritage sites in Sycamore Canyon, despite efforts by fire fighters to dig fire lines and apply protective wrap to the structures. In addition to destroying the Buck Ridge cabins, a several-centuries-old Sinagua cliff dwelling, and a 1930s-era stone cabin were damaged by the fire. The Incident Status Summary indicated three responders lost time to injuries/illnesses on the fire. The cost for managing the Rafael Fire was estimated at $15 million, or $192 per acre.

Vegetation and Past Fires

The Rafael Fire burned primarily through ponderosa pine (42 percent), piñon-juniper (26 percent), and conifer-oak (18 percent) with several other vegetation types representing less than three percent of the area. Thirty-nine percent of the Rafael Fire was classified as high departure from historical vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis. Most of the area affected by the Rafael Fire had not burned in any of the previous ten fire seasons. The Rafael Fire did share a 3.5-mile perimeter with the 2019 Whiskey and Saber fires. These fires were adjacent to one another on the eastern flank of the Rafael Fire.

Fire Severity

More than 16,000 acres (21 percent) of the Rafael Fire were classified as greater than 90 percent canopy mortality. The ecological impact of canopy mortality differs between vegetation communities. For instance, the impact of canopy mortality on a grassland is relatively limited compared to a ponderosa pine or mixed-conifer forest. The Rafael Fire burned through large areas of ponderosa pine but the canopy mortality in this vegetation type was less severe than it was in piñon-juniper (31 percent in highest mortality class), conifer-oak (35 percent), and chapparal (32 percent). Despite this lower severity in ponderosa pine, there were still nearly 6,300 acres of ponderosa pine with greater than 90 percent canopy mortality.

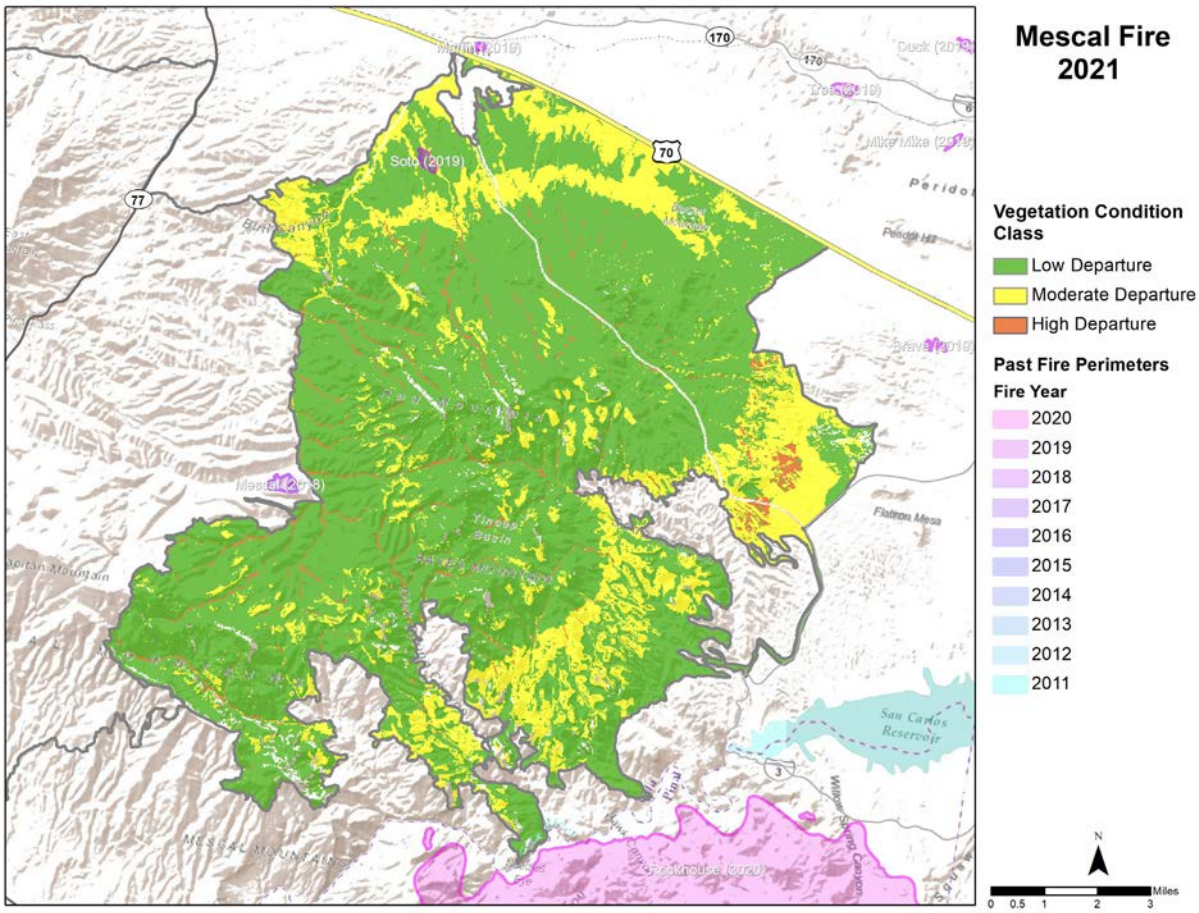

Figure 8. Vegetation departure from historical conditions based on the LANDFIRE Vegetation Condition Class analysis in the Mescal Fire.

Mescal Fire, Arizona

The Mescal Fire began on June 1 as a human-caused wildfire twelve miles northeast of Hayden in Gila County, Arizona. The fire spread through the Mescal Mountains and into the Needles Eyes Wilderness located on BLM-administered lands, as well as BIA-administered lands, and lands within the San Carlos Apache Reservation. High temperatures, strong winds, dry fuel, and single digit relative humidity supported extreme fire behavior, leading to daily advances from four to six miles. The Mescal Fire reached 72,250 acres by the time it was considered contained on June 17.

The Mescal Fire was approached by fire managers with a full suppression, values-driven strategy that used a mix of tactics (direct, indirect, and point protection). Crews took direct suppression approaches where feasible and conducted firing operations when needed while continually scouting and preparing control lines for indirect suppression tactics. Point protection was provided for specific values at risk.

Evacuation orders were issued for 556 structures, but no structures were reported as damaged or destroyed. There were several area and road closures, including shutting down Arizona Highway 77. Six injuries were reported for responders during the fire. Management of the Mescal Fire was estimated at $15 million, or $192 per acre.

Vegetation and Past Fires

The area affected by the Mescal Fire was predominantly scrub (52 percent) and grass (19 percent) with lesser components of piñon-juniper (8 percent), chapparal (7 percent), non-vegetated (7 percent) and several other vegetation types that each represented less than three percent of the area. Other than six small fires (< 50 acres) from 2019, most of the area affected by the Mescal Fire had not burned in any of the previous ten fire seasons. The Mescal Fire shared a 16-mile fire perimeter with the 2021 Telegraph Fire (covered earlier in this report) as the result of a successful burnout operation on June 15. Combined, these fires covered more than 253,000 acres.

Seventy-five percent of the Mescal Fire had a low departure from historical vegetation conditions based on the LANDFIRE Vegetation Condition Class analysis (Figure 8).

Fire Severity

No fire severity data were available for the Mescal Fire.

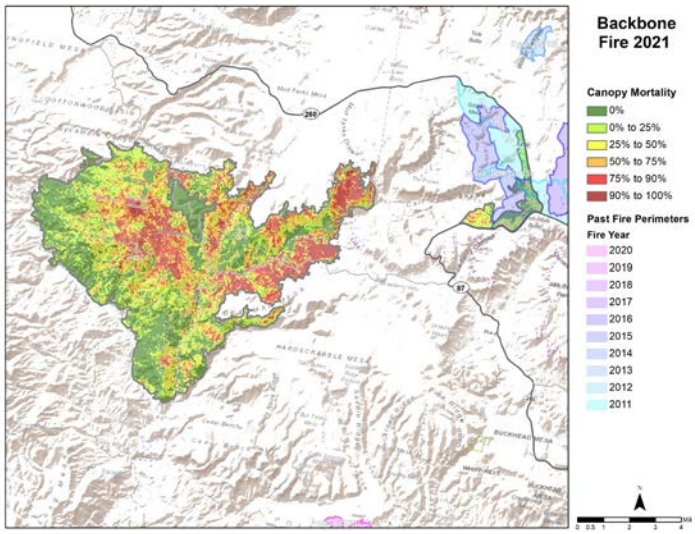

Figure 9. Canopy mortality in the Backbone Fire.

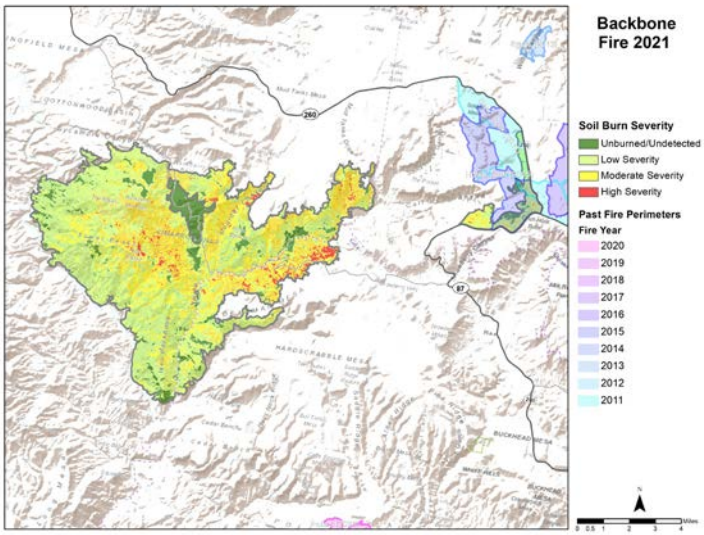

Figure 10. Soil burn severity in the Backbone Fire.

Backbone Fire, Arizona

The nearly 41,000-acre Backbone Fire was ignited by lightning on June 17 eleven miles west of Pine, Arizona in the Fossil Creek Wilderness. Hot, dry, windy weather combined with drought and low moisture in vegetation led to rapid expansion of the fire north and then northeast and northwest from its starting point and caused the evacuation of 3,500 civilians in the communities of Strawberry and Pine, Arizona. Fire managers used a full suppression approach utilizing 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. Several firing operations were initiated to protect the communities of Strawberry and Pine. Fire managers also initiated a firing operation along Arizona Highway 87 to make this route available if evacuation became necessary for the community of Payson. This firing operation never merged with the wildfire, leading to the isolated portion of the burn area (Figure 9).

Arizona State Highways 260 and 87 were closed during the fire in addition to several smaller roads. The Coconino, Tonto, and Prescott national forests were all under a closure order that included the Fossil Creek Recreation Area, the Childs Dispersed Camping Area, and the Verde River. Four injuries or illnesses to responders were reported. No damaged structures were reported. The wildfire cost an estimated $13.2 million to manage, or $323 per acre.

Vegetation and Past Fires

The Backbone Fire burned primarily in piñon-juniper (70 percent), with lesser amounts of chaparral (7 percent), conifer-oak (6 percent), scrub (6 percent), non-vegetated (6 percent), and ponderosa pine (3 percent). The Backbone burn area had one of the lowest departures from historical conditions (81 percent low departure) of the fires reviewed in this report, according to the LANDFIRE Vegetation Condition Class analysis. The primary block of the Backbone Fire had not burned in any of the previous ten fire seasons. The only area included in the Backbone Fire perimeter that had burned in the past ten fire seasons was the area burned during firing operations along Arizona Highway 87. This isolated area of Backbone Fire was burned in the 2011 Sand Rock Fire. The western boundary of the fire perimeter runs along the Verde River for approximately 12 miles.

Fire Severity

The Backbone Fire was relatively evenly split between the canopy mortality classes, according to the RAVG analysis (Figure 9). More than 14,000 acres (33 percent) of the Backbone Fire experienced no canopy mortality, while there were areas of canopy mortality greater than 90 percent in the central and eastern part of the burn area, totaling nearly 5,200 acres (12 percent). The soil burn severity analysis indicated a lower severity level than the RAVG analysis (Figure 10). Sixty-four percent of the burn area was documented as low (22,750 acres) or unburned/undetected (4,100 acres) and only 790 acres (2 percent) indicated high soil burn severity.

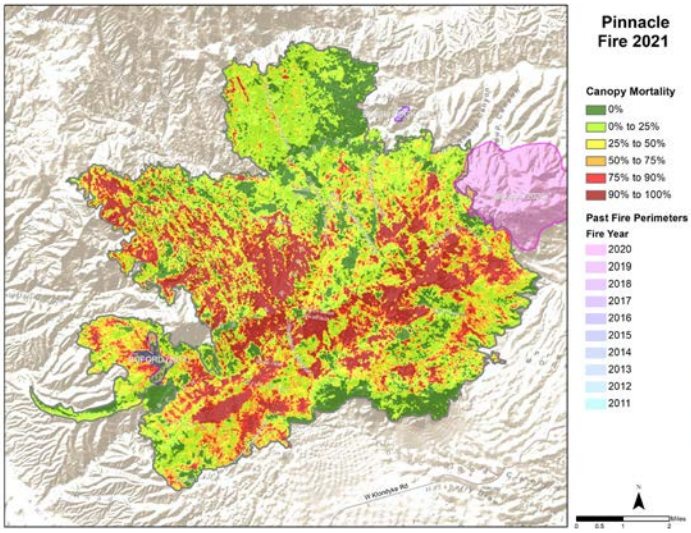

Figure 11. Canopy mortality in the Pinnacle Fire.

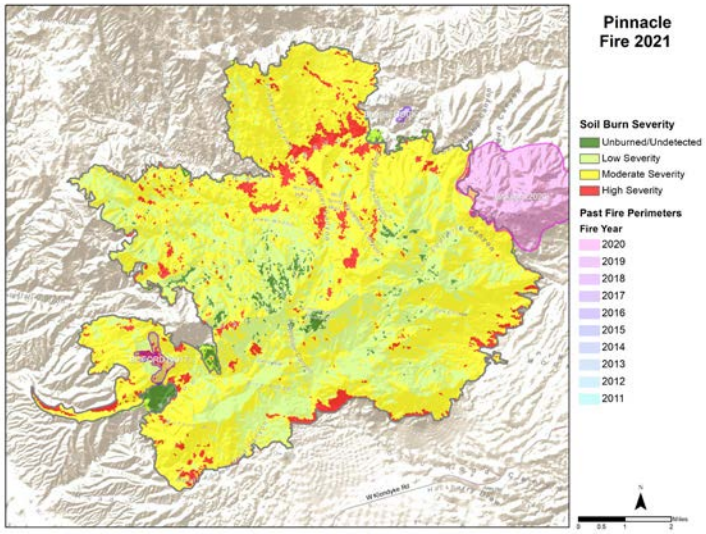

Figure 12. Soil burn severity in the Pinnacle Fire.

Pinnacle Fire, Arizona

The Pinnacle Fire was a human-caused wildfire in the Coronado National Forest south of Bylas, Arizona. The fire started on June 10 and burned nearly 34,500 acres before it was fully contained on July 16.

Fire managers chose a full suppression approach, using both direct and indirect strategies. Challenges included limited water access, remote and rugged terrain, extreme temperatures and low humidity, and coordination between multiple agencies. The high temperatures and low humidity made fuels at all elevations readily available to burn. Fuels were described as ranging from ponderosa pine and dry, mixed conifer with heavy dead and down fuels in the upper elevations, to decadent brush in the mid-elevations, and cured grass in the lower elevations. Values at risk included Mexican spotted owl habitat, bald eagle nests, archaeological sites, wilderness characteristics and watershed integrity in the Santa Teresa and North Santa Teresa Wilderness areas, range improvements, and private lands, and infrastructure.

Evacuation orders were issued for 14 residences, but no structures were reported as damaged or destroyed. Seven injuries were reported for responders during the fire. Management of the Pinnacle Fire was estimated at $15 million, or about $436 per acre.

Vegetation and Past Fires

The Pinnacle Fire burned through chaparral (26 percent), scrub (20 percent), conifer-oak (20 percent), and piñon-juniper (16 percent), along with several other vegetation types representing less than five percent of the area. Eighty percent of the vegetation within the Pinnacle Fire was classified as low departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis. Only a small portion of the area within the Pinnacle Fire perimeter had burned in the past ten fire seasons. The northeast perimeter of the Pinnacle Fire shared a 2.8-mile boundary with the 2020 Jacks Fire.

Fire Severity

Over 5,200 acres (15 percent) of the Pinnacle Fire displayed canopy mortality greater than 90 percent in the RAVG analysis. This highest level of canopy mortality was primarily in the conifer-oak and piñon-juniper communities spread through the center of the burn area (Figure 11). The areas of low or undetected canopy mortality were primarily on the northern and southern edges of the fire. The soil burn severity analysis did not indicate as much high severity area (7 percent) as RAVG but had most of the fire (61 percent) in the moderate severity category and only 538 acres in the lowest unburned or undetected categories (Figure 12).

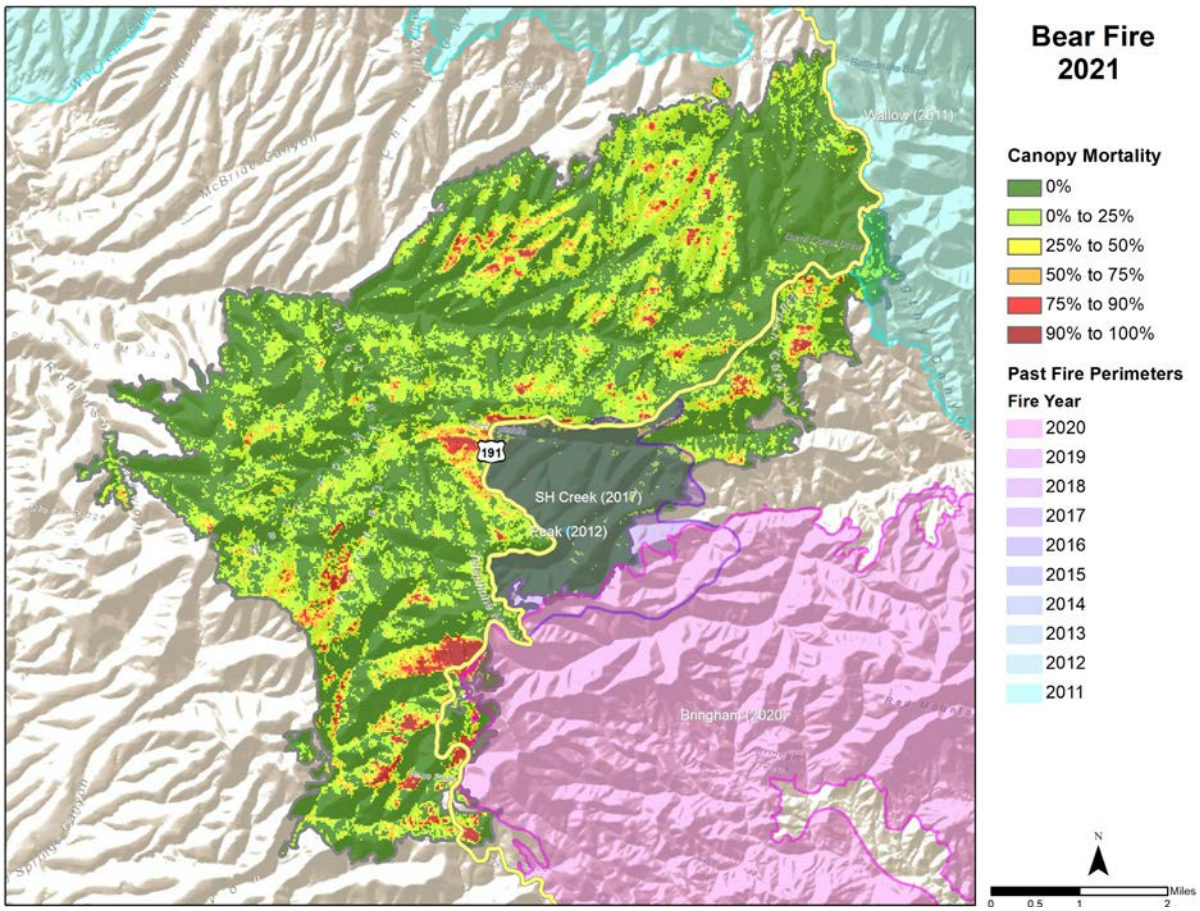

Figure 13. Canopy mortality in the Bear Fire.

Bear Fire, Arizona

Lightning ignited the Bear Fire on June 16 about 10 miles south of Hannigan Meadow, Arizona. Given the location and values at risk, fire managers chose a monitor and point zone protection approach to the Bear Fire, which eventually reached 24,000 acres before it was fully contained. The Bear Fire was described in the 209 reports as having periods of active fire behavior with uphill runs, single tree torching, and flanking.

Evacuations were issued for a handful of individuals near the fire while the community of Hannigan Meadow and ranches along Eagle Creek were placed on a pre-evacuation notice but did not need to evacuate. U.S. Highway 191 was closed along with other area and road closures in response to the Bear Fire. Management of the Bear Fire was estimated at $200,000, or about $8 per acre.

Vegetation and Past Fires

The Bear Fire burned through an area of predominantly ponderosa pine (64 percent) with smaller components of conifer-oak (22 percent) and piñon-juniper (11 percent). Thirty-six percent (8,500 acres) of the vegetation within the Bear Fire had high departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis.

The Bear Fire perimeter included approximately 2,200 acres that had burned in the 2017 SH Creek Fire. The area that burned in 2017 and again in 2021 was likely of low severity, as the RAVG assessment shows zero percent canopy mortality through nearly all of this overlap area. The rest of the area affected by the Bear Fire had not burned in the previous ten fire seasons. In addition to the overlapping area, the Bear Fire shared a 2.4-mile boundary with U.S. Highway 191 and the 2011 Wallow Fire along the northeast perimeter and a 2.5-mile perimeter with U.S. Highway 191 and the 2020 Bingham fire along the southeast perimeter.

Fire Severity

Canopy mortality, as depicted in the RAVG analysis, varied across the fire but tended to be lower than other fires covered in this report, with only one percent (333 acres) in the over 90 percent mortality class (Figure 13). More than 15,500 acres (64 percent) of the burn area experienced zero percent mortality. The scattered pockets of near-complete canopy mortality were most common on the valley slopes in the eastern part of the fire.

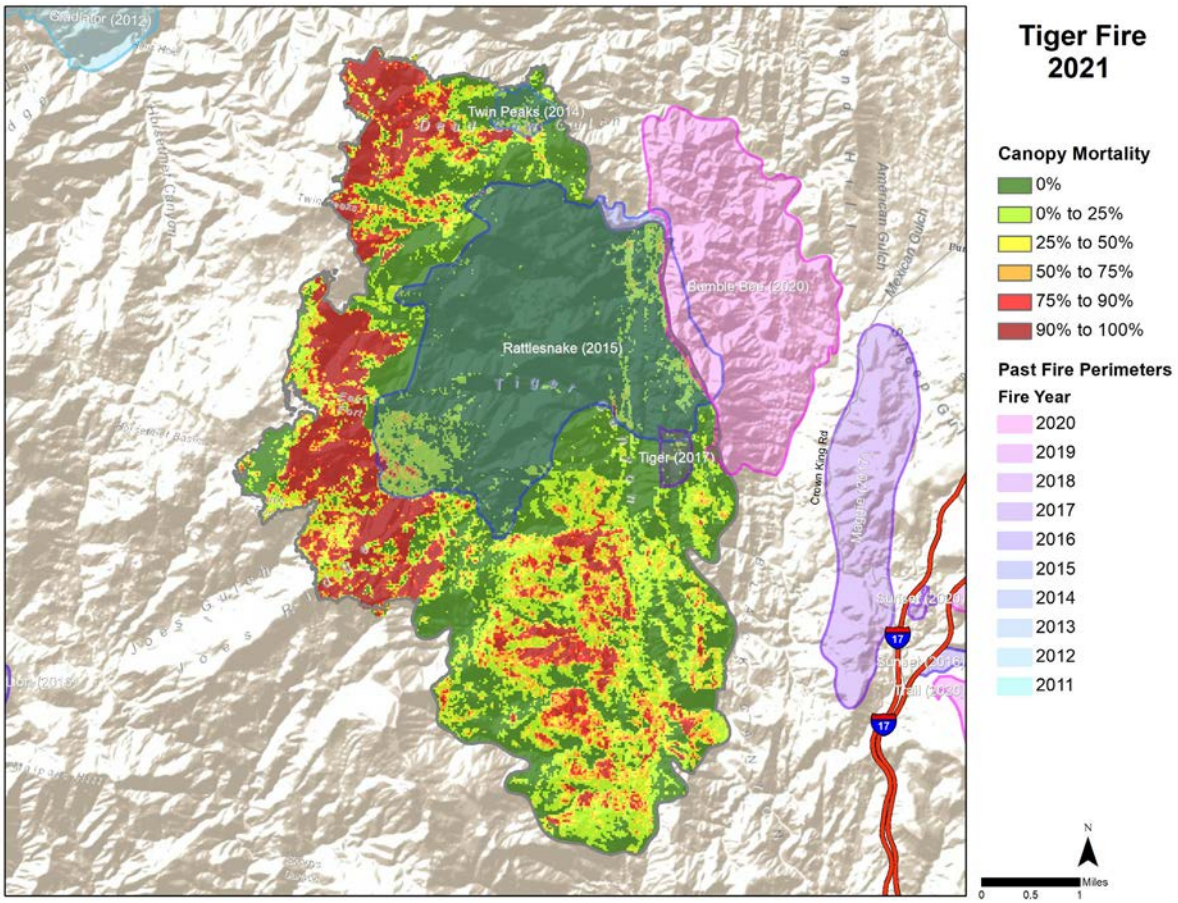

Figure 14. Canopy mortality in the Tiger Fire.

Tiger Fire, Arizona

The Tiger Fire burned more than 16,000 acres after starting from a lightning strike on June 30 in the Prescott National Forest Castle Creek Wilderness southeast of Crown King. Fire managers chose a full suppression approach that utilized a variety of land and aircraft-based strategies to slow expansion out of the Castle Creek Wilderness toward Black Canyon City and Interstate 17. The overall strategy outlined in the 209 report involved point protection around values at risk, including communities and major infrastructure, and making tactical decisions that take advantage of the suppression strategies of confine, contain, and control based on fuels, weather, topography, and seasonality.

Operational challenges on the Tiger Fire included remote access and steep terrain, gusty and erratic outflow winds, and public interest in the fire along the I-17 corridor. Environmental concerns included tortoise habitat, threatened and endangered species habitat, grazing allotments, wilderness and inventoried roadless areas, and riparian avoidance areas.

Several communities surrounding the Tiger Fire including Crown King, Cleator, and Black Canyon City placed in "Ready" or "Set" status of Arizona's "Ready-Set-Go!" program. The Incident Status Summary indicated that no structures were lost to the Tiger Fire and that two responders lost time to injuries/illnesses while working the fire. Management of the Tiger Fire was estimated at $5.64 million, or $347 per acre.

Vegetation and Past Fires

The Tiger Fire burned through an area of piñon-juniper (34 percent), scrub (23 percent), conifer-oak (17 percent), chaparral (10 percent), and grass (8 percent). Ninety percent (14,700 acres) of the vegetation within the Tiger Fire had low departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis; this was the highest percentage of low departure of any of the fires covered in this report. The Tiger Fire perimeter contained nearly all 4,910 acres of the Rattlesnake Fire (2015) and the 2014 Twin Peaks Fire. The Tiger Fire shared a 2.7-mile perimeter with the 2020 Bumblebee Fire along the Tiger Fire's eastern edge.

Fire Severity

The Tiger Fire had areas of high and low canopy mortality in the RAVG analysis (Figure 14). Nearly 2,000 acres (12 percent) of the area experienced over 90 percent canopy mortality. This high mortality class was most common in the conifer-oak communities on the western and northern sides of the fire. The Tiger Fire also featured 8,200 acres (51 percent) that had no recorded canopy mortality. Most of this was within the fire scar of the 2015 Rattlesnake Fire.

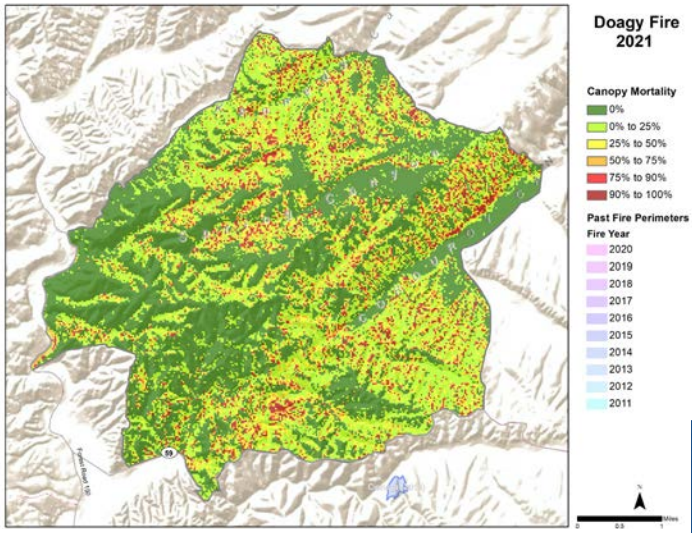

Figure 15. Canopy mortality in the Doagy Fire.

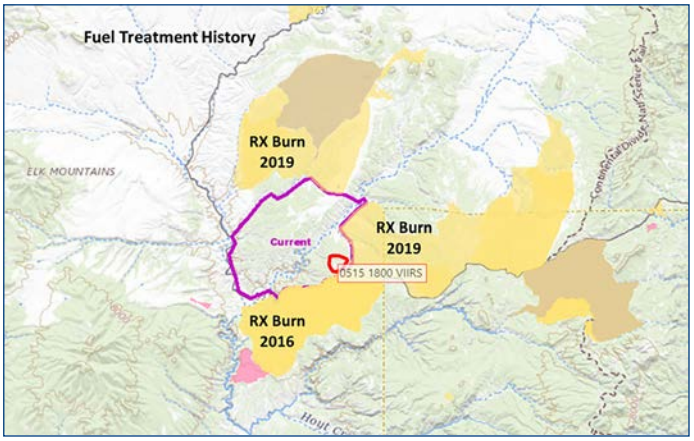

Figure 16. Image available on the Inciweb website shows the date and location of prescribed burns surrounding the Doagy Fire. These prescribed burns aided in the management of this wildfire.

Doagy Fire, New Mexico

The Doagy Fire was ignited by lightning on May 14 near Doagy Well in Doagy Canyon of the Gila National Forest. The fire burned nearly 13,000 acres before it was deemed 100 percent contained.

Fire managers chose a confine and point zone protection approach to the Doagy Fire, with a focus on protecting infrastructure and cultural features within fire area and minimizing smoke impacts to area communities and travel corridors as well as minimizing impacts on Mexican gray wolf sensitive areas. Fire managers noted an intention to maintain fire and its natural role on the landscape where it aligns with suppression objectives on federal lands. The fire management team was able to utilize an Unmanned Aerial System (UAS) to achieve these objectives while mitigating risk by reducing fire fighter interaction with hazardous environments. The UAS used on the Doagy Fire was able to provide real-time camera images, aerial ignition capabilities, and provide infrared data to find potential spot fires.

This portion of the Black Range Ranger District served as an excellent example of how returning fire to the landscape either through prescribed fire or natural ignitions sets up managers for success in managing large, landscape fires. The project area surrounding the Doagy Fire was treated by prescribed fires in the years prior to the wildfire and greatly aided the wildfire control efforts. Reports also noted the effectiveness of fire adaptation efforts by the surrounding private landowners in the management of this fire.

New Mexico State Highway 59 served as a 5.5-mile perimeter along the southern edge of the Doagy Fire. Two injuries or illnesses were reported to responders. No damaged structures were reported. Management of the Doagy Fire was estimated at $1.4 million, or $110 per acre.

Vegetation and Past Fires

The Doagy Fire burned primarily in piñon-juniper (72 percent) with lesser components of grass (9 percent), scrub (8 percent), and ponderosa pine (8 percent). None of the area affected by the Doagy Fire had burned in a wildfire over the past ten fire seasons but the area around the Doagy Fire had been treated by prescribed fires in 2016 and 2019 (Figure 16). Seventy percent of the vegetation within the Doagy Fire perimeter had medium (6,100 acres) or high (2,900 acres) departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis.

Fire Severity

Seventy-seven percent of the Doagy Fire was identified as no canopy mortality (5,576 acers) or less than 25 percent (4,255 acres) mortality in the RAVG analysis (Figure 15). Areas of high canopy mortality were scattered throughout the burn area and appear to be more influenced by slope and aspect than vegetation community type. Soil burn severity data were not available for this fire.

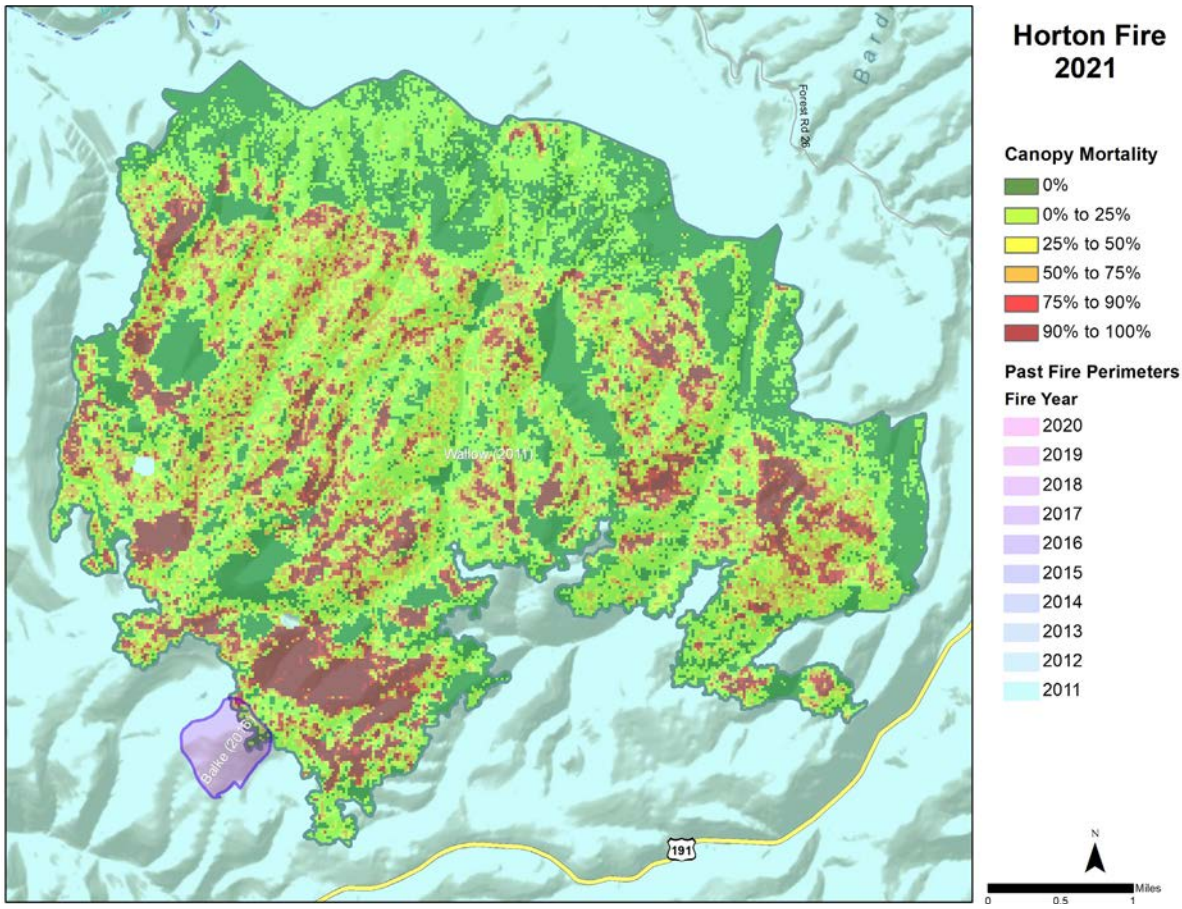

Figure 17. Canopy mortality in the Horton Fire. Note that the entire area displayed in this figure was burned in the 2011 Wallow Fire.

Horton Fire, Arizona

The Horton Fire was reported on June 16 and burned 12,300 acres over the next 27 days. The fire was located approximately five miles north of Hannigan Meadow, Arizona and was one of several lightning fires burning within the 2011 Wallow Fire scar. Fire managers met high variation in ground and canopy fuels based on Wallow burn severity, with some areas having dense overstory and others a mix of brush and grass with patches of heavy down fuel. Dead fuel moistures were critically low, with heavy fuels contributing to fire spread. Fire managers chose a full suppression approach that used aviation resources to check fire growth in critical areas and implemented burnout activities as necessary.

Fire managers were able to keep the fire from approaching or crossing U.S. Highway 191 and no structures were reported as damaged or destroyed. Three injuries or illnesses were reported on the fire. The Horton Fire cost $3.5 million to manage, or about $285 per acre.

Vegetation and Past Fires

The Horton Fire burned primarily in conifer-oak (40 percent) and ponderosa pine (31 percent) with lesser components of scrub (11 percent), grass (9 percent), spruce-fir (5 percent) and mixed conifer (4 percent). Seventy-seven percent of the vegetation within the Horton Fire perimeter had medium (4,900 acres) or high (4,500 acres) departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis. The Horton Fire lies entirely within the perimeter of the 538,000-acre Wallow Fire (2011). The only other fire in the area in the past ten fire seasons was the 2016 Blake Fire, which shared a short fire perimeter with the Horton Fire.

Fire Severity

The Horton Fire experienced a mix of fire intensities, as measured by the RAVG canopy mortality analysis (Figure 17). Over 1,000 acres (8 percent) experienced canopy mortality greater than 90 percent. The high canopy mortality was found throughout the fire but most concentrated in certain areas. Most of this high canopy mortality was in the conifer-oak vegetation communities. Eighty-four percent of the ponderosa pine community was identified as having no canopy mortality (1,600 acers) or less than 25 percent (1,600 acres) mortality. Soil burn severity data were not available for this fire.

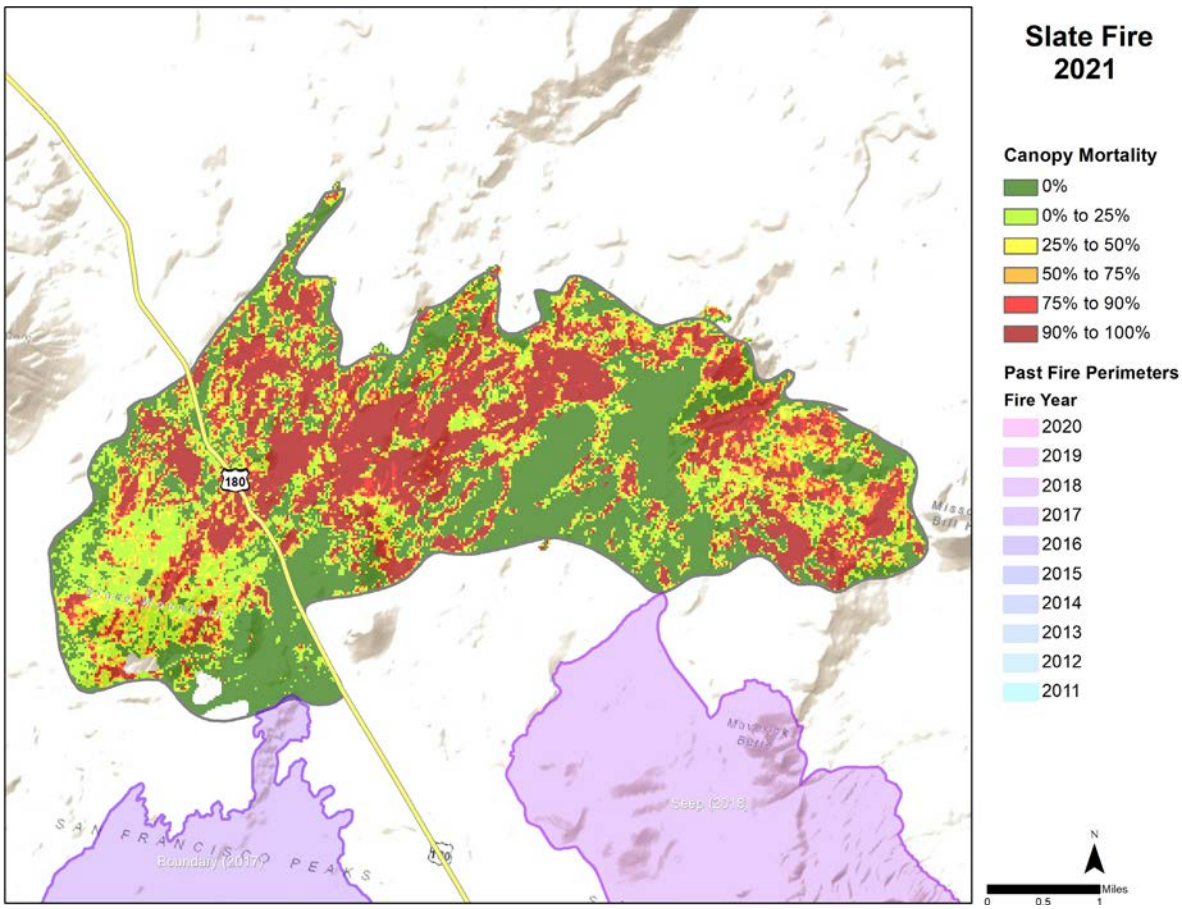

Figure 18. Canopy mortality in the Slate Fire.

Slate Fire, Arizona

The 11,500-acre Slate Fire started on June 8 near the summit of Slate Mountain in the Flagstaff Ranger District of the Coconino National Forest, approximately 23 miles northwest of Flagstaff. Fire managers chose a full suppression approach that utilized technical firing operations in rugged terrain along with aerial ignition, which allowed them to bring the fire to existing and natural holding features and reduced exposure to personnel. Fire managers initially reported mostly low-to-moderate fire behavior but anticipated intensity to pick up as the persistent drought along with record-setting temperatures and very low fuel moistures created readily available fuels. They also noted increased fire activity as the fire moved out of the ponderosa pine fuel sources into the piñon-juniper, which burned a lot hotter and faster.

There were no reports of structural damage or mandated evacuations, however, U.S. Highway 180 and other area and road closures were instituted in response to the Slate Fire. One injury or illness was reported on this fire. There was also a report of damage to an unmanned aerial system but no human injuries were reported along with it. Management of the Slate Fire was estimated at $3.5 million, or $306 per acre.

Vegetation and Past Fires

The Slate Fire burned almost exclusively in piñon-juniper (63 percent) and ponderosa pine (34 percent) plant communities. Eighty-seven percent of the vegetation within the Slate Fire perimeter had medium (7,400 acres) or high (2,500 acres) departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis. The area affected by the Slate Fire had not burned in the previous ten fire seasons.

Fire Severity

The RAVG canopy mortality analysis of the Slate Fire showed concentrated areas of almost complete canopy mortality (2,900 acres with greater than 90 percent mortality) and areas of no (4,100 acres) or limited (1,900 acres 0–25 percent mortality) canopy mortality without many acres in between (Figure 18). The distribution of canopy mortality classes across vegetation communities was comparable, indicating that canopy mortality in the Slate Fire was more likely influenced by slope, aspect, and local fire behavior than plant community type. Soil burn severity data were not available for this fire.

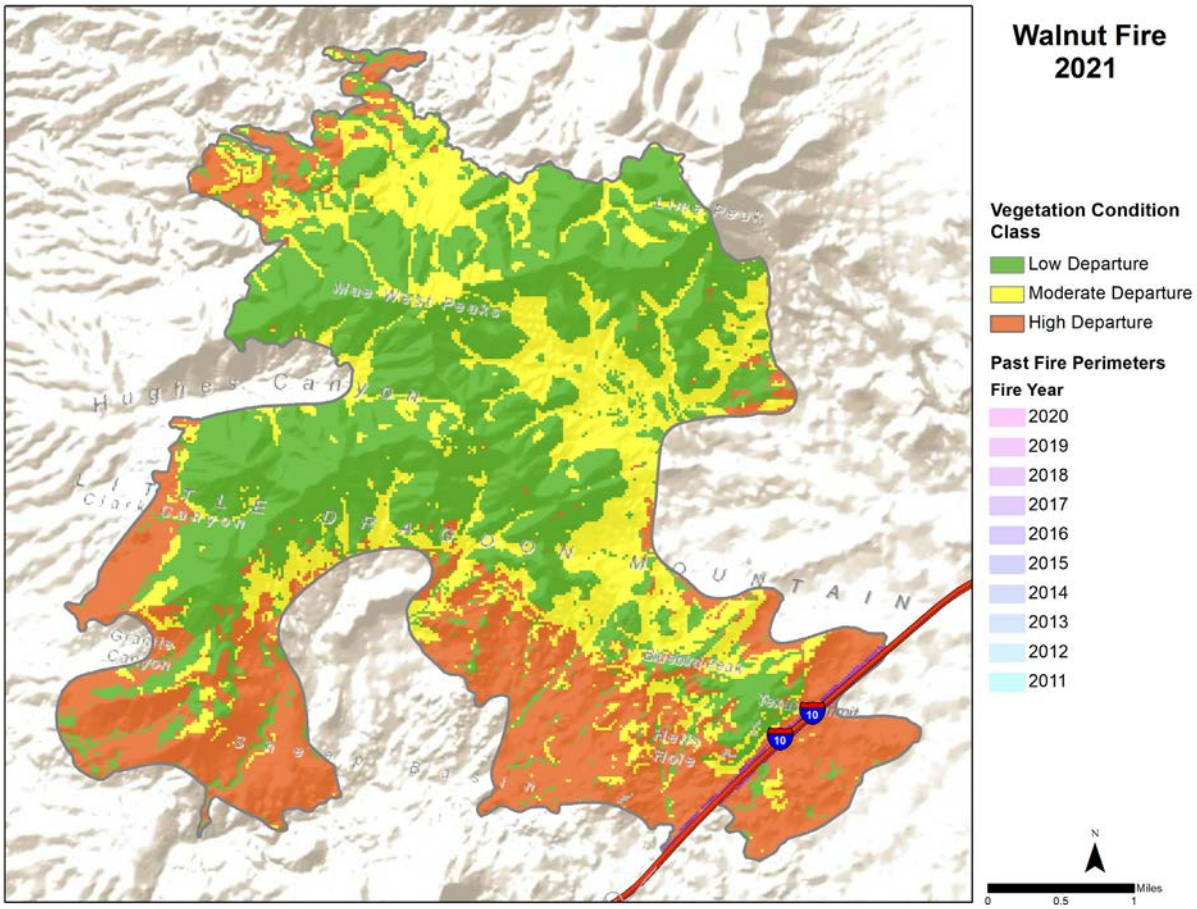

Figure 19. Vegetation departure from historical conditions based on the LANDFIRE Vegetation Condition Class analysis in the Walnut Fire.

Walnut Fire, Arizona

Lightning ignited the 10,700-acre Walnut Fire on June 20 in the Little Dragoon Mountains between Benson and Willcox in Cochise County, Arizona. Fire managers initially chose a mix of full suppression and point protection but switched to a full suppression approach as the fire moved down the mountain toward, and eventually crossing, Interstate 10. The extreme heat and wind hampered ground forces and fire mangers relied on aircraft to create opportunities to establish anchor points.

Fire managers issued several area closures, including stretches of Interstate 10, but no structures were reported as damaged or destroyed. Three injuries were reported for responders during the fire. Management of the Walnut Fire was estimated at $1.5 million, or about $141 per acre.

Vegetation and Past Fires

The Walnut Fire burned through an area of sparce vegetation and is the first fire covered in this report where non- or sparsely vegetated communities are the predominant community type (41 percent of the area classified as non-vegetated). Other vegetation communities included scrub (35 percent) and grass (21 percent). Fifty percent of the vegetation within the Walnut Fire had high (28 percent) or moderate (22 percent) departure from historical conditions, according to the LANDFIRE Vegetation Condition Class analysis (Figure 19). None of the area affected by the Walnut Fire had burned in the previous ten fire seasons.

Fire Severity

No fire severity data were available for the Walnut Fire.

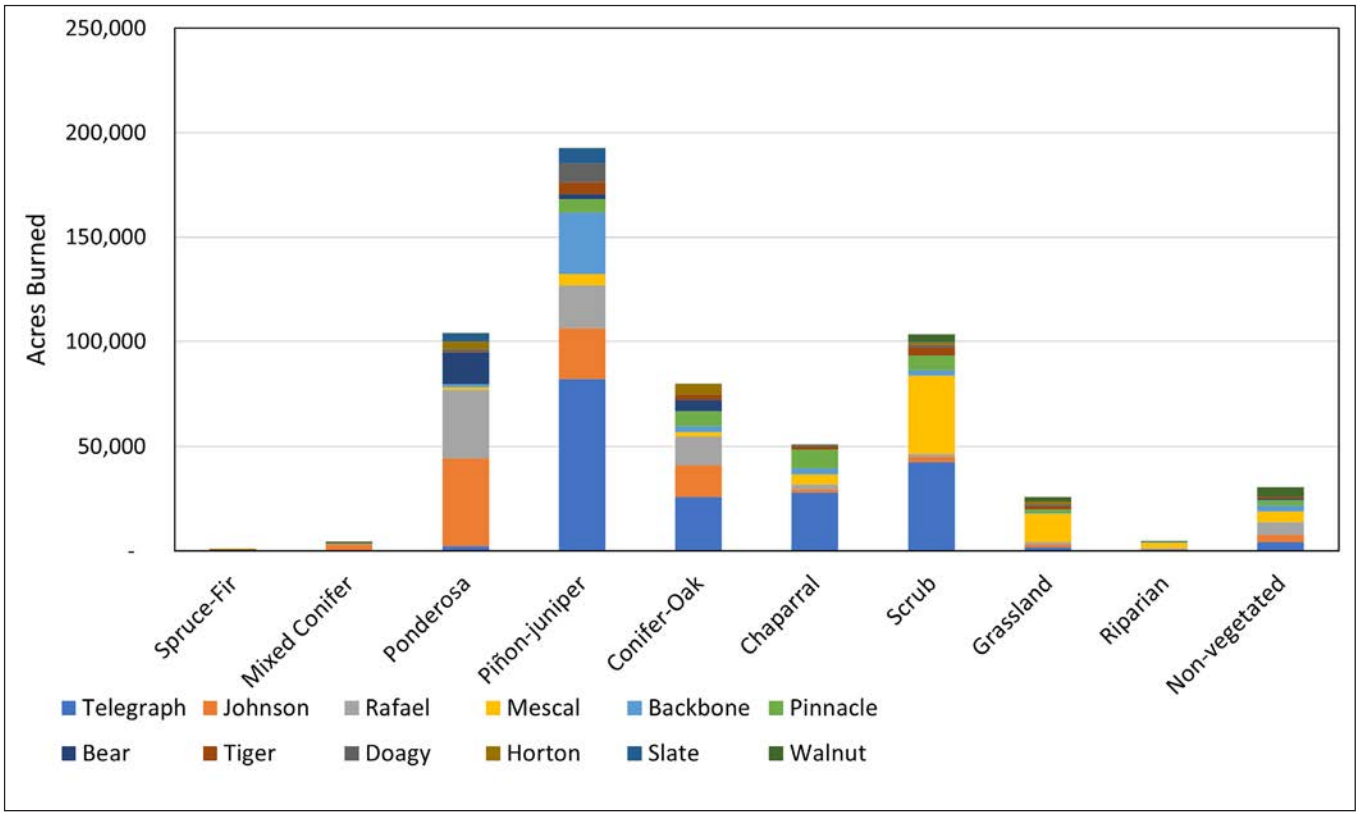

Figure 20. Summary of acres burned in the largest fires of the 2021 fire season by vegetation type.

Conclusion

This report covers the twelve largest wildfires in Arizona and New Mexico of the 2021 fire season. These 12 wildfires represented 90 percent of all acres in the Southwest burned by wildfire in 2021. The most widespread vegetation types affected by these fires were piñon-juniper, ponderosa pine, and scrub, with more than 100,000 acres of each type burned (Figure 20). The fires reviewed in this report and those covered in the 2020 Fire Season Report each covered approximately 600,000 acres, but the distribution of acres across vegetation community types varied between year. Most notably is the nearly 90,000-acre increase from 2020 to 2021 in piñon-juniper and large decreases in grassland (down 61,000 acres) and chaparral (down 53,000 acres). The largest fires in each of these fire seasons influence this distribution of plant communities, as more than 82,000 acres of the 2021 piñon-juniper acres burned were in the Telegraph Fire, whereas the largest fire of the 2020 fire season (Bush Fire) burned in primarily scrub, grassland, non-vegetated, and chaparral communities. The large fires in 2021 burned more than 21,000 more acres of ponderosa pine than the largest fires in 2020 and 60,000 more acres than the fires reviewed in the 2019 analysis.

Full soil burn severity data were only available for three of the 12 fires analzyed in this report, covering 164,000 acres (28 percent of acres in report). Eighty-seven percent of the area covered by these three fires was classified as low or moderate soil burn severity (Figure 21). Only two percent of the acres for which soil burn severity data were available displayed high soil burn severity. Sixty percent of these high-severity acres were in the Pinnacle Fire.

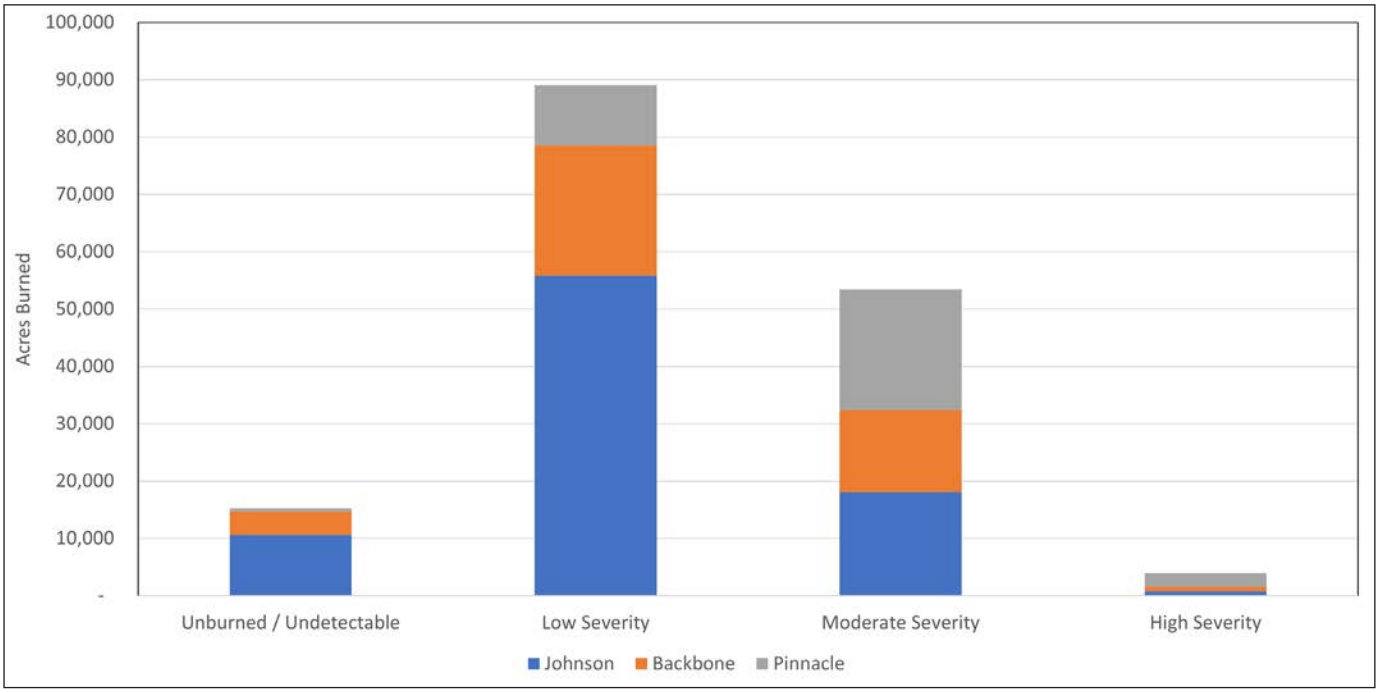

Figure 21. Summary of acres burned by soil burn severity class.

Rapid Assessment of Vegetation Condition after Wildfire (RAVG) data were available for ten of the twelve fires covered in this report (Figure 22). Of these 515,000 acres, 37 percent (191,000 acres) showed no detectable canopy mortality, while nearly 82,000 acres (16 percent) showed greater than 90 percent mortality. The Telegraph and Rafael fires account for more than 77 percent of the highest canopy mortality areas. In the Telegraph Fire, this highest canopy mortality class was primarily in piñon-juniper, scrub, chaparral, and conifer-oak, whereas much of the high canopy mortality in the Rafael Fire was ponderosa pine. 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 16 percent of the area covered in this analysis was highly departed from historical conditions based on the LANDFIRE Vegetation Condition Class analysis (Figure 23). It is reasonable to assume that the high proportions of wildfire burning with low severity and the high portion of area that burned close to the historical condition are related. Most of the 91,000 high-departure acres were in the Rafael (30,000 acres) and Johnson (29,000 acres) fires, with no other fire accounting for more than 8,500 acres. These fires also had two of the three highest portions of their burn areas in the top canopy mortality category.

Several of the fires reviewed in this report led to evacuations and smoke-related impacts, but despite the large numbers of acres burned, human communities were only significantly affected by the Telegraph Fire in 2021. The Telegraph Fire burned more than 180,000 acres and led to the destruction of 13 homes and 28 non-residential structures in addition to damaging several others and prompting the evacuation of several thousand civilians. There certainly were localized impacts of the other eleven fires that should not be minimized, but no structures were reported lost in these other fires and there were relatively few reported evacuations for these fires.

Past reports noted that the majority of the large fires in the Southwest are caused by lightning (naturally ignited), but we noted in the 2020 report that most of the fires during that fire season were listed as human caused or undetermined at the time of writing. The 2021 fire season returned to the historical trend, with most of the fires reported as lighting caused.

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.

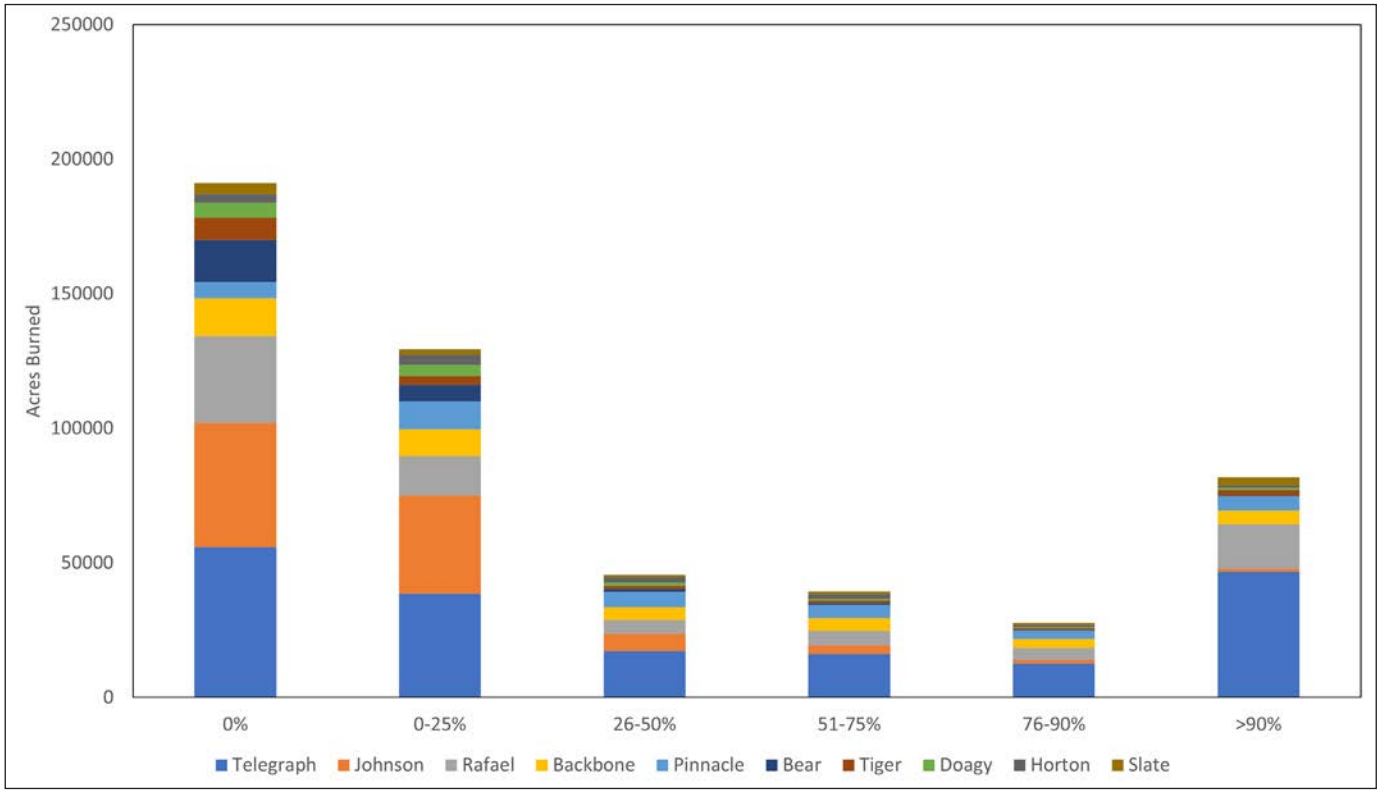

Figure 22. Summary of acres burned by canopy mortality class.

Other fires, such as the Horton Fire, fell completely within a past fire perimeter. The Doagy Fire was bound by areas that were burned as part of a prescribed fire program 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 twelve fires in this analysis were managed at an estimated cost of nearly $123 million dollars, for an average of $210 per acre. This average cost was similar to the costs reported in the 2018, 2019, and 2020 fire season analyses, but roughly half of the cost in the 2017 report. As noted above, managers identify the most appropriate strategy for each wildfire to minimize threats and maximize positive outcomes. In 2021, managers classified their strategy as full suppression on nine of the twelve fires. While this is a high percentage of the fires, it is a marked decrease from the 2020 fires (all fires classified as full suppression) and more in line with our findings 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, which may have been reduced as fire managers were in the second year of the pandemic. It should also be noted that while the overall strategy is often listed as 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 nearly 600,000 acres burned in 2021 provided some ecological benefit.

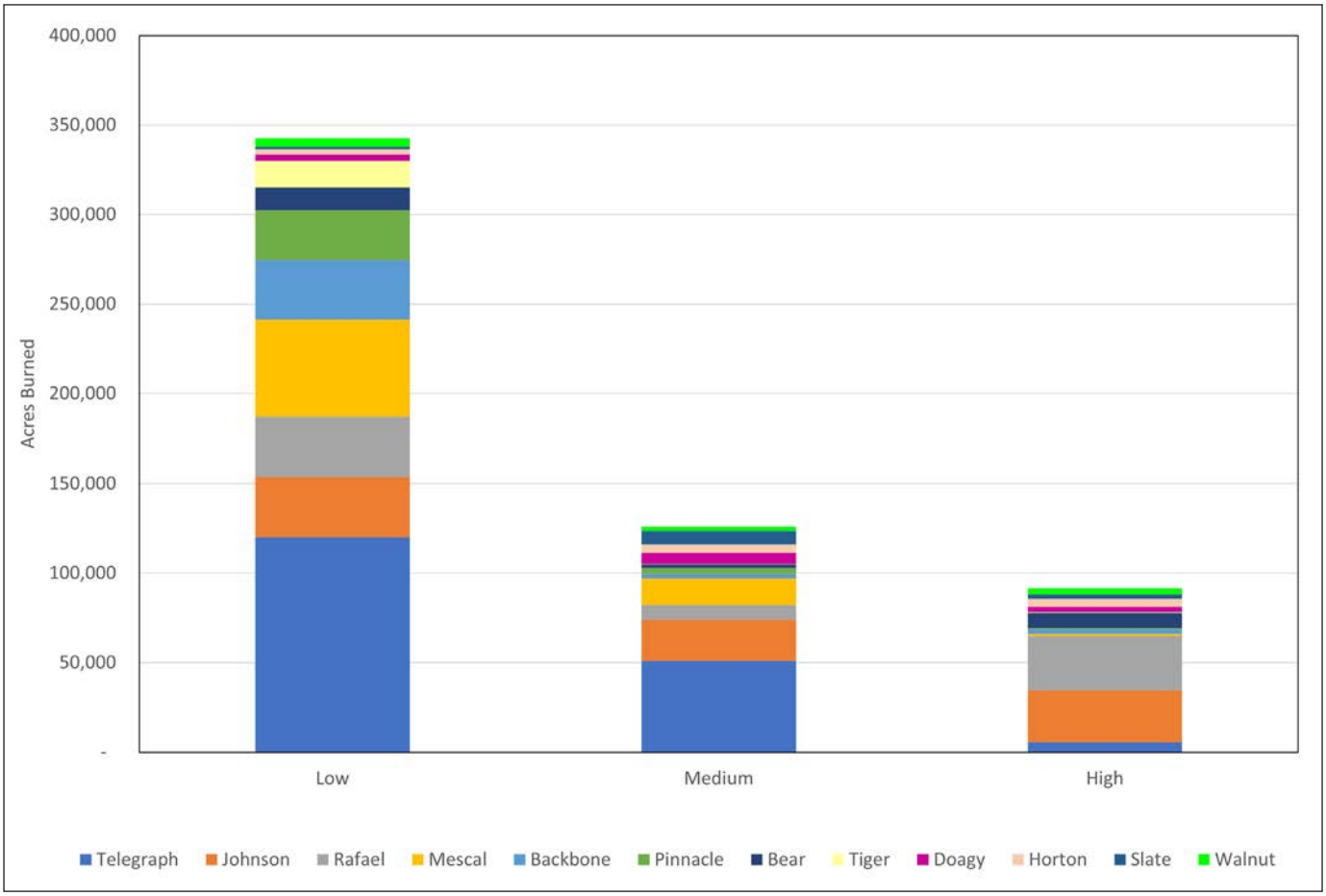

Figure 23. Summary of acres burned by vegetation condition class.

Appendix I. Fire Statistics

General				Vegetation Departure		
Name	**Acres**	**Cost**	**cost/ac**	**Low**	**Medium**	**High**
Telegraph	180,757	$40,000,000	$221.29	66%	28%	3%
Johnson	88,918	$10,500,000	$118.09	38%	26%	33%
Rafael	78,065	$15,000,000	$192.15	43%	11%	39%
Mescal	72,250	$13,000,000	$179.93	75%	21%	2%
Backbone	40,855	$13,200,000	$323.09	81%	6%	6%
Pinnacle	34,437	$15,000,000	$435.58	80%	10%	2%
Bear	24,067	$200,000	$8.31	54%	9%	36%
Tiger	16,278	$5,644,000	$346.73	90%	1%	2%
Doagy	12,785	$1,400,000	$109.50	28%	48%	23%
Horton	12,263	$3,500,000	$285.41	23%	40%	37%
Slate	11,435	$3,500,000	$306.08	12%	65%	22%
Walnut	10,667	$1,500,000	$140.62	43%	22%	28%
Sum	**582,777**	**$122,444,000**	**$210.10**			

	Soil Burn Severity				RAVG Canopy Mortality					
Name	**Unburned**	**Low**	**Moderate**	**High**	**0%**	**0-25%**	**26-50%**	**51-75%**	**76-90%**	**>90%**
Telegraph	-	-	-	-	30%	21%	9%	9%	7%	25%
Johnson	12%	65%	21%	1%	49%	39%	7%	3%	1%	1%
Rafael	-	-	-	-	41%	19%	7%	7%	6%	21%
Mescal	-	-	-	-	-	-	-	-	-	-
Backbone	10%	54%	34%	2%	33%	24%	11%	11%	8%	12%
Pinnacle	2%	30%	61%	7%	17%	29%	16%	14%	9%	15%
Bear	-	-	-	-	64%	25%	5%	3%	1%	1%
Tiger	-	-	-	-	51%	19%	7%	6%	4%	12%
Doagy	-	-	-	-	44%	33%	10%	5%	2%	7%
Horton	-	-	-	-	25%	30%	15%	14%	7%	8%
Slate	-	-	-	-	36%	17%	8%	8%	6%	26%
Walnut	-	-	-	-	-	-	-	-	-	-

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