Forest Stewards Guild
putting the forest first

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Increasing Wildfire Awareness and Reducing Human-Caused Ignitions in Northern New Mexico

REPORT

Acknowledgements

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This report was written by Alexander Evans and designed by Sam Berry. Cover photos are by Sam Berry (large) and Texas State Parks Ambassador Program (inset).

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Executive Summary

Large wildfires that burn at high-severity are a common occurrence in the forests of northern New Mexico. These wildfires burn through forests that are not adapted to high-severity fire and can devastate ecosystems and human communities. For example, the Las Conchas Fire of 2011 left a high-severity burn across 156,593 acres, caused severe flooding, and removed ponderosa pine forests, perhaps forever. Although lightning causes many wildfires in the Southwest, human ignitions are a significant risk. In 2013, human ignited wildfires burned over 60,000 acres in Arizona and New Mexico (SWCC 2016). Since human ignitions are preventable, raising education and awareness could be the key to reducing the number of large wildfires.

To effectively reduce the wildfires caused by people, prevention efforts should recognize the variation in how and where people start wildfires. People start wildfires with their vehicles, cigarette butts, campfires, fireworks, debris burning, powerlines, arson, and other activities. Data from the Southwest show the impact of abandoned campfires, which account for 44% of the human caused wildfires since 2001. Research suggests that campfire bans have limited effectiveness because of the particular importance of campfires to people recreating in the forest. However, 80 percent of wildfires started by campfires are within a quarter mile of a road. This type of analysis combined with local knowledge may suggest ways to target outreach to people likely to build campfires.

Public awareness campaigns such as Smokey Bear and the more recent One Less Spark seek to change behaviors, but there is little information about their effectiveness. For example, there is scant research on which wildfire prevention signs have the most impact on behavior. Recent academic research in Florida suggests that prevention campaigns are a good investment, but expanding this type of research could have a significant positive impact. Building a case for the effectiveness of wildfire prevention programs could also help make a case for increasing prevention budgets. Currently, federal agency budgets for prevention do not reflect the importance of these programs. Another opportunity is to increase the integration of prevention messaging in programs such as Firewise that focus on homeowners in the wildland-urban interface (WUI) and Fire Adapted Communities that include the many facets of communities' relationship to fire. Linking human caused ignitions to the risk WUI residents face could help build a strong group of advocates for wildfire prevention and reduce the high costs of wildfire.

Abandoned campfires are the most common single source of human ignitions, and 80 percent of wildfires started by campfires are within a quarter mile of a road.

Human caused wildfire

How many acres are burned by human caused wildfires?

Over the last 16 years, wildfires burned an average of 4.6 million acres annually in the coterminous U.S. (NIFC 2017). During big fire years such as 2006, as many as 9.5 million acres burned, while in other years such as 2004, fewer than 2 million acres burned (Figure 1). On average, human-caused wildfires burn over half (55%) of the total acres burned in a given year (NIFC 2017). Some years the percentage of acres burned by human-caused wildfires is much greater; for example, 82 percent in 2009. These human-ignited wildfires are different from controlled burns (also called prescribed fire), which are intentionally ignited under specific conditions and managed to benefit ecological conditions. Analysis of wildfire records from 1992 to 2012 showed an increasing trend in large wildfires ignited by humans (Balch et al. 2017).

Different regions of the U.S. have different patterns of fire and different ratios of human and nature ignitions (Figure 2). For instance, the southern U.S. has a higher percentage of human-caused wildfire (81% of the acres burned are human caused) compared to other regions such as the Northwest (only 26% of the acres burned are human caused). Scientific studies explore these regional differences in more depth (Stephens 2005, Bartlein et al. 2008, Balch et al. 2017).

As the climate gets warmer, and in many areas drier, large, severe fires are likely to become more common. In fact, this pattern is already visible. An examination of wildfires in the western U.S. between 1984 and 2011 showed that both the number of large fires and the acreage burned increased significantly (Dennison et al. 2014). Abatzoglou and colleagues (2016) estimate that the changing climate resulted in an additional 10 million acres of wildfire between 1984 and 2015. Regional studies have documented an increase in burn severity in both California and the southwestern U.S. (Dillon et al. 2011, Miller and Safford 2012). By the end of

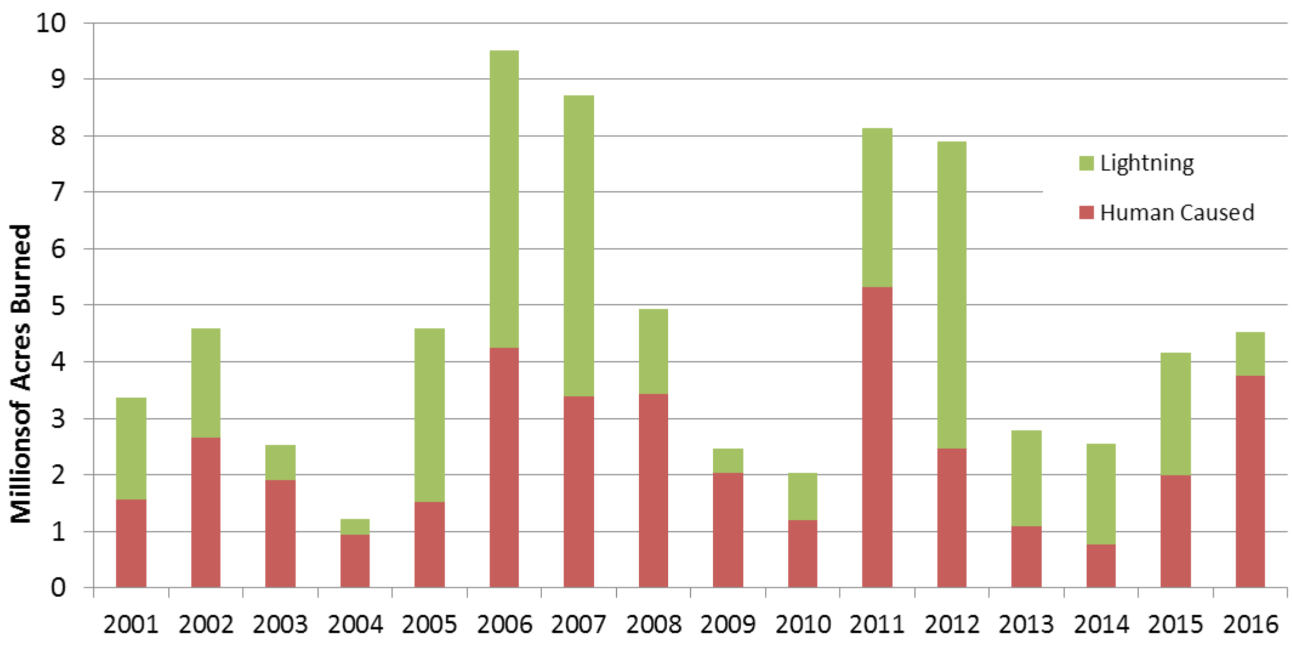

Figure 1. Acres burned by wildfire in the coterminous U.S.

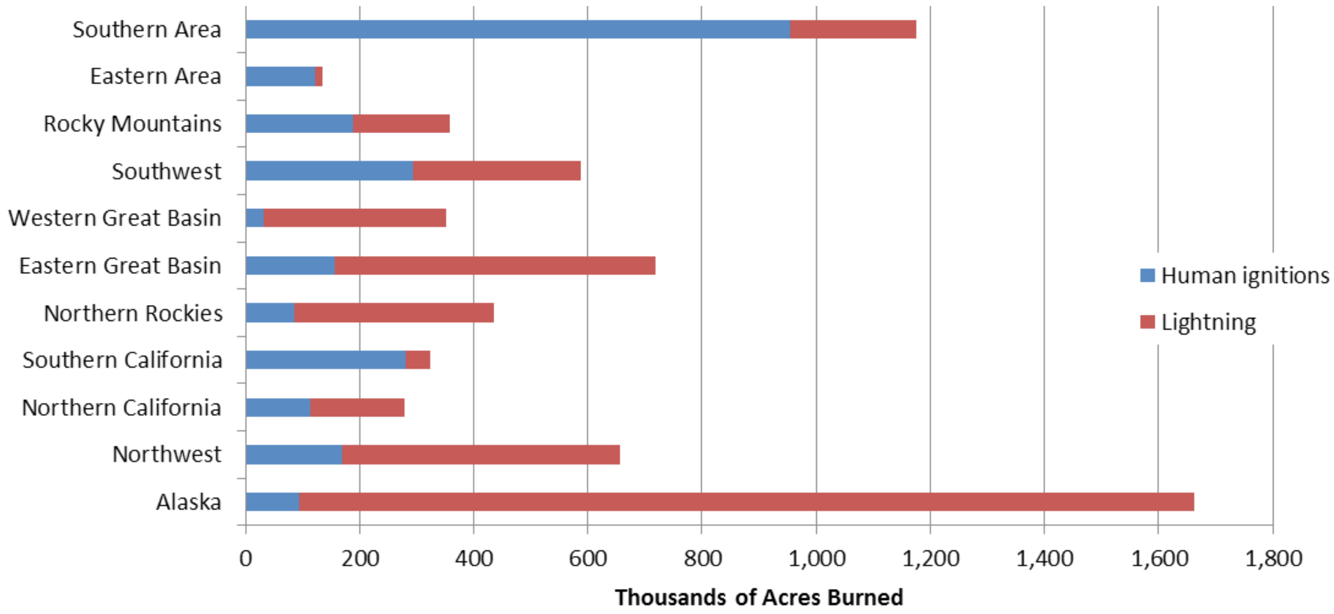

Figure 2. Average acres burned by wildfire in each region, by ignition source (2001 to 2016)

the 21st century, the western U.S. will be warmer and drier than it was during the 20th century, with warmer spring and summer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons (Westerling et al. 2006, IPCC 2007, Dominguez et al. 2010, Booz Allen Hamilton 2015). The warmer, drier climate will mean an increase in severity and acres burned by wildfires (Westerling et al. 2006, Westerling and Bryant 2008, Mitchell et al. 2014, An et al. 2015).

In New Mexico, people ignited nearly half (45%) of the wildfires since 2000, and these fires accounted for half (50%) of the acres burned by wildfire in the state during this period (Figure3; SWCC 2016). In years with a lot of wildfire, such as 2011 or 2006, human ignited wildfires often make up a larger percentage of the number of acres burned (71% in 2011 and 66% in 2006).

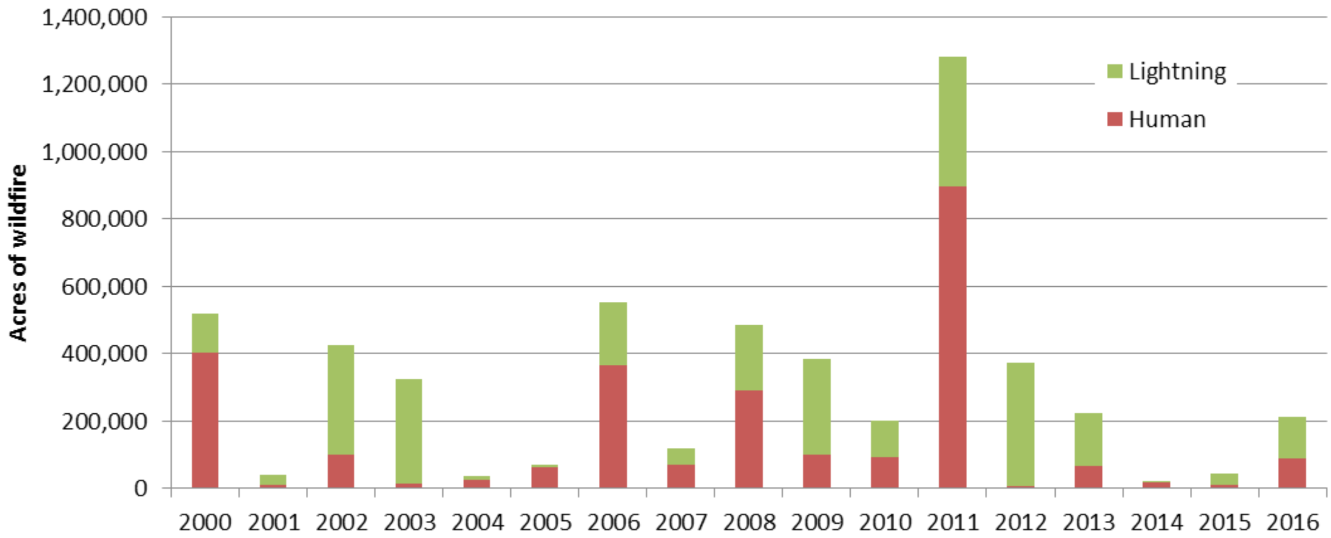

Figure 3. Acres of wildfire in New Mexico, by ignition source (SWCC 2016)

How are wildfires started by people?

People start wildfires in a wide variety of ways. Vehicle exhaust pipes, cigarette butts, and poorly extinguished campfires are all common causes for wildfires (Narayanaraj and Wimberly 2012). July fourth is the most common day for human-ignited wildfires to start, likely because of the incendiary power of fireworks (Balch et al. 2017). The primary source of human ignitions varies by ecoregion. For example, in marine coastal forest of Washington, agriculture is the important predictor of wildfire ignitions, while in the Great Basin and interior deserts, distance to railroads is more important (Fusco et al. 2016). In the east, the majority of human caused wildfires result from escaped fires from debris burning (Balch et al. 2017).

Data from the US Forest Service (USFS) provides insight into the relative impact of different types of human ignition. Abandoned campfires are the most common single source of human ignitions (Figure 4). On average since 2001, abandoned campfires have started 44% of the human-ignited wildfires in the Southwest (Arizona, New Mexico, and west Texas). The next most common category is miscellaneous, which accounts for an average of 36% of the human ignited wildfires in the Southwest since 2001. The Miscellaneous category includes a range of human sources such as power lines or electrical lines, burning vehicles, fireworks, 'highway', stove fuel sparks, and timber harvest slash burning.

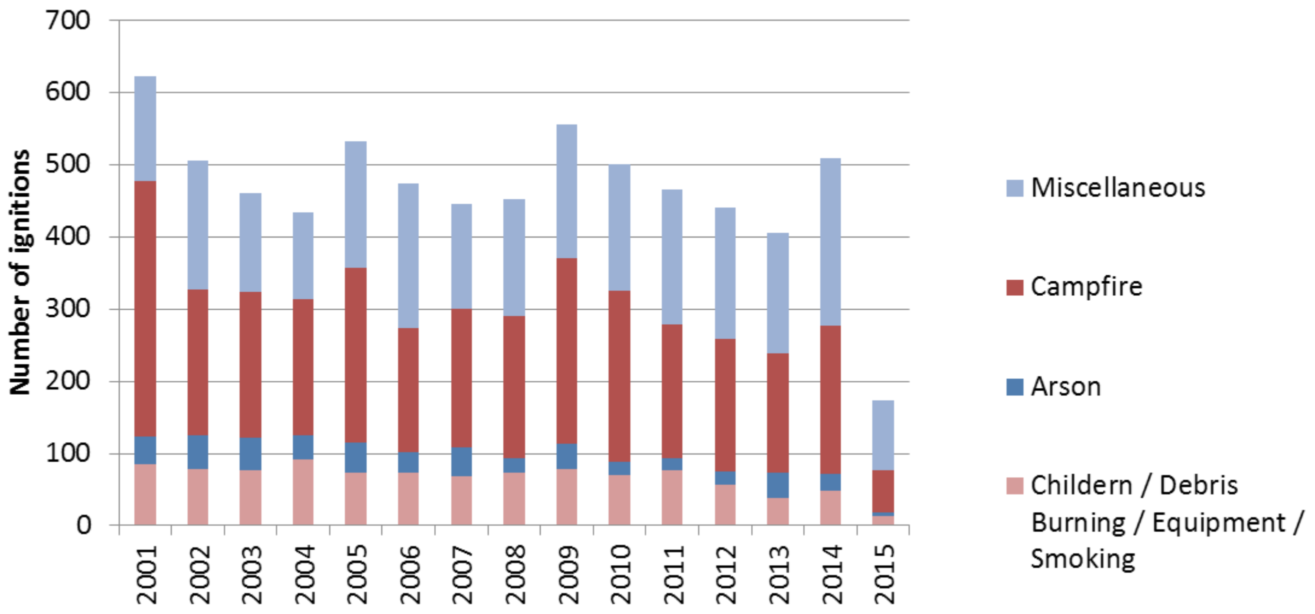

Figure 4. Number of wildfires, by type of human ignition in the Southwest (Arizona, New Mexico, and west Texas)

An examination of the sources of human ignition by acres rather than the number of ignitions shows that on average, wildfires in the Miscellaneous category have burned the largest percentage of the acres burned by human-ignited wildfire since 2001 in the Southwest (Figure 5). Fifty-eight percent of the human-ignited wildfires were in the Miscellaneous category and the next highest category was campfires at 37 percent of the human ignited acres burned. Organizing wildfires by acres burned highlights the importance of a few, very large fires. The Wallow Fire burned more than half a million acres after it was ignited by an abandoned campfire, which is more than the average number of acres burned by human-ignited wildfires over the past 15 years.

Humans can cause fires in a variety of ways, including equipment fires.

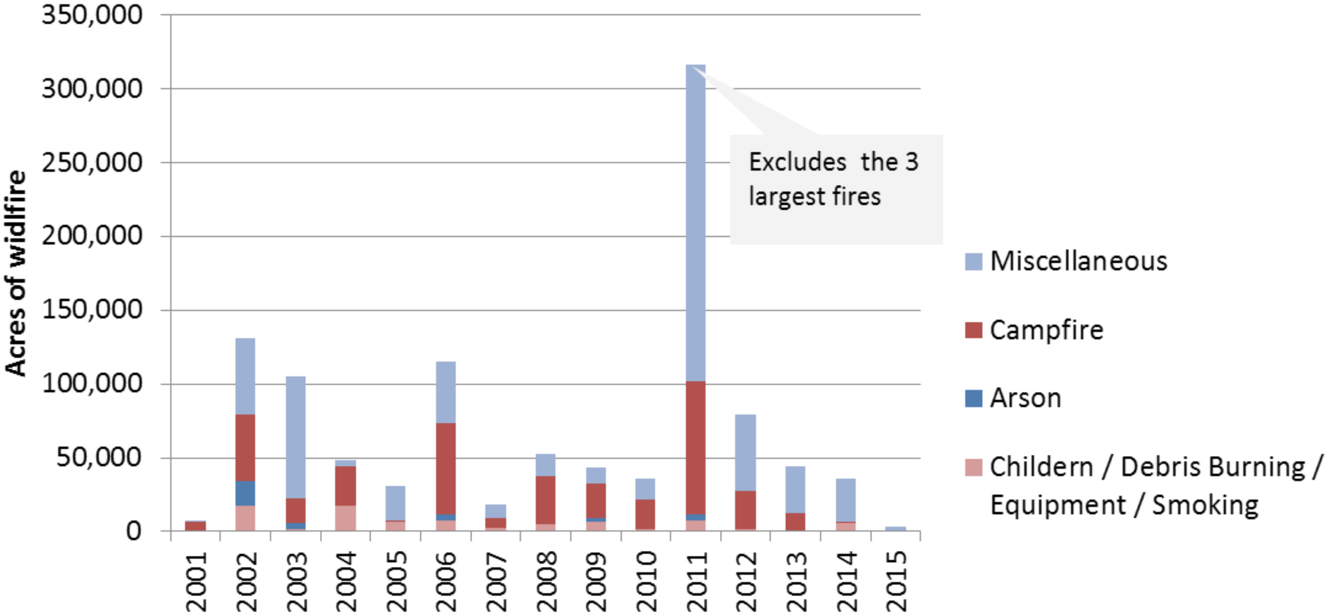

Figure 5. Acres of wildfire by, ignition source in the Southwest (Arizona, New Mexico, and west Texas) Figure 5 excludes a wildfire that burned through over 50,000 acres of grassland Texas in 2006 and the three largest fires of 2011, to better display the trends.

photo by Maine Forest Service

Campfires

Some the country's most devastating and costly wildfires have been started by campfires. For example, the 2016 Soberanes Fire in California was started by an illegal campfire and cost at least $229 million dollars to suppress (Branson-Potts 2016). Unattended campfires are common too. Over Memorial Day weekend in 2017, Santa Fe National Forest staff found 41 unattended campfires (Paskus 2017). Campfire and road ignitions may drive larger fires because of their locations. In contrast to lightning, which may be more likely on a ridge (and then burn down slope), human ignitions are often linked to roads and recreation sites in valleys. Fires that start in valleys or lower slopes can burn up slope easily and hence grow faster.

The potential for campfires to ignite wildfires has driven efforts to educate the public (e.g., Smokey Bear) and to restrict campfires. However, research suggests that campfire bans have limited effectiveness, perhaps because of the importance of campfires to people visiting the forest (Reid and Marion 2005). Campfires are a central part of many people's forest recreation. For example, a study found campfires were more important than many other campsite attributes including: campground host presence, campsite cost, availability of picnic tables, recreational vehicle hookups, or even restroom facilities (Lillywhite et al. 2013).

Campfires are an imortant part of recreation for many visitors, but escaped campfires are a major source of wildfire.

photos by
top: National Park Service
bottom: Zander Evans

Powerlines

A view of wildfire ignitions by the number of acres burned suggests that electrical lines deserve a separate category, since the total number of acres burned by powerlines (nearly 178,000 acres) is more than the sum of acres burned by wildfires ignited by arson, children, debris burning, equipment use, and smoking over 15 years. When a powerline is knocked down by a falling tree, the electrical current or sparks can easily start a wildfire. Electrical lines can also start wildfires when hot particles are produced by arcing powerlines or when burning embers are produced by the collision of high voltage power lines with surrounding trees (Tse and Fernandez-Pello 1998). The ignition of large wildfires by powerlines in the Southwest is a recent phenomenon. Three major wildfires in New Mexico since 2011 were caused by downed powerlines: the 2013 Tres Lagunas Fire, 2013 Thompson Ridge Fire and 2011 Las Conchas Fire (Evans 2014).

Downed powerlines are a significant fire threat.

Electrical lines are a significant source of wildfire ignitions in other parts of the country too. For example, power lines started three wildfires in San Diego County during the fall of 2008 (the Witch, Guejito, and Rice Fires), and these three wildfires killed 2 people, injured 40 firefighters, destroyed 1,141 homes, and burned more than 207,000 acres (Archibald 2008). A study in southern California found that electrical line wildfires can often be larger than wildfires caused by other types of ignitions because the high winds that can cause line faults also makes firefighting more difficult (Mitchell 2009).

While landowners and utilities are required to keep electrical lines right-of-ways clear, the job is immense. Thousands of miles of electrical lines run through the fire-adapted forests of the western US. Even where right-of-ways are maintained, setbacks may not be wide enough. In New Mexico, for example, easement widths are 10 feet on each side of the center for distribution lines and 20 feet in each direction for the higher voltage transmission lines.

photos by
top: County of Fairfax Virginia
bottom: Argonne National Labratory

Given that tree heights can be many times these easement widths, an inherent hazard exists along most powerlines strung through New Mexico's forests. The Jemez Mountain Electrical Co-op has 4,000 miles of distribution line, the Mora San Miguel Electric Coop has 1,900 miles, and Kit Carson Electric in Taos has 2,700 miles (Last 2013). Moreover, clearing right-of-ways to at least tree height on both sides would fragment forests, reducing habitat value and facilitating the invasion of exotic plants (Tittler et al. 2012), and threaten endangered species, thus requiring in depth environmental review.

Reducing the threat of electrical line-caused wildfire in San Diego county by replacing wooden poles with steel, installing heavier conductors, and upgrading substation cost nearly $500 million dollars (Johnson 2014). The Kit Carson Electric Cooperative spends about $400,000 a year on trimming trees along its distribution lines and estimated that burying lines costs $100,000 per mile (Last 2013). Recently, a jury found that Jemez Mountains Electric Cooperative and TriState Generation and Transmission Inc. distribution lines bear 95% of the responsibility for starting the 2011 Las Conchas Fire (Associated Press 2015). The costs of this negligence will likely be significant given that the Las Conchas Fire cost over $48 million dollars to suppress and may have incurred a total cost as high as $1.4 billion dollars (Walker et al. 2013). Given these costs and the threat of wildfire, it might be more cost effective to install solar panels to produce electricity for remote costumers and remove the electrical lines. This would reduce the risk of wildfire and the cost of annual right-of-way maintenance.

Trees on either side of right-of-ways often overtop electrical lines through the forest.

photo by Zander Evans

Arson

Arson is another consistent source of wildfire ignitions. Research suggests that arson ignitions are responsive to law enforcement actions, weather and climate, and labor market variables (Prestemon and Butry 2008). Wildfire hotspot modelling, which identifies high potential for arson, can help law enforcement efficiently allocate resources to reduce arson incidents (Prestemon et al. 2016). A review of research on wildfire arson identified seven key ways to reduce the problem (Prestemon and Butry 2008):

1. Reduce hazardous fuels and eliminate attractive hazards such as piled fuels.

2. Monitor weather and climate drivers of wildland arson success.

3. Monitor predictors of arson such as the socio-economic drivers of arson and other crime rates.

4. Increase law enforcement presence both as a deterrent and to raise the arrest rate.

5. Catch arsonists quickly and frequently by identifying arson hotspots in space and time.

6. Work with fire departments and fire suppression teams to reduce firefighter-set fires.

Hotspot modeling to identify areas of high arson potential can help law enforcement reduce wildfire threats.

photo by inciweb

Where do wildfires start?

Proximity to roads, energy infrastructure, and houses are good predictors of wildfire ignitions in human dominated landscapes (Cardille et al. 2001, Sturtevant and Cleland 2007, Syphard et al. 2008, Chas-Amil et al. 2015, Robinne et al. 2016). Human influences drive wildfire locations in regional studies across North America: New Jersey (Peters et al. 2013), California (Mann et al. 2016), Bristish Columbia (Camp and Krawchuk 2017), Alaska (Calef et al. 2008), Missouri (Yang et al. 2007), and Michigan (Bar Massada et al. 2013). However, areas of dense human development and expansive agriculture have a reduced probability of human-caused wildfire because roads, buildings, and irrigated agriculture do not burn well and fragment natural fuels (Parisien et al. 2012).

The connection between development and wildfire ignitions is important because so many people live in the wildland-urban interface (WUI). The most recent assessment estimated 190 million acres of WUI in the U.S., 44 million houses in the WUI, and 99 million WUI residents or 32 percent of the U.S. population (Martinuzzi et al. 2015). Not only is the WUI in the U.S. extensive, but it is growing rapidly; it grew approximately seven percent between 2000 and 2010 (Radeloff et al. 2005, Martinuzzi et al. 2015). Of course, this growth trend puts more people and homes at risk from wildfire too. The expansion of the WUI combines with the changing climate to increase the threat of wildfire (Syphard et al. 2007, Liu et al. 2015).

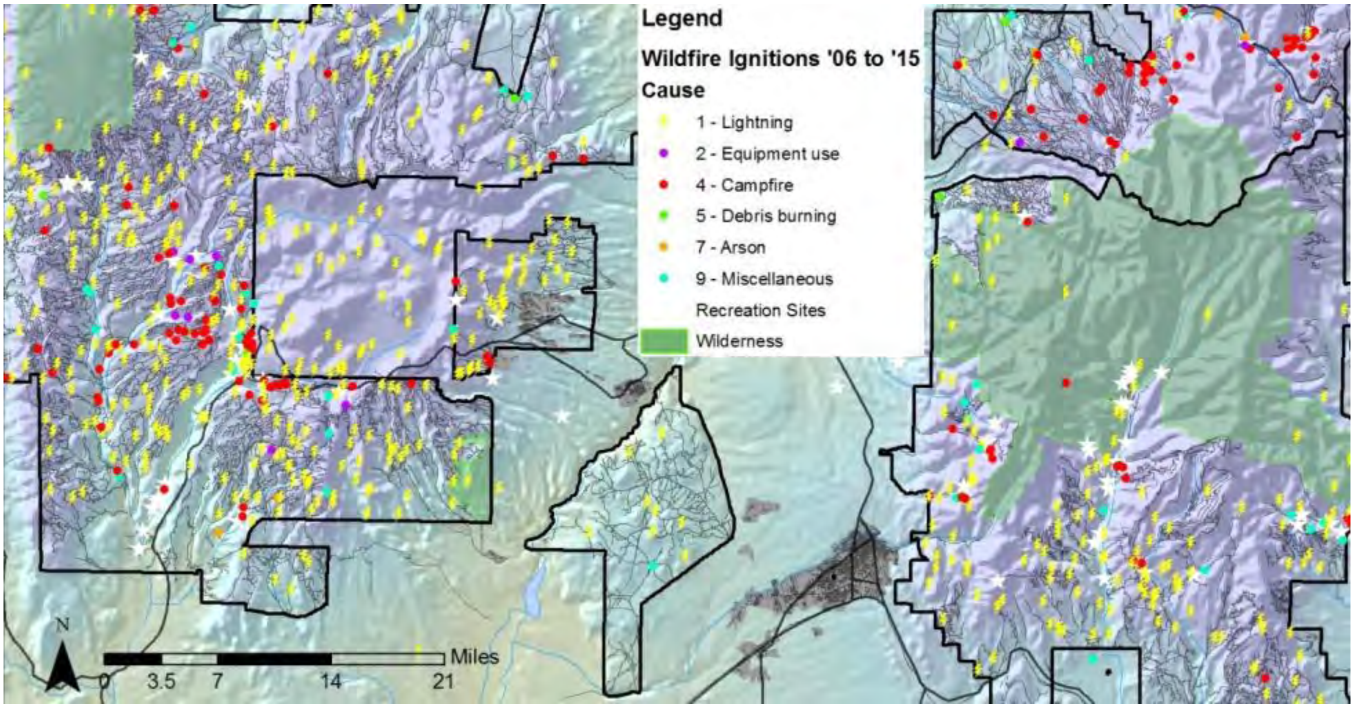

Figure 6. Map of wildfire ignitions by source from 2006 to 2015 on the Santa Fe and Carson National Forests

An analysis of the location of human-ignited wildfires (including equipment use, campfires, debris burning, arson, and other causes) shows that recreation sites and roads are related to human ignitions (Figure 7). Of the 3,644 human caused ignitions on National Forest land from 1980 to 2015, only six percent were, in wilderness areas compared to 23 percent of lightning ignitions that were in wilderness areas (Figure 7, first column). Thirty-six percent of human ignitions were within one mile of a recreation site, compared to only thirteen percent of lightning ignitions (Figure 7, second column). Ninety one percent of human ignitions were within a half mile of a road, and 77 percent were within a quarter mile of a road (compared to 65 and 48 percent respectively for lightning ignitions; Figure 7, third and fourth columns). For campfires, the relationship to roads is even stronger, since 80 percent of wildfires started by campfires are within a quarter mile of a road. Both the recreation sites and roads data come from the USFS geospatial database, and it is worth noting that the roads database includes small forest roads not passable by passenger vehicles. More knowledge about the spatial patterns of human ignitions presents the opportunity for targeted outreach and education, which is a cost effective way to reduce wildfire impacts.

Wildfire ignition sources, such as abandoned campfires, are more common closer to roads.

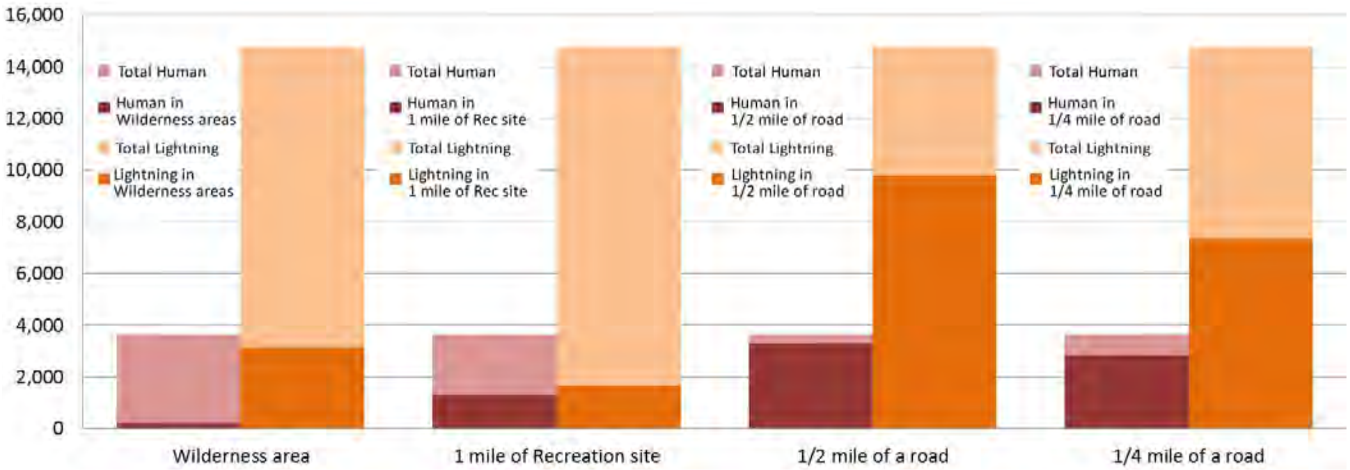

Figure 7. Comparison of the total number of wildfire ignitions to ignitions in specific areas on National Forest land in the Southwest from 1980 to 2015.

photo by Zander Evans

Public awareness of wildfire risk

Public awareness of wildfire threat to homes and communities

Many public awareness programs focused on wildfire are aimed at landowners and home mitigation work. Hundreds of millions of dollars have been invested in community wildfire protection plans, forest thinning (often called fuel reduction), and making homes more resistant to wildfire (Evans et al. 2015). Home mitigation programs that reduce the risk that homes will burn during wildfire are a central focus of public wildfire awareness campaigns, but the adoption of home hazard reduction practices often falls short of program goals (Brenkert-Smith 2011). The limitations of efforts to inspire homeowners to take action and reduce wildfire threat have implications for campaigns to reduce human ignitions.

Research has uncovered a number of reasons why residents do not take steps to reduce risk from wildfire, including not wanting to cut trees, risk perceptions, wildfire knowledge, and economic issues (Collins 2005). Residents who are knowledgeable about wildfire risk are motivated to take action based on their perceptions of risk severity (Martin et al. 2007, McCaffrey et al. 2011). Perceptions of wildfire risk are also influenced by individual's assessments of the costs and benefits of a particular measure (McCaffrey 2015). Neighbors can be the crucial factor that determines whether a resident will take steps to mitigate wildfire hazard (Brenkert-Smith 2010, Dickinson et al. 2015). When local fire departments and county wildfire specialists share information with residents about hazard reduction, it can also help motivate mitigation activities (Brenkert-Smith et al. 2012). A crucial caveat is that there is great variety in WUI residents. Programs, ideas, and solutions are unlikely to work across all community contexts or for all WUI residents (Brenkert-Smith 2011, Stidham et al. 2014). The information sources that residents find most useful and the factors that motivate residents to take hazard reduction measures vary significantly by location (McCaffrey et al. 2011).

photo by Environmental Protection Agency

Seasonal homes make up about 10 percent of the homes in the WUI across the coterminous U.S. In New Mexico, there are an estimated 29,000 seasonal homes in the WUI (Martinuzzi et al. 2015). These seasonal homes and the part-time residents who live in them are an important part of the hazard reduction equation. All residents need to participate in efforts to reduce wildfire threats and sources of ignitions; however, part-time residents may be less likely to take mitigation actions than full-time residents (Collins and Bolin 2009). Often, it is more difficult for part-time residents to find the time to implement fuel reduction activities than it is for full-time residents (Bright and Burtz 2006). Interactions with their full-time-resident neighbors is a key link between part-time residents and their community (Brenkert-Smith 2010).

Research on why residents take action to reduce wildfire threat suggests that increasing people's perception of the severity of the risk of human ignitions might motivate them to take action. Similarly, the positive influence that neighbors and local firefighters have on WUI risk reduction might be beneficial for campaigns to reduce human ignitions. Infrequent visitors to the forest may need different or greater engagement to raise awareness of human ignitions, just as WUI risk reduction efforts may look different for part-time residents.

Both seasonal and full-time WUI residents are attracted to the trees, wildlife, quiet, privacy, views, and recreational opportunities linked to the wildland (Nelson et al. 2004). The natural environment and seclusion that attracts WUI residents can also add to the risk of human ignitions. The trees that provide privacy can become fuel for wildfires. Activities around WUI residences such as smoking, outdoor cooking, fires, or parking cars on dry grass are potential sources of wildfires just as those activities are on public lands.

Homes in the wildland-urban interface are at risk of wildfire and can be a source of wildfire ignitions.

More homes and cabins in the wildland also mean more powerlines.As noted earlier, powerlines are a significant source of human-ignited wildfire. Moreover, at least in some cases the maintenance and protection of lines from the road to the building are a homeowner's responsibility and a source of wildfire risk.

photos by
top: inciweb
bottom: Michigan DNR

Public awareness of the risk of wildfire ignitions

Public awareness of wildfire ignitions overlaps with efforts to raise awareness of wildfire risk but includes a larger population. Rather than just targetting residents of the WUI, awareness campaigns for wildfire ignitions must include all visitors to forests or natural areas. Prevention education used in combination with fuel reduction is effective in minimizing the costs and losses from unintentional wildfires (Butry et al. 2010). In a study of Bureau of Indian Affairs tribal units, prevention activities led to significant reductions in wildfires caused by escaped campfires, juveniles, fire-use (e.g. escaped debris burns), and equipment, and these program benefits were 4.5 times greater than the costs (Abt et al. 2015). For example, a prevention program might cost one million dollars, but would avoid a wildfire that would cost $4.5 million to suppress. Wildfire prevention education efforts significantly reduced the numbers of wildfires ignited by debris burning, campfire escapes, smoking, and children in Florida (Prestemon et al. 2010). In the Florida example, the additional reduction in wildfire damages was 35 times greater than the additional cost of prevention education.

Burty and colleagues (2010) highlight that wildfire prevention education programs are more flexible, in both time and space, than fuel reduction treatment. Prevention programs can respond to unexpected wildfire outbreaks, but longevity of their effect on wildfire ignitions is limited (Butry et al. 2010). In general, prevention programs most likely to be effective are those that give people information and tools that enhance their perception of their power, as individuals, to prevent wildfires. (Bates et al. 2009).

While recent research on prevention programs will help improve their effectiveness (e.g., Butry et al. 2010, Prestemon et al. 2010, Abt et al. 2015, Prestemon et al. 2016), there are notable research gaps. For example, while the USFS provides detailed guidance on how to erect fire danger rating signs (e.g., NWCG 2005, USFS 2008), there is little research on the effectiveness of these signs or comparison between sign designs or messages. In fact, some signs designed to raise awareness of the risks of unattended campfires may cause more confusion than awareness. For example, the sign with a shovel and bucket bearing the message 'Required for camping" has been confused with a message about wilderness hygiene. The sign is designed to emphasize the importance of coming prepared with the right tools whenever lighting a campfire, but this crucial message may not be obvious to everyone.

The most recent investigation into the effectiveness of wildfire prevention signs appears to have been more than 40 years ago.

The most recent investigation into the effectiveness of wildfire prevention signs appears to have been conducted more than 40 years ago (Folkman 1966, 1973). Some sign design and placement advice is common sense, for example "Place signs where they provide adequate time for viewer response, considering such things as approach, speed, and road conditions" (NWCG 2005). However, given the advancements in advertising and marketing over the last 40 years, wildfire prevention signage could benefit from additional research.

photo by Sam Berry

Smokey Bear and US Forest Service Prevention Budgets

Since its creation over 100 years ago, the USFS has led the federal effort to raise awareness on how to avoid wildfire ignitions. A central part of the USFS public awareness campaign has been Smokey Bear. Smokey Bear and the slogan 'Remember, only you can prevent forest fires' is often cited as the most successful public awareness campaign ever (Dombeck et al. 2004). The Smokey Bear campaign grew out of campaigns for conservation during World War II. The power of the Smokey Bear campaign grew with the identification of a living mascot in 1950 and the national Smokey Bear Act of 1952. The Smokey Bear program is administered by the USDA Forest Service, the National Association of State Foresters, and the Ad Council. The Smokey Bear campaign has reached out through radio, newspapers, television, posters, pamphlets, calendars, coloring books, comic books, and many other mediums. For example, in 1979, $1 million dollars' worth of materials was sent out, TV and radio spots generated four billion home impressions, and $55 million dollars' worth of advertising space was donated (McNamara et al. 1981). By Smokey Bear's 70th birthday in 2014, the Ad Council totaled more than $1.4 billion in donated time and space from media companies and reported that 96 percent of the U.S. adult population recognized Smokey Bear (Ad Council 2017).

Though the Smokey Bear program is ubiquitous, actual dollars for the USFS to raise awareness about wildfire ignitions are limited. The USFS has spent about $1.3 million dollars each year managing the Smokey Bear program. The money available from Smokey Bear licensed products has been at a $54,000 program level for the last several years (USFS 2016) and is mainly used for special projects such as the annual Smokey Bear Awards or Smokey Bear's birthday events. The National Wildfire Prevention Program has an annual budget of $95,000 and one full time staff person to help coordinate national awareness efforts.

photo by
National Agricultural Library

In comparison, the overall wildfire preparedness budget was $1.1 billion in fiscal year 2016 (USFS 2016). Wildfire preparedness also includes "planning, prevention, education, information technology development, training, advancement of firefighting technology, and organizational learning through program review" (p. 273 USFS 2016). USFS asserts that for every one dollar reduction in preparedness funding there is an increase of $1.70 in suppression costs (USFS 2016). Had investments been made to prevent the escaped campfire that caused the Wallow Fire, over $100 million in suppression and immediate post-fire rehabilitation could have been avoided.

There are 400 wildfire prevention technicians listed in the USFS budget (or about five percent of the total number of full-time equivalent employees in the preparedness budget line item). These technicians combine firefighting with public awareness job duties. Their prevention activites include:

• Presenting the role of fire in ecosystems management educational programs.

• Helping present fire prevention programs in local schools and at community events.

• Conducting routine inspections of areas such as electrical/electronic sites, power lines, resorts, camps, and developed facilities.

• Identifying, collecting, and preserving evidence in the probable cause of wildland fires.

During active wildfire seasons, the duties of fire suppression are likely to eclipse routine inspections and education programs. At the regional level, many of the Wildfire Prevention Coordinator positions are currently vacant or the tasks are assigned to someone in another position.

The reduction in wildfire damages was 35 times greater than the additional cost of prevention education.

The USFS has developed National Fire Prevention Education Teams that can be sent to areas that are experiencing higher-than-normal wildfire danger or a high incidence of human-caused wildfires. These teams supplement and support the wildfire prevention efforts of local personnel and agencies by facilitating community awareness, coordinating interagency closures, and engaging local agencies, fire departments, businesses, citizens and civic and homeowners organizations. These teams are paid for through the wildland fire management budget.

The State Fire Assistance (SFA) program is another important part of the USFS investment in wildfire prevention. The SFA focuses on mitigating the risk of wildfire in communities, particularly those communities taking an active role in preparing and planning for wildland fire. The SFA budget for wildfire prevention program has averaged $3.2 million over the last five years (Figure 8).

The rest of SFA $78 million program budget is invested in national wildfire awareness and preparedness programs, assistance to states, and support for firefighting resources. SFA provides crucial support for national wildfire awareness programs such as the Fire Adapted Communities Learning Network and the Ready, Set, Go! Program. In fiscal year 2015, SFA invested $15.9 million in preparedness activities (USFS 2016). SFA also funded training for 127,186 firefighters and nearly $6 million in the purchase, maintenance, and rehabilitation of firefighting equipment.

Regional and local efforts to raise awareness of wildfire ignitions

The regional offices of federal agencies and state agencies are also engaged in raising awareness about preventing wildfire ignitions. Their efforts are harder to track because they are usually not paid for from a specific public awareness budget. Rather, they are put together with funding for related programs and through partnerships. The One Less Spark campaign is a good example of this type of awareness program (www.readyforwildfire.org/One-Less-Spark-Campaign/). The One Less Spark program focuses on ignition sources including outdoor equipment use, debris burning, and ignitions from vehicles. To create the One Less Spark campaign, the USFS partnered with National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Bureau of Reclamation, and state agencies such as CALFIRE. Another example of prevention efforts initiated at the local level is a program that placed small flyers about campfire safety directly in fire rings in recreation areas.

Figure 8. State Fire Assistance Budget and Public Education Programs

photo by US Forest Service

Restrictions and Forest Closures

One response to temporary periods of heightened wildfire risk and increased probability of human ignition is the tightening of restrictions or complete forest closure. Targeted or temporary restrictions are also used to reduce wildfire risk. For example, in 2016 the Governor of New Mexico urged municipal officials to ban firewoks before Independence Day because of dry conditions. Municipalities responded with restrictions like those in Bernalillo County, which banned the use of all fireworks in the unincorporated areas in the mountains and along the Rio Grande Bosque with fines up to $1000 and less than one year in jail (Rivera 2016).

State and federal managers can use graduated restrictions to respond to heighted risk. Stage I fire restrictions limit fire, campfire, charcoal, coal, or wood stove, to developed recreation sites and prohibit fireworks. Stage II fire restrictions prohibit any fire or campfire, stove fire, smoking, operating a chainsaw, running equipment powered by an internal combustion engine, or using a motor vehicle off roads.

Stage III fire restriction is forest closure. Agencies view forest closures as a last resort because their impact on communities and recreation (SWCG 2014). For example, a 60 day closure of New Mexico forests in 2001 cost an estimated $479 million loss in state output (Starbuck et al. 2006). The current interagency plan for fire restrictions states that fire danger alone does not justify closures and that other important factors in determining closures include the life and safety risks from wildfire; high potential for human-caused fires; potential high-risk occasions (4th of July, etc.); severe shortages of resources; and large fires burning in other locations (SWCG 2014). Land management agencies in the Southwest have made a concerted effort to ensure consistency in restrictions and closures. Lack of consistency leads to public confusion and disparities in risk between land management agencies. In the Southwest, there are seven zones that include a range of federal, tribal, and state open space. A Zone Restriction Coordinator, chosen by the Agency Administrators and Tribal Chairpersons within the zone, works with fire managers to simultaneously initiate restriction. Similar procedures are in place for lifting restrictions to avoid responding to small fluctuations in risk, weather, and fire danger, which could result in confusion and lack of support from the public (SWCG 2014). A recently developed website tracks fire restrictions in order to improve awareness (www.firerestrictions.us/nm/).

photo by US Forest Service

Conclusion

Large, high severity fires are becoming more common, and the warming, drying climate is making conditions ideal for these devastating fires. On average in the U.S., human-caused wildfires burn over half of the total acres burned by wildfire in a given year. Even in the Southwest where lightning ignites many wildfires, people are responsible for many of the largest, most severe fires.

To effectively reduce the wildfires caused by people, prevention efforts should recognize the variation in how and where people start wildfires. People start wildfires with their vehicles, cigarette butts, campfires, fireworks, debris burning, powerlines, arson, and other activities. Prevention should be tailored to the mode of ignition. For example, awareness campaigns may be more effective for reducing campfire ignitions but not arson or powerline wildfires. Data from the Southwest shows the impact of abandoned campfires, which account for 44% of the human caused wildfires since 2001. Research suggests that campfire bans have limited effectiveness because of the particular importance of campfires to people recreating in the forest. However, 80 percent of wildfires started by campfires are within a quarter mile of a road. This analysis combined with local knowledge may suggest ways to target outreach to people likely to build campfires.

Wildfire prevention program effectiveness should be monitored. Recent academic research in Florida suggests that prevention campaigns are a good investment, but in general, there appears to be a lack of monitoring to establish effectiveness. Admittedly, linking prevention efforts to changes in area burned by human-caused wildfire is difficult because of other factors such as weather. However, intermediate measures such as numbers of abandoned campfires versus numbers of forest visitors could demonstrate effectiveness. The lack of hard data on the ability of prevention efforts to reduce wildfires may be in part responsible for the small size of the USFS budget allocated to prevention.

The tremendous cost of large, high-severity wildfires justifies much greater investment in prevention. Research has shown that the reduction in wildfire damages can be as much as 35 times greater than the cost of prevention education. A dramatic increase in the National Wildfire Prevention Program could significantly reduce the number of wildfires each year. Prevention messaging can be integrated into successful programs, such as Firewise or Fire Adapted Communities, that include the many facets of communities' relationship to fire. Linking human-caused ignitions to the risk WUI residents face could help build a strong group of advocates for wildfire prevention. Since people cause wildfires, we also have the power to prevent those wildfires.

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Resources

- **Statistics on human caused wildfires** www.nifc.gov/fireInfo/fireInfo_stats_human.html
- **One Less Spark Campaign** www.nmfireinfo.com/links/outdoor-fire-safety/one-less-spark
- **Ready, Set, Go!** www.readyforwildfire.org/Ready-Set-Go-Campaign
- **Fire Adapted Communities – New Mexico** www.fireadaptednm.org
- **Current fire restrictions** www.firerestrictions.us/nm

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