BRUSH, GRASS, AND FOREST FIRES

Marty Ahrens

November 2013

National Fire Protection Association
Fire Analysis and Research Division

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Abstract
Based on data from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey, NFPA estimates that during 2007-2011, local fire departments responded to an average of 334,200 brush, grass or forest fires per year. In most, less than one acre burned. These incidents accounted for 24% of all fires reported to local fire departments. This study examines the circumstances and causal factors of: a) brush or brush and grass mixture fires; b) grass fires; c) forest, woods, or wildland fires; and d) total brush, grass, and forest fires, including unclassified natural vegetation fires. One in five was intentionally set. The most common heat source was a hot ember or ashes. Open burning, high winds, and smoking materials were also frequent factors. Lightning accounted for a larger percentage of forest, woods, or wildland fires than the other types of natural vegetation fires.

Keywords: fire statistics, natural vegetation fires; brush fires, grass fires, wildland fires; forest fires; mulch fires.

Acknowledgements

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS. We would also like to thank the National Interagency Fire Center for providing so much information about wildland fires handled by state and federal agencies.

For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7443.

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Executive Summary

Fires in the wildland/urban interface have often been in the news in recent years. Nine of the 25 costliest (in terms of property loss) fires in U.S. history were described as forest, wildland or wildland/urban interface fires. The eight costliest fires were in the last two decades. Federal or state agencies are typically involved in these massive fires. The term wildland/urban interface (WUI) is typically used to describe areas where extensive vegetation mixes with numerous structures and their inhabitants. WUI fires of note often begin and grow large in the vegetated areas before spreading to structures.

Many people do not realize how often local (municipal or county) fire departments around the country are called to smaller brush, grass and forest fires.

During 2007-2011, local fire departments responded to an estimated average of 334,200 brush, grass, and forest fires per year. This translates to 915 such fires per day.

- Only 10% of these fires were coded as forest, woods, or wildland fires;
- Two of every five (41%) were brush or brush and grass mixtures;
- More than one-third (37%) were grass fires; and
- 13% were unclassified forest, brush or grass fires or unclassified natural vegetation fires.

In three-quarters (76%) of the brush, grass, and forest fires handled by local fire departments, less than an acre burned. Only 4% burned more than ten acres. Fires in forests tended to be larger than other vegetation fires. Only three-fifths (59%) of the forest fires were less than an acre, while 9% consumed more than ten acres.

These statistics are derived from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey. Fires handled by federal and state wildland fire agencies are generally not included in these statistics unless they were also reported to a local fire department.

Regional differences are seen in the overall frequency of these fires and in rates per 1,000 square miles. The rate is based on total area without regard for ownership.

- More than half (57%) of total brush, grass, and forest fires handled by local fire departments were in the South, as were 51-67% for each of the four types of vegetation fires listed above. The South also had the highest rate of total brush, grass, and forest fires per 1,000 square miles overall, as well as the highest rate for grass fires and forest fires specifically. It ranked second in brush or brush and grass mixture fires.
- One of every five (18%) brush, grass or forest fire responses handled by local fire departments occurred in the Midwest. The Midwest ranked second in all four of the specific types of vegetation fires and third on all measures of brush, grass or forest fires per 1,000 square miles.
- The Northeast covers the smallest geographic area of the four census regions. Not surprisingly, the number of all types of brush, grass and forest fires that occurred in the Northeast was lower than the other regions. However, the Northeast led the country in

the *rate* of fires involving brush or brush and grass mixtures per 1,000 square miles. The Northeast had the second highest rate for total brush, grass, and forest fires and forest woods or wildland fires and grass fires specifically.

- Local fire departments in the West ranked third in the percentage of U.S. brush, grass, and forest fires handled, but they had the lowest rate of fires per 1,000 square miles for all the fire categories studied. Although most of the largest wildland fires were in the West, many of these were on lands owned by the federal government and are not protected by local fire departments.

Brush, grass and forest fires endanger much more than other brush, grass and forest land. One indication can be seen in the property use codes recorded for these fires. In many cases, the property use codes describe places where people, buildings, and vehicles would be expected to be nearby. Roughly one-third (35%) of these fires occurred in open lands or fields. One in six (16%) occurred on highways, streets or parking areas. Ten percent, or an average of 32,200 fires per year, occurred at one- or two-family homes.

The important point is that these fires often occur on properties where people live, work, or travel. A brush, grass, or forest fire can spread to buildings or vehicles on the property. A fire that starts outside a building can get into the concealed spaces between the exterior and interior. A fire inside the wall or attic space may not activate smoke alarms or sprinklers until it gets into the living space.

Prevention and Mitigation Strategies

There are two important goals in fire prevention and fire protection. The first is to prevent unwanted fires from starting in the first place. The second goal is to minimize the probability that a fire, once started, will cause serious harm. NFPA's Firewise program helps people who live in wildland-urban interfaces protect their homes from wildfire. Many of the same strategies can reduce the likelihood of structural ignition or fire spread from brush, grass or forest fires around the country. Vegetation, landscaping, and garden materials can be fuel sources for fires in a wide variety of settings.

To prevent fires, it is necessary to know how they typically start. The leading causes of, or factors contributing to, brush, grass and forest fires were: intentional (20%); hot embers or ashes (16%); outside fires for debris or waste disposal (14%); high wind (14%); smoking materials (11%); playing with heat source (5%); fireworks (4%); lightning (4%); spark, ember or flame from operating equipment; and electrical power or utility lines (4%). The cause profile varies by type of fire and the material first ignited. Lightning caused 16% of the forest fires but only 4% of all brush, grass and forest fires. Because the causes are pulled from different NFIRS fields, they are not mutually exclusive.

Prevention strategies are relatively easy to identify for some of the causes. Be sure that smoking materials are disposed of properly in fire-resistant containers. Provide metal containers for cigarette disposal to prevent them from being tossed on the ground. If you have a campfire or bonfire, be sure it is completely out. Avoid outside fires on dry or windy days. When using equipment or mowing lawns, minimize sparks and avoid such activities when the fire risk is high. Leave fireworks to the professionals. Keep matches and lighters away from children.

To protect your home or property from potential fire spread from a brush, grass or forest fire, reduce the available fuel on and around the home. In particular, keep plants that burn fast and hot away from the structure. Get rid of dead branches, leaves, brush and tree limbs that hang over your home. Use gravel or some other non-combustible material next to the building instead of an organic mulch. Ensure the home itself is as ignition-resistant as possible by choosing non-flammable roofing, fire-resistant siding, screened or ember-resistant vents, and attachments (fences, decks, porches) that are fire-resistant or modified to keep from carrying fire to the main structure.

Most people have a long list of things to do around home and yard and not enough time to do them in. Landscaping to reduce the threat of fire can pay off in additional ways. Some of these techniques also increase the security of your home. In their information on crime prevention through environmental design, the Seattle Police Department recommends a maximum height of three feet for hedges and a minimum height of eight feet for tree canopies, particularly in areas close to doors and windows. This approach provides fewer hiding places. Higher tree canopies make it less likely that a fire that starts on the ground will reach the branches. Keeping tree branches, vegetation, and mulch away from siding or roof can not only limit fire spread, it can help keep carpenter ants out of the home.

Many of us would like to have a more natural yard to make our lands more attractive to birds and pollinators. It is important to remember fire safety in the process.

Safety Tips to Prevent Brush, Grass, and Forest Fires

General

- Place cigarette butts in metal containers. Do *not* throw them on the ground or into vegetation.
- Leave fireworks to the professionals. Do not use consumer fireworks.
- Follow the recommendations at www.firewise.org to make your home and landscaping more resistant to fire, specifically "How to Have a Firewise Home."
- Reduce the risk from sparks by being sure nothing is dragging from your vehicle, keeping tires properly inflated, and being careful when using lawn mowers or other equipment. Get more information at http://www.preventwildfireca.org/OneLessSpark.
- Don't let a target shooting hobby start a wildfire. Avoid steel bullets outside as they can spark when they hit rocks or other hard objects. Observe all laws and restrictions about where, when and what to shoot.

Outdoor burning

- Be aware of, and comply with, any local ordinances or permit requirements pertaining to outdoor or open air burning. This includes campfires, brush fires, fire pits, chimineas, and outdoor fireplaces. You may not be permitted to do outdoor burning in some municipalities and during some seasons.
- Closely attend all outdoor fires. Be sure to put out the fire completely before leaving.
- Avoid burning on windy, dry days. When conditions are windy or dry, it is too easy for open burning to spread out of control.
- Do not use gasoline or other flammable or combustible liquids to burn brush, trash, or other waste.

National Fire Protection Association

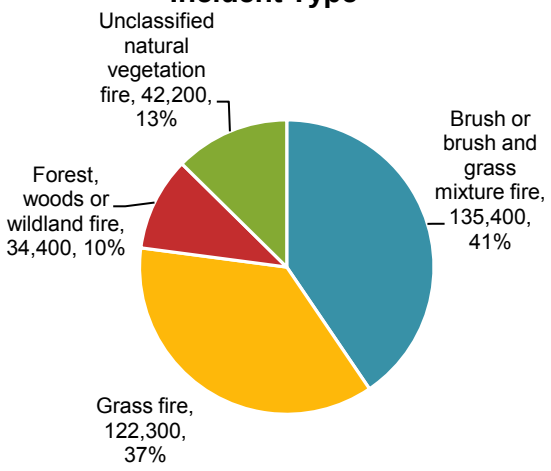
Fire Analysis & Research

Local Fire Department Responses to Brush, Grass or Forest Fires in 2007-2011 Fact Sheet

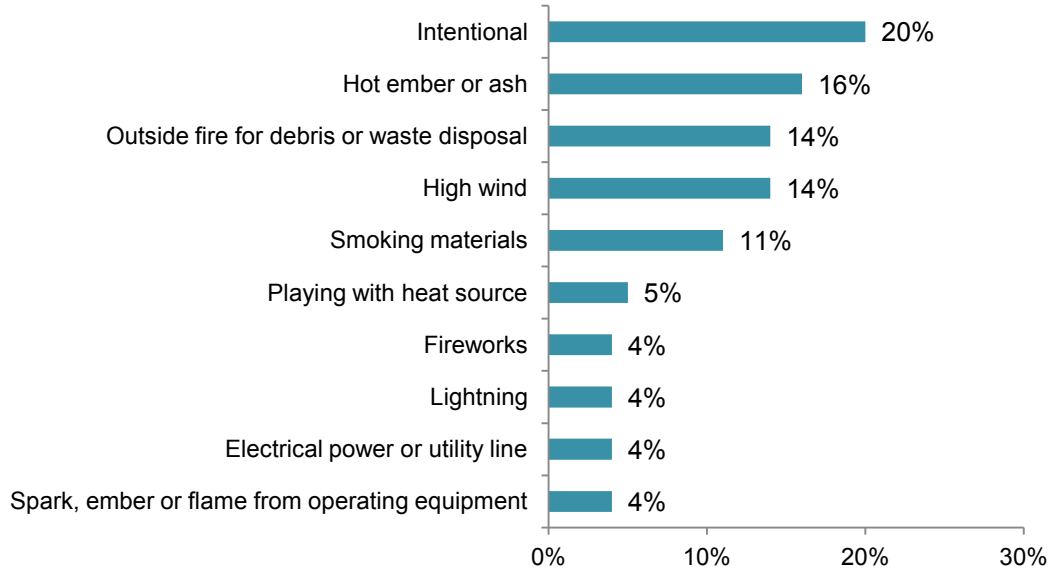
During the five-year period of 2007-2011, local (municipal or county) fire departments responded to an estimated average of 334,200 brush, grass, and forest fires in the U.S. per year.[1]

- Two of every five (41%) were brush or brush and grass mixtures. More than one-third (37%) were grass 13% were unclassified forest, brush or grass fires or unclassified natural vegetation fires.
- On average, 915 brush, grass, or forest fires were reported per day.
- These incidents accounted for 24% of all fires reported to local fire departments.
- Less than an acre burned in three-quarters (76%) of these fires. Only 4% burned more than ten acres.
- Ten percent, or an average of 32,200 fires per year, occurred at one- or two-family homes.

Brush, Grass and Forest Fires by Incident Type



Brush, Grass and Forest Fires by Major Causal Factors and Type of Fire



Overall, one in five of these fires were intentionally set.

Other leading factors include hot embers or ashes, open burning of debris, high winds, and smoking materials.

Lightning caused 16% of the forest, woods or wildland fires, but only 4% of overall brush, grass or forest fires.

[1] Fires handled by the federal and state wildland fire agencies are not included in these statistics unless they were also reported to a local fire department.
The full report may be downloaded from http://www.nfpa.org/assets/files//PDF/OS.BrushGrassForest.pdf

Brush, Grass, and Forest Fires

In recent years, fires in the wildland/urban interface have often been in the news. Fire is a natural phenomenon and a necessary part of many natural habitats; it becomes a problem when it impinges on inhabited areas. The term wildland/urban interface (WUI) is typically used to describe areas where extensive vegetation mixes with numerous structures and their inhabitants. WUI fires of note often begin and grow large in vegetated areas before spreading to structures.

Nine of the 25 costliest fires in U.S. history were described as forest, wildland or wildland/urban interface fires. The eight costliest such incidents occurred since 1990.[2] Federal or state agencies were typically involved in fighting these massive fires. Fortunately, these fires did not have the huge losses of life seen in the late 19th and early 20th centuries. The four deadliest wildland fires in US history, each killing between 170 and 1,200 people, occurred between 1880 and 1920. [3]

Federal or state agencies are typically involved in fighting the largest wildland-related fires. Many people are unaware of how often local fire departments around the country are called to much smaller brush, grass and forest fires. Most of the analysis that follows focuses on fires handled by local fire departments. Information obtained from the National Interagency Fire Center's website about wildland fires handled by state and federal wildland agencies is also included toward the end of the report.

Fires Reported to Local Fire Departments

334,200 brush, grass, and forest fires, on average, were reported to local fire departments annually.

During the five-year period of 2007-2011, local U.S. fire departments responded to an estimated average of 334,200 brush, grass, and forest fires per year. Crop and cultivated vegetation fires are excluded from these statistics, as are plant fires occurring in or on structures. On average, 915 brush, grass, or forest fires were reported per day. These incidents accounted for one-quarter (24%) of all fires reported to local fire departments and half (49%) of the outside and unclassified fires. These estimates were derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and NFPA's annual fire department experience survey. See the text box on the following page and the Appendix for more details.

Figure 1 shows that the 334,200 natural vegetation fires reported per year include an average of:

- 135,400 (41%) brush or brush and grass mixture fires;
- 122,300 (37%) grass fires;
- 34,400 (10%) forest, woods or wildland fires; and
- 42,200 (13%) natural vegetation fires that were not classified further.

"Natural vegetation fires" is a term used to describe brush, grass, or forest fires regardless of their causes.

[2] NFPA. "The 25 Largest-Loss Fires in U.S. History," September 2012. See Appendix A. Losses refer to direct property damage and were adjusted for inflation.

[3] NFPA. "The 10 Deadliest Wildland Fires in U.S History," October 2013. See Appendix B.

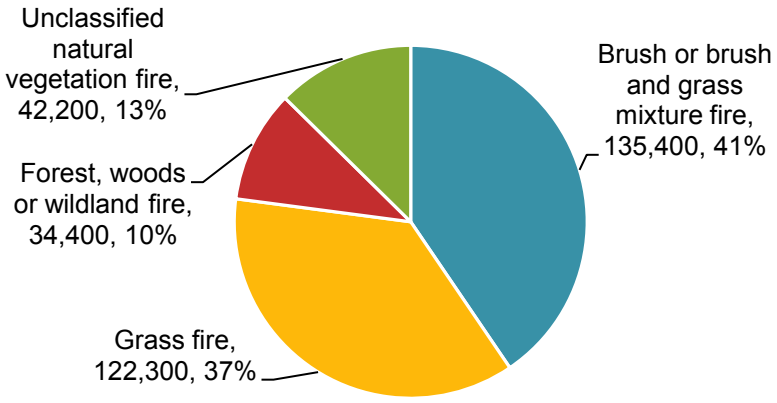
Data Sources, Definitions and Conventions Used in this Report

Unless otherwise specified, the statistics in this analysis are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. These estimates are projections based on the detailed information collected in Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS 5.0) and the National Fire Protection Association's (NFPA's) annual fire department experience survey. Except for property use and incident type, fires with unknown or unreported data were allocated proportionally in calculations of national estimates.

NFIRS incident type codes 140-143 capture natural vegetation fires, including forest, grass, and brush or brush and grass mixture fires. "Natural vegetation fires" is a term to describe brush, grass, or forest fires regardless of their causes. Unclassified natural vegetation fires are included in the totals, but no further analysis was done of these incidents. Cultivated vegetation and crop fires are captured by incident types 170-179. Percentages calculated from the details in NFIRS 5.0 were applied to projections derived from NFPA's survey. The national estimates approach groups all outside, non-structure and non-vehicle fires together into one category to calculate scaling ratios. In most of the national estimates (except property use and incident type), fires with missing or unknown data were allocated proportionally among fires with known data. Appendix C describes the methodology used. Tables supporting the text are provided at the end of this analysis.

Although one NFIRS incident type in this analysis captures forest, woods, or wildland fires, it does not capture all the losses associated with wildland fires in the same way that the media, land management organizations and the National Interagency Fire Center (NIFC) do. Structure and vehicle fires resulting from exposure to vegetation fires were not captured in this analysis. NFPA collects reports from local fire departments on firefighter fatalities, large-loss fires, and multiple death fires. In these studies, the term "wildland fire" is consistent with the use by the other agencies. NFPA's national estimates use the NFIRS data and definitions.

Figure 1. Brush, Grass and Forest Fires by Incident Type
2007-2011 Annual Averages

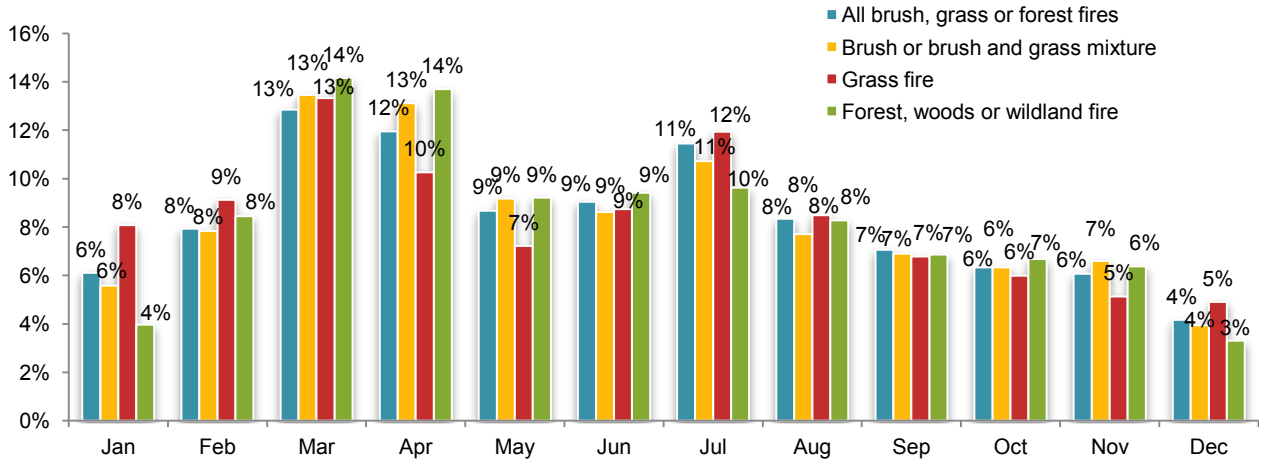


Source: NFIRS 5.0 and NFPA survey.

During the same period, local fire departments responded to an estimated average of 10,700 cultivated vegetation fires per year, including 4,600 cultivated grain or crop fires, 1,800 cultivated trees or nursery stock fires, 200 cultivated orchard or vineyard fires, and 4,600 unclassified cultivated vegetation or crop fires. These fires are excluded from this analysis.

Local fire department responses to brush, grass and forest fires peak in March and April. Figure 2 and Table 1 show that, for the country as a whole, local responses to total forest, brush and grass fires, fires in forests, woods or wildlands; and brush or brush and grass mixture fires peaked in March and April. Grass fires also peaked in March, but for these fires, July ranked second and April third. Peak months vary considerably by region.

Figure 2.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Month of Alarm and Type of Fire
2007-2011



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

Fourth of July was peak day for these fires. Although March was the peak month for these fires, Table A shows that July 4th had almost five times the daily average of 915 forest, brush or grass fires. July 5th ranked second and July 3rd was third. This is consistent with the peak days for fireworks-related fires of all types.[4] March dates filled the fourth through ninth slot, while July 2nd ranked tenth.

Supporting Tables

A few tables are included in the text. These tables, such as Table A, below, are identified with letters. The numbered tables (Tables 1-16), support the text but are not as critical to understanding the material discussed. These tables are found in a separate section at the end of the report-

Table A.
Peak Days for Local Fire Department Responses to Brush, Grass, and Forest Fires
2007-2011 Annual Averages

	Date	Fires	
1.	July 4	4,400	(1.3%)
2.	July 5	2,500	(0.8%)
3.	July 3	2,000	(0.6%)
4.	March 21	1,800	(0.5%)
5.	March 24	1,800	(0.5%)
6.	March 20	1,800	(0.5%)
7.	March 22	1,800	(0.5%)
8.	March 18	1,800	(0.5%)
9.	March 23	1,700	(0.5%)
10.	July 2	1,700	(0.5%)

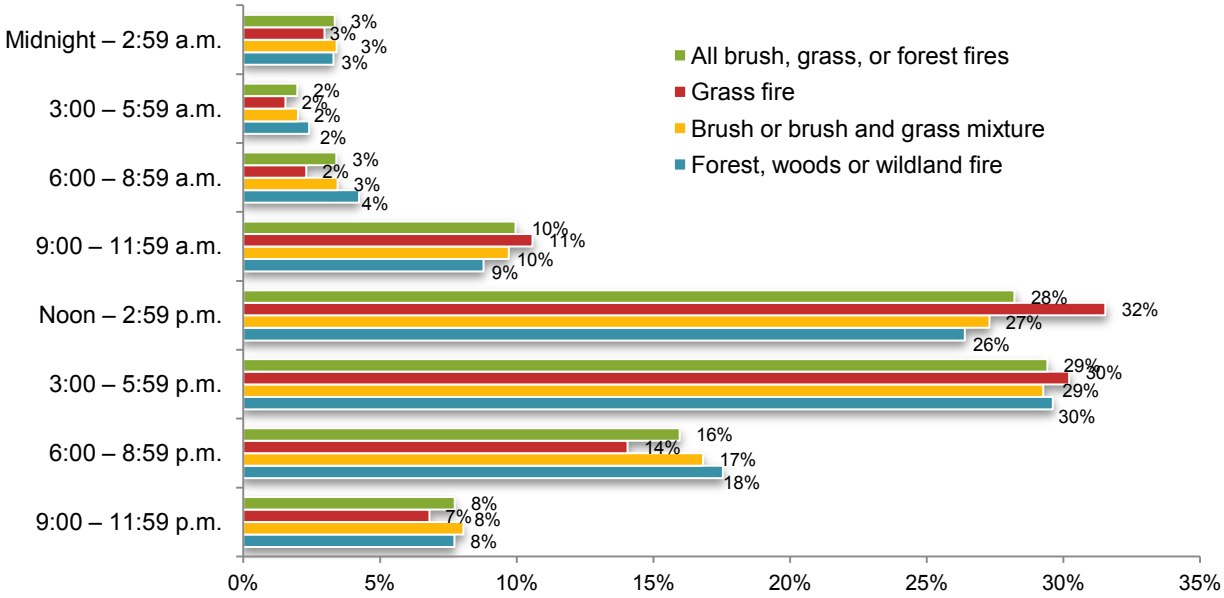
Source: NFIRS 5.0 and NFPA survey.

Saturday was peak day for natural vegetation fires. Table 2 shows that Saturday was the peak day for these fires. Sunday ranked second. It is likely that these are peak days to be engaging in outside activities. Figure 3 and Table 3 show that these fires peak between noon and 6:00 p.m.

Ten percent of natural brush, grass and forest occurred at one-or two-family homes. Figure 4 and Table 4 show that one-third of the natural vegetation fires occurred on properties described as open land or fields. For brush or brush and grass mixture fires and grass fires, the second most common property use mentioned was the combination of highway, street, and outside parking areas; one-or two-family homes ranked third. Forests, timberland, or woodland ranked second among the forest, woods, or wildland fires. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself. Many of the property uses are not completely distinct. A home may be on open or cared-for land. Also, some property types are more common than others.

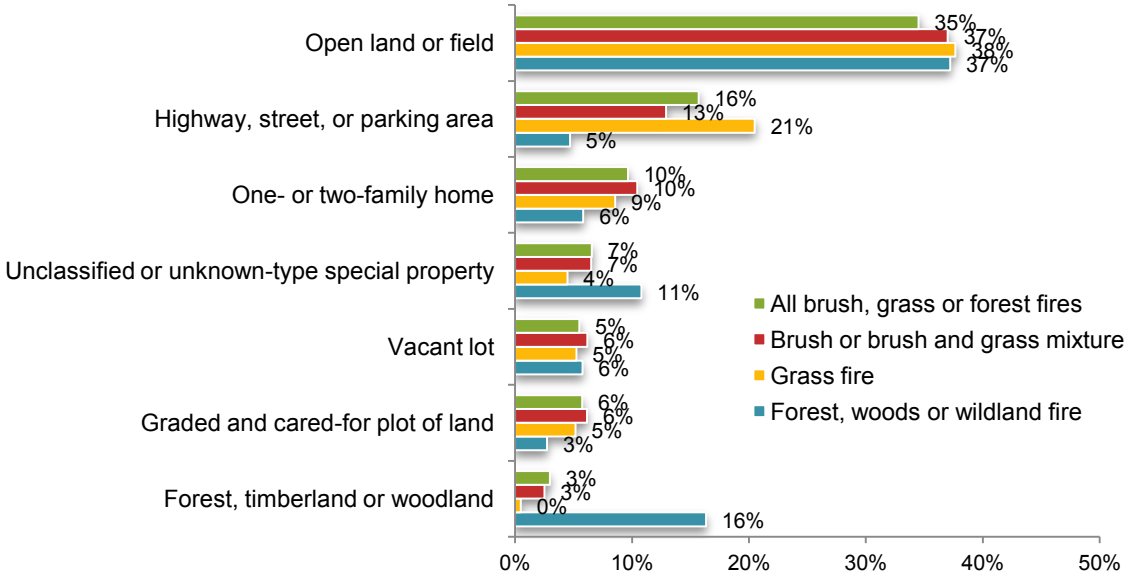
[4] John R. Hall, Jr. *Fireworks*,, Quincy, MA: National Fire Protection Association, 2013, p.19.

Figure 3.
Local Fire Department Responses to Brush, Grass and Forest Fires
by Alarm Time and Type of Fire
2007-2011



During this period, heavy or light vegetation was the item first ignited in an average of 5,000 reported home s*tructure* fires per year. These fires caused an average of five civilian deaths, 54 civilian injuries, and $92 million in direct property damage. This does not include home fires in which a home ignited because of a vegetation fire nearby.

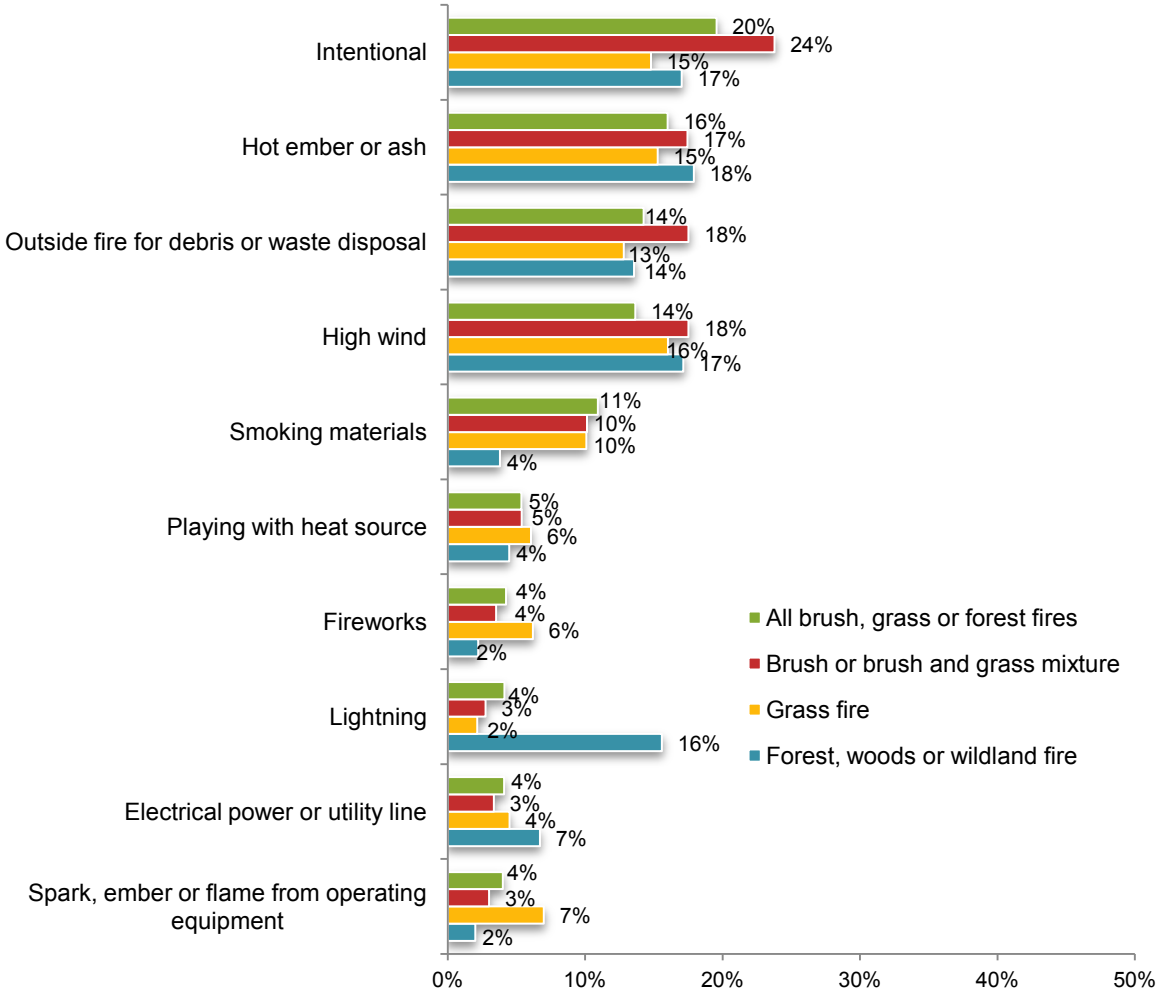
Figure 4.
Local Fire Department Responses to Brush, Grass and Forest Fires
by Property Use and Type of Fire
2007-2011



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

One in every five reported brush, grass, or forest fires was intentionally set.
Figure 5 shows the leading causes of, or factors contributing to, brush, grass and forest fires, with data summarized from several NFIRS data elements. For some information, the equipment involved in ignition is most relevant; heat source, the element labeled "cause of ignition," and factor contributing to ignition also provide relevant information. Because the causes are pulled from different NFIRS fields, they are not mutually exclusive.

Figure 5.
Local Fire Department Responses to Brush, Grass, or Forest Fires
by Major Cause or Contributing Factor and Type of Fire
2007-2011



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

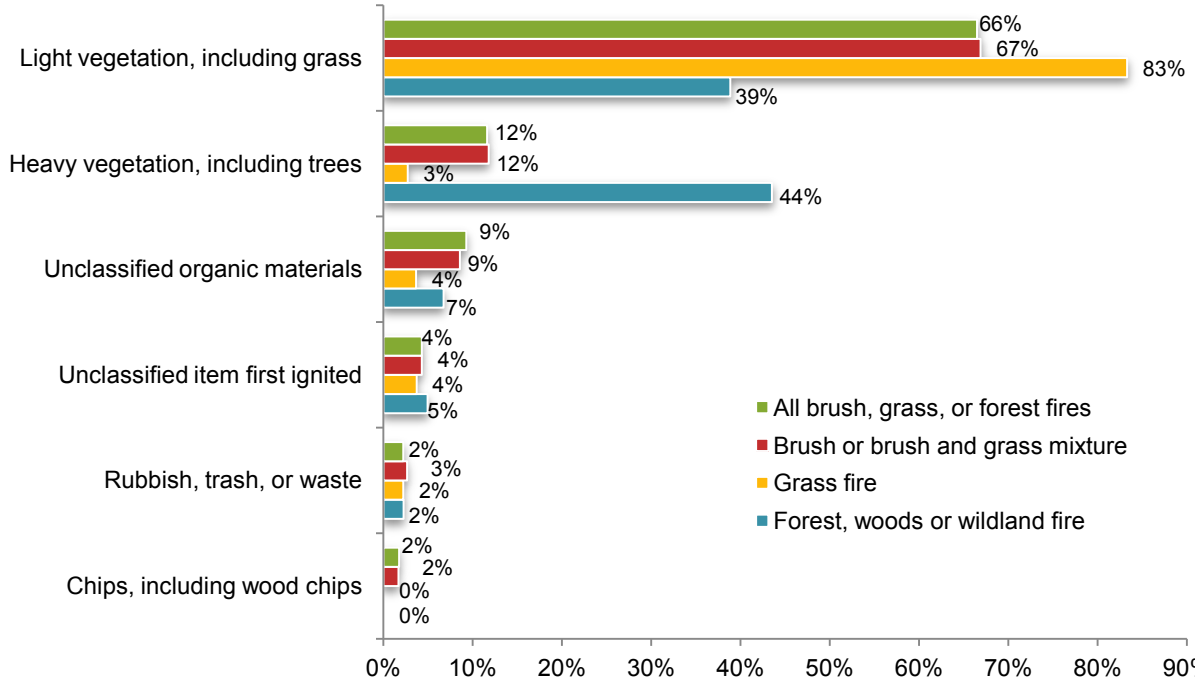
The leading causes of, or contributing factors to, all reported brush, grass and forest fires were: intentional (20%); hot embers or ashes (16%); outside fires for debris or waste disposal (14%); high wind (14%); smoking materials (11%); playing with heat source (5%); fireworks (4%);

lightning (4%); spark, ember or flame from operating equipment (4%); and electrical power or utility lines (4%). The cause profile varies by type of fire and the material first ignited. Lightning caused 16% of the forest fires but only 4% of these fires overall. Electrical power or utility lines were involved in 7% of the forest fires but only 4% of overall natural vegetation fires. Seven percent of grass fires were started by a spark, ember or flame from operating equipment but only 4% of overall vegetation fires. While high wind is not a heat source, wind can cause non-hostile fires, such as campfires or fires for open burning, to spread out of control.

The causes or factors shown were considered most relevant or descriptive and were only shown in Figure 5 if they accounted for at least 5% of at least one of the fire types. For a more complete listing, refer to the tables for specific data elements. The broad categories of cause of ignition, a data element in NFIRS 5.0, are shown in Table 5. Factors contributing to ignition are shown in Table 6. Table 7 shows more information on heat sources. More detailed information on equipment involved in ignition may be found in Table 8.

Two-thirds of the combined brush, grass and forest fires began with light vegetation. Figure 6 and Table 9 show that 83% of grass fires, 67% of brush or brush and grass mixture fires, and 39% of forest, woods or wildland fires begin with light vegetation, including grass, leaves, needles, chaff, mulch and compost. Not surprisingly, the light vegetation share is highest for grass fires, and the share of heavy vegetation, including trees (44%), is highest in forest, woods, or wildland fires.

Figure 6.
Local Fire Department Responses to Brush, Grass, and Forest Fires by Leading Items First Ignited and Type of Fire 2007-2011

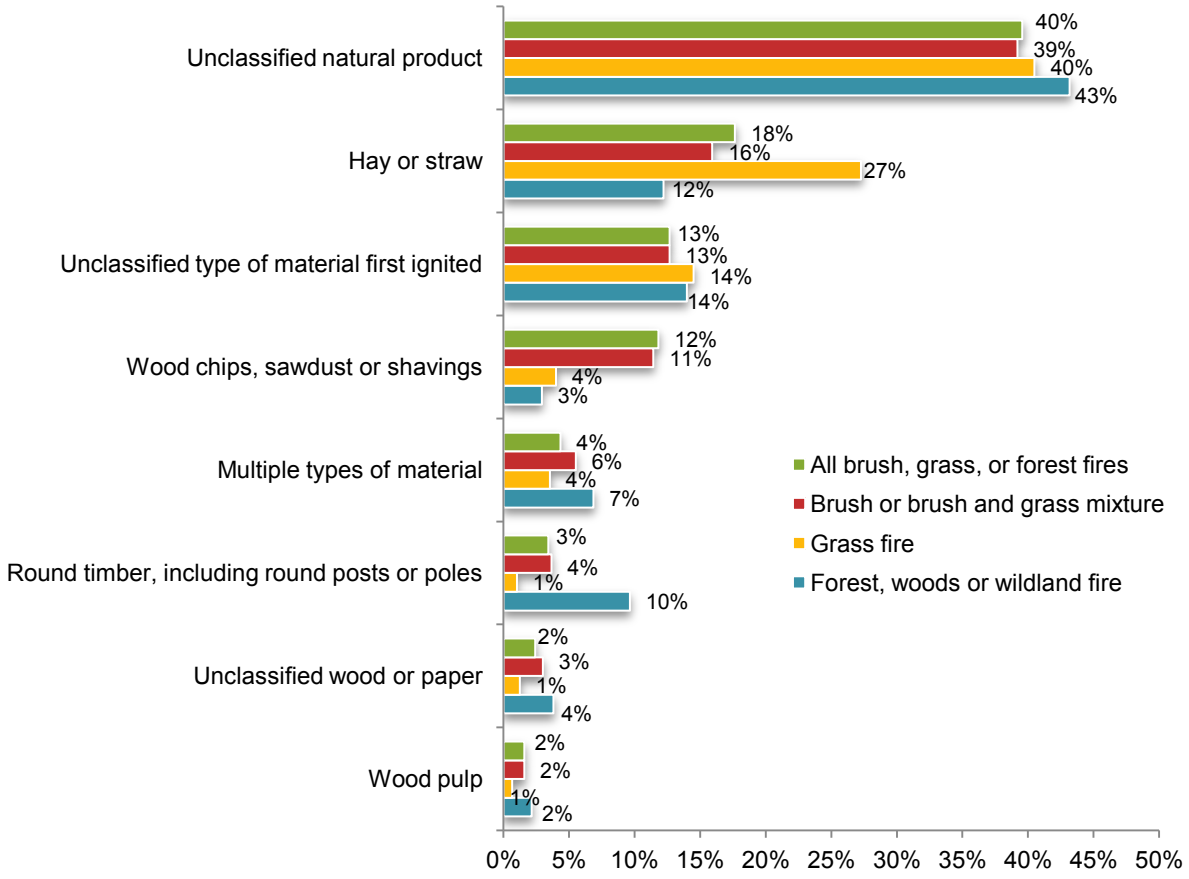


Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

Hay or straw, and wood chips, sawdust, or shavings were the leading specific types of material first ignited.

Table 10 and Figure 7 show that an unclassified natural product was first ignited in two out of five of these incidents. Hay or straw was first ignited in one-quarter (27%) of the grass fires and 12-18% of the remaining categories. Wood chips, sawdust, or shavings were first ignited in 11% of the brush or brush and grass mixture and 12% of total forest, brush, or grass fires, including the unclassified natural vegetation fires.[5]

Figure 7.
Local Fire Department Responses to Forest, Brush, and Grass Fires by Type of Material First Ignited and Type of Fire 2007-2011 Annual Averages



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

[5] In NFIRS 5.0, the type of material ignited, or what the item first ignited is made from, is not required for certain items, including vegetation. However, it is sometimes completed even when not required. In 29-33% of the brush, grass, and forest fires, it was not required and not completed. For this analysis, these incidents were treated like other fires with unknown information and allocated proportionally.

MULCH FIRES

Mulch fires are attracting increased attention.
As more homes and businesses ban indoor smoking, a larger share of smoking is done outside. Too often, the discarded cigarettes end up in the landscaping mulch, leaves, vegetation, or even potted plants. Unfortunately, NFIRS does not have a code that specifically identifies mulch.

Johnston City, Tennessee had an average of 100 mulch fires annually.
In a 2008 article, Mark Finucane wrote that the Johnston City, Tennessee Fire Department responds to an average of 100 mulch fires per year. He noted that the burning mulch was sometimes right next to a commercial or residential building. Burning mulch can ignite the underside of the structure's siding and spread into the structure. Large piles of mulch can spontaneously ignite.[6]

Shredded rubber, pine needles and shredded western red cedar were the most dangerous of seven mulches tested.
Stephen Quarles and Ed Smith evaluated the combustibility of specific brands of seven landscape mulch treatments: composted wood chips, medium pine bark nuggets, pine needles, shredded rubber; shredded western red cedar, medium pine bark nuggets and three configurations of chipping operations byproducts including a combination of pine needles, wood chips, bark and other plant materials of various sizes, shapes and textures.[7] The first configuration had the chips spread at a depth of two-three inches, the second had chips treated with a fire retardant spread at the same depth, and the third had only a single layer of chips without fire retardant. Naturally occurring pine needle mulch was also tested.

Mulch was applied in 24 outside 8-foot circles (three of each type) at a Carson City, Nevada facility and allowed to weather for 79 days. All but the single layer category of mulch were two-three inches deep. The circles were ignited and monitored for 20 minutes on an August day with an extreme National Fire Danger Rating. Fans created winds of 10 to 15 miles per hour.

All burned, but flame height, speed of fire spread and temperature four inches above the mulch varied considerably. Based on the combination of the three measures, the burning shredded rubber, pine needles and shredded western red cedar created the most hazardous conditions. Flame heights (averaging over three feet) and temperatures were highest from the rubber mulch. All except the composed wood chips showed active flaming. The least hazardous conditions were seen with single layer of chips and the composted wood chips. The composted chips smoldered with occasional flaming.

The duration of burning and amount of mulch consumed also matters.
In their 2007 paper on mulch flammability, Wayne Zipperer and his colleagues noted that other factors, such as how long the item burns, how much heat is produced, and how much of the fuel

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[6] Mark J. Finucane. "Combating and Preventing Mulch Fires," *Fire Engineering*, 161 (3) 139-140+, March 2008.
[7] Stephen Quarles and Ed Smith. "The Combustibility of Landscape Mulches," SP-11-04, Nevada State Publications Repository, 2011, accessed on August 28, 2013 at http://www.unce.unr.edu/publications/files/nr/2011/sp1104.pdf

is consumed, are also important.[8] They studied four different mulches: pine straw, shredded cypress wood and bark, small pine bark chunks, and large pine bark chunks under laboratory and field conditions. They found the pine straw was easiest to ignite. The large pine bark and pine straw had produced large amounts of heat and had high rates of consumption. However, the pine straw burned for the shortest length of time. The authors note:

> "Each one of the tested mulches burned and none are 100% safe. Mulch should not be used next to flammable material or vinyl surfaces on buildings…Only decorative gravel or stones or some other non-flammable material should be used immediately adjacent to the home…"

Weathering made some mulches more ignitable and some less.
In a 2003 article, Steward, Sydnor, and Bishop reported on their findings about how easily 13 types of landscape mulches were ignited by cigarettes, matches, and a propane torch.[9] Ground recycled pallets, composted yard waste, and shredded pine bark were most easily ignited by cigarettes. Decorative ground rubber, pine straw, and oat straw were the most easily ignited by the propane torch. They did not find statistically significant differences in tests with matches. The authors also noted that weathering increased the ignitability of some mulches and decreased others.

Keep organic mulch five feet away from structures to protect against wildfire.
The Firewise program advises homeowners seeking to make their home safe from wildfire to make sure organic mulch is at least 5 feet from structures.[10] In February, 2013, the Office of the State Fire Marshal of Massachusetts published information about preventing mulch fires.[11] In September 2012, a new Massachusetts regulation took effect that prohibits the new application of mulch within 18 inches of combustible exteriors of buildings with combustible exteriors such as wood or vinyl. Residential properties with no more than six units are exempt from the legal requirement. They advise property managers, building owners, and landscapers to provide 18-inch clearance between mulch beds and combustible building materials such as wood, vinyl siding or decks, and use rock or pea stone around gas meters and parts of the building that can catch fire. They also advise that appropriate containers be provided for smoking materials outside public buildings and in designated smoking areas. Mulch should not be used in these areas. A May 2008 Massachusetts mulch fire spread and caused almost $7 million in damage to an apartment complex, displacing 750 people temporarily and 36 permanently.

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8 Wayne Zipperer, Alan Long, Brian Hinton, Alexander Maranghides, and William Mell. "Mulch Flammability," *Proceedings of Emerging Issues along Urban-Rural Interfaces II: Linking Land-Use Science and Society:* 192-195, 2007.

9 Larry G. Steward, T.Davis Sydnor, and Bert Bishop. "The Ease of Ignition of 13 Landscape Mulches," *Journal of Arborculture* 26 (6): 317-320, November 2003.

10 Firewise Communities. NFPA "A Firewise Home" FWC22612.

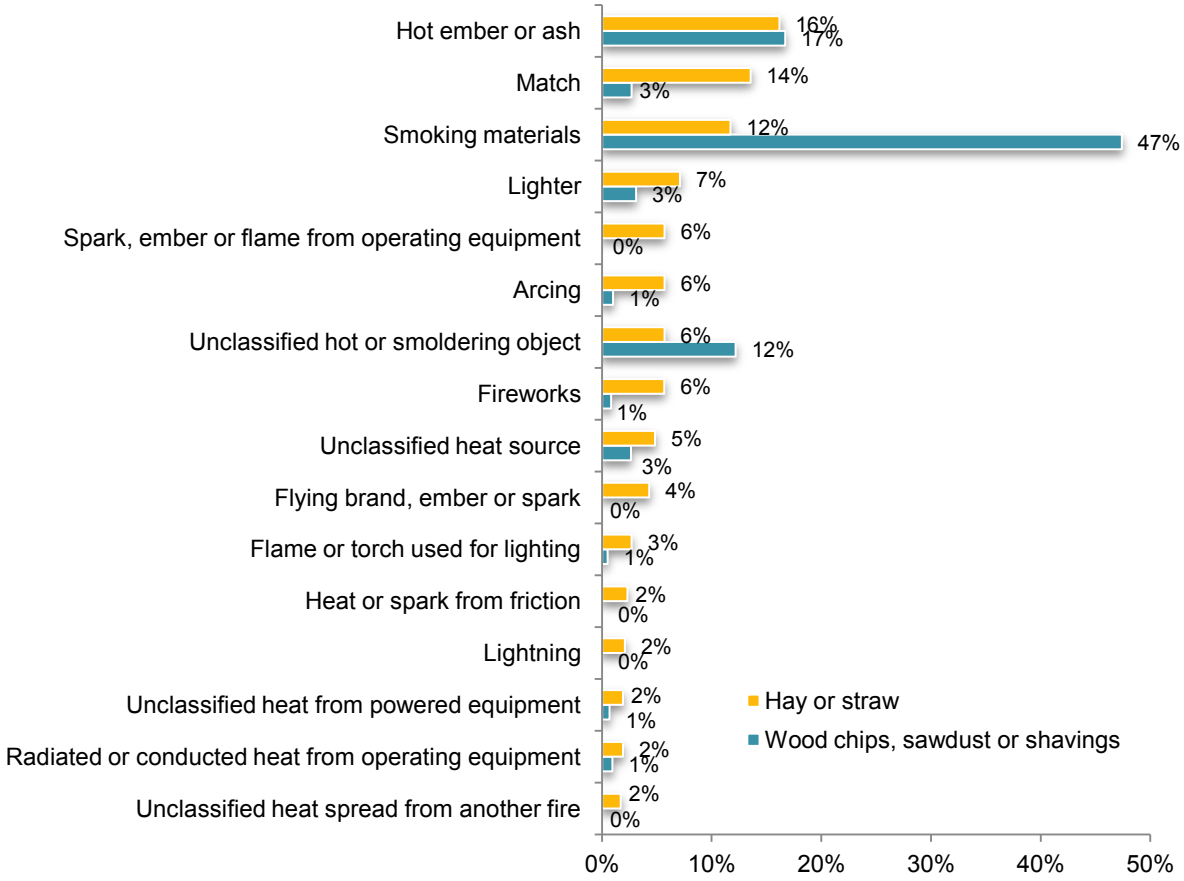
11 Commonwealth of Massachusetts, Office of the State Fire Marshal, "Preventing Mulch Fires, " *FireFACTORS* series, February 2013, accessed on August 7, 2013 at http://www.mass.gov/eopss/docs/dfs/osfm/pubed/flyers/mulchfires20131362672454235.pdf.

Smoking materials started roughly half of all forest, brush or grass fires beginning with wood chips, sawdust, or shavings.

As mentioned earlier, NFIRS does not specifically identify mulch. Some are probably captured as unclassified natural products, the leading type of material first ignited in these fires. Unfortunately, that category is not specific enough to provide much useful information. An analysis of heat sources in brush, grass and forest fires beginning with two types of material that could be mulch - a) wood chips, sawdust, and shavings; and b) hay or straw - found that the first group was more likely to have been ignited by smoking materials.

Figure 8 shows that smoking materials were the heat source in almost half (47%) of the brush or brush and grass mixture fires that began with wood chips, sawdust, or shavings. Table 7A shows that this is more than four times the proportion of forest, brush, or grass fires started by smoking materials. Hot embers or ashes were common heat sources for both hay or straw and wood chips. See Table 11 for more details.

Figure 8.
Local Fire Department Responses to Brush, Grass, or Forest Fires That Began with Hay or Straw Compared to Fires that Began with Wood Chips, Sawdust, or Shavings 2007-2011



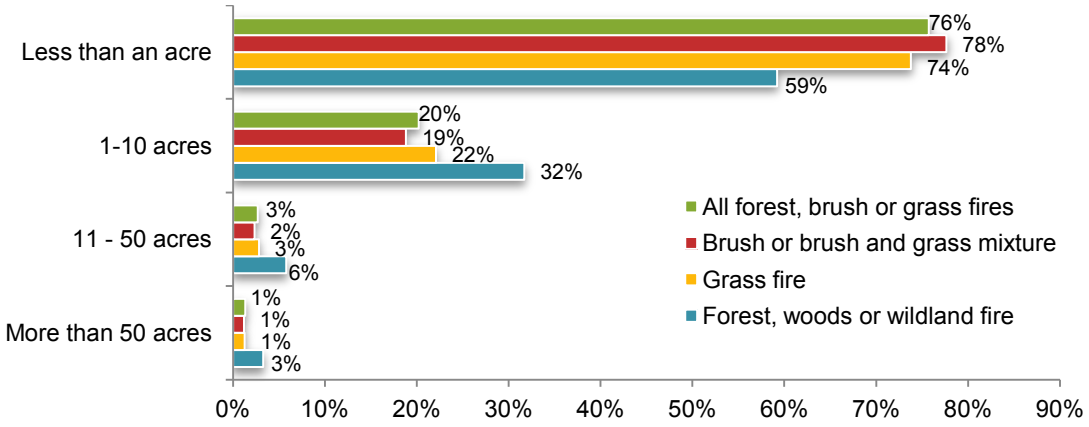
Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass, or forest fires" but not shown separately.

In general, fires starting with hay or straw were more likely than wood chips, sawdust or shavings to have had a flaming ignition source such as matches (14% vs. 3%), lighters, (7% vs. 3%), and fireworks (6% vs. 1%). A spark, ember or flame was also a more frequent heat source in hay or straw fires (6% vs. 0%), as was arcing (6% vs. 1%). An unclassified hot or smoldering object was the heat source in only 6% of the hay or straw fires compared to 12% of the wood chips, sawdust or shavings fires.

Size of Fire and Fire Department Response Time

Unlike the wildland fires that make the news, three-quarters of brush, grass, and forest fires handled by local fire departments burned less than an acre.
Figure 9 and Table 12 show that 59% of forest, woods, or wildland fires and 74-78% of the remaining types of fires consumed less than one acre. Nine percent of the forest, wildland, or wood fires consumed more than ten acres compared to 4% of the remaining types of fires.

Figure 9.
Local Fire Department Responses to Natural Vegetation Fires
by Acres Burned and Type of Fire
2007-2011

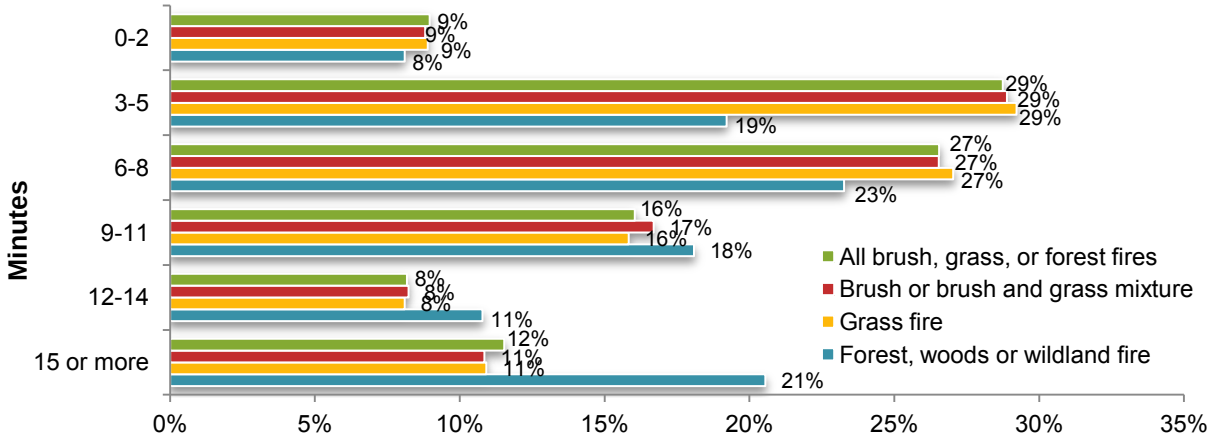


Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

Response time was often greater for forest fires than for brush or grass fires.
One reason that forest, woods, or wildland fires were likely to grow larger than other vegetation fires is that the response time tended to be longer. Figure 10 shows that it took local fire departments 15 minutes or more to reach 21% of the forest, woods or wildland fires.

For the other categories of natural vegetation fires, only 11-12% of the responses took that long. Also, only 27% of forest, woods, or wildland fires were reached within five minutes, compared to 38% of other categories of natural vegetation fires.

Figure 10.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Response Time and Type of Fire
2007-2011



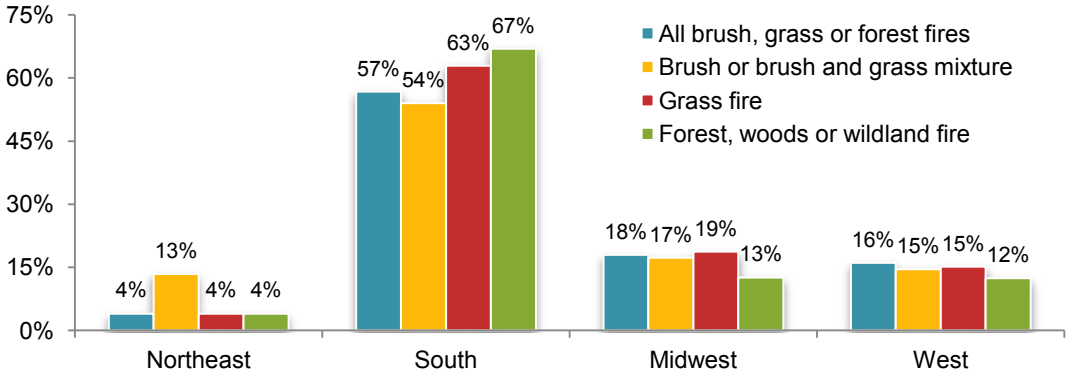
Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

Brush, Grass and Forest Fires by Census Region

Types of fires, frequency, causes and circumstances can vary dramatically by and within region depending on land use, weather, customs and other factors.

Southern fire departments responded to the majority of U.S. brush, grass, and forest fires. While most of the wildland fires in the news occur in the West, Figure 11 and Table 13 show that fire departments in the South made 57% of all local fire department responses to brush, grass and forest fires. The Midwest ranked second. Figure 12 shows the states that are in each census region. The Northeast is the smallest in area.

Figure 11.
Local Fire Department Responses to Natural Vegetation Fires
by Census Region and Type of Fire
2007-2011



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

Local fire departments in the Northeast had the smallest percentages of all types of reported brush, grass, or forest fires. The distribution of fires in the Northeast was also different. Fires involving brush or brush and grass mixtures accounted for almost two-thirds (64%) of the brush, grass or forest fire responses in the region, compared to 37-39% in the South, Midwest, and West. Fires involving grass only accounted for 12% of these fires in the Northeast but 34% to 41% in the other three regions.

Figure 12. U.S. Census Regions

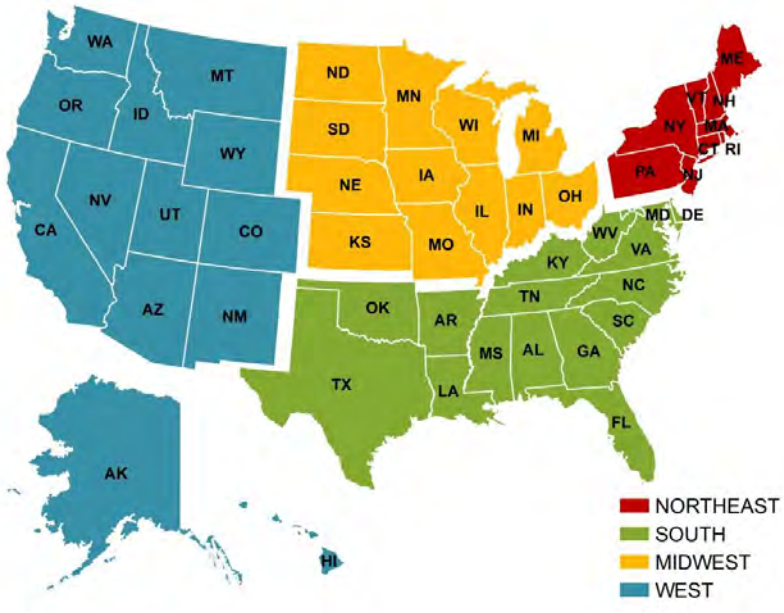
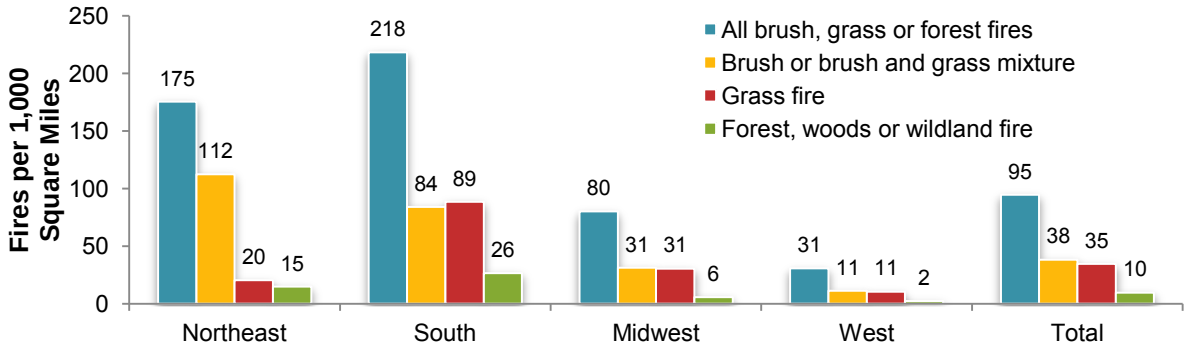


Figure 13 and Table 14 show that the South had the highest rate of total brush, grass, and forest fires per 1,000 square miles of land area overall as well as the highest rate for grass and forest fires specifically. The Northeast ranked second overall but led the country in the rate of brush or brush and grass mixture fires.

Figure 13.
Local Fire Department Responses to Natural Vegetation Fires
Per 1,000 Square Miles of Land Area by Census Region and Type of Fire
2007-2011



Sources: NFIRS 5.0 and NFPA survey and "Land and Water Area of States, 2008, (in square miles), accessed at http://www.infoplease.com/ipa/A0108355.html on October 15, 2013. Unclassified natural vegetation fires are included in "all brush, grass or forest fires" but not shown separately.

Local fire departments in the West had the lowest rate for all the fire categories studied. This may seem counterintuitive. However, large parts of the West are state, federal, or tribal lands and are protected by firefighters from those agencies rather than local fire departments.

Almost half of the privately owned U.S. forested land is in the South.
The *National Atlas* reports that the U.S. federal government owns almost 30% of the land area in the country. Their map of Federal Lands and Indian Reservations shows that most federally owned lands are in the Western region.[12] Table B shows that 80% of the forested land owned by federal or state government is located in the West.[13]

Table B.
Forest Land Area in the US in 2007 by Census Region and Ownership
Expressed in Million Acres

Property Ownership	Northeast		South		Midwest		West		Total	
Federal and state	12.5	(4%)	28.6	(9%)	23.4	(7%)	252.7	(80%)	317.2	(100%)
County and municipal	1.9	(17%)	2.3	(21%)	5.6	(51%)	1.1	(10%)	10.9	(100%)
Private	55.4	(13%)	198.7	(47%)	64	(15%)	104.9	(25%)	423.0	(100%)
Total forested areas	69.8	(9%)	229.6	(31%)	93	(12%)	358.8	(48%)	751.2	(100%)
Private plus county and municipal	*57.3*	*(13%)*	*201*	*(46%)*	*69.6*	*(16%)*	*106*	*(24%)*	*433.9*	*(100%)*
Share of private plus county and municipal in region		*(82%)*		*(88%)*		*(75%)*		*(30%)*		*(58%)*

Source: Smith, Miles, Perry and Pugh, U.S. Forest Service, 2009.

Federal agencies such as the U.S. Bureau of Land Management, the Bureau of Indian Affairs, the Fish and Wildlife Service, the National Park Service, and the Forest Service handle fires on their own properties. State Forest Services also maintain firefighting crews. In many cases, homes or communities abut these lands. Fire in one jurisdiction can spread to others. Federal and state agencies may also provide assistance when local fire departments need help fighting larger brush, grass or forest fires in their jurisdictions.

Local fire departments are less likely to be involved in firefighting on federal properties and state parks and more likely to be fighting fires on private property or land owned by the municipality or county. Forty-six percent of the forested land owned privately or by county or municipal

[12] National Atlas.gov. "Federal Lands and Indian Reservations" accessed on July 28, 2010 at http://www.nationalatlas.gov/printable/fedlands.html#us.

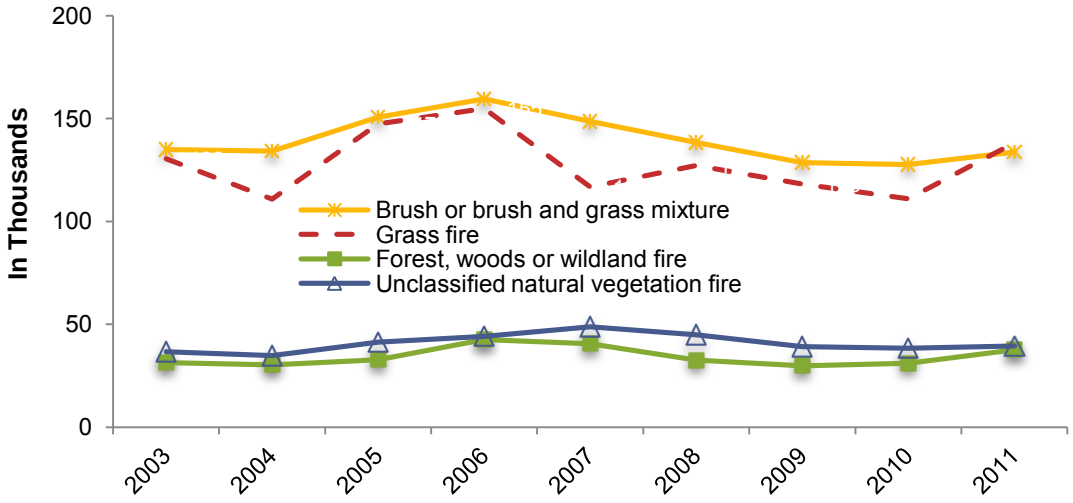
[13] W. Brad Smith, Patrick D. Miles, Charles H. Perry, Scott A. Pugh. Table 2. "Forest Land Area in the United States by Ownership, Region, Subregion, and State, 2007" in *Forest Resources of the United States,2007,* Gen. Tech. Rep. WO-78, Washington, DC: U.S. Department of Agriculture, Forest Service, 2009. State data were summed to obtain totals for each census region as the report uses a different regional grouping. Properties owned by Indian tribes are considered private property.

governments is in the South. Consistent with its smaller size, the Northeast had the smallest amount of forested land in all categories of ownership. The last line of Table B shows that 58% of the country's land is owned privately or by municipal or county governments. Fires on these properties are likely to be reported to NFIRS. Only 30% of the land in the Western region is under private, county or municipal ownership. Consequently, many vegetation fires in the West are not captured by NFIRS.

Recent Trends in Brush, Grass and Forest Fires

Figure 14 and Table 15 show trend data beginning with 2003 when 79% of the data in NFIRS was collected with definitions and rules of NFIRS 5.0. No clear trends can be seen in the frequency of these incidents. Weather plays a significant role in vegetation fires and is outside of human control. While high winds contribute to fire spread in all kinds of fires, wind can also turn a friendly fire such as a bonfire or debris burn into a hostile fire. Drought or a lack of rainfall can increase the likelihood that vegetation will ignite and that a fire will spread.

Figure 14.
Local Fire Department Responses to Brush, Grass and Forest Fires, by Year
2003-2011



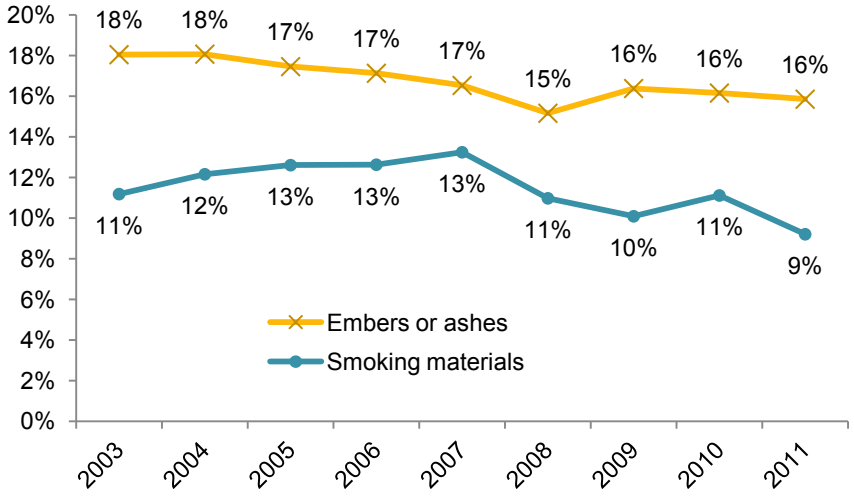
Sources: NFIRS 5.0 and NFPA survey

Percentage of brush, grass and forest fires started by smoking materials has fallen. All 50 states have passed laws "fire-safe" cigarettes that are less likely to keep burning when left unattended. New York's law, passed in 2003, was the first in the county. It took effect in 2004. By mid-2011, laws in all 50 states were in effect.[14] While the percentage of brush, grass and forest fires started by smoking materials has fluctuated, Figure 15 and Table 16 show that the 9% started by smoking materials is the lowest seen over the period.

[14] John R. Hall, Jr. *The Smoking Material Fire Problem* , Quincy, MA: NFPA, July 2013, p. 11.

The list of heat sources shows embers or ashes before smoking materials, and it is likely that some portion of fires started by discarded cigarettes were coded as embers or ashes. Unfortunately, the source of embers or ashes is not captured by NFIRS coding. However, the combined total of smoking materials and embers or ashes fell from 29-30% in 2003-2007 and to 25-27% in 2008-2011.

Figure 15.
Local Fire Department Responses to Brush, Grass and Forest Fires Started by either Smoking Materials or Embers or Ashes, by Year 2007-2011



Sources: NFIRS 5.0 and NFPA survey

Wildland Fire Statistics from the National Interagency Fire Center

State and federal agencies handle some vegetation or wildland fires independently and assist local departments with others.
Information on federal and state wildland firefighting activities may be found at the National Interagency Fire Center's (NIFC's) web site, http://www.nifc.gov/. An unknown portion of the fires included in their statistics were also handled by local fire departments and are also counted in NFPA's estimates. At present, the different data collections systems are independent and it is not possible to confidently connect them. Statistics for Figures 16-19 are independent of statistics presented elsewhere in this analysis.[15] Note that different sources release data at different times. The latest data available from each source was used in this analysis.

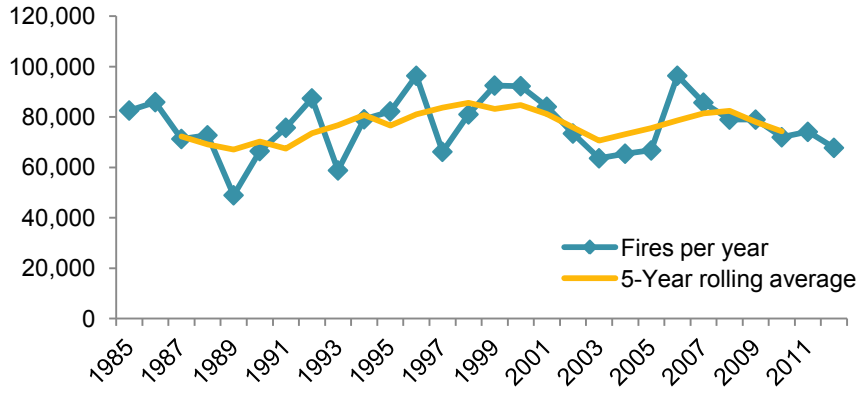
Wildland fire agencies handled roughly 67,800 fires in 2012.
Figure 16 shows the number of wildland fires handled by federal or state wildland fire agencies since 1985. Annual totals varied from a low of 48,900 in 1989 to highs of 96,400 in 1996 and

[15] National Interagency Fire Center. "Fire Information -- Wildland Fire Statistics. Accessed at http://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html on August 7, 2013.

2006. In 2012, these agencies responded to 67,774 wildland fires that burned 9.3 million acres with an average of 138 acres burned per wildland fire handled by these agencies.

The frequency and severity of these fires fluctuate from year to year. To identify trends, it is helpful to look at five year rolling averages, shown by the smooth gold lines in Figures 16-18. The first point, shown at 1987, is the average for 1985-1989. The next, shown at 1988, is the average for 1986-1990. The last point shown, at 2010, is the average for 2007-2011.

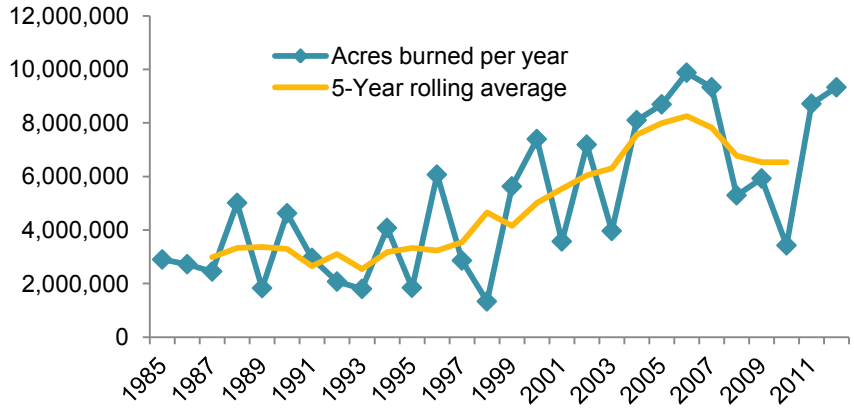
Figure 16.
Wildland Fires Handled by Wildland Fire Agencies, by Year
1985-2012



Source: National Interagency Fire Center
2004 data does not include state lands for North Carolina.

Acreage burned in these wildland fires peaked in 2006-2007, with 2012 a close third. Figure 17 shows that the acreage burned in wildland fires handled by wildland fire agencies was higher in 2004-2007 and in 2011 and 2012 than at any point since 1985. The rolling averages show a fairly steady increase from the late 1990s on, despite the smaller number of incidents in recent years. The average number of acres burned per wildland fire handled by these agencies fluctuates greatly from year to year.

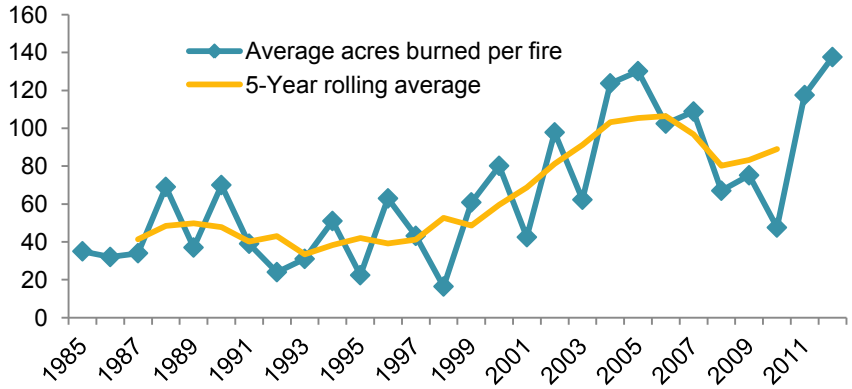
Figure 17.
Acres Burned in Wildland Fires Handled by Wildland Fire Agencies, by Year
1985-2012



Source: National Interagency Coordination Center.
2004 data does not include state lands for North Carolina.

Figure 18 shows that the five-year rolling average acres burned per wildland fire has generally been increasing in the past decade along with the total acreage burned. The most recent rolling averages in Figures 17 and 18 show a dip due to lower than average acreage burned in 2008-2010. Taken together, the data suggest that it is the severity, rather than the frequency, of these fires that is the major change.

Figure 18.
Average Number of Acres Burned in Wildland Fires Handled by Wildland Fire Agencies, by Year 1985-2012

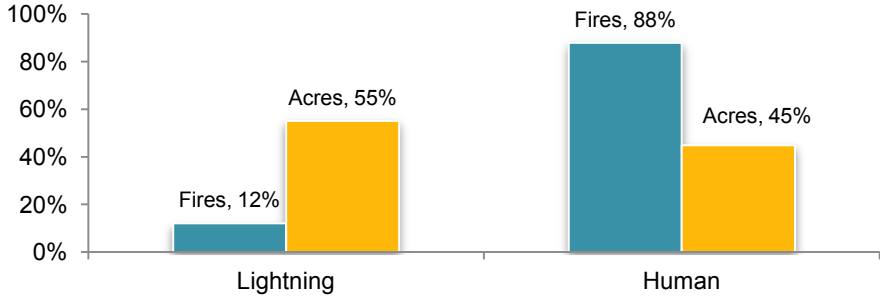


Source: National Interagency Coordination Center.
2004 data does not include state lands for North Carolina.

Fires started by lightning accounted for 55% of acres burned in 2008-2012 fires handled by wildland fire agencies.

Twelve percent of wildland fires handled by wildland fire agencies were started by lightning[16] but Figure 19 shows that more than half of the burned wildland acres were consumed in these fires. The percentage of fires started by lightning was actually somewhat lower than the 2007-2011 percentage of local fire department responses to forest, woods, or wildland fires started by lightning discussed earlier.

Figure 19.
Human Caused vs. Lightning-Caused Wildland Fires Handled by Wildland Fire Agencies 2008-2012



Source: National Interagency Coordination Center.

[16] National Interagency Fire Center. "Fire Information -- Wildland Fire Statistics," sourced to National Interagency Coordination Center. Accessed at http://www.nifc.gov/fireInfo/fireInfo_stats_lightng.html on October 15, 2013.

Firefighter Fatalities at Forest, Brush, or Grass Fires

On average, 15 firefighters per year were fatally injured by wildland or prescribed fires. NFPA maintains a census of all US on-duty firefighter fatalities. While NFPA's national estimates of fires are based on local fire department responses, NFPA's statistics on firefighter fatalities include local career and volunteer firefighters, firefighters working for federal and state agencies, members of industrial fire brigades, and prison inmates serving on firefighting crews.[17]

From 2003 through 2012, 147, or 17% of the 877 firefighter fatalities, died as a result of wildland fires, defined here as forest, brush or grass fires, and prescribed burns.[18] Twelve of the 147 deaths resulted from 10 prescribed fires while 135 were related to 100 wildfires. Just over half (52%) of the fatal firefighter injuries associated with wildland or prescribed burns occurred on the fire ground. Fifty-five percent of these victims were associated with federal or state land management agencies. The rest were associated with local fire departments, including 32% who were volunteer firefighters and 13% who were career firefighters.

More than one-quarter (26.5%) of all fire ground firefighter fatalities resulted from wildland fires or prescribed burns.

On June 30, 2013, 19 wildland firefighters were killed on the fireground in the Yarnell Hill fire in Arizona after they had deployed fire shelters.[19] According to NFPA records, it is the deadliest incident for firefighters since September 11, 2001. Appendix B shows that it was the third highest firefighter death toll associated with U.S. wildland fires. The 1910 Devil's Broom wildfire in Silverton, Idaho killed 78 firefighters and the 1933 Griffith Park blaze in Los Angeles, California, killed 29.

Prevention of and Protection from Brush, Grass, and Forest Fires

Prevention strategies are relatively easy to identify for some of the fire causes. Be sure that smoking materials are disposed of properly in fire-resistant containers. Provide metal containers for cigarette disposal to prevent them from being tossed on the ground. If you have a campfire, fire for waste disposal, or bonfire, be sure it is completely out. Avoid outside fires on windy days. Leave fireworks to the professionals. Keep matches and lighters away from children. The California Wildland Fire Coordinating Group's "One Less Spark- One Less Wildfire" campaign educates the public about how to prevent fires started b sparks from equipment and vehicles.

Sometimes, a fire will start in spite of efforts to prevent ignition. NFPA's Firewise® program provides detailed information on how to make your home safer from wildfire. To prevent a fire

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[17] Rita F. Fahy, Paul R. LeBlanc, and Joseph L. Molis. *Firefighter Fatalities in the United States- 2012*, Quincy, MA, 2013, p. 2

[18] Fire Analysis and Research Division, *Wildland Firefighter Fatalities,* Quincy, MA: NFPA, July 2013. "Prescribed fires" or "prescribed burns" are terms that describe fires that were deliberately set under controlled conditions to manage resources or the amount of vegetative fuel present.

[19] State of Arizona Serious Accident Investigation Team. *Yarnell Hill Fire June 30, 2013: Serious Accident Investigation Report,* September 2013, accessed at https://sites.google.com/site/yarnellreport/ on October 8, 2013..

from damaging your home or spreading, reduce the amount of available fuel on and around the home. In particular, keep plants that burn fast and hot away from the structure. Get rid of dead branches, leaves, brush and tree limbs that hang over your home. Use gravel or some other non-combustible material next to the building instead of an organic mulch. Ensure the home itself is as ignition-resistant as possible by choosing non-flammable roofing, fire-resistant siding, screened or ember-resistant vents, and attachments (fences, decks, porches) that are fire-resistant or modified to keep from carrying fire to the main structure.

Protecting your home from a landscape fire can also help protect against carpenter ants and crime.
Entomologist Mike Potter of University of Kentucky College of Agriculture offers a number of tips to prevent carpenter ant problems. Several sound similar to strategies to protect against fire spread. Among them are:

- "Eliminate wood-to-ground contact such as where landscaping has moved soil or mulch up against the wood siding of a home.
- Clip back tree limbs and vegetation touching the roof or siding of the house. Limbs and branches serve as "bridges" between carpenter ants nesting in a dead tree limb and the structure.
- Stack firewood away from the foundation…"[20]

It is also possible to reduce the fire threat while increasing the security of your home. In their information on crime prevention through environmental design, the Seattle Police Department recommends a maximum height of three feet for hedges and a minimum height of eight feet for tree canopies, particularly in areas close to doors and windows. This approach provides fewer hiding places.[21] Eliminating lower branches makes it less likely that fire that starts on the ground will spread into the tree canopy.

These techniques reduce the fuel and the path for fire to spread into your home.

Many of us would like to make our lands more attractive to birds and pollinators by keeping our yards as natural as possible. Allowing vegetation to grow unchecked and leaving brush piles, leaves or pine needles on the property may provide food and habitat for wild creatures. However, such practices can provide additional fuel for any fire that happens to start. It is important to remember fire safety when making landscaping choices.

Safety Tips

General

- Place cigarette butts in metal containers. Do *not* throw them on the ground or into vegetation.
- Leave fireworks to the professionals. Do not use consumer fireworks.

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[20] Mike Potter. "Carpenter Ants" University of Kentucky College of Agriculture, ENTFACT-603, accessed at http://www.ca.uky.edu/entomology/entfacts/ef603.asp on August 7, 2013.
[21] Seattle Police Department. "Crime Prevention through Environmental Design," accessed at http://www.seattle.gov/police/prevention/Neighborhood/CPTED.htm on August 7, 2013.

- Follow the recommendations at www.firewise.org to make your home and landscaping more resistant to fire, specifically "How to Have a Firewise Home."
- Reduce the risk from sparks by being sure nothing is dragging from your vehicle, keeping tires properly inflated, and being careful when using lawn mowers or other equipment. Get more information at http://www.preventwildfireca.org/OneLessSpark.
- Don't let a target shooting hobby start a wildfire. Avoid steel bullets outside as they can spark when they hit rocks or other hard objects. Observe all laws and restrictions about where, when and what to shoot.

Outdoor burning

- Be aware of, and comply with, any local ordinances or permit requirements pertaining to outdoor or open air burning. This includes campfires, brush fires, fire pits, chimineas, and outdoor fireplaces. You may not be permitted to do outdoor burning in some municipalities and during some seasons.
- Closely attend all outdoor fires. Be sure to put out the fire completely before leaving.
- Avoid burning on windy, dry days. When conditions are windy or dry, it is too easy for open burning to spread out of control.
- Do not use gasoline or other flammable or combustible liquids to burn brush, trash, or other waste.

Supporting Tables

The tables that follow were referenced in the text. Please refer back to the text for a discussion of key points.

Table 1.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Month and Type of Fire
2007-2011 Annual Averages

Month	Brush or Brush/Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
January	7,600	(6%)	9,900	(8%)	1,400	(4%)	20,400	(6%)
February	10,600	(8%)	11,200	(9%)	2,900	(8%)	26,500	(8%)
March	18,200	(13%)	16,300	(13%)	4,900	(14%)	43,000	(13%)
April	17,800	(13%)	12,500	(10%)	4,700	(14%)	39,900	(12%)
May	12,400	(9%)	8,800	(7%)	3,200	(9%)	29,000	(9%)
June	11,700	(9%)	10,700	(9%)	3,200	(9%)	30,200	(9%)
July	14,500	(11%)	14,600	(12%)	3,300	(10%)	38,300	(11%)
August	10,400	(8%)	10,400	(8%)	2,800	(8%)	27,900	(8%)
September	9,300	(7%)	8,300	(7%)	2,400	(7%)	23,600	(7%)
October	8,600	(6%)	7,300	(6%)	2,300	(7%)	21,200	(6%)
November	8,900	(7%)	6,300	(5%)	2,200	(6%)	20,300	(6%)
December	5,300	(4%)	6,000	(5%)	1,100	(3%)	13,900	(4%)
Total	135,400	(100%)	122,300	(100%)	34,400	(100%)	334,200	(100%)
Average	11,300	(8%)	10,200	(8%)	2,900	(8%)	27,800	(8%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 2.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Day of Week and Type of Fire
2007-2011 Annual Averages

Day of Week	Brush or Brush/Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
Sunday	20,600	(15%)	18,000	(15%)	5,400	(16%)	50,300	(15%)
Monday	19,300	(14%)	17,500	(14%)	5,000	(15%)	47,800	(14%)
Tuesday	18,200	(13%)	16,600	(14%)	4,600	(13%)	45,200	(14%)
Wednesday	17,900	(13%)	16,300	(13%)	4,600	(13%)	44,500	(13%)
Thursday	17,800	(13%)	16,400	(13%)	4,500	(13%)	44,300	(13%)
Friday	18,500	(14%)	17,200	(14%)	4,500	(13%)	46,200	(14%)
Saturday	23,000	(17%)	20,400	(17%)	5,700	(17%)	55,900	(17%)
Total	135,400	(100%)	122,300	(100%)	34,400	(100%)	334,200	(100%)
Average	19,300	(14%)	17,500	(14%)	4,900	(14%)	47,700	(14%)

Table 3.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Alarm Time and Type of Fire
2007-2011 Annual Averages

Alarm Time	Brush or Brush/Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
Midnight - 3 a.m.	4,600	(3%)	3,600	(3%)	1,100	(3%)	11,200	(3%)
3 - 6 a.m.	2,700	(2%)	1,900	(2%)	800	(2%)	6,600	(2%)
6 - 9 a.m.	4,700	(3%)	2,800	(2%)	1,500	(4%)	11,400	(3%)
9 a.m. - noon	13,100	(10%)	12,900	(11%)	3,000	(9%)	33,300	(10%)
Noon - 3 p.m.	36,900	(27%)	38,600	(32%)	9,100	(26%)	94,300	(28%)
3 - 6 p.m.	39,600	(29%)	36,900	(30%)	10,200	(30%)	98,300	(29%)
6 - 9 p.m.	22,800	(17%)	17,200	(14%)	6,000	(18%)	53,400	(16%)
9 p.m. - midnight	10,900	(8%)	8,300	(7%)	2,700	(8%)	25,800	(8%)
Total	135,400	(100%)	122,300	(100%)	34,400	(100%)	334,200	(100%)
Average per time period	16,900	(13%)	15,300	(13%)	4,300	(13%)	41,800	(13%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Unclassified vegetation fires are not shown separately.

Source: NFIRS 5.0 and NFPA survey.

Table 4A.
Local Fire Department Responses to Brush, Grass, and Forest Fires, by Property Use
2007-2011 Annual Averages

Property Use	Fires	
Outside or special property	**238,200**	**(71%)**
Open land, beach or campsite	*153,900*	*(46%)*
Open land or field	115,300	(35%)
Graded or cared-for plot of land	19,100	(6%)
Vacant lot	18,300	(5%)
Highway, street or parking area	*52,500*	*(16%)*
Highway or divided highway	22,800	(7%)
Residential street, road or residential driveway	12,300	(4%)
Vehicle parking area	6,700	(2%)
Street or road in commercial area	4,200	(1%)
Unclassified street	6,400	(2%)
Railroad area	*4,500*	*(1%)*
Railroad right of way	4,300	(1%)
Construction site, outdoor plant yard, pipeline, or oil or gas oil field	2,500	(1%)
Water area	1,900	(1%)
Unclassified special property	*21,900*	*(7%)*
Residential	**39,900**	**(12%)**
One-or-two-family home	32,200	(10%)
Apartment or multi-family home	3,200	(1%)
Unclassified residential	3,900	(1%)
Industrial, utility, defense, agriculture or mining	**16,200**	**(5%)**
Forest, timberland or woodland	*9,900*	*(3%)*
Agriculture	*4,300*	*(1%)*
Crop or orchard	2,300	(1%)
Livestock production	2,000	(1%)
Mercantile or business	**6,700**	**(2%)**
Office, bank or mail facility	*1,900*	*(1%)*

Table 4A. (Continued)
Local Fire Department Responses to Brush, Grass, and Forest Fires, by Property Use
2007-2011 Annual Averages

Property Use	Fires	
Public assembly	**5,000**	**(2%)**
Variable use or amusement or recreation	*1,700*	*(1%)*
Other known property use	**4,400**	**(1%)**
Unclassified or unknown property use	**23,800**	**(7%)**
Total	**334,200**	**(100%)**

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

Table 4B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Property Use
2007-2011 Annual Averages

Property Use	Fires	
Outside or special property	**96,400**	**(71%)**
Open land, beach or campsite	65,600	(48%)
Open land or field	48,400	(36%)
Vacant lot	8,400	(6%)
Graded or cared-for plot of land	8,300	(6%)
Highway, street or parking area	**17,500**	**(13%)**
Highway or divided highway	5,600	(4%)
Residential street, road or residential driveway	5,100	(4%)
Vehicle parking area	3,100	(2%)
Street or road in commercial area	1,500	(1%)
Unclassified street	2,200	(2%)
Railroad area	*2,200*	*(2%)*
Railroad right of way	2,100	(2%)
Construction site, outdoor plant yard, pipeline, or oil or gas oil field	*1,000*	*(1%)*
Pipeline, power line or other utility right of way	700	(1%)
Water area	*800*	*(1%)*
Unclassified special property	*8,800*	*(7%)*
Residential	**17,300**	**(13%)**
One-or-two-family home	14,100	(10%)
Apartment or multi-family home	1,400	(1%)
Unclassified residential	1,500	(1%)
Industrial, utility, defense, agriculture or mining	**5,600**	**(4%)**
Forest, timberland or woodland	*3,400*	*(3%)*
Agriculture	*1,400*	*(1%)*
Crop or orchard	800	(1%)
Livestock production	600	(0%)
Mercantile or business	**3,000**	**(2%)**
Public assembly	**2,200**	**(2%)**
Educational	**700**	**(1%)**

Table 4B. (Continued)
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Property Use
2007-2011 Annual Averages

Property Use	Fires	
Other known property use	**1,200**	**(1%)**
Unclassified or unknown property use	**9,100**	**(7%)**
Total	**135,400**	**(100%)**

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

Table 4C.
Local Fire Department Responses to Grass Fires, by Property Use
2007-2011 Annual Averages

Property Use	Fires	
Outside or special property	**93,200**	**(76%)**
Open land, beach or campsite	*59,000*	*(48%)*
Open land or field	46,100	(38%)
Vacant lot	6,400	(5%)
Graded or cared-for plot of land	6,300	(5%)
Highway, street or parking area	*25,100*	*(21%)*
Highway or divided highway	15,000	(12%)
Residential street, road or residential driveway	4,500	(4%)
Street or road in commercial area	1,600	(1%)
Vehicle parking area	1,100	(1%)
Unclassified street	2,900	(2%)
Railroad area	*1,800*	*(1%)*
Railroad right of way	1,700	(1%)
Construction site, outdoor plant yard, pipeline, or oil or gas oil field	*1,000*	*(1%)*
Unclassified special property	*5,500*	*(4%)*
Residential	**12,700**	**(10%)**
One-or-two-family home	10,500	(9%)
Apartment or multi-family home	800	(1%)
Unclassified residential	1,400	(1%)
Industrial, utility, defense, agriculture or mining	**3,400**	**(3%)**
Agriculture	*2,000*	*(2%)*
Livestock production	1,100	(1%)
Crop or orchard	900	(1%)
Mercantile or business	**1,400**	**(1%)**
Public assembly	**1,200**	**(1%)**
Other known property use	**1,200**	**(1%)**
Unclassified or unknown property use	**9,200**	**(8%)**
Total	**122,300**	**(100%)**

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

Table 4D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Property Use
2007-2011 Annual Averages

Property Use	Fires	
Outside or special property	**22,000**	**(64%)**
Open land, beach or campsite	*15,900*	*(46%)*
Open land or field	12,800	(37%)
Vacant lot	2,000	(6%)
Graded or cared-for plot of land	900	(3%)
Highway, street or parking area	*1,600*	*(5%)*
Residential street, road or residential driveway	600	(2%)
Highway or divided highway	600	(2%)
Unclassified street	200	(1%)
Construction site, outdoor plant yard, pipeline, or oil or gas oil field	*300*	*(1%)*
Pipeline, power line or other utility right of way	200	(1%)
Railroad area	*200*	*(1%)*
Water area	*200*	*(1%)*
Unclassified special property	*3,700*	*(11%)*
Industrial, utility, defense, agriculture or mining	**6,000**	**(18%)**
Forest, timberland or woodland	*5,600*	*(16%)*
Agriculture	*200*	*(1%)*
Residential	**2,500**	**(7%)**
One-or-two-family home	2,000	(6%)
Unclassified residential	300	(1%)
Public assembly	**300**	**(1%)**
Other known property use	**400**	**(1%)**
Unclassified or unknown property-use	**3,300**	**(9%)**
Total	**34,400**	**(100%)**

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

Table 5A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Cause of Ignition
2007-2011 Annual Averages

Cause of Ignition	Fires	
Unintentional	178,900	(54%)
Intentional	65,400	(20%)
Unclassified cause	40,900	(12%)
Act of nature	27,900	(8%)
Failure of equipment or heat source	21,100	(6%)
Total	334,200	(100%)

Table 5B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Cause of Ignition
2007-2011 Annual Averages

Cause of Ignition	Fires	
Unintentional	70,100	(52%)
Intentional	32,200	(24%)
Unclassified cause	17,500	(13%)
Act of nature	9,200	(7%)
Failure of equipment or heat source	6,400	(5%)
Total	135,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the cause of ignition was unknown or not reported were allocated proportionally among fires of known cause of ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 5C.
Local Fire Department Responses to Grass Fires
by Cause of Ignition
2007-2008 Annual Averages

Cause of Ignition	Fires	
Unintentional	72,500	(59%)
Intentional	18,100	(15%)
Unclassified cause	13,500	(11%)
Failure of equipment or heat source	11,500	(9%)
Act of nature	6,700	(5%)
Total	122,300	(100%)

Table 5D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Cause of Ignition
2007-2011 Annual Averages

Cause of Ignition	Fires	
Unintentional	14,900	(43%)
Act of nature	7,400	(22%)
Intentional	5,900	(17%)
Unclassified cause	4,700	(14%)
Failure of equipment or heat source	1,500	(4%)
Total	34,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the cause of ignition was unknown or not reported were allocated proportionally among fires of known cause of ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 6A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Factor Contributing to Ignition
2007-2011 Annual Averages

Factor Contributing	Fires	
Abandoned or discarded material or product	48,500	(15%)
Outside or open fire for debris or waste disposal	47,600	(14%)
High wind	45,600	(14%)
Unclassified natural condition	28,300	(8%)
Unclassified factor contributed to ignition	27,500	(8%)
Electrical failure or malfunction	20,100	(6%)
Unclassified misuse of material or product	19,600	(6%)
Playing with heat source	17,900	(5%)
Unclassified fire spread or control	15,900	(5%)
Agriculture or land management burns	13,300	(4%)
Heat source too close to combustibles	12,500	(4%)
Rekindle	12,500	(4%)
Storm	12,000	(4%)
Mechanical failure or malfunction	10,200	(3%)
Outside or open fire for warming or cooking	5,300	(2%)
Cutting or welding too close to combustibles	4,000	(1%)
Exposure fire	3,600	(1%)
Other known factor contributing to ignition	8,500	(3%)
Total fires	334,200	(100%)
Total factors*	352,800	(106%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as "none," or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 6B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Factor Contributing to Ignition
2007-2011 Annual Averages

Factor Contributing to Ignition	Fires	
Outside or open fire for debris or waste disposal	23,700	(18%)
Abandoned or discarded material or product	19,900	(15%)
High wind	18,100	(18%)
Unclassified factor contributed to ignition	11,300	(8%)
Unclassified natural condition	10,800	(8%)
Unclassified misuse of material or product	8,200	(6%)
Playing with heat source	7,300	(5%)
Electrical failure or malfunction	6,900	(5%)
Unclassified fire spread or control	6,900	(5%)
Agriculture or land management burns	5,600	(4%)
Rekindle	5,400	(4%)
Heat source too close to combustibles	5,000	(4%)
Storm	3,100	(2%)
Mechanical failure or malfunction	3,000	(2%)
Outside or open fire for warming or cooking	2,400	(2%)
Exposure fire	1,400	(1%)
Cutting or welding too close to combustibles	1,300	(1%)
Other known factor contributing to ignition	3,200	(2%)
Total fires	135,400	(100%)
Total factors*	143,500	(106%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as "none," or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 6C.
Local Fire Department Responses to Grass Fires
by Factor Contributing to Ignition
2007-2011 Annual Averages

Factor Contributing to Ignition	Fires	
High wind	19,600	(16%)
Outside or open fire for debris or waste disposal	15,700	(13%)
Abandoned or discarded material or product	14,500	(12%)
Electrical failure or malfunction	10,000	(8%)
Unclassified natural condition	9,400	(8%)
Unclassified factor contributed to ignition	9,100	(7%)
Playing with heat source	7,400	(6%)
Unclassified misuse of material or product	6,800	(6%)
Mechanical failure or malfunction	6,100	(5%)
Unclassified fire spread or control	5,700	(5%)
Agriculture or land management burns	5,300	(4%)
Heat source too close to combustibles	5,000	(4%)
Rekindle	3,200	(3%)
Cutting or welding too close to combustibles	2,500	(2%)
Storm	2,300	(2%)
Exposure fire	1,500	(1%)
Outside/open fire for warming or cooking	1,300	(1%)
Animal	600	(1%)
Other known factor contributing to ignition	3,200	(3%)
Total fires	122,300	(100%)
Total factors*	129,000	(105%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as "none," or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 6D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Factor Contributing to Ignition
2007-2011 Annual Averages

Factor Contributing to Ignition	Fires	
High wind	5,900	(17%)
Outside or open fire for debris or waste disposal	4,700	(14%)
Storm	4,300	(13%)
Unclassified natural condition	3,500	(10%)
Rekindle	2,600	(8%)
Abandoned or discarded material or product	2,300	(7%)
Unclassified factor contributed to ignition	2,300	(7%)
Unclassified fire spread or control	1,900	(6%)
Electrical failure or malfunction	1,700	(5%)
Playing with heat source	1,500	(4%)
Agriculture or land management burns	1,500	(4%)
Unclassified misuse of material or product	1,300	(4%)
Heat source too close to combustibles	1,000	(3%)
Outside or open fire for warming or cooking	800	(2%)
Mechanical failure or malfunction	600	(2%)
Exposure fire	400	(1%)
Other known factor contributing to ignition	700	(2%)
Total fires	34,400	(100%)
Total factors*	36,890	(107%)

*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as "none," or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 7A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Heat Source
2007-2011 Annual Averages

Heat Source	Fires	
Hot ember or ash	53,500	(16%)
Smoking materials	36,500	(11%)
Match	32,600	(10%)
Unclassified heat source	30,200	(9%)
Unclassified hot or smoldering object	23,900	(7%)
Arcing	19,100	(6%)
Lighter	19,000	(6%)
Flying brand, ember or spark	18,000	(5%)
Fireworks	14,100	(4%)
Spark, ember or flame from operating equipment	13,800	(4%)
Lightning	13,800	(4%)
Unclassified heat spread from another fire	11,600	(3%)
Flame or torch used for lighting	10,300	(3%)
Heat from direct flame or convection currents	6,000	(2%)
Heat or spark from friction	5,400	(2%)
Unclassified heat from powered equipment	4,900	(1%)
Radiated or conducted heat from operating equipment	3,000	(1%)
Spontaneous combustion or chemical reaction	2,900	(1%)
Molten or hot material	2,600	(1%)
Multiple heat sources including multiple ignitions	2,600	(1%)
Unclassified fireworks or explosives	2,600	(1%)
Other known heat source	7,900	(2%)
Total	334,200	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 7B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Heat Source
2007-2011 Annual Averages

Heat Source	Fires	
Hot ember or ash	23,600	(17%)
Match	16,300	(12%)
Smoking materials	13,700	(10%)
Unclassified heat source	12,700	(9%)
Unclassified hot or smoldering object	9,700	(7%)
Lighter	9,200	(7%)
Flying brand, ember or spark	7,400	(5%)
Arcing	6,300	(5%)
Flame or torch used for lighting	5,000	(4%)
Fireworks	4,800	(4%)
Unclassified heat spread from another fire	4,700	(3%)
Spark, ember or flame from operating equipment	4,300	(3%)
Lightning	3,700	(3%)
Heat from direct flame or convection currents	2,700	(2%)
Heat or spark from friction	1,700	(1%)
Unclassified heat from powered equipment	1,500	(1%)
Spontaneous combustion or chemical reaction	1,200	(1%)
Multiple heat sources including multiple ignitions	1,100	(1%)
Radiated or conducted heat from operating equipment	1,000	(1%)
Molten or hot material	800	(1%)
Unclassified fireworks or explosives	800	(1%)
Other known heat source	3,300	(2%)
Total	135,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting, and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 7C.
Local Fire Department Responses to Grass Fires
by Heat Source
2007-2011 Annual Averages

Heat Source	Fires	
Hot ember or ash	18,700	(15%)
Smoking materials	12,300	(10%)
Match	10,000	(8%)
Unclassified heat source	9,400	(8%)
Arcing	8,400	(7%)
Spark, ember or flame from operating equipment	8,000	(7%)
Flying brand, ember or spark	7,800	(6%)
Unclassified hot or smoldering object	7,600	(6%)
Fireworks	7,600	(6%)
Lighter	5,800	(5%)
Unclassified heat spread from another fire	4,500	(4%)
Flame or torch used for lighting	3,500	(3%)
Heat or spark from friction	3,000	(2%)
Lightning	2,600	(2%)
Unclassified heat from powered equipment	2,500	(2%)
Heat from direct flame or convection currents	2,300	(2%)
Molten or hot material	1,500	(1%)
Radiated or conducted heat from operating equipment	1,500	(1%)
Unclassified fireworks or explosives	1,300	(1%)
Multiple heat sources including multiple ignitions	900	(1%)
Conducted heat from another fire	600	(1%)
Other known heat source	2,500	(2%)
Total	122,300	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 7D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Heat Source
2007-2011 Annual Averages

Heat Source	Fires	
Hot ember or ash	6,200	(18%)
Lightning	5,400	(16%)
Unclassified heat source	3,200	(9%)
Match	2,800	(8%)
Flying brand, ember or spark	2,400	(7%)
Arcing	2,200	(7%)
Unclassified hot or smoldering object	2,000	(6%)
Lighter	1,800	(5%)
Unclassified heat spread from another fire	1,700	(5%)
Smoking materials	1,300	(4%)
Flame or torch used for lighting	800	(2%)
Spark, ember or flame from operating equipment	800	(2%)
Heat from direct flame or convection currents	800	(2%)
Fireworks	800	(2%)
Multiple heat sources including multiple ignitions	400	(1%)
Heat or spark from friction	300	(1%)
Unclassified heat from powered equipment	300	(1%)
Conducted heat from another fire	200	(1%)
Unclassified fireworks or explosives	200	(1%)
Other known heat source	900	(3%)
Total	34,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 8A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Equipment Involved in Ignition
2007-2011 Annual Averages

Equipment Involved in Ignition	Fires	
No equipment involved in ignition	284,900	(85%)
Electrical power or utility line	13,700	(4%)
Unclassified equipment involved in ignition	6,700	(2%)
Lawn mower	5,400	(2%)
Electrical distribution or lighting equipment except power or utility line or transformer	5,000	(1%)
Torch, burner or soldering iron	3,700	(1%)
Transformer or power supply	2,800	(1%)
Hay processing equipment	2,400	(1%)
Other known equipment	9,600	(3%)
Total	334,200	(100%)

Table 8B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Equipment Involved in Ignition
2007-2011 Annual Averages

Equipment Involved in Ignition	Fires	
No equipment involved in ignition	119,500	(88%)
Electrical power or utility line	4,500	(3%)
Unclassified equipment involved in ignition	2,300	(2%)
Electrical distribution or lighting equipment except power or utility line or transformer	1,800	(1%)
Lawn mower	1,500	(1%)
Torch, burner or soldering iron	1,100	(1%)
Transformer or power supply	900	(1%)
Lighter*	700	(1%)
Other known equipment	3,100	(2%)
Total	135,400	(100%)

* Most fires with lighter as heat source do not show a lighter as equipment involved in ignition.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the equipment involved in ignition was undetermined or not reported were allocated proportionally among fires with known equipment involved in ignition. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Sums may not equal due to rounding errors. Source: NFIRS 5.0 and NFPA survey.

Table 8C.
Local Fire Department Responses to Grass Fires
by Equipment Involved in Ignition
2007-2011 Annual Averages

Equipment Involved in Ignition	Fires	
No equipment involved in ignition	99,300	(81%)
Electrical power or utility line	5,500	(4%)
Lawn mower	3,200	(3%)
Unclassified equipment involved in ignition	2,800	(2%)
Torch, burner or soldering iron	2,200	(2%)
Electrical distribution or lighting equipment except power or utility line or transformer	1,800	(1%)
Transformer or power supply	1,600	(1%)
Hay processing equipment	1,600	(1%)
Other known equipment	4,300	(4%)
Total	122,300	(100%)

Table 8D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Equipment Involved in Ignition
2007-2011 Annual Averages

Equipment Involved in Ignition	Fires	
No equipment involved in ignition	29,700	(86%)
Electrical power or utility line	2,300	(7%)
Unclassified equipment involved in ignition	700	(2%)
Electrical distribution or lighting equipment except power or utility line	400	(1%)
Lawn mower	300	(1%)
Other known equipment	1,000	(3%)
Total	34,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the equipment involved in ignition was undetermined or not reported were allocated proportionally among fires with known equipment involved in ignition. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 9A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Item First Ignited
2007-2011 Annual Averages

Item First Ignited	Fires	
Light vegetation, including grass	222,200	(66%)
Heavy vegetation, including trees	38,800	(12%)
Unclassified organic materials	31,000	(9%)
Unclassified item first ignited	14,400	(4%)
Rubbish, trash, or waste	7,500	(2%)
Chips, including wood chips	6,000	(2%)
Agricultural crop, including fruits and vegetables	4,700	(1%)
Other known item first ignited	9,500	(3%)
Total	334,200	(100%)

Table 9B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Item First Ignited
2007-2011 Annual Averages

Item First Ignited	Fires	
Light vegetation including grass	90,600	(67%)
Heavy vegetation including trees	16,000	(12%)
Unclassified organic materials	11,600	(9%)
Unclassified item first ignited	5,800	(4%)
Rubbish, trash, or waste	3,600	(3%)
Chips, including wood chips	2,300	(2%)
Agricultural crop, including fruits and vegetables	1,400	(1%)
Other known item first ignited	4,100	(3%)
Total	135,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the item first ignited was undetermined or not reported were allocated proportionally among fires with known item first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 9C.
Local Fire Department Responses to Grass Fires
by Item First Ignited
2007-2011 Annual Averages

Item First Ignited	Fires	
Light vegetation, including grass	101,900	(83%)
Unclassified item first ignited	4,600	(4%)
Unclassified organic materials	4,500	(4%)
Heavy vegetation, including trees	3,300	(3%)
Rubbish, trash, or waste	2,700	(2%)
Agricultural crop, including fruits and vegetables	1,400	(1%)
Other known item first ignited	3,900	(3%)
Total	122,300	(100%)

Table 9D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Item First Ignited
2007-2011 Annual Averages

Item First Ignited	Fires	
Heavy vegetation, including trees	15,000	(44%)
Light vegetation, including grass	13,400	(39%)
Unclassified organic materials	2,300	(7%)
Unclassified item first ignited	1,700	(5%)
Rubbish, trash, or waste	800	(2%)
Agricultural crop, including fruits and vegetables	200	(1%)
Other known item first ignited	1,000	(3%)
Total	34,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the item first ignited was undetermined or not reported were allocated proportionally among fires with known item first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 10A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Type of Material First Ignited
2007-2011 Annual Averages

Type of Material First Ignited	Fires	
Unclassified natural product	132,200	(40%)
Hay or straw	59,000	(18%)
Unclassified type of material first ignited	42,300	(13%)
Wood chips, sawdust or shavings	39,400	(12%)
Multiple types of material	14,500	(4%)
Round timber, including round posts or poles	11,400	(3%)
Unclassified wood or paper	8,100	(2%)
Wood pulp	5,300	(2%)
Grain or natural fiber	3,900	(1%)
Sawn wood, including all finished lumber	3,000	(1%)
Paper, including cellulose and waxed paper	2,300	(1%)
Other known type of material	12,800	(4%)
Total	334,200	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 10B.
Local Fire Department Responses to Brush or Brush and Grass Mixture Fires
by Type of Material First Ignited
2007-2011 Annual Averages

Type of Material First Ignited	Fires	
Unclassified natural product	53,000	(39%)
Hay or straw	21,500	(16%)
Unclassified type of material first ignited	17,000	(13%)
Wood chips, sawdust or shavings	15,500	(11%)
Multiple types of material	7,400	(6%)
Round timber, including round posts or poles	5,000	(4%)
Unclassified wood or paper	3,800	(3%)
Wood pulp	2,400	(2%)
Sawn wood, including all finished lumber	1,500	(1%)
Grain or natural fiber	1,500	(1%)
Paper, including cellulose and waxed paper	1,000	(1%)
Anesthetic gas	700	(1%)
Other known type of material	5,100	(4%)
Total	135,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 10C.
Local Fire Department Responses to Grass Fires
by Type of Material First Ignited
2007-2011 Annual Averages

Type of Material First Ignited	Fires	
Unclassified natural product	49,500	(40%)
Hay or straw	33,300	(27%)
Unclassified type of material first ignited	17,700	(14%)
Wood chips, sawdust or shavings	5,000	(4%)
Multiple types of material	4,300	(4%)
Grain or natural fiber	1,900	(2%)
Unclassified wood or paper	1,500	(1%)
Round timber, including round posts or poles	1,200	(1%)
Paper, including cellulose and waxed paper	1,000	(1%)
Wood pulp	800	(1%)
Cardboard	800	(1%)
Gasoline	700	(1%)
Sawn wood, including all finished lumber	700	(1%)
Other known type of material	3,700	(3%)
Total	122,300	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 10D.
Local Fire Department Responses to Forest, Woods, or Wildland Fires
by Type of Material First Ignited
2007-2011 Annual Averages

Type of Material First Ignited	Fires	
Unclassified natural product	14,800	(43%)
Unclassified type of material first ignited	4,800	(14%)
Hay or straw	4,200	(12%)
Round timber, including round posts or poles	3,300	(10%)
Multiple types of material	2,400	(7%)
Unclassified wood or paper	1,300	(4%)
Wood chips, sawdust or shavings	1,000	(3%)
Wood pulp	700	(2%)
Sawn wood, including all finished lumber	300	(1%)
Grain or natural fiber	300	(1%)
Paper, including cellulose and waxed paper	200	(1%)
Other known type of material	1,000	(3%)
Total	34,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

Table 11A.
Local Fire Department Responses to Brush, Grass, and Forest Fires
Beginning with Hay or Straw, by Heat Source
2007-2011 Annual Averages

Heat Source	Fires	
Hot ember or ash	9,500	(16%)
Match	8,000	(14%)
Smoking materials	6,900	(12%)
Lighter	4,200	(7%)
Spark, ember or flame from operating equipment	3,400	(6%)
Arcing	3,400	(6%)
Unclassified hot or smoldering object	3,400	(6%)
Fireworks	3,300	(6%)
Unclassified heat source	2,900	(5%)
Flying brand, ember or spark	2,500	(4%)
Flame or torch used for lighting	1,600	(3%)
Heat or spark from friction	1,400	(2%)
Lightning	1,200	(2%)
Unclassified heat from powered equipment	1,100	(2%)
Radiated or conducted heat from operating equipment	1,100	(2%)
Unclassified heat spread from another fire	1,000	(2%)
Heat from direct flame or convection currents	800	(1%)
Unclassified fireworks or explosives	600	(1%)
Molten or hot material	500	(1%)
Spontaneous combustion or chemical reaction	500	(1%)
Multiple heat sources including multiple ignitions	400	(1%)
Other known heat source	1,300	(2%)
Total	59,000	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors. Because type of material first ignited is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; these estimates probably understate the frequency of these fires..

Source: NFIRS 5.0 and NFPA survey.

Table 11B.
Local Fire Department Responses to Brush, Grass, and Forest Fires
Beginning with Wood Chips, Sawdust, or Shavings, by Heat Source
2007-2011 Annual Averages

Heat Source	Fires	
Smoking materials	18,700	(47%)
Hot ember or ash	6,600	(17%)
Unclassified hot or smoldering object	4,800	(12%)
Spontaneous combustion or chemical reaction	2,000	(5%)
Lighter	1,200	(3%)
Match	1,100	(3%)
Unclassified heat source	1,000	(3%)
Sunlight	800	(2%)
Unclassified chemical or natural heat source	500	(1%)
Arcing	400	(1%)
Radiated or conducted heat from operating equipment	400	(1%)
Fireworks	300	(1%)
Unclassified heat from powered equipment	300	(1%)
Flame or torch used for lighting	200	(1%)
Other known heat source	1,200	(3%)
Total	39,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors. Because type of material first ignited is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; these estimates probably understate the frequency of these fires..

Source: NFIRS 5.0 and NFPA survey.

Table 12.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by Acres Burned and Type of Fire
2007-2011 Annual Averages

Acres Burned	Brush or Brush Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
Less than an acre	105,100	(78%)	90,200	(74%)	20,300	(59%)	253,100	(76%)
1-10 acres	25,500	(19%)	27,000	(22%)	10,900	(32%)	67,500	(20%)
11-25 acres	2,000	(2%)	2,200	(2%)	1,300	(4%)	5,800	(2%)
26-50 acres	1,100	(1%)	1,300	(1%)	700	(2%)	3,300	(1%)
51-100 acres	700	(0%)	700	(1%)	400	(1%)	1,900	(1%)
101-500 acres	600	(0%)	600	(0%)	400	(1%)	1,700	(1%)
More than 500 acres	300	(0%)	200	(0%)	300	(1%)	900	(0%)
Total	135,400	(100%)	122,300	(100%)	34,400	(100%)	334,200	(100%)

Table 13.
Local Fire Department Responses to Brush, Grass, and Forest Fires
by U.S. Census Region and Type of Fire
2007-2011 Annual Averages

Region	Brush or Brush/Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
Northeast	18,200	(13%)	3,300	(4%)	2,400	(4%)	28,400	(4%)
South	73,100	(54%)	76,900	(63%)	23,000	(67%)	189,500	(57%)
Midwest	23,400	(17%)	22,900	(19%)	4,300	(13%)	60,100	(18%)
West	19,700	(15%)	18,500	(15%)	4,300	(12%)	53,700	(16%)
Other US territories or areas	1,000	(1%)	700	(1%)	400	(1%)	2,400	(1%)
Total	135,400	(100%)	122,300	(100%)	34,400	(100%)	334,200	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Unclassified vegetation fires are not shown separately. For Table 12, fires in which the number of acres burned were unknown were allocated proportionally.

Source: NFIRS 5.0 and NFPA survey.

Table 14.
Local Fire Department Responses to Brush, Grass, and Forest Fires
Per 1,000 Square Miles by Census Region and Type of Fire
2007-2011 Annual Averages

Region	Brush or Brush/Grass Mixture	Grass	Forest, Woods or Wildland	Total including Unclassified	Square Miles Land Area
Northeast	112	20	15	175	162,000
South	84	89	26	218	868,000
Midwest	31	31	6	80	750,000
West	11	11	2	31	1,751,000
Total for 50 States and Washington DC	38	35	10	95	3,532,000

Note: These rates were calculated from the data in Table 13 and the country's total square miles. Unclassified vegetation fires are not shown separately.

Source: NFIRS 5.0 and NFPA survey and "Land and Water Area of States, 2008, (in square miles), accessed at http://www.infoplease.com/ipa/A0108355.html on October 15, 2013.

Table 15.
Local Fire Department Response Trends to Brush, Grass, and Forest Fires
by Type of Fire

Year	Brush or Brush/Grass Mixture	Grass	Forest, Woods or Wildland	Total, including Unclassified
2003	134,900	130,400	31,300	333,300
2004	134,200	110,900	30,300	310,200
2005	150,600	147,400	32,700	372,000
2006	159,500	154,900	42,500	401,000
2007	148,600	116,800	40,600	354,800
2008	138,300	127,200	32,600	343,000
2009	128,600	118,200	29,800	315,800
2010	127,700	111,000	31,100	308,200
2011	133,700	138,200	37,600	348,900

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred.

Source: NFIRS 5.0 and NFPA survey.

Table 16.
Local Fire Department Response Trends to Brush, Grass, and Forest Fires
Started by either Smoking Materials or Embers or Ashes

Year	Smoking Materials		Embers or Ashes	
2003	37,300	(11%)	60,200	(18%)
2004	37,700	(12%)	56,100	(18%)
2005	46,900	(13%)	64,900	(17%)
2006	50,600	(13%)	68,700	(17%)
2007	47,000	(13%)	58,700	(17%)
2008	37,700	(11%)	52,000	(15%)
2009	31,900	(10%)	51,700	(16%)
2010	34,300	(11%)	49,800	(16%)
2011	32,100	(9%)	55,300	(16%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of, smoking materials include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material.

Source: NFIRS 5.0 and NFPA survey.

Appendix A. The 25 Largest Fire Losses in U.S. History

(Wildland or forest fires are in bold.)

		Loss in Year Fire Occurred	Adjusted Loss in 2012 Dollars
1.	The World Trade Center New York City, New York September 11, 2001	$33.4 billion	$43.3 billion
2.	San Francisco Earthquake and Fire San Francisco, California April 18, 1906 (See Virtual Museum of the City of San Francisco for more information on this disaster.)	$350 million	$8.9 billion
3.	Great Chicago Fire * Chicago, Illinois October 8-9, 1871	$168 million	$3.2 billion
4.	**Oakland Fire Storm (wildland/urban interface) Oakland, California October 20, 1991**	**$1.5 billion**	**$2.5 billion**
5.	**The Southern California Firestorm San Diego County, California October 20, 2007**	**$1.8 billion**	**$2.0 billion**
6.	Great Boston Fire Boston, Massachusetts November 9, 1872	$75 million	$1.4 billion
7.	Polyolefin Plant Pasadena, Texas October 23, 1989	$750 million	$1.4 billion
8.	**"Cerro Grande" Wildland Fire (wildland/urban interface) Los Alamos, New Mexico May 4, 2000**	**$1.0 billion**	**$1.3 billion**
9.	**"Cedar" Wildland Fire Julian, California October 25, 2003**	**$1.1 billion**	**$1.3 billion**

The 25 Largest Fire Losses in U.S. History (continued)

		Loss in Year Fire Occurred	Adjusted Loss in 2012 Dollars
10.	Baltimore Conflagration Baltimore, Maryland February 7, 1904	$50 million	$1.3 billion
11.	**"Old" Wildland Fire** **San Bernardino, California** **October 25, 2003**	**$975 million**	**$1.2 billion**
12.	Los Angeles Civil Disturbance Los Angeles, California April 29 - May 1, 1992	$567 million	$928 million
13.	Power Plant (auto manufacturing complex) Dearborn, Michigan February 1, 1999	$650 million	$894 million
14.	**Southern California November Wildfire**** **Sacramento, California** **November 13, 2008**	**$800 million**	**$853 million**
15.	**"Laguna Beach Fire"** **(wildland/urban interface)** **Orange County, California** **October 27, 1993**	**$528 million**	**$838 million**
16.	Textile Mill Methuen, Massachusetts December 11, 1995	$500 million	$752 million
17.	U.S.S. Lafayette (formerly S.S. Normandie ocean liner) New York, New York February 9, 1942	$53 million	$746 million
18.	S.S. Grandcamp and Chemical Co. Plant Texas City, Texas April 16, 1947	$67 million	$689 million
19.	Petroleum Refinery Norco, Louisiana May 5, 1988	$330 million	$640 million

The 25 Largest Fire Losses in U.S. History (continued)

		Loss in Year Fire Occurred	Adjusted Loss in 2012 Dollars
20.	Cargo plane in-flight fire Near Newburgh, New York September 5, 1996	$395 million	$578 million
21.	Great Fire of New York New York, New York December 16, 1835	$26 million	$576 million
22.	**Wildland Fire**** **Florida** **May – June, 1998**	**$395 million**	**$555 million**
23.	One Meridian Plaza (high-rise office building) Philadelphia, Pennsylvania February 23, 1991	$325 million	$547 million
24.	**Forest Fire** **Cloquet, Minnesota** **October 12, 1918**	**$35 million**	**$532 million**
25.	Apollo Spacecraft Cabin Cape Kennedy, Florida January 27, 1967	$75 million	$515 million

Loss estimates are from NFPA records. Adjustment to 2011 dollars done using the Consumer Price Index, including Census Bureau estimates for historical times. The list is limited to fires with some reliable dollar-loss estimate that occur in or over the U.S.A.

*Each year Fire Prevention Week falls in the week of October 9th, and thus the anniversary of the Great Chicago Fire of 1871 is dedicated to encouraging fire safety. The National Fire Protection Association has been the proud sponsor of Fire Prevention Week ever since it was first proclaimed in 1922 by President Warren G. Harding.

**Includes multiple fires.

Updated October 2013

Appendix B. The 10 Deadliest Wildland Fires in U.S History

	Event	Date	Number of Deaths
1.	Wildfire Peshtigo, Wisconsin	October 8, 1891	1,200
2.	Cloquet Fire Duluth, Minnesota	October 12, 1918	559
3.	Forest Fire Hinckley, New Mexico and environs	September 1, 1894	418
4.	Forest Fire Lapeer County Caro, Michigan	August 31, 1881	170
5.	The Devil's Broom Wildland Fire St. Joe Valley, Idaho	August 20, 1910	86 (includes 78 firefighters)
6.	The Griffith Park Fire Forest Fire Los Angeles, California	October 3, 1933	29 (all firefighters)
7.	Oakland Hills Fire Storm Oakland, California	October 20, 1991	26 (includes one firefighter)
8.	Yarnell Hill Fire Yarnell, Arizona	June 30, 2013	19 (all firefighters)
9a.	Rattlesnake Fire Mendocino National Forest Fire Willows, California	July 9, 1953	15 (all firefighters)
9b.	Blackwater Forest Fire Shoshone National Forest, Wyoming	August 21, 1937	15 (all firefighters)

Death tolls are based on information in NFPA's records. Please contact us at osds@nfpa.org to provide any updated information.

Source: NFPA's Fire Incident Data Organization data base and NFPA archive files.

October 2013

Appendix C.
How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit http://www.nfirs.fema.gov/. Copies of the paper forms may be downloaded from http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf.

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

Methodology may change slightly from year to year.
NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

NFPA's fire department experience survey provides estimates of the big picture.
Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S.

population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; 3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

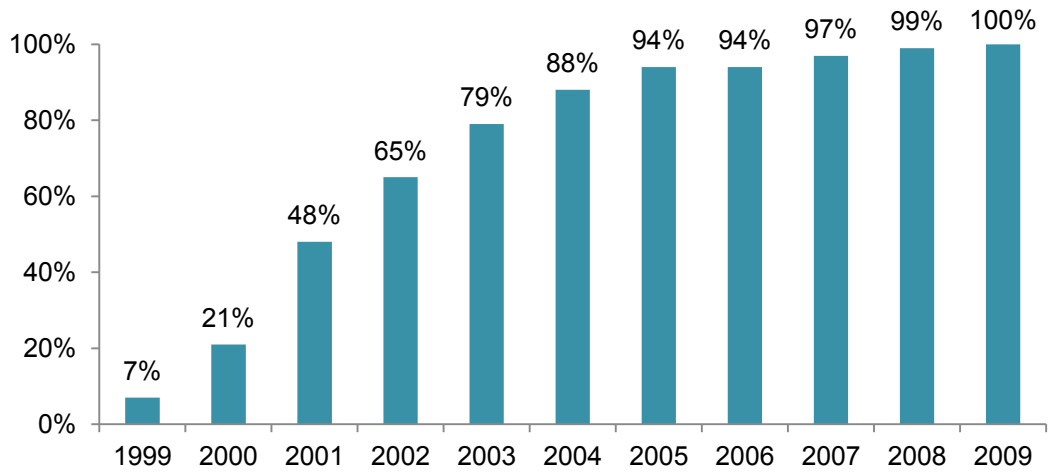
Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

Figure A.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.

Figure A.1. Fires Originally Collected in NFIRS 5.0 by Year



From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

NFPA survey projections
NFIRS totals (Version 5.0)

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

NFIRS 5.0 introduced six categories of confined structure fires, including:

- cooking fires confined to the cooking vessel,
- confined chimney or flue fires,
- confined incinerator fire,
- confined fuel burner or boiler fire or delayed ignition,
- confined commercial compactor fire, and
- trash or rubbish fires in a structure with no flame damage to the structure or its contents.

Although causal and other detailed information is typically not required for these incidents, it is provided in some cases. Some analyses, particularly those that examine cooking equipment, heating equipment, fires caused by smoking materials, and fires started by playing with fire, may examine the confined fires in greater detail. Because the confined fire incident types describe certain scenarios, the distribution of unknown data differs from that of all fires. Consequently, allocation of unknowns must be done separately.

Some analyses of structure fires show only non-confined fires. In these tables, percentages shown are of non-confined structure fires rather than all structure fires. This approach has the advantage of showing the frequency of specific factors in fire causes, but the disadvantage of possibly overstating the percentage of factors that are seldom seen in the confined fire incident types and of understating the factors specifically associated with the confined fire incident types.

Other analyses include entries for confined fire incident types in the causal tables and show percentages based on total structure fires. In these cases, the confined fire incident type is treated as a general causal factor.

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term "all fires" refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

Cause of Ignition: This field is used chiefly to identify intentional fires. "Unintentional" in this field is a specific entry and does not include other fires that were not intentionally set: failure of equipment or heat source, act of nature, or "other" (unclassified)." The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown.

Factor Contributing to Ignition: In this field, the code "none" is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for "not reported" when no factors are recorded. "Not reported" is treated as an unknown, but the code "none" is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, "mechanical failure or malfunction." This category includes:

21. Automatic control failure;
22. Manual control failure;
23. Leak or break. Includes leaks or breaks from containers or pipes. Excludes operational deficiencies and spill mishaps;
25. Worn out;
26. Backfire. Excludes fires originating as a result of hot catalytic converters;
27. Improper fuel used; Includes the use of gasoline in a kerosene heater and the like; and
20. Mechanical failure or malfunction, other.

Entries in "electrical failure, malfunction" (factor contributing to ignition 30-39) may also be combined into one entry, "electrical failure or malfunction." This category includes:

31. Water-caused short circuit arc;

32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

Heat Source. In NFIRS 5.0, one grouping of codes encompasses various types of open flames and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: "Heat from open flame or smoking material, other." NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
67 Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping "smoking materials" includes codes 61-63 (cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data.

Equipment Involved in Ignition (EII). NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to "the piece of equipment that provided the principal heat source to cause ignition." However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII = NNN and heat source is not in the range of 40-99 as an additional unknown.
To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{\text{(All fires – blank – undetermined – [fires in which EII =NNN and heat source <>40-99])}}$$

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

Code Grouping	EII Code	NFIRS definitions
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Fixed wiring and related equipment	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	213	Electric meter or meter box
	214	Wiring from meter box to circuit breaker
	215	Panel board, switch board or circuit breaker board
	216	Electrical branch circuit
	217	Outlet or receptacle
	218	Wall switch
	219	Ground fault interrupter
Transformers and power supplies	221	Distribution-type transformer
	222	Overcurrent, disconnect equipment
	223	Low-voltage transformer
	224	Generator
	225	Inverter
	226	Uninterrupted power supply (UPS)
	227	Surge protector
	228	Battery charger or rectifier
	229	Battery (all types)
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast

	235	Halogen light fixture or lamp
	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light
	238	Light bulb
	241	Nightlight
	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
Cord or plug	260	Unclassified cord or plug
	261	Power cord or plug, detachable from appliance
	262	Power cord or plug- permanently attached
	263	Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker
	637	Toaster, toaster oven, counter-top broiler
	638	Waffle iron, griddle
	639	Wok, frying pan, skillet
	641	Breadmaking machine

Equipment was not analyzed separately for confined fires. Instead, each confined fire incident type was listed with the equipment or as other known equipment.

Item First Ignited. In most analyses, mattress and pillows (item first ignited 31) and bedding, blankets, sheets, and comforters (item first ignited 32) are combined and shown as "mattresses and bedding." In many analyses, wearing apparel not on a person (code 34) and wearing apparel on a person (code 35) are combined and shown as "clothing." In some analyses, flammable and combustible liquids and gases, piping and filters (item first ignited 60-69) are combined and shown together.

Area of Origin. Two areas of origin: bedroom for more than five people (code 21) and bedroom for less than five people (code 22) are combined and shown as simply "bedroom." Chimney is no longer a valid area of origin code for non-confined fires.

Rounding and percentages. The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.