Fires and Exposures

Findings:

- Source fires and the subsequent exposure fires account for about 30,700 fires, 275 deaths, and 875 injuries annually.
- When structure fires are the source of exposure fires, they have the highest loss rates of any source fire.
- Structure source fires have over seven times the fire death rate, over five times the loss rate, and over four times the fire injury rate as the average structure fire.
- March has the highest incidence (12%) of source fires. This is primarily due to the increased incidence (19%) of outdoor source fires.

In 2004, an estimated 12,100 fires spread beyond their boundaries and caused an estimated 18,600 additional fires. These source fires and the fires resulting from their fire spread (exposure fires) resulted in an estimated total of $803 million in direct losses, 875 injuries, and 275 fatalities.[1,2]

Table 1. National Estimates for Source and Exposure Fires, 2004

Measure	Source Fires	Resulting Exposure Fires	Total
Fires	12,100	18,600	30,700
Deaths	255	15	275
Injuries	825	50	875
Dollar Loss	$605,000,000	$197,000,000	$803,000,000

Note: Totals may not add due to rounding
Source: 2004 NFIRS 5.0 data and NFPA Annual Survey

What is an Exposure?

Exposures are defined as anything in the immediate range of a fire that is not burning but could start burning if the fire is not contained. When enough oxygen is available, combustible material burns once its temperature reaches its ignition temperature. Preventing exposure fires requires protecting the objects from heat spread and thus from reaching their ignition temperatures.[3] This is one of the most critical jobs in firefighting, as protecting exposures helps contain the fire and prevents fire spread. After rescuing individuals, protection of exposures is the highest priority for firefighters.[4]

Exposures can be internal or external. Internal exposures are within the property, such as a room or floor of a building. External exposures include other buildings, vehicles, and outside objects or vegetation such as trash, dumpsters, trees, or crops. External exposures are typically known as "exposure fires." These exposure fires and the source fires that cause them are the topic of this report.

Why Fires Spread

A fire spreads for many reasons. The fire may go undetected for a substantial period of time because of the location of fire or, in the case of buildings, because of the lack of appropriate detection or extinguishing systems. There may have been a delay in notifying the fire department. The weather conditions or materials providing the fuel load may have contributed to the spread. Whatever the circumstance and whatever the reason, it is likely that fires with significant fire spread will extend to other areas, and can result in additional injuries, deaths, and dollar loss, as shown in Table 1. The source fire, because of the extent of the fire spread, has substantially higher loss rates than the resulting exposure fires (Table 2). In general, exposure fires have much higher loss rates than all fires.

continued on next page

Table 2. Loss Measures for Source and Exposure Fires, 2004

Measure	Source Fire	Resulting Exposure Fires	Source Fires and Exposures	All Fires
Loss per Fire	$54,248	$11,762	$28,728	$8,498
Injuries per 1,000 Fires	66.1	2.6	27.6	11.3
Deaths per 1,000 Fires	19.0	0.8	8.0	2.3

Note: Loss per fire is computed only for those fires where loss information was provided.
Source: 2004 NFIRS 5.0 data only

Wildland/Urban Interface Exposure Fires

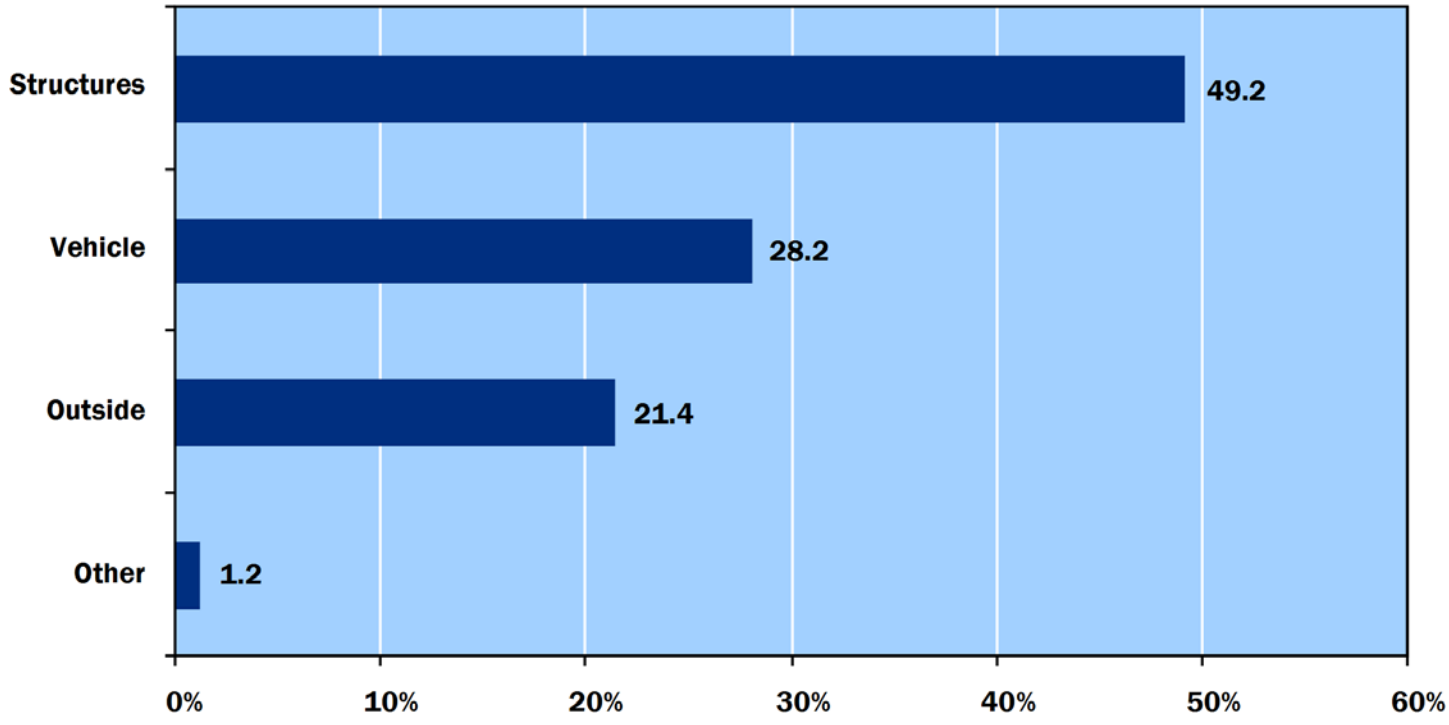
The wildland/urban interface (WUI), the area where structures and other human development meet or intermingle with undeveloped wildland, creates an environment in which fire can move readily between structural and vegetation fuels. WUI fires usually include a large number of simultaneously exposed structures and the immediate involvement of residential and commercial areas. The continuing WUI expansion has increased the likelihood that wildfires will threaten structures and people. Large WUI losses resulting from wildland fires are a serious issue. Public awareness of the WUI problem has grown recently, and the importance of limiting fuel loads (vegetation) around structures in the WUI has been stressed.

Source Fires

Approximately one-half of all source fires, those fires leading to exposure fires, occur in structures, as shown in Figure 1.

Source structure fires have the highest rates of deaths, injuries, and dollar loss compared to the average fire. Structures generally involve buildings, which have a higher percentage of individuals and property than other types of fires. Compared to the average fire, source fires have much higher rates of injuries, deaths, and dollar loss, as shown in Table 3. Generally, the dollar loss for structure fires decreases sharply in the first and second exposure fire following the source fire. Then in the third and fourth subsequent exposure fires the dollar loss increases but not to the level of dollar loss as the source fire, as shown in Table 4. This can happen when fire resources get fully committed before additional fire resources arrive.

Figure 1. Distribution of Source Fires by General Incident Type, 2004 (percent)



Source: 2004 NFIRS 5.0 data only

continued on next page

Table 3. Loss Measures for Source Fires and Average Dollar Loss for All Fires, 2004

	Structures		Vehicles		Outside		Other	
	Source Fire	All Structure Fires	Source Fire	All Vehicle Fires	Source Fire	All Outside Fires	Source Fire	All Other Fires
Loss per fire	$98,298	$17,327	$9,550	$4,562	$2,516	$517	$9,464	$2,734
Injuries per 1,000 fires	113.6	25.3	25.4	5.2	11.1	0.9	58.8	8.1
Deaths per 1,000 fires	33.9	4.7	7.8	2.2	0.9	0.1	0.0	0.6

Note: Loss per fire is computed only for those fires where loss information was provided.
Source: 2004 NFIRS 5.0 data only

Table 4. Dollar Loss for Exposure Fires by Number of Exposures and General Incident Type; Four or Fewer Exposures, 2004

Measure	Number of Exposures:				
	Source	One	Two	Three	Four
Structure Loss Per Fire	$98,298	$15,348	$16,840	$22,148	$28,681
Vehicle Loss Per Fire	$9,550	$6,155	$4,465	$3,520	$4,784
Outside Loss Per Fire	$2,516	$2,009	$6,977	$4,929	$2,931
Other Loss Per Fire	$9,464	$4,473	$2,215	$34,241*	$990

Note: Loss per fire is computed only for those fires where loss information was provided.
Source: 2004 NFIRS 5.0 data only

*This value includes a fire with a dollar loss 50 times the average dollar loss for "other" fires.

Source fires spread to similar type properties. For example, source structure fires spread to other structures 70% of the time. Vehicle fires spread to other vehicles 68% of the time, and outside fires spread to outside fires 47% of the time, as shown in Table 5.

Table 5. Type of Exposure Fire by Source Fire, 2004

Source Fire	Exposures				
	Structure	Vehicle	Outside	Other	Total
Structure	70%	22%	3%	5%	100%
Vehicle	25%	68%	5%	3%	100%
Outside	36%	13%	47%	4%	100%
Other	18%	14%	3%	65%	100%

Source: 2004 NFIRS 5.0 data only; some totals may not add to 100% due to rounding.

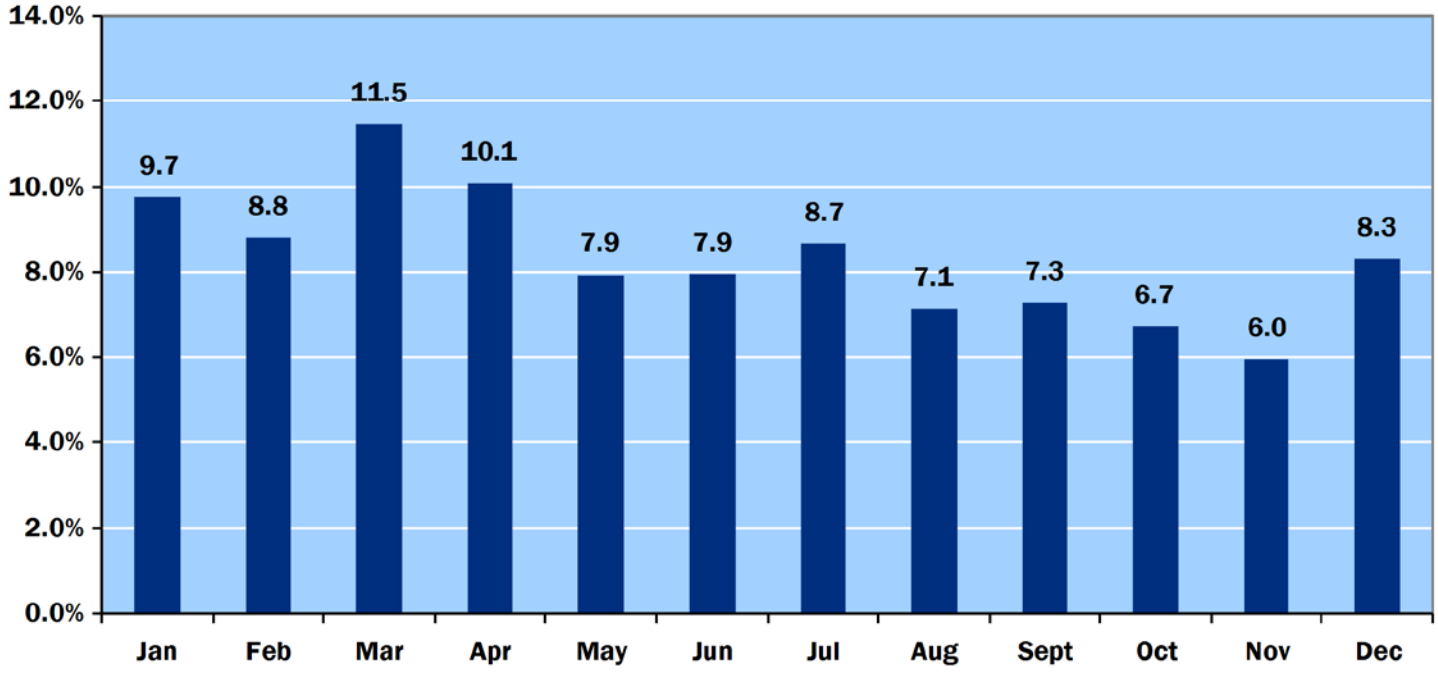
When Source Fires Occur

Overall, source fires occur at a relative constant rate, with a notable peak above average in March, as shown in Figure 2. Structure source fires typically occur at all times of the day, with a slight peak between the hours of 4 a.m. and 5 a.m., as shown in Figure 3. There is also a slight peak in the number of structure source fires during the month of January, and the incidence of these fires remain higher than average in the colder weather months through April, as shown in Figure 4. Vehicle source fires peak between the hours of 2 a.m. and 4 a.m. Although these vehicle fires typically occur at a constant rate throughout the year, there is a slight peak in July.

Outside source fires generally occur in the early spring when conditions are drier, with a sharp peak in March. These outside fires typically occur during the early afternoon, with a definite peak between the hours of 2 p.m. and 3 p.m.

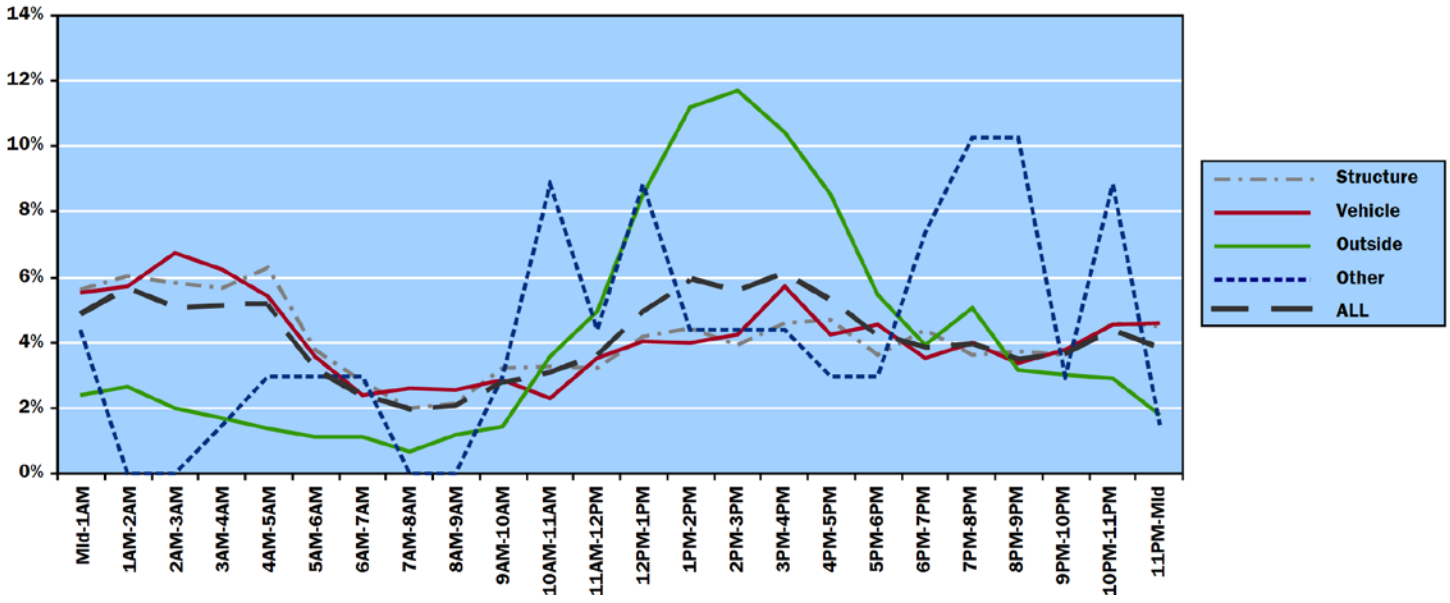
continued on next page

Figure 2. Distribution of Source Fires by Month, 2004 (percent)



Source: 2004 NFIRS 5.0 data only

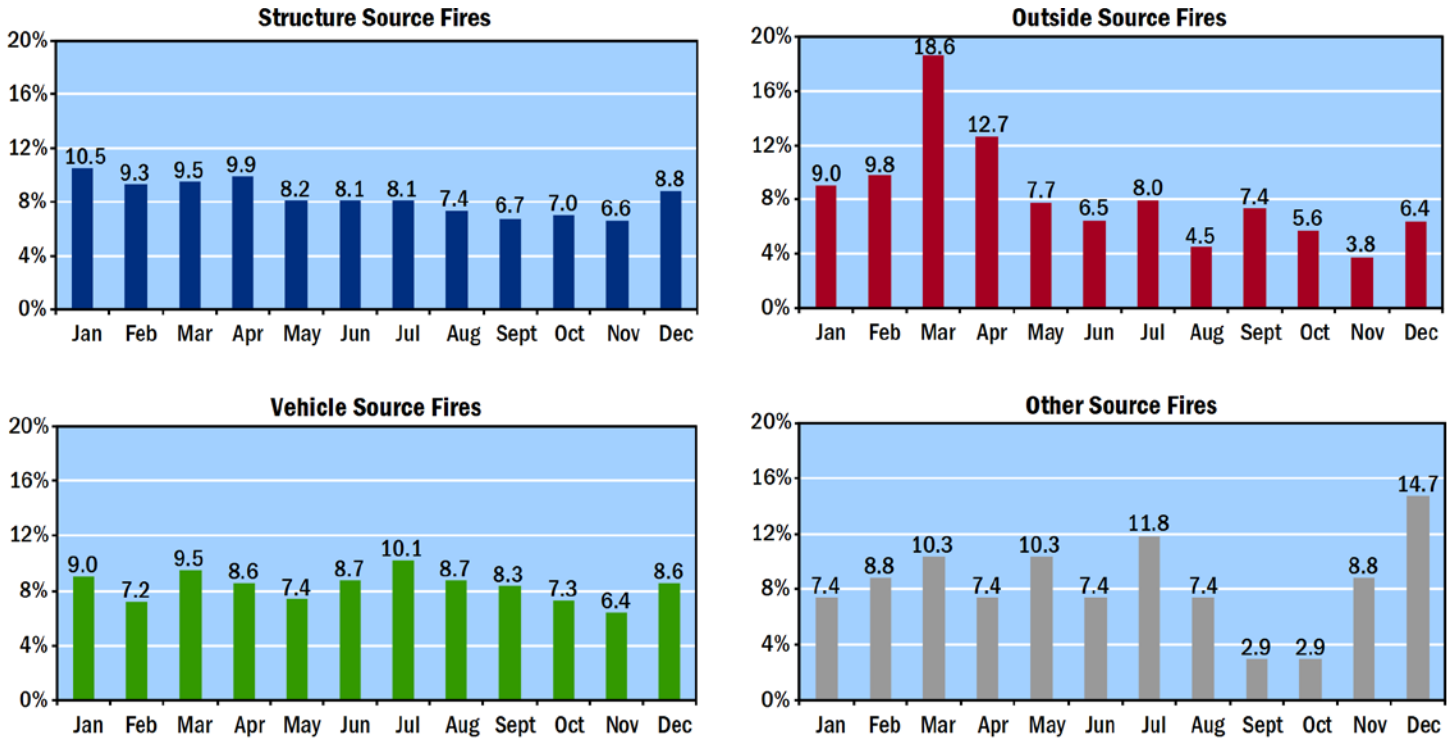
Figure 3. Distribution of Source Fires by General Incident Type and Hour, 2004 (percent)



Source: 2004 NFIRS 5.0 data only

continued on next page

Figure 4. Distribution of Source Fires by Type of Fire and Month of Occurrence, 2004 (percent)



Source: 2004 NFIRS 5.0 data only

Causes of Source Fires

The top three causes of source fires include incendiary or suspicious (43%); open flame, ember, or torch (17%); and other heat, flame, or spark (14%), as shown in Figure 5. For example, numerous vehicle fires fall under the incendiary or suspicious category as a result of insurance fraud.[5] Open flame items such as candles, matches, lighters, and cigarettes can cause devastating fires. Fires from other heat, flame, or sparks can include fireworks or malfunctions of appliances and machinery.

Examples

Each year, newspapers describe various incidents where fires spread away from the original fire source. Below are four examples of such fires:

- February 2007—About 150 firefighters battled a Raleigh, North Carolina, townhouse complex fire for more than an hour. The flames were fanned by winds that reached 30 to 40 mph, which made the fire difficult to control because embers were blown over firewalls separating the units.[6]
- February 2007—Des Moines, Iowa, firefighters responded to a chimney fire at a single family home around 7 p.m. That fire quickly spread to two other connecting buildings.[7]
- February 2007—Pittsburg, Kansas, Fire Department officials say a trash barrel was the source of a fire that destroyed a two-car garage and sent heavy smoke up into the downtown sky.[8]
- February 2007—Two Looneyville, Texas, houses burnt to the ground and the fire spread to the adjoining woods. There were three propane tanks sitting in the middle of the blaze that kept the first responders from being able to initiate their attack.[9]

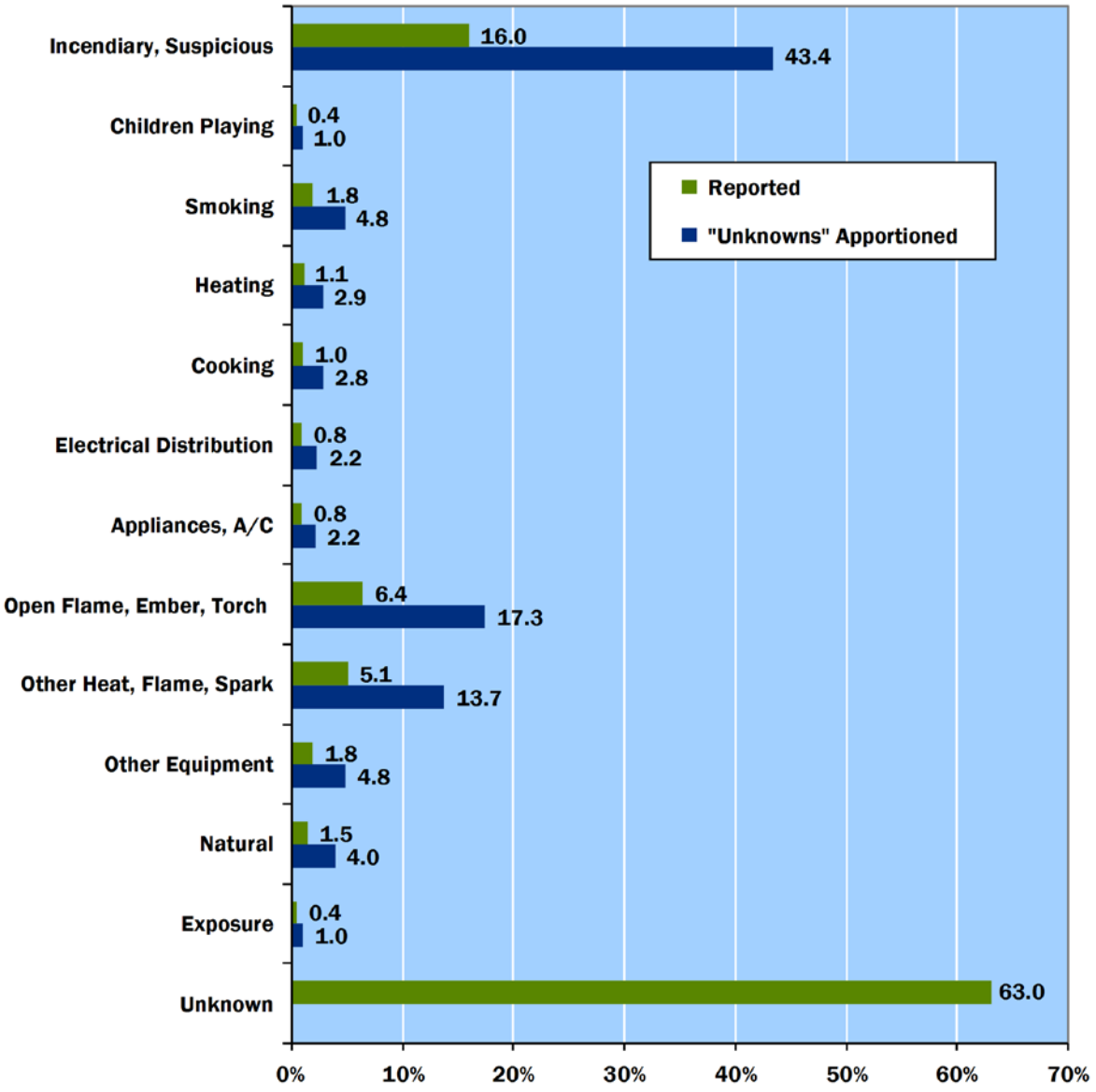
Conclusion

Although the incidence of fires with exposures varies by month, the risk remains serious throughout the year. Therefore, fire safety must be practiced constantly to ensure early detection and early notification. Preventing exposure fires involves controlling the spread of the source fire. It is necessary to make sure that smoke alarms work and sprinklers are installed whenever possible. Do not try to put fires out yourself, and call for fire assistance as soon as possible.

Outside fires do have predictable fire seasons in early spring and late summer. The most successful means of protecting

continued on next page

Figure 5. Cause Distribution of Source Fires, 2004 (percent)



Source: 2004 NFIRS 5.0 data only

structures in the WUI is not necessarily advancements in fire technology but in educating communities in the WUI. Structures that are threatened by wildland fires need special attention during the fire season by clearing out nearby vegetation, brush, and other combustibles. It is recommended that homeowners take responsibility for securing fire-safe conditions and source-fire defense of their residences during wildland fire season by following these guidelines:[10]

- Remove leaves, brush, and dry grass within 30 feet of residences and other structures.
- Remove trees within 10 feet of residences, and space trees 10 feet apart. Cut branches below 6 feet from the ground to prevent fires from spreading into the treetops.
- Clean roofs and rain gutters regularly to keep them free of twigs, leaves, and pine needles. Remove all tree limbs within 10 feet of your chimney or stove pipe.
- Store firewood and other combustible materials, such as picnic tables, at least 30 feet away from any structures.
- Apply a fire-retardant solution, such as phosphate salt, to wood shingles and shake roofs.

continued on next page

More information about how you can help prevent exposure fires can be obtained from your local fire department or the U.S. Fire Administration.

To request additional information or comment on this report, visit

http://www.usfa.dhs.gov/applications/feedback/

Notes:

[1] NFIRS 5.0 contains both converted NFIRS 4.1 data and native NFIRS 5.0 data. This topical report includes only native 5.0 data. Incident type 110 (structure fire, other) is not included in this analysis as it is a "conversion only" code. That is, incident type 110 is technically a version 4.1 incident and, as such, is not included in this analysis.

[2] National estimates are based on native version 5.0 data from the 2004 National Fire Incident Reporting System (NFIRS) and national fire loss estimates from the National Fire Protection Association's (NFPA) annual survey of fire loss. Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25, and loss to the nearest $million.

[3] Heat spreads in three ways. The first is through radiation, which transmits heat in the air. Any material close to a fire absorbs heat until it starts to burn. The second is through conduction, where heat is absorbed by an object or material such as metal that can transfer heat to another area. The third is through convection, where heat, smoke, and fire are drawn upward spreading throughout concealed spaces, floors, walls, roofs, or attic spaces.

[4] Lloyd Layman, *Fire Fighting Tactics*, page 10.

[5] Consumeraffairs.com, "Some SUV Owners Burning More than Gas," http://www.consumeraffairs.com/news04/2006/06/suv_arson.html

[6] WRAL.com, "Investigators Find Fire Cause; Burned-Out Residents Find Very Little," http://www.localtechwire.com/news/local/story/1212119/

[7] WHOtv.com "Fire Spreads to Three Buildings," http://www.whotv.com/Global/story.asp?s=6070271

[8] Greg Grisolano, "Trash Fire Spreads to Garage," Pittsburg State University, http://media.www.psucollegio.com/media/storage/paper437/news/2007/02/22/FrontPage/Trash.Fire.Spreads.To.Garage-2740864.shtml

[9] Johnny Johnson, The Daily Sentinel, "House Fire Spreads into Woods," http://www.news-journal.com/news/content/region/ETtoday/stories/2007/02/26/looneyville.html

[10] Forest Service Publications "On the Line of Fire The Men and Women Who Battle America's Wildland Blazes," http://www.dnr.state.md.us/forests/otheragencies/fire.html