



Fire Suppression in Cedar Woodlands

Most Kansas fire departments are proficient at fighting grass fires. For many departments, these are the most common fires they encounter. Many fire departments that historically protected grasslands are now facing timber fires.

Since 1965, the volume of eastern redcedar (*Juniperus virginiana*) in Kansas has increased more than 23,000 percent. Cedar fires require a significant change in safety procedures and firefighting tactics.

While specifically addressing the spreading cedar woodland, this information also applies to hardwood timber, although hardwood fires are not as common in Kansas and are typically easier to control.

Safety

Safety should be at the forefront of all fire department operations. For wildland firefighting, the acronym LCES — *Lookouts*, *Communications*, *Escape Routes*, and *Safety Zones* — describes the basic level of safety that must be in place before engaging a fire. This strategy is implemented differently in timber than in grass fires.

Lookouts must be able to see fire behavior and track where personnel are working. With a grass fire, everyone can see the fire and adjacent units easily. If fire behavior becomes threatening, everyone can see it immediately and respond

quickly. In a cedar stand, it may not be possible to see fire 50 yards away. Firefighters might not know they are in danger until it is too late.

Someone must be in place to monitor fire behavior, note changes, and advise operating units when there could be a threat to their safety. That leads to the “C,” communications. Hand signals, visually tracking progress of neighboring units, and simply yelling may work on a grass fire, but a timber fire of any size requires radio communications.

Effective radio communication requires equipment that allows all operating units to communicate with the incident commander or division supervisor. Effective radio communications also refers to effective *use* of the equipment, including keeping transmissions concise and using common terminology.

Escape Routes and Safety Zones go hand-in-hand. With a grass fire, that typically means working in the burned area — “the black” — or having immediate access to it. In a timber fire, burned areas may not be burned cleanly enough to prevent them from burning again. These burned areas can retain dangerous heat long after the fire front has passed. Roads, parking lots, and large clearings make effective safety zones. If none are available, it may

be necessary to use heavy equipment or chain saws to create a safety zone.

A safety zone must separate firefighters from the flames for a distance at least four times the flame height. This means more than 100 yards of separation from the fire may be necessary for a true safety zone, and a safety zone is useless if firefighters cannot reach it quickly.

The Escape Route to access the safety zone must be known by all and easily travelled. Consider how long it will take to identify a threatening change in fire behavior, notify all personnel, and for them to reach the safety zone. If the slowest person cannot reach the safety zone well before the fire does, LCES is not adequately in place and changes must be made.

A final consideration for safety is that the potential for much higher flame intensity exists in timber fires. Most are creeping surface fires, but if a crown fire occurs, far more fuel is available in a stand of 20-foot tall cedar trees than in even the densest prairie grass.

Full wildland personal protective equipment, *not* structural firefighting gear, is essential for woodland fires.

Fire Behavior

A grass fire in Kansas is usually dictated by wind, with some

influence from terrain. Flame lengths can range from a few inches to more than 10 feet, with rate of spread approaching the speed of eye-level winds.

Because they burn much heavier fuels, timber fires are typically much slower spreading, even when pushed by wind. With dry conditions and wind or a slope to aid in its spread, a timber fire can still spread faster than a firefighter can run — especially once that firefighter has committed to working within the woods where limbs, down material, and other obstructions slow his or her movement.

Most woodland fires are surface fires, spreading in leaf litter or smoldering in the layers of decaying plant matter on the forest floor, known as duff. This can be deceptive, because the problem appears to be minor, but it can present challenges.

When conditions are right, trees can torch and become a sustained crown fire (a fire spreading through the tree canopy with high intensity). A crown fire is a life-threatening event if LCES is not in place and

personnel do not move to a safety zone quickly. The transition from surface to crown fire can happen quickly with subtle changes in weather and terrain conditions, which highlights the importance of a lookout who can quickly alert personnel. Without a lookout, firefighters working in the woods may not see a crown fire approaching through the trees until escape is no longer a possibility.

Control of a crown fire is generally not possible by ground forces. Equipment such as hand tools and booster hoses will not have any meaningful effect on the fire. Aerial attack may help keep the fire out of the crowns, but it is not widely available in Kansas. Heavy-caliber hoses and deck guns may assist if pumpers and a large water supply are available to support them, but that is rare in these fires. In a crown fire, crews must evacuate to a safety zone and wait for fire behavior to change, concentrating their efforts on evacuating those in its path or on controlling the flanks of the fire.

Control Tactics

Fire engines with nozzle operators or remotely operated nozzles spraying water on the flames typically are used to control grass fires. If done carefully, the fire is often extinguished in the first pass. If any mop-up is conducted, it is usually a matter of traveling the perimeter to make sure nothing was missed, perhaps kicking some debris into the interior and making sure there is no smoke near the edge. Typically, even large grass fires are controlled within a few hours of the initial attack. Few grass fires require attention after they are extinguished. These tactics do not work well to control woodland fires.

It is rarely possible to drive into a wooded area and conduct a rolling attack with engines and hoses. If hoses will reach at all, trees prevent them from being moved quickly from one area to the next.

At times, the easiest tactic in a small woodland area may be to wait for the fire to come out to the grass and attack it there. If this is not an option, fighting the fire will involve hard work. Backpack pumps may be useful in areas with duff layers. The duff layer is often deep enough that water gives a false sense of security, extinguishing visible flames on the surface while doing little to actually stop the fire.

Establishing a control line with hand tools is usually necessary. To establish a control line, it is necessary to dig, scrape, or chop through material to create a line around the fire that is cleaned to bare mineral soil and wider than the height of the flames. If available, natural or man-made barriers can be used as part of the control line.

Firefighters wearing structural gear or who are in poor physical condition will quickly overheat and become exhausted. Lighter-weight wildland gear is much better suited



In the same conditions, fire in cedar woodlands can burn with much greater intensity than in grasslands. Photo credit: Josh Shroyer, Missouri Department of Conservation.



Pulaskis, combi tools, Rhinos, McCleods, and council rakes (top to bottom) are all useful tools for establishing control lines in timber fires

to this task, and being physically fit is essential.

In constructing a fire line, the first tools will be chopping tools such as Pulaskis, followed by scraping tools like combi tools, rhinos, and McCleods. Finally, tools such as leaf rakes, Council Rakes, and leaf blowers can clean up the last of the line as the crew moves forward.

The line may be constructed right on the edge of the fire — a direct attack — if flame lengths allow. Generally this approach is limited to flames less than 4 feet in length. Up to 8 feet of flame length may be safely attacked under most circumstances using heavy equipment such as bulldozers. These tools have seen little use in Kansas historically, but they are becoming more necessary as cedar woodlands expand.

Firefighters may wish to establish relationships with contractors or public works agencies that can provide such equipment and coordinate safety and communications needs before a fire.

If flame length and intensity prevent a direct attack with the

equipment and personnel available, an indirect attack will be necessary. An indirect attack involves working a safe distance ahead of the fire. Construct a fire line far enough ahead of the fire that it can be completed before the fire reaches it.

In most cases, it will then be advisable to burn out the fuels inside the line to expedite control. If the line is not burned out, significant

holding forces may be necessary to ensure the fire does not cross the line when it arrives. A shift in wind, a change in humidity, or other circumstances could allow the fire to build speed and intensity as it approaches the line and to cross the line when it arrives. Sufficient resources must be on hand to stop it quickly if that occurs.

Mop-up and Patrol

Grass fires usually require little mop-up. They rarely require patrol once they are considered to be out, even if small signs of smoke remain inside the burned area. Do not assume the same to be true in timber fires: this attitude increases the chance of attacking the same fire again.

After a timber fire is contained, several factors threaten to allow the fire to escape. Duff layers are often deep enough that even if they were thought to be thoroughly wet down, the bottom may still be dry and can smolder under a wet or even foamed layer for hours or days. If any unburned duff remains inside the line, the fire cannot be considered



Any material near the line that is hot or smoldering will require mop-up before the fire can be considered controlled. Photo credit: Dan Moran, Missouri Department of Conservation.

fully controlled. Heavy materials, particularly dead and down materials, can burn for hours, days, or sometimes even weeks.

Tree roots can smolder for days or weeks, retaining sufficient heat to eventually reach a root from a tree across the control line, surface, and reignite a fire that was thought to have been out. Usually, a grass fire can safely be considered “over” once the perimeter is out. A woodland fire is not out until it has been smoke-free for a period of days.

The first step after a woodland fire is contained (i.e., a control or containment line is fully around it, with no active fire on the perimeter) is to begin mop-up. At this point, the emergent phase of the incident is done, but it is too early to get complacent. Falling limbs or trees, pockets of fuel reigniting, and other threats remain. Firefighters must continue to use full wildland protective gear. Personnel with hand tools, small-diameter hoses, and backpack pumps need to work the entire perimeter, extinguishing any remaining sources of smoke, checking for residual heat, digging up or burning out any remaining leaf litter or duff layers, and making sure nothing remains that will have any potential to threaten the control line.

Check a fire weather forecast with the National Weather Service to learn if wind shifts, drops in humidity, or other changes could cause fire behavior to change. Something that presents no threat now could be a flare-up in 24 to 48 hours if the weather changes.

Mop-up in a timber fire often continues for at least a day or two after the initial fire. It does not require the same resource commitment that the initial attack did, but some resources may need to be on scene at least during the warm, dry parts of the day to identify and address any flare-ups or other potential threats to the line. Roll logs over and make sure there is no heat and check stump holes, pockets of burned material, and the like to make sure there will be no surprises. It is not unusual to be “sure” there was nothing left hot or smoking, only to return the following day and find more heated and smoking material in the same area, especially during the hottest, driest part of the day.

Once it appears nothing remains that could threaten to cause the fire to escape containment, based on current and predicted weather conditions, a fire can safely be deemed “controlled.” At this point, patrol status begins. This involves

checking the perimeter and interior daily or more frequently, until the incident commander is confident that nothing is left burning and there is no chance of the fire reigniting, flaring up, or crossing the control lines. This same step would likely have occurred before sunset the first day on a grass fire, but in timber, these steps take days — even weeks in some situations.

Timber fires are not much more complex than grass fires. They require most of the same steps to control as grass fires, but those steps must be adapted to the timber environment. Plan to spend significantly more time managing a timber fire than a grass fire. Whereas a 1,000-acre grass fire will typically be over the same day it starts, a 10-acre timber fire may require mop-up or patrol for several days following the initial call. It may require more physical work. If methodical, deliberate steps are taken, and mop-up and patrol are undertaken diligently, most Kansas fire departments should be able to handle most timber fires.

The first objective on any fire is to provide for firefighter and public safety. When that objective is met, it is a matter of working until the job is finished.

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