Fire Management in Midwestern Oak Savannas

By Tom Brock: Land manager; Pleasant Valley Conservancy State Natural Area; Black Earth, Wisconsin. June, 2017

Introduction
Oak savannas are fire dependent communities. Fire management in oak savannas differs from that of prairies or oak woodlands. This document provides details on how to conduct an oak savanna burn.

Fire is especially important in oak savanna restoration. An oak savanna restoration project should not be initiated if fire is not an option. Ideally, fire should be used annually for at least 10 years. After 10 years, fire can continue to be used annually, but should be used at least two out of every three years indefinitely.

A controlled burn in a bur oak savanna. This is the first time this savanna had been burned, and is being burned as a headfire. The weather was sunny with a dry air mass and a sharp wind out of the southwest. Two days before a heavy rain had fallen. October 29, 2002.

savanna-burn-2002-N606.jpg
Savanna burns are different than prairie burns

Prairie burns
The principal fuel in a **tallgrass prairie burn** is dried grass. Grass is thick and burns hot. The continuity is very good and it is usually easy to get complete burn coverage. It is very flammable, ignites quickly and fire spreads rapidly. Fire “carries” well in a prairie burn.

Oak savanna burns
The principal fuel in an **oak savanna burn** is dried oak leaves. Fuel continuity may be spotty, depending on how trees are distributed and how leaves fall to the ground. There may be thick piles followed by thin piles, or even some bare areas. Continuous fire lines are harder to create, and more attention must be given to ignition. On the other hand, flame heights are lower and the rate of movement of fire is much slower, so control of the burning process is easier.

**Comparison between prairie (foreground) and savanna (background) burns.**

*Fuel: oak leaves vs. grasses*

*Intensity: low intensity (savanna) vs. high intensity (prairie)*

*Control: relatively easy vs. difficult (because of flashy fuels)*

*Mop-up: easy vs. difficult*
Characteristics of an oak savanna burn

Fuels are different physically and chemically. Fuel in a savanna burn is usually heterogeneous, consisting of oak leaves; weedy forbs; warm-season grasses in sunnier openings; small dead sticks and limbs (coarse woody debris). Because the principal fuel is oak leaves, the fire burns cooler and the flame heights are lower than in prairies.

For a savanna burn, a good wind is important for carrying the fire through the burn unit. Fire may not carry well due to woody litter that may block fire movement. Because of this, interior lighting (stripping) is often essential (at least in the early years of a restoration).

Because flame heights are lower, firebreaks can usually be narrower.

Many savanna burns are carried out in hill country, where a steep slope may determine the behavior of the fire. In a burn unit in hill country the flame characteristics are mostly determined by the slope rather than the wind. This is because the rising flames burn the fuel on the uphill side of the burning front, and this phenomenon propagates up the hill. In addition, convection and radiant heat move upward, resulting in more preheating of the fuel and faster ignition.

If the wind is blowing uphill, it adds to the effect of the slope. Thus, lower wind speeds are needed when burning upslope than when burning on the level. If the wind is too strong, an upslope burn may not be possible, whereas the same wind on a level burn might not be a problem. In general, it is advisable to conduct hill country burns as backburns, starting at the top of the hill.

Mop-up is often a problem in savanna burns because of snags, woody debris, and downed timber. Snags must be protected by clearing around them so they do not catch on fire. Also, special trees may need to be protected. If snags do catch on fire, for safety they may need to be cut down.

Burn crews should have experience doing oak savanna burns.

Fuel in oak savannas
Oak leaves are adapted for burning. They are said to “carry” a fire. They are stiff and weigh more than other hardwood species. They burn at hotter temperatures (~200 C) than other hardwood leaves (U.S. Forest Service data) but much cooler than prairie grasses.

Oak leaves are curled and form a porous fuel bed. Air (oxygen) can circulate, maintaining the fire. Other hardwood leaves such as maple lie flat, retain moisture, and do not burn well.

Oak leaves are slow to decompose compared to other hardwood leaves; they will burn even after being buried in snow for several months. In addition, chemicals in oak leaves help to make them more flammable.
Fire moves relatively slowly through oak leaf fuel bed with lower flame heights. Whereas a prairie fire can often have a flame height of 10-15 feet and move as fast as 50-100 feet per minute, in an oak savanna burn the flame height is generally as low as 6-12 inches, and the rate of movement is 2-3 feet per minute.

However, although oak leaves are generally the principal fuel, well established savannas with extensive open canopies will also have areas of prairie grasses and forbs. These will not be as continuous as in a true prairie, so the fuel may alternate between grasses/forbs and oak leaves. The “prairie” portions of such a savanna will thus burn hotter and quicker, making fire management especially complicated.

**Fuel moisture**

Fuel moisture plays a major role in any burn. (In the fire literature, this is often expressed as “dead fuel moisture”.) Assessing the fuel moisture for a savanna burn is different than that for a prairie burn.

If there has been recent precipitation or heavy dew, the dead-fuel moisture may be too high for a successful burn. A day or two of sunny weather with temperatures above freezing and relative humidity (RH) 40-45% may be necessary to dry the fuel sufficiently for a successful burn. Wait until a dry-air mass moves in on a cold front to provide acceptable weather conditions (strong wind, low RH, sun). Temperature is less important than RH.

In an open savanna (canopy coverage 35-45%), where the fuel is exposed to sun, one day of sunny dry weather may be enough to create suitable burn conditions. In more closed savannas (canopy 55-65%), where sun reaches the ground only in small areas, it may take longer for the fuel to dry out, and a strong wind will be necessary.

Monitor the fuel moisture. The dead fuel moisture content should be less than 15%, preferably less than 10%. Pick up some leaves and see if they crunch. Then use the table below to determine their approximate moisture content.

McCarthy’s test for assessing the moisture content of hardwood leaves by the bending

<table>
<thead>
<tr>
<th>Moisture content</th>
<th>Behavior during bending</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-40%</td>
<td>Leaves crack if creased but do not break entirely</td>
</tr>
<tr>
<td>14-20%</td>
<td>Leaves crack if folded more than a right angle</td>
</tr>
<tr>
<td>14%</td>
<td>Leaves crack if bent at a right angle but do not break freely, especially at the veins</td>
</tr>
<tr>
<td>10%</td>
<td>Leaves break entirely apart if bent at right angles</td>
</tr>
<tr>
<td>&lt;10%</td>
<td>Leaf crumbles when you pick it up</td>
</tr>
</tbody>
</table>

When using the McCarthy bend test, take several samples in both sunlight and shade and if on a slope, at the top, middle, and near the bottom of the unit.

If the leaves have been wet from precipitation, wait at least one day of full sunshine with medium winds and RH <50% to create conditions suitable for a burn.

**Dewpoint** is a measure of the moisture content of an air mass, and is an important parameter to consider in predicting the suitability of weather for a burn. Although dewpoint is the indicator of the dryness of an air mass, RH is the parameter that influences the burn. Monitor the weather on the main NOAA website and wait until the dewpoint is low.

Temperature is important chiefly because of its influence on RH. Consider the graph below: With bright sun the temperature may rise 30 or 40 degrees F between 9AM and 3 PM. At the same time, the RH is decreasing sharply. Thus, the same air mass in the afternoon when the temperature is 60 F can have a low RH, foreseeing a really hot burn. But in the early evening, again with the same dewpoint, the RH can rise again. Remember: it is RH more than temperature that determines fire behavior.

![Graph showing temperature and relative humidity over time](http://www.greenskychaser.com/blog/2011/01/31/meteorology-101-elements-of-weather-moisture/)

After the fall of new oak leaf litter, a good burn may be achieved in a single day on south exposures (the usual exposure for a savanna) after sunny, windy weather and low RH. However, on north exposures (the usual exposure of an oak woodland), due to the small angle of insolation and shade cast even by hardwood crowns, leaves will probably be difficult to ignite.

Wind is necessary for rapid drying, especially on N exposures.
An example of (stripping) interior lighting. This is the first burn at this white oak savanna. Although the solid carpet of leaves means that the fire will burn, the numerous sticks and small branches may block the fire movement in some areas. Kathie had to do lots of interior lighting to get suitable burn coverage. **Do not be satisfied with partial burn coverage!**

*You need at least 80% coverage.*

kathie burning wh oak savanna 1999.tif
Typical oak leaf burn. Note how loose the fuel bed is. These are freshly fallen leaves. But even old oak leaves will burn.

2014-woods-burn-Vahldieck-photo.jpg
Early stage of an oak savanna burn. Note the good continuity of the fire line. This is important, and the igniters must take special efforts to ensure this.
Burn-sav-U19-0554.jpg
Low flame height from burning oak leaves. It is often possible to simply step across the savanna fire line.
4-april-2013-savanna-burn-0594.jpg
Low flame height in a savanna burn. Note also that the firebreak (gravel road) is free of leaves and that the burn line is straight at the firebreak.
Burn-Unit-19D-3-29-2016-2962.jpg
A powerful leaf blower is an essential tool on savanna burns. It is used in creating firebreaks, and in clearing around trees that need to be protected from fire.

Leaf blower crop 2009 IMG_1726.jpg
Firebreaks for savanna burns
Because the flame heights are lower, firebreaks can be narrower than those for prairies. Paved roads are better than gravel roads which are better than dirt roads. In all cases, the firebreak should be free of leaves. A final “touch-up” should be carried out on the morning of the burn.

Typical firebreak for a savanna burn. This break is a gravel road suitable for utility vehicles or even pick-up trucks. Several passes with leaf blowers were needed to make the firebreak free of leaves. Note also the unburned sticks and branches on the ground in the burned area, typical of a savanna burn.

Burn-Kathie-Denny-2017-4650.jpg
Preparing a new firebreak in a wooded area. All down woody material must be moved out of the firebreak. A small chainsaw may be necessary for larger logs. Leaf blowers are then used to clear down to mineral soil.

Fire-break-clearing-2012-0272.jpg
fire-break-clearing-2012-0270.jpg
Small utility tractor mowing a firebreak through a savanna. Workers on foot had first walked the whole firebreak and removed all woody material. Two passes with the tractor were necessary to make the break wide enough. Before the burn two leaf blowers passed along the break and cleared it of all residual leaves. See below photo for an after-burn result.

Mowing-fire-break-savanna-0011.jpg
Tractor-mowed firebreak through a white oak savanna. See above photo for creation of this firebreak. Frequent mowing keeps the lane green. Before the burn, it was cleared of fallen leaves with leaf blowers.

Burn-sav-results-0820.jpg
Utility gravel road serving as a firebreak. The utility vehicle with pumper unit is used for mop-up. It can go almost anywhere in the burn unit.

Burn-4-6-2014-Triangle-12A-2317.jpg
Protecting snags and special trees
Snags (standing dead trees) are important components of savanna ecosystems, providing significant wildlife habitat. However, since snags are quite flammable they must be protected for savanna burns. The bases of snags must be cleared of flammable fuel, using rakes, leaf blowers, or weed cutters.

An ideal procedure involves two people. The first operates a brush cutter containing a blade with plastic flails that will cut standing vegetation but will not damage the tree trunk. The second person follows and clears the loose vegetation with a powerful leaf blower. The goal is to create a vegetation-free zone with bare soil.

Snag ridden with woodpecker holes. A large variety of “critters” make use of standing dead trees. Snags are especially flammable and must be protected by clearing around their bases, and keeping the flame heights low. Photo 10/28/2014 IMG_0441.jpg
AVOID THIS!

Do not permit logs and other woody debris to touch any tree. Although a living tree may be fire-resistant, the fire scar created will shorten its life.

Cedar Creek Natural Area photo
Deciding when conditions are suitable for an oak savanna burn

Oak savanna burns are dormant-season burns that can be carried out either in early spring or late fall.

Although oak leaves are often considered to be one-hour fuels, they will usually take longer to dry out than prairie grass, especially in wooded areas that the sun may not reach. Trees slow or block the wind, so faster wind speeds may be needed to dry the leaves and carry the fire. Wind speeds of 10-15 mph are ideal for savanna burns.

Since oak leaves are what carry a burn, it is important to know when a suitable leaf pack is present on the forest floor. Not all species of oaks lose their leaves at the same time in the autumn. Bur oaks lose all their leaves earlier than other species. White oaks often retain most of their leaves in the fall and gradually lose them through the winter. Some white oak leaves may still be on the tree when new leaves start to appear in the spring. Red and black oaks lose their leaves in the fall, but at different dates depending on the year. Although the really large oaks lose all of their leaves in late fall, younger specimens often retain their leaves until spring, only losing them at the time of bud break. Thus, leaf fall should be monitored. There may be years in which all oak species have lost their leaves before the end of October and an early fall burn can be carried out. In other years it may be necessary to wait until early winter or even the following spring.

If the savanna has not been previously burned, a substantial leaf pack will be on the ground. Only the top portion of this pack may burn but this will be sufficient to create a good burn.

If there had been recent precipitation or heavy dew, the dead-fuel moisture may be too high for a successful burn. A day or two of sunny weather with temperatures above freezing and RH 40-45% may be necessary to dry the fuel sufficiently for a successful burn. Wait until a dry-air mass moves in on a cold front to provide acceptable weather conditions (low dewpoint, strong wind, low RH, sun). As long as it is above freezing, temperature is less important than RH.

In an open savanna (canopy 35-45%), where the fuel is exposed to sun, one day of sunny dry weather may be enough to create suitable burn conditions. In closed savannas (canopy 55-65%), where sun does not reach the ground in most parts of the savanna, it may take longer for the fuel to dry out, unless there is a strong wind.

Monitor the fuel moisture. Use the McCarthy leaf test described above to assess the dead fuel moisture (DMC) content. The DMC should be less than 15%, preferably less than 10%. Pick up some leaves and see if they crunch. Then use the table to determine their approximate moisture content.
Establishing the savanna burn unit

Although the savanna may be large, it should be divided into smaller burn units for easier control. But when weather and other conditions are favorable for burning, burn as many of these units as possible in a single day.

Five to ten acres is a good size for a savanna burn, although if the situation permits, smaller or larger burn units can be used. Each burn unit must be surrounded by suitable firebreaks, such as gravel or paved roads or mowed firebreaks. Paved and gravel roads usually provide secure firebreaks and can be used without any preparation except removal of leaves by leaf blower. Mowed firebreaks, on the other hand, are not really “breaks”, but are entities where blacklines can be established. It is the blackline that constitutes the firebreak. (See below for how to establish the blackline.)

Once the perimeter blackline is secured (see below), a 5-acre savanna burn can generally be burned with four or five crew members, especially if it is being burned as a back or headfire.

Before the main burn is begun, a secure fire barrier (blackline or good road) should exist completely around the perimeter of the unit.

Creating a perimeter blackline
- See diagrams
- The burn crew should be familiar with the whole burn unit, and especially with the firebreaks and environment outside the perimeter. The area “outside” the burn unit is potentially burnable in case of an “escape” (spot fire). If there are areas of potential danger, “spotters” with water should be positioned at critical locations.
- The burn boss, line bosses, and igniters should all be in communication by two-way radios. “Waters” should stay close to the igniters and line bosses and do what they are told.
- Ignition technique for the initial perimeter blackline on a savanna burn
  - Start by burning into the wind or down from the top of the hill (backburning)
  - The line bosses direct the drip torches
  - There are two burn lines. Burn lines start in the middle of the burn unit and move in opposite directions. They eventually meet at the far end of the burn unit (see diagram).
  - Test fire Before proceeding to the burn, a test fire should be created at the starting point of the burn. The behavior of the test fire indicates whether the fire is doing what it is intended to do. If the test fire is not satisfactory, the burn is called off and the crew is sent home. [Note: Abandoning the burn at this juncture should be a rare occurrence.]
  - For each fire line, it is ideal if two drip torches work together. One creates the initial blackline and the second widens it out. The goal is to create a wide blackline especially at the upwind side of the burn unit, since this is the location where spot fires outside the burn unit might occur. Without
sufficient crew members, the second drip torch on each line can be eliminated, but the whole burn will then take more time.

- Line #1 (Drip torch #1): The first drip torch creates the fire line. Keep the nozzle of the drip torch close to the oak leaves and always create a continuous fire line.

- At least two waters are spread out and follow drip torch #1 and ensure that the blackline remains firm. The blackline should be regular and even. No spot fires should develop outside the firebreak. Watch for fragments of fire moving across the firebreak.

- Line #1 (Drip torch #2): Depending on the fuel and wind, drip torch #2 should follow the 50 X 50 foot rule. Work 50 feet upwind (downhill) and 50 feet behind #1. If the wind is strong, drip torch #2 should work closer; 15-30 feet upwind, although still remaining 50 feet behind. As the blackline becomes secure, the distance from torch #1 can be widened. The line boss determines this from the behavior of the fire, and may alter the procedure if conditions change.

- Drip torch #2 (on line #1) is creating a fire line that will move as a headfire to the initial blackline (and then go out), and as a backing fire into new fuel.

- The rule for drip torch #2 is: the farther apart this fire line is, the higher the flame height will be until the fire line reaches the uphill blackline. The distance depends on the wind and slope. If the wind is stronger, or the slope is steeper, keep the two lines closer together. Also, if special trees are within the unburned area, keep the strips closer together.

- The line boss should be monitoring both drip torches and insure that a good solid black line is being created and that the fire is backing properly.

- Line #2 should follow the same pattern as that described above, but moving in the opposite direction.

- The two lines continue to move around the perimeter of the burn until they meet at the far end of the burn unit.

- Once a wide blackline completely surrounds the unit, the whole savanna can now be burned, using either a headfire, strip headfire, or backfire, depending on the size of the savanna, the weather, and the size and character of the savanna. (See diagrams)

- The first time a burn is done on a newly cleared savanna the main burn should probably be a headfire, as there is probably so much downed timber that a backfire will not carry well. After 4-5 years of annual burns, change to a strip headfire, with strips close enough together so that flame heights are less than 5 feet (depends on wind). After 8-10 years of annual burns, it is advisable to burn the whole savanna as backfire. Line bosses monitor the burn to make sure coverage is complete (>90%). If not, one or more drip torches are sent in for interior lighting (stripping).

If only a small crew is available, the burn might be split into two days. The first day would involve creating the perimeter burn. Then with a good blackline in place, the burn itself can be carried out with a smaller crew.
Test fire at the start of a savanna burn.
PVCweb/photos/savanna-test-fire—3837.jpg
Early part of the perimeter burn on an oak savanna.
Perimeter fire 1.gif
Completion of the perimeter burn on an oak savanna.
Ignition techniques
Ignition in a savanna burn requires the use of the drip torch. Do not try to burn a savanna without drip torches!

The drip torch must be manipulated so as to create a continuous fire line. The igniter should always keep the nozzle of the drip torch close to the leaves, walking slowly backward while observing the fire line as it is created. The goal is to create a continuous fire line.

In prairie burns, with lush grassy fuels, it is possible to toss scattered drops of fire which quickly coalesce into a continuous fire line. This will not work with oak leaves.

Because the fuel is less flashy, savanna fire lines need to be lighted differently than those of prairies. Single “drops” of flame are generally not enough. As the pattern here shows, lines of fire perpendicular to the burn line are also made, and these lines help to coalesce the fire and make a wider blackline.

kathie lighting 011.jpg
**Headfire**
This type of fire is recommended only during the early stages of savanna restoration, especially in savannas that have not been burned for a long time, if ever. In such sites, there will be a lot of downed timber of various sizes, so that fire carries poorly, and keeps going out. Choose a day with a good wind, since that will be needed to help “carry” the fire.

*Use of the head fire technique on a savanna burn. This should only be used in savannas that have not had fire in a long time, and after the perimeter is well secured (as described above). Once the headfire has been lit across the whole unit, it can generally be allowed to move on its own until the burn is completed. If the burn coverage is not complete, interior lighting should be used to finish the burn.*

*Head Fire.gif*
Strip head fire
Many prescribed burns on oak savanna are done as strip head fires, as shown in the diagram. Again, the perimeter blackline must be created first. For the strip head fire itself, the original line serves as the control line. The distance between each strip will depend on how the burn is progressing. If the strips are wide apart, then each fire line will attain a higher flame height before meeting the upwind black line and going out. If the strips are close together, then the flame heights will be lower, since each line will more quickly meet the downwind blackline and go out.

The strip head fire technique requires a larger crew, and each igniter must be in communication with others and with the burn boss by two-way radios. It is vital that the upwind igniters remain out in front of the downwind ones, otherwise an upwind igniter might be caught by a headfire.

In the diagram the igniters are positioned along the firebreak on the west side. The first burning strip is created at the downwind side of the burn unit. The burn boss or line boss monitors the creation of the initial strip and sends orders to the other igniters as appropriate.
Strip head fire technique. The number of lighters depends on the wind speed. The higher the wind, the closer the strips should be, which requires more igniters.

Strip HEAD FIRE.gif
**Back fire**

The backfire is one that is running against the wind. Because the wind is tending to push the fire back, toward the area already burned, the backfire is a low-intensity fire, hugging the ground, and moving slowly in the direction from which the wind is coming. Since the flames are being pushed behind the fire, in a direction where there is no fuel, flame lengths are low. Also, the rate of fire movement is slow. The rate of fire movement is affected mainly by the fuel and RH, with little effect of the wind itself.

Because they move more slowly, backing fires consume more of the fuel. Also, because the back fire moves slowly, it remains longer in contact with trees and hence can cause scorching or other fire damage to the bases of trees.

A back fire is simple to carry out and can be done with a smaller crew. It is also easier to control. However, the back fire will take longer and may leave many areas unburned, requiring a large amount of interior lighting to ensure that the whole burn unit is covered.

Start of a back fire. With secure borders, once the fire line has been started it can be allowed to continue on its own. Internal lighting may be needed to deal with areas that do not burn.

BACK FIRE.gif
Later stage of the back burn. The wind speed has little effect on the rate of movement of a back burn.

BACK FIRE 2.gif
Head fire burning through a bur oak savanna. The direction of the smoke shows that this is a head fire. The upslope also contributes to the head-fire nature of this burn. This was the first time this savanna had been burned.

savanna-burn-fall-2002-lightened.jpg
Strip head fire in a bur oak savanna. Three strips have been used, the lower of which is now in prairie grass.
S-slope-burn-2009-3270.jpg
Back burn through a bur oak savanna. Note that the fire has carried well through the savanna, with no unburned areas visible.

Burn-4-6-2014-11D-backburn-2325.jpg
Another savanna backburned. This burn moved out of the savanna into the adjacent prairie. Note the low flame height even in the prairie grass.
March 31, 2011. IMG_8184.jpg
Mop-up
Mop-up refers to the post-burn activities that are needed to make the burn unit safe to leave. Because there is generally a lot of downed wood and dead snags in a savanna, mop-up is a much larger process than in a prairie burn. Large logs or trees can often burn for a long time. A chainsaw is an essential tool in the mop-up process.

Several experienced members of the burn crew should be appointed to remain for mop-up.

It is advisable that a day or two before the prescribed burn all standing dead trees are "fireproofed" by carefully clearing grass, sticks, and other flammable debris from a wide zone at the base.

If a burning log is well within the burn unit, completely surrounded by black, it can be allowed to burn until it extinguishes itself. Part of the reason for savanna burns is the elimination of dead wood, especially logs lying on the ground. Thus, it is not necessary to extinguish every burning log or stump. However, if a smoldering log is too close to the edge of the burn unit, then the fire must be put out. This is because there is always the possibility of a wind shift that might pick up embers off such a log and carry them into unburned areas, causing a spot fire. Use judgement to decide if a burning log is “safe” to leave, keeping in mind that the wind might shift or get stronger.

Once a burning snag or tree has been cut down, it takes a fair bit of water to extinguish the burning portions and the log must be rolled around to reach burning areas. A pumper unit with high-pressure water is ideal for this, but single logs can often be extinguished with water from a backpack water can. If the fire is inside the log and cannot be reached by water, a chainsaw should be used to break up the log and reach the burning places.

The best time to recognize smoldering logs is late in the day, when the weather has started to cool and RH has begun to increase. Steam then starts to condense and be more visible. Also at that time of day the sun is at a steep angle and when backlighted the fire is more visible.
Snag that had caught on fire. Often these older dead trees are hollow, with punky wood that catches on fire easily. Such smokers must be cut down and the fire extinguished in the burning portions. This snag should have been “fireproofed” so that it did not catch on fire!

14 Nov 2004 burn 008.jpg
Using high-pressure water to extinguish fire in a hollow stump. Because of the large amount of wood in this savanna, there is often a lot of mop-up. This burning stump had to be put out even though it was well inside the burn unit because it was endangering the living tree next to it. Note the >90% burn coverage in this white oak savanna burn.

Mop-up—19D-2016-2971.jpg
This burning dead black oak had to be cut down and essentially “dissected” with a chain saw to reach the burning material. Oaks of the black oak group are more liable to catch fire than those of the white oak group. Note also the standing snag in the background that had been fireproofed and did not catch fire.
Extinguishing a burning log. If a log like this is well inside the burn unit it can be left to burn up.

Mop-up-sav-burn-Kathie-6182.jpg
Putting out the fire in a dead white oak snag. Note the fuel-free zone around the base of this snag. Despite that, this snag caught on fire. Punky wood, such as that in the center of this snag, is very flammable and caught fire from radiant heat.
IMG_4818.jpg
Typical crew for an oak savanna burn. This burn crew had just finished the prairie burn in the foreground and was getting ready to burn the savanna in the background. Fourteen people were used to burn about 35 acres of savanna in four units. The burn took 2 hours, plus another 1-2 hours for mop-up. At least six drip torches were used, and approximately 10 gallons of drip torch fuel.

Burn-4-6-2014-crew-2315.jpg
Burning an open savanna where grass is the principle fuel

Typical south-facing open savanna where the principal fuel for the burn is warm-season prairie grasses, predominantly Indian grass. This is an example of a savanna that has been under restoration for almost 20 years, with annual burns. The oaks are mostly bur, with occasional white. To avoid setting lower branches on fire, it is essential to keep the flame height low, which means the whole burn is carried out as a backburn.

Documents>Farm>Canon S100 2013 IMG_1795.jpg
**Comments about doing the burn**

Each burn is unique, and must be carried out with reference to the site (previous burn history, fuels; character, fuel dryness, topography), weather (T, RH, wind), availability of crew, and local factors.

Nothing replaces real field experience. If possible, the operator should try to participate in many oak savanna burns in the area, getting experience with both ignition and suppression techniques. Any contractor hired should have extensive experience doing savanna burns, as well as mop-up.