College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Forest and Natural Resource Management
April 2014
RM-18

Protecting Tree Plantations From Fire in Hawai'i

Bryon Stevens[1], J. B. Friday[2], Doug Cram[2], Clay Trauernicht[2]
[1]Hawai'i DLNR Division of Forestry and Wildlife; [2]UH Mānoa CTAHR Cooperative Extension

Introduction

The threat of wildland fire damaging or destroying tree plantations throughout the Hawaiian Islands is an ongoing yet often underappreciated concern. However, this threat is not equal between different areas and different types of plantations, in part due to the wide range of rainfall and temperature gradients found within the state. In addition, different types of plantations, such as eucalyptus, coffee, and macadamia nut, have different types, amounts, and arrangements of potentially flammable fuels (i.e., vegetation). Furthermore, even traditionally wet locations, such as the eucalyptus plantations on the windward side of the Big Island, can be rendered susceptible to wildland fire rather quickly in the event of drought conditions. With the potential for increased drought conditions in the years ahead, plantations owners and managers are encouraged to evaluate or re-evaluate their potential for partial or complete loss due to wildfire, as well as take steps to prevent and minimize their risk. This publication is intended to help inform that process.

Why Worry About Wildfires in Hawai'i?

Statewide, there have been an average of 1,043 wildfires per year from 2002 to 2011, burning an average of 17,575 acres per year (Figure 1). Damage from wildfire over this same time period exceeded $46 million. If predictions for increased drought and warmer temperatures hold, Hawai'i plantation owners and managers can expect the average number of fires and acres burned to increase over time.

Fire Fundamentals

The traditional "fire triangle" consists of heat, oxygen, and fuel (Figure 2a). Without any one of the three "legs" the triangle collapses, which is to say the flame is extinguished. In contrast, the "fire behavior triangle" consists

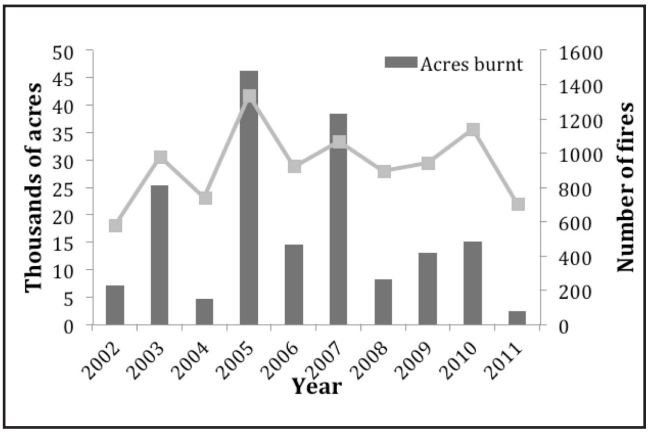

Figure 1. Acres burned and number of fires in Hawai'i between 2002 and 2011 (Hawaii Wildfire Management Organization 2013).

PFX Pacific Fire Exchange

A Joint Fire Science Knowledge Exchange Consortium committed to reducing threat to ecosystems and communities in Hawai'i and the U.S.-Affiliated Pacific from wildfire. http://www.pacificfireexchange.org/

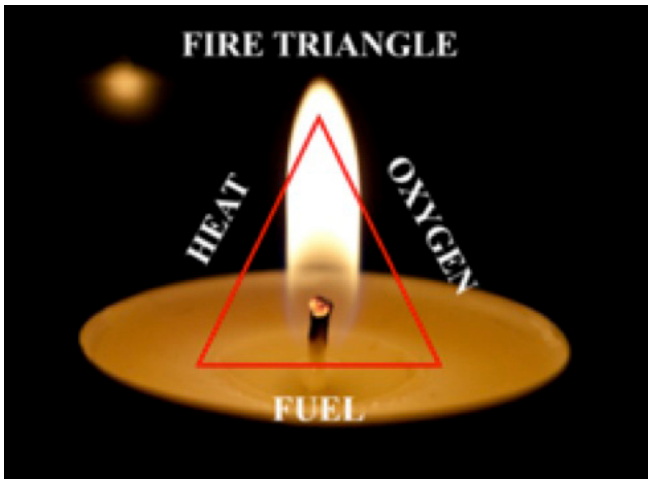

Figure 2a. Fire triangle.

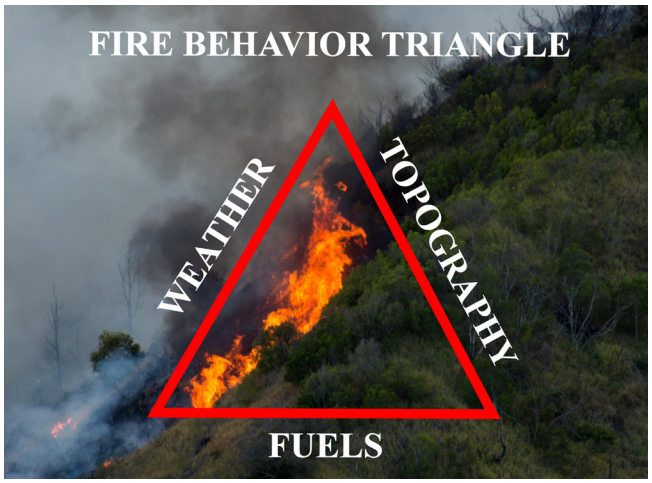

Figure 2b. Fire behavior triangle.

of topography, weather, and fuel – the primary elements determining intensity and spread of wildfires (Figure 2b). Notice that fuel is the common link between the two triangles and is also the only constituent realistically within the realm of management. The risk of ignition, spread, and intensity of fires depends on the moisture, amount, arrangement, continuity, and size of the available fuels. Of these components, fuel moisture is probably the most critical and influential component relating to intensity. Fuel size is probably the next most important characteristic. The quintessential example of fine, highly flammable fuel is dried grass. Fine fuels such as grasses and other plants slightly larger in diameter can experience relatively rapid moisture fluctuations as the weather changes, and this has significant effects on fire behavior.

Fuel arrangement is also important, as different arrangements dictate how much oxygen is available to sustain combustion. For example, matted-down grass will burn with less intensity than standing grass. Although fine fuels can quickly carry a fire, large-diameter fuels can hold heat longer. In some cases, this prolonged radiance of heat can damage the bases of adjacent trees or even kill them due to a girdling effect (Figure 3). For example, slash (discarded branches and twigs) piled or windrowed during site-preparation operations may pose a fire risk, as may mounds of wood chips. Hotter fires also take more time and resources to extinguish. Fires need continuous fuels to spread, and breaking the horizontal fuel continuity can help prevent fires from spreading. "Ladder fuels" provide a vertical pathway for surface fires to reach canopy fuels, and clearing ladder fuels from beneath tree canopies can reduce the chances that surface fires will spread upwards into tree crowns (Figure 4). A rule of thumb is to maintain a distance between surface fuels and the lowest tree branches that is 3 times the height of the surface fuels.

Common Ignition Sources

One of the most effective ways to reduce fire risk is to minimize the risk of ignition. Although wildfires in Hawai'i are occasionally set by lightning strikes, the vast majority are started by people. The following list contains common wildfire ignition sources. Most of these sources can be mitigated using common-sense approaches such as using spark arrestors or keeping water and/or fire tools (see below) nearby when using particular tools or equipment. If weather and fuel conditions are primed for extreme fire behavior, it may be best to wait for another day to weld or use other machinery. Other sources are less manageable, however, and as such represent a reason to be prepared for wildfire.

- Chainsaws
- Power tools (e.g., chop saw, grinder)
- Welders
- Mowers
- All-terrain vehicles and motorcycles
- Catalytic converters – especially when driven over dry grass
- Heavy equipment
- Lightning

Be Aware and Prepared

In Hawai'i, unlike on the Mainland, the potential for wildland fire is year round. Certain times will pose more or less fire risk depending on the weather. By keeping track of conditions such as precipitation, humidity, and wind speeds as well as fuel moistures (see Hawaii Vegetation Fire Risk at http://hawaiifire.stanford.edu/), plantation owners and managers can act accordingly to reduce the risk of ignitions when conditions are high for wildfire. Depending on fuel and weather conditions, the following tools can be used to suppress an ignition that is **less than a quarter acre** and has **flame lengths of less than two feet** (Figure 5):

- Fire extinguisher(s)
- Backpack water pump(s)
- Fire tools: fire shovel, fire rake, pulaski (fire-axe)

The Wildland–Urban Interface (aka Life on the Plantation)

Many rural landowners live adjacent to or within their tree plantations. Trees on plantations and tree farms need to be protected from house fires, and vice versa. Homeowners are advised to keep a 30-foot-wide buffer free of flammable material around the house and not to let dead brush and litter accumulate near the house. (For more information, see "Ready, Set, Go! Hawai'i" and other resources by the Hawaii Wildfire Management Organization at http://hawaiiwildfire.org/hwmo-products.html).

Fuel Breaks

Fuel breaks are meant to interrupt fires from advancing or moving by removing combustible material. Fuel breaks can also serve as an area where firefighters can fight fire (i.e., defensible space). Mowed grass is not technically a fuel break. However, depending on the fuel conditions at the time of a fire, it may reduce the intensity and rate of spread of the head fire, allowing fire crews an opportunity to be successful. A quick rule of thumb is that the width of fuel breaks needs to be two times the height of adjacent fuels. Fuel breaks are often located around the perimeter of the plantation, as well as within larger plantations, thereby dividing land parcels into compartments in which a fire can be contained. To increase efficiency, build fuel breaks into existing harvest or access plans. In other words, the same roads necessary for thinning, harvesting, or access will be used to catch wildfires. Remember that fires are wind driven, so locate breaks perpendicular

Figure 3. A Norfolk Island pine in a coffee windbreak that was girdled and killed when a fire burned the brush piled up against the trunk.

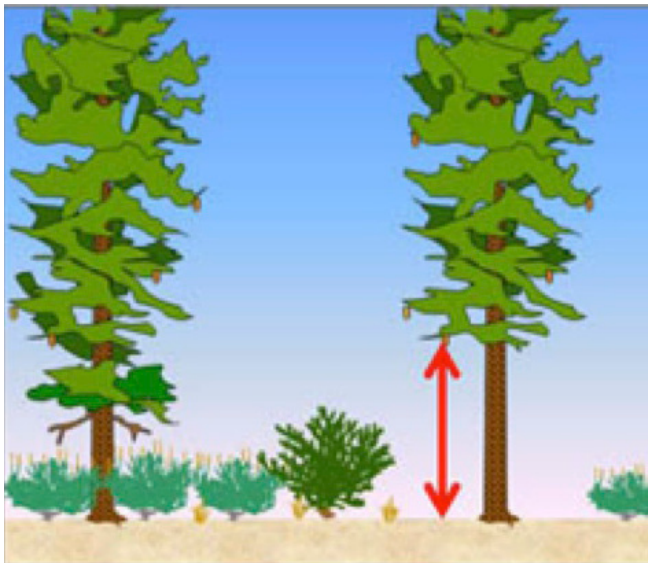

Figure 4. Clearing "ladder fuels" can reduce the spread of surface fires into tree crowns (source: www.extension.org).

to the prevailing winds when possible. If applicable, locate fuel breaks on the leeward sides of ridges, as fires creeping downslope tend to have smaller flame heights and are therefore more likely to be stopped by the fuel break.

Vehicle Access

In the event that there is a wildland fire on your plantation, providing access to firefighters may be critical. However, if the access does not provide for safe and efficient exit, it may not be suitable. For example, in the event of a wind shift, if fire crews cannot easily and quickly turn their equipment around once inside the property, they may not use that particular access point. Consult with the local fire department and arrange for an on-the-ground visit to determine the viability of access points and the provision of vehicle turn-outs and safety zones. Clearly marked and visible signs will help firefighters respond to wildfires more quickly. Signs should be made of metal so that they do not burn during a fire, reflective so that they are visible at night, and free of brush and weeds. Absentee landowners are encouraged to post contact information in case of fire.

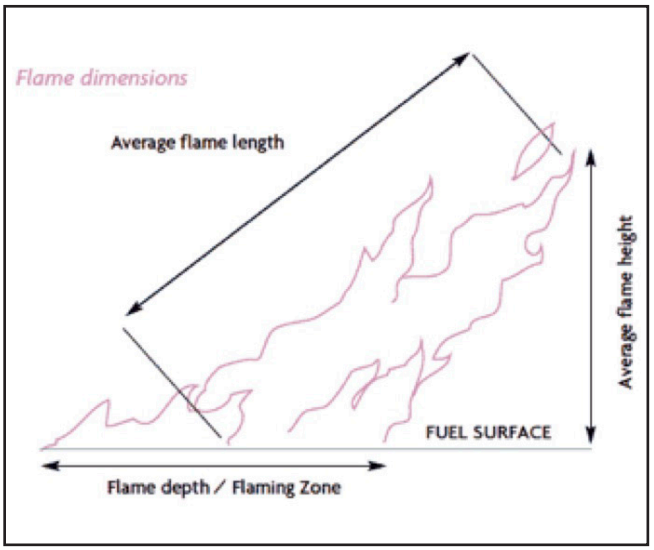

Figure 5. Flame length is measured as the distance from the flame tip to the middle of the flaming zone (source: Scottish Government report 2011).

While fire trucks typically carry bolt cutters that can be used in an emergency, gates with openings less than 12 feet wide may hinder access. Keep roads in good condition. Consider that some bridges may not be safe for heavy equipment to use without improvements or upgrades.

Water Access and Availability

As suggested above, water alone is not enough; safe and easy access is also necessary if the water is to be utilized. Make sure pipes have standard threads. If a stream or ditch is intended to be used as a source, it may need to be deepened at strategic points. Hardened edges of a reservoir will allow trucks to drive up. Alternatively, install a standpipe. Installing helicopter dip tanks is particularly useful if possible. Knowing the locations of nearby water sources, for example on neighboring lands, can also greatly assist firefighters. Potential water sources include the following:

- Hydrants
- Ditches
- Reservoirs
- Natural bodies of water
- Water tanks
- Fold-a-tanks
- Water trucks (tenders)

Fire Suppression

Fire suppression on private property in Hawai‘i will typically be the responsibility of county fire departments. In some cases, depending on adjacent landownership and potential for fire spread, additional firefighting partners maybe called upon for assistance. It is important to remember that the order of priority for firefighters is protecting lives, then structures, and then agriculture or forest crops.

Firefighting Tactics Employed by Professionals

A basic understanding of firefighting tactics may be useful for planning purposes as well as for strategically advising a fire chief in the event of a wildland fire on your property. “Anchor and flank” is the tactic used in all fires. The anchor point is an advantageous location, usually a barrier to fire spread, established at the rear of the fire from which professional firefighters will attack and suppress the flanks in attempts to work toward the

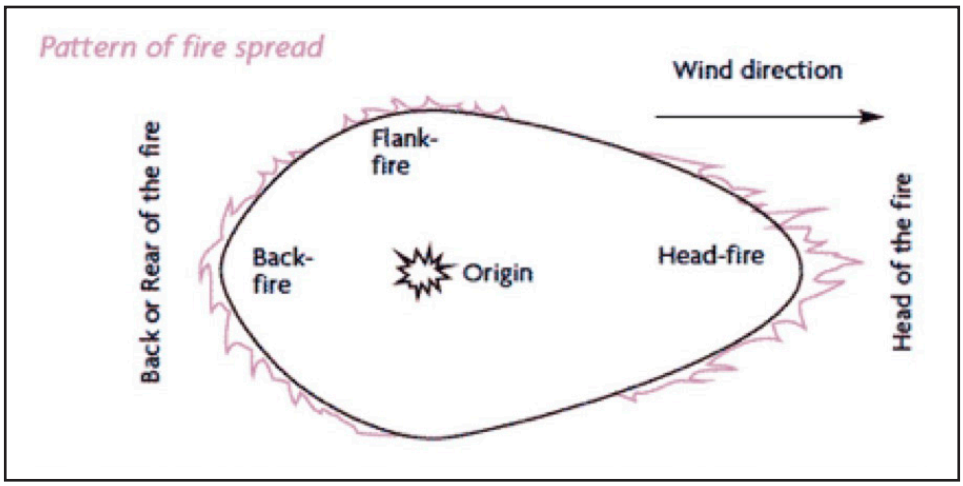

Figure 6. The leading edge (and most dangerous part) of the fire moving in the direction of the wind is called the head, and the sides of the fire are the flanks (source: Scottish Government report 2011).

fire head (Figure 6). Direct attack on the head of the fire may be possible for slow-moving fires in light fuels, but it is generally not a safe tactic. Establishing firebreaks around the fire perimeter frequently involves bulldozers and other heavy equipment. Backfires will often be ignited off the fuel break to further reduce fuel loads and create a more secure fireline.

Take-Home Points

- Wildland fire happens in Hawai'i year-round.
- Preparedness is the key. Proactive steps can reduce the fire risk:
  - Consult with local fire department before fire.
  - Consider and manage fuel loads (e.g., mow grass).
  - Have fire tools on hand for fighting initial ignitions.
  - Strategically implement fuel breaks.
  - Insure access points are suitable (useable) for firefighters.
  - Maintain access to water usable for fighting fire.
- Leave firefighting to the professionals!

Acknowledgments

Thanks to Wayne F. Ching, Fire Management Officer for the Hawaii Division of Forestry and Wildfire DLNR, for valuable comments on an earlier version of the manuscript.

References

Scottish Government. 2011. *Prescribed burning on moorland*. Edinburgh: APS Group Scotland. Retrieved from http://www.scotland.gov.uk/Resource/Doc/158521/0042977.pdf

Hawaii Wildfire Management Organization. 2013. Hawaii state wildfire history data set. Available online at gis.ctahr.hawaii.edu.