# Title of Poster in Arial, Bold, 72-120 Points: Size Dependent on Length

Lab Logo

Names of Authors in Arial, 48-80 Points, Bold

Institution Logo

## Heading 1, Arial, 36-72 points, bold

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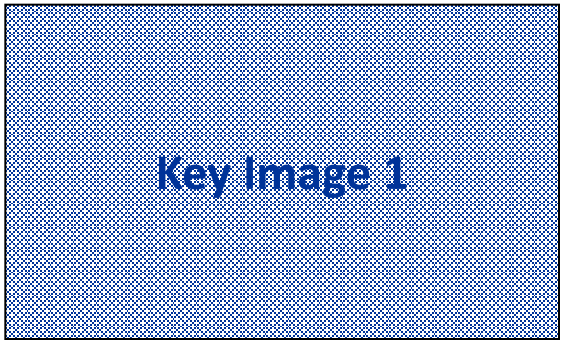


Figure 1. Caption in Arial, 36 points, bold.

## Heading 2, Arial, 36-72 points, bold

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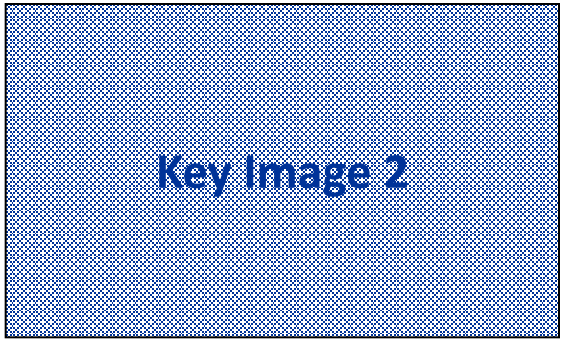


Figure 2. Caption in Arial, 36 points, bold.

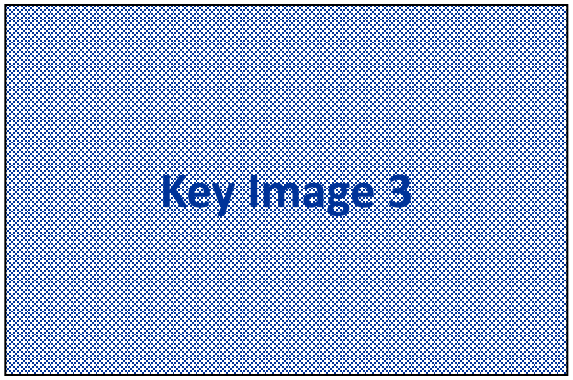


Figure 3. Caption in Arial, 36 points, bold.

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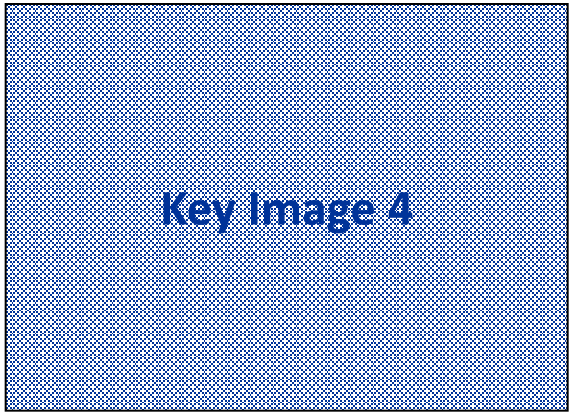


Figure 4. Caption in Arial, 36 points, bold.

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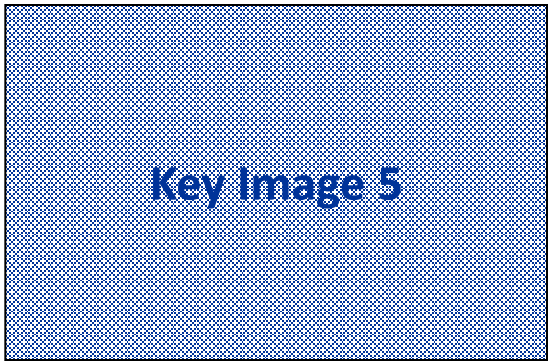


Figure 5. Caption in Arial, 36 points, bold.

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### Acknowledgments (Arial, 40 points, bold)

Acknowledgments in Arial, 32 points, bold--try to keep to one or two lines,

### References (Arial, 40 points, bold)

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Second reference in Arial, 32 points, bold, with a reverse indent: alphabetical or numerical order.

# Can high phenotypic and genotypic diversity of *Pinus ponderosae* regulate bark beetle populations?

Richard W. Hofstetter[1], Jolie Mahfouz[2], Jaina Moan[3], and Carl Edminster[4]

[1]Northern Arizona University, Flagstaff, AZ (Rich.Hofstetter@nau.edu), [2]USDA Forest Service, Pineville LA,
[3]Chemical Lab, Northern Arizona University, Flagstaff, AZ, [4]USDA Forest Service Flagstaff AZ

## Introduction

Many species employ multiple defenses against predators. Trees are no exception and have a variety of mechanisms to defend against predators and herbivores. Some mechanisms include oleoresin, toxins, thick bark, local necrosis and wound reaction.

Arizona contains the largest contiguous stand of ponderosa pine in the world. This forest supports many aggressive bark beetles (~8 *Dendroctonus* and 4 *Ips* species) but extensive tree mortality by bark beetles has only occurred recently. High tree mortality has been attributed to reduced tree defenses due to extreme drought, climate change, and high stand densities.

For over 100 years bark beetle populations in Arizona remained at endemic (low) densities, despite the abundance of trees and diversity of beetle species. High variation in resin quality (Figures 1 & 2) among trees may have provided a mechanism that regulated endemic populations of bark beetles within this region.

## Hypothesis

Extreme high inter-tree variability in defenses maintains low survival and low adaptability of bark beetles.

Ponderosa pine forests, Arizona.

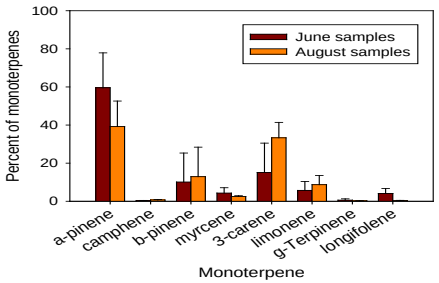



**Figure 1.** Monoterpene composition of ponderosa pine collected June (N=24) and August (N=63) of 2005. Mean ± STD.

## Variability in resin composition

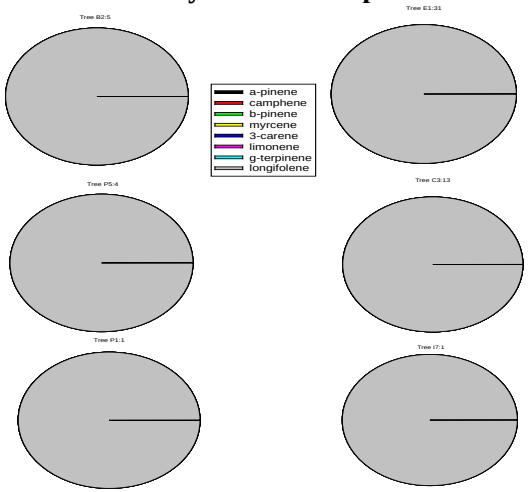



**Figure 2.** Monoterpene profiles of 6 ponderosa pines from one site in Coconino N.F. in Arizona.

## Discussion

Analyses of 90 Ponderosa pines within Coconino N.F. show a high degree of variation in resin composition. This variation is greater than that found in most pine species and locations around the world, and may be a consequence of the age and size of this forest.

Bark beetles attempt to adapt their behavior and attack strategy to existing host mechanisms of resistance. The occurrence of high phenotypic variability may reduce beetle attack success and reproduction at the forest scale.

We are just beginning to test this hypothesis using field surveys and controlled manipulation studies. We welcome any feedback and options you may have on this idea.

**Potential effects of resin variability on beetles**

- reduction in host recognition by bark beetles
- reduction in beetle-fungi performance due to wide range of toxins
- impedance with beetle pheromone communication and the use of tree volatiles for host selection and mating.
- poorer larval survival due to competition and predation within trees of a particular phenotype
- interruption of beetle-fungal relationships

Acknowledgements:
Support for this research was provided by USDA Forest Service and USDA Joint Venture Agreement.

# Cooling Effects of Dirt Purge Holes on the Tips of Gas Turbine Blades

Eric Couch, Jesse Christophel, Erik Hohlfeld, and Karen Thole

## Gas turbine engines run better at higher combustion temperatures

At higher combustion temperatures, these engines generate more power and use less fuel. However, these temperatures are restricted by melting temperatures of the turbine blades downstream of the combustor (see Figure 1).

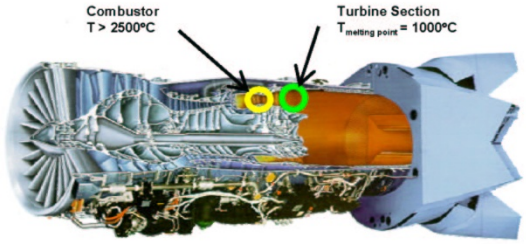
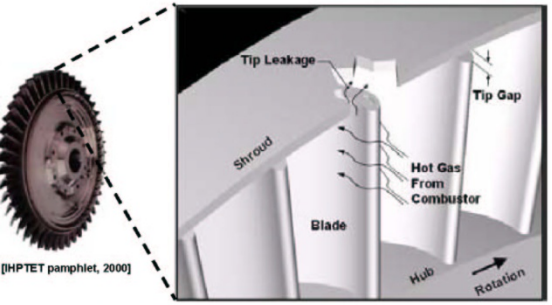



Figure 1. Pratt & Whitney F119 gas turbine engine.

## Dirt purge holes on turbine blade tips allow for higher combustion temperatures

Harmful hot gases from the combustor leak across the gap between the blade tip and the shroud (see Figure 2). Dirt purge holes expel foreign particles from the blade tip so that film cooling holes are not blocked.




gure 2. Flow at the tip region of a turbine blade.

## The project goal was to find the film cooling effects of these dirt purge holes

## To find the effects, we performed wind tunnel experiments with scaled turbine blades

The wind tunnel was low speed and low temperature, and the blades, shown in Figure 3, were scaled at 12 times their normal size. To measure temperatures on the blade tip, we used an infrared camera. Tip gap sizes and amount of coolant flow from the dirt purge holes were both varied.

Figure 3. Large-scale turbine blade in wind tunnel.

## Temperature measurements were converted to dimensionless cooling effectiveness

Effectiveness $\eta = \dfrac{T_\infty - T_{aw}}{T_\infty - T_c}$ where $T_\infty$ = mainstream temperature, $T_c$ = coolant temperature, $T_{aw}$ = adiabatic wall temperature (on tip surface)

## Cooling increased with blowing ratio

The effectiveness contours of Figure 4 show that cooling increased with blowing ratio.

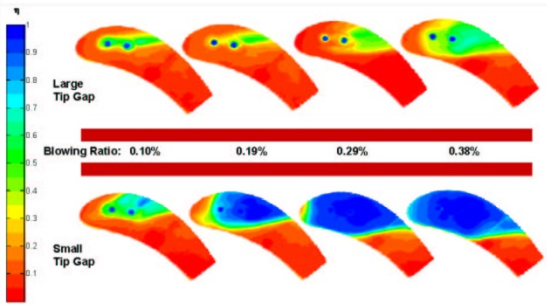



Figure 4. Measurements of film cooling effectiveness.

## Tip size dramatically affected cooling

In Figure 5, the lateral averages of effectiveness plotted against the axial chord length show that tip size dramatically affected the cooling.

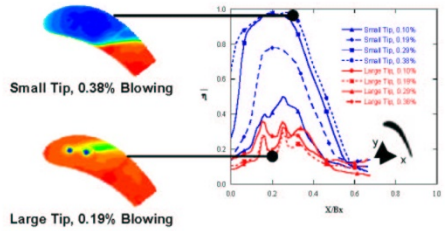



Figure 5. Laterally averaged effectiveness plotted against normalized axial chord.

## In summary, dirt purge holes provide cooling to the tip surface

While intended to remove dirt from the blade, dirt purge holes also provide cooling to the tip surface. This cooling is enhanced with a small tip gap as the dirt purge floods the tip region near the leading edge with cool air.

## Acknowledgments

The sponsor for this project was Pratt & Whitney.

# Groom Creek Fuels Project: A Neighborhood Plan for Community Safety and Forest Health

Anna Lowell[1,2], Richard VanDemark[2], Groom Creek Fire District[3]
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[2] Southwest Forestry, Inc., 21615 N. Hackamore Ln. Paulden, AZ 86334
[3] Groom Creek Fire District 1110 Friendly Pines Road Prescott, AZ 86303

## Your Firewise Community

A Firewise Community is one that provides for the safety of firefighters and homeowners by working cooperatively with public and private partners to address:

- ❖fire hazards
- ❖removing of hazard fuels around homes
- ❖improving access and evacuation routes
- ❖homeowner responsibility
- ❖community/ forest ecosystem balance
- ❖creating a sustainable plan for the future.

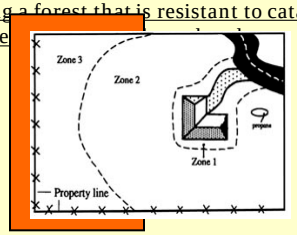
The **Groom Creek Fire District** (GCFD) has been nationally recognized as one of these communities. However, reaching these goals is a challenge due to the fact that these forests are overgrown because they have not been 'cleaned' up by a natural fire in a very long time. This makes them very vulnerable to catastrophic wildfire & bark beetle outbreaks.

## Reducing Fire Hazard on Your Property

To address these threats the GCFD has assisted property owners in Zone 1 & 2 by providing:

- ❖ free property assessment
- ❖ hazardous fuel treatment (house & yard)
- ❖ dumpster/chipper programs
- ❖ debris removal & burning

These initial steps are key to protecting your home, but to protecting your community and forest the fuels in Zone 3 must be dealt with. It is here that real improvements can be made toward creating a forest that is resistant to catastrophic wildfire




## Fuel Reduction In Zone 3

### Current Conditions

- ❖Tree densities around Groom Creek can exceed 600 trees/acre.
- ❖Thick tree/shrub understories can carry fires into the taller pine overstory.
- ❖The dense pine overstories can support intense crown fires.
- ❖You can change these conditions with help from fire and forestry professionals.

### What Does Fuel Reduction Look Like?

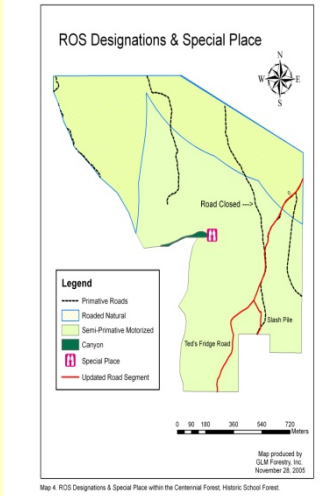
- ❖The goal is to reduce the # of trees, increase the distance between groups of trees, and enhance individual tree health.
- ❖Fire & forester professionals can help you decide which trees to keep to reach this goal (indicated by orange in picture).
- ❖Trees can be cut using mechanical and/or hand methods.
- ❖Cut trees can then be used for consumer products.
- ❖Smaller woody debris will be removed or burned on site.

### Creation of a Healthy Forest

- ❖The end result is 60-100 trees per acre as seen here at the old Groom Creek School House.
- ❖In the forefront of the picture you can see the low stumps of removed trees.
- ❖In the background is a forest that is rich with many different grass, shrub, and tree species.

## Fuel Reduction Projects in Groom Creek

Fuel reduction projects are going on throughout the Groom Creek area. This map shows past and current projects being conducted on federal land, camps, and private parcels. Implementing fuel reduction throughout the Groom Creek area, regardless of property ownership, will be key to achieving complete forest health.



Map 4. ROS Designations & Special Place within the Centennial Forest, Historic School Forest.

## How Can You Get Involved?

For more information regarding ways you can reduce fire hazards, current fuel reduction projects, and free property assessments please visit the Groom Creek Fire District website at:

**www.groomcreek.org**

or call (928) 778-6519