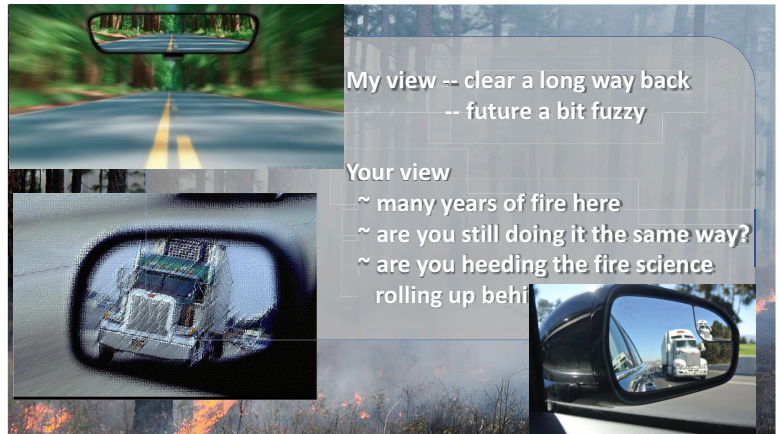




In the Rearview Mirror:

Are You Making Fire Science Work for You?

Alan Loig, Administrative Director, *looming in the mirror*
David Godwin, Administrative Director & Coordinator, *full speed ahead*
School of Forest Resources and Conservation
University of Florida



Essential Regional Partnerships

SFE Science Delivery Programing

User Accessed

- Fact Sheets
- Newsletters
- Website
- Videos
- Email / Social Media

Direct Delivery

- Webinars
- Meeting Presentations
- Fire Ecology Database

Personal Interactions

- Workshops
- Field Tours
- Classes
- Events
- Conferences

Duff and Fuel Moisture

Science and Tools for a Common Problem

Fire as a Maintainer

Southeastern Coastal Plain Ecosystems are among the most fire-dependent in the world

Fire frequency of 1-3 years common in systems that sustain high levels of diversity

Consumption of 2500 kg C ha⁻¹ yr⁻¹

Loss of fire => structure change and loss of diversity

hardwood dominance (shading understory)

change in fuel structure that restricts fire

loss of fauna

Slide: Kevin Hiers

Problems Arise Without Fire

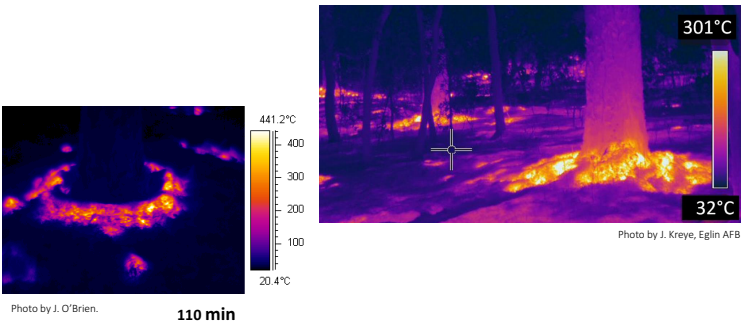


Photo: J.M. Varner

Duff Composition



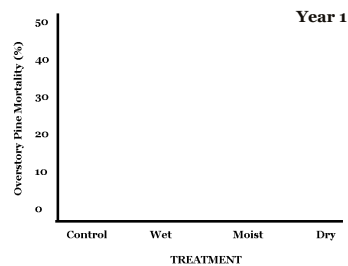
Long Duration Heating



Delayed Duff Mortality

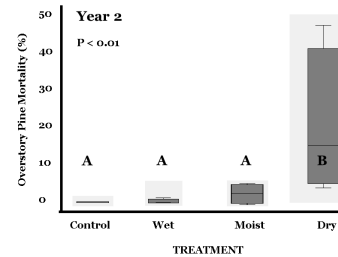
Eglin Air Force Base, Florida

- 4 treatments × 4 reps (>25 ac)
 - No burn
 - Wet duff (115% mc)
 - Moist duff (85% mc)
 - Dry duff (55% mc)
- Injury surveyed within 3 wks
- Mortality surveyed every 6 mo



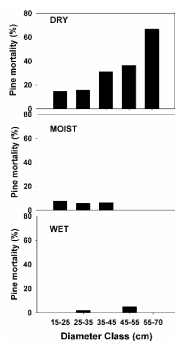
Varner et al. 2007. *Canadian Journal of Forest Research* 37: 1349-1358.

Delayed Duff Mortality



- Mortality delayed 18-24 months
- Mortality peaked in dry burns
- Mortality in unburned not different from moist & wet

Varner et al. 2007. *Canadian Journal of Forest Research* 37: 1349-1358.



Duff Kills Big Trees

$$DBH_{\text{dead}} > DBH_{\text{surviving}} \quad P = 0.002$$

trees < 16" dbh: 19% mortality

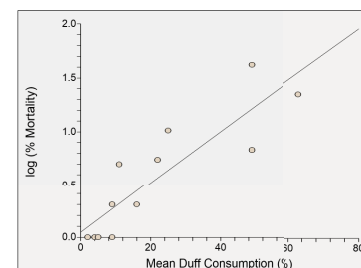
trees > 16" dbh: **53% mortality**

Overstory tree mortality resulting from reintroducing fire to long-unburned longleaf pine forests: the importance of duff moisture

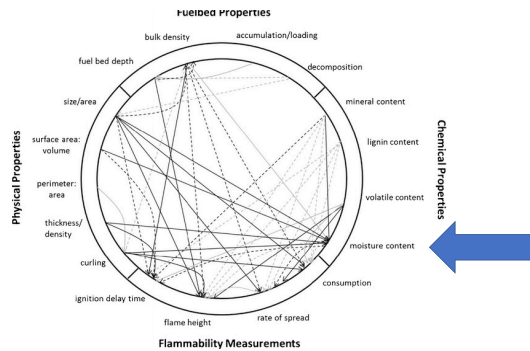
J. Morgan Varner III, J. Kevin Hiers, Roger D. Ottmar, Doris R. Gordon, Francis E. Putz, and Dale D. Wade

Varner et al. 2007. *Canadian Journal of Forest Research* 37: 1349-1358.

Duff Consumption Matters

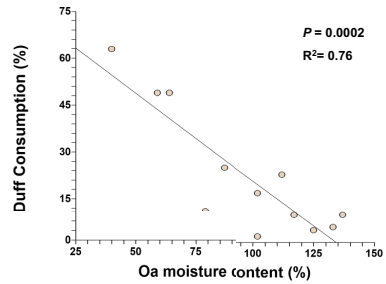


Varner et al. 2007. *Canadian Journal of Forest Research* 37: 1349-1358.



Varner, J.M., J.M. Kane, J. E. Kreye, and E. Engber. 2015. The Flammability of Forest and Wildland Litter: A Synthesis. *Current Forestry Reports*. 1 (2) pg 91-99.

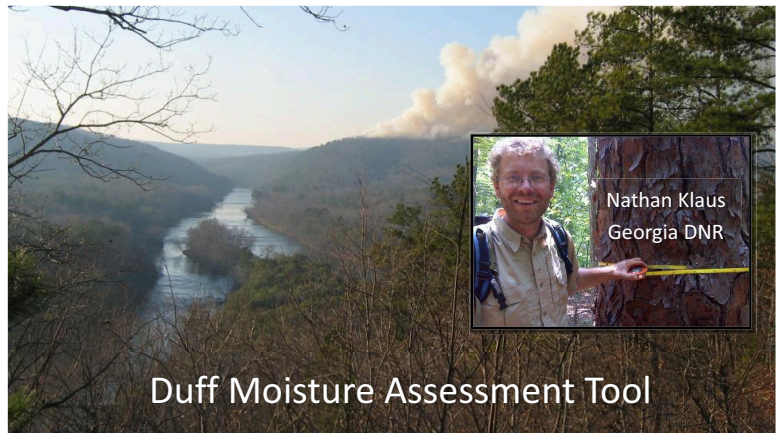
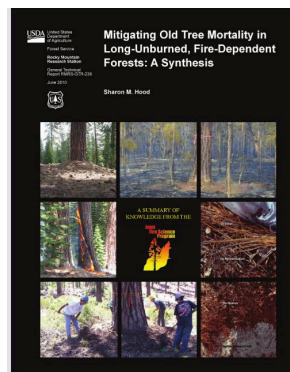
Duff Moisture Matters



Varner et al. 2007. *Canadian Journal of Forest Research* 37: 1349-1358.



Resources You Can Use



Challenges with Duff Management

- Average duff depth = 9"
- Standard prescription: burn <24 hrs after 1"+ rain
- Duff can still burn after 1-2" of rain during droughts
- Most burns in February-March
- Many years - only 4-5 burn days
- Checking duff meant feeling it with hands



New Tool: Delmhorst BD-2100 Moisture Meter

- Designed for sawn lumber
- Gives a true and consistent value
 - Quick to train people to use
 - % scale, 0-100
 - No more guesswork
- Gives values instantly
- Very rugged, holds up to use in fire



How to use the BD-2100 Moisture Meter

- Set meter to % scale
- Pull away straw/litter
- Gently insert probes, get reading
- Repeat at 4-5 depths through entire duff column
- Measure 2-3 spots per tree, different sides of tree
- Measure 10-20 trees, various aspects and slope positions



Duff Moisture Thresholds for BD-2100

- **Above 80% duff will not burn**
- **85%+ you are golden**
- **Below 73% duff will burn**
- **Mid 70s is risky, may get away with it but not on 1st entry, some trees will burn**



Where can I get one?

- Google “Delmhorst BD-2100 WCS”
- \$400-500 online. Not cheap but what is a 200 year-old tree worth?
- Other moisture meters?
 - Evaluated one other, extremely cheap (\$10) meter used to measure soil moisture in potted plants. It was worthless
 - Likely other high-end meters could work



Questions? Nathan.Klaus@dnr.state.ga.us

Sometimes things still go wrong.



Photos:
Shan Cammack and Bryn Pipes

What can you do?

Why not just drown it?

- Smoldering duff is insidious and doesn't always produce smoke or surface evidence
- Time intensive
 - Requires a lot of water
 - Where is your water source?
 - Regular checkups even after treatment
- Wear and tear on equipment



Slides: Shan Cammack and Bryn Pipes

There is a better way

- No water
- Resource and time efficient
- Identifies duff spots, even the “hidden” ones
- Minimal impact (Good M.I.S.T. practice)
- Actually kind of fun!



DUFF BUSTERS!



Slides: Shan Cammack and Bryn Pipes, GA DNR

What you need

- Full PPE (Safety first!)
- Leaf blower
- Boots with fire-resistant soles (Vibram)
- Breathing mask (Whiff or paper)
 - If not available, blow from the upwind side!



Slides: Shan Cammack and Bryn Pipes

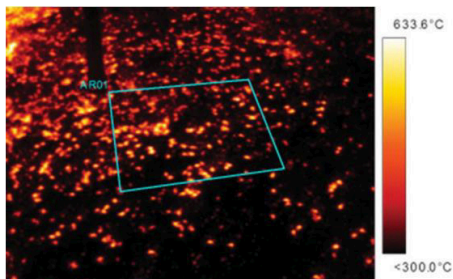
Step by Step

- Blow around base of tree
 - Look for any glowing embers or flare ups
- Kick out hot spots
 - Must separate heat from unburned duff
 - Sometimes the leaf blower does all the work for you!
- Blow the area again to get heat away from duff and check for residual spots
- Repeat as necessary



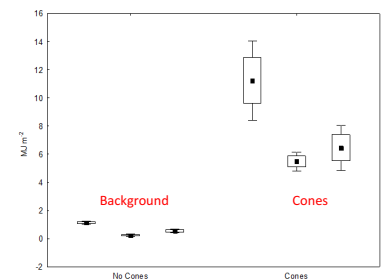
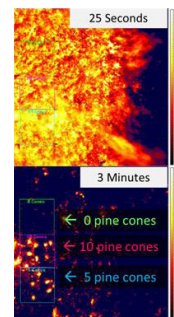
Slides: Shan Cammack and Bryn Pipes

Pine Cones: A Wildcard?



O'Brien et al. 2016. Canopy-derived fuels drive patterns of in-fire energy release and understory plant mortality in a longleaf pine (*Pinus palustris*) sandhill in northwest Florida, USA. *Canadian Journal of Remote Sensing*. 42(5): 489-500.

Pine Cones: A Wildcard?



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Pine Cones: A Wildcard?

“The ignition of longleaf pine forest floor duff in this study was primarily a result of the presence of pine cones.”

“Sixteen of the 17 burn trials that included a cone vector resulted in duff ignition, whereas only 3 of 18 burn trials without a cone resulted in duff ignition.”

Kreye, J.K., Varner, J.M., Dugaw, C.J., Cao, J., Szececi, J., Engbert E.A., 2013. Pine cones facilitate ignition of forest floor duff. *Canadian Journal of Forest Research*, 43:512-516. <https://doi.org/10.1139/cjfr-2013-0019>

Recommendations

- **You are in it for the long haul (but the haul is not as long as we once thought)**
- **Mortality can cause management problems for years—don't break the eggs to make the omelet!**
- **Restore fuels before forest structure**
- **Burn on the margins of combustion**
 - After rain, night (if you can), in front of rain
- **Dedicate mop up resources for 2-3 days afterwards**
 - Focus on “vector” fuels
- **When safe conditions are present prioritize duff units!**
- **Use conservative prescriptions for 3+ burns**
- **Monitor depth reduction with duff pins**

-Adopted from Kevin Hiers and Morgan Varner.



Smoke & Air Quality: Does Source Matter?



Steve Miller



Smoke & Air Quality: Does Source Matter?

AGU PUBLICATIONS

Journal of Geophysical Research: Atmospheres

RESEARCH ARTICLE
10.1002/2016JD026315

Special Section:
Quantifying the Emission,
Properties, and Diverse
Impacts of Wildfire Smoke

Key Points
• Emission factors (EFs) were measured
for three western wildfires for major
gases and particles and rarely
measured OVOCs and organic nitrates
• Aircraft-measured EFPM₁₀ from
wildfires is more than 2 times that of
prescribed fires
• Emission estimates for western U.S.

Airborne measurements of western U.S. wildfire emissions:
Comparison with prescribed burning and air
quality implications

Xiaoxi Liu^{1,2,3}, L. Gregory Huey⁴, Robert J. Yokelson⁵, Vanessa Selimovic⁶, Isobel J. Simpson⁷,
Markus Müller^{8,9}, Jose L. Jimenez^{2,10}, Pedro Campuzano-Jost^{2,8}, Andreas J. Beyersdorff^{6,10},
Donald R. Blake⁵, Zachary Butterfield^{11,12}, Yonghoon Choi^{6,13}, John D. Crounse¹⁴,
Douglas A. Day^{2,8}, Glenn S. Diskin⁵, Manvendra K. Dubey¹⁵, Edward Fortner¹⁶,
Thomas F. Hanisco¹⁸, Weiwei Hu^{2,17}, Laura E. King¹⁸, Levenne Kleinman¹⁷, Simone Meinardi⁸,
Tomas Mikoviny^{18,20}, Timothy B. Onasch¹⁵, Brett B. Palm^{2,8}, Jeff Peischl¹⁹,
Ilana B. Pollack^{7,19,20}, Thomas B. Ryerson¹⁸, Glen W. Sachse⁶, Arthur J. Sedlacek¹⁷,
John E. Shilling²¹, Stephen Springston¹⁷, Jason M. St. Clair^{14,22,23}, David J. Tanner¹,
Alexander P. Teng¹⁴, Paul O. Wennberg^{14,24}, Armin Wisthaler^{6,18}, and Glenn M. Wolfe^{16,25}



Smoke & Air Quality: Does Source Matter?

Compound	Emission Factors (gm/kg)	
	Western wildfires	Southeast Rx fires
Organic aerosol	24.3	2.8
Methane	0.34	0.07
Nitrate	0.87	0.09
Sulfate	0.30	0.17
PM1	26.0	4.4



Smoke & Air Quality: Does Source Matter?

“These findings support the practice of prescribed burning to reduce the impact of (wildfire) particulate matter on air quality.”

BUT,

“A definitive assessment of the trade-offs between wildfires and prescribed fires will also require confirmation that wildfire events can be reduced significantly by prescribed burning.”



Prescribed Fire vs Wildfire



**What the Research Says:
Prescribed Fire and Wildfire Risk Reduction**
Alan Ling and Anne Thomas

A series of research studies have found similar conclusions: Prescribed fire reduces wildfire risk, intensity, and cost in southern pine flatwoods ecosystems, but for a relatively short time.

Over the last century, research across the Southeast has shown that prescribed fire can reduce the risk of wildfire in the long term. Prescribed fire can also reduce the intensity and cost of wildfires. However, the benefits of prescribed fire are not permanent. Research shows that the benefits of prescribed fire are short-lived, lasting only a few years. After that, the risk of wildfire returns to its original level. This means that prescribed fire must be used regularly to maintain its benefits.

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Relationships Among Wildfire, Prescribed Fire and Drought at Fort Benning, Georgia
Zachary Boley, Jennifer Pomeroy, Alan Ling

STUDY SITE
Fort Benning, GA
• 132,000 acres (1.5 million acres)
• 141,000 acres of forest land
• 60,000 acres of upland pine forest
• Prescribed fire is used to manage the forest land
• Vegetation: Longleaf-shortleaf pine, slash pine, loblolly shortleaf pine, and longleaf pine
• Climate: Hot, humid, with frequent droughts
• History: The area has been used for military training since the 1920s
• Prescribed fire is used to manage the forest land
• Vegetation: Longleaf-shortleaf pine, slash pine, loblolly shortleaf pine, and longleaf pine
• Climate: Hot, humid, with frequent droughts
• History: The area has been used for military training since the 1920s

RESEARCH FINDINGS
Prescribed fire is an important tool for managing the forest land at Fort Benning. It can reduce the risk of wildfire, improve the health of the forest, and provide a source of income for the local community. However, prescribed fire is not a silver bullet. It must be used in conjunction with other forest management practices to achieve the best results.

Do you know of similar examples?

Other New Fact Sheets

- Wildland fire smoke effects on public health – what does research say?
- Wrapup of JFSP's past smoke research – science delivery for fire managers & planners
- Fire influence on soil carbon
- Online tools for planning smoke management
- Online tools for customized weather information
- PB-Piedmont
- Quail, turkey, and deer: Fire effects and management recommendations
- Season of burn: An update
- Fire and drought



Summary of Smoke Related Joint Fire Science Program Events Relevant to the Southeastern U.S.
Karen Davis, David W. Miller, and others

This report provides a summary of the events and findings from the Joint Fire Science Program. It includes information on the program's goals, the events held, and the key findings from the research. The report is intended for fire managers, researchers, and the public.



www.SouthernFireExchange.org
contactus@southernfireexchange.org
David Godwin (drg2814@ufl.edu)

