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Research Brief for Resource Managers

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Wildland-urban interface focus: Smoke management

Wade, D. and H. Mobley (2007) Managing smoke at the wildland-urban interface. General Technical Report SRS-103, Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 28 p.

URL: http://www.srs.fs.fed.us/pubs/28550

For this month's wildland-urban interface (WUI) focus, we asked Joel Carlson, a NAFSE community representative, for the number one publication he references to manage smoke during a prescribed fire in MA and RI. He chose a report published by Wade and Mobley in 2007, which details a smoke screening evaluation system that helps managers determine potential smoke effects on nearby smoke-sensitive areas (SSAs). Although the report was designed for southeastern forests, the recommendations are based on relevant smoke science as well as the accumulated experience of fire managers; all highly applicable to any WUI area.

Wade and Mobley advise breaking planned burn blocks into 50 acres each, and recommendations in the report apply only to daytime burns of 50 acres or less in the WUI. They note that there are three main strategies for managing smoke in the WUI:

1- Avoid SSAs (smoke sensitive areas)
2- Disperse and dilute smoke
3- Reduce production of undesirable combustion products

They emphasize that the key to reducing smoke is the right combination of firing technique, weather, and fuel moisture. Some general recommendations include: understanding the difference in smoke production during the active flame portion of the fire and the residual smoldering portion of the fire; understanding moisture levels in different fuel types; and burning when fine fuel moisture is low, to reduce the amount of vapor released.

Management Implications

- Many states require a smoke management plan; the southern smoke screening system may work for small WUI burns in your area.
- Fuel types in this report can be adapted for use in the North Atlantic region (see Table 2).

Backing fires produce less smoldering than head fires, but head fires shorten the duration of the smoke event as well as help the smoke get aloft. So, depending on your needs, balancing backing and head fire areas could help reduce smoke effects. Specific recommendations include not burning with an atmospheric mixing height of less than 1700ft, when horizontal wind speed is less than 9mph, or when the daytime dispersion index (DI) is 40 or below (see Table 1).

Other recommendations include keeping in mind what might be down drainage from the fire, and mopping-up several hundred feet from the edges of the block in WUI areas to reduce residual smoke.

Finally, in order to organize their recommendations in a step-by-step decision support tool, Mobley and Dale developed a southern smoke screening system that takes into account all of the factors mentioned above (see flow chart in the paper). In general, the steps include the following: 1) draw a buffer of 500ft around the 50 acre block as a minimum impact area, 2) use the dispersion index along with the fuel type,

and firing technique to determine the smoke impact distance (see Table 2 and notes about fuel types from Joel Carlson and Dale Wade), 3) plot the centerline to the impact distance and extend impact area 30 degrees to either side of the center-line. If smoke requirements are not met, it may be necessary to reduce available fuel, reduce the burn size, or wait for better weather and fuel moisture conditions to avoid health issues downwind.

Overall, this publication provides a comprehensive system to assess potential smoke impacts in WUI areas of 50 acres or less. If smoke management plans need to cover larger areas, the southern smoke screening system described in this publication would not provide enough information. Dale Wade notes that, in Georgia, managers are moving towards using the web-based smoke model V-smoke exclusively, and they have a version that has been customized for their region.

Table 1—Lavdas Dispersion Index,[a] revised on the basis of extensive use by field practitioners

Lavdas Dispersion Index	Smoke dispersion	Interpretation of daytime values
70 +	Very good	Burning conditions are so good that fires generally present control problems. Reassess decision to burn unless escape, particularly as a result of spotting, is not a problem, e.g., burn unit is surrounded by plowed fields. DI is generally too high for a WUI burn.
50–69	Good	Preferred range for prescription burns, but fire control becomes more difficult as values get higher.
41–49	Generally good	Especially when the planned burn is smaller than 50 acres. Afternoon values in most inland forested areas typically reach this range.
Reassess decision to burn at WUI if daytime DI < 41		
21–40	Fair	Stagnation may be indicated if DI is in this range and windspeed is low. Reassess decision to burn, especially if heavy rough or large dead fuels are present, or unit is larger than 15 acres.
Below 20	Poor to very poor	Do not burn at the WUI.

DI = Dispersion Index; WUI = wildland-urban interface.
[a] Lavdas (1986).

Table 2. Maximum distance of probable smoke impact. *

Fuel category		Firing technique	Dispersion Index		
			41–50	51–60	61–70
			Impact distance in miles		
A	Grass, light understory (< 2-year rough) with no humus layer	Any firing technique	0.75	0.5	0.25
B	Nonwoody marsh fuels—rush, cattail, or sawgrass	Any firing technique	1.5	1.25	1
C	Palmetto/gallberry or waxmyrtle understory regardless of height	Backing fire	1.25	1	0.75
D[a b]	Palmetto/gallberry or waxmyrtle understory regardless of height	Head, flank, or spot fires	4	3	2
E	Any other native understory fuel type regardless of height	Backing fire	1	0.75	0.5
F	Any other native understory fuel type under 3 feet high	Head, flank, or spot fires	1.5	1	0.75
G	Any other native understory fuel type over 3 feet high	Head, flank. or spot fires	2	1.5	1
H[a b]	Melaleuca	Backing, flank, or spot fires	3	2	1
I	Exotic fuelbeds such as Casuarina without much understory	Any firing technique	2.5	2	1.5
J[a]	Scattered logging debris	Any firing technique	2.5	1.5	1
K[a]	Small dry piles	Any firing technique	3	2	1.5
L[c]	Large, wet, piled debris or windrows	Using any firing technique	Do not burn		

*Note: The southern smoke screening system uses southern fuel types; therefore, it is necessary for those burning in the North Atlantic region to interpret the fuel types for our region. Joel Carlson notes that "A, B, E, F, G, I, J, K, and L – all capture something in the northeast and the description works. H – I have not used. C and D – I use for extremely dense, very tall, not burned or cut in 20+ years scrub oak or areas with less scrub oak loading but a significant amount of pitch pine regrowth. Dale Wade notes that these fuel-type/distance relationships are the result of observing "literally hundreds of fires". Users should "take it slow until they become comfortable with the accuracy of the predictions" in N. Atlantic fuel types.