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USDA Forest Service, Rocky Mountain Research Station

Predicting Fire Effects with Fuel Loading Models

Wildland fuel classifications are critical to fire management because they provide a simple way to include fuel characteristics in complicated fire behavior and fire effects computer models. Historically, fuel classifications used to estimate fire effects have been based on the vegetative characteristics of a particular site or location. However, vegetation-based fuel classifications fail to recognize that:

1 - fuel beds, or the fuels in the surface fuel, are composed of diverse fuel components;
2 - each fuel component is highly variable in loading across space and time;
3 - the fuels and vegetation may have different disturbance histories in space and time that affect their correlation; and
4 - most sampling methods are limited in their ability to capture both fuel variability and how much fuel is produced by any particular vegetation type.

Scientists with the Rocky Mountain Research Station, along with cooperators, have created a new fuel classification, called Fuel Loading Models (FLMs), specifically developed to predict fire effects from on-site surface fuels. This system is outlined in a new Rocky Mountain Research Station report titled *Field Guide for Identifying Fuel Loading Models*, General Technical Report RMRS-GTR-225. The FLM classification is one of the first classifications that categorize fuel beds into easily identifiable classes based on their predicted fire effects, and is critical to fire management. "It is unique because the FLM classes are readily identifiable in the field using on-site fuels," says Research Ecologist and co-author of the report Robert Keane. Over 4,000 actual fuel beds from across the United States were used to create the new classification, and the individual groups within it are distinguished by two important fire effects – the amount of smoke that is produced and the amount of soil heating. "Both of these effects are important indicators of the physical and chemical changes that will occur on a site when fuels are burned," said Keane.

Scientists used simulated logs constructed from cardboard tubes to demonstrate coarse woody debris loadings for forested areas. This photo represents coarse woody debris loading of 4.5 tons per acre.

What is an FLM?

Unlike the vegetation-based approaches typically used to classify fire effects, FLMs use computer models to balance the high variability of fuel beds throughout a stand with the resolution needed to broadly describe unique fuel classes for the continental United States. FLMs can be used to capture the variability of individual fuel components within a fuel bed, as well as describe differences in those fuel components across spatial and temporal scales. FLMs are not designed to replace existing fuel classification measures, such as the Fuel Characteristics Classification System, nor are they designed to eliminate the need for extensive fuel inventories. FLMs are intended to be an additional tool for managers to describe fuels for fire management.

Using FLMs

Managers can use FLMs to quickly estimate the fuel loads of six fuel components while in the field. FLMs can be an economical alternative for fuels sampling because sampling can be done quickly or without visiting an area. FLMs can also be easily integrated with other types of plot-level data, such as stand structure or vegetation cover, to create a more comprehensive description of a plot's characteristics with little additional field sampling.

Representative fuel loads in non-sagebrush areas of 11 tons per acre (top photo) and 18 tons per acre (bottom photo).

FLMs can be an economical alternative for fuels sampling.

Because FLMs can be consistently and accurately identified in the field, they can also be used as map units of fuel loadings, which can then be used to quantify fire effects and plan, prioritize and implement fuel treatments. The report details steps for identifying an FLM in forests, grasslands, shrublands and chaparral.

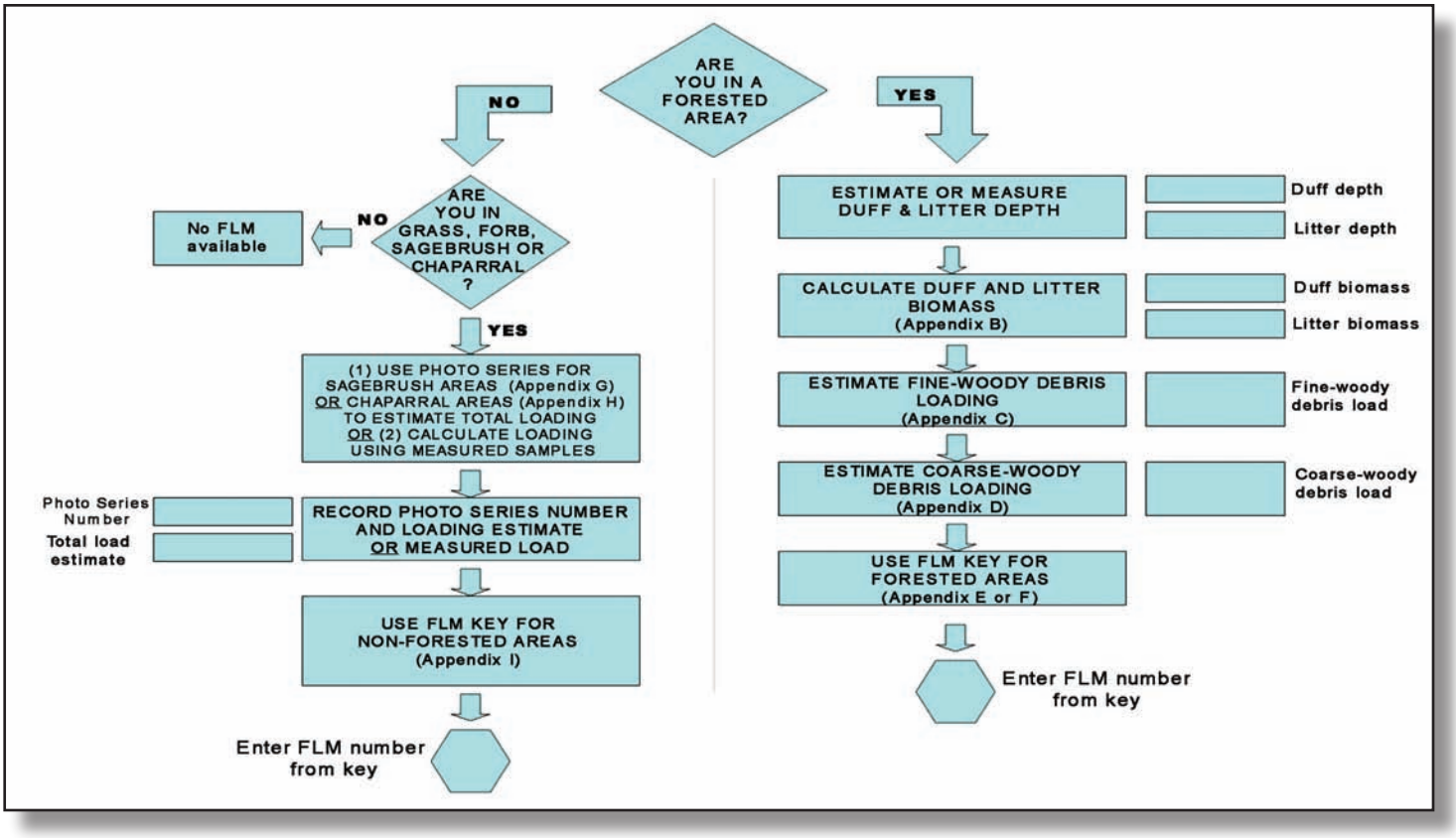
Detailed instructions on the use of the FLM classification are outlined in the field guide, which includes field sheets, photo guides, and a streamlined, easy-to-use key. In short, a person can walk into a stand or plot and compare observed fuel loadings with the key criteria to identify a unique FLM class. This person need only determine if the loadings of the four components are above or below threshold values.

"It often takes less than 10 minutes for field personnel to identify an FLM in the field," says Keane. "Once the FLM classes are determined, they can then be used:

1 - as a fuel inventory method to describe duff, liter, and log loadings at any scale;

2 - to estimate the amount of carbon in the fuelbed for carbon budget inventories; and

3 - as inputs to fire effects models, such as FOFEM and CONSUME to compute smoke emissions, fuel consumption, and carbon released into the atmosphere," he said.



Field form for collecting FLM data.

FLMs constitute an important advance in fuel classification because they relate actual on-site fuels to the smoke and soil heating that may result from burning those fuels. As such, the FLMs can be an important tool in many fire studies and management decisions. In the future, Keane believes there may be fire effects in addition to smoke and soil heating that could be incorporated into the FLM classes that would make them more pertinent to some wildlife, vegetation, and microbe studies. However, the current FLM classes are a positive step in the process to create a fuels classification that directly relates cause to effect in fuels consumption, and they should be an improvement over earlier fuels classification methods for many applications.

You can learn more about FLMs and their usefulness in predicting fire effects from on-site fuels in *Field Guide for Identifying Fuel Loading Models*, General Technical Report RMRS-GTR-225, available from the Rocky Mountain Research Station, or online at www.fs.fed.us/rm/pubs/rmrs_gtr225.html.

You can learn more about fire research at the Rocky Mountain Research Station's Fire Sciences Laboratory in Missoula, Montana by visiting www.firelab.org.

For more information about research programs at the Rocky Mountain Research Station, visit our website at http://www.fs.fed.us/rmrs.

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RMRScience
USDA Forest Service
Rocky Mountain Research Station
240 West Prospect Road
Fort Collins, CO 80526 USA

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