

# Preface

Wildland fire management throughout most of the civilized world is at a critical juncture on how it spends the scant money allocated toward resource management.

These funds could either go toward expensive and largely ineffective wildfire suppression or toward a more holistic and long-term approach that manages wildland fire primarily as an ecological resource with special consideration when fire impacts people and property.

Fire suppression costs are spiraling out of control, often exceeding the value of the land that burned where suppression was attempted. An unfortunate consequence of fighting fires is that even more biomass accumulates, creating conditions that foster even more fires of increased severity. More firefighters will be asked to fight these larger and more dangerous fires, putting themselves at an even greater risk for injury and fatality. The solution to this fire management conundrum will be extremely complex and require consideration of interacting social, political, and ecological issues across multiple time, space, and organizational scales. At the heart of this wildland fire dilemma are wildland fuels.

Wildland fuels may be the most important consideration in fire management, not just because they are important inputs for predicting fire behavior (i.e., how fast and intense a fire gets), but also because fuels are the only factor that can effectively be controlled by direct and indirect management manipulation. Each year, tens if not hundreds of millions of dollars are spent by federal, private, and public organizations on treatments meant to manipulate fuels so that fire spread is reduced and fire intensity is lessened to save property and lives. The amounts and kinds of fuels burned in a fire dictate how dangerous a fire can get, how much smoke is generated, and how ecosystems and society responds. By modifying the fuelbed, managers hope to minimize adverse consequences to protect ecosystems, people, and property. A comprehensive description of wildland fuels is vital for crafting effective treatments and designing novel ways to manage wildfires.

Perhaps an even better reason for the importance of wildland fuels in fire management is that they are the major link between fire behavior and fire ecology. To understand fuel dynamics, we must first understand the ecology of

fuels and what happens to the ecosystem before, during, and after fuels burn. Fire behavior is often viewed as the main driver of fire management. This is because most of the funding for fire management is spent trying to extinguish fires rather than managing fuels before a fire occurs. Effective fuel management demands a consideration of both fire behavior and ecological effects. Therefore, all enlightened solutions to most fire management problems will be found in fire ecology rather than fire behavior, and that the principle driver in most fire effects are the combustion of fuels. Long-term solutions to our fire management problems will only be achieved through a comprehensive understanding of the ecology of wildland so that innovative strategies can be crafted to balance ecological, economic, societal and political concerns.

It is somewhat puzzling why more research hasn't been done to fully understand wildland fuel ecology considering the great importance of wildland fuels to fire management. Wildland fuelbeds are amazingly complex, composed of many types of fuels with each fuel type characterized by diverse physical and chemical properties. Yet, most fire and fuel studies and management applications try to simplify fuels rather than attempt to understand their complexity. This over-simplification of information often introduces additional uncertainties that may compromise the assessment of fuels in various research and management applications. Moreover, most information on fuels is scattered across disparate journals, government publications, and websites making it difficult for fire managers to fully understand fuel dynamics without expending a great deal of their precious time. What is needed is a synthesis of fuels information in the context of ecology that can be used to understand basic fuels characteristics to objectively plan, implement, and evaluate results of fire research and management applications.

This book is an attempt to consolidate general introductory material about wildland fuels into a cohesive synthesis that can be used to understand and manage them. It is also meant as a guide for understanding the particular characteristics of fuels so that when fuels data are entered into fire management computer applications, the user can interpret the results in an appropriate context. The intended audience includes students and novice fire professionals who want to understand how fuel is used in fire management applications to better interpret fire simulation results and veteran fire practitioners who wish to have a better context in which to understand their fire analyses. I hope that readers will find that this book provides critical information about fundamental fuel properties and their applications so that fuels can be objectively described, sampled, classified, and mapped using the most appropriate techniques.

This book is divided into two sections: "Fuel Fundamentals" and "Fuel Applications." "Fuel Fundamentals" contains six chapters describing the basic concepts that are used to describe, quantify, and apply fuel information in fire management. The first chapter introduces wildland fuels by detailing their terminology, history and background. Chapter 2 describes how fuels are used in fire modeling applications and details their properties. Chapters 3 and 4 describe surface and canopy fuels, respectively. Chapter 5 presents information on fuel moisture, its measurement, and

its interpretation. Chapter 6 ties introductory material together by presenting material on the dynamics of surface and canopy fuels, fuel ecology, and disturbance effects. The chapter also discusses the importance of knowledge of landscape ecology and the concept of scale in understanding fuel dynamics. The term “fuel dynamics” refers to how fuels change over time and space under the processes of deposition and decomposition. These processes are important in evaluating the longevity and effectiveness of fuel treatments.

“Fuel Applications” is a synthesis of currently available applications that use fuel information for fire and fuel management activities. Chapter 7 introduces the reader to the complex world of fuel classifications by summarizing and comparing fuel description systems used today. Chapter 8 tackles fuel sampling and describes the methods and techniques that are commonly used to quantify surface and canopy fuels in the field. Because spatial fuels data layers are critical for most fire analyses, Chapter 9 introduces the reader to the approaches and challenges in mapping fuels. Chapter 10 discusses important fuel concepts used in fire management such as flammability, hazard, and fuel treatments through the lens of fire ecology rather than behavior.

It is also important to know what this book doesn’t cover. Most important, this book does not cover fuel treatments. The planning, design, and implementation of fuel treatments were not included because the vast approaches, types, and intensities of fuel treatments almost always demand a local context. That is the subject of another book or series of books. This book also does not detail how to create the applications discussed in the second section. Appropriate fuel sampling designs, classification procedures, and mapping techniques are found in the publications cited in this book and again must be designed around local conditions. This book also doesn’t provide instructions on how to use fuel data in fire management applications; those instructions are contained in the manuals for the applications.

I have attempted to provide fuels information from countries all over the world, but this book is admittedly North American in focus, using concepts, examples, and material mostly from the United States and Canada. In addition, this book focuses mainly on fuel loading (mass per unit area) and less so on other important fuel properties, such as heat content, bulk density, and surface-area-to-volume ratios. This is primarily because loading best relates fire ecology to fire behavior and, more pragmatically, most of the literature in wildland fuel science concerns loading. Fuel moisture is also quite important in fire management, and while most of the principles presented in this book are in the context of loading, they could easily be expanded to describe fuel moisture. Terminology is quite important in the fire management community; consistency and consensus in terminology minimizes confusion, facilitates communication, and provides for appropriate descriptions. In this book, terminology is based on the 2013 National Wildfire Coordinating Group (NWCG) glossary (<http://www.nwcg.gov/pms/pubs/glossary/>).

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