

D. McKenzie, C. Miller and D.A. Falk (eds.): The Landscape Ecology of Fire

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In the *Foreword* of this volume is the statement that “landscape ecology is the ‘glue’ that holds ecosystem theory together and nowhere is that more evident than in the study of wildland fire ecology.” The *Landscape Ecology of Fire* summarizes how landscape ecology has contributed to, and been formed by, the study of wildland fire, and focuses on new and emerging ideas about the landscape ecology of fire. Landscape ecology added a spatial and scaling component to the study of wildland fire that resolved many previously intractable problems. Nevertheless, as this volume describes, theoretical gaps remain that must be filled to advance towards a comprehensive landscape ecology of fire.

The book is a collection of contributed chapters that are well-edited and mostly easy to read. The chapters are all consistent with the title of the volume. However, as is often the case with collections, the book does not present a cohesive, logical development of the new theoretical framework that is presented in Chapter 1. Part I describes some new theoretical concepts about the drivers and regulators of fire regimes, scaling laws and landscape resilience. Part II focuses on the climate context of fire regimes. Part III describes how fire dynamics interact with other

ecosystem properties. Part IV discusses fire management and policy issues associated with global change, although it should be noted that climate change is explicitly addressed in most of the chapters. The book is clearly focused on the western US, but many of the concepts can be extended to other ecosystems.

Chapter 1 is titled “Toward a theory of landscape fire.” This chapter is the most important and substantive of the volume because it outlines a new way of understanding wildland fire dynamics based on theoretical principles. The concepts are inspired by the ecosystem energy perspective of H.T. Odum, and posit that landscape fire dynamics can best be understood by focusing on Energy (potential and kinetic), Regulation and Scale (ERS). Landscape ecologists can study the spatial patterns of stored energy (fuel) and solar energy (weather and drying of fuels) and the dynamics of energy release during a fire event (fire spread and heterogeneity of burn severity). The regulation of these energy fluxes has top-down and bottom-up components that are familiar to landscape ecologists. Finally, flows of energy and mass occur at characteristic scales of space and time, but their dynamics in fire events result in important interactions across multiple scales of space and time. Therefore scale is a critical pillar of this theory of landscape fire. The authors seem to argue that hierarchy theory can be replaced by reference to the “middle-number domain”, but it was not clear to me how this concept is superior to hierarchy theory. I found the text here a bit difficult to follow, and I look forward to seeing more published about this.

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Part I has two additional chapters with a theoretical focus. Chapter 2 provides some new insights into how scaling laws can be applied to the study of wildland fire regimes. This chapter supports the material in Chapter 1 quite nicely, but it does assume that the reader has a high level of familiarity with quantitative spatial statistics. Chapter 3 focuses on the concept of landscape resilience (*sensu* Holling) and demonstrates a credible application of theoretical results to inform management strategies. The authors develop a theoretical framework to understand fire regimes across all of California and provide some empirical tests. I appreciated their objective description of the pros and cons of various approaches. Together, these three chapters comprise about a quarter of the volume, and are the most integrated and cohesive of all the chapters.

Part II has two chapters. Chapter 4 provides an excellent synthesis and summary of top-down (e.g., climate) and bottom-up (e.g., fuels, topography) controls on the spatial pattern of wildfires and their frequency. There is a particularly good presentation of the various climate cycles and their teleconnections to other parts of the globe. Chapter 5 develops a theory of fuel characteristics (flammability and connectivity) based on climate moisture deficits. There is an explicit treatment of the spatial implications of this theory and a linkage to percolation theory and hydrology models. Unfortunately, the link to the theory in Chapter 1 is not as clear as it could be.

The chapters in Part III seem to be even more loosely related to each other and the preceding parts. Chapter 6 combines the landscape ecology of fire and biogeochemical cycling dynamics. Much of the chapter is spent describing this field of study, but it includes an interesting discussion of the theory of biogeochemical resilience. Chapter 7 is a primer on the methods available to reconstruct the landscape pattern of historical fires and fire regimes. Three case studies are presented to illustrate the pro and cons of different techniques, and the authors suggest potential applications for ecosystem and landscape management. Chapter 8 documents the relationship among fire regime, management activities and alien plant invasions, and especially highlights the spatial and

temporal aspects of these relationships. The chapter ends with thoughtful speculation about how climate change will impact these relationships in the major ecosystems of California. Chapter 9 describes a case study of landscape fire modeling and predicting impacts on wildlife habitat from the outputs. This chapter apparently was included for heuristic value since the results were preliminary and unreplicated.

Part IV ostensibly examined the management and policy implications of a landscape ecology theory of fire. It did so, but not in a very synthetic or holistic way. Chapter 10 listed nine practical management options in the face of changing fire regimes under climate change. This chapter had a strong landscape perspective and nice links to climate change. Chapter 11 was specifically about the management of wilderness areas and how changing fire regimes and increasing adjacent housing density will make that more difficult. The authors propose two generalized wildfire management strategies to apply, depending on the situation. Chapter 12 attempts to synthesize the key lessons of all the chapters and comments on the state of the art of landscape fire theory and its application to fire management, and proposes a research agenda. I would say the result is more of a summary than a synthesis. The authors return to the material in Part I, which really forms the heart of this book. The proposed research agenda is primarily related to further developing the ERS theoretical framework and testing its utility for advancing our understanding of the landscape ecology of fire.

The authors' goal for this volume was not to produce a comprehensive summary of the landscape ecology of fire, but to focus on ideas that are not yet well-represented in the literature. The first section presents an intriguing new theoretical framework, but the remainder of the book is collection of contributed chapters that mostly does not explicitly relate to the theoretical framework. My biggest disappointment with the book was that it did not comprehensively explore the implications and application of the new theoretical framework. Nevertheless, the book does indeed achieve its goal of describing cutting edge thinking about the landscape ecology of wildland fire across a broad spectrum of applications.