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Australia's megafires: biodiversity impacts and lessons from 2019 to 2020

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Fire is a key process in fire-adapted ecosystems, where it performs key ecological functions. It is, for example, one of the three main ways to recycle nutrients and organic matter in nature but, despite its importance as a fundamental ecological process, wildfire can also cause a number of negative impacts on ecological functioning and biodiversity. For instance, wildfires release part of the carbon stored in ecosystems into the atmosphere and increase the risk of soil erosion and associated nutrient depletion by removing the protective vegetation cover.

This apparent contradiction (it is a natural ecological process but generates negative environmental impacts) is particularly clear in those events that exceed the natural fire regimes of a region in terms of severity, burned area or frequency. Thus, events of extreme magnitude (for example those included in the broad term megafires, which in this book refers to those larger than 100 000 ha) can exceed the resilience of ecosystems and produce more severe negative impacts (in terms of magnitude or duration) than expected. Characterising accurately the wide variety of impacts of such extreme events is key to being able to anticipate and, thus, mitigate their most severe impacts, especially in the current context, where megafires are becoming increasingly frequent in many regions of the world.

Libby Rumpff, Sarah Legge, Stephen van Leeuwen, Brendan Wintle and John Woinarski have edited this book involving nearly 200 authors from more than 60 different institutions. Their combined contributions characterise the main impacts on biodiversity of the series of megafires that affected Australia during its catastrophic 2019–2020 fire season. Australia is one of the regions of the world where fire plays a major role, being naturally present in a large part of its ecosystems including its temperate forests and where humans have actively managed fire for many millennia. The year 2019 was, to date, the warmest year on record in Australia and the fires of the 2019–2020 season burned more than 10 million ha in the south and east of the country, exceeding by far the size of even the largest forest area burned in a fire season in recorded history in Australia. The economic impacts of these fire alone have been estimated to exceed USD20 billion.

Over 36 chapters and more than 500 pages, the impacts of these events in Australia are explored in depth and from multiple perspectives. First, the general theme of the book is introduced (Ch. 1) and the main drivers and characteristics of this wave of wildfires are analysed (Ch. 2). Then, the book goes on to explore the impacts of these wildfires on aspects relevant to the people of Australia such as the cultural values of Indigenous people (Ch. 3), and the effects on biodiversity hotspots and other world heritage values (Ch. 4). The following chapters analyse impacts on key elements of Australia's biodiversity such as soils and soil-related processes (Ch. 5), aquatic (Ch. 6) and marine ecosystems (Ch. 7), and ecological communities (Ch. 8). Chapters 9–16 explore wildfire impacts on different taxonomical groups such as plants (Ch. 9), fungi (Ch. 10), invertebrates (Ch. 11), wildlife (Ch. 12), frogs (Ch. 13), lizards and snakes (Ch. 14), birds (Ch. 15) and native mammals (Ch. 16). In the following chapters, a series of compound effects are discussed: between wildfires and introduced animals on native flora and fauna, (Ch. 17) between wildfires and diseases on vascular plants (Ch. 18), and between wildfires and forestry activities (Ch. 19). Then, the environmental effects and biodiversity impacts of wildfires (Ch. 20), and those derived from prescribed burns

(Ch. 21) are summarised, followed by an analysis of policy and land management aspects: in Ch. 22, the government's response; in Ch. 23, the response of state agencies; in Ch. 24, the response of conservation non-governmental organisations (NGOs), and in Ch. 25, the response of natural resource management groups. Innovative aspects of fire research such as effects on animal welfare (Ch. 26) or ex-situ conservation interventions (Ch. 27) are also covered. In the final part of the book, lessons and conclusions are drawn from these dramatic events: Ch. 28 summarises the actions taken after the wildfires to restore biodiversity; Ch. 29 explores the main lessons learned in terms of land management and policy; Ch. 30 analyses the main inquiries carried out by the regional and local authorities in relation to the management of these wildfires; Ch. 31 analyses how ecosystems and biodiversity are recovering and how they are being monitored; and Ch. 32 highlights aspects related to data gaps and uncertainties. To further explore the impacts of these wildfires on local communities, Ch. 33 explores the potential role of Indigenous communities and the relevance of the cultural use of fire in post-fire recovery, and Ch. 34 includes personal reflections by different inhabitants of the territories affected by wildfires. The final chapters include recommendations (Ch. 35) and a vision for the possible future of Australia and fire (Ch. 36) from the editors of this book.

Wildfires are global phenomena with notable differences between affected regions and they impact people's well-being in many different ways. Although their impacts on biodiversity have been studied for decades, this book does a thorough and integrative job of exploring these effects from different but interrelated points of view (e.g. from social to ecological), which are of great relevance to the people of Australia. It combines the experience and knowledge of a wide range of experts from researchers to managers, also including local inhabitants. In addition, it focuses on the megafire extreme events, which in the current context of global change are becoming a key part of present and future landscapes in many regions around the world.

This book may be of particular interest to forest or land managers and policymakers who want to assess or mitigate environmental impacts of fire. It is also useful as an academic text to provide undergraduate and postgraduate students with the basis for learning the main effects of fire on the landscape. Finally, it is also of clear interest to fire researchers who want to improve our understanding of how fire (and increasingly important megafires) can affect nature and the benefits people obtain from it.

Conflicts of interest. The author declares no conflicts of interest.

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