Preface

Nearly 10 years ago our CSIRO research group commenced an integrated study of a mulga, *Acacia aneura*, woodland site on the pastoral property, Lake Mere, in western New South Wales, Australia. Our decision to establish studies in these semi-arid woodlands was the culmination of much discussion, consultation and searching. Our search was for an open, grassy woodland in near-pristine condition, and this we found at Lake Mere. Our approach was to study the ecology of this mulga woodland and the impact of grazing on the functioning of this landscape. The original team which set up the study site, and designed a set of integrated studies for the site, included: Dean Graetz, Richard Greene, Graham Harrington, Ken Hodgkinson, John Ludwig, Neil MacLeod, Fiona McFarland, Bill Mulham, Jim Noble, David Tongway, Brian Walker and Allan Wilson.

The Lake Mere study site was designed as a series of plots with a range of grazing pressures applied by combinations of sheep and kangaroos. Allan Wilson set up this grazing and competition study in 1986 and ran it until 1990; David Freudenberger then joined the team and carried the competition study to its conclusion in 1994; other grazing impact studies have continued to the present. Numerous other studies have been completed, or continue, on the site, where we have a commitment to long-term ecological research. The Lake Mere study has enabled us to elucidate the internal workings of a semi-arid landscape, and what happens to that landscape if it is being pushed too far by grazing pressures. Much of our understanding of landscape function has been obtained by our studies at Lake Mere, although our studies and understanding have now evolved well beyond Lake Mere to include other semi-arid lands in Australia, Africa and the USA. In this book we wish to share this understanding, even though incomplete, of how these landscapes work.

As part of the original grazing study, John Ludwig and David Tongway were responsible for a detailed vegetation and soils description for the Lake Mere site. Vegetation and soil patterns were strongly evident: distinctive groves of mulga trees were separated by open, nearly treeless intergroves. Others had reported this pattern for other mulga lands of Australia, so this was not new. However, what did become evident — more with time and observation than from our original data — was the extent and importance of this grove-intergrove patchiness, and other smaller-scale patches, on landscape function. For example, at the same time as the initial soil and vegetation descriptions were undertaken, Jim Noble also surveyed the distributions of harvester termite pavements and soil hummocks formed around fallen mulga logs. Again, there were distinct patterns evident — the densities of both these soil-surface features being greatest in the intergroves. A colleague, Walt Whitford, who was visiting from New Mexico, USA, at the time, helped open our eyes to the importance of these small-scale patches in terms of landscape processes and function.

What became clear from these studies on patchiness at Lake Mere was the critical importance of patches in determining how semi-arid landscape function to conserve scarce water and nutrients within the local system, preventing these vital resources from escaping out into creeks. We've also learned how these patches fall apart. At the beginning of the Lake Mere study, Ken Hodgkinson established a demographic study of the perennial grasses at the site. By following the life and times of individual grasses, we have gained an understanding of how these very small-scale patches break down through death by grazing and drought. Through the work of Allan Wilson and David Freudenberger, we have gained an understanding of the importance of patches to animal production. In addition, another colleague, Richard Greene, now at the Australian National University, carried out studies on Lake Mere with other colleagues to quantify relationships between patch density and runoff. These studies, and the intellectual exchanges fostered by them, have combined to develop our understanding how landscapes function to conserve scarce resources. This understanding can contribute to the management of grazing lands for sustainable production, and for the conservation of habitats and biodiversity; these are the central themes of the book.

The first Section of this book is on the ecology of how semi-arid landscapes function. In Chapter 1 we develop a conceptual model, called the trigger–transfer–reserve–pulse framework, for how landscapes function — we use this construct throughout the book. The processes by which landscapes conserve scarce water and nutrients are covered in Chapter 2. When stores of water and nutrients exceed critical thresholds, pulses of activity occur in the landscape. Plant production pulses are discussed in Chapter 3, and the many and varied pulses of consumers in Chapter 4.

The second Section of the book deals with what happens when things go wrong, when a landscape loses its ability to efficiently capture and store water and nutrients — a state we call dysfunctional. Chapter 5 describes landscape dysfunction in detail, while Chapter 6 looks at its causes and consequences.

In the third Section of the book we consider ways of managing rangelands through an understanding of landscape function. Chapter 7 discusses management responses from the perspective of rangelands being viewed as functioning landscapes. Chapter 8 examines appropriate responses for managing total grazing pressures on rangelands and impacts on conservation values, while Chapter 9 looks at rehabilitation. We end with a look to the future — some scenarios for the way rangeland landscapes may be used, some management strategies for their sustainable use, and some future research needs such as indicators of sustainable use.

One of our aims in writing this book is to extend to the many and diverse groups interested in arid and semi-arid lands our knowledge on how these landscapes function as resource conserving systems. Landcare and Catchment Management groups are forming a growing communication and education network across Australia's rangelands. Coordinators are often engaged by these groups to facilitate educational activities. We hope that they, and government policy-makers, land administrators, extension staff, research officers, and students undertaking courses in the management of natural resources, will find this book of value. We are also hoping that it will be of use to our fellow scientists, including overseas colleagues with an interest in Australia. We know there are many similarities between arid and semi-arid landscapes in Australia and other parts of the world.

Although most of this book was written by five of us in the Canberra-based unit of the National Rangelands Program, Division of Wildlife and Ecology, CSIRO, we want to acknowledge our colleagues who made

direct contributions to some of the chapters: Graham Griffin, in the Alice Springs unit of CSIROs National Rangelands Program, and Neil MacLeod and Joel Brown from CSIRO Tropical Agriculture at Brisbane and Townsville, respectively. We also acknowledge the indirect contributions of many research colleagues in CSIRO, State Departments, Universities and overseas who have helped us crystallise our thinking on landscape function, and who encouraged us to write about it in a general style. We gratefully acknowledge the enormous contributions made by technical staff and volunteers, too numerous to list, who have assisted in our research. Without them, the Lake Mere and related studies would not have been possible. We sincerely thank John Calaby for reviewing and Ed Highley for technical editing draft chapters. We thank Robert Eager for assistance with preparing the index. Our publishing editor, Laurie Martinelli, enabled this all to be put into print.

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