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978-0-521-70778-7 - Large-Scale Landscape Experiments: Lessons from Tumut

David B. Lindenmayer

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Large-Scale Landscape Experiments

Landscape change and habitat fragmentation are key factors impacting biodiversity worldwide. These processes have many facets, each of which is usually studied in isolation. The Tumut Fragmentation Study has run for 13 years and has yielded extensive data on changes in both plant and animal populations in areas of native forest and pine plantation. It is unique in the way that many different factors and processes influencing a wide range of species groups have been studied in a single large-scale natural experiment. Writing for academic researchers, professionals and graduate students, David B. Lindenmayer uses the Tumut Fragmentation Study and other relevant research to provide an overview of the relationships between landscape change, habitat fragmentation, and biodiversity conservation. He details the background ecology of landscape change and habitat fragmentation, the experimental design underpinning the establishment of the large-scale natural experiment, the implementation of, and results from, an array of key and strongly contrasting research programmes over the past 13 years. Key lessons are drawn on throughout the book on the design and implementation of large-scale ecological studies, biodiversity conservation in fragmented landscapes and the management of plantation landscapes for enhanced nature conservation. The book highlights how important new insights can be generated from integrating demographic, genetic and modelling research.

DAVID B. LINDENMAYER is Professor of Conservation Science and Ecology in the Fenner School of Environment and Society at The Australian National University, Canberra.

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For Ross Cunningham

whose statistical insights and mentoring turned a good idea into reality.

For Karen Viggers

with thanks for her great patience with book-writing projects over the years.

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Preface

The Tumut Fragmentation Study is a relatively rare beast in the world of ecological research – it's a large-scale, long-term ecological research programme that incorporates observational studies that have run for over a decade, experimental manipulations and integrated demographic and genetic research. The research programme has provided a platform for a range of simulation modelling studies. The Tumut Fragmentation Study has also served as a wonderful test bed for a broad range of ecological theory and a platform for modelling. And it all began with a glance out of a plane window.

In the early 1990s, I was flying to Melbourne from Canberra when I saw a fascinating landscape near the timber town of Tumut in southern New South Wales, south-eastern Australia. I saw vast areas of land in which the native forest had been cleared for pine plantation, and set in this plantation were numerous pockets of native forest that were now 'islands in a sea of pines'. The exciting thing was that these 'islands' were not the unwanted parts of the landscape that you often find in pine plantations where, for example, native remnants are only on rocky hills. Nor were these remnants only representing riparian areas. They were, in fact, patches of forest of the same type as the nearby intact native forest.

And from this observation immediately sprang a series of questions: How does the biodiversity of these native remnants compare with the biodiversity of the intact native forest? And, flowing on from this, what contribution might these remnants make to conserving biodiversity in production landscapes such as plantations? What role might they play in assisting animal dispersal and movement in fragmented landscapes?

And so the idea for the Tumut Fragmentation Study was born. It officially commenced in 1995.

The study is focused on the Buccleuch State Forest 100km west of Canberra. The forest is a 50,000ha plantation of Radiata Pine established by clearing native forest from 1932 until 1985. In the process, however, patches of native bush ranging in size from half a hectare to 125ha were

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left in place. And beyond the boundaries of the plantation are large continuous areas of native eucalypt forest.

Field sites were established in the Radiata Pine stands (the plantation), in large unfragmented forest (the control sites) and in the native forest 'islands' within pine stands (treatment sites). Initially data were gathered on the presence and abundance of arboreal marsupials, small mammals, forest birds and plants at each of the sites. However, the study grew to include a range of other studies that examined aspects ranging from how different groups of animals behaved in and around the patches to what was the genetic make-up of the different organisms using these remnants.

The loss, fragmentation and degradation of native vegetation is the single greatest driver of biodiversity decline in Australia. Finding ways to improve the quantity and quality of native vegetation with optimal conservation outcomes is critical to conserving biodiversity. The Tumut Fragmentation Study is a rare long-term, large-scale ecological investigation that provides valuable empirical evidence on the ecological processes at play and how we might best manage our production landscapes to ameliorate the loss of biodiversity.

The data generated by the Tumut Fragmentation Study have led to the publication of over a hundred journal papers and have contributed to four books. However, while the study is still a 'work in progress', there has been a growing call to write a book on what has been achieved, in order to draw together the various strands of work and outline some of lessons learned. This volume is an attempt to do this.

The book that has resulted isn't perfect. Some will want more detail, while others will find it overly technical. However, for anyone interested in the science of landscape change, biodiversity conservation and the realities of large-scale ecological studies, this overview of the Tumut Fragmentation Study will hopefully be an illuminating read.

It's not often that we have the opportunity to explore landscape change over scales of hundreds of kilometres and time frames of decades. It's my hope that the lessons presented here, gleaned from many years of hard work by many researchers, will benefit us all through the better conservation of our precious biodiversity.

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Acknowledgements

The Tumut project owes its origins, conceptual development and much of its statistical design to Adjunct Professor Ross Cunningham. His insights and mentorship helped convert what seemed like good ideas on paper to a reality on the ground.

In 2006, a close friend and colleague, Professor Jerry Franklin, insisted that it was time to draw together the published material and general insights from Tumut into one place. That idea was then supported by the Joint Venture Agroforestry Program (JVAP) within the Rural Industries Research and Development Corporation, based in Canberra, Australia. In particular, Dr Rosemary Lott, from that organisation, championed this writing project.

A vast number of people and organisations have made major contributions to the research at Tumut (see Appendix 1). In particular, field staff have been pivotal to the success of the project, especially Mason Crane, Chris MacGregor, Damian Michael, Dr. Rebecca Montague-Drake, Matthew Pope, David Rawlins and Craig Tribolet.

A great deal of excellent work has been completed at Tumut by postgraduate students. They include: Dr Sam Banks, Dr Joern Fischer, Ms Heidi Hewittson, Mr Matthew Pope, Dr Monica Ruibal, Dr Peter Smith, Dr Jeanette Stanley, Dr Darius Tubelis and Ms Kara Yongentob.

Work at Tumut has progressed through collaborative partnerships with many colleagues (see Appendix 1). These include: Dr Sam Banks, Dr Andrew Claridge, Adjunct Professor Ross Cunningham, Ms Christine Donnelly, Dr Joern Fischer, Dr Phil Gibbons, Professor Richard Hobbs, Dr Bob Lacy, Dr Sarah Legge, Professor Mike McCarthy, Dr Sue McIntyre, Dr Kirtsen Parris, Dr Rod Peakall, Dr Emma Pharo, Professor Hugh Possingham, Dr Peter Smith, Dr Paul Sunnucks, Dr Andrea Taylor, Professor Hugh Tyndale-Biscoe, Dr Karen Viggers, Professor Alan Welsh and Dr Jeff Wood.

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Volunteers have made an enormous contribution to the work at Tumut. In particular the efforts of the dedicated birdwatchers from the Canberra Ornithologists Group (COG) have been invaluable. My father, Bruce Lindenmayer, has been instrumental in gathering support from many outstanding amateur ornithologists.

David Salt edited the book and made many valuable changes that greatly improved a manuscript that started out much sloppier than it should have been! This book could not have been produced without the heroic efforts of Rachel Muntz who contributed her considerable expertise to many facets of this work.

Finally, Alan Crowden steered this book through the process of conception, contract development and those other fiddly stages that are always more convoluted than they initially seem.