

Living in a Dynamic
**TROPICAL
FOREST
LANDSCAPE**

Edited By Nigel Stork
& Stephen M. Turton



Blackwell
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CONTENTS

List of Contributors	ix
Foreword by <i>Peter H. Raven</i>	xiii
Acronyms and Abbreviations	xv
Editors	xviii
Introduction	1
<i>Nigel E. Stork and Stephen M. Turton</i>	
1 Australian Rainforests in a Global Context	4
<i>Nigel E. Stork, Stephen Goosem and Stephen M. Turton</i>	
PART 1: HISTORY AND BIODIVERSITY OF THE WET TROPICS	21
2 The Synoptic Meteorology of High Rainfalls and the Storm Run-off Response in the Wet Tropics	23
<i>Mike Bonell and Jeff Callaghan</i>	
3 Impacts of Tropical Cyclones on Forests in the Wet Tropics of Australia	47
<i>Stephen M. Turton and Nigel E. Stork</i>	
4 Aboriginal Cultures in the Wet Tropics	59
<i>Sandra Pannell</i>	
5 European Settlement and its Impact on the Wet Tropics Region	71
<i>David J. Turton</i>	
6 The Establishment of a World Heritage Area	81
<i>Peter S. Valentine and Rosemary Hill</i>	
7 The Nature of Rainforest Tourism: Insights from a Tourism Social Science Research Programme	94
<i>Philip L. Pearce</i>	
8 The Dynamic Forest Landscape of the Australian Wet Tropics: Present, Past and Future	107
<i>David W. Hilbert</i>	
9 Floristics and Plant Biodiversity of the Rainforests of the Wet Tropics	123
<i>Daniel J. Metcalfe and Andrew J. Ford</i>	
10 Towards an Understanding of Vertebrate Biodiversity in the Australian Wet Tropics	133
<i>Stephen E. Williams, Joanne L. Isaac, Catherine Graham and Craig Moritz</i>	
11 Origins and Maintenance of Freshwater Fish Biodiversity in the Wet Tropics Region	150
<i>Brad Pusey, Mark Kennard and Angela Arthington</i>	
12 Diversity of Invertebrates in Wet Tropics Streams: Patterns and Processes	161
<i>Niall M. Connolly, Faye Christidis, Brendan McKie, Luz Boyero and Richard Pearson</i>	

13	The Invertebrate Fauna of the Wet Tropics: Diversity, Endemism and Relationships <i>David Yeates and Geoff B. Monteith</i>	178
14	International Perspective: the Future of Biodiversity in the Wet Tropics <i>Jiro Kikkawa</i>	192
PART 2: ECOLOGICAL PROCESSES AND OTHER ECOSYSTEM SERVICES		195
15	Hydrological Processes in the Tropical Rainforests of Australia <i>David McJannet, Jim Wallace, Peter Fitch, Mark Disher and Paul Reddell</i>	197
16	Seed Dispersal Processes in Australia's Tropical Rainforests <i>David A. Westcott, Andrew J. Dennis, Matt G. Bradford, Graham N. Harrington and Adam McKeown</i>	210
17	Floral Morphology, Phenology and Pollination in the Wet Tropics <i>Sarah L. Boulter, Roger L. Kitching, Caroline L. Gross, Kylie L. Goodall and Bradley G. Howlett</i>	224
18	Services and Disservices from Insects in Agricultural Landscapes of the Atherton Tableland <i>Saul A. Cunningham and K. Rosalind Blanche</i>	240
19	Economic Approaches to the Value of Tropical Rainforests <i>Ian Curtis</i>	251
20	International Perspective: Ecological Processes and Ecosystem Services in the Wet Tropics <i>S. Joseph Wright</i>	261
PART 3: THREATS TO THE ENVIRONMENTAL VALUES OF THE WET TROPICS		265
21	Impacts of Climate Variability and Climate Change on the Wet Tropics of North-Eastern Australia <i>Jacqueline Balston</i>	267
22	The Impact of Climate Change on the Biodiversity and Ecosystem Functions of the Wet Tropics <i>Stephen E. Williams, Joanne L. Isaac and Luke P. Shoo</i>	282
23	Impacts of Habitat Fragmentation and Linear Clearings on Australian Rainforest Biota <i>William F. Laurance and Miriam Goosen</i>	295
24	Invasive Weeds in the Wet Tropics <i>Stephen Goosen</i>	307
25	Vertebrate Pests of the Wet Tropics Bioregion: Current Status and Future Trends <i>Bradley C. Congdon and Debra A. Harrison</i>	322
26	Applications of High Resolution Remote Sensing in Rainforest Ecology and Management <i>David Gillieson, Tina Lawson and Les Searle</i>	334
27	Environmental Impacts of Tourism and Recreation in the Wet Tropics <i>Stephen M. Turton and Nigel E. Stork</i>	349
28	International Perspective: Conservation Research in the Australian Wet Tropics <i>William F. Laurance</i>	357
PART 4: LIVING IN A WORLD HERITAGE AREA		361
29	The Wet Tropics Conservation Strategy: Conservation in a Community Context <i>Campbell Clarke</i>	363

30	Cultural Landscapes in the Wet Tropics <i>Sandra Pannell</i>	373
31	Encountering a World Heritage Landscape: Community and Visitor Perspectives and Experiences <i>Joan Bentrupperbäumer and Joseph Reser</i>	387
32	Integrating Effort for Regional Natural Resource Outcomes: the Wet Tropics Experience <i>Allan Dale, Geoff McDonald and Nigel Weston</i>	398
33	'Getting the Mob in': Indigenous Initiatives in a New Era of Natural Resource Management in Australia <i>Sandra Pannell</i>	411
34	Framing and Researching the Impacts of Visitation And Use in Protected Areas <i>Joseph Reser and Joan Bentrupperbäumer</i>	420
35	Linking Cultural and Natural Diversity of Global Significance to Vibrant Economies <i>Rosemary Hill</i>	430
36	Rethinking Road Ecology <i>Miriam Goosem</i>	445
37	Living in a World Heritage Landscape: An International Perspective <i>Jeffrey A. McNeely</i>	460
	PART 5: RESTORING TROPICAL FOREST LANDSCAPES	467
38	Forest Restoration at a Landscape Scale <i>David Lamb and Peter Erskine</i>	469
39	Restoration in North Queensland: Recent Advances in the Science and Practice of Tropical Rainforest Restoration <i>Nigel Tucker</i>	485
40	Rainforest Restoration for Biodiversity and the Production of Timber <i>Grant W. Wardell-Johnson, John Kanowski, Carla P. Catterall, Mandy Price and David Lamb</i>	494
41	Biodiversity and New Forests: Interacting Processes, Prospects and Pitfalls of Rainforest Restoration <i>Carla P. Catterall, John Kanowski and Grant W. Wardell-Johnson</i>	510
42	Monitoring the Outcomes of Reforestation for Biodiversity Conservation <i>John Kanowski, Carla P. Catterall and Debra A. Harrison</i>	526
43	The Future for Forest-based Industries in the Wet Tropics <i>Steve Harrison and John Herbohn</i>	537
44	International Perspective: Restoring Tropical Forest Landscapes; Restoring What and for Whom? <i>Jeffrey Sayer</i>	552
	PART 6: SCIENCE INFORMING POLICY AND CONSERVATION AND MANAGEMENT OF TROPICAL FORESTS	555
45	Catchment to Reef: Water Quality and Ecosystem Health in Tropical Streams <i>Richard Pearson and Nigel E. Stork</i>	557

46	A preliminary Assessment of Priority Areas for Plant Biodiversity Conservation in the Wet Tropics Bioregion <i>Kristen J. Williams, Chris R. Margules, Petina L. Pert and Tom Barrett</i>	577
47	New Tools for Monitoring World Heritage Values <i>Stuart Phinn, Catherine Ticehurst, Alex Held, Peter Scarth, Joanne Nightingale and Kasper Johansen</i>	591
48	Rainforest Science and its Application <i>Stephen Goosem, Nigel E. Stork and Stephen M. Turton</i>	610
49	Lessons for Other Tropical Forest Landscapes <i>Nigel E. Stork, Stephen M. Turton, William F. Laurance, Jiro Kikkawa, Jeffrey A. McNeely, Jeffrey Sayer and S. Joseph Wright</i>	618
	Index	623

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FOREWORD

The world's tropical rainforests, which occupy no more than 7% of the Earth's land mass, sequester within them about 40% of all carbon that is not held in the oceans. Importantly, they are home to a large part of global biodiversity, with perhaps as many as half of the world's total species found nowhere else. In addition, they play a key role in the Earth's atmospheric circulation and in the determination of climate, including precipitation, at a local and regional scale. Located almost entirely within developing countries, these forests are heavily impacted by legal and illegal logging, destructive mining, clearing for agriculture and plantations and shifting cultivation. A majority of Indigenous people living in rainforest areas have been removed from their traditional lands, and the mega-fauna in these forests, essential to their regular functioning, is being devastated by hunting.

Despite strong efforts for more than three decades, it has proved extraordinarily difficult to develop sustainable land-use systems in the moist tropics. Their resources have proved attractive for exploitation by corporations and individuals within their own countries, and the speed of their destruction has been increased by the demands of an emerging global economy. Industrialized countries have, as a whole, exhibited insufficient will to secure the protection of resources outside of their boundaries, despite continued lamentation about the situation.

Tropical rainforests are found on the mainland of only one industrialized nation, Australia, and it is in the so-called 'Wet Tropics' of that nation that major progress has been made in achieving sustainable systems for these forest ecosystems. The local scientific community has played a major, long-term role, particularly in driving the creation of the Wet Tropics of Queensland World Heritage Area in the 1980s. Impressive advances have been made in the past 10–15 years through the creation of a multidisciplinary science-based partnership – the Cooperative Research Centre for Tropical Rainforest Ecology and Management – that unites universities, the Commonwealth Scientific Industrial Research Organisation (CSIRO), other

research organizations, local communities and local people, the Indigenous community, governments at all levels, industry, particularly the tourism industry, and non-governmental organizations in an effort to manage these ecosystems sustainably. This book provides an in-depth analysis of how this progress has been achieved.

It is fitting that we should pay respect to the research pioneers of the Wet Tropics and in particular to Len Webb, whose botanical studies in the 1960s and 1970s and later, often with Geoff Tracey, laid out the path for others to follow. Len was passionate about Indigenous people, and would be pleased to see the recent strength of engagement with Rainforest Aboriginal peoples, evidenced by numerous chapters in this book. It is also good to see a few of those pioneers as authors in this book – Jiro Kikkawa, Mike Bonell, and many more. Also included as authors are some of those who made the conservation and protection of rainforests in North Queensland happen, including Aila Keto, Rosemary Hill and Mike Berwick. The battles to preserve Australia's rainforests up and down the east coast and in south-west Tasmania have been fierce and have received much international attention.

In the final chapter, editors Nigel Stork and Steve Turton ask whether there are lessons from the Australian Wet Tropics that can be applied elsewhere. There certainly are! It is essential in pursuing sustainability anywhere to engage all the stakeholders in debates about the way rainforests can be managed, to make science-based decisions and to work across disciplines and ecosystems. The ways in which our landscapes are managed directly affect the health of waterways, estuaries, wetlands, coral reefs and oceans. This book takes a uniquely comprehensive and therefore exemplary holistic approach to landscape science and sustainable management, and is a valuable contribution that will certainly attract interest throughout the world.

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ACRONYMS AND ABBREVIATIONS

AATSE	Australian Academy of Technological Sciences and Engineering	DBH	diameter at breast height
ABA	additive basal area	DEC	Department of Environment and Conservation
ACF	Australian Conservation Foundation	DEM	digital elevation model
ACIUCN	Australian Committee for the World Conservation Union	DFG	disperser functional groups
AGB	above-ground biomass	DN	digital numbers
AHC	Australian Heritage Commission	DNRM	Department of Natural Resources and Mines
AIMS	Australian Institute of Marine Science	DNRMW	Department of Natural Resources, Mines and Water
ALP	Australian Labour Party	DOGIT	deed of grant in trust
ANN	artificial neural network	DPI	Queensland Department of Primary Industries
ATSIC	Aboriginal and Torres Strait Islander Commission	DPIF	Department of Primary Industries and Fisheries
AWS	automatic weather station	EIA	environmental impact assessment
BA	basal area	EMS	environmental management systems
BK	Bellenden Ker	ENSO	El Niño Southern Oscillation
BMB	Black Mountain Barrier	EOS	experience opportunity spectrum
BMC	Black Mountain Corridor	EPA	Environmental Protection Agency
BP	before present	EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
BRDF	bidirectional reflectance distribution function	ERS	European Remote Sensing satellite
CAFNEC	Cairns and Far North Environment Centre	E_s	forest floor evaporation
cal. yr BP	calculated year before present	ET	evapotranspiration
CAPE	convective available potential energy	EVI	enhanced vegetation index
CCA	Community Conserved Areas	FANN	forest artificial neural network
CDM	clean development mechanism	FFG	fruit functional groups
CEO	chief executive officer	FIS	forest inventory survey
CMA	Catchment Management Authorities	FLR	forest landscape restoration
CNVF	complex notophyll vine forest	FNQ NRM	Far North Queensland Natural Resource Management Ltd.
CRC	Cooperative Research Centre	FNQEB	Far North Queensland Electricity Board
CRRP	Community Rainforest Revegetation Program	FPQ	Forestry Plantations Queensland
CSIRO	Commonwealth Scientific and Industrial Research Organisation	FWPRDC	Forest and Wood Products Research and Development Corporation
CTCC	Cape Tribulation Community Council	GAM	generalized additive models
CVM	contingent valuation method	GBR	Great Barrier Reef
Cwlth	Commonwealth	GBRMPA	Great Barrier Reef Marine Park Authority
CYCC	Cape York Conservation Council	GCM	global climate models
D	Recharge	GCP	ground control points
DASETT	Department of Arts, Sports, the Environment, Tourism and Territories	GDR	Great Dividing Range

GIS	geographical information systems	NIR	near infra-red
GLM	generalized linear models	NORMA	Northern Rainforest Management Agency
GPS	global positioning systems	NPP	net primary production
HCO	Holocene climatic optimum	NQAA	North Queensland Afforestation Association
HoA	heads of agreement	NQTC	North Queensland Timber Cooperative
<i>I</i>	canopy interception	NRM	natural resource management
IBRA	Interim Biogeographic Regionalisation for Australia	NRM & E	natural resources, mines and energy
IFOV	instantaneous field of view	NSW	New South Wales
ILUA	Indigenous land use agreement	NT	Northern Territory
IPA	Indigenous Protected Areas	OC	Oliver Creek
IPCC	Intergovernmental Panel on Climate Change	OECD	Organisation for Economic Co-operation and Development
IPCC TAR	International Panel for Climate Change Third Assessment Report	P	total precipitation
IPM	integrated pest management	PAR	photosynthetically active radiation
ITSG	Indigenous technical support group	P_c	cloud interception
IUCN	International Union for Conservation of Nature and Natural Resources (World Conservation Union)	PFANN	palaeo-forest artificial neural network
IWG	Indigenous working group	P_g	rainfall
JCU	James Cook University	P_{ga}	rainfall corrected for slope effects and wind losses
JERS	Japanese Earth Resource Satellite	PHT	Pleistocene/Holocene transition
Ji	joint implementation	PJVS	plantation joint venture scheme
K'	satiated (saturated) hydraulic conductivity	PSG	programme support groups
LAI	leaf area index	PSIA	psychosocial impact assessment
LGM	Last Glacial Maximum	PV	potential vorticity
MDI	mean daily intensity	QBVR	quantifying the biodiversity values of reforestation
MEA	millennium ecosystem assessment	QCC	Queensland Conservation Council
MHR	Member of the House of Representatives	QDMR	Queensland Department of Main Roads
MIS	managed investment schemes	QF	quickflow
MJO	Madden-Julian Oscillation	QFD	Queensland Forestry Department
ML1	Mount Lewis	QPWS	Queensland Parks and Wildlife Service
MP	Member of Parliament	QRR	quickflow response ratios
MSL	mean sea level	<i>R</i>	runoff
MVF	mesophyll vine forest	RAAF	Royal Australian Air Force
NAP	National Action Plan	RAIN	Rainforest Information and Action Network
NAPSWQ	National Action Plan for Salinity and Water Quality	RCSQ	Rainforest Conservation Society of Queensland
NCAR	National Centre for Atmospheric Research	RE	regional ecosystem
NCEP	National Centre for Environmental Prediction	RF	return flow
NDVI	normalized difference vegetation index	RFID	Rainfall intensity–frequency–duration
NGO	non-government organization	RIS	regional investment strategy
NHT	Natural Heritage Trust	ROS	recreation opportunity spectrum
		RPAC	Regional Planning Advisory Committee
		SAP	structural adjustment package
		SAR	Synthetic Aperture Radar

SCP	Smithfield Conservation Park	UNESCO	United Nations Educational, Scientific and Cultural Organisation
S_i	stemflow	VIM	visitor impact management
SIA	social impact assessment	VMS	visitor monitoring system
SLATS	Statewide Landcover and Trees Study	VP	vertical percolation
SNSM	simple notophyll and simple micro-phyll forests and thickets	VPD	vapour pressure deficit
SoE	state of the environment	WA	Western Australia
SOF	saturation overland flow	WAG	Douglas Shire Wilderness Action Group
SoWT	State of the Wet Tropics	WHA	World Heritage Area
SPOT	Système Pour l'Observation de la Terre	WHC	World Heritage Committee
spp.	species (plural)	WMC	Western Mining Corporation
SSF	subsurface stormflow	WTAPPT	Wet Tropics Aboriginal Plan Project Team
SVI	spectral vegetation indices	WTMA	Wet Tropics Management Authority
T	transpiration	WTP	willingness to pay
TEK	traditional ecological knowledge	WTQWHA	Wet Tropics of Queensland World Heritage Area
T_i	throughfall	WTTPS	Wet Tropics Tree Planting Scheme
TIN	triangulated irregular network	WTVPRAS	Wet Tropics Vertebrate Pest Risk Assessment Scheme
TOAC	Traditional Owner Advisory Committee	WTWHA	Wet Tropics World Heritage Area
TOFTW	tall open forests and tall woodlands	WTWHPM Act	Wet Tropics World Heritage Protection and Management Act 1993
TREAT	Trees for the Evelyn and Atherton Tablelands	$\delta\theta$	soil water storage
TRS	Tropical Rainforest Society		
TWS	The Wilderness Society		
UB	Upper Barron		

EDITORS

Nigel Stork holds the Chair of Resource Management and is Head of School of Resource Management and Geography, Head of the Burnley Campus and Associate Dean for Knowledge Transfer at the University of Melbourne. Formerly the CEO of the Cooperative Research Centre for Tropical Rainforest Ecology and Management, he has studied tropical forest ecology with particular interest in insect diversity in many tropical regions of the world. He has edited or co-edited ten books and written more than 150 scientific papers. Nigel is a Director of Earthwatch Australia, Member of Council for Association for Tropical Biology and Conservation and was the former Chair of the Wet Tropics Management Authority Community Consultative Committee.

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INTRODUCTION

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This book is a compendium of what we have learnt about the so-called 'Wet Tropics' landscapes of north-east Australia and brings together a wealth of scientific findings and traditional ecological knowledge. These forested landscapes, although only a very small part of Australia in geographical terms, are home to a high proportion of the continent's species and ecosystems, and have a special significance both nationally and internationally. These tropical forest landscapes have also been the home for Indigenous Australians for thousands of years. In recognition of the global significance of the natural history of the region the Wet Tropics was World Heritage listed by UNESCO in 1988.

Like other regions of eastern Australia (and the humid tropics in general), the Wet Tropics has experienced widespread clearing for agriculture, notably along the coastal plain between Mossman and Ingham and on the Atherton Tablelands inland from Cairns (Figures I.1 and I.2). Despite these major land use impacts, the region still contains large tracts of intact forest and wetlands that, elsewhere in eastern Australia, have been severely fragmented. In recent decades there has been increasing pressure for further agricultural, urban, peri-urban and tourism development in the Wet Tropics and these and other uses compete with nature conservation in what is a highly contested landscape.

This has provided regional planners with both challenges and opportunities for sustainable use of Australia's most biologically complex landscape. Many of these impacting forces are discussed in this volume.

Although a few scientists had worked for many years on various aspects of the natural history of the Wet Tropics, until quite recently our understanding of the region was patchy. This changed with the significant funding of the Cooperative Research Centre for Tropical Rainforest Ecology and Management (the Rainforest CRC) from 1993 to 2006. The Rainforest CRC, driven by the wide-ranging needs of its stakeholders, encouraged long-term foundational research and supported multidisciplinary projects often emphasizing the importance of linking social and ecological systems. It is doubtful that such an integrated, concerted and broad-scale research effort has ever been achieved before for a tropical forest landscape anywhere in the world. All those involved in the Rainforest CRC were keen to acknowledge that the important lessons gained from this living research laboratory should be used to guide future research efforts in tropical and sub-tropical Australia and elsewhere in the world. We therefore felt compelled to bring together this knowledge and the lessons learnt in a single comprehensive volume of work. In doing this we were well aware of the paucity

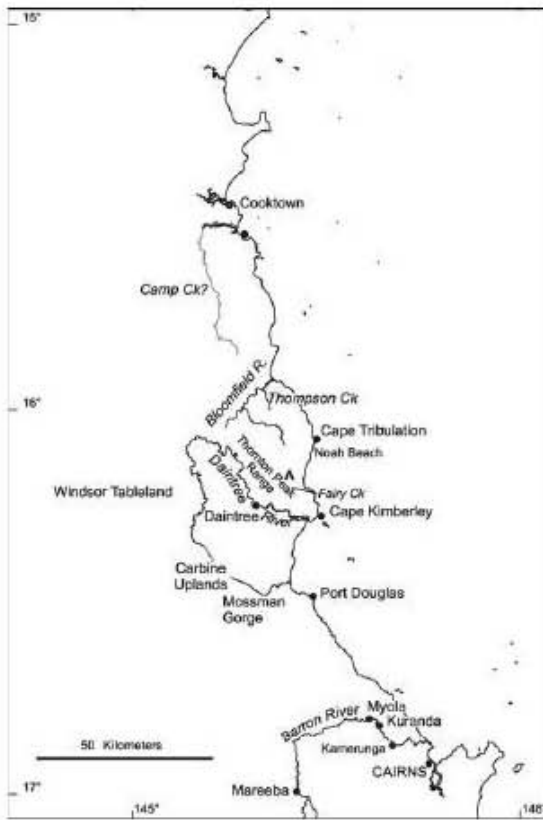


Figure I.1 Wet Tropics region of Australia – northern coastal section.

of information for other tropical forest landscapes around the world. Internationally there are no texts that provide such a holistic view of any tropical forest landscape, including the social, cultural and economic dimensions. Furthermore, no other texts provide such a breadth of understanding and linkages among different fields of study. Other texts focusing on individual tropical forests really only take a biological view and usually lack an Indigenous and management focus (e.g. Gentry 1990; McDade *et al.* 1994; Leigh *et al.* 1996; Laurance & Bierregaard 1997). Recent books by Bermingham *et al.* (2005) examining the history and ecology of tropical forests and by Laurance and Peres (2006) on the threats to tropical forests draw heavily on examples from the Wet Tropics.



Figure I.2 Wet Tropics region of Australia – southern coastal section and Atherton Tablelands.

Australia has a reputation for its environmental science and its application to improve natural resource management, conservation and sustainability at the landscape scale. It is also the only developed country with tropical rainforest on its mainland. The rainforest science carried out in many fields of study over the past 10–15 years has been world class and there have been many internationally significant scientific breakthroughs, such as those in conservation genetics, vegetation modelling, agroforestry and revegetation techniques, biodiversity assessment and modelling of the impacts of climate change on tropical biodiversity, and the integration of science with natural resource management, to name but a few. In this book authors have been encouraged to place their chapters in an international context.

Since the Australian Wet Tropics rainforests and their adjacent agricultural and urban landscapes are now as well understood as or better understood than any other tropical forest landscapes in the world, we hope that this book also will be of interest to a wide range of readers, including students, scientists, policy-makers and natural resource managers, especially in the humid tropics. The book is presented in six parts, with part summaries being written by international luminaries who have tried to place the chapters in a global context. Part I looks at the history and biodiversity of the Wet Tropics region and includes chapters on Indigenous cultures and European settlement as well as the establishment of the World Heritage Area. Part II examines ecological processes and other ecosystem services and includes chapters on seed dispersal, pollination and economic valuation of the region. Part III looks at the threats to the environmental values of the region, including biological and human-induced threats, such as climate and land-use change. Part IV examines the social and cultural dimensions of living in a World Heritage Area, including reference to the Indigenous People and their ancient links with this landscape. Part V tackles various approaches to restoring tropical forest landscapes, including production versus biodiversity trade-offs. Part VI is concerned with how science can inform policy, conservation and management of tropical forest landscapes. Most authors have included a summary at the end of their chapters and many have also included text boxes highlighting significant issues or case studies.

In writing and editing this book we have been influenced and assisted by a large number of people. We are grateful for the inspirational leadership and encouragement provided by Ralph Slatyer and Sydney Schubert, who chaired the Rainforest CRC from 1993 to 2002 and 2002 to 2006, respectively, the inaugural CEO of the CRC, Jiro Kikkawa, and many Directors of the CRC, including Mike Berwick, David Butcher, Guy Chester, John Courtenay, Josh Gibson, Daniel Gschwind, Brian Keating, John Mullins, Norman Palmer, Julia Playford, David Siddle, Vicki Pattermore and Russell Watkinson. Working in government-funded research programmes means that your research is often subjected to endless reviews! However, we found these to be very useful in guiding our research, with an increased likelihood of useful outcomes for

our stakeholders. Here we would like to acknowledge the wise advice provided by some of those reviewers, which often led to significant changes in direction and scientific advances. In particular, we thank Keith Boardman, Henry Nix, Andrew Beattie and Graham Kelleher, all of whom particularly influenced our thinking.

Our editorial assistant, Annette Bryan, performed miracles transforming draft chapters into ready to go text and working with the authors. Adella Edwards similarly transformed the figures provided by authors into a uniform and polished style. We also acknowledge and thank Shannon Hogan, David Knobel and Trish O'Reilly of the Rainforest CRC for their support in the production of the book. Our thanks are also extended to Ward Cooper, Delia Sandford and Rosie Hayden from Blackwell Publishing for their assistance and guidance.

Finally, we wish to acknowledge the remarkable contribution that the late Geoff McDonald made to our own understanding of tropical landscapes and the involvement of indigenous and non-indigenous communities in sustainable management. He was a true visionary.

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