Ecology of Desert Rivers

Desert or dryland regions cover about half the world's land surface and contain an extraordinarily diverse range of rivers. Despite their importance for people and wildlife, the ecology of these rivers is poorly known compared with that of mesic rivers of the world. Deserts are considerably more variable than mesic regions, with floods over vast floodplains followed by dry periods. This variability determines the behaviour and composition of organisms that can live in desert rivers. From algae to vertebrates, organisms have different strategies that equip them for the ecology of desert rivers: a 'boom and bust' ecology. This ecology changes when desert rivers are dammed to supply water to human communities. River regulation decreases hydrological variability, reducing habitat value for endemic species and favouring exotic species. Big challenges affect these unique rivers and their dependent ecosystems around the world; this book examines the threats and challenges.

Professor Richard Kingsford from the University of New South Wales, Australia, has wide experience in conservation biology. Born in East Africa in Kenya, his interest in wildlife began in childhood. His research over the past 20 years or so has focussed on the waterbirds, wetlands and rivers of arid Australia, which covers about 75% of the continent. These systems define the ecology of the Australian continent with their boom and bust periods, times of droughts and floods. Professor Kingsford's research has focussed on the wetlands of Cooper Creek, one of the world's most magnificent desert rivers, and the Paroo River, the last free-flowing river in the Murray–Darling Basin. His research has demonstrated the ecological value of many rivers in arid Australia, and the impacts of water resource development on desert rivers. In 2001 he was awarded a national science prize (Eureka) for environmental research for his work on Australian rivers.

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CAMBRIDGE UNIVERSITY PRESS

Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9780521818254

First published 2006

A catalogue record for this publication is available from the British Library

ISBN 978-0-521-81825-4 Hardback

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Preface

Rivers flow in and out of my childhood memories. There was the mountain river in Kenya where we caught butterflies and the contrasting desert river we passed on the way to the coast, a magnet for Africa's big game: elephants, buffalos and lions. In my teenage years, I would watch with fascination one of the world's most bizarre river creatures, the platypus, as it busily dived and bobbed to the surface in the nearby river, munching various invertebrate delicacies. Now my adulthood is immersed in the ecology of rivers.

Rivers weave their way through everyone's lives. We depend on them even if we don't realise it. They deliver most of our drinking water and, directly or indirectly, a considerable amount of our food, energy and clothing. People often first settled on the floodplain of a river, close to a permanent source of water. Relatively few of the world's cities and towns are far from rivers. But rivers serve more than such utilitarian functions. They give communities a sense of place. They occupy a central position in the cultural beliefs of many people, particularly indigenous communities. And they provide a home and resources for countless other species that coexist with us on this planet. Many organisms depend on rivers. Sometimes these bacteria, fungi, plants and animals provide 'ecosystem services' for us. They purify our water, give us food (fish and plants) and provide the goods (food and fibre) from the river that sustains us.

Rivers are places of contradiction: frenetic but peaceful. The inexorable power and direction of a flowing river is indescribably calming, but concentrate on one small part of the river and it is ever-changing. Currents churn, producing eddies, swirls and whirlpools where flotsam tosses and rolls unpredictably. From the bank of the river, it seems

stable and predictable at one level but at another chaos reigns supreme. Even the perceived stability is only a reflection of relative awareness based on how far we look and how long we watch. Visit at another time and the whole river will be different, another path carved, a new rapid formed, a raging torrent, a trickle or perhaps even dry. The unpredictable nature of floods and dry periods and everything in between over time create an incredible diversity of different places for plants and animals to live. Rivers are always alive with life.

Most of us interact with only part of a river where we collect water, wash or swim. This is the enigma of a river: you seldom know more than a part of it. But to really understand the river or more importantly to look after it, we need to know the whole river, from its catchment to its end, from source to sea. Fiddling with parts of rivers has repercussions that extend well beyond 'our bit'. This begs the question: what is a river? The common perception is that a river comprises a channel filled with perennially flowing water. Many desert rivers would fail to meet this criterion. They don't flow all the time and it is sometimes hard to find a major channel. A river encompasses all of its dependent ecosystems: the catchment, tributaries, main channel, distributaries, lakes, swamps, floodplains, estuaries and the groundwater systems dependent on river flows. Groundwater systems are really underground rivers. Many decisions about rivers have ignored downstream effects on people and ecosystems. Sometimes we have not even known of the existence of this dependency until it is too late. This is the true vulnerability of the river.

Rainfall is the dominant force shaping the world's ecology, including people. Nearly half the world has low annual rainfall (less than 500 mm): the world's desert regions. Because of the scarcity of water and dependency of life on water, rivers in desert regions are the most dominant factor shaping the ecology of deserts. Despite the importance of desert rivers, our knowledge of their ecology is poor. Most people do not live in these regions; there is little dependable water. Affluent societies, which produce most of the world's science, live in well-watered regions. Even in Australia, with 75% of the land surface receiving less than 500 mm a year, most scientific effort on aquatic organisms and rivers has been done near our research institutions in well-watered parts of the country. There is still much to learn and understand about the basic ecology of desert rivers and their role in shaping the lives of dependent organisms.

Obviously, water is in short supply in desert regions. Here, the needs of human societies for water, predominantly abstracted from desert rivers, has had irreparable effects on the ecology of desert rivers. This is where the greatest environmental change has occurred, as our species appropriates this resource to meet our needs. Desert rivers and their dependent ecosystems rank high in a growing list of the world's ecological disasters caused by humans. They include the Aral Sea and its supply rivers, the Mesopotamian Marshlands, the wetlands of the Murray–Darling Basin, rivers in central China and the rivers of North America. The ecological effects are so severe that effects on local economies and quality of life are demonstrable. Understanding the full effects of such impositions is essential for current management and future decisions for rivers. Water does not just go into the desert to evaporate. Most rivers support some of the most biodiverse places on earth, places that if managed well can provide immeasurable ecosystem services but where current management of desert rivers is seldom sustainable.

This book attempts to provide some of the necessary knowledge to understand, appreciate and sustainably manage these magnificent ecosystems. There is one certainty about a desert river: it is always changing. This is part of its nature and reflects the variability of the climate in desert regions. Raging rivers in flood and dry river beds are an integral part of a river's life but often we have changed desert rivers forever, sometimes making some of them even disappear. There is no greater challenge for our generation and those to follow than the management of our rivers. Freshwater accounts for only about 2.5% of the world's water and most of this (69%) is locked up in snow and ice, although climate change is reducing this all the time. Only 0.26% of the total fresh water is found in lakes, reservoirs and rivers, and of this we can only access an even smaller amount. Access to fresh water will limit population increase as no other resource does. Currently more than a billion people do not have access to clean water, whereas more affluent nations are profligate with our water use. Populations growing in number and in quality of life will need water that can only come from our rivers. What will be the ultimate cost when we are long gone?

Richard Kingsford

Acknowledgements

I thank Paul Adam for encouraging me to take on this task. Alan Crowden showed great patience while Clare Georgy expertly guided me through the production process. Each chapter in this book was peer-reviewed and I am particularly indebted to Andrew Boulton who took on the onerous task of editing and coordinating reviews for all chapters that I authored or co-authored. Rachael Thomas helped compile and organise the chapters at the end of the process and Megan Head helped with the indexing. I am indebted to the managers in the New South Wales National Parks and Wildlife Service with the vision to realise that scientific research only reaps a good harvest when creativity is fostered. I especially thank the people of the rivers in inland Australia who have and continue to inspire me to pursue greater understanding and better management of our desert rivers.