## Ecology of Urban Environments

Kirsten M. Parris



WILEY Blackwell

This edition first published 2016 © 2016 by John Wiley & Sons Ltd

Registered office: John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex,

PO19 8SQ, UK

Editorial offices: 9600 Garsington Road, Oxford, OX4 2DQ, UK

The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

111 River Street, Hoboken, NJ 07030-5774, USA

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at www.wiley.com/wiley-blackwell.

The right of the author to be identified as the author of this work has been asserted in accordance with the UK Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book.

Limit of Liability/Disclaimer of Warranty: While the publisher and author(s) have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular nurpose. It is sold on the understanding that the publisher is not engaged in rendering professional services and neither the publisher nor the author shall be liable for damages arising herefrom. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

Library of Congress Cataloging-in-Publication Data applied for

ISBN: 9781444332643 (Hardback) ISBN: 9781444332650 (Paperback)

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Set in 9/12pt, MeridienLTStd by SPi Global, Chennai, India.

1 2016



## Contents

	Fore	eword		xi
	Pref	ace		xiii
	Ack	nowle	dgements	xv
			·	
1	Int	roduc		1
	1.1	Settir	ng the scene	1
	1.2	What	is urban ecology?	1
	1.3	Why	is urban ecology interesting?	2
		1.3.1	Urban environments are extensive and growing	3
		1.3.2	Urban environments have inherent ecological interest	6
		1.3.3	Urban environments are ideal for testing and developing ecological theory	6
		1.3.4	The nature of urban environments affects human health and wellbeing	7
		1.3.5	Urban environments are important for conserving biological diversity	8
	1.4	The a	ims of this book	10
		Study	questions	10
		Refer	ences	10
2	Urb	an en	vironments	15
	2.1	Intro	duction	15
	2.2	Prima	ary biophysical processes associated with urbanization	19
		2.2.1	Removal of existing vegetation	20
		2.2.2	Construction of buildings, roads and other urban infrastructure	21
		2.2.3	Replacement of permeable with impermeable surfaces	22
		2.2.4	Reduction in the area of open space	22
		2.2.5	Modification or destruction of aquatic habitats	24
		2.2.6	Production of pollution and waste	25

	2.3	Secondary biophysical processes associated with urbanization	28
		2.3.1 Habitat loss, fragmentation and isolation	28
		2.3.2 Climatic changes	28
		2.3.3 Altered hydrological regimes	29
		2.3.4 Pollution of air, water and soil	29
		2.3.5 Altered noise and light regimes	30
	2.4	Stochasticity in urban environments	31
	2.5	Summary	32
		Study questions	33
		References	33
3	Pop	pulation- and species-level responses to urbanization	41
	3.1	Introduction	41
	3.2	Responses to the secondary biophysical processes of urbanization	43
		3.2.1 Habitat loss, fragmentation and isolation	43
		3.2.2 Climatic changes	48
		3.2.3 Altered hydrological regimes	49
		3.2.4 Pollution of air, water and soil	50
		3.2.5 Altered noise and light regimes	53
	3.3	Biological introductions and invasions	57
		3.3.1 Plants and fungi	57
		3.3.2 Animals	59
	3.4	Human disturbance	63
	3.5	Stochastic effects on populations in urban environments	65
	3.6	Summary	66
		Study questions	66
		References	67
4	Cor	nmunity-level responses to urbanization	81
	4.1	Introduction	81
	4.2	Selection: niche theories in urban ecology	84
		4.2.1 The ecological niche and the environmental gradient	84
		4.2.2 Habitat models	90
		4.2.3 Feological guilds and resource-competition models	91

			Contents	ix
	4.2	Total different different de la cataloga de la cata		07
		Ecological drift: modelling stochasticity in urban communities	S	97 99
		Dispersal: the movement of individuals through space		
	4.5	Diversification: the evolution of new lineages in urban environments		102
	16			104
	4.0	Study questions		105
		References		105
	Eco	system-level responses to urbanization		114
,		Introduction		114
				116
	1.4	5.2.1 Introduction to the carbon cycle		116
		5.2.2 Effects of urbanization on the carbon cycle		119
		5.2.3 Mitigation strategies		122
	5.3	Water		127
	),)	5.3.1 Introduction to the water cycle		127
		5.3.2 Effects of urbanization on the water cycle		127
		5.3.3 Mitigation strategies		129
	5.4	The nitrogen cycle		131
	7.4	5.4.1 Effects of urbanization on the nitrogen cycle		132
		5.4.2 Mitigation strategies		135
	5.5			136
	7.7	Study questions		136
		References		137
ŝ	The	e urban ecology of humans		146
•	6.1	Introduction		146
		The urban form		150
	0.2	6.2.1 Urban parks and open space		150
		6.2.2 Urban sprawl and car dependence		156
		6.2.3 Neighbourhood disadvantage and neighbourhood disorder		157
	63	Pollution and waste		158
	0.7	6.3.1 Outdoor air pollution		160
		6.3.2 Indoor air pollution		161
	6.1	Climatic changes in urban environments		162
	0.4	Chillage Changes III urban environments		102

	6.5	Health inequities in the world's cities	163	
	6.6	Summary	164	
		Study questions	165	
		References	165	
7	Cor	nserving biodiversity and maintaining ecosystem services		
	in c	rities	175	
	7.1	Introduction		
	7.2	Strategies for conserving biodiversity and maintaining ecosystem services in cities		
		7.2.1 Integrate urban ecology with urban planning and design	177	
		7.2.2 Protect biodiverse landscape features and important biophysical assets	180	
		7.2.3 Grow the green city	182	
		7.2.4 Maintain or re-establish landscape connectivity	185	
		7.2.5 Use small spaces	187	
	7.3	Novel habitats, novel ecosystems	190	
	7.4	Summary	192	
		Study questions	192	
		References	193	
3	Sun	nmary and future directions	204	
	8.1	Introduction	204	
	8.2	Do we need a new theory of urban ecology?	204	
		8.2.1 The complexity of urban ecosystems	205	
		8.2.2 The human domination of urban ecosystems	206	
		8.2.3 The uniqueness of urban ecosystems	206	
	8.3	The definition and scope of urban ecology	207	
	8.4	Do we need a new theory of urban science?		
	8.5	Future directions	209	
		Study questions	210	
		References	211	
	Inde	v	214	