Future City 3

S.T.A. Pickett
M.L. Cadenasso
Brian McGrath *Editors*

Resilience in Ecology and Urban Design

Linking Theory and Practice for Sustainable Cities

Springer

Resilience in Ecology and Urban Design

Future City Description

As of 2008, for the first time in human history, half of the world's population now live in cities. And with concerns about issues such as climate change, energy supply and environmental health receiving increasing political attention, interest in the sustainable development of our future cities has grown dramatically.

Yet despite a wealth of literature on green architecture, evidence-based design and sustainable planning, only a fraction of the current literature successfully integrates the necessary theory and practice from across the full range of relevant disciplines.

Springer's *Future City* series combines expertise from designers, and from natural and social scientists, to discuss the wide range of issues facing the architects, planners, developers and inhabitants of the world's future cities. Its aim is to encourage the integration of ecological theory into the aesthetic, social and practical realities of contemporary urban development.

For further volumes:
http://www.springer.com/series/8178

S.T.A. Pickett • M.L. Cadenasso
Brian McGrath
Editors

Resilience in Ecology and Urban Design

Linking Theory and Practice for Sustainable Cities

Springer

Editors
S.T.A. Pickett
Cary Institute of Ecosystem Studies
Millbrook, NY, USA

M.L. Cadenasso
Department of Plant Sciences
University of California
Davis, CA, USA

Brian McGrath
School of Constructed Environments
Parsons The New School for Design
New York, NY, USA

ISSN 1876-0899 ISSN 1876-0880 (electronic)
ISBN 978-94-007-5340-2 ISBN 978-94-007-5341-9 (eBook)
DOI 10.1007/978-94-007-5341-9
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2012951115

Cover illustration: A giant billboard announcing a new real estate development influenced by "globalized landscape urbanism," where a new roadway soars across the old course of the Chao Phraya River in Bangkok. This new urban form contradicts and is replacing settlement based on "localized-traditional waterscape urbanism." Photo: Danai Thaitakoo

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

We dedicate this book to Dr. Gene E. Likens, to Dr. William R. Burch, Jr., and to the memory of Dr. F. Herbert Bormann.

Gene and Herb showed the power of the ecosystem concept as a guide for synthetic ecological research, and it has proven robust in application to cities, suburbs, and towns. In addition, their concept of the "shifting mosaic" stimulated the spatial and dynamic approach taken in this book. Gene, when he was Director of the Cary Institute of Ecosystem Studies, created an intellectual environment from which modern American urban ecology could grow as a science. He also established the Cary Conferences, a venue that was crucial to the birth of this book. Bill Burch advanced our education in the application of the ecosystem concept to human settlements and social processes, and introduced us to Baltimore, a place that the editors now share in their work. In part, Bill's ecological perspective was honed in talks with Herb Bormann as they circumambulated Lindsey Pond in their shared neighborhood in the woods of Connecticut. It's always about place, networks, interactions, and community – ecosystems.

Foreword

Our cities bulge with magical places, cultural hot spots, productive centers, economic engines, social synergisms, dynamic opportunities, and indeed daily delights. We are energized and enriched in these collectively created spaces. Yet outward, the urban tsunami gathers steam….swiftly and powerfully rolling across the land. We seem paralyzed, watching the urbanization. And unlike a tsunami, afterward there is no opportunity for rapid reconstruction or restoration of the forests, farms and waters we also treasure.

How can we divert or stop the outward urban force, and indeed, severe urban flooding, summer heat, clean water shortage, unhealthful air pollutants, wastewater flows, greenhouse gas emission, stormwater runoff, and traffic effects? Two powerful ideas push past paralysis. Plan regionally, and *then* act locally to achieve the plan. Combine environmental and socioeconomic dimensions equally in the plans and action.

Some say that these challenges, as well as the ideas, are too big, too complex. Yet the make-all-stakeholders-happy approach seemingly takes forever, and leads to least-common-denominator incrementalism. In essence, paralysis. Alternatively, we could pepper society with visions, big ideas, and bold approaches. Big ideas may spring from established disciplines, interdisciplinary dialogues or "metalogues", or unexpected sources. Fine. Evaluation and survival-of-the-fittest solutions then become the norm. Thus leaders, even the public, discover and focus on urbanization spread and the other major issues. Planning large areas is a surrogate for long-term thinking. Devise big plans where each puzzle piece fits in context with its surroundings, and is small enough to readily accomplish. Get past too big/too complex and mold a better future, both for us and for nature.

Consider major projects or human activities that have affected large areas: (a) creating the 1930s US Dust Bowl, (b) draining Russia's Aral Sea, (c) transforming Louisiana's delta region, (d) straightening Florida's 100-mile Kissimmee River to half its length, (e) fifty years of American sprawl. All caused extensive habitat loss, displaced residents, and mainly benefitted distant economic interests. But environmental successes also result from large projects: (1) forest protection of water supplies for Boston and New York, (2) thirty-year restoration of Lake Washington in

Seattle, (3) lead removal in gasoline and ensuing reduction in the environment, (4) agricultural and natural land sustained by a growth boundary around Portland (Oregon), (5) forty-year (1965–2005) habitat protection worldwide skyrocketing from 2 to 15 million km^2 (now 10+% of the land surface). Such projects or effects, both bad and good, mainly operate over a few decades. Thus, a large-area few-decades perspective can produce major environmental and societal success. Also, since big things typically have more inertia and are harder to disrupt than little things, large-area successes are more likely to be sustained.

The book in your hand is unique and quite remarkable. Editors Steward Pickett, Mary Cadenasso and Brian McGrath have filled a treasure chest with stimulating authors and a cornucopia of approaches. They highlight ecology, design, and social dimensions, and call for closer vibrant connections. The science of ecology is conceptually central in the book, though occasional metaphoric and green-marketing approaches add contrast. Design is broadly conceived, a product of landscape architects, urban and regional planners, architects, engineers, and others working in urban areas. The societal dimension is more general, bringing in social groups, institutions, norms, and much more. This book is challenging. For the reader, sparks of new insight captivate. Nuggets of wisdom motivate.

Twenty-eight years ago I left the comforts of my impressive biological and ecological milieu for the opportunity to work with a much broader set of thinkers and actors. Though I knew synergisms would broaden my vision and contributions, the specific challenge was to significantly accelerate the use of ecology in landscape architecture and planning to design a noticeably better world. From the outset the designers liked ecology, but only exceptional ones dove in to absorb the science at a reasonably serious level. The concurrent emergence of landscape ecology helped. The optimist/activist side of me says that progress has been glacially slow, whereas key designers have pointed out the remarkable progress in but a generation. Even if they are right, I am still challenged by the fragmented dispersed information on ecological patterns, processes, and changes in urban areas. That's where, and at the scale where, most designers work.

Leaders from the design professions, ecology, and other fields have graced the pages ahead, providing legitimacy and suggesting synergisms. Vintage Pickett appears, reflective and framework framing. Even a chapter criticizing projects and superfluous terms appears, something much needed in all fields, especially design. All landscape architects should have this book. Most ecologists will find it eye-opening and discover new opportunities for having an impact. Urban planners, architects, engineers, hydrologists, transportation specialists, and other doers will find portions highly applicable in their own fields.

The science of ecology emerged in the 1860s, was an established field across Europe by the 1890s, and was further strengthened 110 years ago by a robust emergence in North America. Spurts of major new theory have followed and, not surprisingly, the field has greatly grown during the past generation. New paradigms have helped transform long-familiar areas in ecology, including succession, disturbance/resistance/resilience, food webs, predation/parasitism, spatial pattern/heterogeneity, wildlife movement patterns, species diversity/biodiversity, habitat selection,

genetic/evolutionary ecology, soil ecology, dispersal/colonization/extinction, avian and fish migration, freshwater ecosystems, and microbial ecology. Furthermore, new ecological subdisciplines have emerged or coalesced…landscape ecology, global ecology, road ecology, conservation biology, aerobiology, restoration ecology, and urban ecology.

A few such trends are usefully introduced in the book. Today the richness and power of ecological principles can no longer be ignored by designers or by society. Serious study of ecology has become a sine qua non for effective designs and solutions. Society needs scholars and practitioners with deep understanding of both ecology and design. Such people are likely to be compelling for decision-makers, who must understand, explain, and defend an idea or initiative. Such leaders in turn can divert, even stop, the urban tsunami. Policies and actions for large areas that combine ecological science and socioeconomics are at the heart of solutions for land and city.

Now, find the insights and the wisdom awaiting in the pages ahead…

Harvard University Richard T.T. Forman
Cambridge, MA

Acknowledgements

We thank Matt Gillespie, Assistant to the Scientific Staff at the Cary Institute of Ecosystem Studies, for his careful help with editorial details in completing this book. The book was stimulated by the interactions between urban design and science supported by the Baltimore Ecosystem Study, one of the National Science Foundation's (NSF) Long-Term Ecological Research sites, and by an NSF grant on Biocomplexity to that team of scientists and designers. These projects were the foundation for the interactions between Cadenasso, McGrath, and Pickett, first in urban design studios focusing on Baltimore at Columbia University's Graduate School of Architecture, Planning and Preservation, and more recently in design studios at Parsons The New School for Design. The project developed further as the result of a network of designers and scientists that convened at a Cary Conference on the topic of the book in 2007, and we are grateful to the NSF, the USDA Forest Service, the Center for Humans and Nature, and the Cary Institute of Ecosystem Studies for financial support of that seminal activity. We thank Jean Gardner and Joel Towers for their help in designing such a fruitful exchange in that Conference. The network of contributors represented in this volume significantly extends that which convened in the Conference. We thank Dr. Kristina Hill for advice about the book in its early planning phase. MLC acknowledges the NSF for support through a CAREER grant during the completion of this project.

Contents

Contributors

Julie Bargmann D.I.R.T. Studio, New York, NY, USA

Rod Barnett Landscape Architecture, Auburn University, Auburn, AL, USA

Christopher G. Boone Arizona State University, Tempe, AZ, USA

Ignacio F. Bunster-Ossa Wallace Roberts and Todd, LLC, Philadelphia, PA, USA

M.L. Cadenasso Department of Plant Science, University of California, Davis, Davis, CA, USA

Dilip da Cunha Landscape Architecture, University of Pennsylvania, Philadelphia, PA, USA

Jill Desimini Graduate School of Design, Harvard University, Cambridge, MA, USA

Stevan Earl Global Institute of Sustainability, Arizona State University, Tempe, AZ, USA

Nan Ellin City and Metropolitan Planning, University of Utah, Salt Lake City, UT, USA

Alexander J. Felson School of Architecture and School of Forestry and Environmnetal Studies, Yale University, New Haven, CT, USA

Richard T.T. Forman Graduate School of Design, Harvard University, Cambridge, MA, USA

Gerardo Gambirazzio Office of Research and Development, ESD, US EPA, Las Vegas, NV, USA

Nancy B. Grimm School of Life Sciences and Global Institute of Sustainability, Arizona State University, Tempe, AZ, USA

J. Morgan Grove USDA Forest Service, Baltimore, MD, USA

Elizabeth M. Hagen School and Life Sciences, Arizona State University, Tempe, AZ, USA

Rebecca Hale School of Life Sciences, Arizona State University, Tempe, AZ, USA

Hilairy Hartnett School of Earth and Space Exploration and Department of Chemistry and Biochemistry, Arizona State University, Tempe, AZ, USA

Elisabeth K. Larson Urban Ecology Research Laboratory, College of Built Environments, University of Washington, Seattle, WA, USA

Jacqueline Margetts Landscape Architecture, Auburn University, Auburn, AL, USA

Victoria Marshall School of Design Strategies, Parsons The New School for Design, New York, NY, USA, and Till Design, NY, USA

Anuradha Mathur Landscape Architecture, University of Pennsylvania, Philadelphia, PA, USA

Michelle McCrackin Science Department, Washington State University, Vancouver, WA, USA

Brian McGrath School of Constructed Environments, Parsons The New School for Design, New York, NY, USA, and urban-interface.com, Newark, NJ, USA

Melissa McHale North Carolina State University, Raleigh, NC, USA

Mary Miss Mary Miss Studio, New York, NY, USA

Joan Iverson Nassauer School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI, USA

Alissa North Landscape Architecture, University of Toronto, Toronto, ON, Canada

Ying Palopakon Faculty of Architecture, Chang Mai University, Chang Mai, Thailand

S.T.A. Pickett Cary Institute of Ecosystem Studies, Millbrook, NY, USA

Rowan Roderick-Jones ARUP, San Francisco, CA, USA

Kerry J. Rubin AECOM, San Francisco, CA, USA

D. Grahame Shane The Cooper Union, New York, NY, USA

Kelly Shannon Katholieke Universiteit Leuven, Leuven, Belgium

Suebsiri Srithanyarat Department of Landscape Architecture, Chulalongkorn University, Bangkok, Thailand

Erika S. Svendsen USDA Forest Service, New York City, NY, USA

Julie Sze American Studies, University of California, Davis, Davis, CA, USA

Danai Thaitakoo Department of Landscape Architecture, Chulalongkorn University, Bangkok, Thailand

Paola Viganò Università IUaV of Venice, Venice, Italy, and Studio Associato Bernardo Secchi Paola Viganò, Milan, Italy

Charles Waldheim Graduate School of Design, Harvard University, Cambridge, MA, USA

Jianguo Wu Arizona State University, Tempe, AZ, USA

Tong Wu Center for Forestry, University of California, Berkeley, CA, USA

Introduction

Developing a Metalogue: Ecology, Society, and Design

Cities and urban settlements are clearly the immediate future of humankind, and the filter through which the vast majority of people will experience nature from now on. Consequently, the future of the world's cities, in all their amazing variety, is the most pressing issue for scholars who study cities, professionals who design them, and for citizens who advocate for better urban environments. What will the cities of the future be like? How will they meet the needs of all their future residents? How can they soften the impact of human consumption of resources, of technological life support, and the consequences of these two? How can ecological metabolism, which is the ultimate and ongoing origin of material resources and human life support, continue to function and adapt in an increasingly urban world?

These questions are of equal interest to biophysical ecologists, social scientists, and urban designers. In this book, "urban designer" is used as a broad and inclusive term, comprising architects, landscape architects, urban and regional planners, civil engineers, and even all the urban actors who collectively construct the city. The term ecology is most generally used to refer to the study of the interactions and structures mediated by organisms and their metabolic transformations and the physical structures they generate. Yet, despite the common concerns across these disciplines, there is often a seeming conflict between environmentalism and urbanism. Traditionally the natural and the designed, the wild and the built, have been conceived, especially in the psyche of the industrialized and formerly colonial powers, as separate. But the questions of urban change and transformation must be met on a different footing straddling both nature and culture.

The burgeoning urbanization of Earth is occurring at an amazingly rapid rate. It is also occurring in the context of rapidly changing climate, a global economy that seems to be charting new territory, and massively shifting patterns of human migration on regional and global scales. All of these changes are exposing new or exacerbated vulnerabilities – sea level rise, storm intensification, shifting spatial and seasonal patterns of precipitation, and intensification of temperature extremes. These produce unprecedented complexities that demand solutions that go beyond the empirically familiar and disciplinarily comfortable. Furthermore, the city forms that have been the familiar seeds for urban theory, and hence for the practice of

design and mediation, are being made anew in some parts of the world, and drastically modified in others. What new theory might emerge to accommodate such novelty? How can that theory advance the practice of ecological urban design?

Perhaps most importantly, how can ecological science and the theory and practice of urban design join in the effort to position cities and towns – both those that exist, and those still to be imagined in Asia and Africa – to adapt to the massive, accelerated, and sometimes unprecedented changes they face. In other words, how can ideas and experience with the concepts and knowledge of resilience be employed to understand and improve humanity's urban settlements?

This book posits that the multi-way linkages among ecology, society, and design, and within each of these realms, between theory and practice, can be turned toward improved knowledge of cities and indeed toward improved cities. Tracing, evaluating, and promoting the feedbacks in this complex conceptual space rely on the development of many new tools. Throughout the book, metaphors, models, and norms will reappear, used perhaps in slightly different ways by the different disciplines. Metaphors are the images that capture some essential vision of what cities are and how they operate. Metaphors are almost always the starting point of conversation among disciplines. But as the book will show, they are only the entry point. Models, or conceptual and empirical constructions that explain the details and mechanisms of structure and process, are the bread and butter of substantive exchange between scholarly disciplines, and of the conversion of city visions to city realities. Norms introduce the values held in society, and the actions that result from them. Notably, norms differ in different social contexts and among different social groups. Designs express not only the creativity of the designers, but also the values of the sponsors and the different communities that will use the designed systems. Norms deal with what, in a social sense, should be. However, new norms must frequently be charted during periods of extreme change. Resilience is often achieved through the ability to readjust to a new normal.

Here sustainability, as a set of social goals, has a place. It is not a desire for stasis, as the term may connote. Rather it is an ideal norm that optimizes plans and actions in a three dimensional conceptual – or perhaps better value – space: society, environment, and economy. This familiar troika expresses the norm that no decision or action, no design or plan, should advance any one of the three processes without also supporting the others. Presumably a plan for sustainability should: emerge from an open, fair, and inclusive social process, not disadvantaging any social group; maintain adaptive ecological processes of nutrient flow, energy flow, and material dynamics; and provide economic support for satisfying livelihood and well being. These broad social goals are supported by mechanisms of resilience in each of the three realms. Resilience refers to the ability of a system to experience internally and externally generated shocks and perturbations but still adjust to the changes that result. The phrase "sustainable city" refers to one in which an open social process articulates shared goals for achieving social, environmental, and economic norms, and in which mechanisms of resilience in each of the three realms are in place.

To meet such demanding goals, and to generate the mechanisms of resilience that future cities will require, suggests a different operational model than has governed the interactions between the relevant disciplines in the past. Heroic utopianism,

whether urbanistic or ecological, should be avoided. So should disciplinary one-upmanship. Rather an egalitarian conversation should form the basis for ecological urban design in a socially supportive context. Clearly monologue is inappropriate. But surprisingly, even dialogue, which implies a bipolar conversation, is insufficient. Rather, the conversation must rise above the usual disciplinary polarities: environment versus design; humans versus nature; engineering versus let it be. This book, as an ideal, represents an attempt to sketch the shape of a *metalogue* – a conversation above dialogue, and above the constraints of discipline. Yet the reality of the disciplinary traditions as they have emerged over the last 150 years in the biophysical sciences, the social sciences, engineering, the design professions, and economics are hard won territories that are hard to open up and hard to dislodge.

Perhaps, then, the best we can do is give relatively unfettered voice to the different disciplines that will inform the ideal metalogue. This is, of course, quite difficult. There are not only different connotations of the same word, but there are also entirely different styles of communication. Take first the problem of connotation. Although this might seem arbitrary and merely "semantic," the different connotations may actually represent very different theoretical structures and conceptual assumptions. Exposing these, especially when they represent sometimes unspoken norms and ideologies, is a crucial step. The second problem is the issue of style. Designers use highly imagistic language, and maybe loathe to analyze the content of those images. The act of design requires thinking in images first and words later, and drawing is the fundamental act of design. Therefore, they use literal images to make an argument, but often do not cite them or indicate how their discourse links to the particulars of any one picture, plan, or diagram. Of course, designers are used to this, and have no problem negotiating publications that seem to be independent streams of graphics and text. Indeed, they find it stimulating and liberating. Natural scientists are used to being guided through the relationship between figures and text. Perhaps field or lab experiments are the places where science avoids logocentricism.

Here lies the problem of a "common language." Multidisciplinary teams are often exhorted to find a common language. Designers struggle to understand quantitative analyses, while scientists work to read drawings. The physicist and philosopher of science, David Bohm (1996), notes, however, that a common vocabulary can hide differences in meaning. That is, different fields may silently attach different assumptions to the same term, or may embed the social values of their profession, or of a social group if one such group happens to be demographically predominant in a discipline. In other words, a given term may innocently and tacitly stand for different, whole theoretical structures or philosophies of application in different disciplines. Thus, common language can be a snare and a delusion. Giving voice to different disciplines in this volume has often meant pressing authors to expose the assumptions and norms that underlie their terms as well as their images. The goal of this introduction is not to unambiguously define the terms and settle the controversies, but to raise awareness that different chapters may use such terms as ecology, ecologies, model, nature, landscape, architecture and a host of others, to very different effect. These issues and concerns are important in shaping the metalogue about resilience in ecology and urban design. The book is organized around the following roadmap.

The Roadmap

This book emphasizes insights and experiences from two disciplines, the science of ecology and the profession of urban design, but leavens the interaction between those two within the social arena, with information on context and social-economic drivers of urban change.

Part I

The chapters in Part I lay out key fundamentals of each of the disciplines. Ecological science is introduced for specialists in other disciplines (Pickett et al., Chap. 1). Boone (Chap. 3) provides an introduction to the complexity of social contexts for ecological urban design and emphasizes the need to advance environmental justice in such design. Large frameworks for integration are highlighted, such as the "metacity" (Pickett et al., Chap. 1), an integral approach to urbanism (Ellin, Chap. 4), the role of landscape as a medium for integrating the three disciplines (Nassauer, Chap. 5), and an ecological approach toward resilience in design. The history of urban ecology, both in its social and its biophysical incarnations, is sketched (Cadenasso and Pickett, Chap. 2).

Part II

This part identifies conceptual tools for linking ecology and urban design. Part II is arranged according to important themes. Of course, not all important themes can be included in one book. We have chosen four that seem to be preeminent at the interface of design and ecology, especially in light of crises associated with the dynamic urban condition of the planet. The four themes are examined from at least two disciplinary perspectives, with alternating chapters representing different disciplinary voices. The chapters in this part present a fair amount of detail so that the assumptions and societal values associated with each of the topics can be presented.

Theme 1 is spatial heterogeneity, which is a paramount concern in contemporary ecology and a longstanding concern in design. The chapters represent an approach to conceptualizing urban land that integrates built, surficial, and vegetated covers (Cadenasso et al., Chap. 6). Paired with this ecologically motivated chapter is Chap. 7, by Grahame Shane, that shows the patchy nature of urban change in London, and how it reflects both the action of specific actors and the relationship to environmental features and processes.

Theme 2 identifies the flux of water as key to understanding and designing urban systems. One chapter is by an urban designer and the other is by a group of ecologists. Shannon (Chap. 8) lays out a very broad way to consider water in cities. But in their particulars, the two chapters represent coastal or riverine cities (Shannon, Chap. 8)

and arid land cities (Larson et al., Chap. 9). Hard engineering and ecological engineering, and the contrast between design and traditional restoration are important ideas that emerge from Theme 2.

Theme 3 highlights resilience and adaptation. If sustainability is a socially determined goal, comprising environmental, social, and economic health, then resilience exposes the mechanisms and the measurables that scientists, scholars, and managers can address. Wu and Wu (Chap. 10) define and discuss the fundamental concepts of resilience in a way accessible to multiple audiences. How cities adapt on temporal scales described as slow, moderate, and fast by McGrath (Chap. 11) is exemplified by Rome, New York City, and Bangkok, respectively. In addition to spatial heterogeneity, water reappears as an organizing motif for resilience across the temporal scales.

Theme 4 describes the role of social actors and institutions in linking ecology and urban design. Chap. 12, by an urban design scholar (da Cunha), explores how an urban settlement was situated conceptually in a larger landscape, and how this process employed particular "anchors," such as rivers. Svendsen (Chap. 13), a social scientist, shows how social networks self-organize around environmental stewardship issues and opportunities, and how they build and use place-specific narratives to achieve their goals. The role of environmental justice also appears here. Chapter 14, by two other social scientists, Sze and Gambirazzio, shows how ecology is often used as screen for an ideology of city building. Corporate and governmental "greenwashing" are criticized here.

Part III

This part addresses designs in practice. The seven chapters in this part focus on one or two designed projects, some built, and some not. The intent is to show how designers respond to the need for ecological designs by various clients. The projects range from those made on behalf of corporations, governments, and communities. Some are relatively large scaled, such as a large city district, and others exist at the neighborhood or site scale. In addition to the design goals of experiential and aesthetic pleasure, some are also highly motivated by social justice and social inclusion, while others aim to satisfy a particular environmental good or satisfy some government mandate. The part is summarized by Grove (Chap. 21), a researcher trained both in social science and architecture, and who is experienced in integrated socio-ecological research and application. His analysis points to the opportunity for enhanced integration of social scholarship and research – an example of the need for enhanced metalogue.

Part IV

The chapters here view urban design in expanded disciplinary contexts and contrasting geographic and climatic situations. The first two chapters in the part emphasize interdisciplinary connections. Felson (Chap. 22) exemplifies a design

project that sought to bring ecologists and designers together on an equal footing. What worked and what didn't is important fodder for future activities. Miss (Chap. 23) shows how art can engage scientists in collaboration with the design process, and how scientific insights about sites can be communicated through art. The remaining chapters emphasize different geographic, and hence environmental, contexts. North and Waldheim (Chap. 24) show how an environmental thread through post-industrial North American urban design emerges in a landscape-based design orientation. This perspective summarizes the value of not neglecting the green and blue components of urban mosaics, a theme that resonates through many of the chapters of the book. Viganò (Chap. 25) bases an approach to urban design on explicit models – ecological rationality – of the functioning in urban systems. Using projects centering on the flow and interaction of water with the urban mosaic, she shows a way to link ecology and urban design, and using European examples, reminds us of the powerful role of water in many cities. Thaitakoo and colleagues (Chap. 26) show how Bangkok has evolved as a water based city, the tensions taking it toward a road based model, and the resulting shifts in agricultural, industrial, and consumption processes as organizing factors. Barnett and Margetts (Chap. 27) focus attention on the island nations of the Pacific, and the crises of global change and environmental justice they face. Ecological design based on the understanding of disturbance, which has been a significant influence on the structure and organization of settlements, should not be neglected as these islands come under the influence of north-temperate, industrialized, continental design theories and exemplars.

Moving Forward

Chapter 28, by the editors, attempts to bring together the disciplinary perspectives, the conceptual themes, and the synthesizing idea of metacity, first introduced in Chap. 1. This chapter presents a framework that accepts the mosaic nature of cities of all sizes, the dynamism and change in the patches constituting those spatial mosaics, the networks that influence patch connections across large distances, and the opportunity that such dynamism in mosaics offers for consciously adaptive design. This concluding chapter follows the integrative impetus that motivates each contribution to this volume, and suggests an open framework to help unify the metalogue the diverse chapters represent. The metacity can be a powerful tool for resilience in urban systems.

Literature Cited

Bohm D (1996) On dialogue. Routledge, New York

S.T.A. Pickett
M.L. Cadenasso
Brian McGrath

Part I
Ecology, Design, and Social Contexts: Disciplinary Voices and History

Key intellectual markers in the conceptual and practical territory of ecological science, urban design, and the social contexts of contemporary urban systems will be presented by the five chapters. The descriptions of each discipline are not intended to reify the boundaries between them, but to allow specialists outside of each disciplinary tradition to understand the insights and assumptions that insiders may take for granted. After all, everyone in a particular field already knows the foundations, and when dialogues start with that premise, there is the danger to miss both important hooks for integration and significant stumbling blocks.

The part lays out the fundamentals that will ultimately be brought to bear in understanding and promoting urban resilience through the intersection of ecological science and urban design in later parts. Resilience is in the background for the concerns of all the disciplines represented in the part. The concept emphasizes the capacity of a system to adapt to changes, whether sudden or gradual, in the biogeophysical environment, social processes and contexts, and economic drivers and resources. Resilience is the tool by which urban systems can attempt to achieve sustainability. It reminds scholars and practitioners that the goal is to adapt to change rather than attempt to prevent it.

The part will also expose a variety of voices that characterize the different disciplines. Although integration is an ultimate goal of this volume, there are styles of discourse and argument, and modes of analysis and criticism that differ among the perspectives included here. It is important to understand the history from which these voices spring, which is addressed in this part as well. Different connotations of some shared terms are also flagged here, to alert readers to potentially contrasting uses by the different disciplines represented in the part.

A central aspect of the conversation between disciplines is the use of the terms city and urban. These two terms are often used, as in this introductory material, to refer to the totality of dense, heterogeneous, built up settlements. That usage means that core cities, suburbs, and exurbs are all part of spatially connected and extensive systems. City and urban will be used in their most general senses in this book to refer to such inclusive spatial arrays. Context and specification will make clear when those terms are used for downtown, the concentrated business districts, areas

that are predominantly built or impervious, or multi-story densely packed residential enclaves, in contrast to suburbs, urban fringe areas, or the rural and wild.

The part begins with an exploration of the nature of ecology as a science, but leavened with insights from urban design (Steward Pickett, Mary Cadenasso and Brian McGrath, Chap. 1). Ecology has an extraordinarily broad scope, but it is always centered around interactions involving organisms and the structures and processes they generate or are involved in. A key insight is that ecology as a science refers to two things: (1) the activity that leads to discoveries about organisms, environmental interactions, and the structures and processes that result; and (2) the body of knowledge, in all its forms, that summarizes those discoveries. Often the term "ecology" is used in the design world to mean a model of the environment in a particular place or the set of relationships that exist there. This is a potential source of confusion in conversations involving ecological scientists and urban designers, because ecologists rarely use "ecology" to refer to specific models. The scientific understanding produced by ecological science emerges from a dialog between the material world and the expectations scientists express as theories or models. Metaphor plays an important role in stimulating model construction and in translating scientific results to non-specialists in other professions and in the lay public. But for substantive exchange, dialog must also rely on models. Both the models of science and the models of urban design are instruments of such dialog. While the models of ecology may focus on the structures and interactions in which organisms are engaged, the models of design include visions of how a city should be, as well as a physical or graphic representation of a project or a designed area. An important bridging model between design and ecology may be to exploit the role of categories of the "meta" in both fields. In ecology, an example is the metapopulation. Metapopulations consist of spatially isolated populations of a given species. Individual populations may be extirpated by disturbance or because of small size, leaving a vacant patch. New areas, suitable but unoccupied, can be colonized, generating new isolates of the population. Exchange of genes or of information among the population isolates connects them. Hence, the concept of "meta" in ecology emphasizes spatially and temporally dynamic systems of isolates. Such metasystems can be potentially adaptive and resilient components of extensive spatial mosaics or landscapes. A parallel may be found in the metacity concept. This term was introduced originally to represent cities of extraordinary size, but is co-opted here to emphasize patchiness and dynamics of any urban mosaic.

Mary Cadenasso and Steward Pickett highlight the history of urban ecology in Chap. 2. Urban ecology is a term that has been adopted by many different disciplines over the years. It was historically associated with the Chicago School of social science, which had its heyday in the 1920s and 1930s. This school adopted uncritically certain aspects of the biophysical ecology of the day. It was criticized and replaced as early as the 1930s, but the outmoded conceptions of urban ecology as the description of a primarily spatial and deterministic machine for attracting and moving immigrants through to middle class status persisted (Gottdiener and Hutchison 2000). Into this void, in the 1970s, a different approach to urban ecology was proposed (Stearns and Montag 1974). It involved both social and biophysical

scientists, and employed the ecosystem concept, which, at the time, emphasized metabolic budgets of nutrients, energy, and information. This approach was useful and interesting, but it slipped into disuse when continued financial support for research and nurturing interdisciplinary collaborations did not materialize. Furthermore, the approach in North America did not much engage many of the specialties in mainstream ecology that focused on the diversity of organisms, evolutionary processes, or the increasing appreciation of disturbance and spatial heterogeneity as drivers of system change. At the same time, in Europe, and to some extent in Asia, a tradition of urban ecology that focused on documenting the structure and significance of green patches in cities matured (Sukopp et al. 1990). This approach was explicitly linked to spatial planning in European cities (Sukopp 1990). Meanwhile in mainstream ecology, ecosystem ecology, while maintaining its focus on metabolism, expanded its basic assumptions and scope of focus. Ecosystem ecology abandoned the older assumptions of equilibrium, of strict material boundedness, and internal homogeneity. Ecological scientists began to build linkages among ecosystem, community, population, evolutionary, and landscape ecological specialties. Indeed, landscape ecology, the discipline that examines the role of spatial heterogeneity in all kinds ecological systems at all spatial scales, was not widely recognized until the late 1970s and 1980s (Forman and Godron 1986). The third phase of urban ecology, which is now engaging the interest and talents of an ever growing number of researchers in many disciplines, brings the dynamic, spatial, and integrative interests of contemporary ecological science into alignment with the concerns of urban geographers and urban sociologists, among others, to fashion a new kind of synthetic science. This is the urban ecology that can best support the linkage with urban design in a rapidly urbanizing world.

In the third chapter, Christopher Boone surveys the contemporary social contexts into which the dialog between ecology and urban design must fit. Hence, this chapter contributes significantly to the framework for a metalogue that spans more than two disciplines at a time. Design decisions are social decisions and involve human institutions. Yet they occur within a natural context, and they neglect that context at risk of unintended consequences. It is likewise risky to neglect the massive changes in the social and demographic characteristics of cities, or the contrasts in social features across cultures and regions. One social contrast is highlighted by comparison of cities in the industrialized and developing worlds. In developing countries, urban social processes may differ from those in the northern hemisphere models, and there are burgeoning slums and shanty towns, for example. Furthermore, the mere size of cities is exploding, with megacities of more than 20 million becoming more and more common, especially in the developing world. The ways in which cities grow – and shrink – are diverse, including by birth, migration, annexation, and absorption. And there are statistical regularities associated with increasing density, including positives such as creativity and wealth, and negatives such as crime and spread of disease. Yet the "demographic transition" in which the positive attributes of urban living first lower mortality rates, and later reduce birth rates, is outpaced by the rapid changes in many places. Rather than relying on empirical expectations of urban demographic change derived from old, industrial nations, contemporary urbanization requires an