

10th ANNIVERSARY EDITION

ECOLOGICAL

DESIGN

SIM VAN DER RYN
STUART COWAN



with a new introduction by the authors

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The background of the cover is a detailed architectural site plan. It features a central circular area with a fountain, surrounded by various rooms and outdoor spaces. Labels include 'REAL SHOW ROOM', 'APRON', 'FOUNTAIN', 'GRASSES CONG.', 'GRASSY TRUSS', 'CONCRETE FOUNTAIN', 'CAP. ALL', 'SLOPE', 'N2005', and 'E3557'. There are also several circular markers with numbers and letters like 'L1', 'A7', and 'A4'.

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Stuart Cowan

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PREFACE

If we are to create a sustainable world—one in which we are accountable to the needs of all future generations and all living creatures—we must recognize that our present forms of agriculture, architecture, engineering, and technology are deeply flawed. To create a sustainable world, we must transform these practices. We must infuse the design of products, buildings, and landscapes with a rich and detailed understanding of ecology.

Sustainability needs to be firmly grounded in the nitty-gritty details of design. Policies and pronouncements have their place, but ultimately we must address specific *design* problems: How can we design our products and manufacturing processes so that materials are completely reclaimed? How can we create wastewater treatment systems that enhance, rather than damage, their surrounding ecosystems? How can we design buildings that produce their own energy and recycle their own wastes? How can we create agricultural systems that are not dependent on subsidies of pesticides, fertilizers, and fossil fuels?

Design problems like these bridge conventional scientific and design disciplines. They can be solved only if industrial designers talk to biogeochemists, sanitation engineers to wetland biologists, architects to physicists, and farmers to ecologists. In order to successfully integrate

ecology and design, we must mirror nature's deep interconnections in our own epistemology of design. We are still trapped in worn-out mechanical metaphors. It is time to stop designing in the image of the machine and start designing in a way that honors the complexity and diversity of life itself.

This is a book about *ecological design*, which can be defined as “any form of design that minimizes environmentally destructive impacts by integrating itself with living processes.” Ecological design is an integrative, ecologically responsible design discipline. It helps connect scattered efforts in green architecture, sustainable agriculture, ecological engineering, and other fields. Ecological design is both a profoundly hopeful vision and a pragmatic tool. By placing ecology in the foreground of design, it provides specific ways of minimizing energy and materials use, reducing pollution, preserving habitat, and fostering community, health, and beauty. It provides a new way of *thinking about* design.

This book emerges from two voices spanning several generations. One of us has spent more than thirty years practicing, teaching, and exploring ecological design. The other, trained in science and mathematics, and with an equally strong love for the natural world, is not yet thirty. Our respective worlds of architecture and nonlinear dynamics meet in what Wendell Berry calls “searching for pattern.” The following pages took form out of our dialogues devoted to this search. They exemplify the kind of interdisciplinary dialogue that we feel is central to ecological design.

This book is not a design handbook or a technical reference filled with detailed case studies, charts, and tables. These details are vitally important, but our concern here is to give them context and connect them into a coherent whole. This book grows from the conviction that people in very different design disciplines are beginning to struggle with the same questions. Both automobile designers and architects are

looking at the entire life-cycle of the materials they choose and are designing in ways that allow these materials to be reclaimed. Landscape architects and environmental engineers are working together to create artificial wetlands to purify wastewater. Responding to this shared quest, this book is a small step toward creating a design process that has the preservation and restoration of the ecological commons at its core.

The first part of the book, “Bringing Design to Life,” presents an overview of ecological design. The first chapter discusses the connection between sustainability and design. The second chapter is a self-contained statement of the underlying principles and philosophy of ecological design, concluding with a short history of the field. “Nature’s Geometry,” the third chapter, suggests that we look for design principles that explicitly link different levels of scale from the molecular to the planetary.

The book’s second part, “The Ecological Design Process,” devotes chapters to five design principles that we think are fundamental to ecological design. These principles are intended as a starting point, an inspiration to creativity rather than a definitive set of rules.

The book concludes with a resource guide and an annotated bibliography for those wishing to explore these concepts further. The resource guide provides current contact information for some of the most interesting projects and organizations in the field of ecological design. The bibliography describes books that have been critical to our thinking and to the development of ecological design.

Our discussions are, of necessity, incomplete. There is an extraordinary proliferation of excellent work in ecological design, and it would take dozens of volumes to treat it fully. Instead of striving for completeness, we chose examples that best demonstrate the patterns of thought involved in ecological design. As a result, some fields with a great deal of significant activity—particularly renewable energy, transportation, and urban planning—are not well represented.

This book would not have been possible without the extraordinary contributions of our predecessors and contemporaries. In turn, it is offered to the next generation in a spirit of hope.

Sim Van der Ryn and Stuart Cowan

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I owe a great deal to my students in ecological design seminars and studios at the University of California at Berkeley. Over the years their enthusiasm, questioning, and commitment to finding a better design path was a constant source of emotional support, friendship, and intellectual stimulation.

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My work family at the Ecological Design Institute has always accepted my irregular schedule and preoccupations with patience and good humor. Thanks especially to Peter Retondo, David Arkin, and Marci Riseman. Conversations with Michael Katz, Christine Price, David Harris, and Cherie Forrester were helpful in shaping the book.

The board of the Ecological Design Institute—Marty Krasney, Ranny Riley, and Michael Murphy—has always supported my vision with good cheer and sound advice.

Stuart Cowan enrolled in my ecological design seminar in 1992 and brought a fresh perspective and keen intelligence to the class. A book had been taking shape in my mind and on paper for some time. I invited Stuart to collaborate with me, and through several years of long talks and rambling walks through the forests and beaches of Point Reyes my shapeless notes emerged into a new form from our joint efforts. It's been a pleasure to be in the company of his upbeat temperament, energetic metabolism, and quick mind. Katie Langstaff, a former student of mine and project manager of our Ecological Design Institute met Stuart, they married, and Katie contributed her spirit and presence to our effort.

Sim Van der Ryn

This book would have been impossible to write without the constant care and compassion of my wife, Katy Langstaff. A fine ecological designer and builder, she has challenged me to feel more deeply and write more clearly. Her voice and spirit inform every page. Without her courage, I would have given up on this book long ago.

I am also greatly indebted to my coauthor, Sim Van der Ryn, who has been an extraordinary mentor and friend during a critical turning point in my life. Thanks for the bocce ball tournaments, clam chowder, and hikes.

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Stuart Cowan

Ecological Design

Tenth Anniversary Edition

A Ten-Year Retrospective



This year marks the tenth anniversary of the publication of *Ecological Design*. Our goal in writing the book was stated in the preface: “In order to successfully integrate ecology and design, we must mirror nature’s deep interconnections in our own epistemology of design.” We sought to understand the interface of living systems and human design by articulating five basic principles of ecological design, which emerged from a detailed mapping and synthesis of literally dozens of candidate principles.

One of the reasons for the continuing relevance of *Ecological Design* is that these principles remain critical to creating a more sustainable future, and the epistemology that underlies these principles is rich enough to support a vast range of design innovation across many different fields. The approaches we explore in this book have become widely embraced over the last ten years, which is heartening, but the challenges have multiplied much more quickly.

The first principle, “Solutions Grow from Place,” states that solutions grow from the unique cultural and physical characteristics of place, which are so often ignored by standardized designs. The present-day globalized, highly mobile economy works against knowledge of and protection of place. All over the world, local groups are fighting to protect their cultural and natural heritage. The ecological, material, and human character of place is always the context of design even as the mechanical world is busy creating what James Howard Kunstler calls the “geography of nowhere.”

“Ecological Accounting” is becoming a major force in architecture and construction through the remarkably successful voluntary rating system developed by the United States Green Building Council (USGBC) called Leadership in Energy and Environmental Design (LEED™). This system explicitly allows environmental and social

factors, including site, water, energy, materials, and indoor air quality, to be weighed side by side with financial metrics in the design process. The growth of the USGBC is a testament to the exploding interest in ecological approaches to building design. USGBC membership has grown tenfold since 2000, and now includes over 6,300 companies and organizations. There are LEED-certified projects in all fifty states and twelve countries.

“Design with Nature” has found multiple expressions in the last ten years, ranging from Janine Benyus’s groundbreaking book *Biomimicry: Innovation Inspired by Nature* and biomimicry database (<http://database.biomimicry.org>) to Robert Frenay’s *Pulse: The Coming Age of Systems and Machines Inspired by Living Things*. Living systems have become an extremely popular metaphor, model, and measure for the built environment, technologies, and even social institutions. Despite this, entrenched practices in design and engineering continue to keep people from seeing and applying the obvious, such as designing building orientation and shape to reflect the movement of the sun.

“Everyone Is a Designer” is increasingly being applied by a new breed of designers who place collaboration with all the stakeholders at the center of their design process. It also captures the underlying impulse of the open source movement, which allows an entire community of users to collectively design software, coauthor a document (“wiki”), or design a product.

Many open source ecological design initiatives are underway. Architecture for Humanity cofounder Cameron Sinclair recently announced his intention to “create a community that actively embraces open source design to generate innovative and sustainable living standards for all” (<http://architectureforhumanity.org>). The Worldchanging Web site (www.worldchanging.com) provides an international forum for sustainability innovations with the intention of fostering their rapid replication. Thinkcycle (www.thinkcycle.org) provides an open source platform for sustainable design innovation for marginalized communities worldwide.

Finally, “Making Nature Visible,” which is linked to the concept of biophilia developed by E. O. Wilson and Steven Kellert, is beginning to be taken seriously by building operators and architects. Each building and site becomes a pedagogical opportunity for the exploration of water, energy, food, materials, waste, and biodiversity. In an increasingly urbanized world, it is critical to make natural systems and processes visible and accessible for both children and adults. Buildings like Oberlin College’s Adam Joseph Lewis Center and parks like Betsy Damon’s Living Water Garden in Chengdu, China offer multiple levels of interaction with both ecological processes and the resources that sustain us.

In retrospect, perhaps the most compelling theme of *Ecological Design* is the search for a unified approach to the design of sustainable systems that integrates scales ranging from the molecular to global. How can industrial design, architecture, city and regional planning, and infrastructure development be woven together with the capacities and needs of specific bioregions in the service of a world that works for all? How can we design in a way that responds to living systems that are continuously exchanging energy and materials and supporting self-organizing forms across a dizzying range of scales?

The last ten years have seen extraordinary theoretical and technical advances in the field of ecological design. Yet the challenges facing the planet have only accelerated, ranging from the loss of biodiversity to the rapidly increasing impacts of global climate change. The Millennium Ecosystem Assessment, conducted by more than a thousand leading scientists over several years, provides a recent authoritative and chilling overview of the declining condition of dozens of ecosystem services, including provision of fresh water, climate stability, soil health, and many others.¹

There is a growing consensus that we have approximately one generation to make the transition from fossil fuels, ecological overshoot, and devastating social inequity to renewable energy, stable ecosystem services, and the ability to meet fundamental human needs. This will

require unwavering political will; massive economic, social, and values transformation; and a huge reservoir of ecological design metrics, tools, case studies, and practitioners. *Ecological Design* was written with the hopeful premise that even as political and economic forces slowly aligned with sustainability, architects, landscape architects, planners, product designers, chemical engineers, and those in kindred disciplines could develop comprehensive, integrated, and culturally sensitive design frameworks.

At the bioregional scale, the Conservation Economy framework (www.conservationeconomy.net) was developed in 2002 by the innovative Portland-based nonprofit Ecotrust under Stuart's direction. This research initiative was designed to capture the deep structure—the recurring economic, social, and ecological patterns—of a sustainable bioregion at scales ranging from individual buildings to vast wildlands corridors. The resulting “pattern language” is documented in a non-proprietary, transparent way on a dedicated Web site using a wide range of explanatory essays, case studies, images, references, and internal links.² The goal was to create an open source platform for rapid international diffusion, critique, and archiving of best practices around ecological design and the social and economic factors that support it.

While the Conservation Economy framework was generated specifically for the coastal temperate rainforest of North America stretching from Big Sur, California to Kodiak Island, Alaska, it has turned out to have broad resonance in a wide range of other bioregions. It would appear that bioregions all over the world share a common challenge: how to grow a postextractive economy that honors culture and place, restores landscapes and stabilizes ecosystem services, enhances social equity, and provides diverse and stable livelihoods. The Conservation Economy framework demonstrates that the principles of ecological design, applied systematically from the smallest to largest scales and supported by appropriate social institutions, can allow a resilient, enduring, and prosperous adaptation to place.

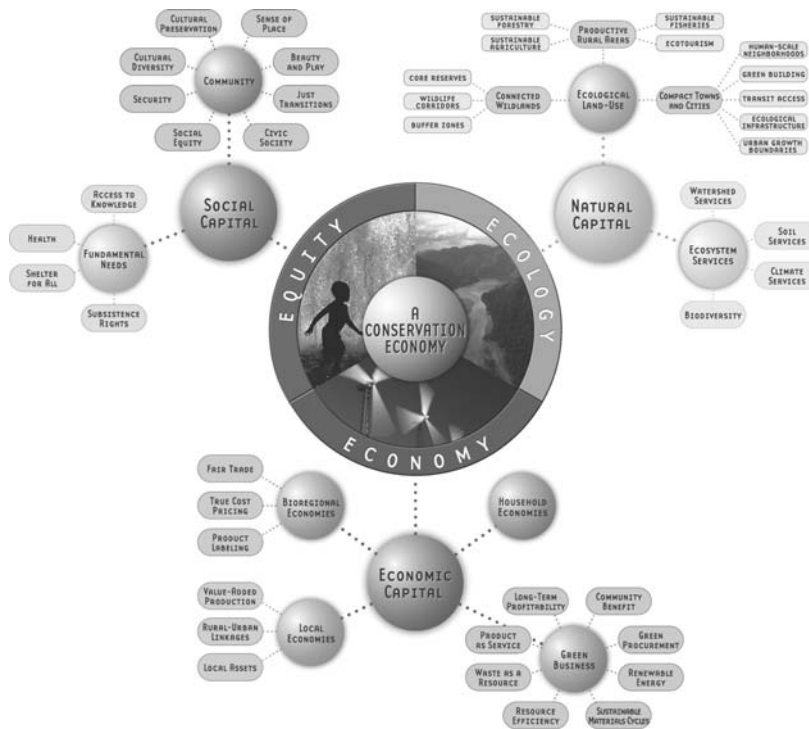


FIGURE 1. *The Conservation Economy: a bioregional pattern language for the coastal temperate rain forest bioregion of North America.*

During the last few years, our close colleague Christopher Alexander, an architect and mathematician who originated the pattern language approach, has published an extraordinary four-volume series called *The Nature of Order*. These books “hold out the magnificent prospect that there are processes that ordinary people can use, in small groups or vast collaborations, to create living structure, whether at the scale of a single hand-painted tile, a city or a continent. These processes use precisely the same kinds of transformation spontaneously employed by breaking waves, developing frog embryos, spiral galaxies, or nonlinear chemical reactions.”³ *Ecological Design* began to apply concepts from the new science of complex systems, including fractal geometry and self-organization, to the design process. It will take many more

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