

Geotechnologies and the Environment

Michelle Eva Portman

# Environmental Planning for Oceans and Coasts

Methods, Tools and Technologies

 Springer

# Geotechnologies and the Environment

Volume 15

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Michelle Eva Portman

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Methods, Tools and Technologies



Springer

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Geotechnologies and the Environment

ISBN 978-3-319-26969-6

ISBN 978-3-319-26971-9 (eBook)

DOI 10.1007/978-3-319-26971-9

Library of Congress Control Number: 2016932496

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*I seem to have been only like a boy playing on the seashore, and diverting myself, now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.*

– Isaac Newton (1642–1726)  
physicist-philosopher



# Foreword

My son, Matthew, grew up as the son of a coastal and ocean social scientist who was involved intimately in broadly interdisciplinary work regarding the application of social science to environment policy, in particular with coasts and oceans. Matthew was by inclination an arts and humanities person, and shied away from the “sciences”, though he had a great feeling for the coastal and ocean environment in which we have both been life-long participants as surfers, sailors, paddlers and fishermen.

A few years ago, Matthew called me and said that he had been reading up on coastal management. He said, “Coastal management is really more about planning than just science, isn’t it?” I heartily agreed, and Matthew now has a Master’s Degree in City and Regional Planning, with an emphasis on the relationship between water policy and coastal development, and a fine job in that field.

This is the first part of what is important about Michelle Portman’s book: it emphasizes the role of planning, as opposed to either science or management, in coastal and ocean affairs. A second important aspect is that it treats the coast and ocean as one, not as separate intellectual or policy domains. This latter part distinguishes it from the vast majority of other works on the subject.

The third aspect of *Environmental Planning for Oceans and Coasts* is that it emphasizes the difference between science, and policy and management. Science strives to be objective, reliable and to produce valid results. Science is about what was, what is or what might be if humans behave in one way or another. It is never, however, about what should be; that is, science is never normative. Policy and management, on the other hand, are not about science but about governance. Governance is, appropriately, always normative. Although this book treats an interesting (and somewhat extraordinary, given the “normal” list of coastal and ocean issues) set of coastal and ocean policy and management sectors as examples, it does not dwell on the science of those topics, but rather moves quickly and completely to the planning, policy and management context of the topics. This is as it should be in a book about environmental planning, including decision support tools to assist in this planning for coasts and oceans.



Finally, this book presents a perspective on how to deal with change in the biophysical, socioeconomic and public policy aspects of coasts and oceans. It is not a long list of the issues themselves; it is rather a framework within which to approach and deal with issues and the changes that are occurring at faster and faster rates in and around our coasts and oceans.

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# Preface

*The dismal truth is that shores . . . are fast disappearing, and may well do so completely within the life of some of us.*<sup>1</sup>

– Rachel Carson, 1957

Like many people of my generation and many of those born before me, such as Rachel Carson, I entered adulthood acutely aware of the changes taking place in the natural world before my eyes – unwanted changes, in my opinion – changes that worried me. I spent my early childhood in the 1960s in Silicon Valley, California. Before being called “Silicon Valley”, it was the Santa Clara Valley and it still had agricultural fields and fruit orchards, remnants of the “fruit basket” of the U.S. West Coast. But these field and orchards were rapidly becoming housing developments, shopping malls and gas stations. It seemed that orchards turned into parking lots overnight, just like in the Joni Mitchel song: “You never know what you’ve got till it’s gone. . .” I knew what we had then, and I knew it was going. . . .

These changes signified to me far-reaching transitions from the natural world to the developed, which engendered feelings of loss, which in turn brought me to want to dedicate my career to addressing the situation. I hoped that as an environmental planner I could improve conditions under which development takes place, and if not stop it, at least try to mitigate some of its more disastrous effects on the environment. Unfortunately, intermittingly from job to job as a planner, I found myself contributing more to development than to conservation and environmental protection. With this realization, I decided to get a doctoral degree in public policy and use my experience as a planner to help others to better care for the environment. I felt that this was a way to reach out, bring my knowledge and feelings about sustainability and conservation together, and make a difference. I view this book as a stepping stone towards these goals.

---

<sup>1</sup> Souder W (2012) *On a farther shore, the life and legacy of Rachel Carson*. Random House, New York, p 267.

Without specifically planning it, I've never lived far from the sea. Although my family was not particularly beach-going, I spent my summers at sleep-away camps in Oregon and Washington, and in various places in California – always right on the water. I understood the tremendous draw of the ocean and lakes for tourism, recreation and development. As a high school exchange student for a year in Recife, Brazil, I lived in a seafront home (*na beira mar*) on one of the most beautiful beaches in the world: Piedade-Boa Viagem. My college years took me to the magical beaches of the Sinai Desert and of the Mediterranean Sea. By the time I got to the legendary Cape Cod, where I spent two years as a post-doctoral fellow at the Woods Hole Oceanographic Institution, I had seen such incredible beaches that the cold, windswept shores of Massachusetts were not particularly inviting! But it was there that I learned to appreciate the importance of fishing grounds, industrial ports and ocean sanctuaries, among other uses of oceans and coasts.

While living and working in New England, I realized that the conservation of coastal and marine environments is part and parcel of other paradigms, such as the public trust doctrine, that guarantees the rights of all people to the sea's shores and oceans, just as our rights are guaranteed to the air we breathe and the water we drink. Just as significant as these rights is the obligation of the "powers that be" – in this case, the government – to plan, manage and protect ocean and coastal resources for the public and for posterity. About a decade ago, as a doctoral student of public policy – and at the same time a planner working for the Massachusetts Department of Environmental Protection – I decided that this was a topic to which I would dedicate the next chapter of my career.

While not targeted solely towards planners working in the public sector, this book assumes a praxis-oriented view. For the most part it is organized around the following theme: we have a responsibility to act as stewards of the natural resources entrusted to us as planners, as policy makers and as citizens. Good stewardship requires a responsible attitude and a good understanding of the world around us and of the institutions through which public policies are made and carried out. And more than this, it requires an appreciation of natural processes, a humbling before the forces of nature. Nowhere on Earth – or on the "water planet" as we should perhaps rightly say – are these forces more immediately apparent than in the near-shore coastal environment, at the meeting of land *and* sea.

\*\*\*\*\*

This book consists of 12 chapters organized in three parts. The first section (Part I) highlights the basic tenets of environmental planning for oceans and coasts. It covers important concepts from the general field of planning and relates these to oceans and coasts. Problems inherent within these environments are addressed, such as sea level rise, marine pollution, overdevelopment, etc.

A number of methods are regularly used by planners working to improve environmental quality and conditions of oceans and coasts. Part II covers those methodological approaches tailored to oceans and coasts – among others: integrated planning, pollution prevention, marine spatial planning and the ecosystem services approach.

The last section, Part III, focuses more specifically on state-of-the-art tools and technologies employed by planners for marine and coastal protection. These include marine protected areas, marine spatial planning, decision support tools and various forms of communication, including visualization, narration and strategies for stakeholder participation. The last chapter in this section (Chap. 11) deals with coastal adaptation, thus revisiting how the book began with an emphasis on change.

The concluding chapter (Chap. 12) stands alone. It reviews the main points brought up throughout the book and includes some examples. It provides some new information, such as about coastal and marine online databases and classification schemes, but for the most part it summarizes the fundamental concepts and ideas most important to the book.

Before embarking on the use of this book, or its chapters, the reader should be aware of a few organizational points and emphases. Generally, in the spirit of integration (across landscape units, in this case), there is no hard and fast separation between coastal and marine (ocean) topics. Further, the book does not attempt to present an “objective” view of oceans and coastal planning; its message is one of environmental protection and sustainable use. Although examples and case studies I use are from throughout the globe, most are taken from developed, industrial countries. This by no means implies that environmental planning for oceans and coasts is not taking place, or should not take place, in developing countries – more likely it has to do with use of the English language and availability of materials on the Web. Finally, the book’s outline mirrors that of a class I teach entitled: Planning and Management of the Coastal and Marine Environment. While not designed throughout as a textbook, I hope this book can be used as one.

To wrap up this (somewhat personal) introduction, I acknowledge the following assistants, who accompanied me on this journey – Jen Holzer and Miri Koolyk. Their expert editing and general assistance in administration and correspondence were invaluable. I also thank Professor Jay Gatrell of Bellarmine University in Louisville, Kentucky. A chance meeting with Jay led to the contract for this book, a huge boost which led to my idea becoming a reality. Others who helped me along the way include Maria Adelaide Ferreira, Michael Orbach, Gesa Geißler, Johann Köppel, Judi Granit, Yael Teff-Seker, Erez Roter, Emri Brickner, Yarden Elhanan, David Terkla, Ran Levy and Gaul Porat.

Finally, if there is anyone, without whose help this book would not have been possible, it is my dear and supportive husband, Etan Rozin, who is always ready to aid and support me in my endeavors be they illustrating, writing, meetings, teaching or singing!

August 2015

Michelle Eva Portman



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# Abbreviations

BSH	Federal Maritime and Hydrographic Agency (Germany)
CBD	Convention on Biological Diversity
CMSP	Coastal and marine spatial plans
CS	Continental shelf
CZMP	Coastal Zone Management Plan (India)
DST	Decision support tool(s)
EBM	Ecosystem Based Management
EC	European Commission
ECS	Extended continental shelf
EEA	European Environment Agency
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ES	Ecosystem services
ESA	Ecosystem services assessment
EU	European Union
GDP	Gross domestic product
GHG	Greenhouse gases
GIS	Geographic information system(s)
ICZM	Integrated coastal zone management
IMO	International Maritime Organization
IMP	Integrated marine planning
IPCC	Inter-governmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWM	Integrated watershed management
IWRM	Integrated water resources management
MARPOL	Convention for the Prevention of Pollution from Ships (1973)
MCA	Multi-criteria Assessment
MMO	Marine Management Organisation
MSFD	Marine Strategy Framework Directive (EU)
MPA	Marine protected area

MSP	Marine spatial planning
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration (US)
PP	Pollution Prevention
PTD	Public Trust Doctrine
ROV	Remote operated vehicle
SEA	Strategic Environmental Assessment
SLR	Sea level rise
TBPA	Transboundary protected area
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States of America
USAID	United States Agency for International Development
WFD	Water Framework Directive (EU)
WWF	World Wildlife Fund

## Measures

kg	kilogram(s)
km	kilometer(s)
mm	millimeter(s)
MT	metric ton(s)
nm	nautical mile(s)
ppm	parts per million
Tg	teragram(s)

**Part I**  
**Foundations and Issues**

# Chapter 1

## Connections: Environmental Planning, Oceans and Coasts

*The sea, once it casts its spell, holds one in its net of wonder forever.*

– Jacques Y. Cousteau

**Abstract** This chapter draws relevant planning concepts into the purview of coastal and ocean policy and management and introduces some of the main environmental issues related to oceans and coasts from a planning perspective. To understand such a perspective, the development of the planning profession is briefly explained along with its connection to environmental management. Different types of planning can be more or less suitable to problem solving in the marine and coastal environment. Changes brought on by the current era of immense human impact and influence highlight the need for planning, to address myriad threats to coastal and marine environments.

**Keywords** Coastal zone management • Environmental planning • Generic planning • Marine spatial planning • Planning outcomes • Planning process • Reactive and proactive planning

It has often been said that the name of our planet, Earth, is a misnomer. With more than 70 % of its surface covered by water, the name “Water” or “Ocean” would be more fitting. One fact often overlooked is that the amount of land exposed between large bodies of water on our planet is constantly in flux. We know, and are becoming painfully aware of this fact as climate change wreaks havoc on our planet, that the amount of water flowing in our oceans depends on how much water is locked up in frozen ice caps and glaciers.

This leads to the second most important characteristic of our planet: the ever-present *force of change*. The present *rate of change* is, in fact, what differentiates this period from all others throughout history; certainly the history of mankind, but also throughout the known history of our planet. While there is some uncertainty regarding chronologies, major change events are familiar to those who study such phenomena.

For example, despite what you may have learned in primary school, scientists don't know exactly what earthly phenomenon caused the extinction of the dinosaurs and 65 % of the other living organisms that disappeared with them. Paleontologists have two competing theories: one tells of the collision of a celestial meteorite slamming into Earth causing a dusty upheaval that enshrouded the planet in a thick blanket of clouds, which in turn caused a lethal drop in temperature that engendered the mass extinction. The second theory contends that intensive volcanic eruptions caused a similar dusty cover, which by chance were later followed by the meteorite landing. To sort this out, paleoecologists look for clues about the timing of these events in ancient sediments.

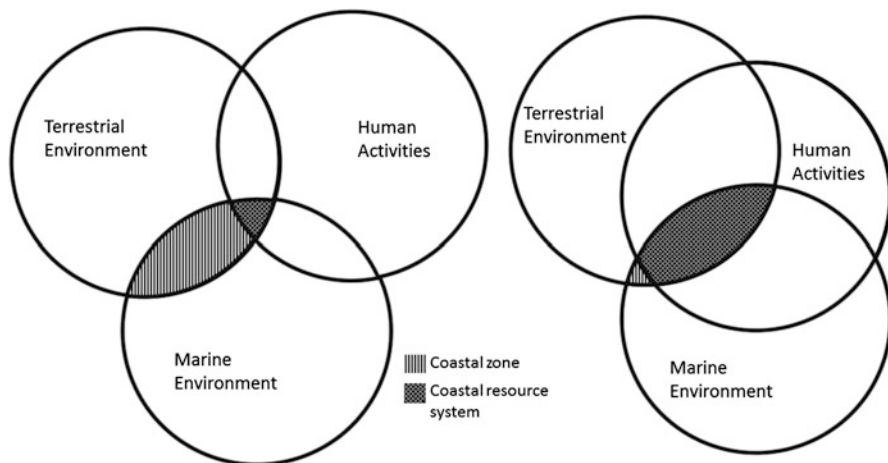
But despite all the uncertainty surrounding them, it is clear that these events happened. What is unclear is their chronology. The most recent theories posit that the planet incurred a double whammy, with the nefarious volcanic eruptions spewing soot into the air followed by the meteoric event *right after*. Records suggest that “right after” was about *200,000 years* afterwards (Kerr 2012); in other words, a period equivalent to the duration of man on Earth. Yet when we talk about the *anthropogenic* climate change occurring today, we usually refer to changes since the industrial age began – give or take a mere 150 years! How can it be that our terms of reference vary so? This is due to the current complex relationship of man to the natural environment, such as that found where sea meets land and is, in essence, the subject of this book.

The two most fundamental environmental issues of our time are indeed climate change and extinctions, with the latter framed more professionally as “biodiversity loss”. These two issues are interconnected and complex. Oceans and coasts exemplify such complexity. As the interface between land and sea, the coast is the staging ground for numerous changes – from diurnal tidal fluctuations to what can be catastrophic results of seasonal erosion. Irrespective of sea level rise, increased and intensified storm activity and the loss of biodiversity through the destruction of habitat by coastal development, the coast is ever changing.

The mark of time is forever present on the malleable land and seascape that comprises the coastal zone. But, you may wonder, what is the *coastal zone* and where is it? For environmental planners, this depends to a large extent on the circumstances and planning situation at hand. I expand on the answer to this question in the next chapter, but for now, suffice it to say that the types of environments that comprise areas of concern for planning and management of oceans and coasts have changed in recent decades.

Mostly due to technological advances, human ability to exploit the oceans has improved. We can now extract resources in ways, at depths and at distances from shore that we were unable to in the past (e.g., Arrieta et al. 2010). For example, electronic devices aid commercial fishers in locating concentrations of fish (Roberts 2007) and new, resistant materials allow wind turbines to withstand the harsh conditions that exist in very deep water and far out at sea (Portman et al. 2009).

Change has also transpired in other ways. While in the past the ocean environment far from shore was largely ignored by coastal planners, today it is considered an important area of attention. It is a venue for planning almost to the same extent as



**Fig. 1.1** Above (*left*) is Scura et al.'s (1992) conceptualization of the relationship between the coastal zone and coastal resource systems (also used by Cicin-Sain and Knecht 1998). Above (*right*) is a more current interpretation, showing human activities as more prevalent at the interface of terrestrial and marine environments (reprinted with permission from the publisher, Worldfish)

that of the terrestrial coastal area (Fig. 1.1). As for the ocean environment, just as much activity can take place there, and sometimes more, than can on land.

A few common definitions of the coastal zone are presented in Chap. 2 (Box 2.1), but the most straightforward definition is that it is the interface between land and sea. How much of each it includes varies by definition. Therefore, environmental planners should be prepared to learn as much as they can about the two similar and interrelated environments whether they are concerned with the marine environment *or* the terrestrial environment, or, as most likely, both.

## 1.1 The Planning Connection

The planning profession emerged in the mid-nineteenth century out of a series of calamities – health crises that led to epidemics, social crises that led to riots and strikes and crises that revolved around hazards both anthropogenic and natural, such as fire and floods (Knox 2010). Progressive intellectuals of that time envisioned healthy cities much as environmentalists today envision healthy ecosystems. By many accounts, our oceans and coastal environments are highly threatened and, as such, are “in crisis” (EEA 2006; Halpern et al. 2008; Lester et al. 2010; Lubchenco and Sutley 2010). Therefore, there is no doubt that, as in the past, the planning profession has much to offer as we grapple with managing these environments.

In the early days of the profession, planners working in urban areas sought to improve conditions so as to achieve laudable environmental quality goals even

though the sub-field of *environmental planning* per se, did not yet exist. The first urban planners helped introduce air pollution control, water purification, sewage handling, public laundries, public health inspectors and replacement of the gutter with the park as the site of children's play. As population increased along the coast, and since the tourism sector became a major economic development force starting in the post-World War II era (O'Connell 2003), planners have increasingly attended to both undeveloped seashores as well as growing coastal metropolises. In the past decade, marine spatial planning, which brings the main tenets of the planning profession to the marine environment, is developing as a sub-discipline of urban and regional planning.

Coastal communities and regions throughout the world continue to attract population and development at an alarming rate. Currently, more than 44 % of the world's population (more people than inhabited the entire globe in 1950) lives within 150 km of the coast (UN Atlas Project 2014). Two thirds of the world's major cities are located along coasts. As development and population growth continue in most of these areas, so do the pressures on the resource base of oceans and coasts, both natural and human-made.

Sustaining the ecological health and productivity of our coastal and marine environments in the face of the intense global social, economic and environmental changes is one of our most daunting tasks. Fisheries depletion, coastal wetland loss and destruction of critical coastal and marine habitats from coral reefs to ice-sheets are pressing issues. Pressures for offshore oil and gas development compete with the need to protect the recreation and tourism value of the coastal zone. Efforts to establish new marine protected areas are at odds with desired access to these areas by commercial fisheries (Beatley et al. 2002; Hastings and Botsford 2003).

The good news is that we don't have to reinvent the wheel. Even though early planners and architects who sought to preserve natural unbuilt spaces, including those along coasts, often viewed the preservation of open spaces as "civilizing features", limited to representing social refinement and aesthetic beauty (Dooling et al. 2006), aspects that have little to do with the undersea-scape, many of their approaches are still relevant. Although they didn't have to contend with the number of competing goals that exist today, there is still much to learn from past developments and accomplishments in the field.

Planning is essentially a matter of identifying both what needs to be done and how to do it. There are "best-practice" approaches to figure this out, some of which are described below. Planning is basic problem solving or "applying knowledge to action" (Friedmann 1987) and it is critical to managing how we humans interact with our environment (Randolph 2011).

Environmental planners put a premium on guiding human activities while working with the physical elements of the environment as both challenges and opportunities. Coastal and marine planners and managers must also adopt such an approach to the greatest extent possible (Cicin-Sain and Knecht 1998; Ehler and Douvere 2009). All the while, planners must be aware of the special characteristics of the coastal and marine environment in all that they do.



## 1.2 The Management Connection

Environmental management refers to a set of actions broader than those of environmental planning and over a different time frame. It provides the means for controlling or guiding human-environment interactions in order to protect and enhance human health and welfare and environmental quality; management is a longer-term process than planning and it can include planning within it as a stage or part of the management process.

Approaches to environmental management have evolved in recent years – in response to changing conditions faced by professionals. A well-known tenet of the discipline is that environmental managers address human activities taking place within the environment and not the physical (environmental) processes themselves. However, in recent years the basis of the field has evolved from a desire for living with nature to a responsibility for managing natural systems, because we both *need* and *impact* nature’s systems (Randolph 2011).

The extent to which we impact natural systems is encompassed in the term “Anthropocene”. This term is informally used as the name of the present geological epoch that started approximately at the beginning of the Industrial Revolution.<sup>1</sup> The term, coined by the ecologist Eugene F. Stoermer and popularized by the Nobel Prize-winning atmospheric chemist, Paul Crutzen, reflects the overwhelming influence of human behavior on the Earth’s atmosphere in recent times (Crutzen 2002).

As mentioned, environmental management is a long-term process and therefore applicable to the coastal and ocean environment in the Anthropocene. Planning in this era calls for a broad and long-range perspective to guide activities. As discussed in Chap. 4, one of the advantages to integrated coastal zone management is that it relates to temporal cross-generational concerns. This fosters management for sustainability. Sustainable development is progress and change that aims to meet the needs of today without compromising the ability of future generations to meet their needs (Brundtland 1987). This essential approach has many implications for coastal and marine management.

Environmental management often depends on the use of technological approaches that provide the necessary interdisciplinary perspective, analytical tools and participatory processes to arrive at a plan. Of course, there are different types of planning, from generic styles to situation-tailored approaches. Here, too, we can discern effects of the evolution of the profession. Adaptive approaches have been promoted in recent years, both for planning and management, because they incorporate adjustments over time and recognize the dynamic nature of natural ecosystems. Adaptive management is therefore commonly applied for ocean and

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<sup>1</sup> The term has not been adopted as part of the official nomenclature of the geological field of study although a proposal has been put forth to the Geological Society of London to accept it. There is still some controversy over when the epoch actually began. See: Kutschera (2008).