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Beach Management Tools - Concepts, Methodologies and Case Studies

 Springer

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Foreword

We shall defend our island, whatever the cost may be, we shall fight on the beaches.
(Speech to the House of Commons, 4 June 1940, by Winston Churchill)

The Stratton Commission (1969) presented US Congress with a report in the field of coastal management, and this eventually culminated in the US Coastal Zone Management Act of 1973. This act was a baseline in preserving and developing US coastal communities and resources where they were under the highest pressure, and it marked the commencement of coastal management programs in the USA. Since then the subject has gone global. Currently it is being subsumed into the area of marine spatial planning. The Rio Summit (3–14 June 1992) provided a big impetus to the subject; for example, with respect to the Mediterranean Sea, the revised Barcelona Convention (1995) introduced the second phase of the Mediterranean Action Plan, which was followed by a European Union-funded Demonstration Programme on Integrated Coastal Zone Management (CZM; 1995) and implemented a year later. This aimed to provide technical information regarding the sustainability in CZM and to provide a stimulus among the European actors in this discipline. The end result of the above has been a plethora of global research activities, from which many tools and instruments varying from simple to extremely sophisticated have evolved, together with diverse approaches, e.g., “community/ecosystem based” and the Japanese “satoumi.” From this background, a subset of coastal management emerged, the one we call beach management.

The management of beaches is essentially looked at from an anthropogenic viewpoint, as, without any help, nature has managed beaches for countless millenniums, erosion and deposition being constant processes along shorelines. Beaches are part of the complex dynamic coastal system, and man enters the system by, for example, the insertion of a coastal defense protection structure which alters the water/land dynamics, such as river dams which cut off sediment input to beaches. One of the criteria for the establishment of national parks is usually the superb natural scenery that exists within their boundaries, but the magnificent Seven Waves Bay, located in Tayrona National Natural Park in Colombia, has its beach draped in

a mosaic of litter items, including logs, fishing gear, and the ubiquitous plastics – all having an anthropogenic origin. The quote given above by Churchill might be apt for the fight against litter, but this is but one of a large item list that beach managers have to tackle. Bascom (1964, 1), in his classic book, posed the question, “is there anyone who can watch without fascination the struggle for supremacy between sea and land?” At this junction, the many varieties of world beaches that come in a variety of guises are found. *Beach Management Tools* gives an exemplary account of the many and diverse ways in which sound management of this priceless asset may be achieved.

The book is divided into two sections (24 and 24 selected papers, respectively), the first covering general management tools and the second dealing with specific management tools. Parts I–III of the first section cover papers relating to tools within ecosystems (8 papers), geomorphology (8 papers), and risk (8 papers), while Parts IV–VII of the second section cover innovation (5 papers), governance (9 papers), environmental quality (5 papers), and users’ perception (5 papers). A dip into the contents of these two sections reveals an amazing diversity of countries, e.g., Brazil, Colombia, the Dominican Republic, Mexico, the US East Coast, Morocco, Italy, India, and Costa Rica, to name but a few. This is eclipsed by the sheer eclectic variety of what is involved in the term “beach management”; examples of topics covered are governance, models, dunes, recreation, perception, fuzzy logic, morphodynamics, waves, remote sensing, perception, and health, to name but a few, all authored by some of the main authorities within the country concerned. Whew, a veritable feast! *Beach Management Tools* is needed for many diverse reasons, as the term has many interpretations, i.e., what is the purpose of managing a beach, e.g., is it for recreation, conservation, preservation, fishing, ramblers, and liaison with farmers? The list is endless. This book provides a holistic viewpoint that encompasses the bulk of the myriad issues that face such managers. The incorporation of coastal scientists and experienced managers makes for a rock-solid foundation encompassing ideas, and the book reader will benefit from viewing the approaches that have been impressively demonstrated by examples from the host of countries on display.

This scholarly work is an excellent book and one that should be in a prime position on the bookshelves of any serious coastal practitioner/academic. However management is viewed, I leave the last words as an apt quote from one of the world’s greatest poet-dramatists (Shakespeare) because the shoreline, where beaches may be found, is an area where sometimes the “rocky shore beats back the envious siege/Of watery Neptune,” but occasionally anthropogenic help in the form of sound beach management is needed!

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Preface

Beaches are one of the most intensely used coastal ecosystems, and they are responsible for more than a half of tourism incomes in the world. However, their management in several cases is not supported in techniques specifically designed for current beaches, usually pressured by massive tourism, traditional fishermen, environmental activists, and real estate speculators, all interested in the same common and worthy good. Beaches have three dimensions, as what Ariza et al. (2010) state, all of them equally important and complex. First of all, beaches are ecosystems with all ecological functions and structure of any other coastal ecosystem and several times with strong links to dunes, seagrass meadows, and coral reefs. Secondly, beaches are the most natural defense to extreme climate events, protecting inland areas and recovering itself as an example of resilience. Finally, beaches are the most valuable unit of production over any ecosystem in the world. Several studies have demonstrated that a square meter of beach could produce up to 12,000 euros per year and have an inestimable value for local communities and their traditions. Therefore, managing this very complex and worthy coastal system should be done with right and powerful tools.

Although several authors describe beach management as a type of coastal management, the truth is that the majority of ICZM strategies and tools are not suitable to a microlocal scale of beaches. When a coastal manager has to deal with challenges on the beach, he/she needs more than a policy cycle described by GESAMP (1996); beach managers need fast and simple tools to face daily situations. An overview of beach management tools could include carrying capacity, beach nourishment, environmental and tourism awards (like Blue Flag and others), bathing water quality, functional zoning, beach typologies, quality indexes, users' perception, interdisciplinary and citizenship monitoring, coastal legislation, shore protection, social and economic indicators, ecosystem services, and coastal governance (applied in beach's case studies), among others. Many of these tools are described and analyzed in this book.

From a scientific perspective, there are several efforts to understand beaches from disciplines, mainly natural sciences and engineering; however beach managers need tools to face interdisciplinary challenges. Therefore, this book seeks to show

the best knowledge about tools that reach a wide range of solutions for problems like coastal erosion, tourist development, urban growth, and local conflicts, just to define some of them. This book is divided in two sections. The first section is related to general tools to manage beaches, such as ecosystem services, coastal modeling, or geographical techniques. This first section has three parts: (a) Ecosystem Management, (b) Geomorphology, and (c) Risk Assessment. Meanwhile, the second section is focused on specific tools designed for beach management, such as certification schemes, microbiological indicators, or users' preferences. This second section has four parts: (a) Innovative Tools, (b) Governance, (c) Environmental Quality, and (d) Users' Perception. This distribution of sections and parts seeks to make it easy for readers to find chapters about tools with similar approaches, even though several chapters have links with others within the book.

A special feature of this book is the first chapter of each of the seven parts. We, as editors, did a state of the art of every topic related to the chapter's title, to give the readers a context of the groups of tools presented by the authors. In consequence, this exercise is wider than deeper, without entry into detailed descriptions or exhaustive lists. All state of the art were done with the same tool called *tree of science*, which allows to create a diagram of literature related to any topic (Robledo et al. 2014). This tool uses graph theory to measure three variables of linking: input grade, intermediation, and output grade. References with high input grade and zero output grade are called *roots* and show the first publications in the topic; publications with a high degree of intermediation are termed *trunk*, and they are strong references for several papers; and finally, articles having a high output rating and a zero input rating are referred to as *leaves*, which show a perspective of the topics and subtopics developing.

Part I, included within the first section, contains eight chapters that are examples of beaches as units we need to protect through an ecosystem-based approach. Chapter 1 (“State-of-the-Art Beach Ecosystem Management from the Tree of Science Platform”), by Omar Cervantes, Camilo M. Botero, and Charles W. Finkl, shows a robust tree of science with two roots, three trunks, and four leaves highlighted. Chapter 2 (“A DEcision MAKing [DEMA] Tool to Be Used in Ecosystem-Based Management System [EBMS] Applications”), by Rafael Sardá and Juan Pablo Lozoya Azcárate, features a new tool for beach management called DEMA, which is based on an ecosystem-based management system for decision-making process. Authors merge in this tool techniques from risk assessment, ecosystem services, and uncertainty assumption. Chapter 3 (“Dune System Restoration in Osório Municipality [Rio Grande do Sul, Brazil]: Good Practices Based on Coastal Management Legislation”), by Luana Portz, Rogério P. Manzolli, and Javier Alcántara-Carrió, discusses the implementation of a coastal management plan in Osório Municipality (north of Rio Grande do Sul, Brazil) for the restoration of the foredune. This example is a demonstration of good practices of dune management plans and also a warning to promote the legal protection of foredunes which protect also beaches. Chapter 4 (“Environmental Analysis and Classification of Coastal Sandy Systems of the Dominican Republic”), by Francesc Xavier Roig-Munar, José Ángel Martín-Prieto, Antonio Rodríguez-Perea, and Oliver Olivo Batista, calculates

the vulnerability index and the management measures in 99 beach-dune systems of the Dominican Republic. This work demonstrates the risk of beach erosion and ecosystem degradation to which the most visited insular tourist destination in the Caribbean is currently exposed. Chapter 5 (“Environmental Services of Beaches and Coastal Sand Dunes as a Tool for Their Conservation”), by Natalia Rodríguez-Revelo, Ileana Espejel, Concepción Arredondo García, Lina Ojeda-Revah, and María Alejandra Sánchez Vázquez, illustrates the importance of ecosystem services for beach management in Baja California Peninsula, Mexico. Authors evaluate 350 selected papers with explicit and implicit mentions to ecosystem services, to conclude which of them are more quoted in scientific literature. Chapter 6 (“Evolutional Trends and the Current Management of the Beach-Dune Systems Along the Western Polish Coast [Southern Baltic Sea]”), by Leszek Kaszubowski, refers to Świna Gate Spit (western coast of Poland) to describe the evolutional trends and current management of a beach-dune system. Through several images and calculation of an index, the author compares the attractiveness of seaside resorts for tourists in a relatively straightforward manner. Chapter 7 (“Recreational Beaches as Factors of Involvement in a Coral Community: Colima Case Study”), by Marco A. Liñán-Cabello and Jesús Emilio Michel-Morfin, analyzes how a coral community in the central Pacific coast of Mexico is affected by pressures generated in the surrounding recreational beaches in the area. Several negative ecological impacts are showed, reinforcing claims for an ecosystem-based management of tourist and recreational activities. Chapter 8 (“Spatially Explicit Models in Local Dynamics Analysis: The Potential Natural Vegetation [PNV] as a Tool for Beach and Coastal Management”), by Francisco Gutierrez, Pedro Gomes, Jorge Rocha, and Ana Cláudia Teodoro, applies the concept of potential natural vegetation in two study areas of Portugal, to demonstrate the power of this approach for habitat restoration. Two Natura 2000 network areas were analyzed in this chapter.

Part II contains eight chapters which revolve around geomorphology and its usefulness for beach management. Chapter 9 (“State-of-the-Art Beach Geomorphology from the Tree of Science Platform”), by Omar Cervantes, Camilo M. Botero, and Charles W. Finkl, shows a robust and balanced tree of science with three papers in roots, three in trunk, and three in leaves. This tree demonstrates how strongly research about geomorphology is related with beach management. Chapter 10 (“A Hybrid CA-ANN-Fuzzy Model for Simulating Coastal Changing Patterns”), by Jorge Rocha, Francisco Gutierrez, Pedro Gomes, and Ana Cláudia Teodoro, posits a method to simulate both the coastline and the land use/cover evolution, by coupling cellular automata (CA) and multilayer perceptron (MLP) artificial neural network (ANN) with fuzzy set theory (CA-ANN-Fuzzy) in a GIS environment. The method proposed by the authors predicts high shoreline drawbacks, with an overall accuracy of 86% (14% of error in 60 years). Chapter 11 (“Assessing Shoreline Change Rates in Mediterranean Beaches”), by Fernando J. Aguilar, Ismael Fernández, Manuel A. Aguilar, and Andrés M. García Lorca, assesses shoreline rates in a heavily human-influenced coastal sector of the Mediterranean coast at Almeria Province, Spain. This study case combines two kinds of sources to derive shoreline positions: (i) digitizing the high water line (HWL) through orthoimage interpretation and

(ii) automatically extracting a contour level from a LiDAR-derived coastal elevation model (CEM). Chapter 12 (“Florida and US East Coast Beach Change Metrics Derived from LiDAR Data Utilizing ArcGIS Python-Based Tools”), by Quin Robertson, Lauren Dunkin, Zhifei Dong, Jennifer Wozencraft, and Keqi Zhang, investigates coastal metrics for almost 3,300 km of US coastline, between two time periods, with an innovative toolbox called JALBTCX. This study mixes LiDAR images with Python language and ArcGIS tools. Chapter 13 (“From Sediment Movement to Morphodynamic Changes, Useful Information from the Modeling World to the Beach Management Practice”), by Isaac Azuz-Adeath, Norma Muñoz-Sevilla, and Alejandra Cortés-Ruíz, reviews empirical and numerical models emanating from the coastal engineering arena that can be useful in the practice of local beach management. Background for this work stems from the fact that beaches respond in several time and space scales to physical phenomena like wind, waves, tides, storm surges, littoral currents, river discharges, and sea level rise. Chapter 14 (“Mexican Beach Sands: Composition and Vulnerability”), by Arturo Carranza-Edwards and Leticia Rosales-Hoz, highlights the importance of knowing the variations that control beach characteristics, by analyzing several examples in more than 11,000 km of Mexican coastline. Chapter 15 (“Nourishing Tourist Beaches”), by Enzo Pranzini, Giorgio Anfuso, and Camilo M. Botero, deals with the challenges and opportunities of beach nourishment, through several examples around the world. Special attention is given to sand color, as an important parameter rarely included in nourishment projects. Chapter 16 (“The Morphodynamics Behavior of a Cross-Shore Sandbar in a Microtidal Environment, Anjos Cove, Arraial do Cabo, Rio de Janeiro – Brazil”), by João Wagner Alencar Castro, investigates the evolution of an offshore sandbar located off Anjos cove, Rio de Janeiro, within a time span of 55 years. After several quantifications and analysis, the author concludes that if the same deposition condition is preserved, the formation of a barrier island in the sandbar area will be expected.

Part III is composed of eight chapters, which deal with the examples and techniques of risk assessment on beach environments. Chapter 17 (“State-of-the-Art Risk Assessment on Beaches from the Tree of Science Platform”), by Omar Cervantes, Camilo M. Botero, and Charles W. Finkl, describes current patterns of research in risk assessment, through a growing tree of science. The tree, with several leaves, shows a wide spectrum of recent studies which link risk assessment and beach management issues. Chapter 18 (“Assessment of Potential Impacts in Tourism of the Increase in the Average Sea Level”), by Pedro Gomes, Francisco Gutierrez, Jorge Rocha, and Ana Cláudia Teodoro, proposes an approach for assessing potential impacts of increase in average sea level to tourism in a coastal area. Tripartite methodology was designed and applied to a case study on the beach of São Jacinto, in Aveiro, at the Portuguese coast. Chapter 19 (“Beach Management Practices and Occupation Dynamics: An Agent-Based Modeling Study for the Coastal Town of Nags Head, NC, USA”), by Ayse Karanci, Liliana Velasquez-Montoya, Juan F. Paniagua-Arroyave, Peter N. Adams, and Margery F. Overton, focuses on an agent-based model to exemplify its usage and capabilities for beach management practices in coastal towns subjected to storms and sea level rise. The model has

three interactive sub-models: (1) natural processes and coastal landforms, (2) beach management, and (3) household decisions. Chapter 20 (“Beach Safety Management”), by Enzo Pranzini, Giorgio Pezzini, Giorgio Anfuso, and Camilo M. Botero, correlates several aspects of beach management which deal with the safety of users in the beach. Examples all over the world are used to demonstrate how a wide and complex beach far from casualties and accidents could be maintained. Chapter 21 (“Impacts of Coastal Erosion, Anthropogenic Activities, and Their Management on Tourism and Coastal Ecosystems: A Study with Reference to Karnataka Coast, India”), by K. S. Jayappa and B. Deepika, discusses about the positive and negative impacts of coastal erosion structures for tourism activity. Karnataka Coast, in India, is taken as a reference to show the application of beach management strategies against coastal erosion. Chapter 22 (“Management Tools for Safety in Costa Rica Beaches”), by Isabel Arozarena Llopis and Alejandro Gutiérrez Echeverría, focuses on drownings as an effect of insufficient risk assessment and management on beaches. An exhaustive research allows to get information on the casualties in Costa Rica beaches and a mapping of rip currents which are the main cause of drownings. Chapter 23 (“Risk Assessment to Extreme Wave Events: The Barranquilla-Cienaga, Caribbean of Colombia Case Study”), by Nelson Guillermo Rangel-Buitrago, Giorgio Anfuso, Allan Williams, Jarbas Bonetti, Adriana Gracia, and Juan Carlos Ortiz, reports a research which examines the interacting physical, socioeconomic, conservational, and archeological/cultural characteristics, in a risk assessment framework. In a sector of the Caribbean coast of Colombia, a hazard index and a vulnerability index are analyzed, which together constitute a single numerical measure called coastline risk to extreme waves. Chapter 24 (“Seawalls and Signage: How Beach Access Management Affects Rip Current Safety”), by Sarah Trimble and Chris Houser, demonstrates what happens when developers do not consider beach and nearshore geomorphology in their designs for beach access. Examples from the USA, Costa Rica, Australia, and the UK suggest that developers may force unsuspecting and unaware beach users toward the rip hazard, increasing the potential for drownings.

Part IV is one of the shortest of the book, five chapters, but at the same time, it deals better with the spirit of the book. Chapter 25 (“State-of-the-Art Innovative Beach Management Tools from the Tree of Science Platform”), by Camilo M. Botero, Omar Cervantes, and Charles W. Finkl, illustrates the growth of innovative tools specially designed for beach management. From the metaphor of tree of science, this chapter deals with a young forest of fast-growing small trees, which could become a mature science area in the coming years. Chapter 26 (“Analysis of Blue Flag Beaches Compared with Natural Beaches in the Balearic Islands and Canary Islands, Spain”), by Francesc Xavier Roig-Munar, Pablo Fraile-Jurado, and Carolina Peña-Alonso, discusses the application of a worldwide-known ecolabel, Blue Flag, in natural beaches with relevant geo-environmental or scenic values. Eighty-one beaches are analyzed in Canary and Balearic Islands (Spain) by measuring 15 variables focused on their conservation status and their artificiality, to obtain conclusions about the achievement of environmental quality of Blue Flag beaches. Chapter 27 (“Counting Beach Visitors: Tools, Methods, and Management

Applications”), by Damian Morgan, highlights the importance of suitable tools and methods to measure beach users for improving beach planning and management at different levels. This chapter analyzes several aspects about data sets of human uses of the beach environment and how they can improve management. Chapter 28 (“Remote Sensing Data and Image Classification Algorithms in the Identification of Beach Patterns”), by Ana Cláudia Teodoro, Francisco Gutierrez, Pedro Gomes, and Jorge Rocha, verifies that conjunction of remote sensing from two satellites and one aerial image with image processing algorithms could be a powerful tool to accurately identify beach patterns. Chapter 29 (“The Prospect of Nautical Recreational and Beach Tourism Service Providers About the Beach Certification: At Gaviotas Beach, in Mazatlán”), by Juan Pablo Mariño Jiménez and Marcela Rebeca Contreras Loera, analyzes the relationship between tourism service providers and implementation of the Mexican beach certification scheme. This study reveals that certification of the beach does not guarantee an evolution in the working conditions of the service providers nor the visit of tourists with better purchasing power.

Part V contains nine chapters regarding the importance of integrating a bottom-up approach in decision making for beach management. Chapter 30 (“State-of-the-Art Beach Governance from the Tree of Science Platform”), by Camilo M. Botero, Omar Cervantes, and Charles W. Finkl, describes main scientific references that link governance with beach environments. A tree with many small leaves and roots, and two strong references in the trunk, suggests a topic of high importance in the near future. Chapter 31 (“Beach Management, Beyond the Double Standard for Client Demands and Environmental Sustainability”), by José R. Dadon, features the trends of the sun and beach tourism and the relationships among three of the main change drivers (the quality service demand, the public use and enjoyment, and the environmental sustainability) under the assumption that the economic profits are positive. After a brilliant analysis, this chapter demonstrates that the search for high-quality services and massive enjoyment derives from either selective elitism, environmental degradation, or both. Chapter 32 (“Interdisciplinary Criteria and Indicators to Identify Priorities for Beach and Dune Management”), by Patricia Moreno-Casasola, Rodolfo Silva, M. Luisa Martínez, Debora Lithgow, Edgar Mendoza, Rubí Esmeralda Martínez-Martínez, Ileana Espejel, Gabriela Vázquez, and Jorge López-Portillo, presents a group of indicators, which authors consider as critical to determining management priorities in beach and dune environments. This work was done in nine coastal cells in the same number of municipalities of Veracruz, Mexico. Chapter 33 (“Microscale Governance and Temporal Regulations in Beach Management”), by Isaac Azuz-Adeath, Norma Patricia Muñoz-Sevilla, Evelia Rivera-Arriaga, Lidia Silva-Íñiguez, Oscar Arizpe-Covarrubias, Omar Cervantes, Gisela García-Morales, José Alfredo Arreola-Lizárraga, Laura Martínez-Ríos, Alejandra Cortés-Ruíz, and Alfredo Ortega-Rubio, discusses the processes and structures of nearshore and coastal governance by focusing on microscale situations, inside the Mexican legal and regulatory context. The study area covers several study places in the Mexican Pacific coast, Gulf of California, and Gulf of Mexico, most of them urban touristic beaches. Chapter 34 (“Pacific Island Beaches: Values, Threats, and Rehabilitation”), by Joanna Ellison, gives interesting examples of the

high value of beaches in the Pacific Islands and what their main threats are. Through rehabilitation strategies, the author raises attention to ecosystem-based adaptation strategies and increasing the resilience of beaches. Chapter 35 (“Privatization of the Mexican Coast, the Case of the Municipality of Solidaridad, Quintana Roo, from the Perspective of the Public Administration and Everyday Life Practices”), by Ulsía Urrea-Mariño, highlights a negative situation occurring in Mexico, where several coastal areas are becoming private property, which is against the national and local regulations. This study is focused on tens of small actions done by people or companies, which prohibit free access to beaches, and the role of public administration within this conflict. Chapter 36 (“Sources of Information for the Management of Coastal Territory in Mexico”), also by Ulsía Urrea-Mariño, identifies main sources of information used by public authorities in charge of coastal management in Mexico, by analyzing each kind of administrative action. Chapter 37 (“Strategies for the Management of the Marine Shoreline in the Orla Araranguá Project [Santa Catarina, Brazil]”), by Samanta C. Cristiano, Luana Portz, Pedro C. Nasser, Adelina C. Pinto, Paulo R. da Silva, and Eduardo G. Barboza, features a case study on the south Brazilian coast, in which coastal management is covered for a national strategy called Orla Project. A detailed description of the Araranguá Project is done, to suggest improvements for better conservation of the coastline. Chapter 38 (“Sustainable Coastal Zone Management Strategies for Unconsolidated Deltaic Odisha, the Northern Part of East Indian Coast”), by Nilay Kanti Barman, comprises several methods of coastal research, to detect the appropriate beach management tools for a case study on the northern coast of East India. This study was done at a small spatial scale, where the author considers that it may be feasible to put into practice a beach management program.

Part VI contains five chapters related to environmental quality and some important parameters to measure it on beaches. Chapter 39 (“State-of-the-Art Beach Environmental Quality from the Tree of Science Platform”), by Camilo M. Botero, Omar Cervantes, and Charles W. Finkl, describes a tree with few and weak roots, but strong trunk and leaves, signaling a topic which could split into new trees of science in the medium term. Chapter 40 (“Beach Litter Characteristics Along the Moroccan Mediterranean Coast: Implications for Coastal Zone Management”), by D. Nachite, F. Maziane, G. Anfuso, and A. Macias, investigates litter accumulation and quantification on 14 sandy beaches, including the most important and emblematic touristic destinations along the Morocco Mediterranean coast. Results about the number of items, litter categories, and patterns during autumn and spring are presented in detail. Chapter 41 (“Beach Sand Quality and Its Associated Health Effects of Port Dickson Beaches (Malaysia): An Analysis of Beach Management Framework”), by Sarva Mangala Praveena, Siti Shafiq Shamira, and Ahmad Zaharin Aris, deals with a very well-known microbial indicator, to indicate beach sand quality along Port Dickson coastal area (Malaysia) and how beachgoers perceive health risk symptoms. The method used to understand the beach management framework is a SWOT analysis. Chapter 42 (“Environmental and Health Risk by the Presence of Parasites in the Sand of Cartagena Beaches”), by Ganiveth Manjarrez-Paba, Jorge Iván Blanco Herrera, and Betsy Paola González Arrunategui,

investigates the presence of parasites of health interest in the sands of three beaches in Cartagena (Colombia). Authors identify what the three parasites' dangers were and give a proposal for the mitigation, minimization, and control of these microbes. Chapter 43 ("Temporal Space Behavior of Three Environmental Quality Determinants from Touristic Beaches in Cartagena, Colombia"), by Juan Carlos Valdelamar Villegas, Kevin Andrade-Quintero, Claudia Díaz-Mendoza, and Ganiveth Manjarrez-Paba, describes the temporal space behavior of five environmental quality parameters and the relationship among them. Results from 1 year of monitoring are showed and discussed.

Part VII contains five chapters related to a polemic and worthy area, users' perception, and its application to beach management. Chapter 44 ("State-of-the-Art Users' Perception on Beaches from the Tree of Science Platform"), by Omar Cervantes, Camilo M. Botero, and Charles W. Finkl, describes a tree of science with a very strong trunk, many leaves of small and medium size, and some weak roots. Chapter 45 ("Integrating Social Perceptions in Beach Management"), by Elisabet Roca and Míriam Villares, aims to go beyond traditional reductionist approaches and includes a social dimension in beach management. A set of methodologies describes how expectations of local authorities and public bodies, tourist sector and other economic stakeholders, beach users, and environmentalist groups can all be met. Chapter 46 ("Recreational Preferences of Estonian Coastal Landscapes and Willingness to Pay in Comparison: A Good Tool for Creating National Beach Management Strategy"), by Mart Reimann, Üllas Ehrlich, and Hannes Tõnisson, discusses values of the coastal landscapes of an ex-Soviet republic, using two methodologies about the same shore types. This chapter compares users' preferences and willingness to pay only to discover that sandy shore is the most preferred shore type and had also the highest WTP. Chapter 47 ("Users' Perception of Beach Characteristics and Management in Summer and Autumn Seasons: The Case of Gran Canaria Island [Spain]"), by Carolina Peña-Alonso, Eduard Ariza, and Luis Hernández-Calvento, investigates the feedback from users of twelve beaches located on Gran Canaria Island (Spain) in relation to the importance of some beach characteristics. One of the main results establishes that some opinions of users indicate that characteristics evaluated as most important are also perceived as the most problematic aspects. Chapter 48 ("Utility of Users' Data and Their Support for Differential Beach Management in South Africa"), by Serena Lucrezi, Linda-Louise Geldenhuys, Peet Van der Merwe, and Melville Saayman, closes the book with a loop to ecosystem services but focuses on users' data and their potential to assist in the differential management of recreational sandy beaches in South Africa. This chapter also shows a demonstration of the tree of science as a users' perception tool, which was also included by the first author (Serena Lucrezi) in two of the biggest leaves.

What is presented in these two sections is the top of the iceberg, with hundreds of examples of beach management tools in action still unpublished. Nevertheless, these 48 chapters cover contributions from authors and case studies from the five continents. Some general statistics show that 102 researchers participated in this book, from 19 countries, in which Mexico, Spain, and Colombia have the bigger

numbers. About case studies, presented here are 39 study areas in 15 countries, from big countries such as India or the USA to small islands in the Pacific Ocean. This wide geographical coverage is complemented with a wide spectrum of topics and tools. The ecosystem service approach highlights the importance of managing beaches as a socioecological system, with some clear threats, such as erosion or pollution, but also a hidden risk to its stability, such as disorganized tourism and cultural conflicts. Some regions of the world are more dependent to beaches than others; fortunately, several of them have already begun to study, understand, and manage beaches from an interdisciplinary and holistic view; several chapters in this book are a proof to this. We are optimistic about the future of beach management, about the scientific community which is working on that, and about the transfer of this knowledge to stakeholders. These 48 chapters demonstrate a maturity for a really interdisciplinary topic that follows the path marked by Allan T. Williams and Anton Micallef in 2009.

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