

THE SAND MOTOR: A NATURE-BASED RESPONSE TO CLIMATE CHANGE

FINDINGS AND REFLECTIONS OF THE INTERDISCIPLINARY
RESEARCH PROGRAM NATURECOAST

EDITED BY
Arjen Luijendijk
Alexander van Oudenhoven



Arjen Luijendijk (right) was active in the NatureCoast program as a postdoctoral researcher at Delft University of Technology from the start in 2013 until the end in 2018. He focused on setting up the interaction between the PhD researchers and end-users, as well as integrating the research findings. He worked on developing integrated model forecasts and developed the world's first global beach erosion map. He is currently working as a Specialist at Deltares and as a researcher at the Delft University of Technology on predicting the future behavior of the world's beaches.

Alexander van Oudenhoven (left) was active in the NatureCoast program as postdoctoral researcher at Leiden University between 2015 and 2018. He focused on integrating the program's scientific findings, thereby looking at the potential benefits that nature-inclusive coastal management can generate and how these are perceived. He is currently working as an assistant professor at the Institute of Environmental Sciences at Leiden University, working on the interface between biodiversity, ecosystem services and societies' quality of life. In the spring of 2018, he became Co-Editor in Chief of Ecosystems and People, an interdisciplinary open access scientific journal.

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Alexander van Oudenhoven, Ewert Aukes and Arjen Luijendijk

TOWARDS MULTIFUNCTIONAL COASTAL MANAGEMENT

Alexander van Oudenhoven was active in the NatureCoast program as a postdoctoral researcher at Leiden University between 2015 and 2018. He focused on integrating the program's scientific findings, thereby looking at the interactions between nature and people, the potential benefits that nature-inclusive coastal management can generate. He is currently working as an assistant professor at the Institute of Environmental Sciences at Leiden University, working on the interface between biodiversity, ecosystem services and societies' quality of life.

Ewert Aukes was active in the NatureCoast program as a postdoctoral researcher, shortly after obtaining his PhD within the same program in 2017 at the University of Twente. He currently works at the department of Science, Technology and Policy Studies at University of Twente, as a postdoctoral researcher.

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*Photo (left page):
The Sand Motor being constructed, as seen from the dunes of Ter Heijde. The sand is being sprayed on through so-called rainbowing. (Photo by Arjen Luijendijk)*

Climate change is the most formidable challenge that our ever-increasing world population faces, and it poses special problems for those living near coasts. People have always been attracted to the coast, as a place to live and work, and to relax. By 2050, around half of the world's population is expected to live near the coast, the vast majority in developing countries. How will we cope with rapidly rising sea levels and more intense and frequent storm surges?

Although retreating from coastal areas might not be such a bad idea, this is an unlikely option for most coastal settlements. This means that active protection of urban areas and infrastructure against flooding will remain our primary focus. Artificial protective barriers, such as concrete dikes, dams and breakwaters have traditionally been the go-to way to deal with coastal protection. However, such hard structures have always had the single aim of providing coastal protection, without considering their impact on the coastal ecosystem. In other words, traditional coastal management solutions were treating symptoms; building coastal protection structures in nature often created new problems or moved existing problems to other places.

Throughout history, the fate of the Netherlands has always been intimately linked to the sea. Without our coastline protection and inland water management, two-thirds of the country would be under water. However, we have also realized that just treating symptoms is no longer sufficient. Protecting people and infrastructure will always remain the main aim of coastal management, but the impact on the environment must also be considered, as well as the wider societal

context. This means that we need to fully understand how coastal ecosystems function, as well as their societal context. This knowledge is crucial if we are to create integrated multifunctional coastal protection solutions that have minimal environmental impact and are widely appreciated.

The shift away from treating symptoms towards integrated, multifunctional designs requires a new approach. Throughout the Netherlands, the Building with Nature approach has been adopted. The key to this innovative approach is using prototype pilots to develop new knowledge and insights. In this book, we present the findings of a multidisciplinary research program, called "NatureCoast", which studied a full-scale coastal protection pilot project, the "Sand Motor".

Building with Nature

Building with Nature (BwN) is a proactive approach to surface water management. The approach advocates an integrated approach that harmonizes coastal management solutions with the requirements of ecosystems. Decisions must be taken about desired societal and ecological functions, which means that the state and the functioning of the ecosystem has to be studied and understood before a design can be proposed.

The BwN approach maintains that this knowledge is crucial if environmental and nature concerns are to be integrated into coastal infrastructure projects. By considering how the local ecosystem can become part of the solution, project managers anticipate legal opposition and avoid having to create alternative nature areas. This is almost directly opposite to mainstream infrastructure approaches,



Photo (left page): NatureCoast researchers sharing their findings during an excursion of the Rijkswaterstaat Sand Motor conference in 2016. Throughout the years, our researchers have provided numerous excursions to the Sand Motor. Excursions, discussions and guest lectures are just some of the ways through which NatureCoast has been in dialogue with end-users and society. (Photo by Alexander van Oudenhoven)

which tend to focus on the current situation rather than the future and build in nature, rather than with nature. Besides being proactive, the BwN philosophy attempts to maximize the use of natural processes in infrastructure projects. The Sand Motor is one of the first large-scale applications of the BwN approach.

The Sand Motor

The Sand Motor is a large sandy peninsula, constructed in 2011 on the Dutch North Sea coast near The Hague. This unprecedented pilot project involved placing 21.5 million m³ of sand on and in front of the beach with the aim that it would spread along the coast. Sand nourishment itself is not a new method to prevent coastline erosion. In fact, the Netherlands has had a structural nourishment program since the early 1990s. However, the Sand Motor is a unique beach nourishment due to its size, the design philosophy behind it, and its multifunctionality. The volume of sand used for the Sand Motor is about five times that of an average nourishment. The Sand Motor is intended to feed the adjacent coasts by using the natural forces of tides, waves and wind; in a way, it is built to “disappear”. Another unique aspect of the Sand Motor is that it combines the primary function of coastal protection with the creation of a new natural landscape that also provides new leisure opportunities. From the outset, “learning by doing” has been a crucial part of the project. Because of its innovations, the Sand Motor has triggered considerable political and scientific interest from all over the world. Large research consortia such as the NatureCoast program were formed to conduct interdisciplinary research on the Sand Motor.

Interdisciplinary research: NatureCoast

NatureCoast is the largest research program that focused on the Sand Motor. The program was carried out by a large consortium of knowledge institutes, and the research was conducted in cooperation with end-users from private companies, research institutes and governmental organizations. The Dutch Technology Foundation (NWO-TTW) supplied the largest share of the project funds. The research in NatureCoast

focused on six themes: coastal safety, dune formation, marine ecology, terrestrial ecology, hydrology and geochemistry, and governance. NatureCoast researchers collaborated actively with researchers from the NEMO project (Page 19), who studied the behavior of the Delfland coast, including the Sand Motor.

The purpose of this book

Interdisciplinary research is crucial to support integrated coastal protection solutions and to put the lessons learned into practice. In this book, we will tell you more about both the innovative meganourishment, the Sand Motor, and about the uniquely interdisciplinary NatureCoast program. We share concrete research findings about the Sand Motor’s behavior and about the societal context of the pilot Sand Motor. We also reflect on the merits of collaboration and integration within a multidisciplinary research program.