THE SAND MOTOR: A NATURE-BASED RESPONSE TO CLIMATE CHANGE
RESEARCH PROGRAM NATURECOAST – Luijendijk and Van Oudenhoven (eds)

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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Kathelijne Wijnberg

IMPROVING THE ABOVE-WATER DESIGN OF LARGE SAND NOURISHMENTS

REFLECTION

Kathelijne Wijnberg is a professor of Coastal Systems and Nature-based Engineering at the University of Twente, Faculty of Engineering Technology. Within the NatureCoast program she was the principal investigator of scientific research project S2, which focused on dune formation.

The core ingredient for maintaining Dutch coastal flood defenses is sand. This is not surprising when realizing these mainly consist of dunes. Initially, sand was only used to repair storm damage to the dunes. At present, it is added once the volume of sand in an indicator zone drops below a reference value. This proactive approach was only developed because of increased scientific understanding of the coastal system and the processes involved in moving the sand.

With the Sand Motor pilot project, we are stepping up to the next level. Not only by scaling up the magnitude of sand nourishment and by raising the ambition that the nourishment should serve multiple purposes, but even more so by expecting natural processes to complete the job. In a few decades, the dunes in the region should have been strengthened to guarantee flood safety from rising sea levels. In the meantime, the Sand Motor area should provide space for recreation and allow additional beach-dune habitat to develop without jeopardizing the long-term goal of reinforcing the dunes.

To go from voicing the bold idea of the Sand Motor, to actually constructing it has posed many challenges, one of which was how to properly design it. Contrary to hard engineering measures, the Sand Motor is not a static intervention that needs to meet all its goals upon completion, when the contractors have finished their work. The Sand Motor is a dynamic intervention where nature is actually the master builder that should ensure that all goals are met over time.

Compared to our knowledge of below-water developments, little was known about how the above-water landscape would develop. Estimates of the magnitude of wind-blown sand supply necessary for dune growth as a flood defense were essentially based on past dune growth rates. Predicting how the above-water landscape at the Sand Motor would develop seemed largely left to artists, whose impressions often showed the Sand Motor covered with dunes and vegetation. Apparently, developments at the surface of the Sand Motor were not expected to have much impact on the rate of sand supply to the dunes. This was undoubtedly due to the lack of numerical models to predict above-water developments with computer simulations.

It turned out that considerable amounts of wind-blown sand were trapped in the lagoon and lake (Pages 86 and 88), which was not foreseen. This affected the initial dune growth rates observed at the foot of the dune reinforcement (Pages 96 and 100). The long-term effects of the trapping remain to be seen, because at some point these reservoirs of fine, wind-blown sand will become available, as the waves and currents continue eroding the Sand Motor. Additionally, the seaward expansion of vegetation was affected by activities such as raking the beaches, driving on them, and construction of beach huts; this slowed down the development of a new dune row (Pages 86 and 96).

With respect to new dune development away from the dune reinforcement, valuable insight was given by the research conducted by Van Puijenbroek (Page 92), who showed that the high, barren plain of dredged sea bed material was difficult for perennial plants to colonize, because root stalks transported by storms could not reach the higher elevations. Wind-blown seeds that could reach these elevations found conditions that were too dry to germinate, and the steadily lowering bed level due to wind erosion did not help either. Without perennial vegetation, it was hard for permanent dunes to form at the Sand Motor itself.

We are now finally starting to see a small incipient dune field forming on the south side of the Sand Motor. This dune field may actually become a new local sink for wind-blown sand, meaning that it will not reach the dune reinforcement, thus locally affecting the sand supply to the dune reinforcement zone.

So, will the long-term goal of strengthening the dunes be jeopardized by the shorter-term goals for recreation and development of natural habitat? We certainly see an influence, but to know the final effect we will have to keep following this dynamic project. We will only have the scientific basis for a definite answer towards the end of the Sand Motor's life span. NatureCoast research has offered advances in long-term monitoring approaches for wind-driven sand transport and predictive modeling. These consitute an important step towards improving the above-water design of large sand nourishments.