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Comment on 'Is 're-mobilisation' nature restoration or nature destruction? A commentary' by I. Delgado-Fernandez, R.G.D. Davidson-Arnott & P.A. Hesp

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Abstract
In their recently published paper, Delgado-Fernandez et al. (2019) critically review the limitations and dangers of the relatively recent shift towards dune rejuvenation management in North-western Europe. We would like to comment on the paper from the Dutch perspective.

Keywords Coastal dunes · Remobilisation · Aeolian processes · Management · Bio diversity

Comment

In their recently published paper, Delgado-Fernandez et al. (2019) critically review the limitations and dangers of the relatively recent shift towards dune rejuvenation management in North-western Europe. Aside from efforts to deal with invasive species, the article is critical of landscape interventions aiming at reverting succession trends in dunes. The focus is on British dunes, where, as the authors state, remobilisation is primarily directed at creating bare sand habitats for the conservation of rare species. In addition, other types of human impacts (e.g. trampling) are reviewed. The article advocates an approach that focuses on removing artificial stressors from coastal dunes so that these can continue to evolve naturally, i.e. without human intervention. The authors set the Dutch situation aside. They state that the Dutch approach does not necessarily provide a good example for the management of coastal dunes in other countries because the Dutch situation is different from the rest of the North-western European dunes due to the monofunctional management focus on coastal safety after the 1953 storm-surge disaster. We would like to comment on the paper from the Dutch perspective. In addition, we strongly feel the need to clarify the different, often scale-dependent, approaches of some Dutch projects, which we do believe can at least be relevant and/or partly applied elsewhere.

First, we wish to share our view on natural landscapes. It can be questioned if the landscape should be regarded as the sum of all species. This would disregard the underlying abiotic processes and its importance for nature. In our opinion, the landscape can best be regarded as the sum of all abiotic and biotic factors, including their interactions (e.g. Bakker et al. 1981; Hesp 2002; Schwarz et al. 2019), and could preferably be managed as such. In a truly natural system, the landscape is built by the interaction of biotic and abiotic components without any human interference. In a constructed system, both biotic and abiotic components are fully determined by human action. However, even then, some species might colonize those constructed systems spontaneously, thereby introducing some 'natural' elements. In practice, the coastal landscape consists of a spectrum of states, with true wilderness on one side and artificial sand dykes on the other and anything in between. In the Netherlands, large parts of the current dune landscape were more or less built by natural processes (Klijn 1990), and is nowadays often covered with introduced or stimulated

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vegetation: a relatively natural landscape from a geomorphological point of view, a disturbed, man-made landscape from an ecological point of view.

Apart from abiotic and biotic entities of the landscape, in Dutch practice, the environment is manipulated to serve the societal need. In the Netherlands, dunes provide safety against flooding (as noted in the paper) but also serve as drinking water reservoirs, create favourable conditions for habitat, mostly in the framework of Natura 2000 and the European Habitats Directive. Recreational use is also more and more important through municipalities that want to stimulate the local economy. Without visitors being able to experience nature, support for management declines. So, dunes serve as a multifunctional landscape and in most cases not just nature reserves or pristine 'wilderness' areas. Most Dutch dunes are protected under the Natura 2000 legislation. An important characteristic of the Natura 2000 sites is that they are not necessarily pristine 'wilderness' areas. Moreover, Europe's biodiversity has been shaped by human activity more than on any other continent (semi-natural landscapes, Tansley 1911). The main goal of the Natura 2000 network is to safeguard Europe's most valuable and threatened species and habitats, listed under the Birds and Habitats Directives. Species and dune habitats protected under the European Habitats Directive show predominantly unfavourable conservation status. Management is designed to improve the conservation status.

The paradigm shift in coastal dune management has been discussed for some years now (Van Boxel et al. 1997; Arens et al. 2004, 2005, Arens and Geelen 2006, Arens et al. 2013a; Geelen et al. 2015; De Groot et al. 2017; Martínez et al. 2013; Provoost et al. 2011; Psuty and Silveira 2013; Osswald et al. 2019). Most of the Dutch dunes are the result of coastal erosion of an extensive barrier coast, induced by sea-level rise, resulting in the development of smaller or wider dune belts with transgressive dunes (Klijn 1990). For centuries, these dunes were strictly managed as a coastal defence zone. Dunes were planted for over 150 years with Marram grass (*Ammophila arenaria*) and non-indigenous Pine trees, mostly Black pines (*Pinus nigra*), to protect them against erosion. Foredunes were turned into sand dykes, cutting off the originally dynamic transgressive dunes from the sea, a situation which started around the second half of the nineteenth century and lasted until the 1990s. After every storm period, new spots of bare sand in the dunes were stabilized, incipient blowouts were erased manually; legal stipulations demanded the complete fixation of blowing sand. Consequently, pioneer situations became very rare, biodiversity declined and, stimulated by other factors like increased nitrogen input and the sharp decline of the population of the European rabbit (*Oryctolagus cuniculus*) due to epidemic diseases, climax vegetation started to dominate (Van der Hagen et al. in press). In the 1990s, consciousness increased that ages of stabilizing efforts in the coastal dunes had resulted in a fossilized and partly acidified landscape. Moreover, coastal management policy changed from fixating the coastline by suppressing natural processes to a more flexible approach by keeping the coastline in place by means of artificially adding sand to the system (nourishments; e.g. Grunnet and Ruessink 2005; Ojeda et al. 2008). This artificial sediment supply caused foredunes to grow in volume in most locations (Arens et al. 2010; De Vries et al. 2012) and this gave room for a much less intense and interfering foredune management while keeping up the local safety standards. Bare sand in the landscape was no longer a threat to safety but became an opportunity for both safety and ecology.

In this light, a new management strategy was introduced. Restoring geomorphological dynamics by setting abiotic conditions for natural processes should both increase the adaptive capacity to adjust to an accelerating sea-level rise and reverse decreasing dune biodiversity. On the largest possible scale, the connection between dunes, foredunes, beach and the sea can be re-established (e.g. Arens et al. 2013b; Ruessink et al. 2018). The larger the scale, the sooner the inland gradients of sand transport are restored. This will also increase the sediment budget of the dunes behind the foredunes, thereby making them more robust. On a smaller scale, reactivation of blowouts inside the dunes as well as the foredunes could locally provide fresh sand over acidified soils (e.g. Aggenbach et al. 2018). With the intensified movement of sand, climax vegetation is destroyed or adapted by being buried by smaller or larger amounts of sand. Within the landscape, new pioneer situations develop, where vegetation development can start from scratch.

Delgado-Fernandez et al. (2019) provide an incentive to evaluate our primary goals for nature management. Often, management goals are set to create as much diversity in the areas as possible. This might even result in the construction of features that were not present before. An example is the digging of dune slacks in young dune areas where erosion has not yet resulted in deflation down to the groundwater. In that case, management is driven by ecological desires, not by an understanding of the system. However, it is also an example of trading the geomorphological value for ecology. A more extreme example is to encourage people to trample dunes to create bare sand. In fact, visitors are then invited to destroy the geomorphology of the landscape for the benefit of some species.

We agree that nature management should be driven by a system approach. Not the desired species should be leading, but a healthy system, built by and subjected to natural processes that can adapt to current climatic and environmental conditions, where several stages of dune building can coexist. In such a system, the species will follow provided that nature reserves are sufficiently connected. We believe that nature management is about making choices, not about 'good' or

'bad'. Every choice is valid, as long as it is based on a sound understanding of the system. Therefore, 'doing nothing' is also a choice. However, it is an illusion that this will result in a truly natural landscape because in the Netherlands, and probably almost everywhere in North-western Europe, the present dune landscapes are not only reflections of natural processes but also of long records of human interference.

Delgado-Fernandez et al. (2019) suggest dunes be solemnly left to nature. Human impacts and artefacts should be banned. Meanwhile, room is needed to prevent coastal squeeze. It is evident that this is not an option for the Dutch situation but also for many other dunes areas in Europe. There is no space and there is too much pressure from many different functions. Should we then stop our attempts to manage those last bits of nature reserves that we have? We think not because we can create places where natural processes shape and reshape the dunes, and where species find their place in the living landscape, even in small dune areas. Despite a development within strict boundaries, artificially fed by sand from outside, and surrounded by all possible threats, such areas can exhibit characteristics of 'true wilderness'. Because other locations are prone to experience similar natural and anthropogenic pressures to at least some extent (see for instance the IPCC report by Nicholls et al. 2007), we believe that the Dutch example, regarding restoration of dune mobility, can and will be applied anywhere elsewhere in the future.

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