

The role of soil erosion and nitrogen deposition in the expansion of an alien moss species in Dutch Atlantic deserts

Introduction

Inland dune landscapes are a protected habitat type according to the European Habitat Directive. Several factors, such as changing land use, nitrogen deposition and habitat fragmentation cause a loss of biodiversity and enhance soil formation on formerly wind-blown sand. In the 1960s a further threat appeared, being a successful alien moss species, *Campylopus introflexus*, originating from the Southern Hemisphere [1]. It forms 4-8 cm thick carpets that constitute a poorly degradable ectorganic layer and produce 3-4 times more biomass than the original vegetation, consisting of non-competitive mosses and lichens. Especially lichens outnumber all other plants species diversity in well developed inland dunes.

Hypothesis

It appears that not all inland dunes are affected. In this study we try to relate geomorphological processes, soil formation, vegetation and excess nitrogen deposition (Fig. 1) to the local dominance of this moss species. The main hypothesis is that this moss species is only present in threatening quantities when N deposition is high, in cases where nature restoration measures left a top soil high in organic matter, or at places where litter accumulates e.g. in colluvial zones and forest borders (Fig 3). More trivially, moss carpets are absent in highly dynamic zones and zones where wind-blown sand covers the vegetation.

Methods

In eight inland dunes in different parts of The Netherlands (Table 1) we map moss carpets, geomorphological units, soil data and vegetation structure. The data is combined in a GIS with nitrogen deposition data from models.

Additionally, nitrogen deposition and fall of leaf litter is simulated in the field in an area with the lowest possible N-deposition in the Netherlands (Drouwenerzand). Moss carpets of *Campylopus introflexus* do not occur here. The setup of this experiment is illustrated in Fig. 2. The experiment will run for two years.

Prospects

One of the outcomes of this study may be that simple conservation measures suffice to prevent this moss to become dominant, e.g. sod cutting after logging on sand dunes.

References

- [1] Meulen, F. van der, Hagen, H. van der and Kruijssen, B. (1987). *Campylopus introflexus*. Invasion of a moss in Dutch coastal dunes. – Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen. Series C., 90: 73-80.
 [2] MNP (2000), "Nitrogen deposition data from the OPS model". MNP unpublished data set.

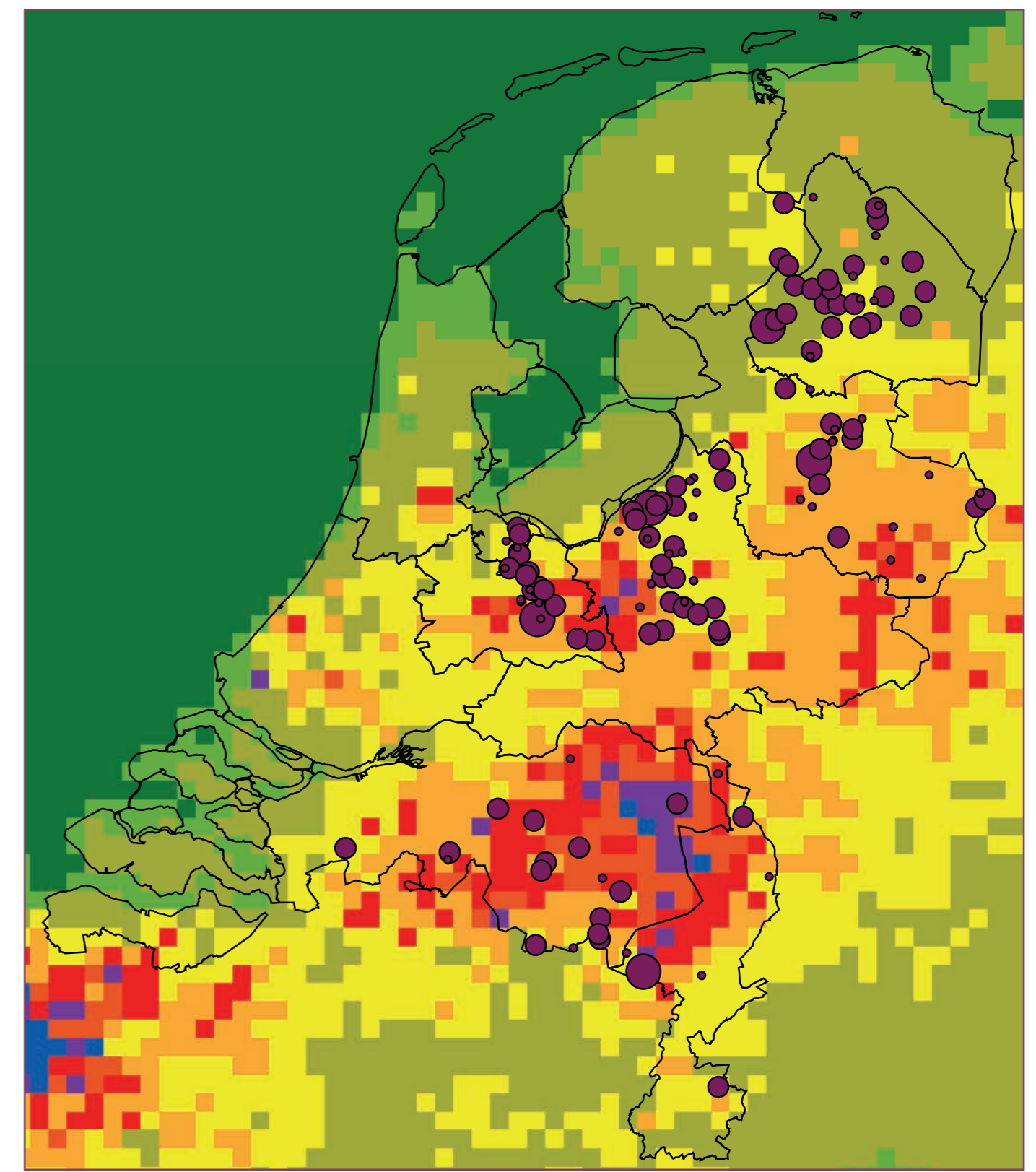


Fig. 1. Inland dunes and nitrogen deposition (green= low), yellow (moderate), red/purple (high). Dot size represents the number of characteristic lichen species [2].



Fig. 2. Setup of an invasibility experiment in Drouwenerzand: cylinders of *Campylopus* are placed in a vegetation type where *Campylopus* would become dominant in high N-deposition areas. Plots are treated with leaf litter, and a solution of NH_4NO_3 equivalent to the highest deposition value in the country.

Three situations in which *C. introflexus* becomes dominant



A. At logging sites after the forest floor becomes exposed to sunlight: high litter decomposition.

B. In the colluvial zone of dune slopes below trees and forest borders. This process is driven by litter transport and water erosion.

C. In high N deposition areas. Here the moss carpets grow on almost bare sand.

Fig. 3. Three situations in which *C. introflexus* becomes dominant. These examples support the hypothesis used in this study.

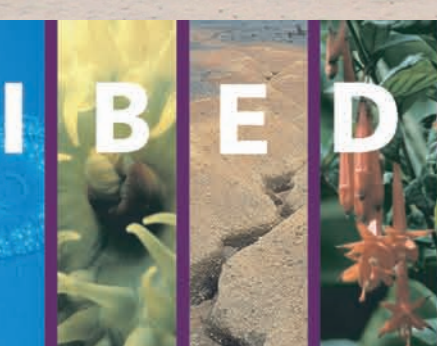
Table 1. Nitrogen deposition [2] in the study areas and presence of extensive moss carpets of *Campylopus introflexus* in open dune areas. This preliminary survey suggests a high correlation between nitrogen and dominance of moss carpets.

Area	kg N/ha/yr	Species is dominant in open dune areas
<i>north</i>		
Drouwenerzand	1805 (low)	no
Aekingerzand	2066 (low)	no
Lemelerberg	2624 (middle)	yes
<i>center (Veluwe)</i>		
Kootwijkerzand	2447 (middle)	no
Otterlosche zand	2517 (middle)	yes
Wekeromse zand	3593 (high)	yes
<i>south</i>		
Bergerheide	2802 (high)	yes

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