Representing biodiversity

Spatial analysis of multi-taxon species composition in the Netherlands

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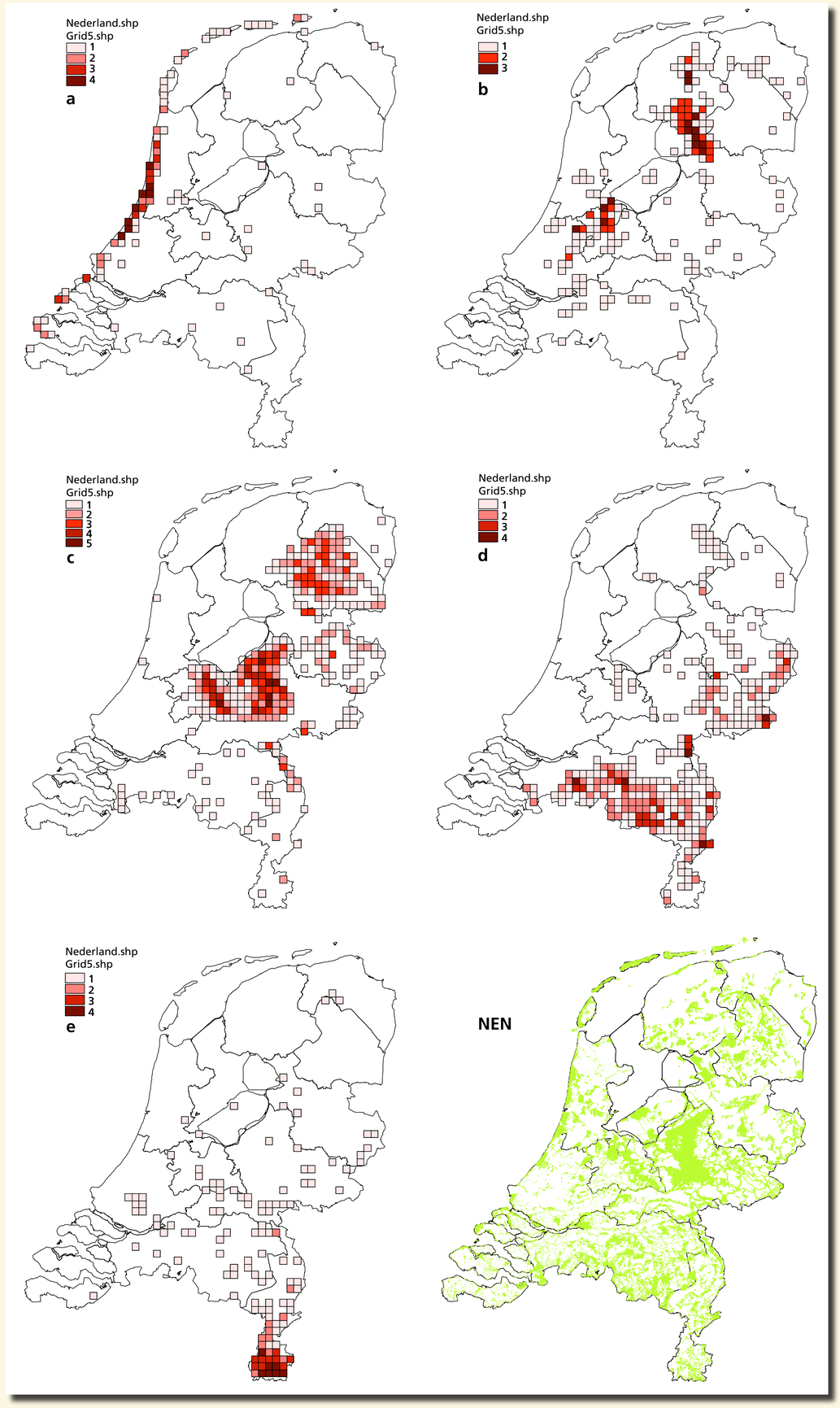
Introduction

Understanding spatial variation in species composition has become one of the fundamental goals in conservation biology. As it is virtually impossible to protect all places that contribute to biodiversity conservation, we have to prioritize areas in order to maximize the number of species conserved per unit of land. Classifying geographical areas into homogeneous regions with different species composition provides a framework of natural, rather than administrative areas and can be of great help in identifying priority areas. In the Netherlands where population and economic growth have altered the natural landscape in fundamental ways, the efficiency of nature conservation policy is an important issue. Therefore, we used species occurrence data of a broad array of taxonomic groups (Syrphidae, Orthoptera, Odonata, herpetofauna and bryophytes) to produce a quantitative classification of the Netherlands. We focused hereby on regions that contain several characteristic species of different taxonomic groups, so-called hotspots of uniqueness, as these are the most interesting areas from a conservation perspective.

Constructing hotspots of uniqueness

1. A numerical classification was used to cluster grid squares according to similarity in species composition for each taxonomic group.
2. We then identified characteristic species for each cluster using a preference index.
3. Sørensen's similarity index was used to identify corresponding clusters among the different taxonomic groups.
4. We identified regions containing characteristic species for several taxonomic groups, umbrella regions, combining the results of step 2 and 3.
5. Finally, we determined environmental conditions separating these regions using stepwise discriminant analysis.



Regionalization of the Netherlands based on the distribution of species from five taxonomic groups. Colours refer to the number of taxonomic groups for which a grid square is attributed to the regions: a. DUNE, b. FEN, c. SAND, d, SE and e. LIMB. For comparison we also included the Dutch National Ecological Network (NEN) in this figure.

Describing the hotspots of uniqueness

a. DUNE, occurs in four of the taxonomic groups but is based on only few characteristic species (n = 66). The dune region receives more sunshine than the other regions.

b. FEN, is found in the North and central west parts of the Netherlands and is recognized for three out of the five taxonomic groups, characterized by 34 species. The FEN region contains a relative high percentage of freshwater and is to a large extent situated on peat soil.

c. SAND, centres on the Pleistocene sand plateau in the centre and northern part of the Netherlands and is the only region that is congruent for all five taxonomic groups (76 characteristic species). SAND region has a lower mean annual temperature and higher precipitation surplus.

d. SE, is confined to the South East part of the country and is recognized within all taxa (60 characteristic species) except the Orthoptera. The SE region receives a considerably higher deposition of nitrogen each year than the other regions.

e. LIMB, the smallest with by far the most characteristic species (n = 189), is predominantly situated in the Southern part of the province of Limburg. Higher altitude and a high percentage of non-calcareous loamy soils make that the second function separates LIMB from the other regions.

Implications for nature conservation

In the Netherlands five regions can be distinguished. They have a unique species composition for several taxonomic groups. These spatially distinct regions also differ regarding their environmental conditions. The combination of these regions comprises the majority of the species of the studied groups, represented in the Netherlands. Therefore these regions could play a leading role in future nature conservation planning and underrepresented regions should e.g. be included in the National Ecological Network (NEN).

Results of the Stepwise Discriminant Analysis with the five regions as categorical response variable and the most important environmental predictor variables. Loadings represent the correlations between the variables and the discriminant functions (DF), while means allow us to determine the regions that are best discriminated by each discriminant function. Loadings > 0.4 are given in red.

Variables	*Loadings*			
	DF 1	DF 2	DF 3	DF 4
Precipitation surplus	-0,224	-0,095	0,198	0,539
Amount of global radiation	0,723	-0,097	-0,156	-0,106
Duration of sunshine	0,533	-0,29	0,175	0,18
Temperature	0,276	0,152	-0,247	-0,441
Altitude	-0,043	0,672	-0,169	0,223
pH	0,415	0,083	0,273	-0,431
Nitrogen deposition	-0,337	0,095	-0,275	-0,409
Non-calcareous loam	0,177	0,756	0,081	0,181
Peat soil	0,017	-0,109	0,579	-0,091
Freshwater	0,107	-0,069	0,437	-0,216
Region	*Means*			
DUNE	4,503	-1,469	-1,146	0,495
FEN	0,713	-0,703	2,095	-0,449
SAND	-1,292	-0,31	-0,098	1,015
SE	-0,636	0,245	-0,704	-0,987
LIMB	2,276	7,228	0,5	0,715

Biodiversity of the Netherlands:
± 42.000 species, e.g.

- *Vertebrates: 457 species*
  - *** Reptiles & Amphibians: 24 species**
- *Insects: 17.455 species*
  - *** Syrphidae: 325 species**
  - *** Orthoptera: 45 species**
  - *** Odonata: 72 species**
- *Vascular plants: 1.450 species*
- **Mosses: 507 species**
- *Algae: 3.800 species*
- *Bacteria: >1000 species*
- *Viruses: ? species*

Geosciences

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