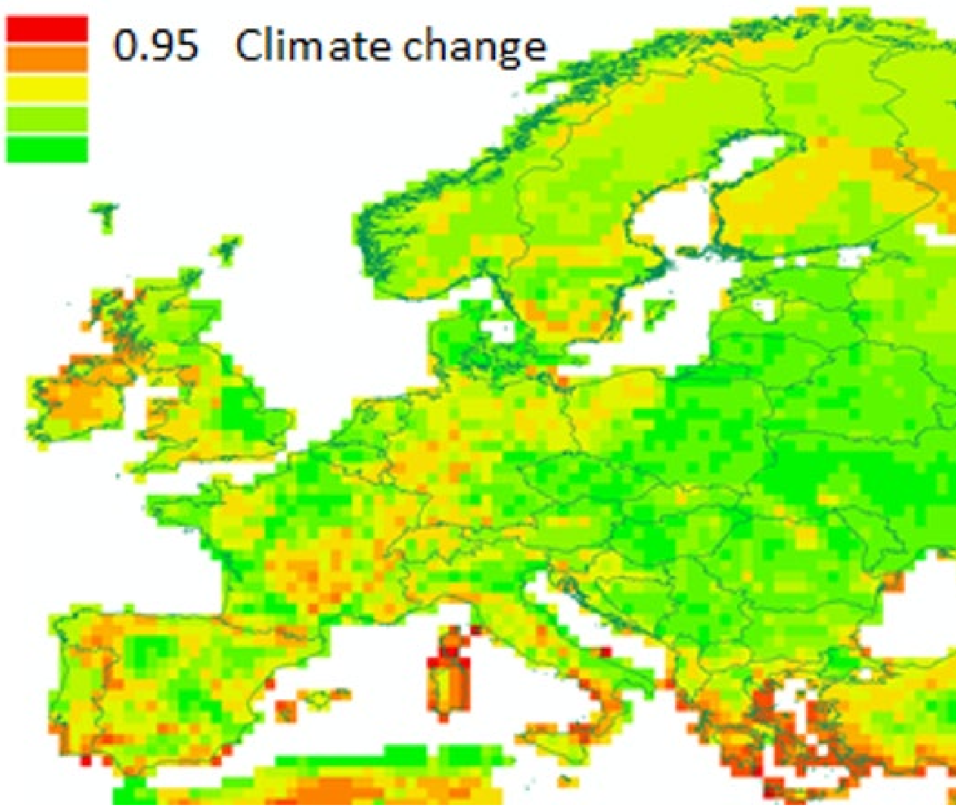
Integration between air pollution, climate, and biodiversity

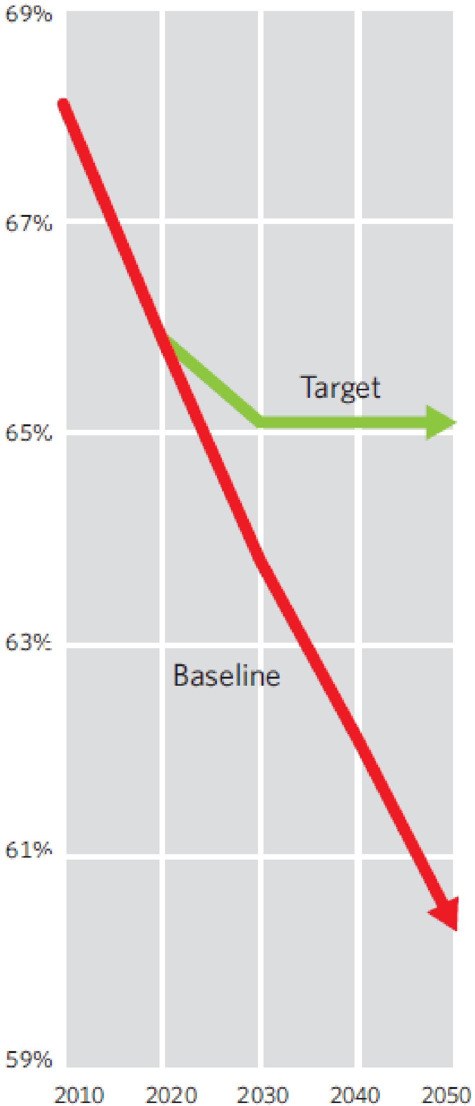
Jesper Bak, Aarhus University, Denmark

Methods to assess N and CC
as pressures to biodiversity

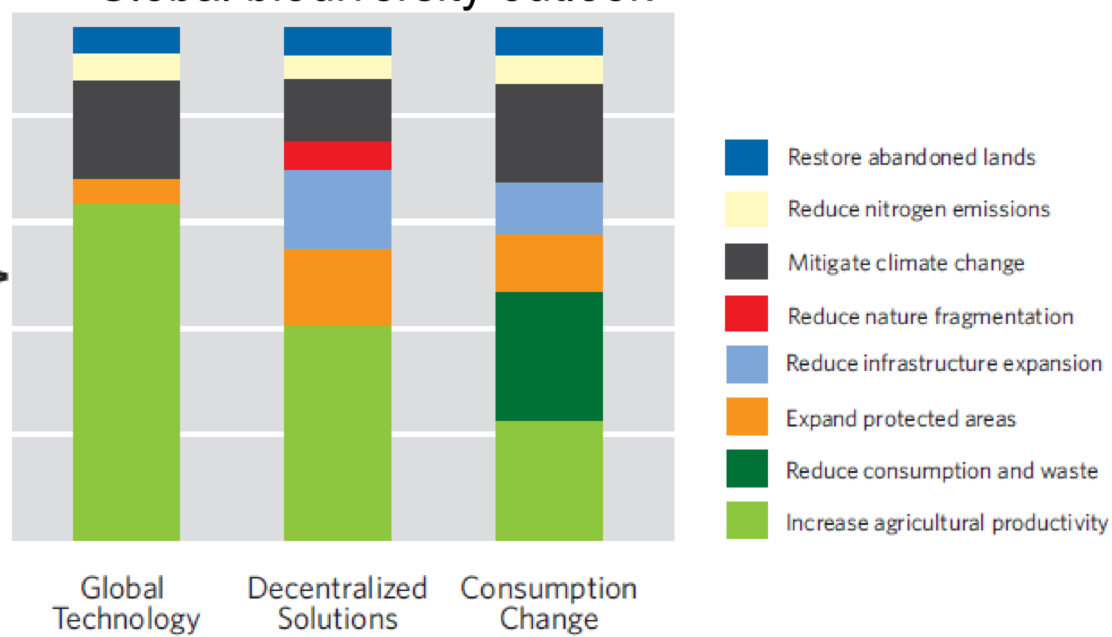
And ecosystems as carbon sink



Convention on
Biological Diversity



Global biodiversity outlook



Biodiversity pressures and threats

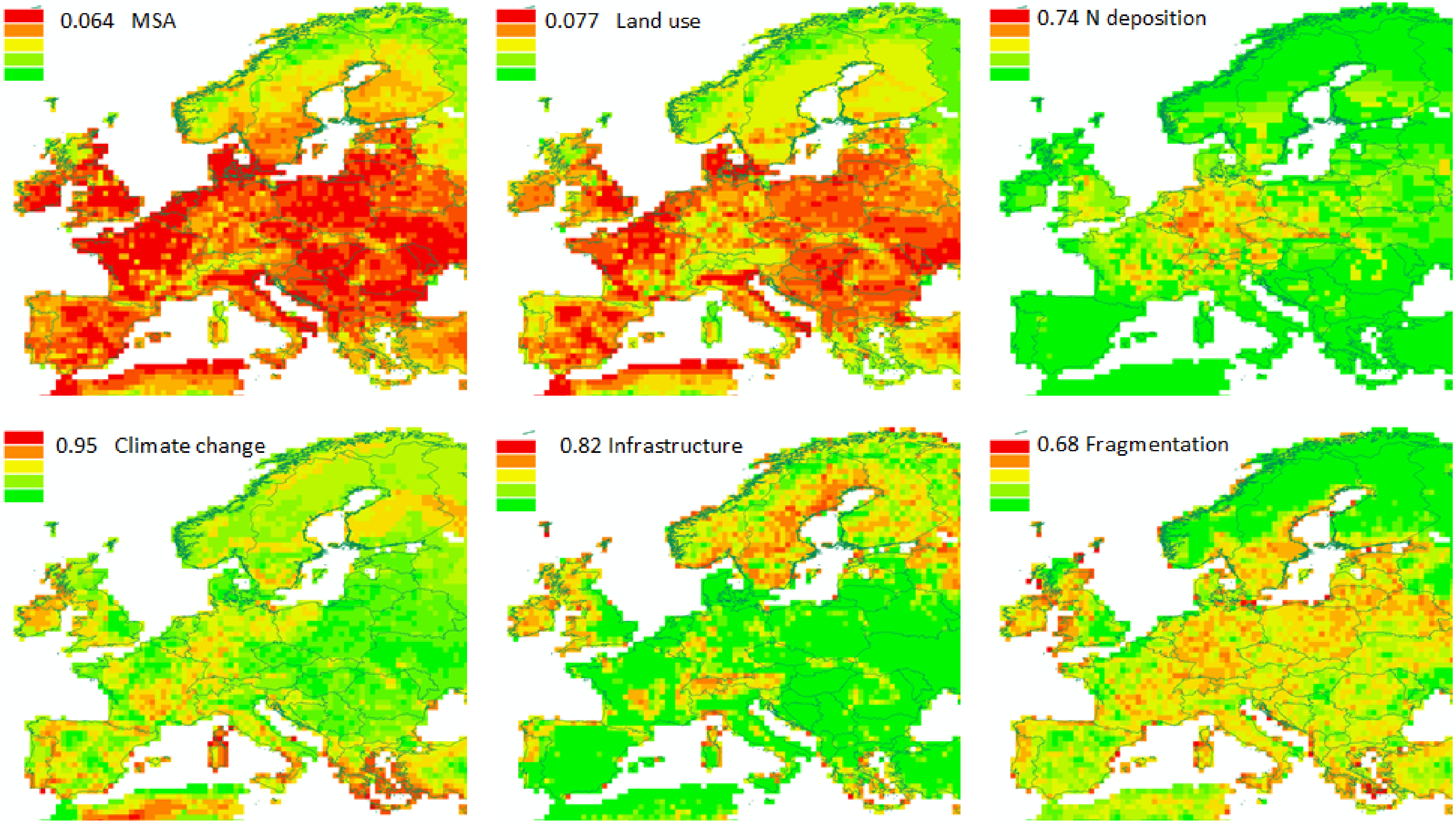
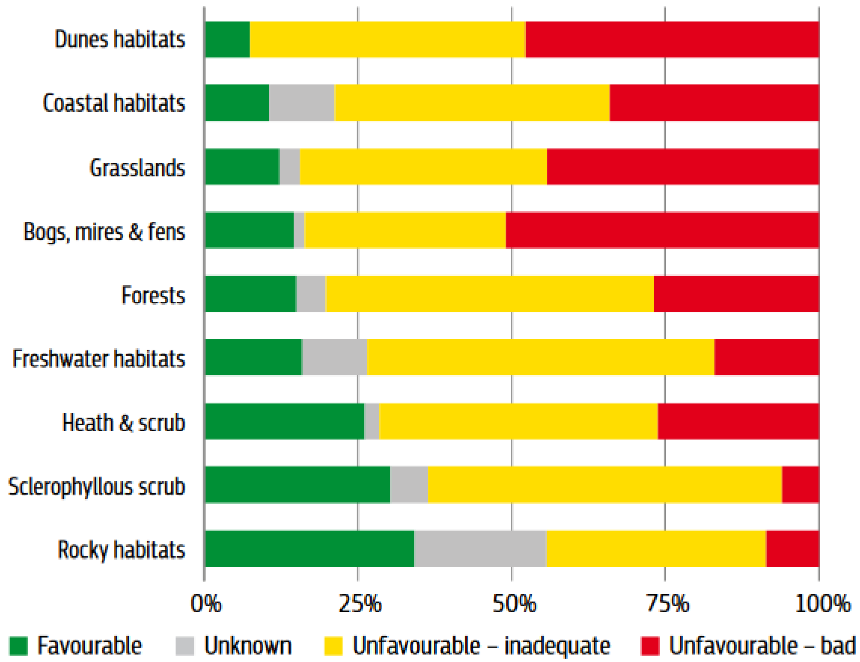


Figure xx. MSA calculated with GLOBIO3 for 2000, both total (upper left) and for land use, N deposition, climate change, infrastructure and fragmentation individually.

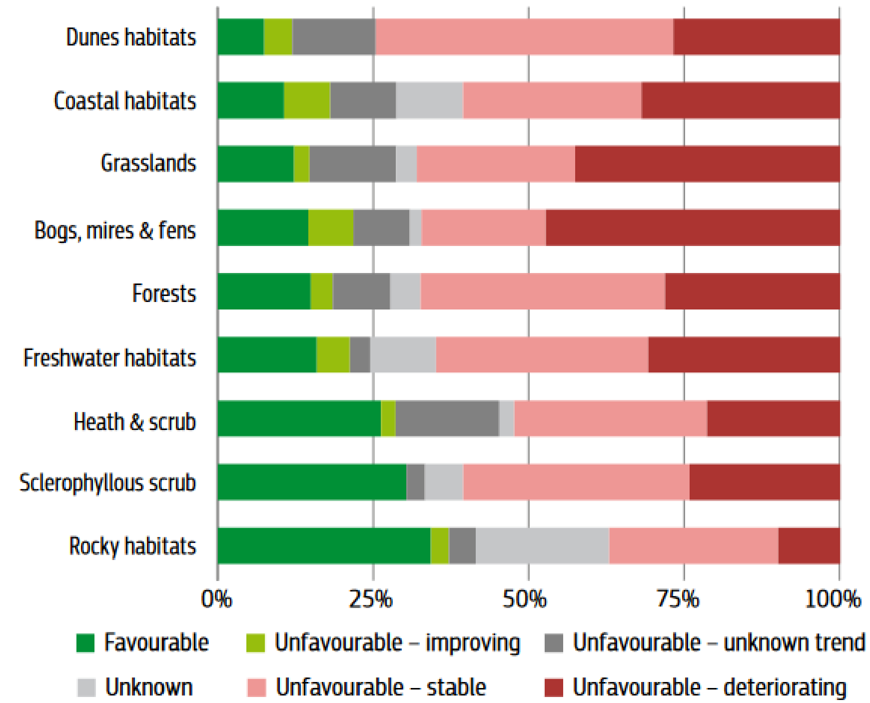
Map 3.2 Dominant landscape types in Europe based on Corine Land Cover (CLC) 2000

Dominant landscape types in Europe based on Corine land cover 2000

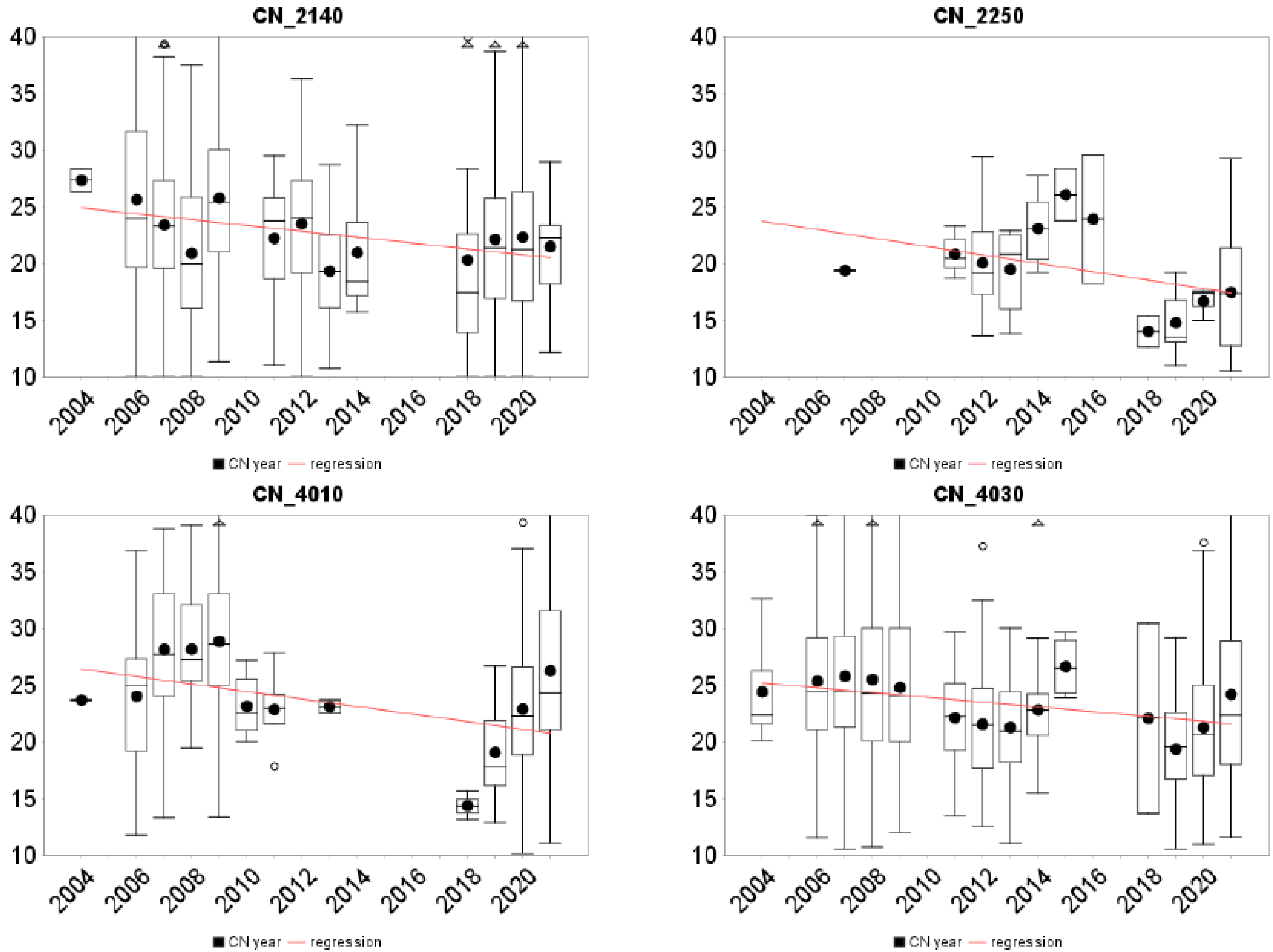
- Urban areas
- Broad pattern agricultural areas
- Agricultural mosaic and pastures
- Forests
- Natural grasslands and shrubs
- Composite landscape and bare rock
- Wetlands and water bodies
- Outside data coverage



Conservation status of habitat types by main habitat group



Conservation status trends of habitat types by main habitat group


CN_2140
CN_2250
CN_4010
CN_4030
40
35
30
25
20
15
10
2004
2006
2008
2010
2012
2014
2016
2018
2020
CN year
regression

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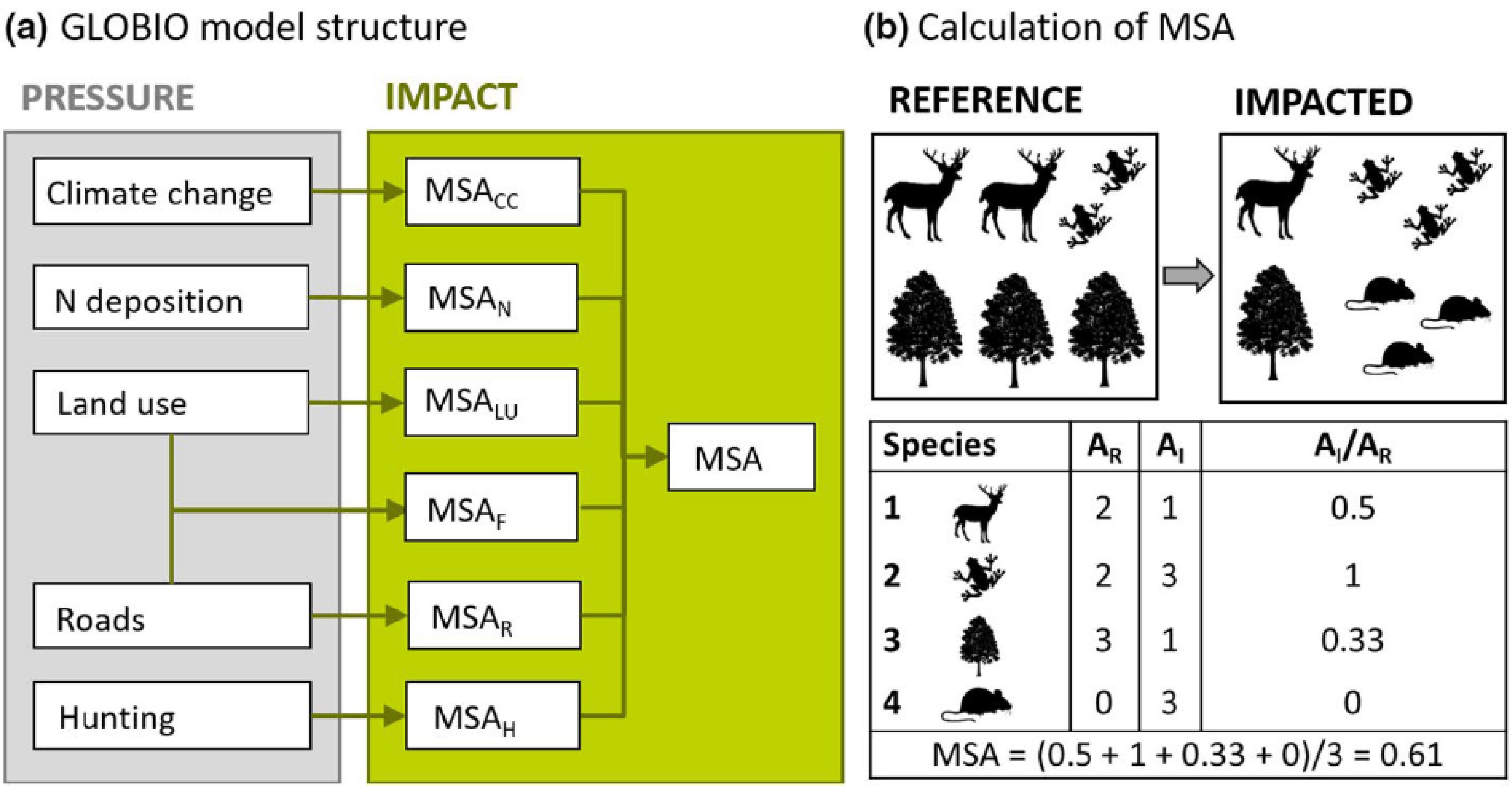
PRIMARY RESEARCH ARTICLE

Global Change Biology WILEY

Projecting terrestrial biodiversity intactness with GLOBIO 4

Aafke M. Schipper[1,2] | Jelle P. Hilbers[1] | Johan R. Meijer[1] | Laura H. Antão[3,4] | Ana Benítez-López[2,5] | Melinda M. J. de Jonge[2] | Luuk H. Leemans[2] | Eddy Scheper[6] | Rob Alkemade[1,7] | Jonathan C. Doelman[1] | Sido Mylius[1] | Elke Stehfest[1] | Detlef P. van Vuuren[1,8] | Willem-Jan van Zeist[1] | Mark A. J. Huijbregts[2]



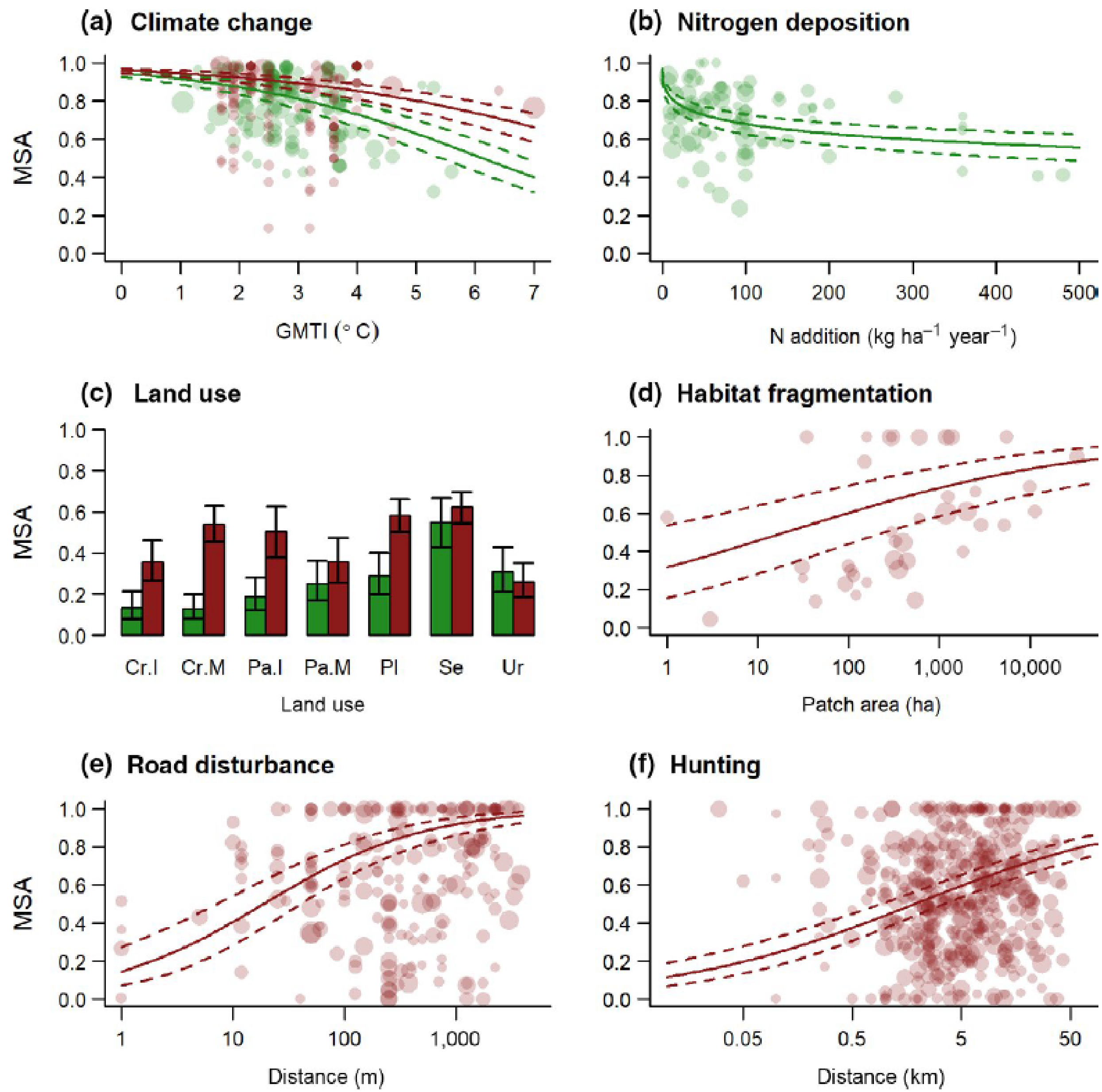
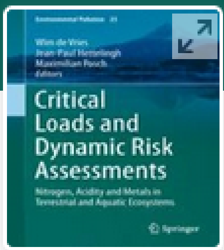


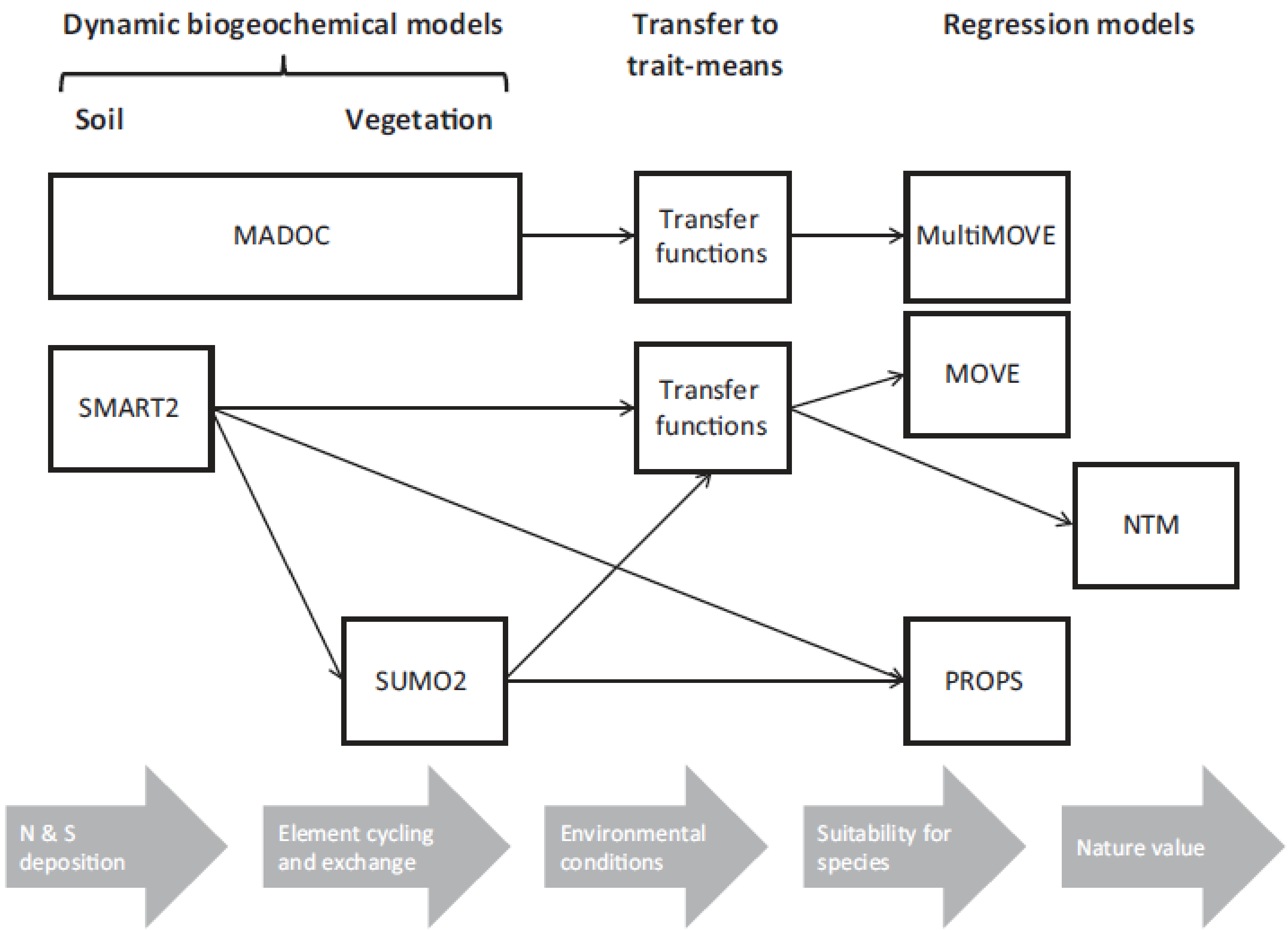
FIGURE 2 Pressure–impact relationships quantifying mean species abundance (MSA) for plants (green) and warm-blooded vertebrates (red) in relation to (a) climate change (based on global mean temperature increase), (b) atmospheric nitrogen deposition, (c) land use, (d) habitat fragmentation (based on patch size), (e) disturbance by roads (based on distance to roads) and (f) hunting (based on distance to hunters' access points). Dashed lines and error bars represent the 95% confidence interval. Points represent the individual MSA values with the size reflecting their weight in the model fitting, calculated as the square root of the number of species included in the underlying sample. Land-use classes include cropland (Cr), pasture (Pa), plantations (Pl), secondary vegetation (Se) and urban (Ur), with M, minimal use and I, intense use. [Correction added on 31 December 2019 after first online publication: figure 2C has been updated in this current version.]



Critical Loads and Dynamic Risk Assessments pp 297–326 | Cite as

Field Survey Based Models for Exploring Nitrogen and Acidity Effects on Plant Species Diversity and Assessing Long-Term Critical Loads

Ed C. Rowe, G. W. Wieger Wamelink, Simon M. Smart, Adam Butler, Peter A. Henrys, Han F. van Dobben, Gert Jan Reinds, Chris D. Evans, Johannes Kros & Wim de Vries


Dynamic biogeochemical models
Soil
Vegetation
Transfer to trait-means
Regression models
MADOC
Transfer functions
MultiMOVE
SMART2
Transfer functions
MOVE
NTM
SUMO2
PROPS
N & S deposition
Element cycling and exchange
Environmental conditions
Suitability for species
Nature value

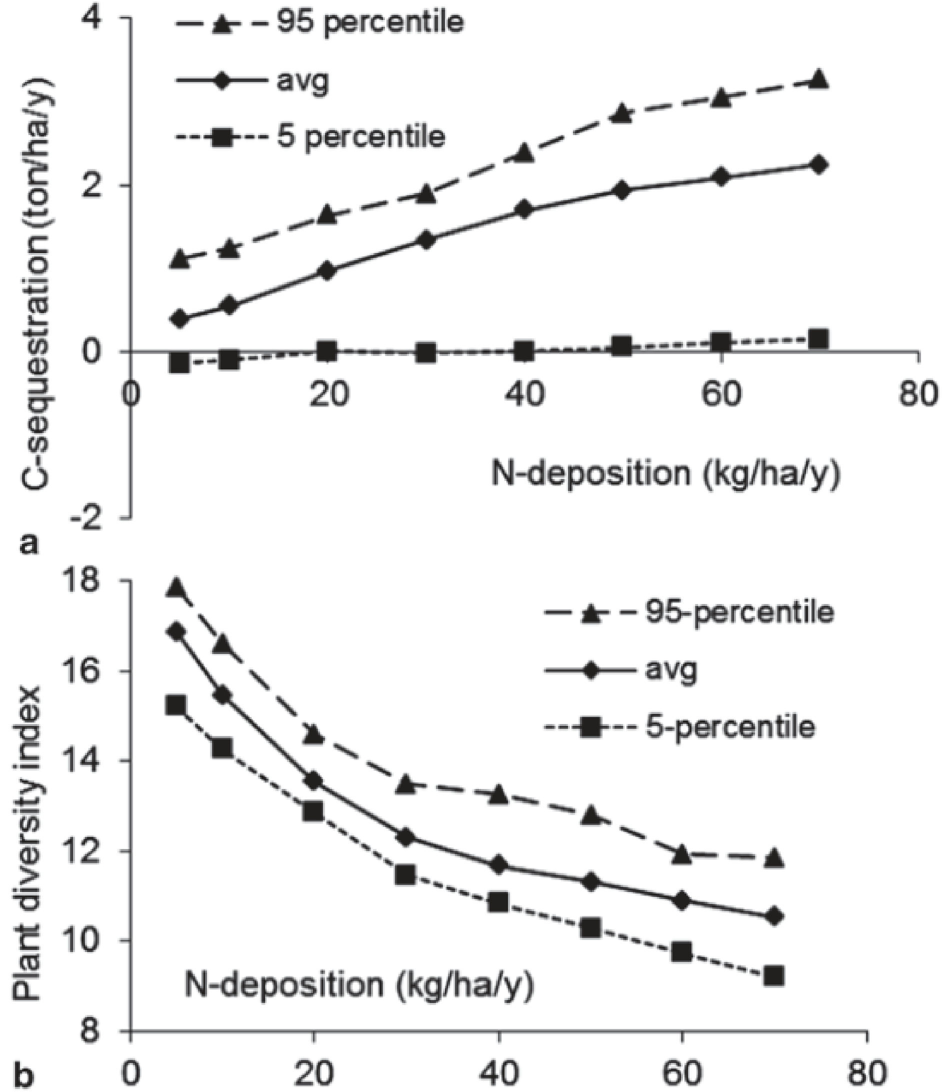


Fig. 11.9 Simulated carbon sequestration by deciduous forests (average for the Netherlands; *left*) and the plant diversity index for grassland (average for the Netherlands; *right*) as a result of N deposition in 2020. (Wamelink et al. 2009a)

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Terrestrial carbon sequestration under future climate, nutrient and land use change and management scenarios: a national-scale UK case study

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Tipping E, Rowe E C, Evans C D, Mills R T, Emmett B A, Chaplow J S and Hall J R 2012 N14C: A plant–soil nitrogen and carbon cycling model to simulate terrestrial ecosystem responses to atmospheric nitrogen deposition *Ecol. Modelling* **247** 11–26

Table 1. Scenario names and brief descriptions. For further details see supplementary methods. GMST stands for global mean surface temperature. CMIP5 is climate model inter-comparison project, phase 5.

Scenario Name	Description
Land Cover (LC) change scenarios, ASSET 2.0	
LC_+Ara	Further arable expansion
LC_+Ara_Aff	Arable expansion coupled with afforestation
LC_Aff	Afforestation on its own
LC_+Gra_Aff	Semi-natural grassland restoration coupled with afforestation
LC_+Gra	Semi-natural grassland restoration on its own
Arable Management (MNG) scenarios, ASSET 2.0	
MNG_Ara_Cereal+	Switching to cereal-dominated cropping patterns
MNG_Ara_Diversify	Diverse cropping patterns with longer rotations
MNG_Ara_Extensify	Extensive cropping patterns with grass leys and fallow years
MNG_Ara_Extensify+	Extensive cropping plus organic fertilisers and no tillage
Climate (RCP) scenarios, UKCP18	
RCP2.6	GMST anomaly of ~1.6 °C in 2081–2100 (Coupled Model Intercomparison Project 5 (CMIP5) ensemble mean)
RCP4.5	GMST anomaly of ~2.4 °C in 2081–2100 (CMIP5 ensemble mean)
RCP6.0	GMST anomaly of ~2.8 °C in 2081–2100 (CMIP5 ensemble mean)
RCP8.5	GMST anomaly of ~4.3 °C in 2081–2100 (CMIP5 ensemble mean)
Atmospheric N deposition (NDep) scenarios, relative to recent trend [63]	
NDep_Medium	Linear extrapolation of current decline trend out to 2100
NDep_High	Current decline trend until 2030, constant level afterwards
NDep_Low	Current decline trend until 2030, double the rate of decline afterwards

Ecological Modelling 306 (2015) 35–45

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Developing an approach for Sweden, Switzerland, United States and France for setting critical loads based on biodiversity including management, pollution and climate change☆

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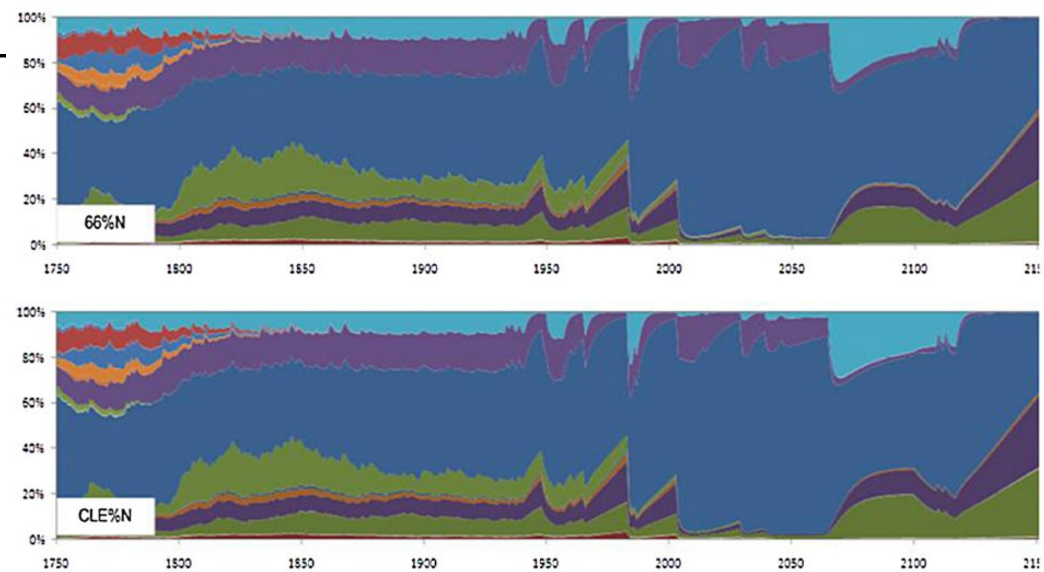

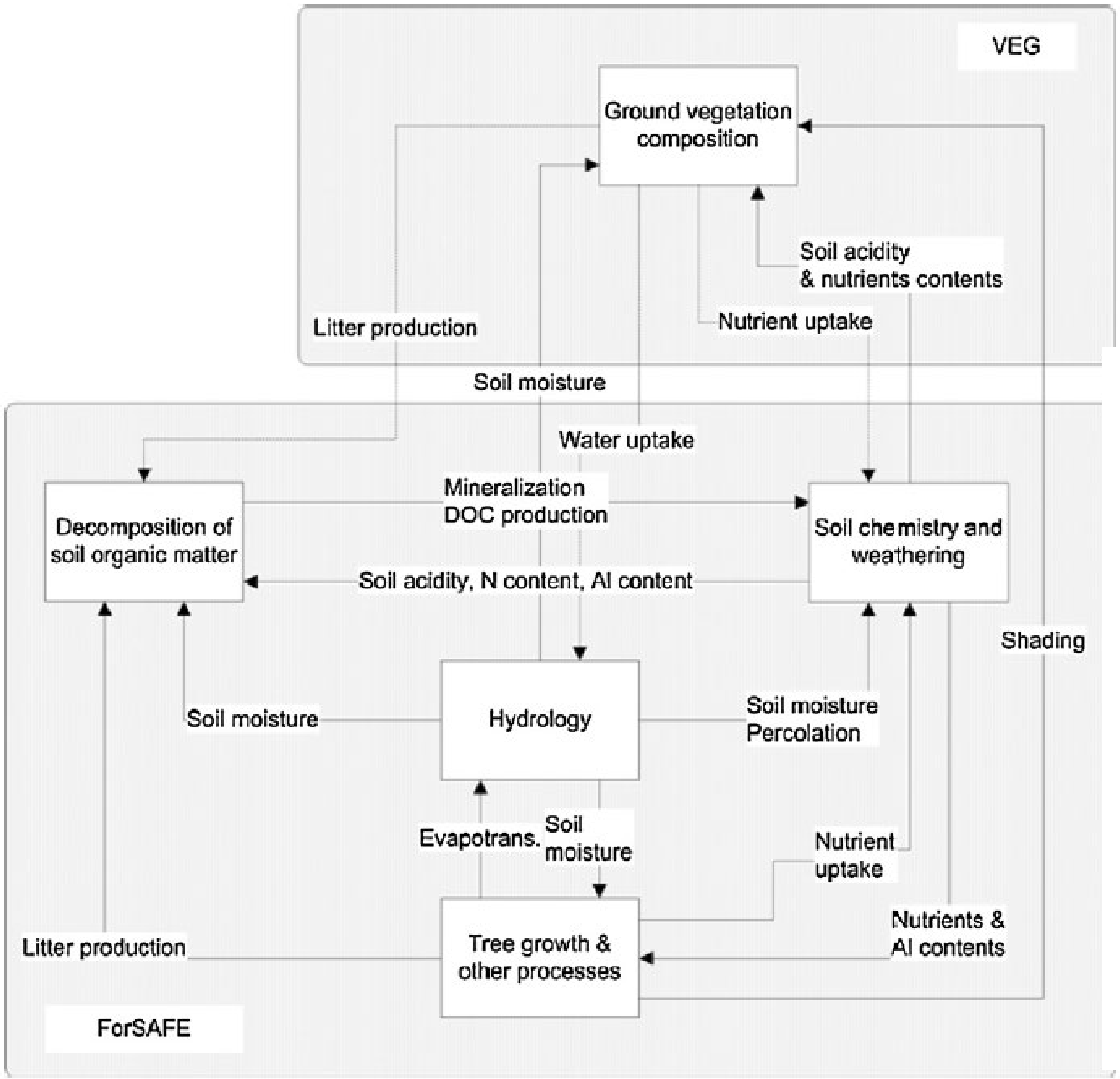

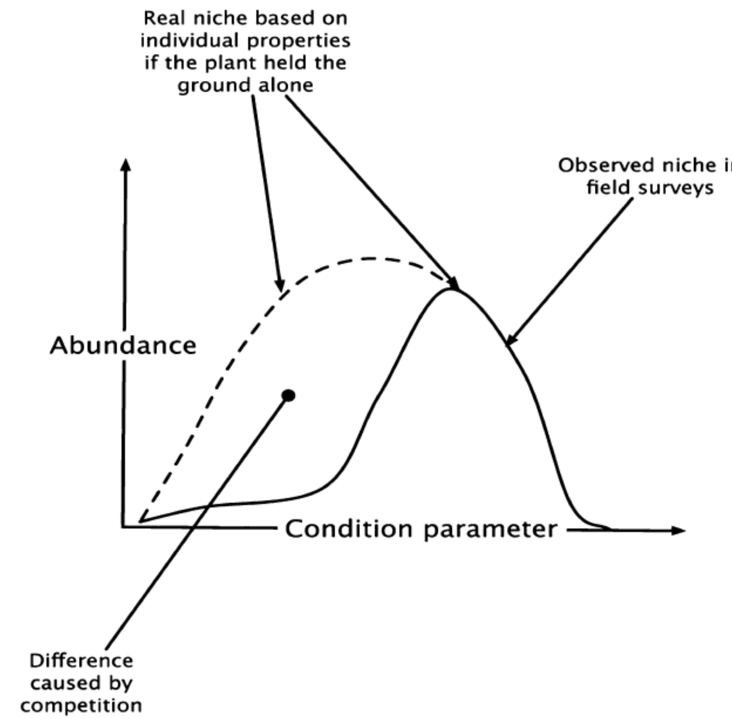

Fig. 3. ForSAFE-VEG is composed of different internal modules, which together simulate a closed forest ecosystem.

Conclusions and recommendations

- Both Nitrogen and climate change are and will remain to be major pressures for biodiversity in existing, restored and new nature
- It will vary geographical and for different nature types which is most important and how best to mitigate effects at different scales
- Models exist, both empirical, mechanistic and different combinations with different advantages and disadvantages, but need further development and more targeted data collections.
- Some of these models can also handle nutrient and carbon balances.
- Often models are not equally good in handling carbon and nutrients, and projects and research groups have focused on different isues. More cooperation is needed.
- A main focus point for the future should be further development of biodiversity indicators for local scale and to be used on European or Northamerican scale.
- If distribution areas for nature types shift following climate change, this should be reflected in the way air pollution effects are assessed for scenarios reaching into the future.