Netherlands

National Focal Centre

Arjen van Hinsberg
PBL Netherlands Environmental Assessment Agency
PO Box 303
NL-3720 AH Bilthoven
tel: +31 30 2743062
arjen.vanhinsberg@pbl.nl

Collaborating Institutions

Gert Jan Reinds, Janet Mol
Alterra, Wageningen UR
PO Box 47
NL-6700 AA Wageningen
tel: +31 317 486508
gertjan.reinds@wur.nl
janet.mol@wur.nl

Introduction

In the CCE Call for Data of 2012-14 on 'no net loss of biodiversity' countries were asked to compile output variables of soil-vegetation models for every relevant EUNIS class (level 3). This output should enable CCE to calculate (country-specific) biodiversity indicators for (scenario) assessment of changes in biodiversity on a regional scale. This report describes which methods were used to deliver information on Dutch ecosystems.

Model selection

In the Netherlands there is a long history of using dynamic soil-vegetation models in making environmental assessments (Kros et al. 1998). The backbone of this modelling has long been the SMART2-MOVE model. The SMART2 model has been used to simulate the response of abiotic soil conditions due to different deposition scenarios, while MOVE was used to assess how the changes in the soils influenced plant species occurrences. These models have also been used to derive critical loads for Dutch vegetation types (Van Dobben et al. 2006) and nature targets types (Van Hinsberg and Kros 2001). In response to the Call for Data we have now used the PROPS model instead of MOVE, and VSD+ (Bonten et al. 2009) instead of SMART2. PROPS could be described as a new version of MOVE. PROPS is a plant response model based on regression of simultaneous measurements of abiotic soil conditions (e.g. pH, soil nitrogen concentrations) and plant species occurrences, whereas MOVE is based on regression of plant occurrences against (Ellenberg) indicators for abiotic conditions. By using

PROPS, it is no longer needed to translate Ellenberg indicator values into abiotic soil conditions, thus reducing the model's uncertainty. SMART2 and VSD+ are also very similar models. The main difference between VSD+ and SMART2 is the organic matter module. In SMART2, there is an 'inert' organic pool in the mineral layer and a decomposable organic pool in the litter layer. In contrast, VSD+ distinguishes four organic matter pools, allowing more differentiation in parameterization of C:N-ratios and decomposition rates. The use of VSD+ and PROPS for Dutch ecosystems has been described in the 2011 CCE Status Report.

Selection of modelled EUNIS classes

Realization of the targets of the European Birds and Habitat Directives is the major priority of Dutch nature policies. The directives aim to protect biodiversity in Europe. They require that Member States take measures to restore the natural habitats and species of community importance. Species and habitat should get a 'favourable conservation status'. Under the directives the Natura 2000 network of protected natural areas is established. The Natura 2000 network aims to assure the long-term survival of Europe's most valuable and threatened species and habitats. Nitrogen (N) deposition is one of the important threats for the protected habitats and species (Wamelink et al. 2013). From the 251 European habitat types 51 occur in the Netherlands. 45 of the Dutch habitat types are sensitive to N deposition and have critical load below 34 kg N/ha/yr (Dobben et al. 2014). The sensitive habitat types occur in a wide range of different EUNIS classes. In order to create a representative dataset for the CCE, we focused on the most occurring sensitive habitat types in the Dutch Natura 2000 sites. In addition, we looked at all major terrestrial EUNIS classes (i.e. bogs, dunes, forests, grasslands and heathland).

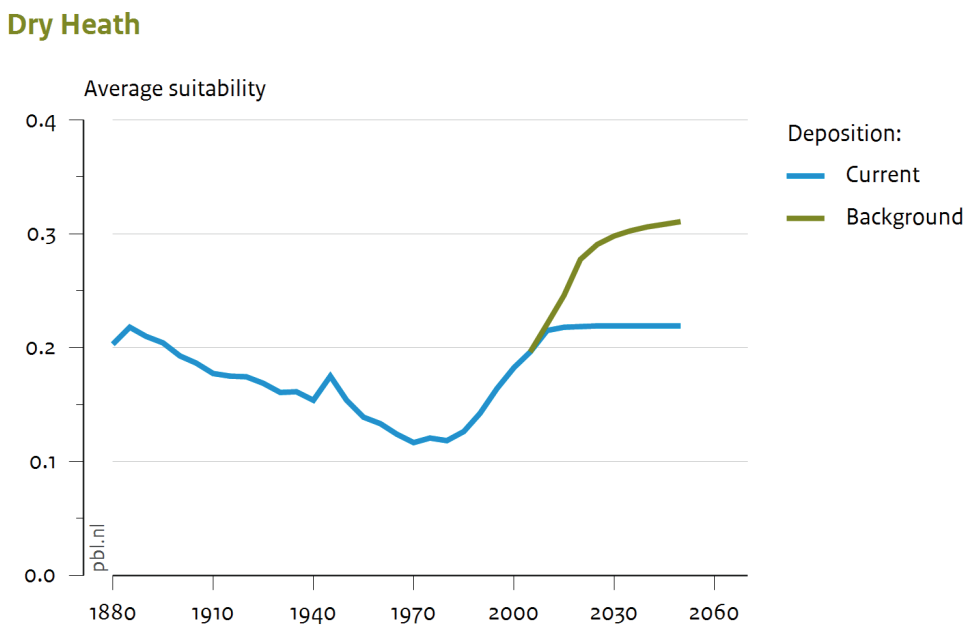
Biodiversity indicator

The Habitats Directive aims to achieve 'favourable conservation status' of habitats and species of community interest. During the implementation of the Habitat Directive in the Netherlands the Ministry of Economic Affairs has characterized the habitats in terms of typical species, plant associations and abiotic conditions (www.synbiosys.alterra.nl/natura2000). The list of typical species is used for monitoring and quantifying the habitat quality. The list contains species from a wide range of genera (e.g. birds, mammals, higher plants, butterflies). Species are often characteristic for a particular habitat type and often more or less restricted to a habitat type. These species are often the target species of the Dutch nature policy, which were selected because they were rare, had negative trends or were protected by national or international policies (Bal et al. 2001). Protection of these species largely depends on the protection of the habitat types. Most of the typical species are also Red List species. In addition, indicator species are added which indicate a good abiotic or biotic condition. For vegetation modelling this list of typical species has limited value because the rare species are often difficult to model. The relatively low number of mentioned plant species also limits the possibility to calculate robust biodiversity indicators. However, the link with the Dutch vegetation system offers another source of plant species which can be used to describe habitat quality. Each habitat type is characterized in terms of plant associations which should be present when conditions are favourable. The complete species compositions of plant associations are in turn described in the Dutch vegetation database (Hennekens and Schaminee 2001) and Synbiosys (www.synbiosys.alterra.nl). Based on this information we compiled a list of plant species for each of the selected habitat types. From this list we removed the invasive or undesired species, i.e. the species that are more abundant in less-developed forms of the given plant associations. PROPS was used to calculate the suitability for occurrence of the selected species at a particular site where the habitat type occurs. This suitability was calculated relative to the maximum suitability which occurs at optimal abiotic conditions. The average suitability over all species per habitat type was used as the indicator for 'good habitat quality' (see also Van Hinsberg et al. 2012).

Model runs

To deliver the desired output, VSD+ was parameterized for each of the selected habitat types using habitat specific soil and vegetation conditions (see also Van Hinsberg et al. 2011, 2012). The model was run for a grid in which the current critical load exceedance was equal to the average exceedance over all grids in which the habitat type was present. VSD+ was run for three different deposition scenarios; a scenario with current deposition level, a scenario with deposition according the Gothenburg protocol and a scenario in which background

Figure NL.1 Average suitability for occurrences of dry heath species at different deposition scenarios.



Source: Alterra, PBL 2014

deposition levels were reached. Figure NL.1 shows an example of the model output for a dry heath site. The figure shows that the average suitability of the modelled plant species decreases from 1880 until the 1980s. During this period sulphur and N deposition increased at the site (data not shown). During the second period (from the 1980s till present) the average suitability increases, as deposition levels go down. In the background scenario the suitability increases even further. The individual plant species show often a similar response (data not shown). Surprisingly, the suitability in the background scenario exceeded the suitability calculated at low deposition levels around 1880.

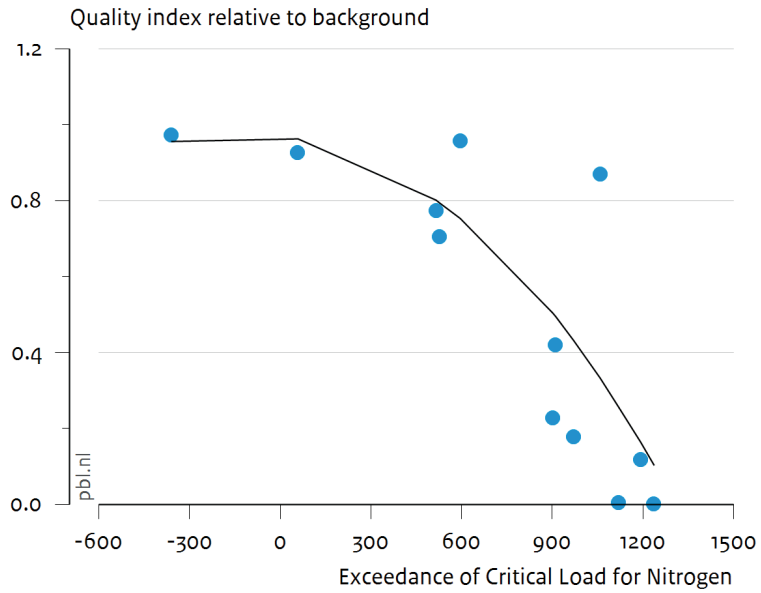
Figure NL.2 shows how the habitat quality index of the different habitat types, relative to the quality index at background deposition levels in 2050, relates to the exceedances of critical loads for nitrogen in 2050. It suggests that the quality of the habitats sharply decreases with increasing deposition.

Discussion and conclusions

- Based on descriptions of protected habitat types and available soil-vegetation models it was possible to deliver the desired information for different relevant EUNIS classes in the Netherlands to the CCE. With PROPS it was possible to calculate information on most (80%) of the selected species and VSD+ could be run for different habitat types. Delivering information on both diversity between and within habitat types is very relevant for biodiversity policy.
- The average suitability of selected species seems a useful policy relevant indicator. Results show that this indicator in also (very) sensitive to deposition changes.
- In order to deliver a dataset for all habitat types occurring in The Netherlands more work is needed. More habitat types need to be included and models should be improved. Parameterization and testing of model runs for habitats from wet, calcareous or salt conditions needs special attention.
- The current vegetation model delivers information on suitability for occurrences. Biological recovery itself is not modelled, since information on aspects such as dispersal is missing.

Figure NL.2 Habitat quality index (average suitability of a particular habitat type in 2050 divided by the average suitability of that habitat type in 2050 at background deposition) plotted against the exceedance of the N critical load in 2050. Critical loads of habitat types are based on Van Dobben et al. (2014).

Relationship biodiversity and critical load exceedance



Source: Alterra, PBL 2014

References

Bonten L, Mol J, Reinds GJ, 2009. Dynamic modelling of effects of deposition on carbon sequestration and nitrogen availability: VSD plus C and N dynamics (VSD+). In: Hettelingh J-P et al. (eds): CCE Status Report 2009, Bilthoven, Netherlands; www.wge-cce.org

Hennekens SM, Schaminée JHJ, 2001.TURBOVEG, a comprehensive data base management system for vegetation data. *Journal of Vegetation Science* 12: 589-591

Kros J, Reinds GJ, De Vries W, Latour JB, Bollen MJS, 1995. Modelling the response of terrestrial ecosystems to acidification and desiccation scenarios. *Water, Air and Soil Pollution* 85(3): 1101–1106

Van Dobben HF, Van Hinsberg A, Schouwenberg EPAG, Jansen M, Mol-Dijkstra JP, Wiegers HJJ, Kros J, De Vries W, 2006. Simulation of critical loads for nitrogen for terrestrial plant communities in the Netherlands. *Ecosystems* 9: 32–45

Van Dobben H, Bobbink R, Bal D, Van Hinsberg A, 2014. Overview of critical loads for nitrogen deposition of Natura 2000 habitat types occurring in The Netherlands. Report, Alterra, Wageningen University, Wageningen

Van Hinsberg A, Kros H, 2001. Dynamic modelling and the calculation of critical loads for biodiversity. In: Posch M et al. (eds), CCE Status Report 2001, Bilthoven, Netherlands; www.wge-cce.org

Van Hinsberg A, Reinds GJ, Mol JP, 2012. The Netherlands. In: Posch M et al. (eds), CCE Status Report 2012, Bilthoven, Netherlands; www.wge-cce.org

Van Hinsberg A, Reinds GJ, Mol JP, 2011. The Netherlands. In: Posch M et al. (eds), CCE Status Report 2011, Bilthoven, Netherlands; www.wge-cce.org

Wamelink GWW, De Knegt B, Pouwels R, Schuiling C, Wegman RMA, Schmidt AM, Van Dobben AF, Sanders ME, 2013. Considerable environmental bottlenecks for species listed in the Habitats and Birds Directives in the Netherlands. *Biological Conservation* 165: 43–53