Sensitivity to climate change of plant species characterising Danish habitat types included in the Habitats Directive

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Introduction

During the last decade European nature conservation have focused on the development of a coherent ecological network (Natura 2000) of sites, i.e. with the goal of maintaining a favourable conservation status of habitat types included in the Habitats Directive (HD)[1]. However, this goal may be difficult to achieve given the observed[2] and predicted[3,4] impact of climatic change on species distributions.

Here, we evaluate the sensitivity to climate change of plant species characterising Danish habitat types included in the HD[1], at both Danish and European scales. In addition, we address if some habitat types are more sensitive to climate change than others.

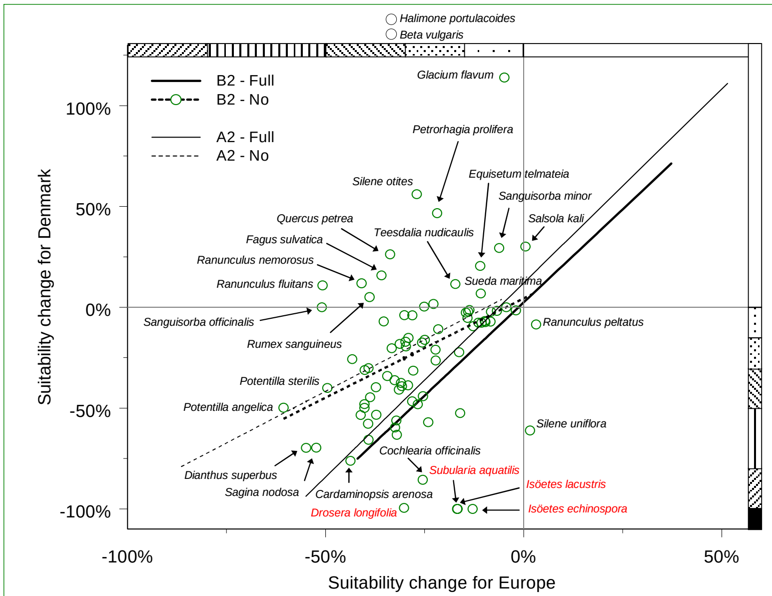

Figure 3. The relationship between species suitability change in Denmark and Europe under the B2 and A2 scenario and the assumption of full and no dispersal, respectively. Regression lines fitted. IUCN categories indicated at top and right margin.

Methods

A fuzzy bioclimatic envelope model[4] was used to predict climatically suitable areas for 84 plant species characterising Danish habitat types included in the HD[1] at present and in 2100 (B2 and A2 scenario[5]), by linking Atlas Florae Europaeae data[6] and climate (growing degree days, absolute minimum temperature and water balance).

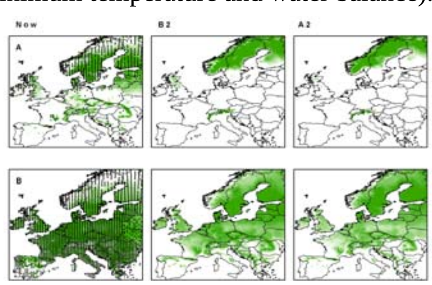

Figure 1. Observed (dots) and modeled distribution of Isöetes lacustris (A) & Urtica dioica (B)

Bioclimatic suitability was calculated both within the species' present distribution and across all cells, assuming no and full dispersal, respectively.

References & Notes

(1) Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
(2) Walter *et al.* (2002) Nature 416: 389-395.
(3) Thuiller *et al.* (2005) PNAS 102: 8245-8250.
(4) Skov & Svenning (2004) Ecography 27: 366-380.
(5) IPCC (2001) Climate change 2001: Synthesis report - Summary for policymakers. Cambridge University Press, Cambridge.
(6) Jalas & Suominen (1972-1994) Atlas Florae Europaeae, vol. 1-13.
(7) IUCN (2001) IUCN red list categories & criteria. Version 3.1.
(8) The IUCN (2001) does not separate the "Least Concern" and "Near Threatened" according to range loss. We chose to separate at -15%.

Results & Discussion

Bioclimatic suitability was predicted to decrease for 80–88% and 96–100% of the species characterising the Danish habitat types in Denmark and Europe, respectively. In Europe the decrease was strongest under the assumption of no dispersal, emphasising the importance of migration for species ability to cope with climate change.

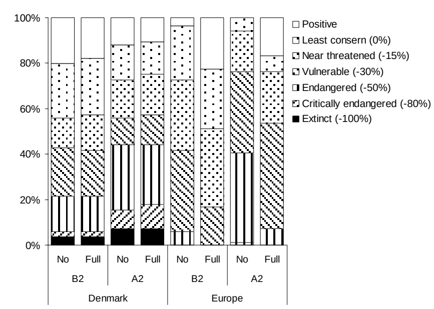

Figure 2. Proportion of species assigned to different IUCN threat categories[7,8] on the basis of their predicted change in bioclimatic suitable areas. Limits between categories in legend.

No species were predicted to go extinct in Europe, while four (Fig. 3; Red) and six species could be lost from Denmark under the B2 and A2 scenario, respectively (Fig. 2, 3). According to the mild B2-scenario and the assumption of no dispersal, 29% of the species would be at least vulnerable in both Denmark and Europe, while 19% would be positively affected in Denmark, but negatively affected in Europe (Fig. 2, 3).

Focusing on the latter group of species in a Danish conservation strategy would be important for their overall conservation in Europe.

In Denmark geographical variation in the effect of climate change was observed, with the eastern part predicted to be more negatively affected than the western. This suggest a need for geographic differentiation in the Danish conservation strategy.

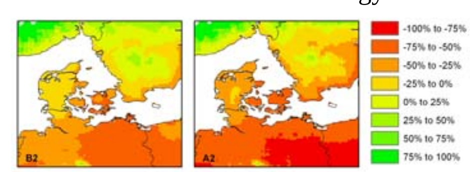

Figure 4. Change in bioclimatic suitability from present to year 2100 assuming no dispersal.

We found no difference in the sensitivity of the Danish habitat types included in the Habitats Directive, reflecting that species react individualistic to climate change. Our findings underline that it often will be unrealistic to try to preserve the current status of specific habitat types in place. A better conservation strategy might be focusing (1) on the individual species and (2) more broadly circumscribed vegetation type categories. However, the Natura 2000 network will probably become important for the species' possibility to migrate in response to climate change.