Introduction to the symposium theme: Climate change in fragmented landscapes; can we develop spatial adaptation strategies?

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Introduction

The Intergovernmental Panel for Climate Change (IPCC) concluded that by increasing the concentration of greenhouse gasses, man has a discernible influence on climate, and this is expected to be a long-term phenomenon affecting the environment in the forthcoming decades or even centuries. Since climate is a key driving force for ecological processes, climate change is likely to exert considerable impact on ecosystems. Since nature policy worldwide is often based upon policy plans which do not take climate change into account, it is questionable whether current biodiversity conservation goals can be achieved with the current efforts. There is therefore a need for a new, climate-proof, nature policy.

Climate change already has a large impact on ecosystems and these effects will be amplified in the coming century. Temperature rise already has effects on the distribution of species. Some species are expanding their range polewards and to higher elevations, while species adapted to cooler conditions are declining. The occurrence of weather extremes will enlarge population fluctuations, which may lead to extinctions. Ecosystems will be subject to increased disturbances, caused by direct climatic impacts (e.g. flooding) and by shifting species composition and changed species interactions (e.g. phenological mismatches).

Landscape ecology can contribute to the knowledge of these dynamics in space and time, and spatial planning of nature conservation areas can lead to effective adaptation strategies. We cannot stop climate change, but we may be able to enhance the ability of landscapes to cope with it. Central focus of the symposium is: How can landscapes best be adapted to improve resilience of ecosystems to the effects of climate change? What might be effective adaptation strategies to cope with partly unknown risks? How can the landscape, land use and spatial configuration of ecosystems (ecological networks, robust corridors, multifunctional landscape buffers, protection of strategic ecosystem refugia, etc.) contribute to the resilience to climate change? The different contributions focus on different aspects.

Climate change in fragmented landscapes: metapopulations in a changing world

Climate change will lead – and is leading already - to range shifts. But what happens if the habitat of species and ecosystems occurs in small, isolated patches? Will the species be able to track the changing conditions? Will they adapt? Or will they become trapped on their islands that are no longer suitable, and perish? Dispersal limitation will most probably lead to unoccupied suitable habitat at the frontier of the shifting range, especially in species with limited dispersal abilities and fragmented habitat. On the other hand, time lags (‘extinction debt’, Tilman *et al.*, 1994) will lead to the opposite: occupied habitat that is no longer suitable for long term survival. Even in the centre of their distribution range populations are not safe; Increased environmental variation will increase population fluctuations. More environmental stochasticity means higher extinction rates (see Fig. 1) leading to shifts in the colonization/extinction ballance.

Towards new assessment tools

In the Netherlands, spatial planning for biodiversity is based upon the methodology described by Vos *et al.* (2001) and Verboom *et al.* (2001) combining ecologically scaled landscape indices and key patch standards. But this methodology does not take into account climate change and has to be adapted to new insights. At least three steps have to be taken: (1) a new system of eco-environmental profiles has to be developed; (2) standards for minimum viable populations must be corrected for increased environmental variation (see Fig. 1); (3) a dynamic view of the landscape must be adopted instead of a static approach.

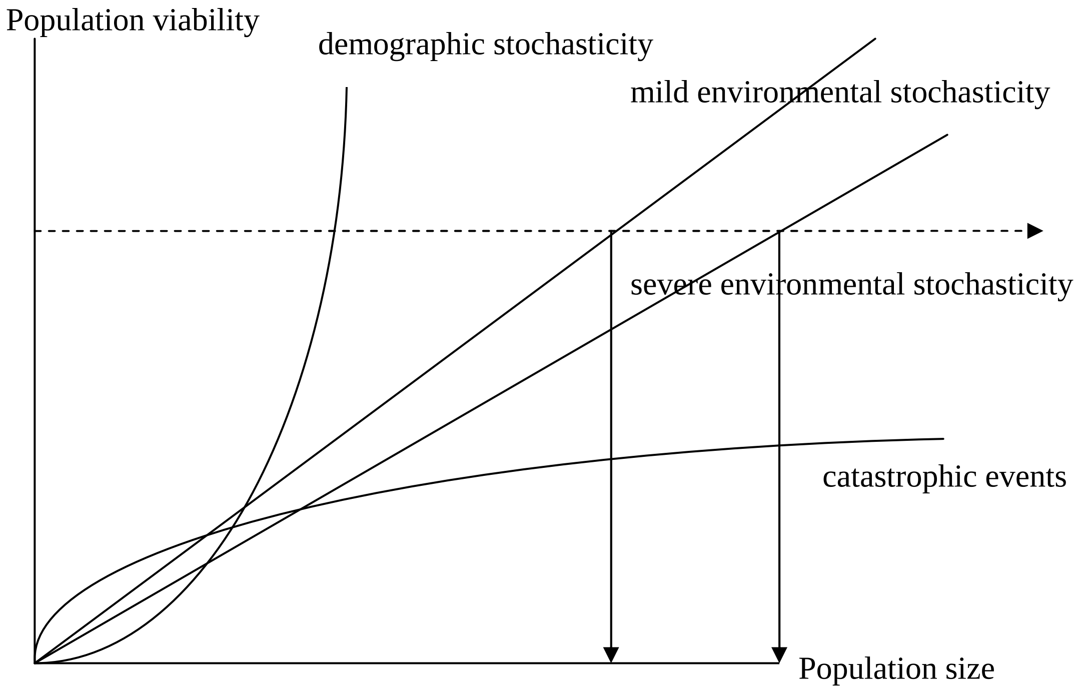

Figure 1. Population viability is known to increase with population size; the form of the relationship depends upon the importance of demographic stochasticity, environmental stochasticity, and catastrophes. If due to climate change the level of environmental stochasticity rises, as is predicted, population viabilities will drop and larger populations will be needed to achieve the same viability. Therefore, standards for minimum area requirements will have to be changed.

References

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