

Adapt, move or perish

Genetic processes in fragmented populations under climate change



Marleen Cobben, Plant Research International, WUR
October 2006-October 2010

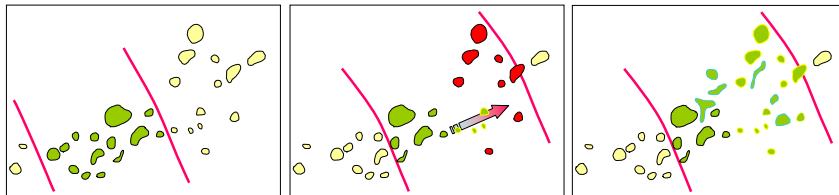
Supervisors and promotors:

Jana Verboom, Alterra
René Smulders, PRI

Paul Opdam, Socio-Spatial Analysis Group, WU
Rolf Hoekstra, Genetics Lab, WU

Context

Metapopulation theory and models have been used to understand population survival in fragmented landscapes and to model optimal designs of habitat configuration. However, population genetics of metapopulations is relatively poorly developed, and the possible effects of climate change on individual fitness and subsequent effects on metapopulation diversity have not been considered.



Research question

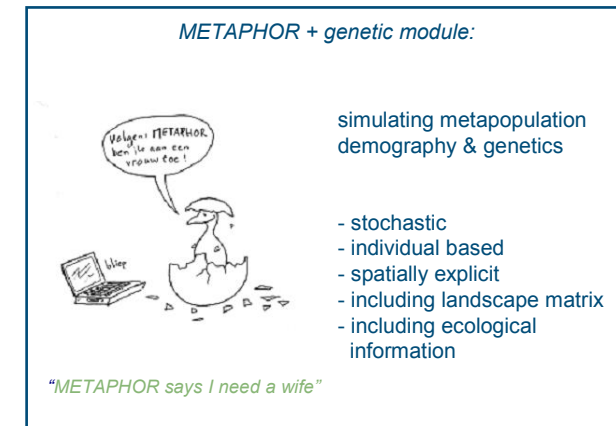
Which factors determine the level and distribution of genetic diversity in fragmented populations, and how are these affected by increased temperature and weather variability?

Subquestions:

- What are the effects of habitat fragmentation and metapopulation dynamics in terms of loss of neutral genetic diversity and what is the time lag in this effect?
- What are the preconditions for range shifts in response to increased temperature and what are the effects of this process in terms of loss of neutral genetic diversity?
- What are the preconditions for selection and adaptation as a response to increase in average temperature and increased weather variability, and what are the effects in terms of loss of selective genetic diversity?
- Where and how should the spatial structure of the Dutch National Ecological Network (EHS) be adjusted to facilitate range shifts and to prevent or decrease the loss of genetic diversity?

Methodology

We will extend METAPHOR, a stochastic, spatially explicit, individual-based simulation model for demography of fragmented populations, with a genetic module to explore our research questions.



Focus and expectations subquestion 1

We will focus on:

- the interplay of metapopulation variables, being population sizes and connectivity;
- metapopulations in non-equilibrium, i.e. not in migration-drift balance.

We hope to:

- find stable interplay outcome under specific conditions;
- show a useful relationship between metapopulation equilibrium state and the decay of nonrandom gene associations (linkage disequilibrium), to direct and support future empirical research.

Overall research outcome

- directing future empirical studies and help pinpointing their results;
- providing insight in the effects of climatic change on genetic diversity by identifying possible outcome and main drivers;
- indirectly contributing to climate change policy by exploring possibilities and opening the discussion on genetic consequences.