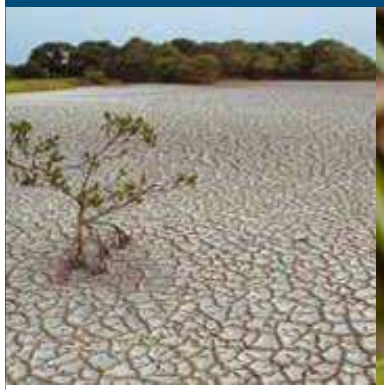
Adapting landscapes to climate change:

identifying priority zones for linking networks

Claire Vos, Hans Baveco, Peter Schippers & Jana Verboom





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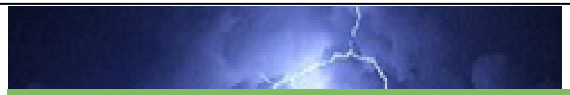
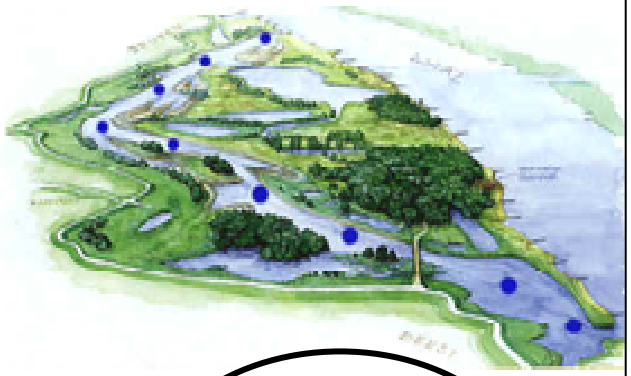
- Climate change and habitat fragmentation a bad combination
- Adaptation strategy
  - Linking Networks: example climate corridor for wetlands

How to adapt to climate change?



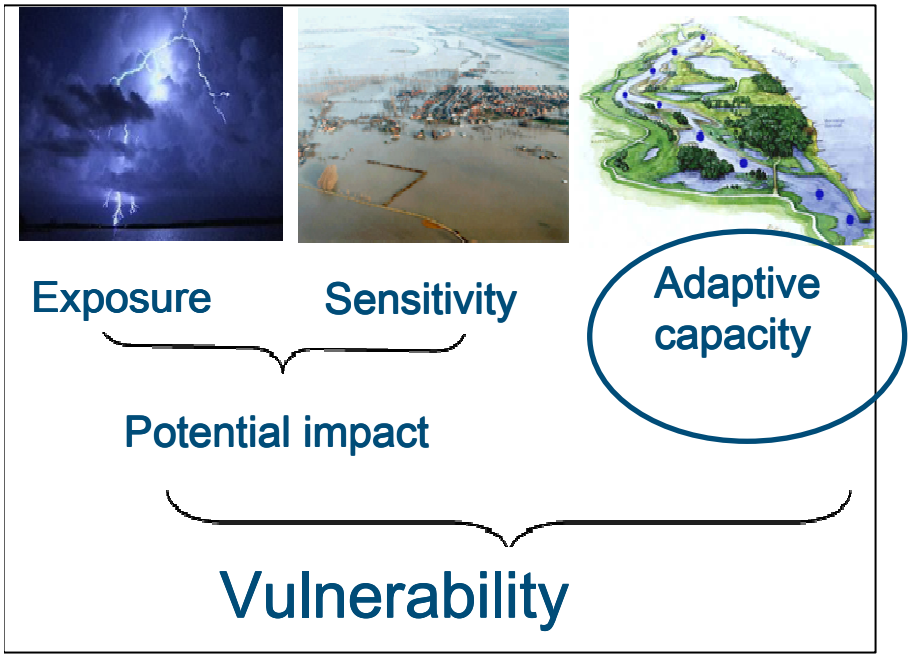
How can we increase the adaptive capacity of ecosystems?



Adaptive capacity

Climate proofing ecosystems

Naar Veraart et al 2006



Socio-economic capacity

Willingness to adapt

Adaptive capacity

Climate proofing ecosystems

Building adaptive capacity

- Society decides
- Nature is only one of the land use functions.
- Building adaptive capacity for ecosystems in multifunctional landscapes
- Ecological networks are well placed to fulfill that role

Why does habitat fragmentation enhance the effects of climate change?

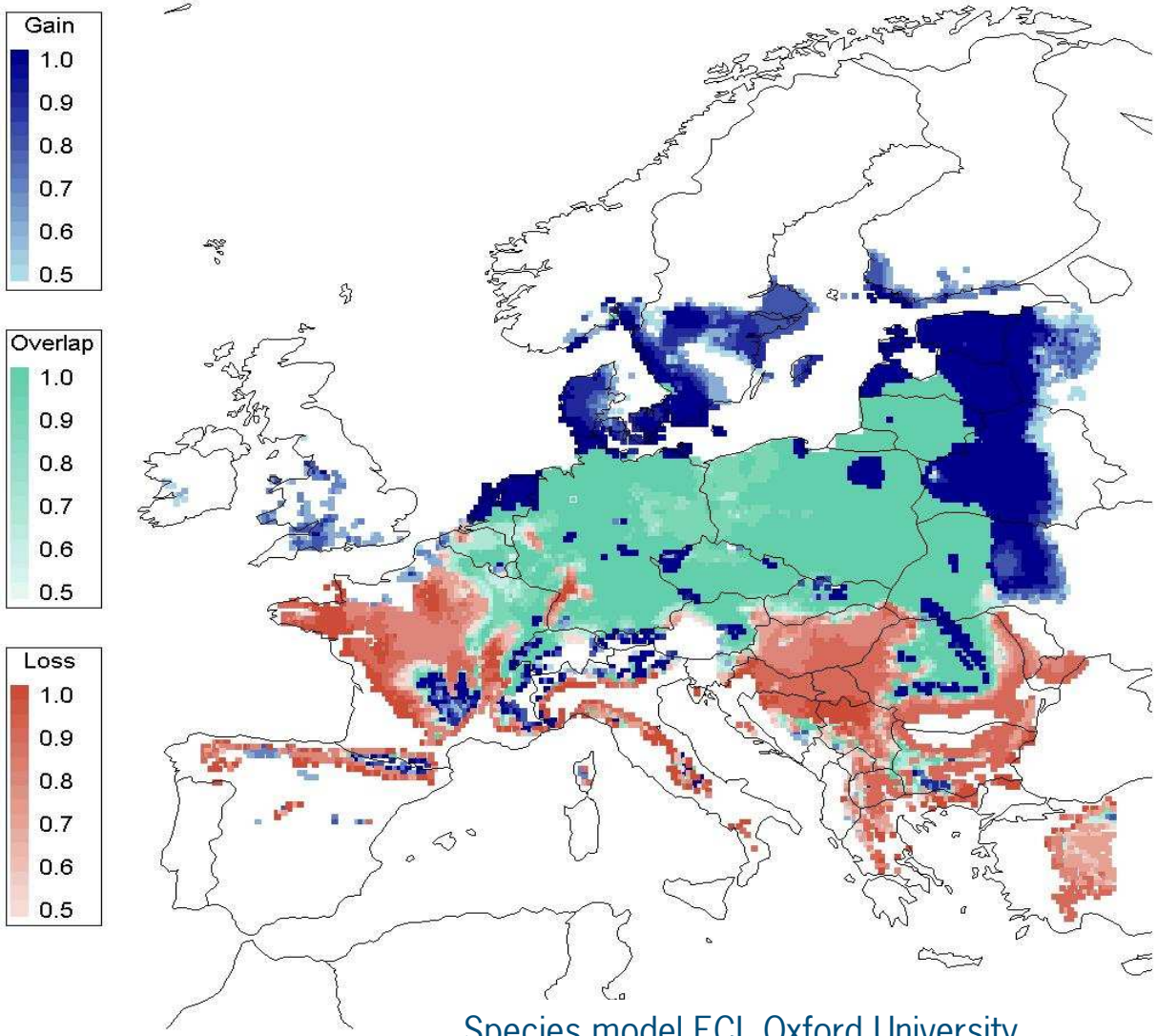
1. Species expansion is hampered by habitat fragmentation
2. Recovery after disturbances is less effective

Climate envelope models predict further shifts of suitable climate envelopes

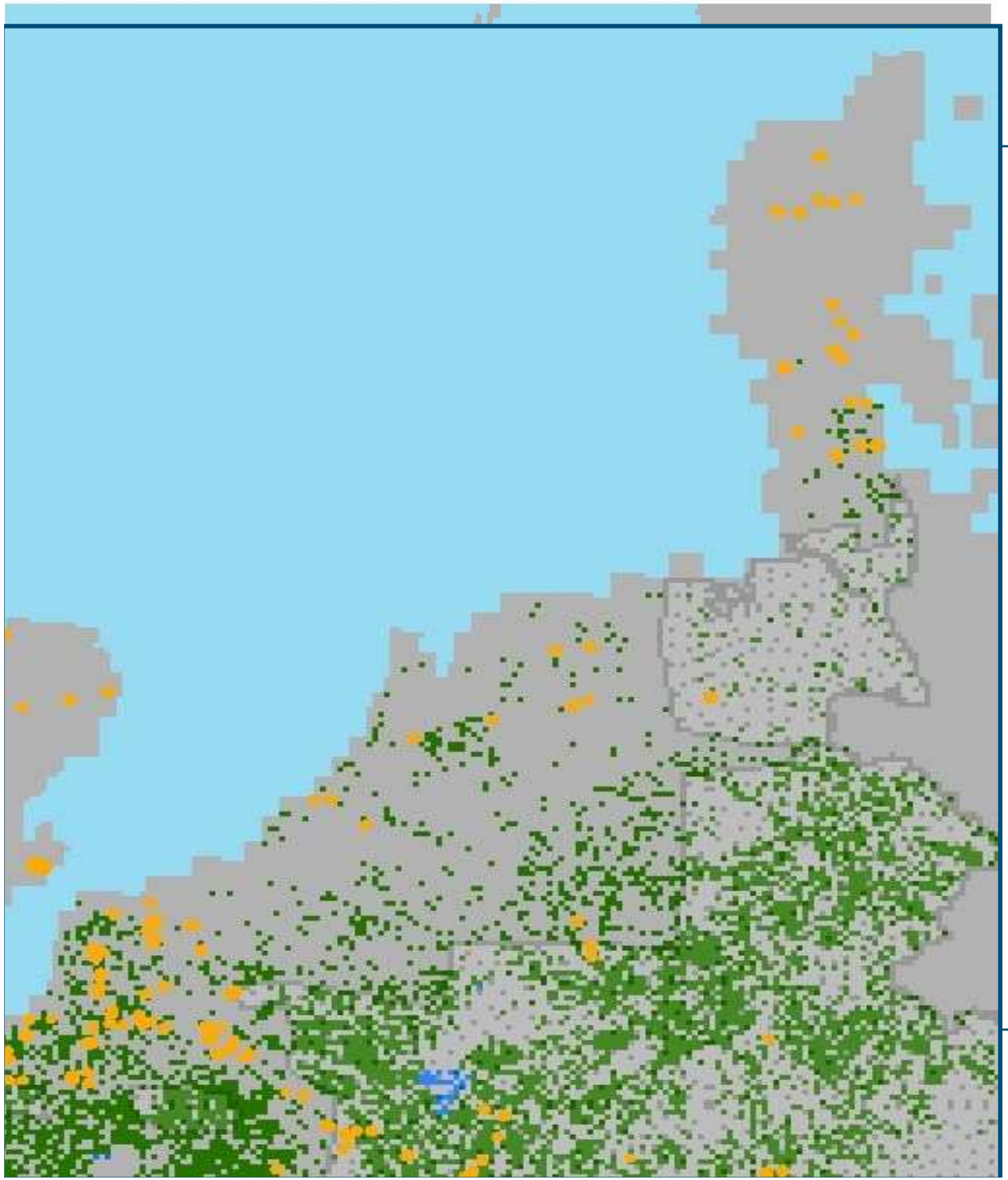
Identify areas where the distances between suitable habitats are too large for colonization

1. Shifting envelopes
2. Configuration of habitat
3. Dispersal model

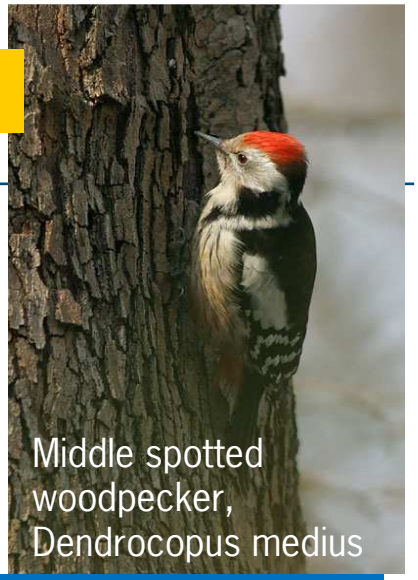
www.branchproject.org



Species model ECI, Oxford University



2020



Middle spotted woodpecker, Dendrocopus medius

Climate no longer suitable

Climate proof – expansion is possible

Not Climate proof: habitat is suitable but too isolated

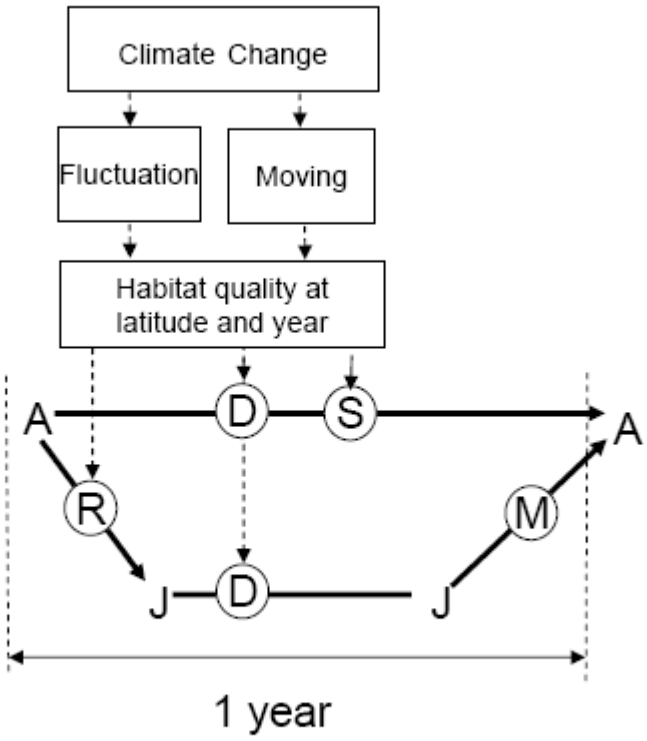
Vos et al. 2008

Species expansion: are species able to keep up with the rate of climate change?

- Expansion slows down or stops where habitat is too fragmented

- We modelled:
  - Speed of shifting climate
  - Speed of species expansion
  - Amount of habitat in the landscape

METAPHOR moving window



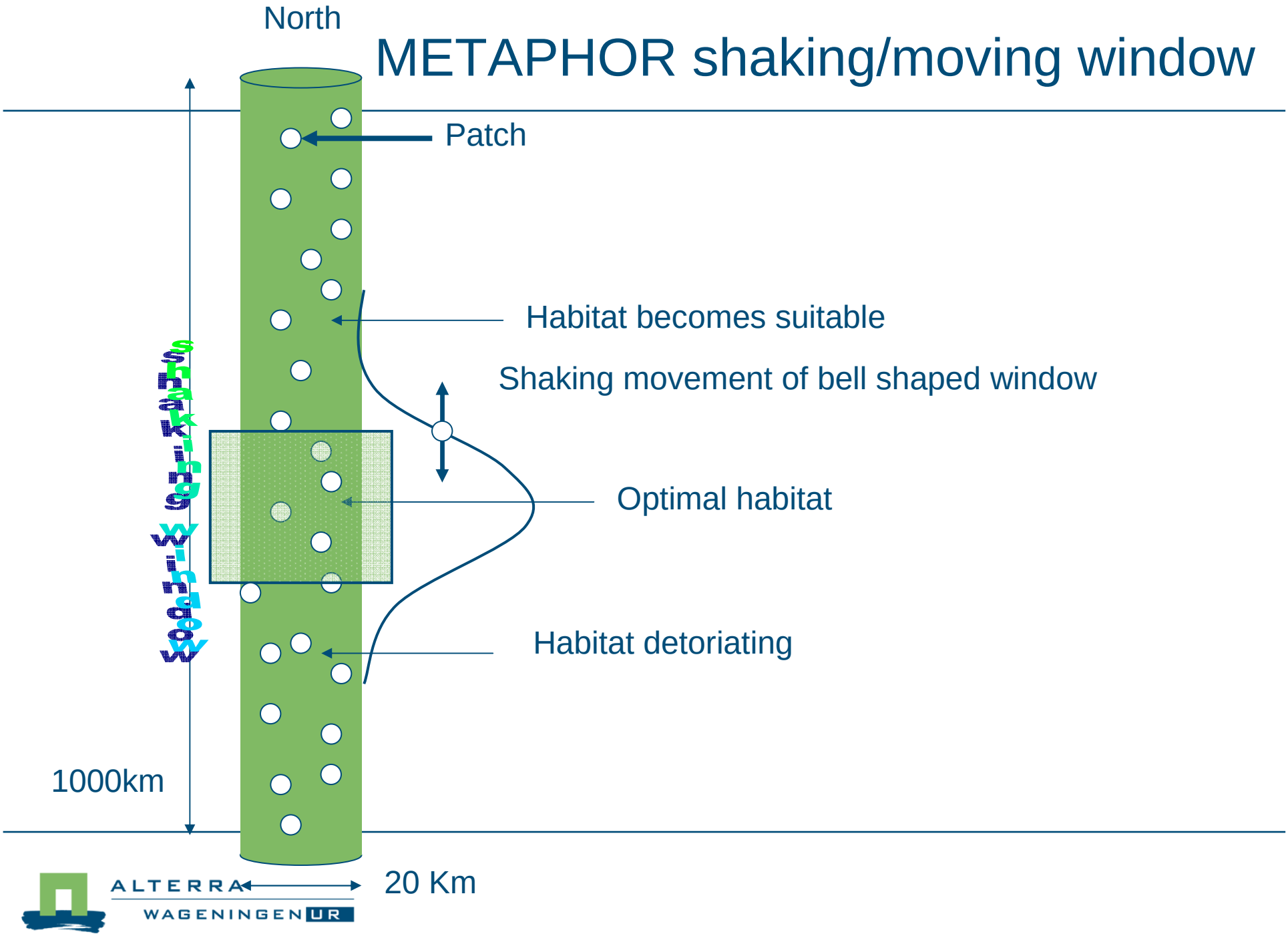
Metapopulation model

Spatially explicit

Individual based

Shifting suitable climate zone

METAPHOR shaking/moving window



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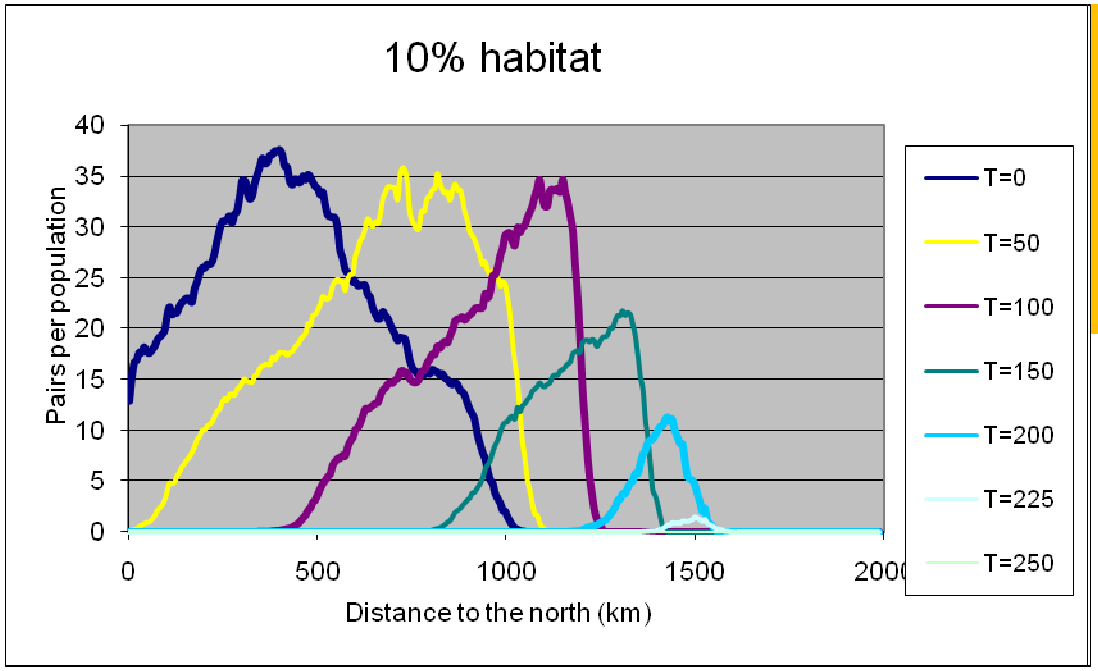
Effect of habitat fragmentation temp 4°C/century

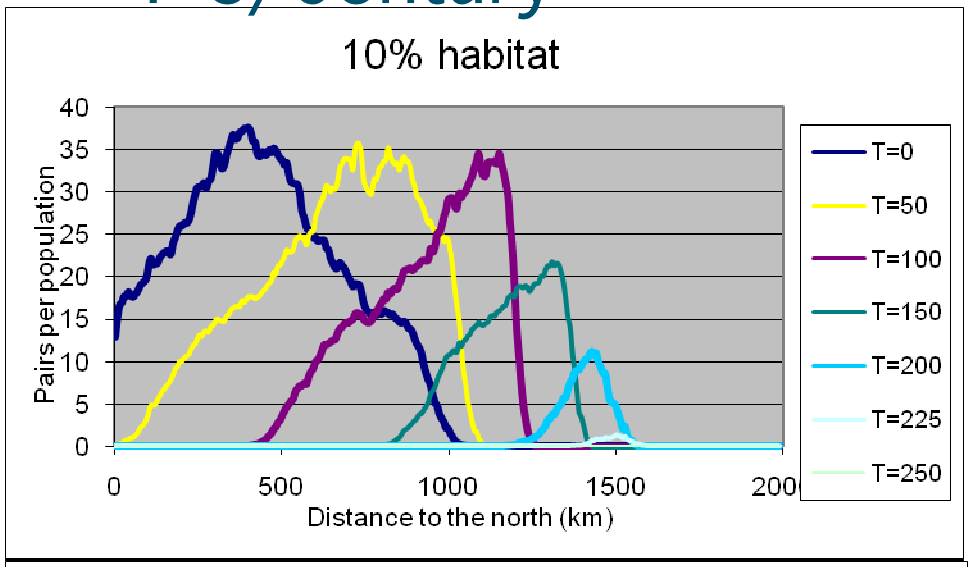


10% habitat

extinction after 225 years

expansion 600 km

Effect of habitat fragmentation temp 4°C/century



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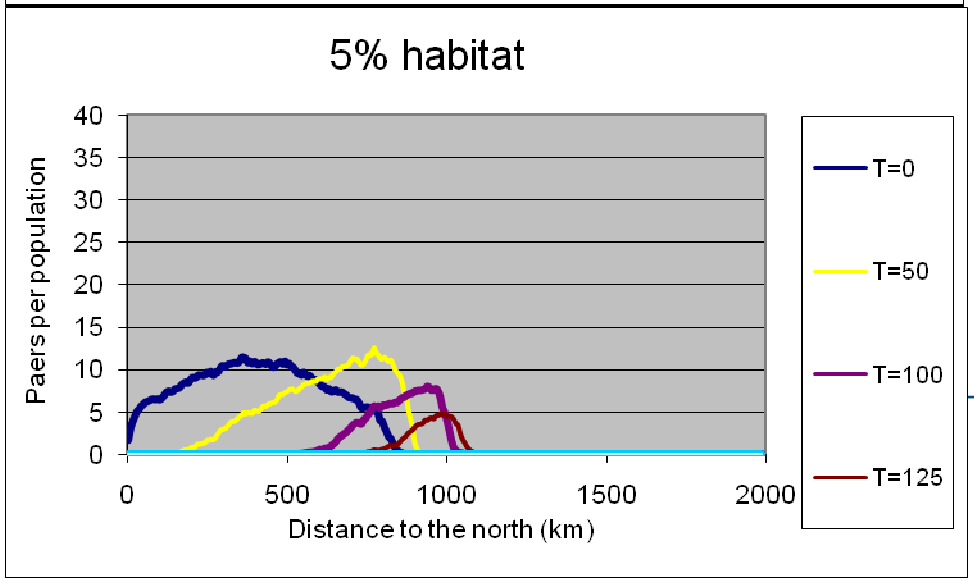


5% habitat

extinction after 155 year

expansion 220 km

Time to extinction depends on:

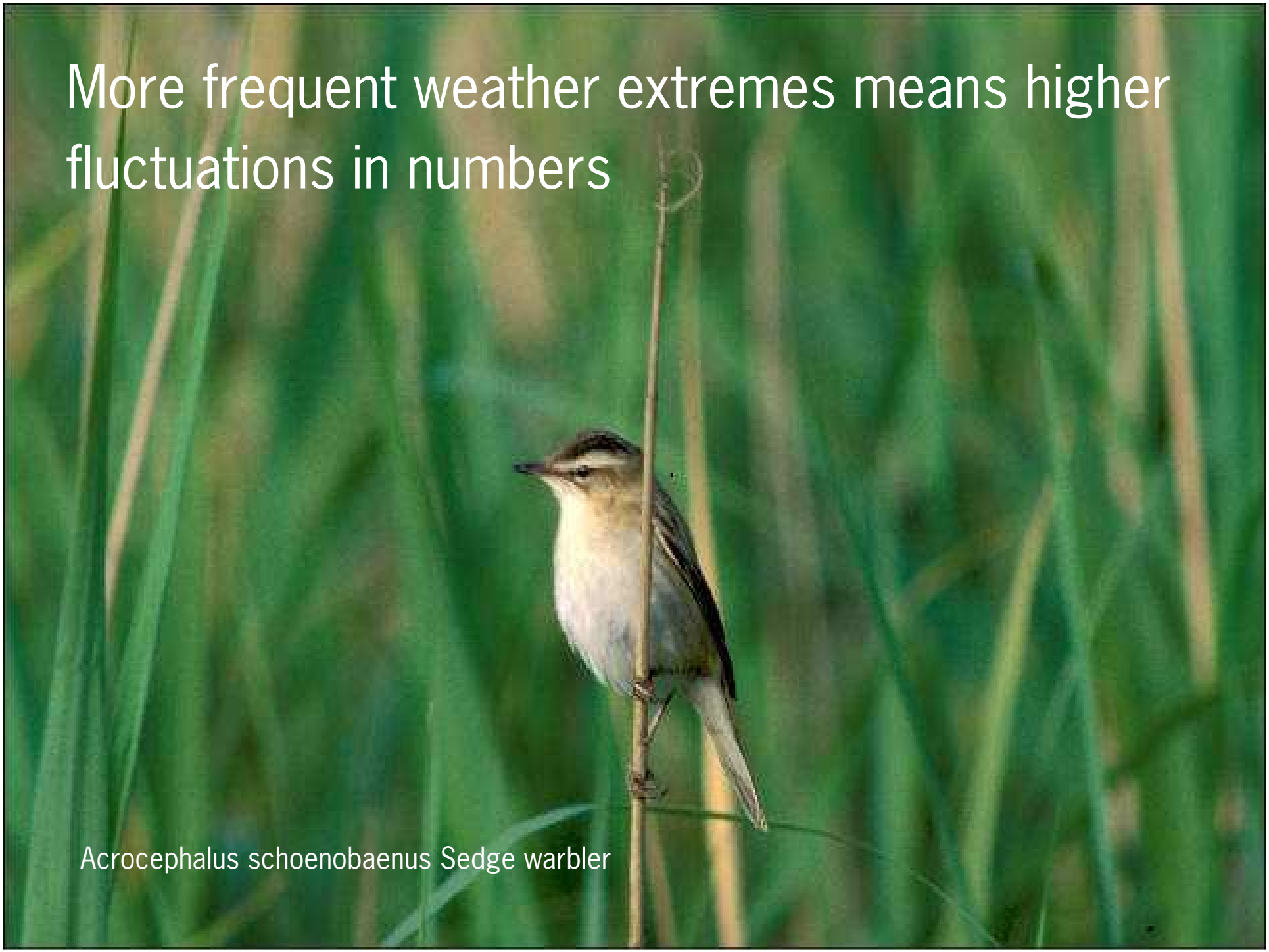
- rate of climate change
  - species cannot keep up
- the size of the species distribution range
  - species with small ranges most sensitive
- the northward expansion rate
  - species traits
    - dispersal capacity
    - population growth rate
  - Habitat fragmentation
    - more habitat helps

2. Weather extremes more frequent and stronger

- More warm and dry periods
- More extreme precipitation
- More storms

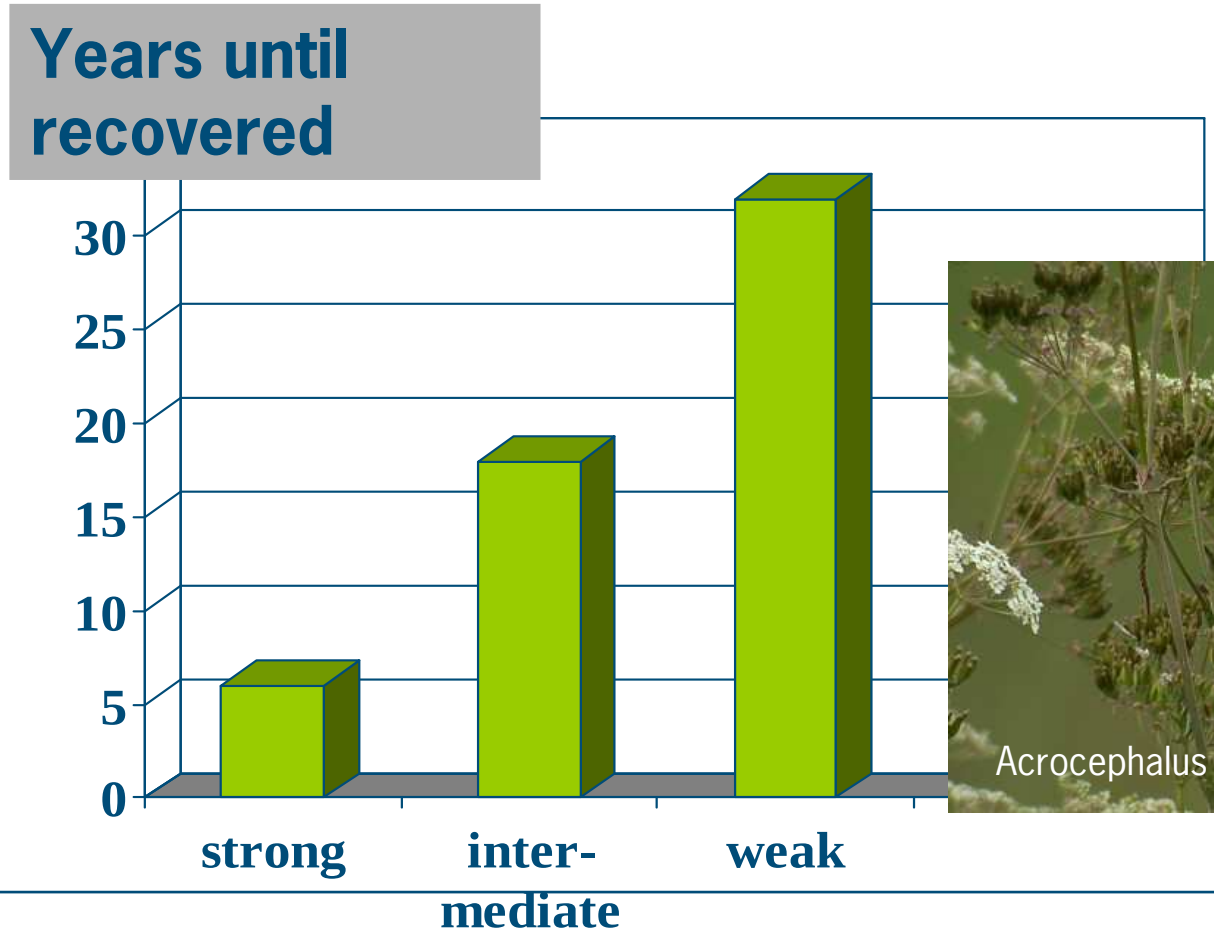
Results in larger fluctuations of populations: increase of extinction risk

More frequent weather extremes means higher fluctuations in numbers



Acrocephalus schoenobaenus Sedge warbler

Predicted sedge warbler recovery: faster in stronger habitat networks



Foppen et al. 1999

Adapting the landscape to climate change defining a strategy

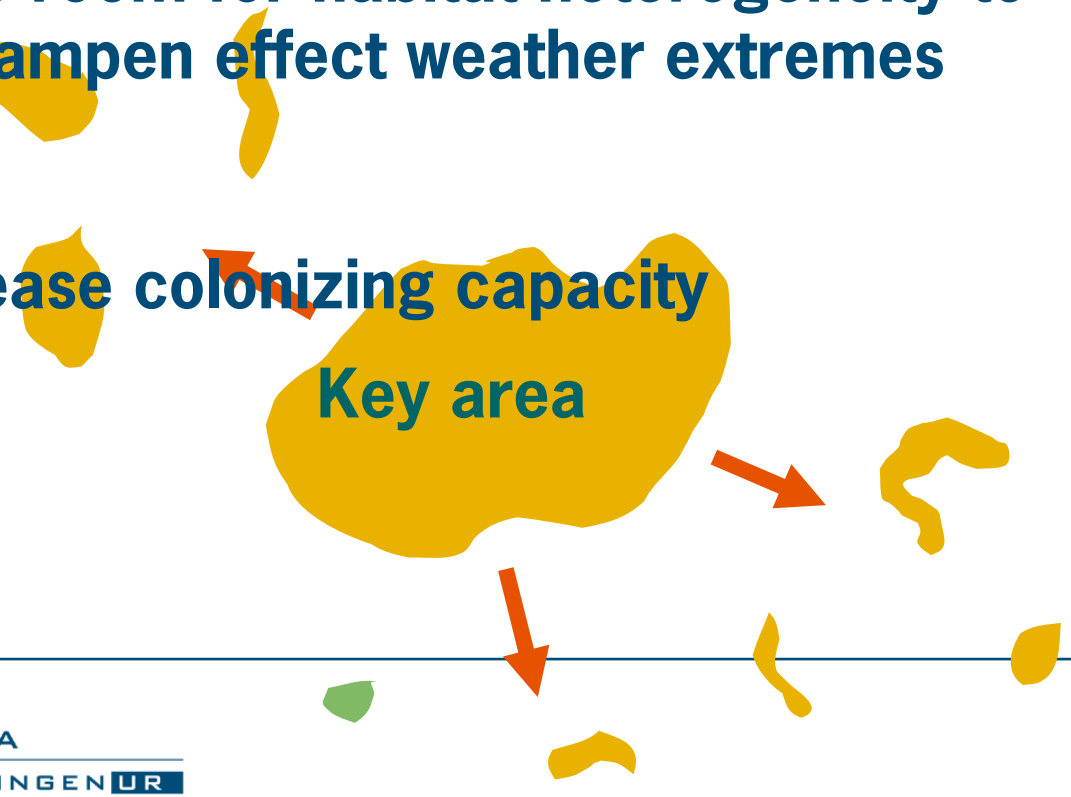
- Adaptation on two levels:
- 1. Improve adaptive capacity of ecosystems on the spot
  - to cope with disturbances
  - to accommodate change (and do not try to control a steady state)
- 2. Improve adaptive capacity of species and habitats
  - Facilitate migration to cope with shift of suitable climate or conditions

Adaptation strategy 1: Enlarge Areas

To compensate for population fluctuations

More room for habitat heterogeneity to dampen effect weather extremes

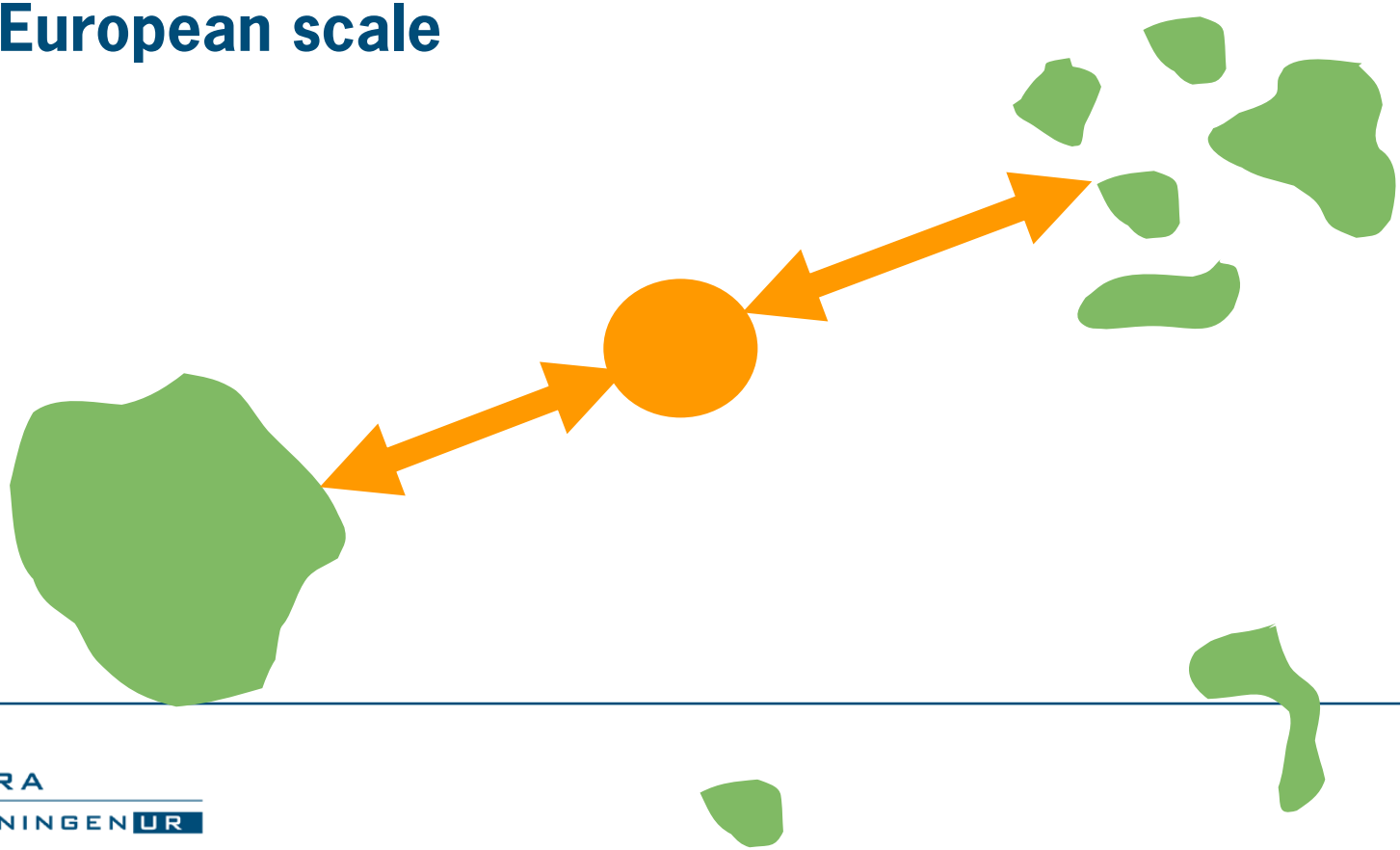
Increase colonizing capacity



Adaptation Strategy 2:
Link habitat networks

To facilitate range shifts of species

On a European scale



Applying the addaptation strategy

Where is adaptation of the National Ecological Network needed?

Example Wetland Ecosystem

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Adaptation strategy: climate corridor for wetlands

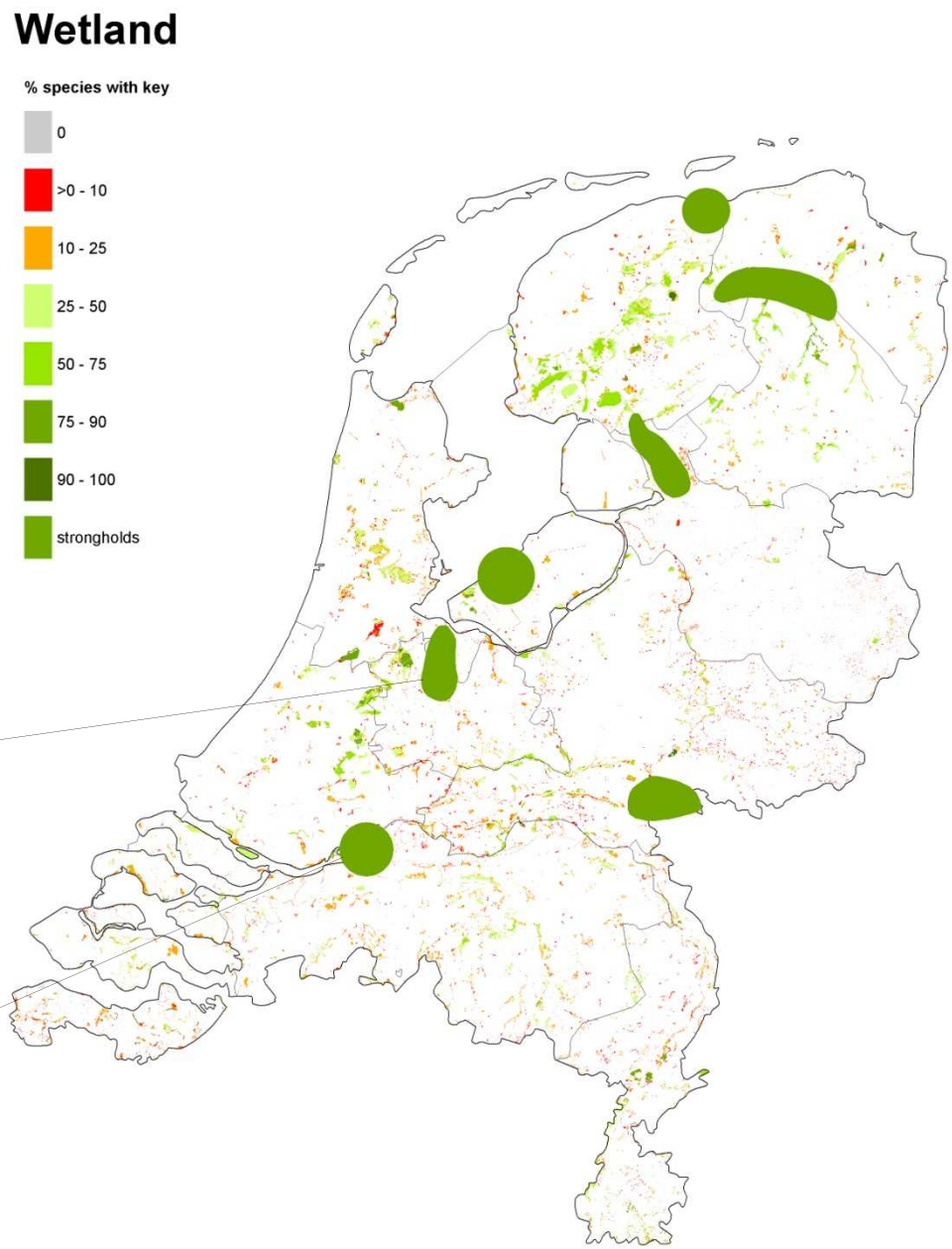
- Create an (international) resilient network of wetland ecosystems
  - enlarge areas
  - increase spatial cohesion
  - improve abiotic conditions
  - give room to natural processes -> heterogeneity
- Concentrate adaptation measures within this corridor
  - most efficient
  - best opportunities
  - more effective protection so that (new) land use that blocks adaptation can be avoided
  - focus to increase efforts or to adapt strategy when necessary

Spatial assessment

- Identify nature areas that might be too small
  - Identify bottlenecks for species with different dispersal capacity
  - Identify suitable conditions where habitat restoration is possible
  - Identify possibilities for synergy with other functions

Design of a climate corridor for wetlands

Step 1 Identify strongholds



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Step 2

Connect the strongholds with a climate corridor

Step 3

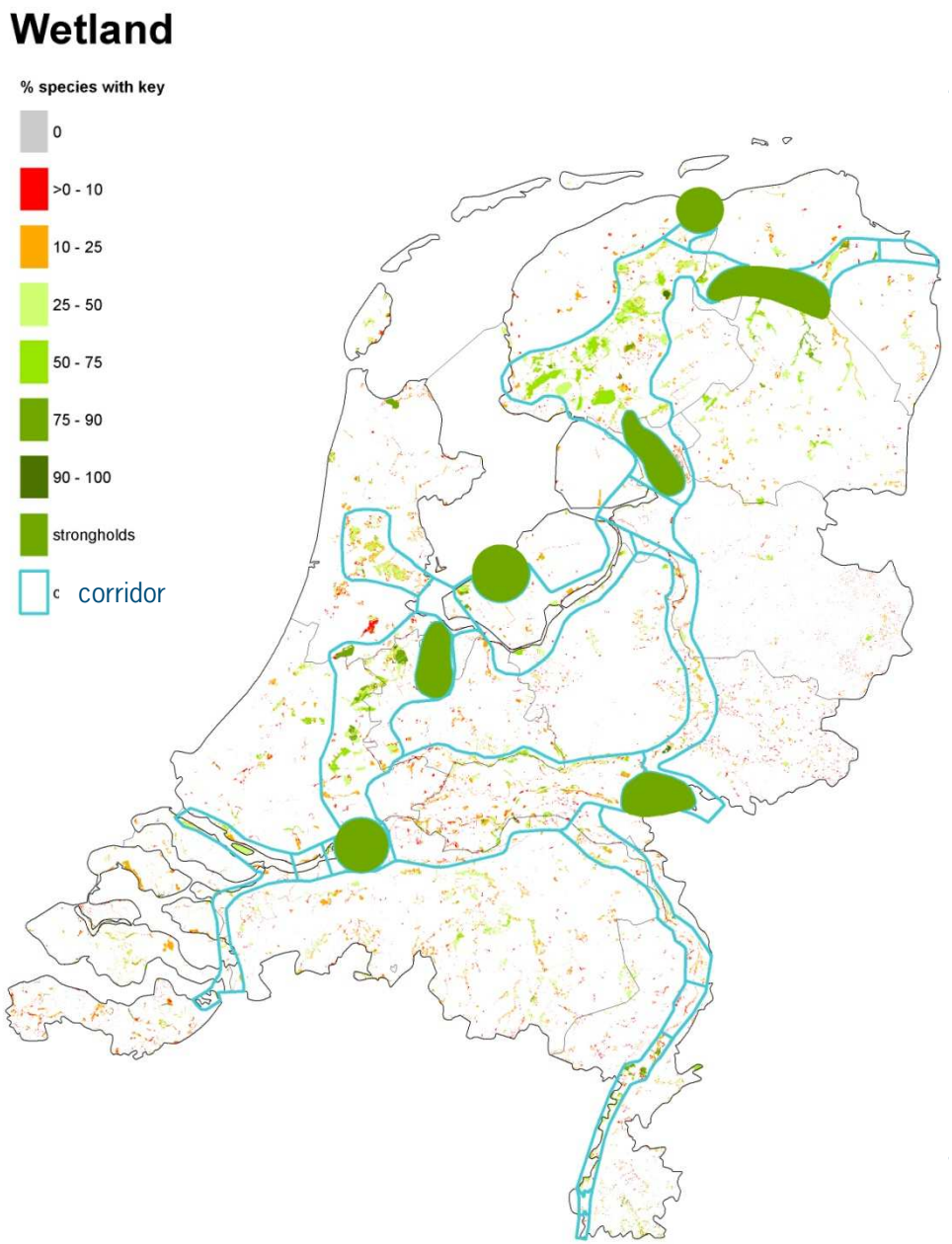
Enlarge wetlands within the climate corridor

- Increase carrying capacity
- Increase heterogeneity

Step 4

Link networks within the climate corridor

- Increase connectivity
- Create new wetland areas
- Solve barriers

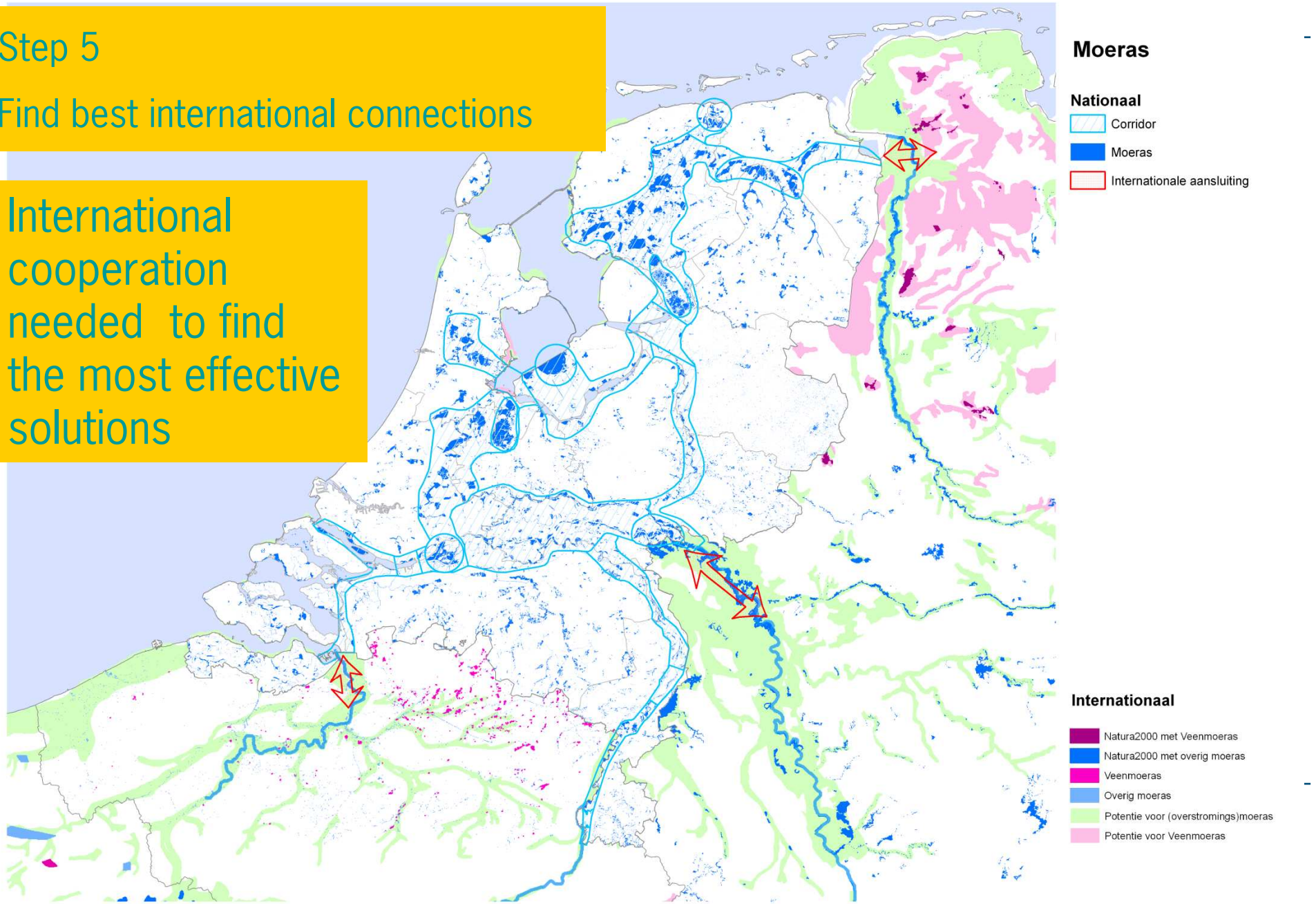


Design of a climate corridor

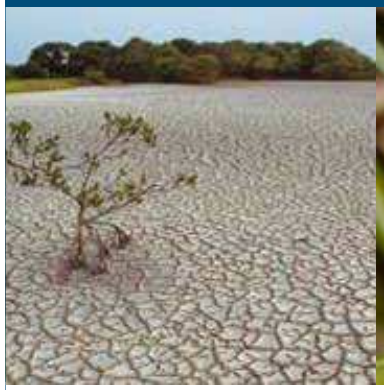
Step 5

Find best international connections

International cooperation needed to find the most effective solutions



Thank You





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