

Staying connected

The importance of ecological networks



Claire Vos

Content

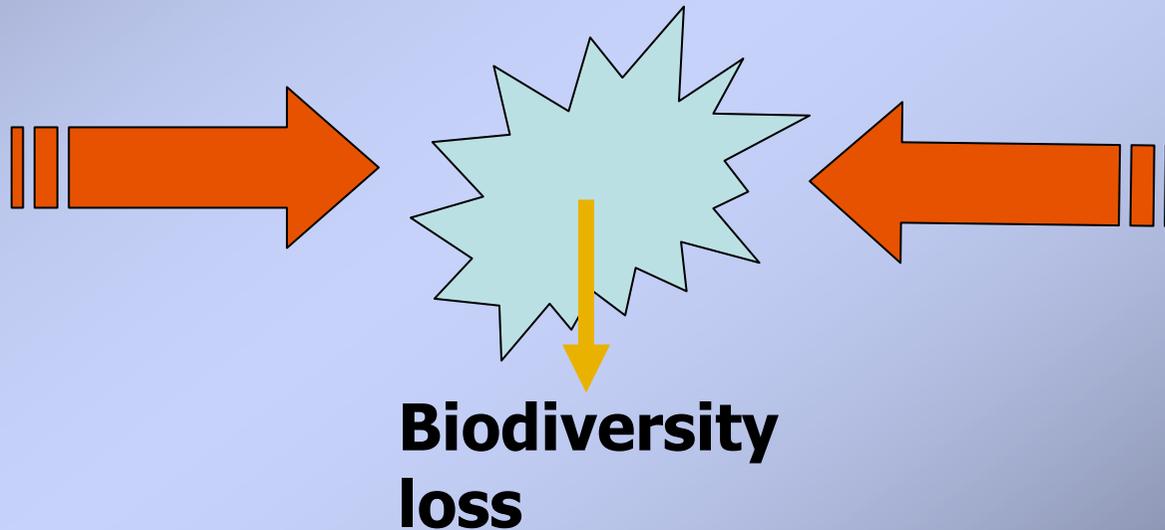
- Extra stress of climate change in fragmented landscapes
- Adaptation strategies



Habitat fragmentation and climate change a bad combination?

Climate change

Habitat fragmentation



Effects climate change

- Still a lot of questions:
 - Which ecosystems are affected?
 - Which species might be lost?
 - Which species will benefit?
- Are changes in species composition a problem for nature conservation?

If we decide it is a problem ...

Climate Change

Habitat
Fragmentation



**We can't stop
climate change**

**So we must adapt
the landscape**

What are the expected effects of climate change in a fragmented world?

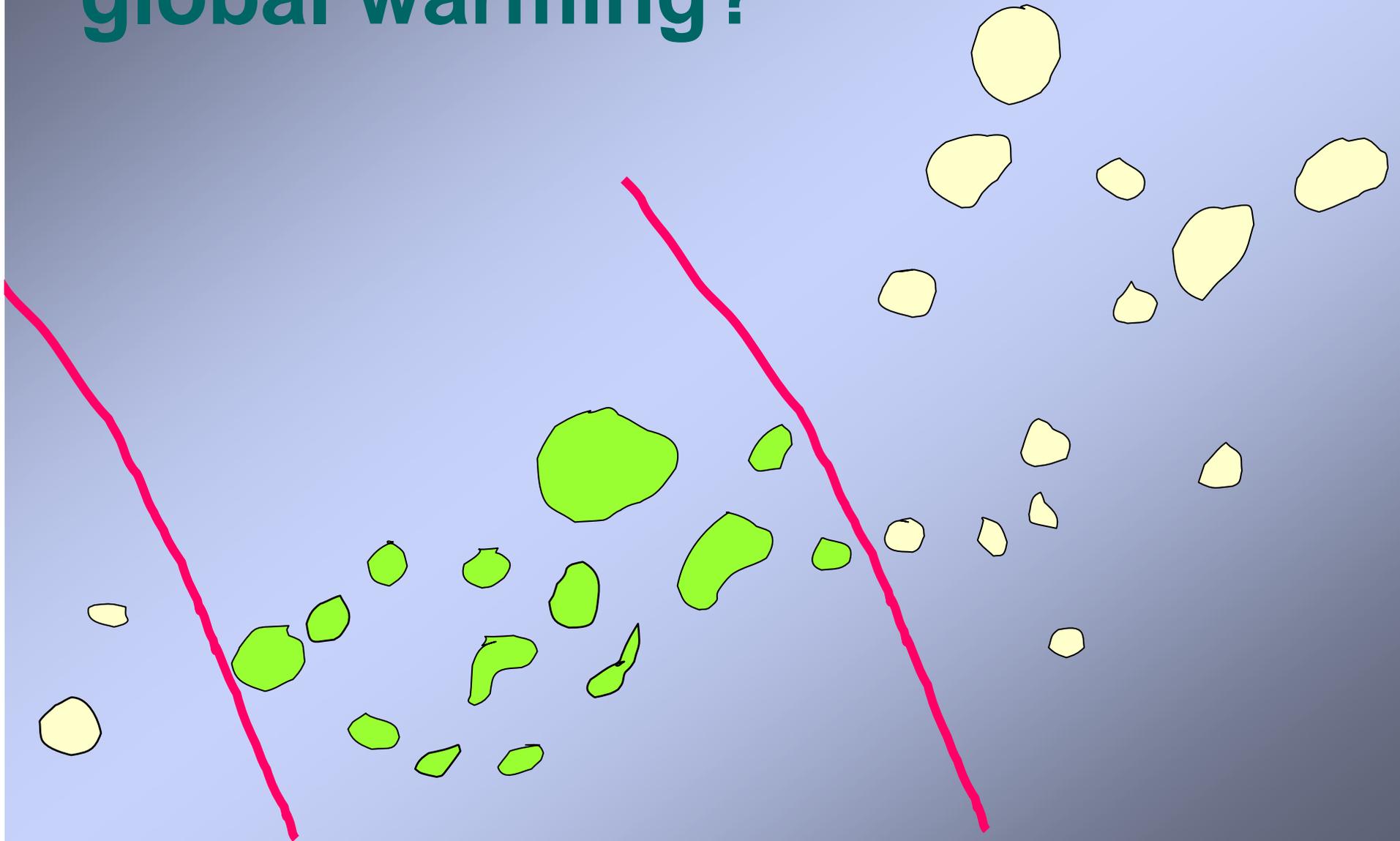
How will the climate change?

- **Temperature rise**

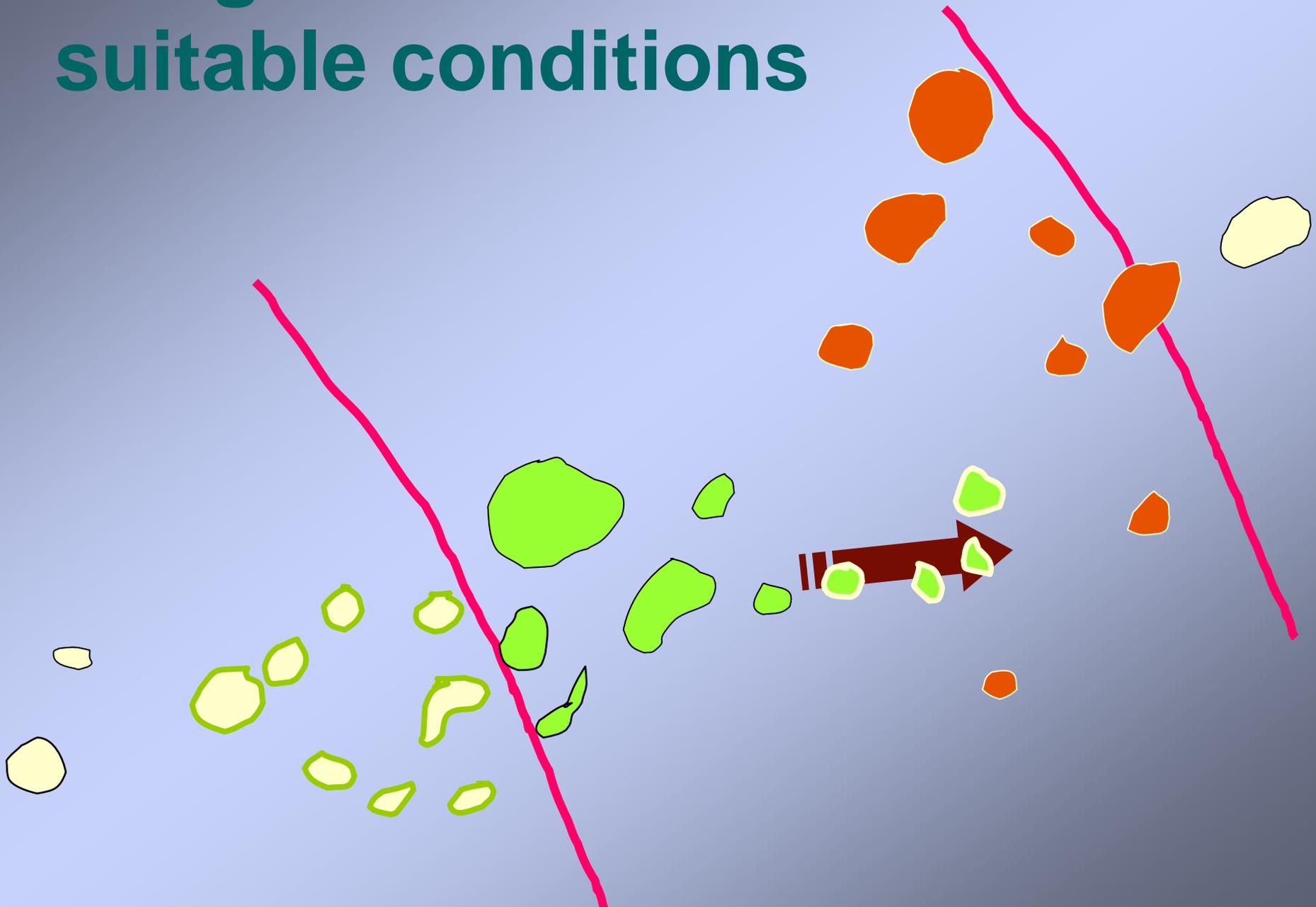
Expected effects I

Effects of temperature rise will be stronger for species with small dispersal capacity.

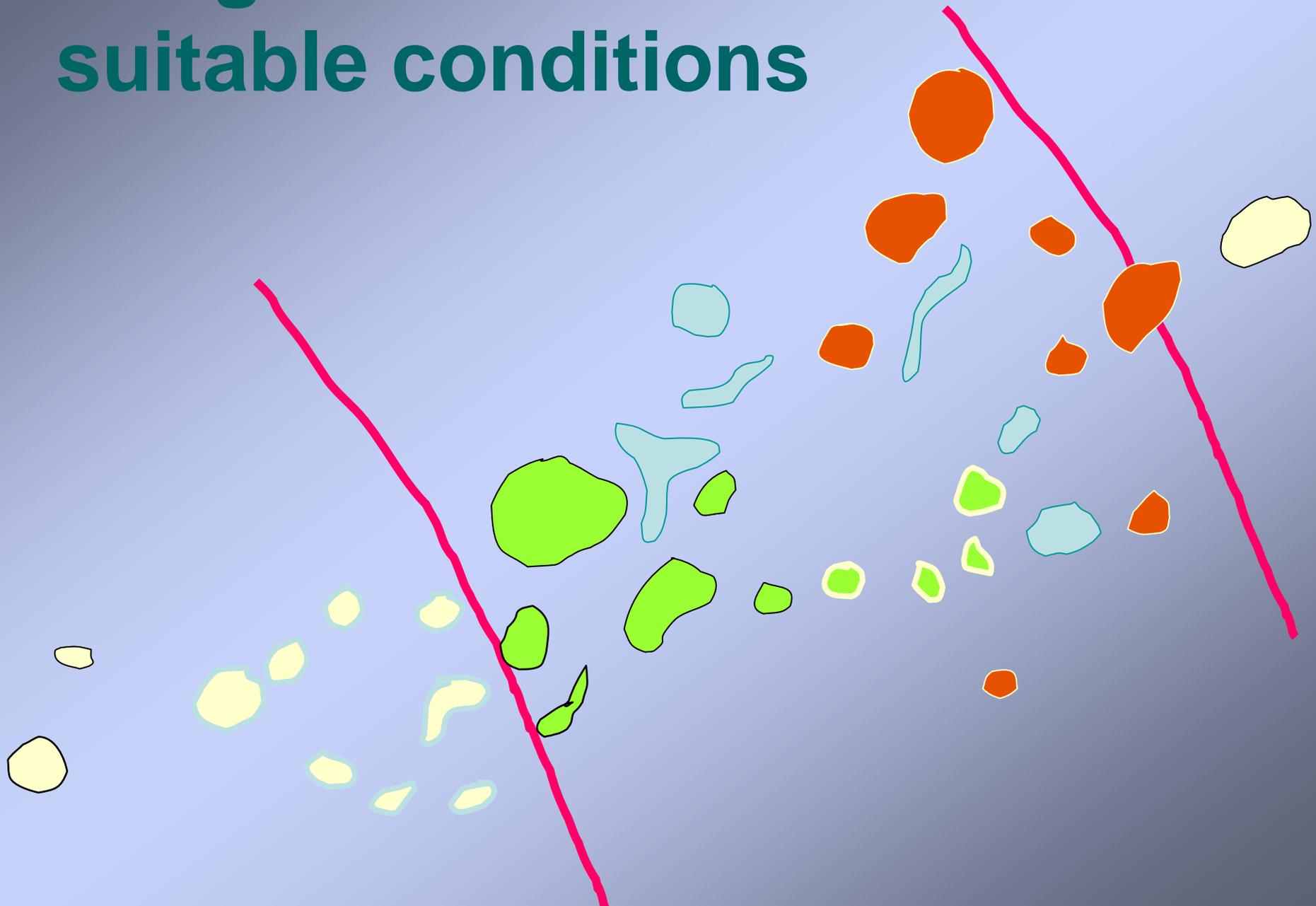
What happens during global warming?



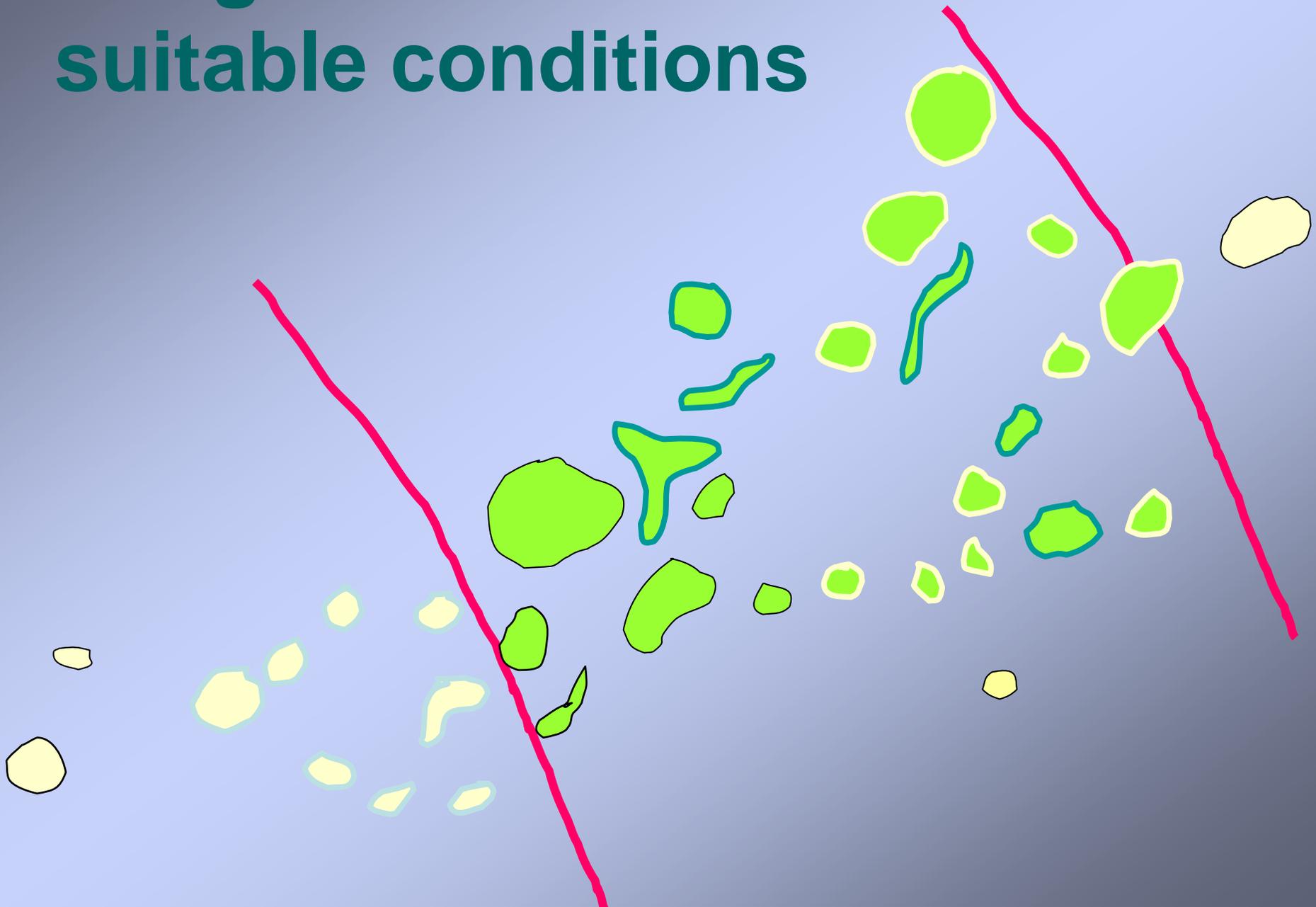
Range shift suitable conditions



Range shift suitable conditions



Range shift suitable conditions

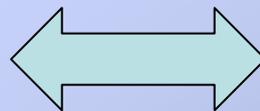


Species affected by habitat fragmentation not able to follow shifting temperature zones



Pararge aegeria Speckled wood

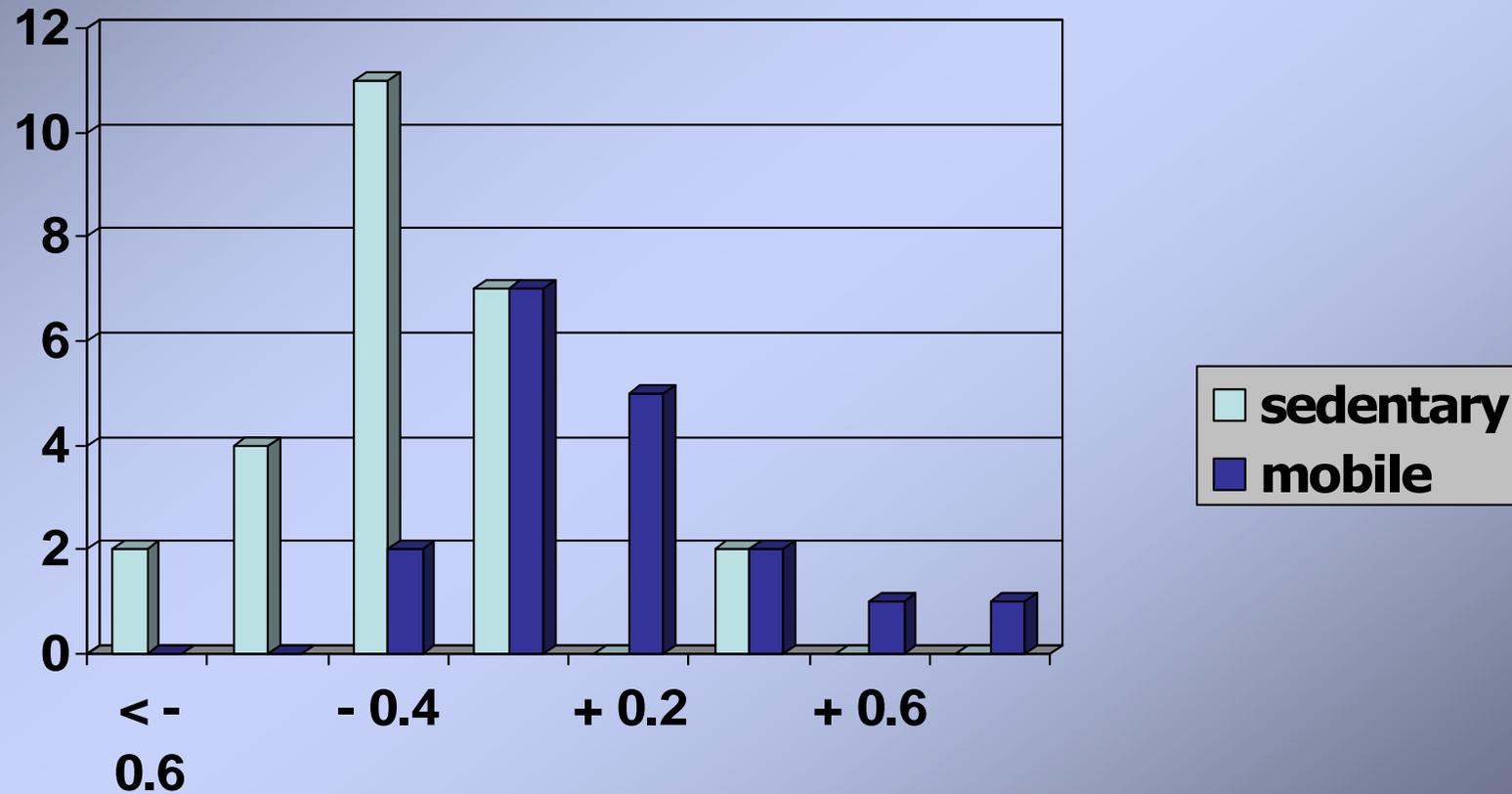
Short-distance disperser



Polygonia c-album Comma

Long-distance disperser

Climate change in fragmented landscape: mobile butterfly species respond to increased temperature, sedentary species don't

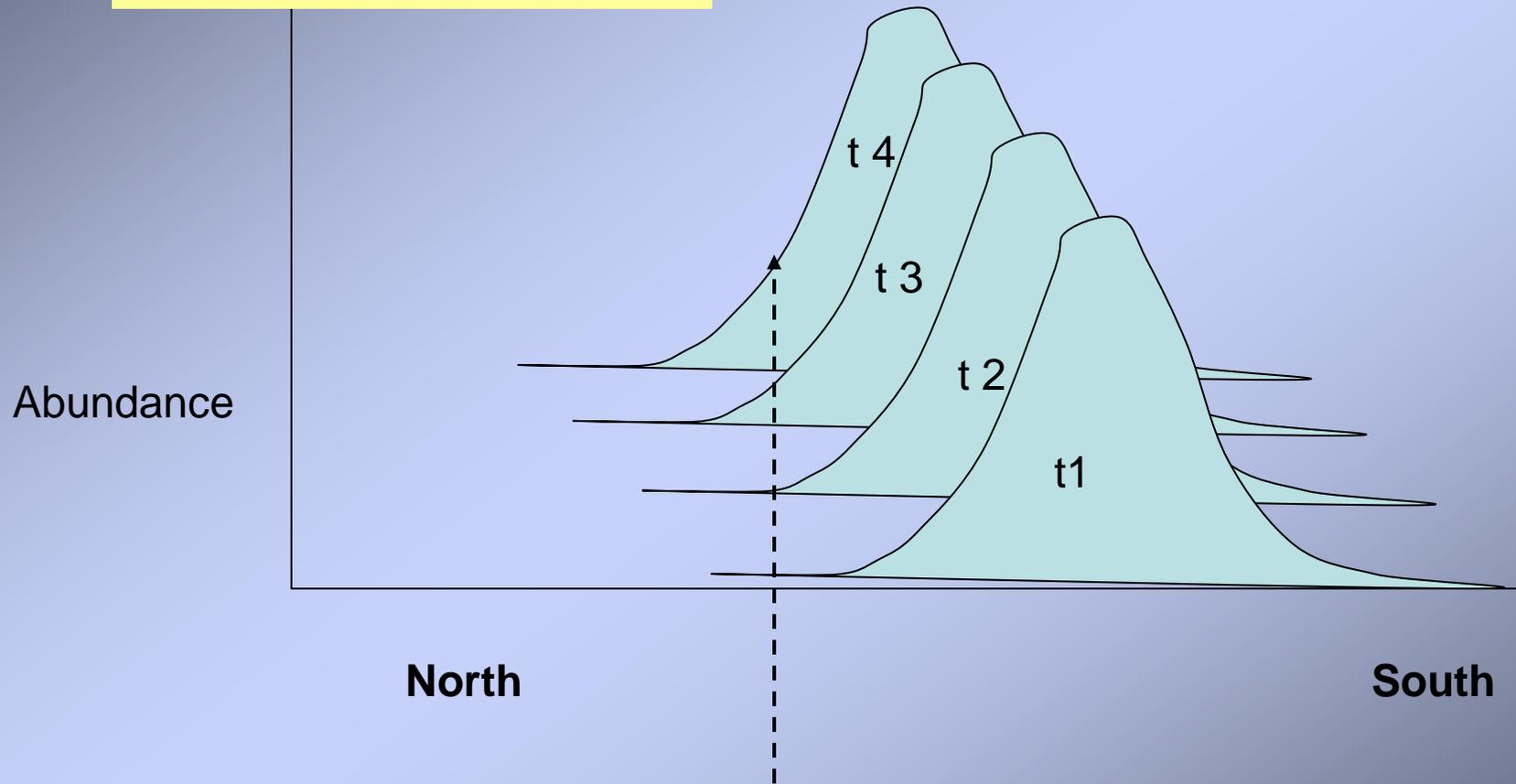


Decrease (<0) and increase (>0) of English butterfly species since 70's.

Warren et al. 2001

Expanding side of range:

- new species
- higher densities
- colonisation > extinction

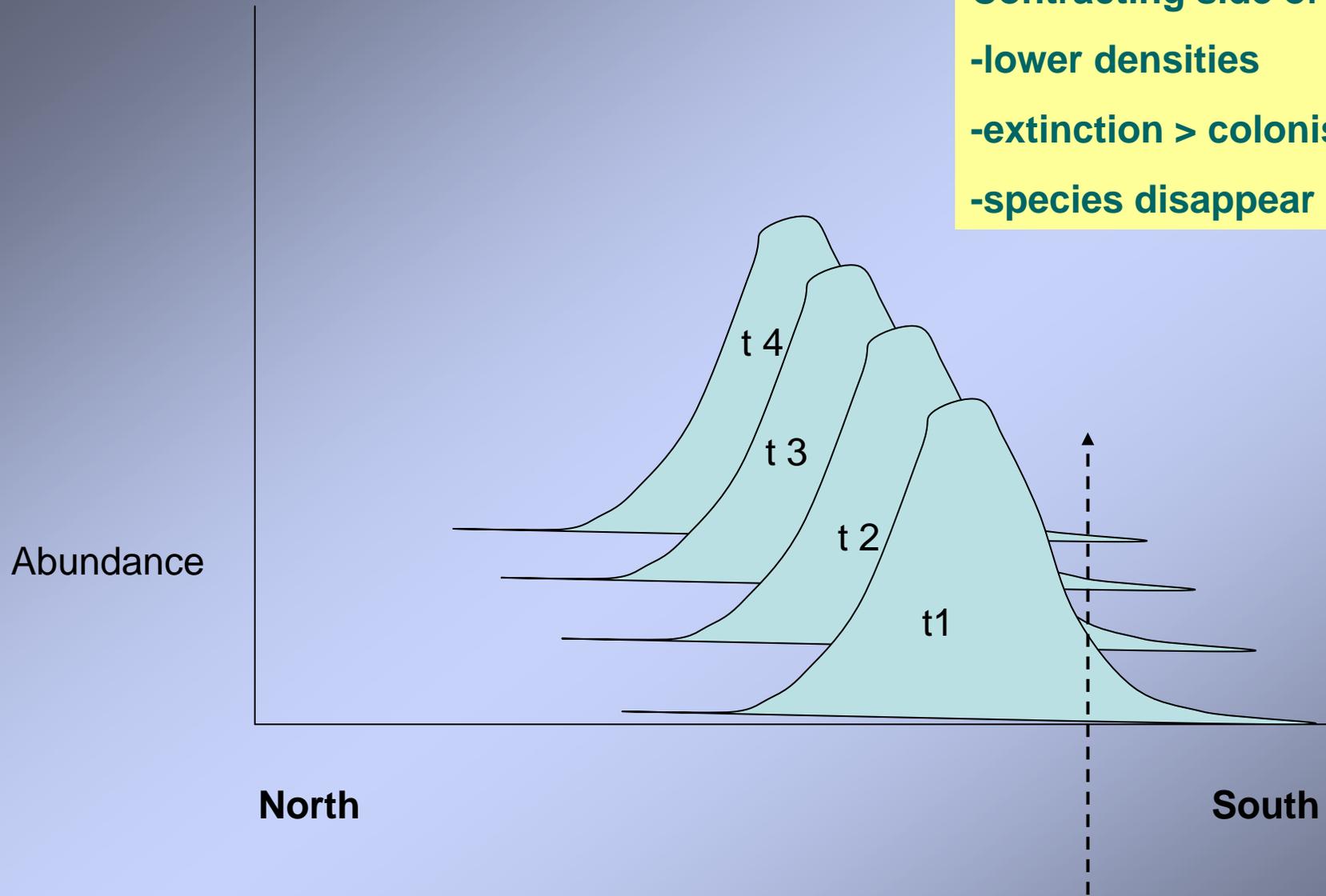


Contracting side of range:

-lower densities

-extinction > colonisation

-species disappear

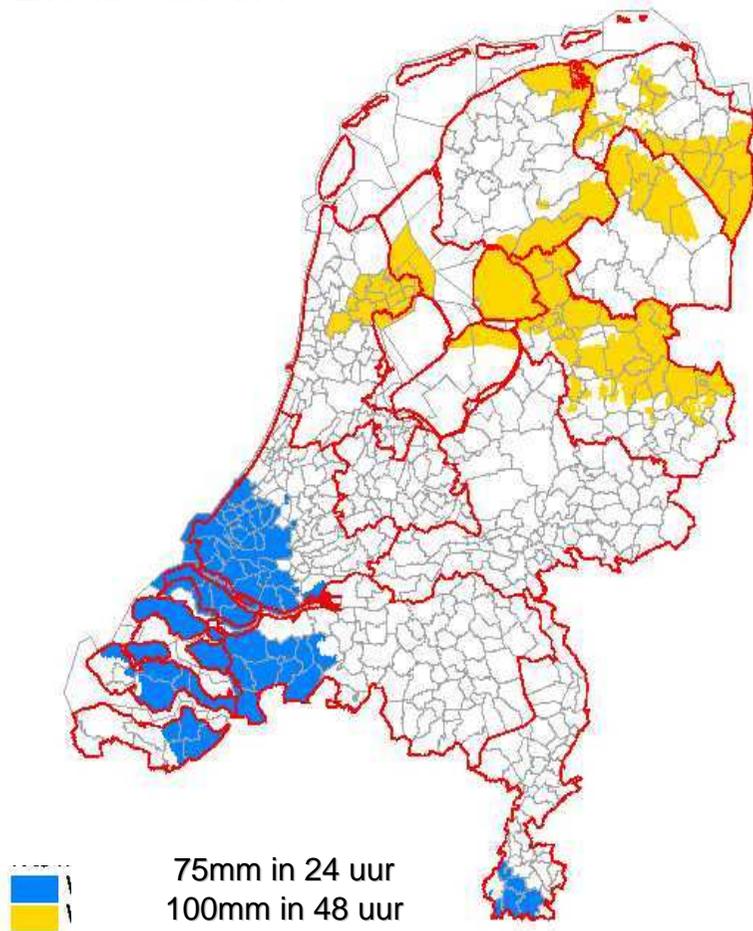


How will the climate change?

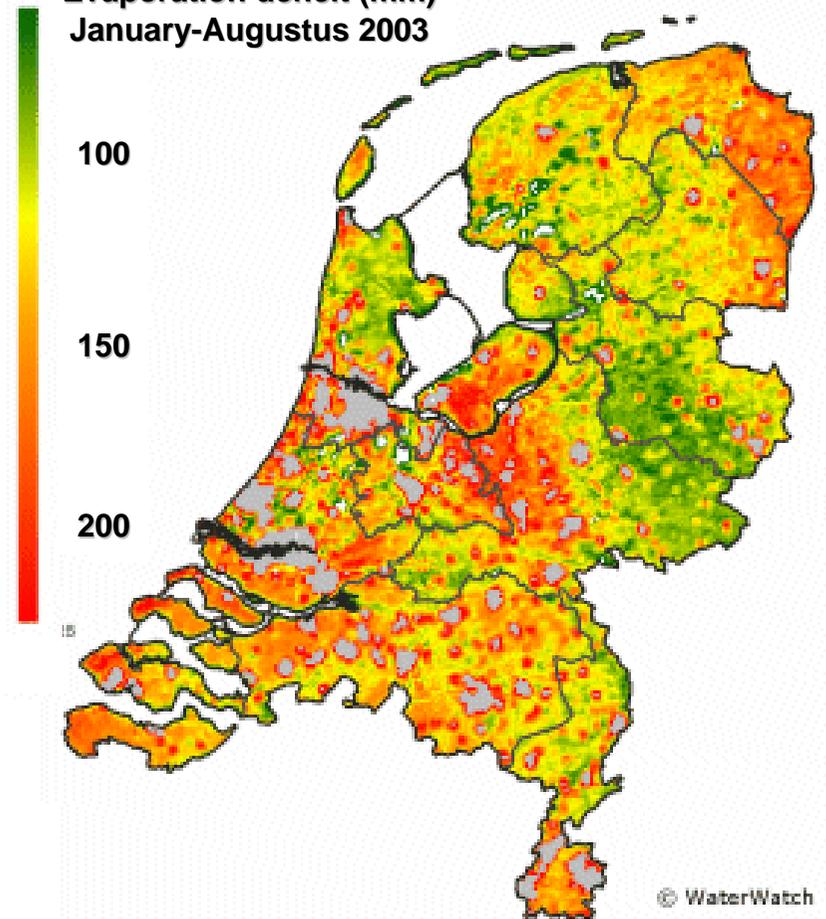
- **Weather extremes more frequent and stronger**

Weather extremes

Extreme rains in 1998



Evaporation deficit (mm)
January-Augustus 2003



Expected effects II

Effects of weather extremes will be stronger in more fragmented systems.

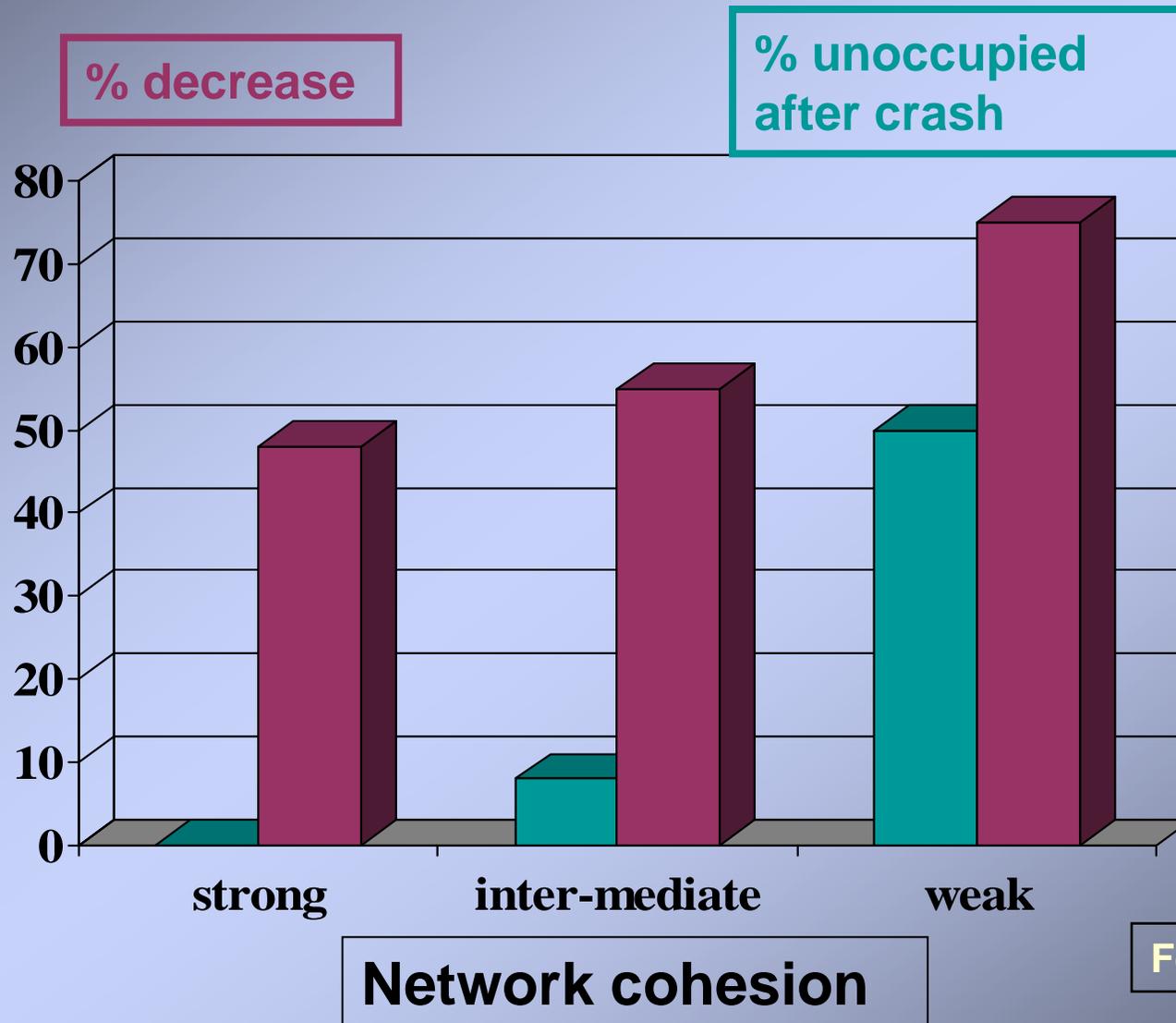
More frequent weather
extremes means higher
fluctuations in numbers



Acrocephalus schoenobaenus
Sedge warbler

Sedge warbler crash during Sahel drought

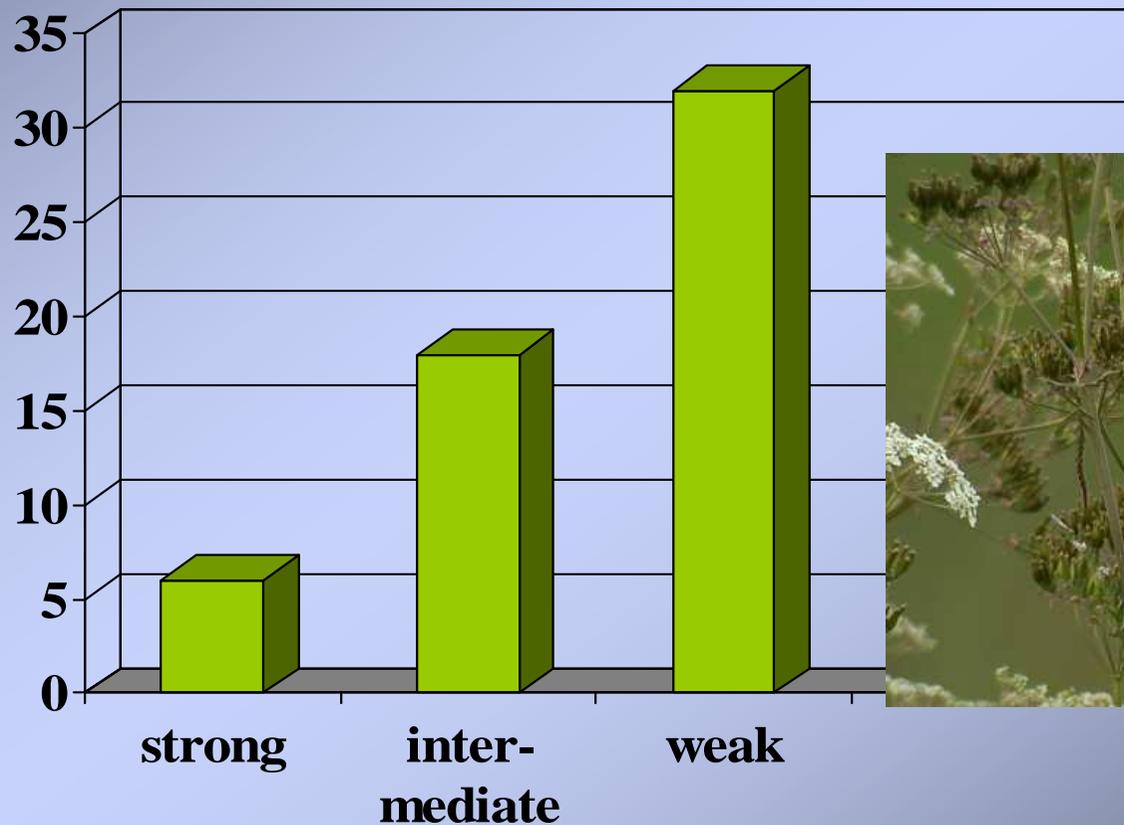
less severe in stronger habitat networks



Foppen et al. 1999

Predicted sedge warbler recovery: faster in stronger habitat networks

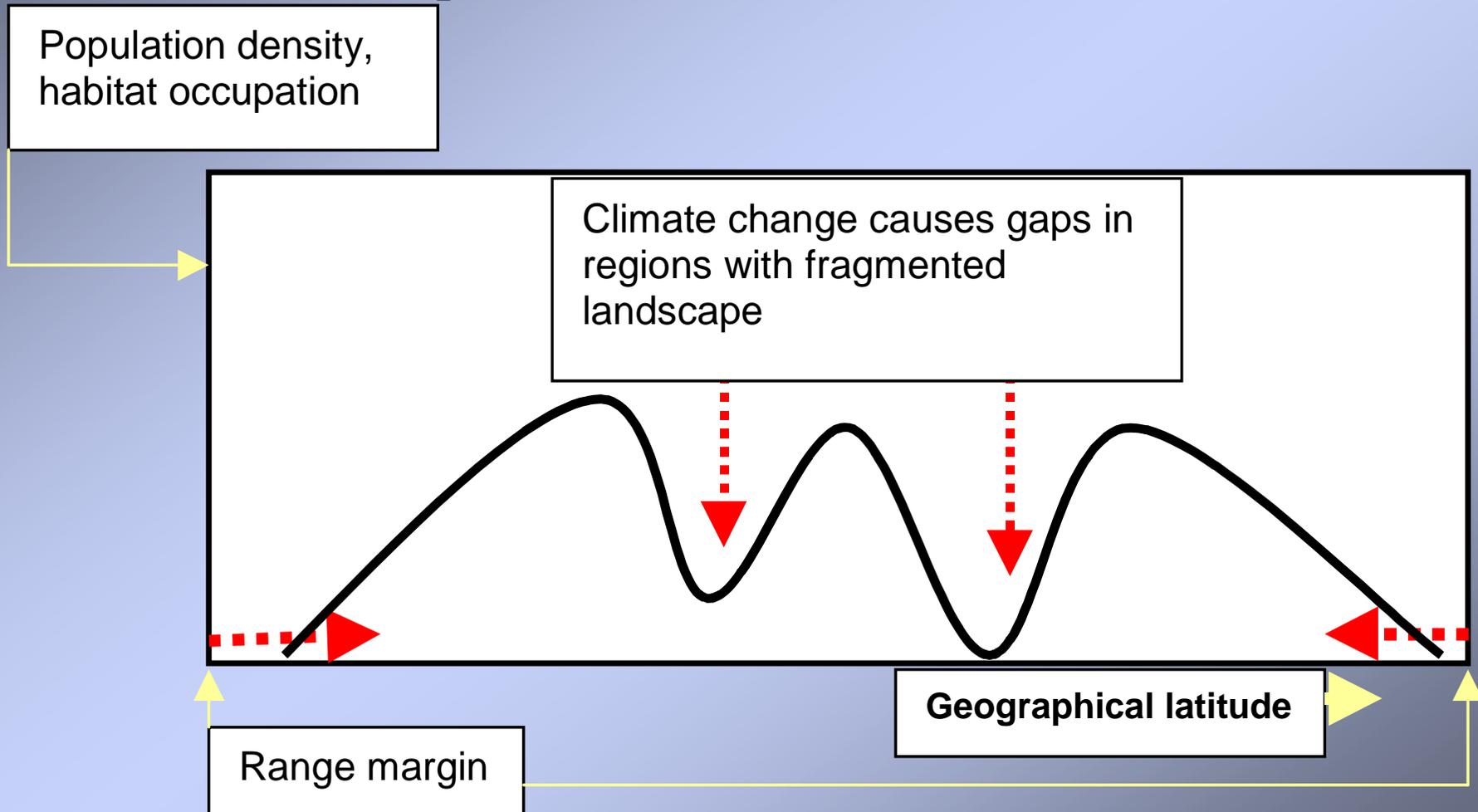
Years until recovered



Foppen et al. 1999

Network cohesion

Range dynamics during perturbations



Expected effects III

Effects of weather extremes will be stronger in homogeneous systems.

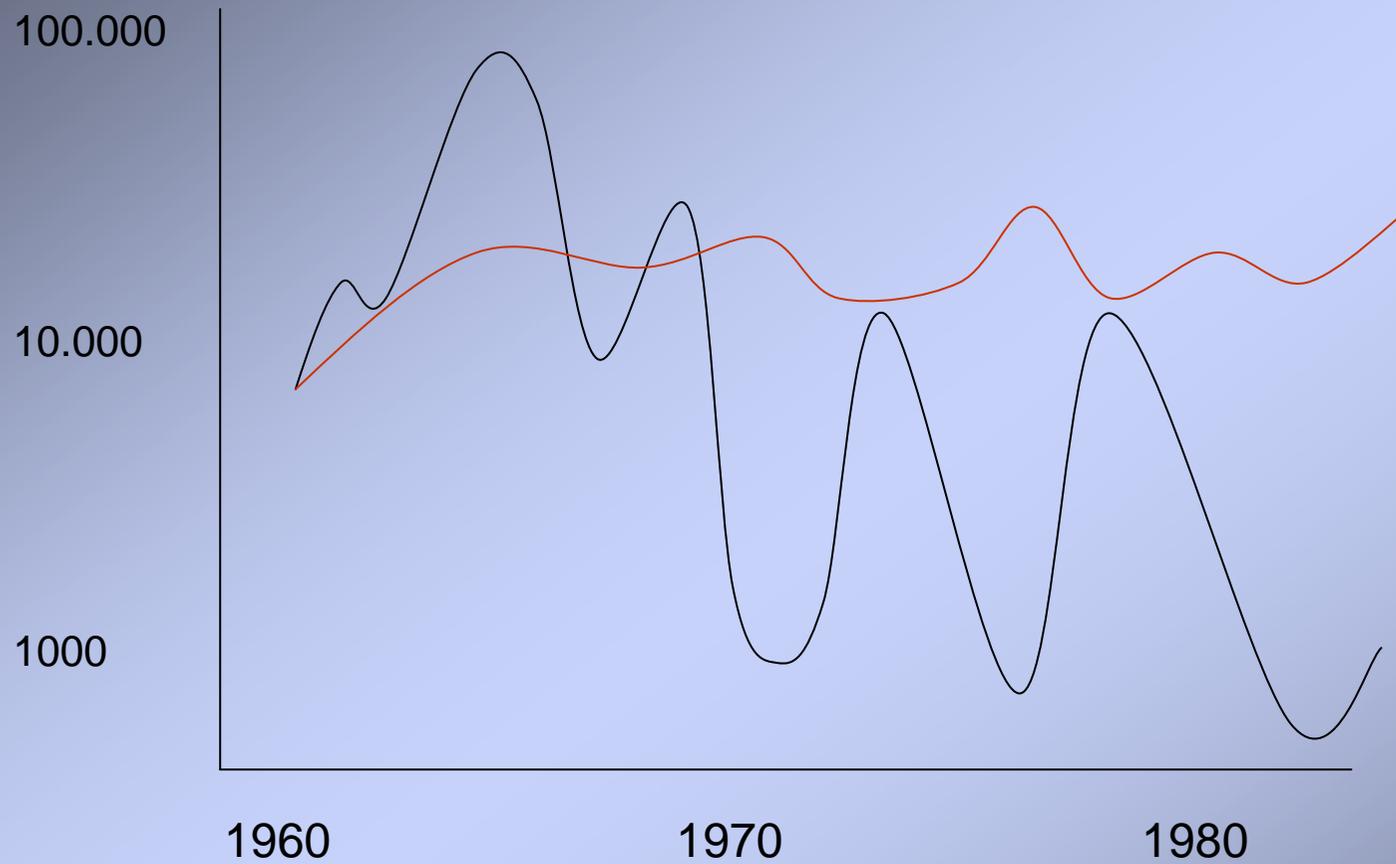
Population dynamics



**Pterostichus
versicolor**



**Calathus
melanocephalus**



Den Boer 1986

Local or synchronized fluctuations?



Synchronized population fluctuations
caused by dominant environmental factor



Independent population fluctuations
caused by local environmental conditions

Summarizing expected effects climate change

- Range shifts are affected by habitat fragmentation
- Effects of fluctuations are larger in weak networks
- Fluctuations are stronger in homogeneous networks

Which species are at risk?

Temperature rise

Weather extremes

Potential Range shifts

Fluctuating populations

Group I
Contracting
range of
'northern
species'

Group II
Expanding
range of
'southern
species'

Group III
Sensitive for
Environmental
stochasticity

Group IV
Low growth rate:
slow recovery
after disturbance

Habitat fragmentation
present and/or future habitat

Managing landscapes for biodiversity: defining a strategy

- Go for conditions for ecosystem resilience in stead of trying to control steady state
- Spreading the local risk of extinction across the region
- Large scale spatial cohesion

Increase spatial cohesion within and between habitat networks

Available strategies:

- Patch area

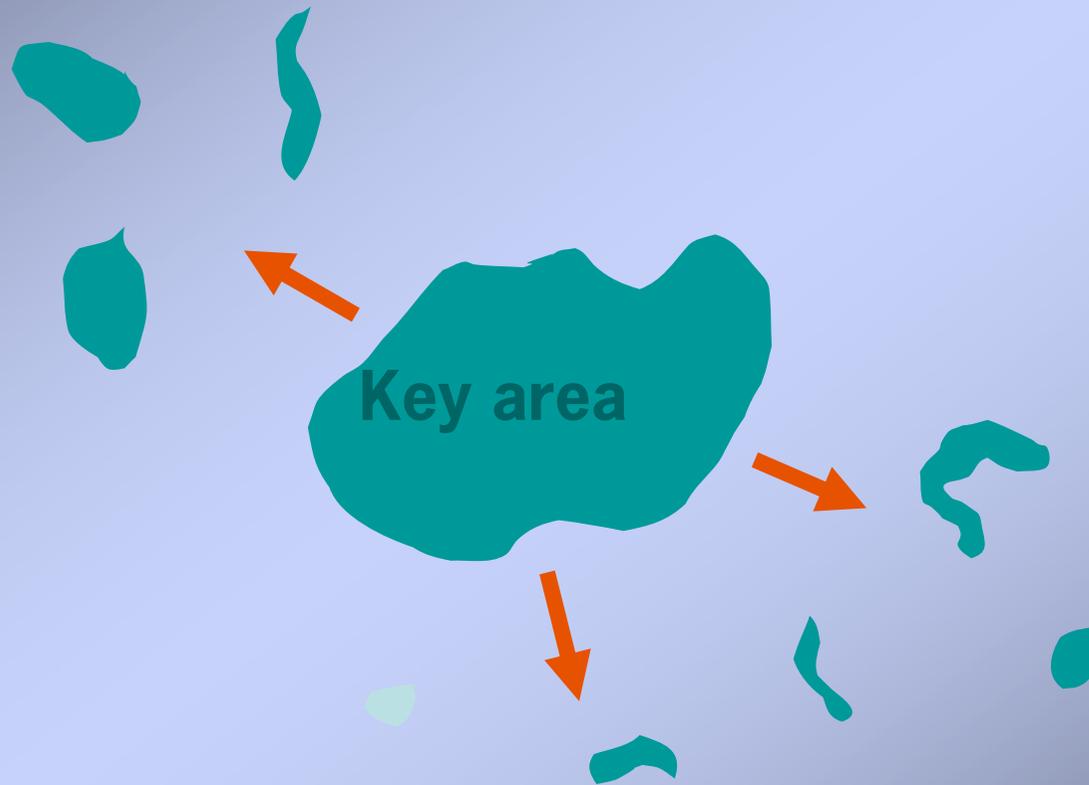
- Patch quality

- Patch density

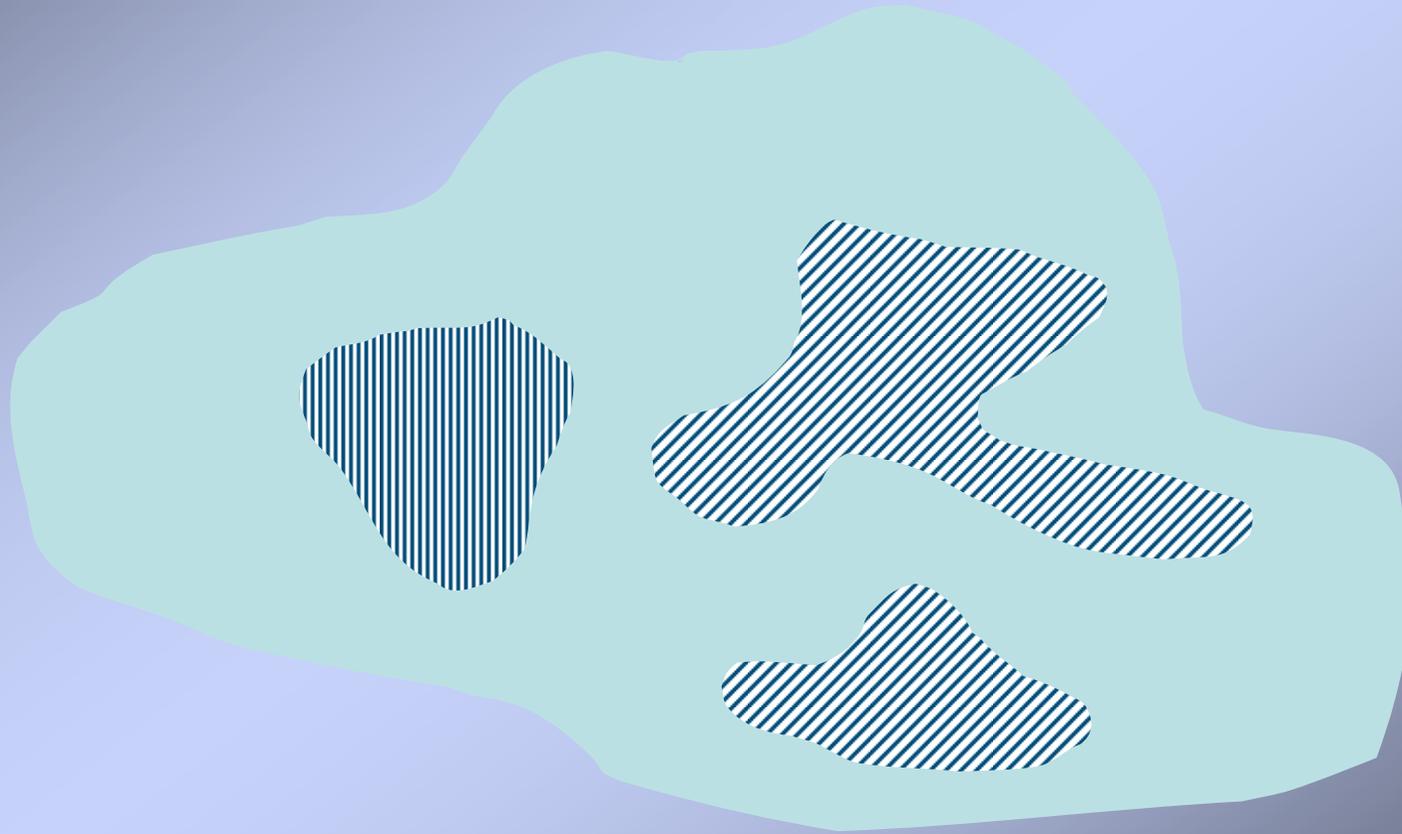
- Landscape permeability

- Connectivity

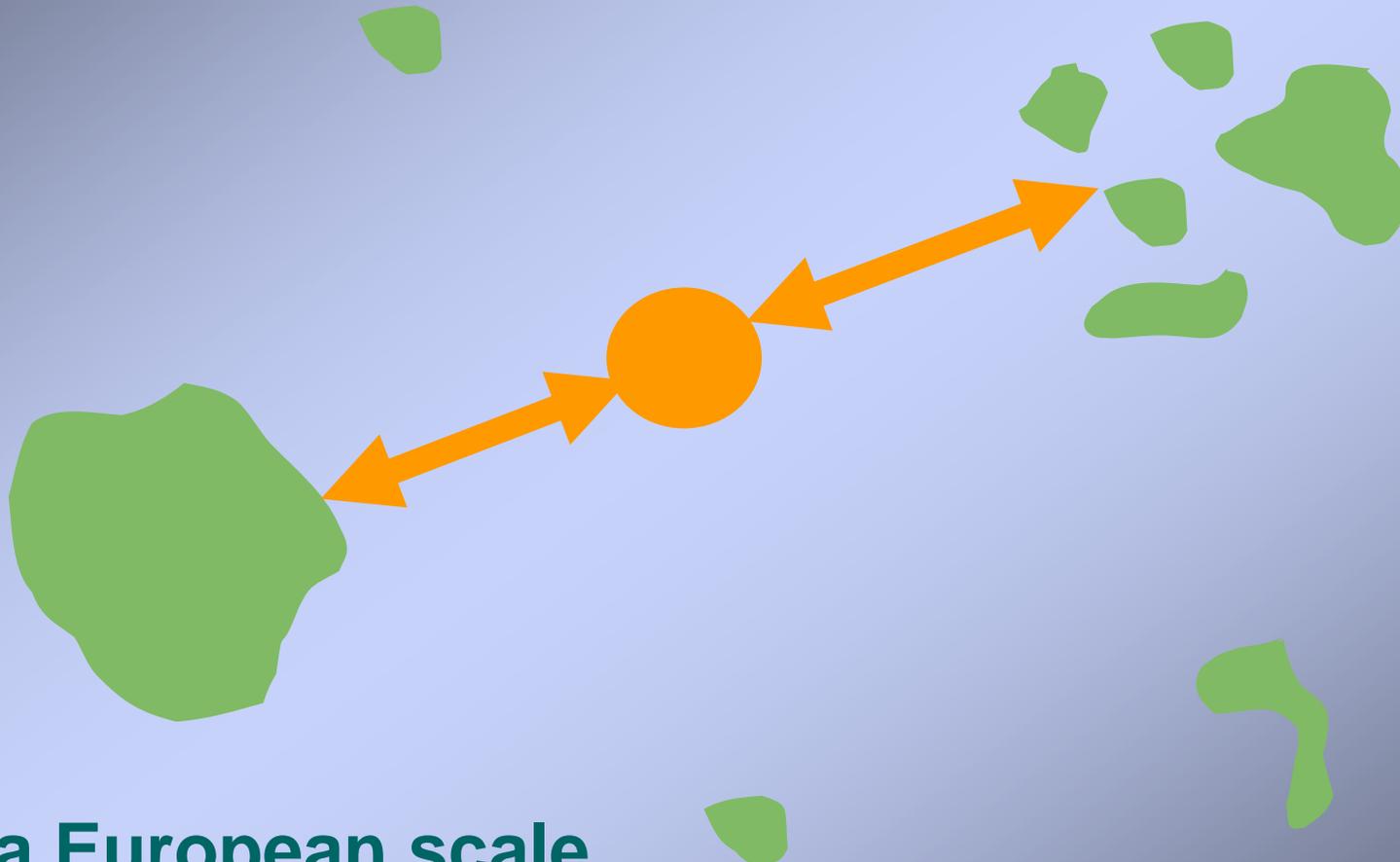
Strategy 1: Enlarge Areas to compensate for fluctuations



Strategy 2: Increase Heterogeneity to dampen fluctuations

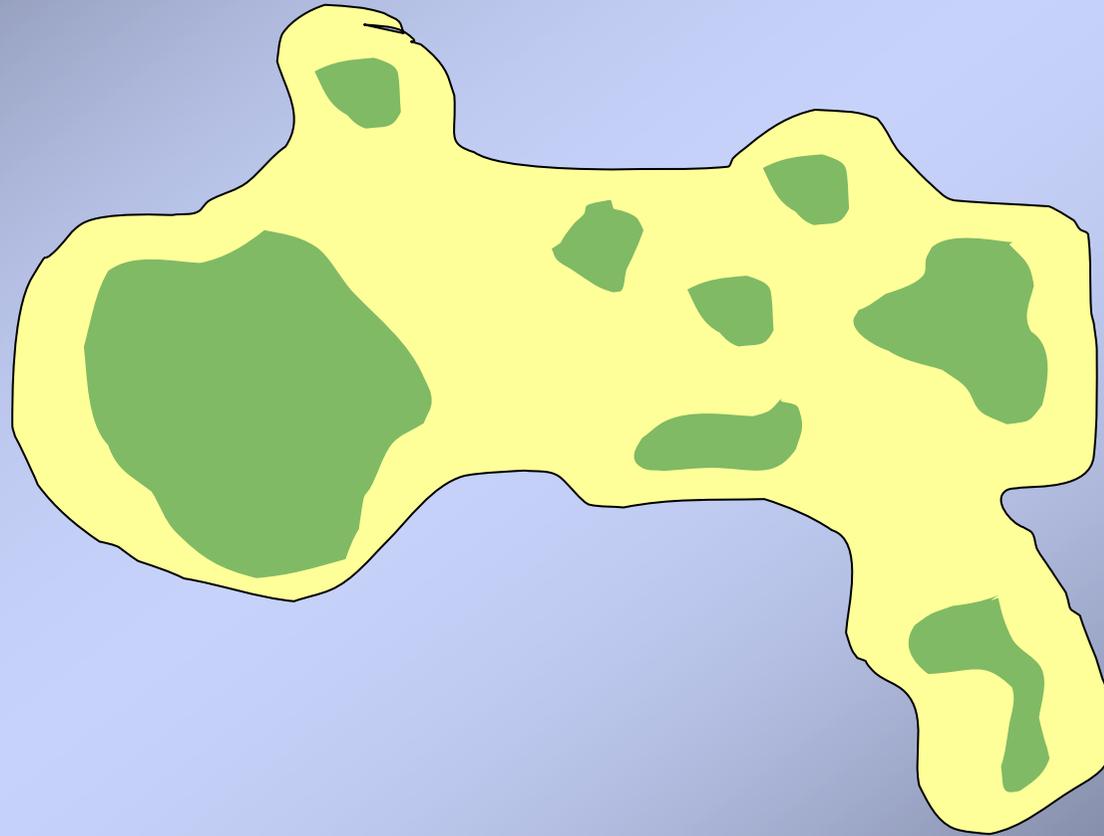


Strategy 3: Create Robust corridors to link networks



on a European scale

Strategy 4: Increase Matrix Permeability to improve connectivity

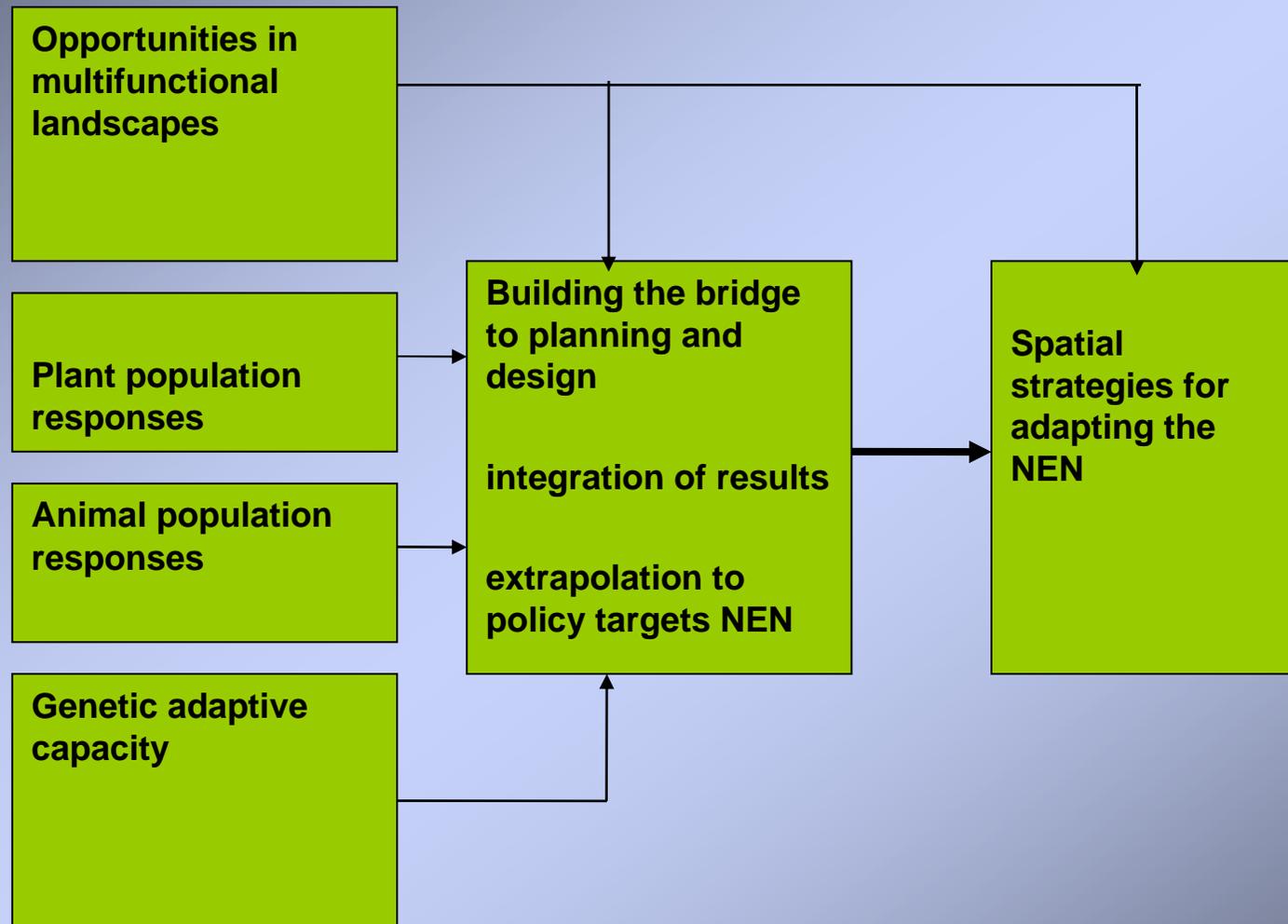


Thank you

Climate Change Projects 2005-2009

- BSIK Adaptation Dutch ecological network
- Interreg BRANCH - NW European scale

BSIK Adaptation National Ecological Network



BRANCH

**Biodiversity Requires Adaptations in
Northwest Europe Under CHanging
Climate**

EU-Interreg project 2004-2007

Consortium

- UK
 - English Nature – Lead partner
 - Tyndall Centre
 - Environmental Change Institute
 - County Council Hampshire and Kent
- FR
 - Conservatoire du Littoral
- NL
 - Alterra
 - Province Limburg

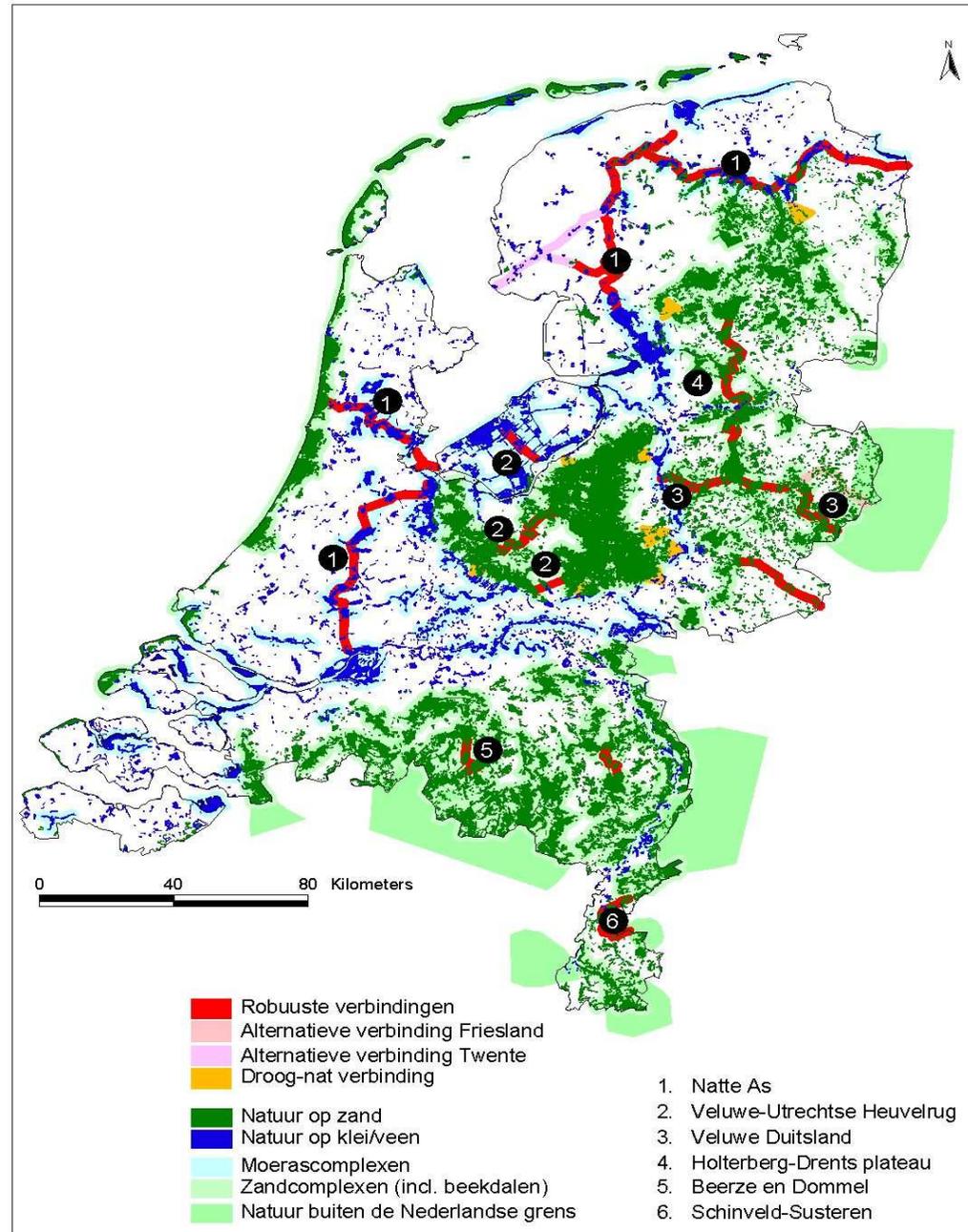
Aims

- Identify areas vulnerable to climate change in NW Europe
- Assess the potential impact on terrestrial and coastal ecosystems
- Identify spatial planning adaptation strategies
- Test strategies with regional stakeholders

Nature Policy
Plan 1990:

National
Ecological
Network

ROBUUSTE VERBINDINGEN (indicatief)



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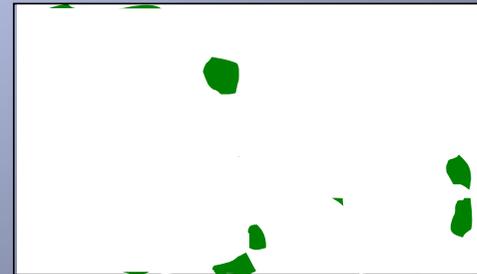
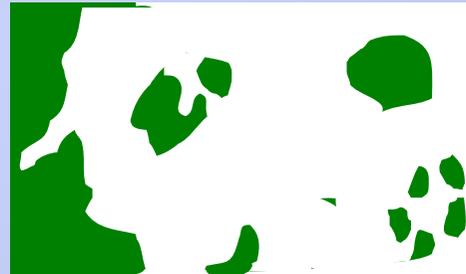
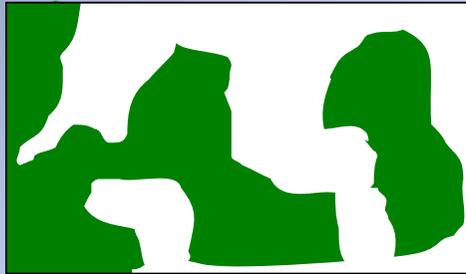
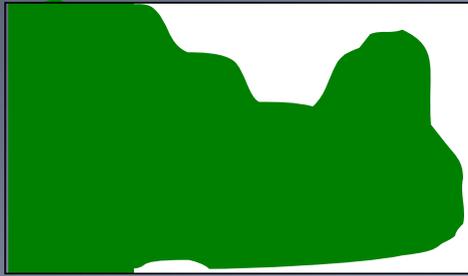
Occupatie Noordwest Europa

-  bebouwing
-  verstedelijkt
-  bevolkingsdichtheid >200 inw / km²
-  gas- / olieplatform incl. veiligheidszone
-  bos
-  gras / bouwland
-  water

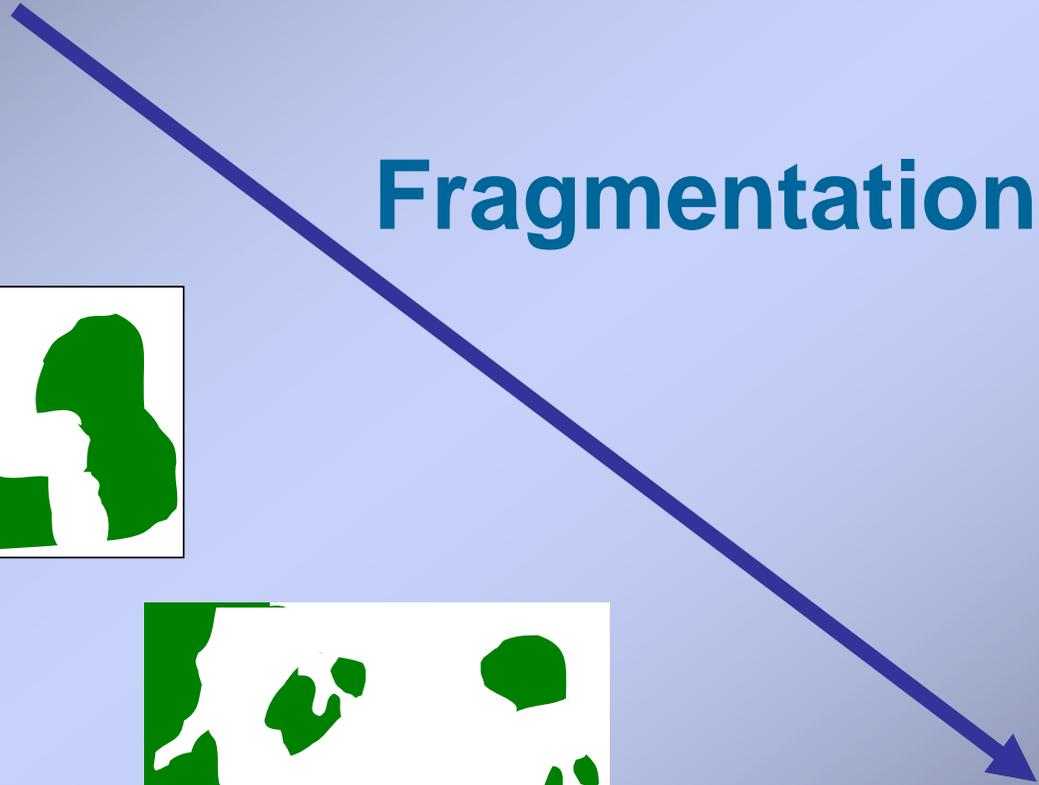
Vijfde nota RO

0 10 20 50 100 200 km





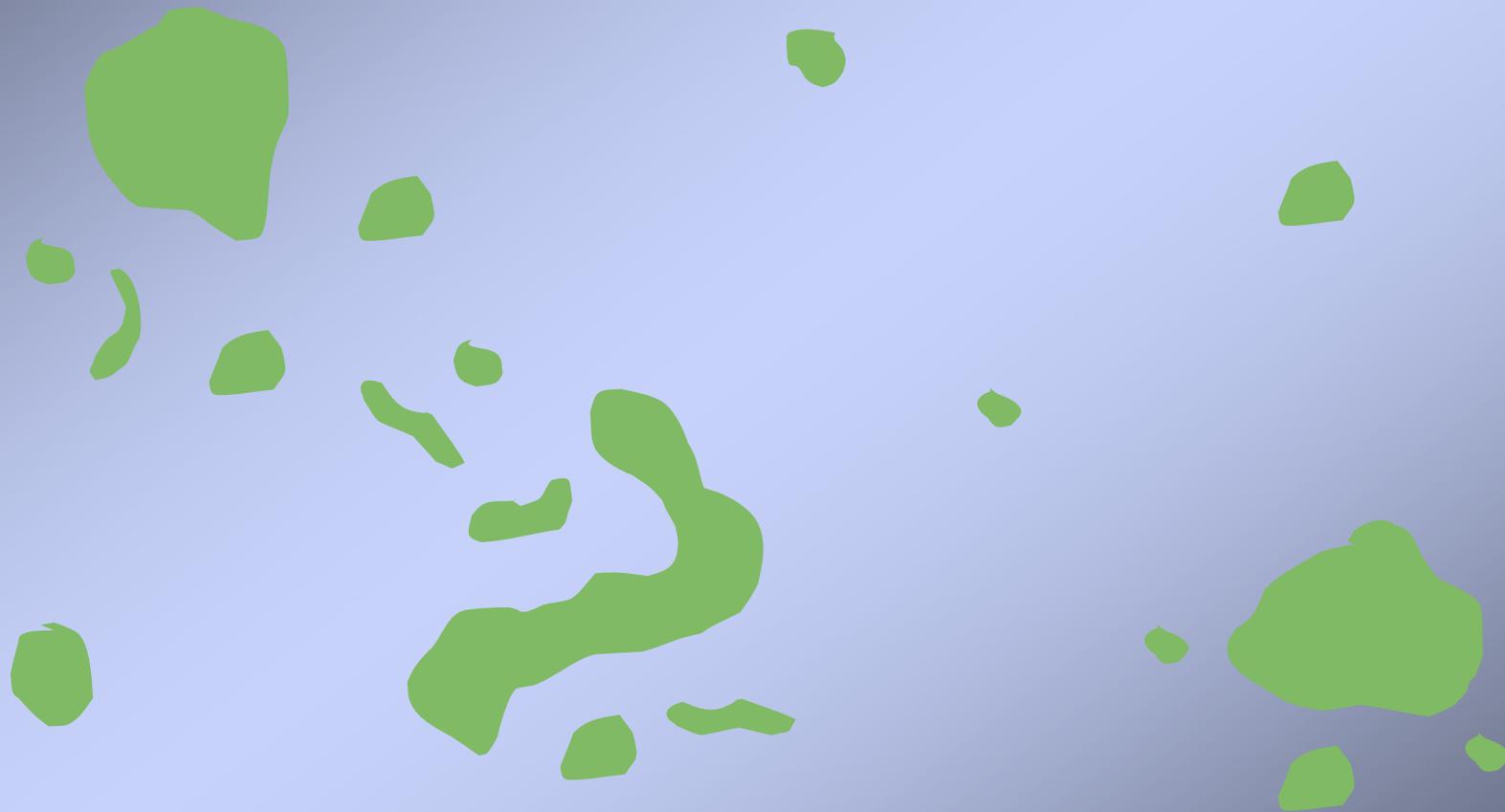
Fragmentation



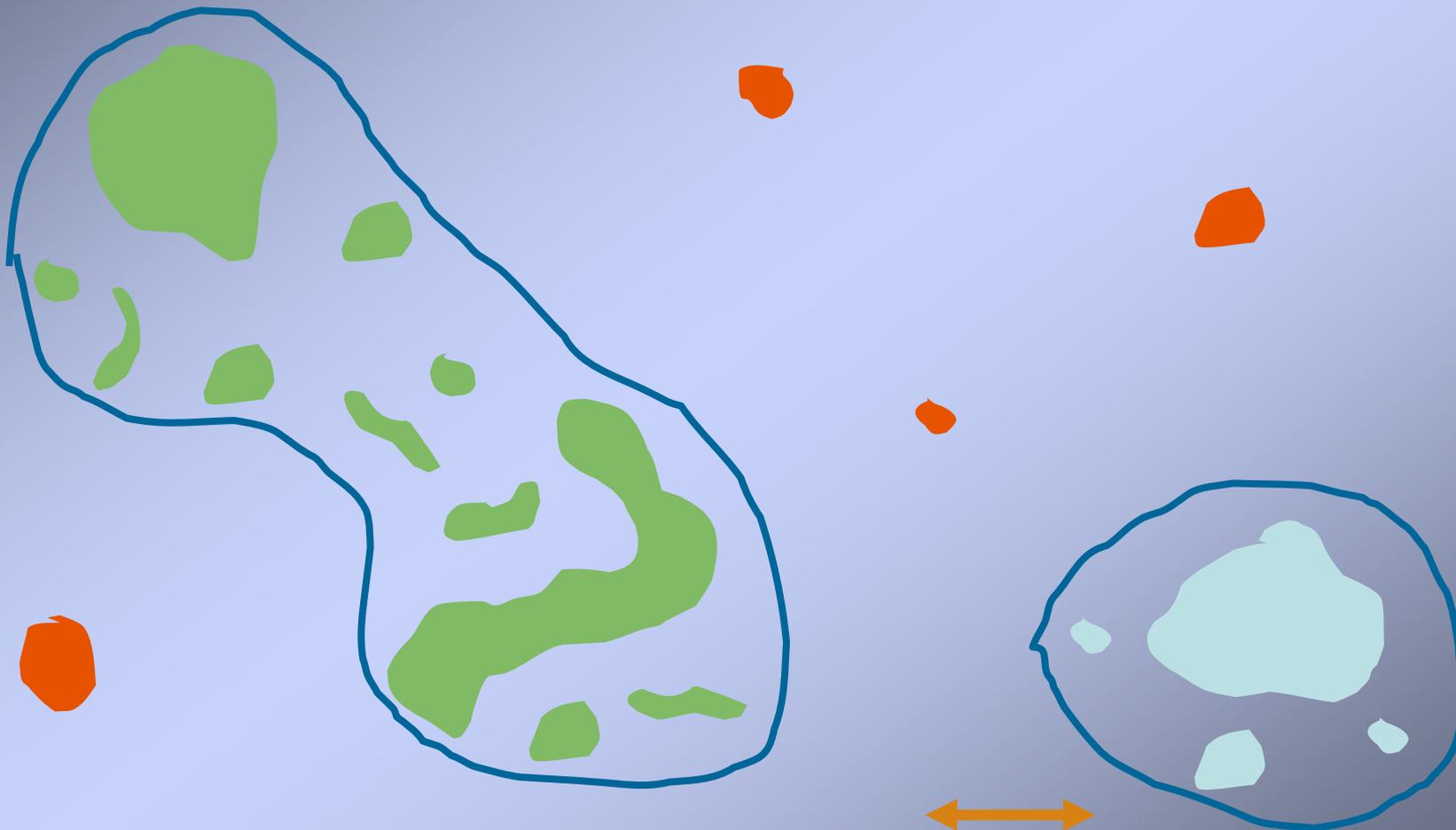
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Habitat patches



Species survive in habitat networks



Metapopulation persistence

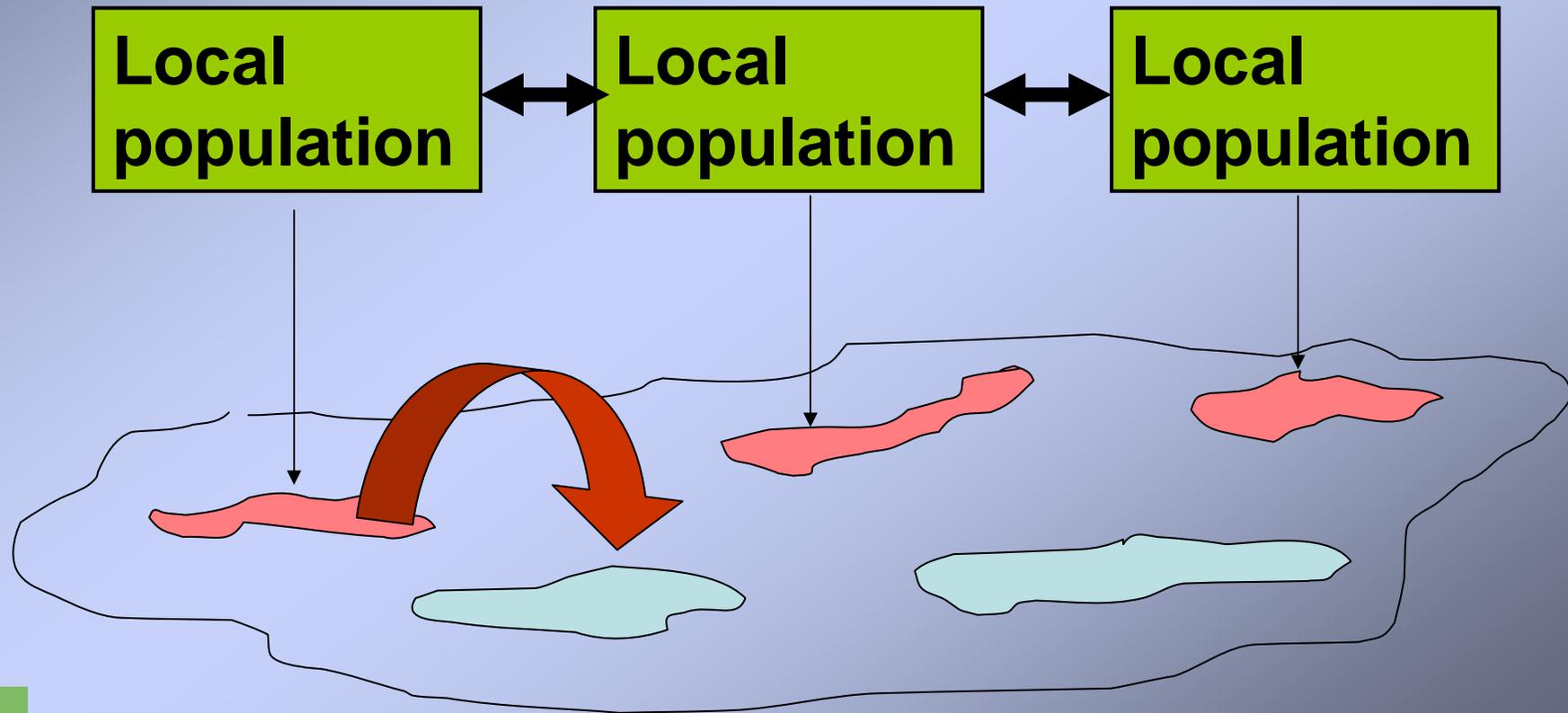


Extinction in
patches



Re-occupation of
empty patches

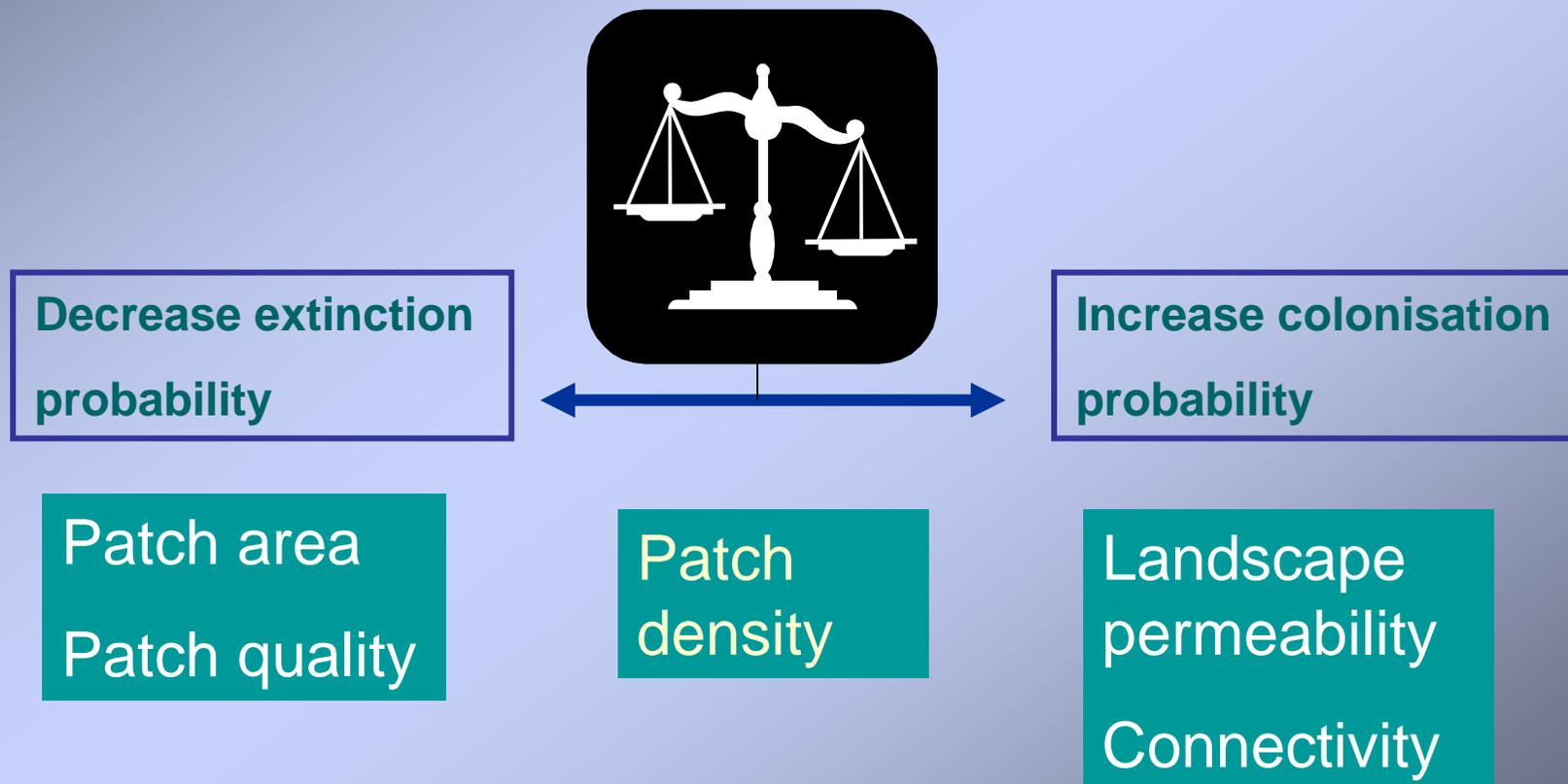
Metapopulation persistence: the **local** extinction risk spread over the network



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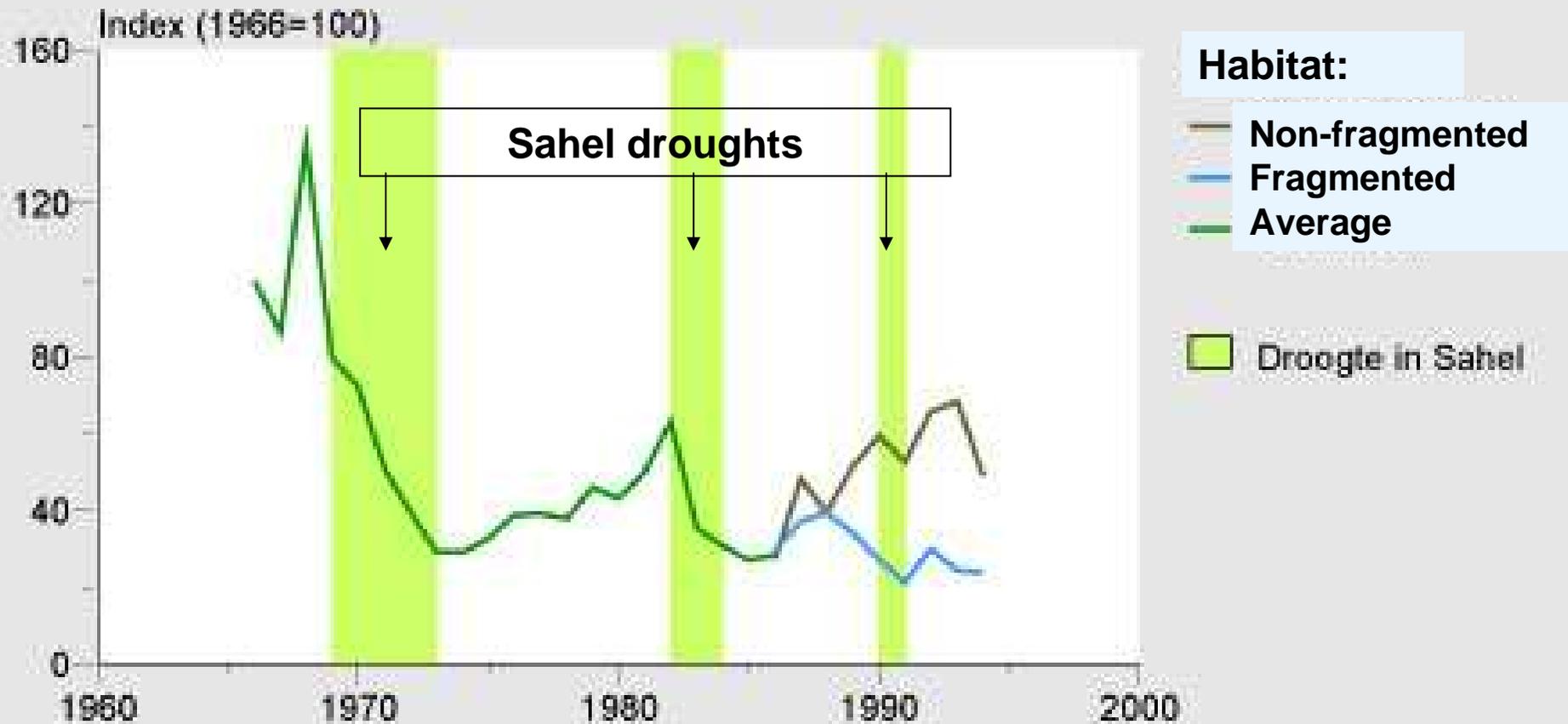
Metapopulation persistence



Interaction Climate Change and Habitat Fragmentation

	Network Cohesion		
	High	Medium	Low
Contracting species	↓	↓↓	↓↓↓
Lower Densities	—	↓	↓↓
Increasing fluctuations	↓	↓↓	↓↓↓
No range shift	—	—	—
Higher densities	↑↑	↑	—
Expanding species	↑↑↑	↑↑	—

Sedge warbler trend in monitoring data



Spatial strategies

	Change spatial structure of network	Improve surrounding landscape	Management of existing nature
Network quality		<ul style="list-style-type: none"> - Diminish flow of nutrients - Lower recreation pressure 	<ul style="list-style-type: none"> - Increase heterogeneity of vegetation of critical ecosystems
Total network area	<ul style="list-style-type: none"> -Extend large areas and merge smaller areas to get one large - Develop robust corridors 	<ul style="list-style-type: none"> - Create new habitat patches 	<ul style="list-style-type: none"> Change distribution of ecosystem types in favor of most critical ones
Network density	Increase stepping stones	Develop habitat patches	
Matrix permeability	Increase density of corridors	Improve matrix permeability	

Habitat heterogeneity: Spreading of risk

- Variation in habitat quality will dampen effects of extreme weather events
 - E.g. relatively wet and dry heath land patches
- Habitat heterogeneity will increase metapopulation resilience

Effects on ecosystem level?

1. Direct abiotic changes –hydrological conditions

2. Changes in species interactions

- * Competition
- * Predator prey
- * Mutualism

Changes in species composition and ecosystem structure

- * Loss of biodiversity
- * Increase of mobile species with broad habitat choice