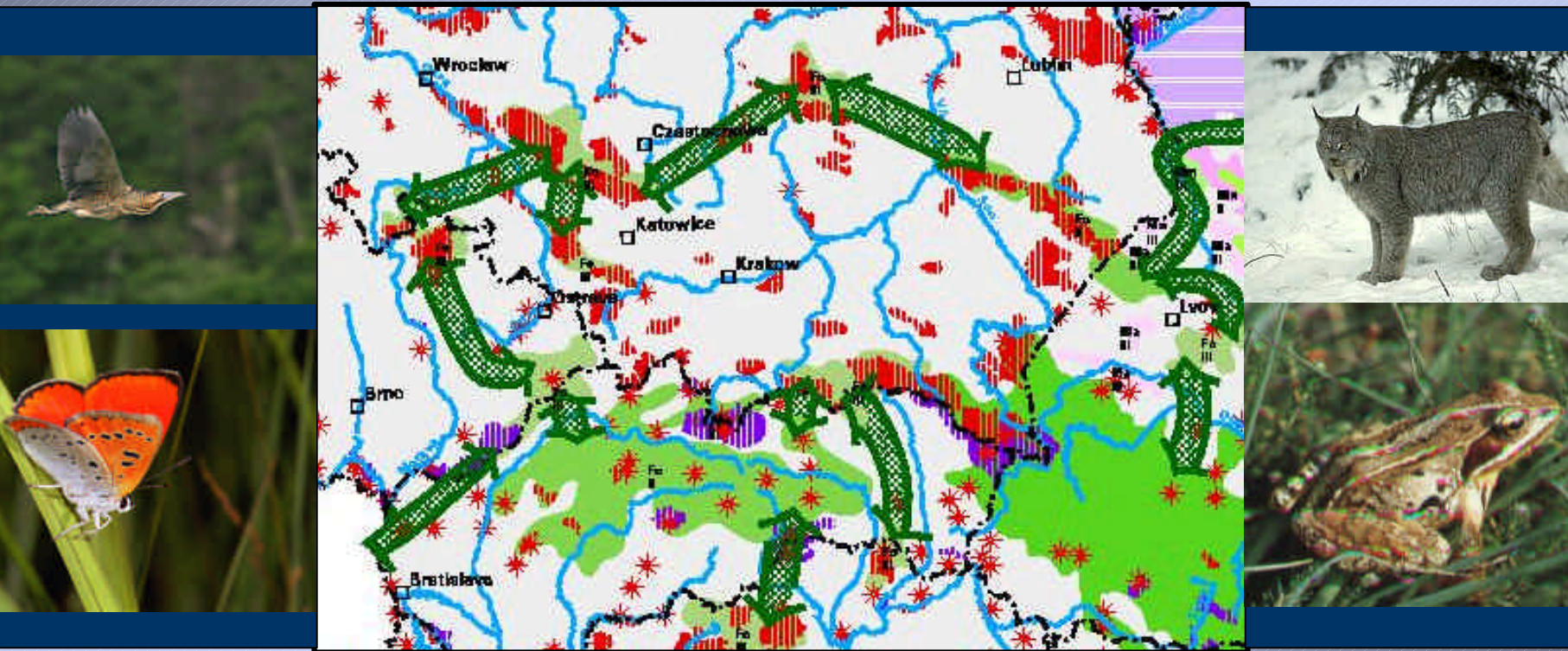
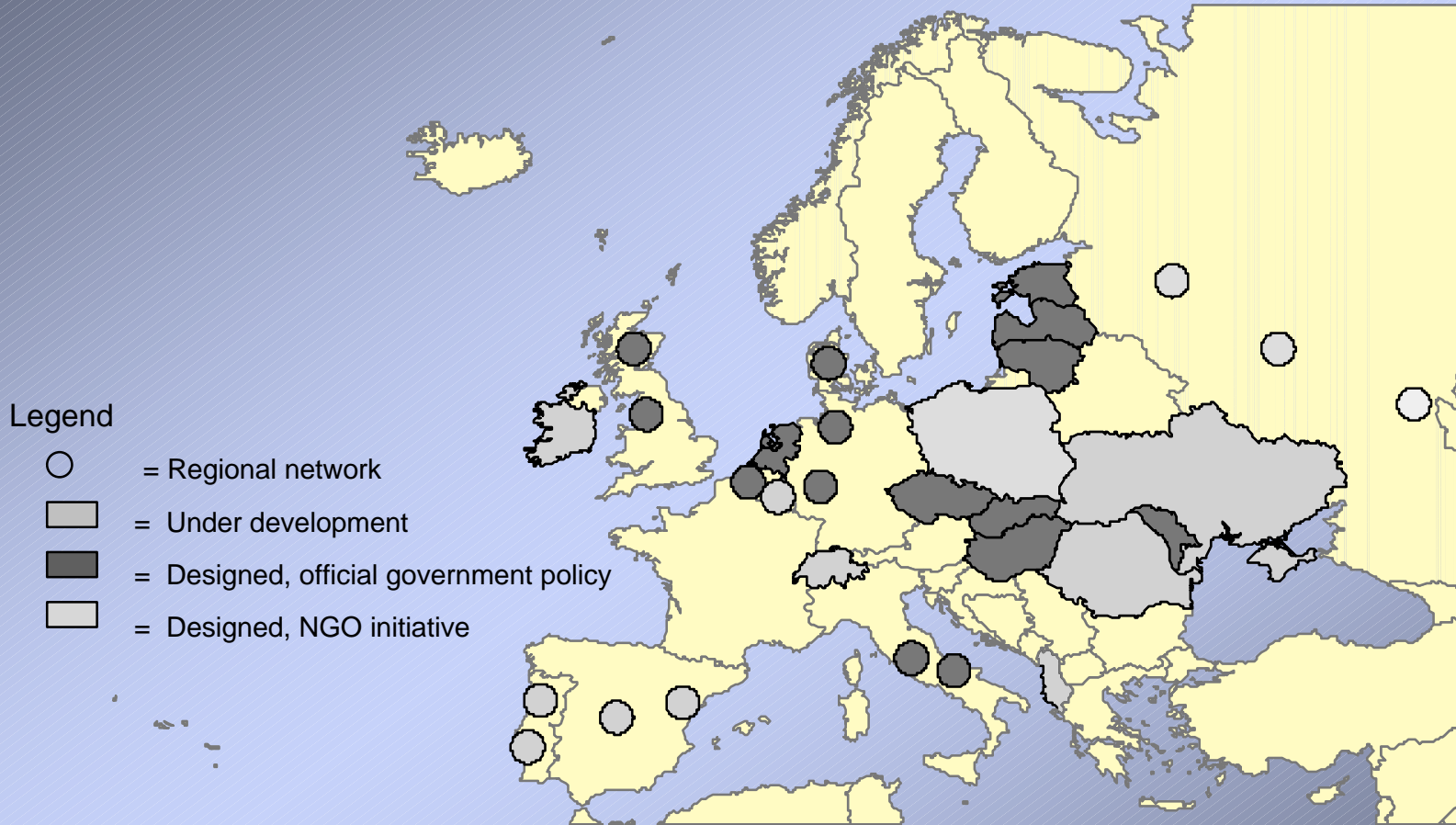


Coherent networks of protected areas: why and how?



Paul Opdam & Irene Bouwma

Countries at work



Based on Jongman, R.H.G. & I. Kristiansen, 2001, Sepp & Kaasik, 2003

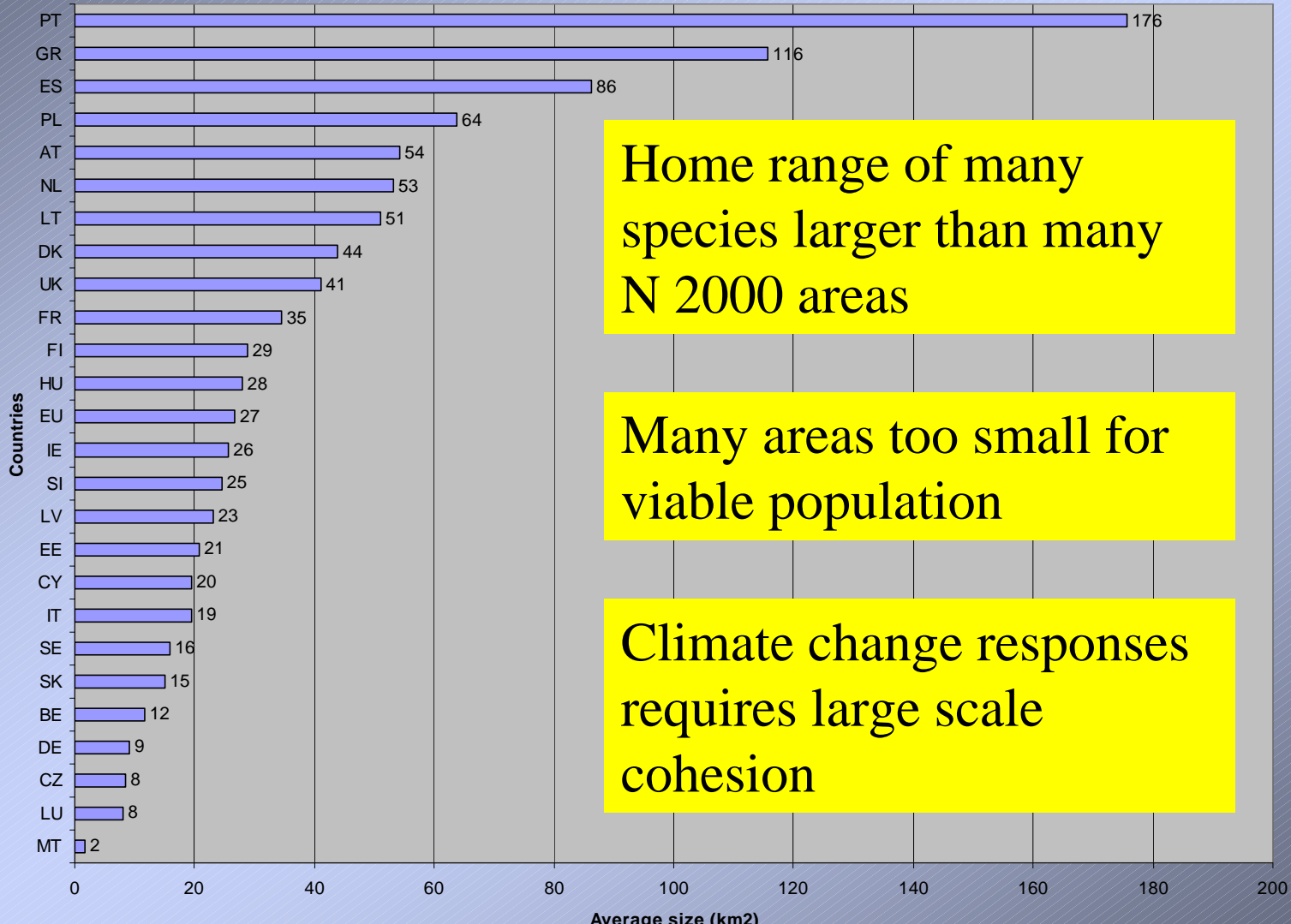


Take-home message

**Natura 2000 sites
only ensure
long-term persistence
if they are part of
a functionally coherent network of
ecosystems**



Average size of Natura 2000 areas



Home range of many species larger than many N 2000 areas

Many areas too small for viable population

Climate change responses requires large scale cohesion

Article 10: Our view

- + Article 3: Conditions ensuring long term persistence
- “Improve ecological coherence of Natura 2000”
- “In land use planning and development”
- “Landscape features important for wild fauna and flora”



After designating Natura 2000 sites:

How to make them part of a functionally cohesive network?

- Inserting Natura 2000 sites into an existing network (is it enough?)
- How to develop a supportive network structure for the Natura 2000 sites?
- How to incorporate these goals in regional planning policy?



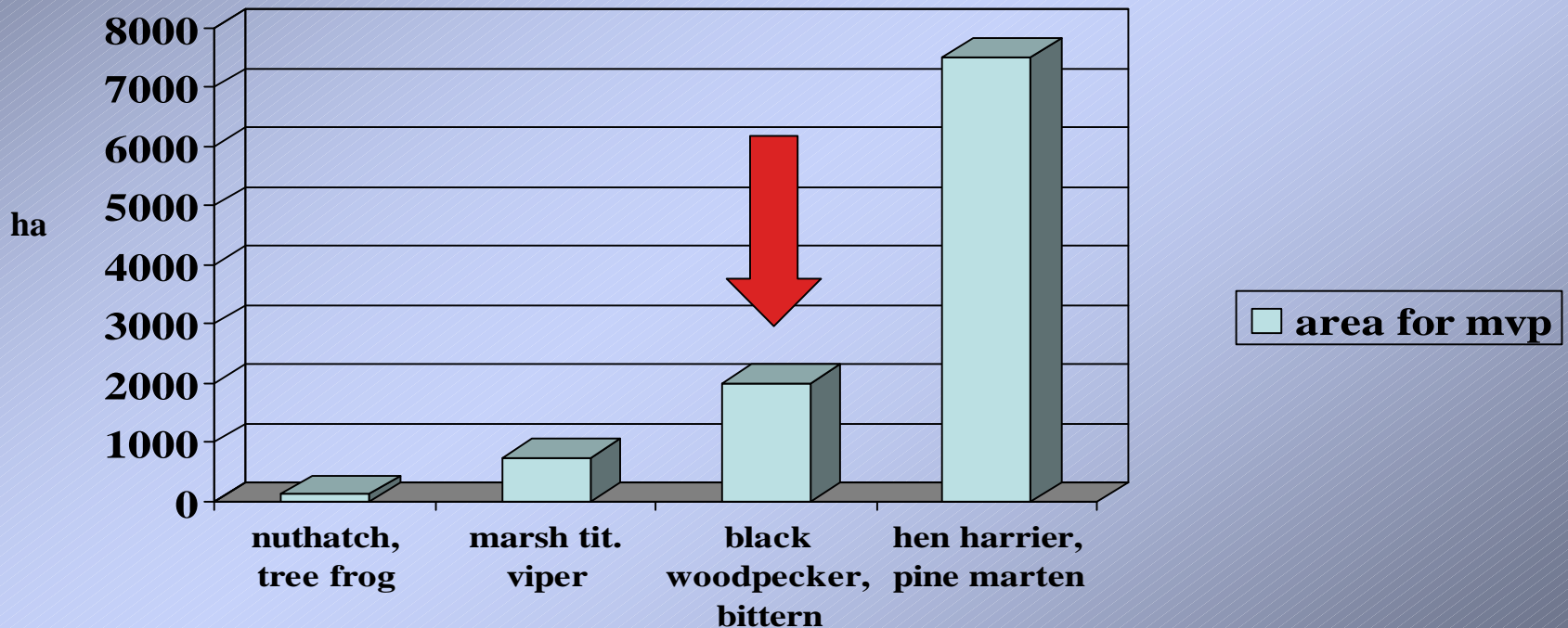
Structure

- **Why functional cohesion?**
- Principles of network cohesion
- Diagnosis and strategies
- Perspectives

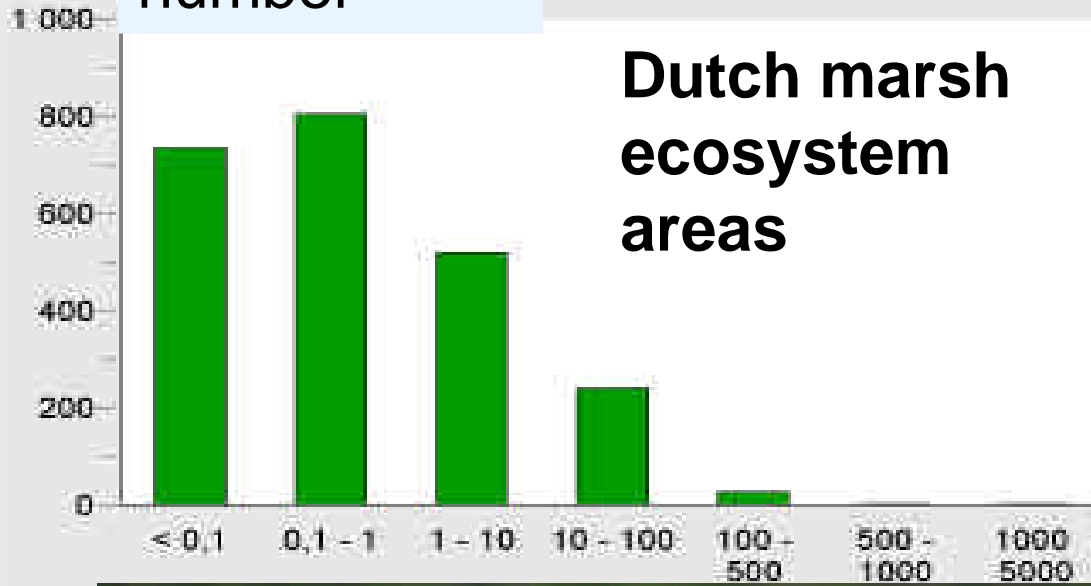


Area of continuous high quality habitat required for persistence

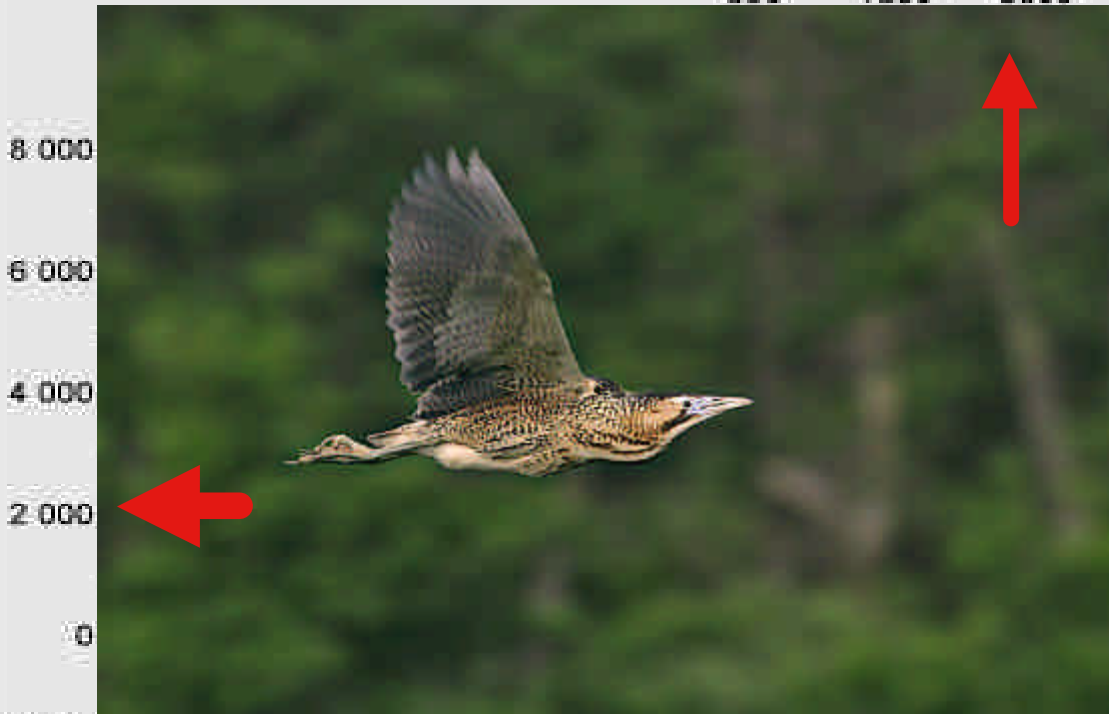
(minimum viable population with 5% chance of extinction in 100 years, no large scale disturbances)



number

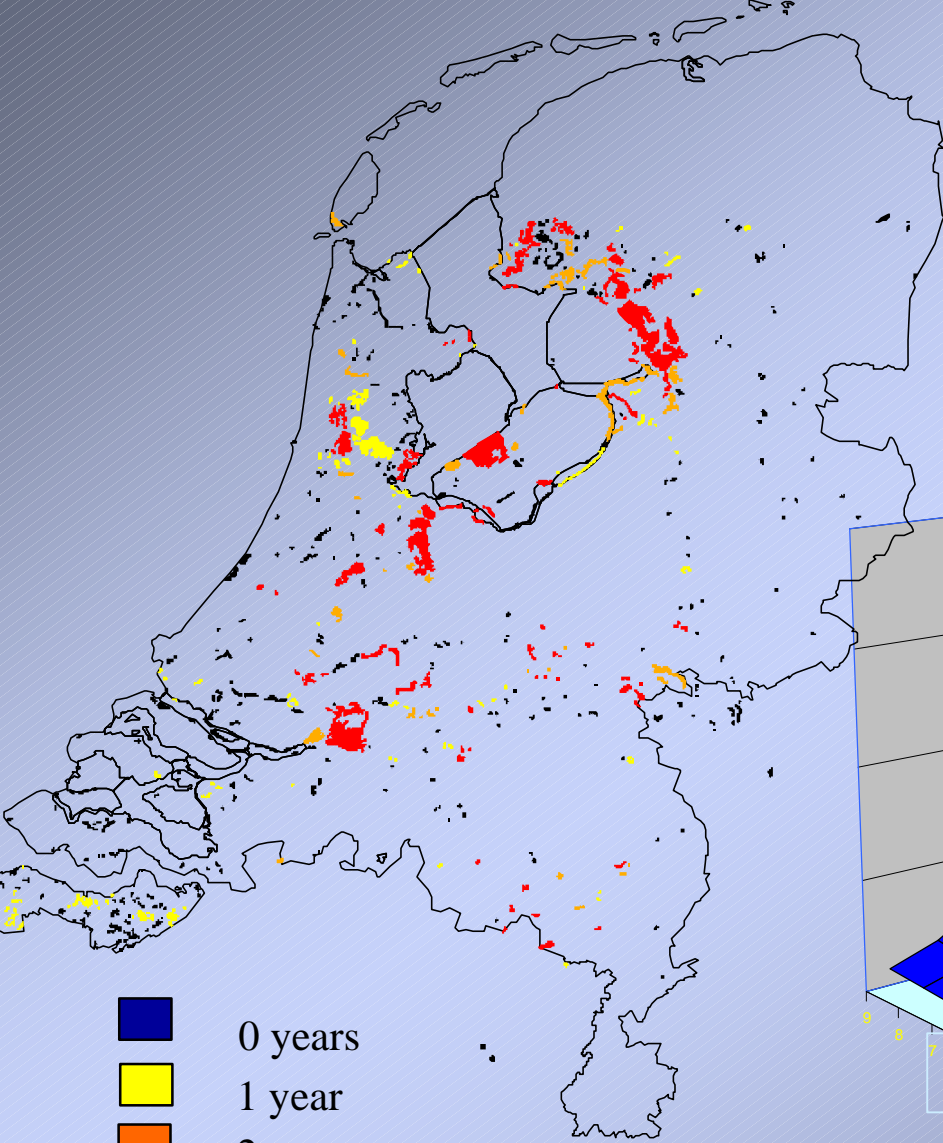


size



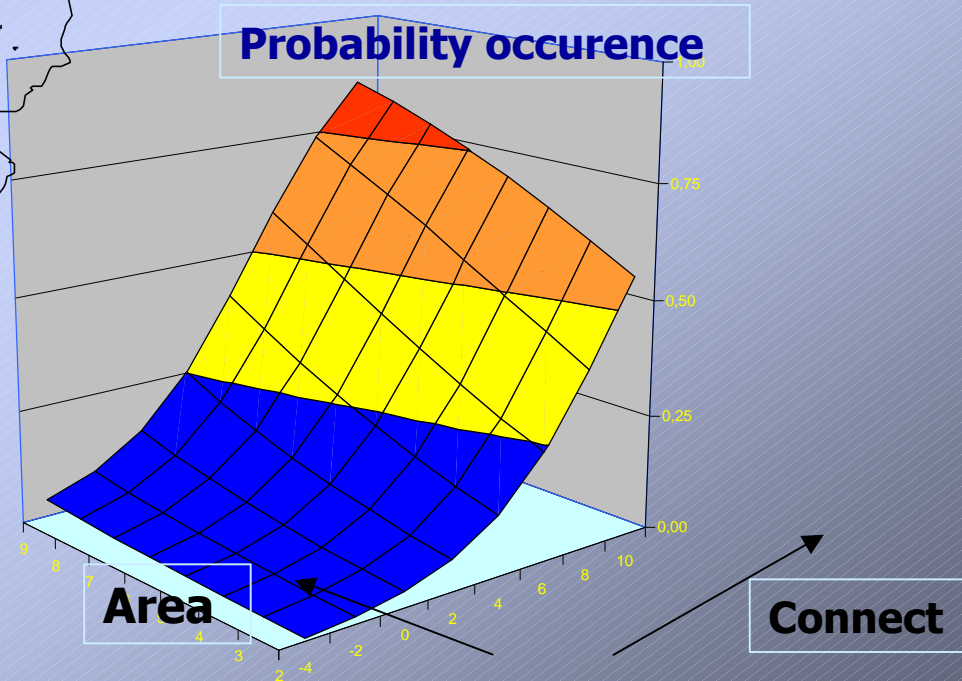
Bittern: national level habitat network

Foppen, 2002



- 0 years
- 1 year
- 2 years
- >2 years

(SOVON data)

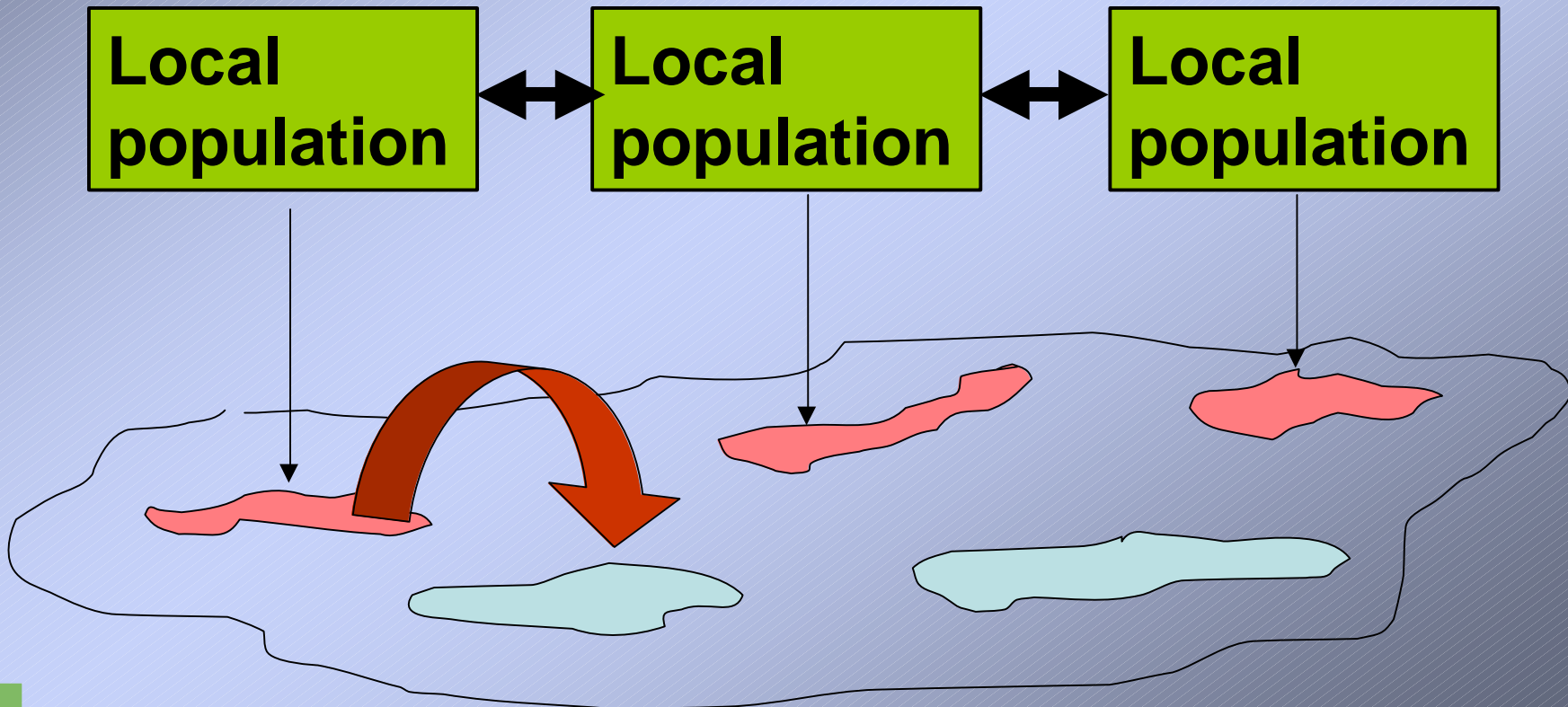


Probability occurrence

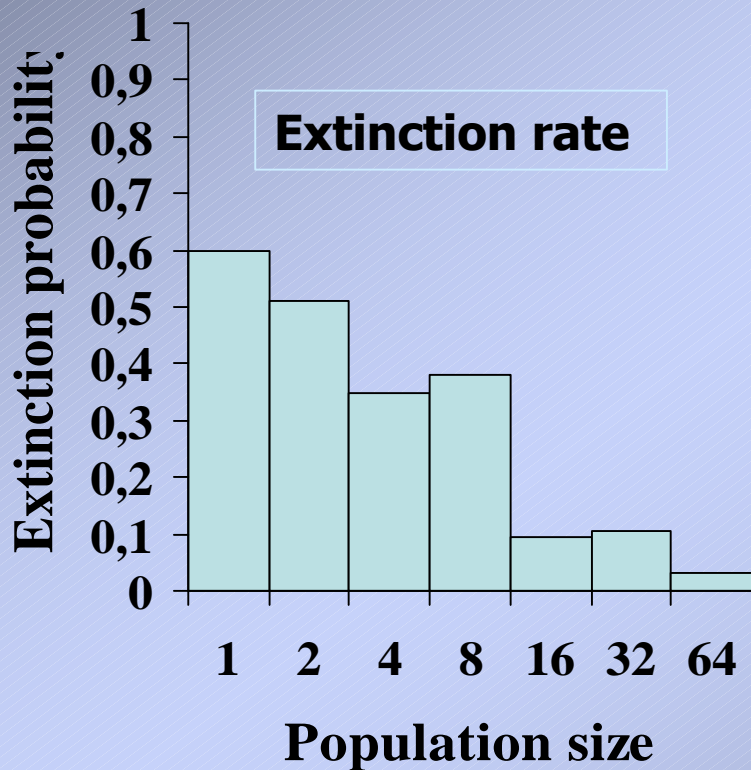
Area

Connect

Metapopulation: network of populations

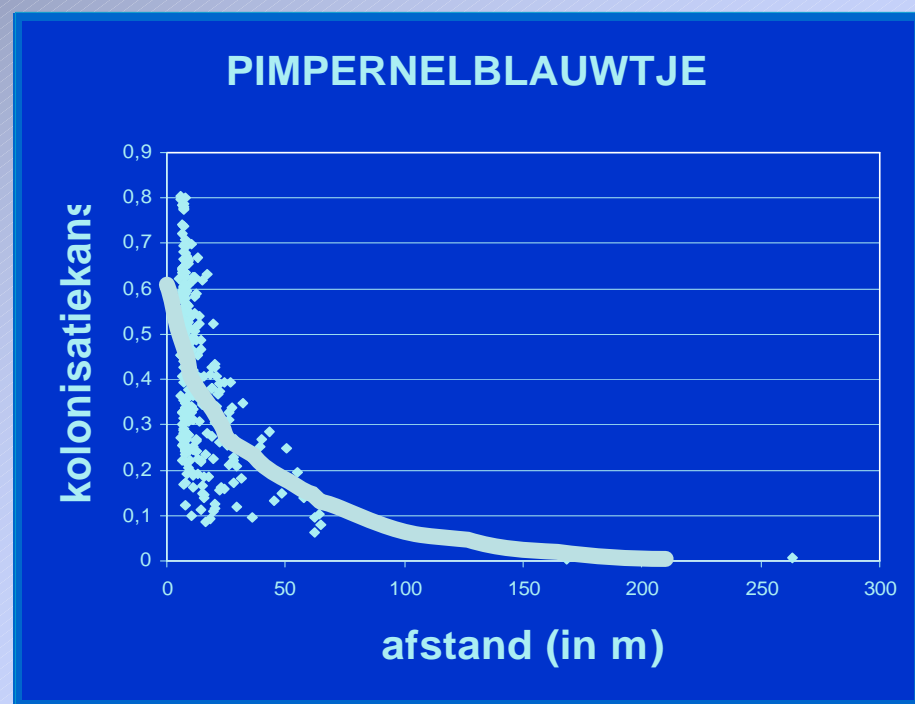


Two basic processes in networks



Silver studded blue

Thomas 1994

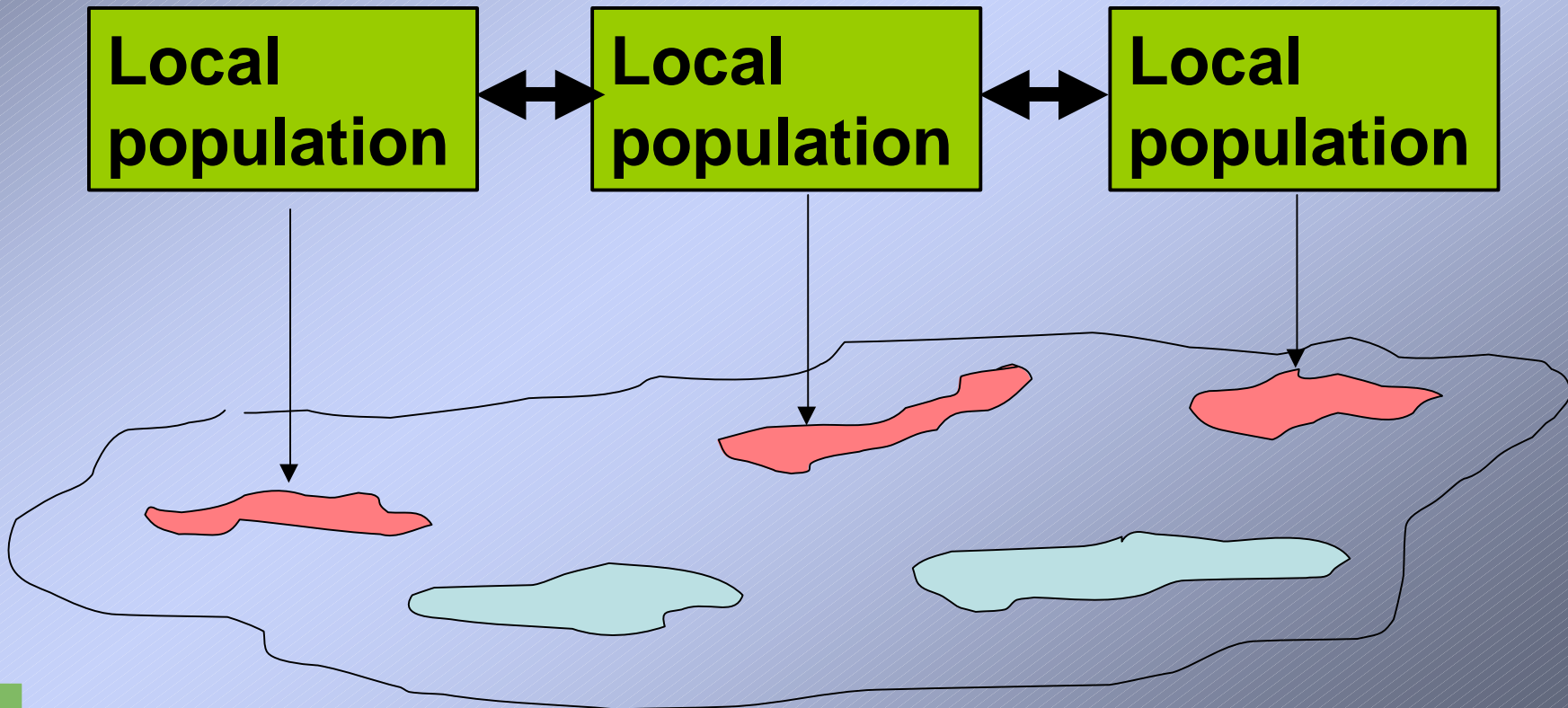


Colonisation rate

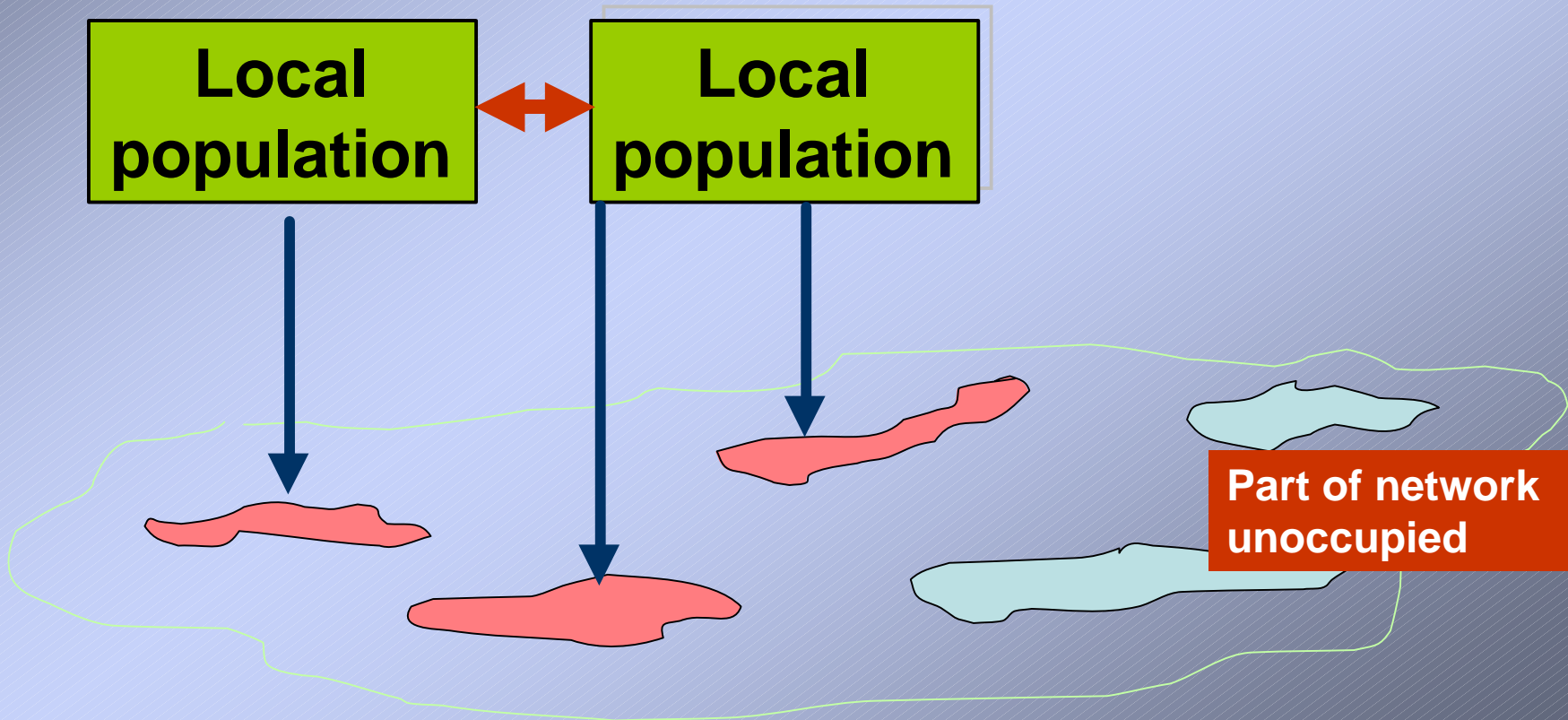
V. Langevelde et al. 2001



Metapopulation: Spatial dynamics within network

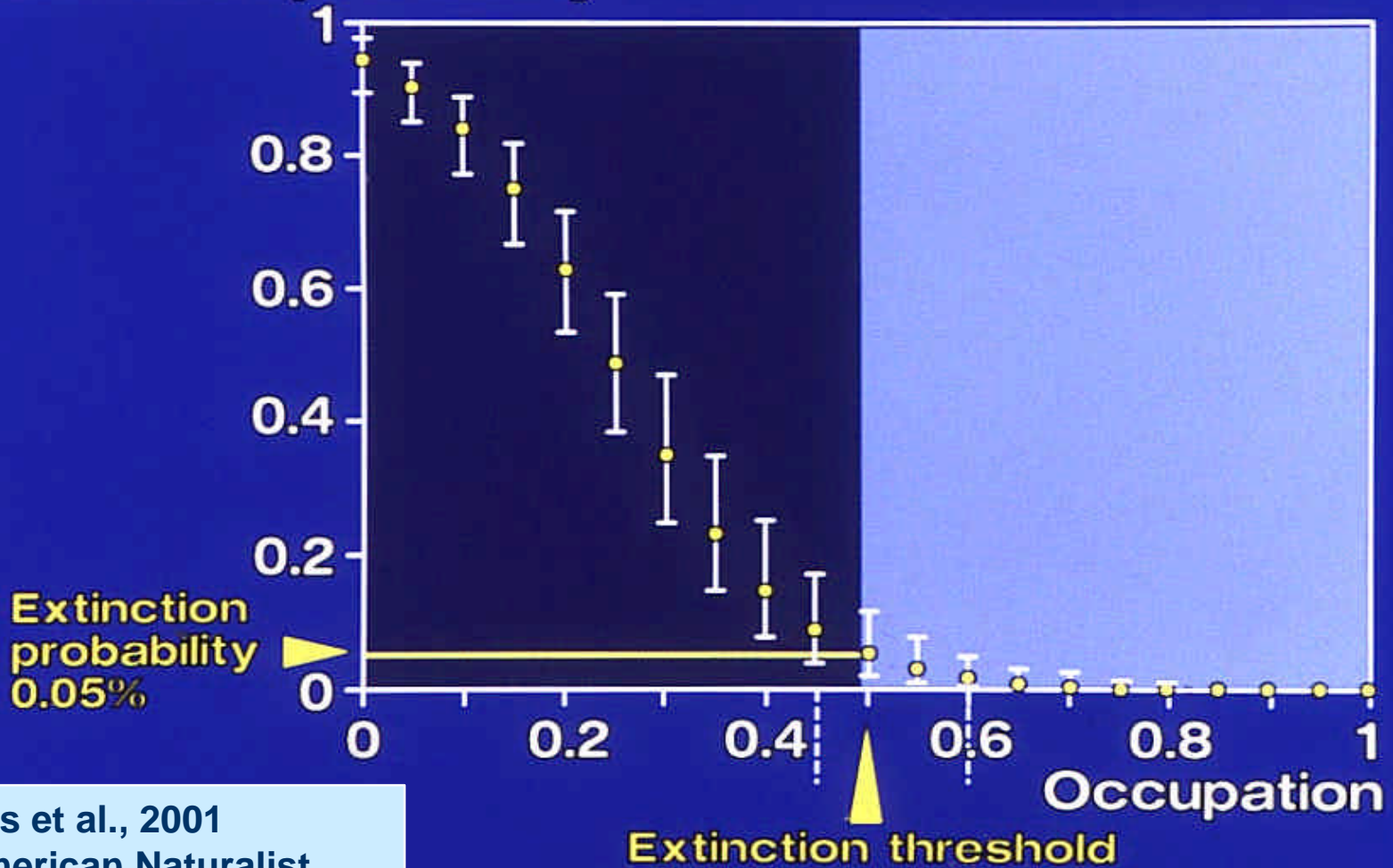


Metapopulation: Spatial dynamics within network



50% occupation as a critical threshold

Extinction probability



Vos et al., 2001
American Naturalist

**Natura 2000 sites should
function as an ecosystem
network**



Fragmentation: the first argument for cohesive networks

- **Fragmentation: habitat areas too small for long-term persistence**
- **If ecosystems in network: small habitat areas support each other**
- **Two key processes: dispersal and local extinction**



The second argument: climate change

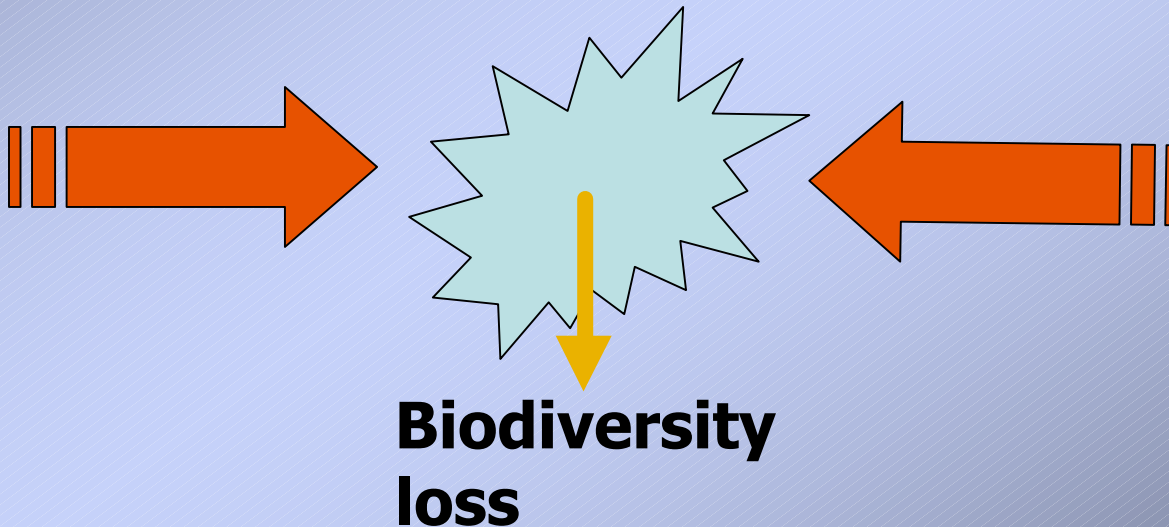
- **Temperature increase**
- **Increase of extreme weather events**



Habitat fragmentation and climate change are a deadly mixture

Climate change

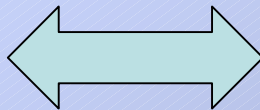
Habitat fragmentation



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

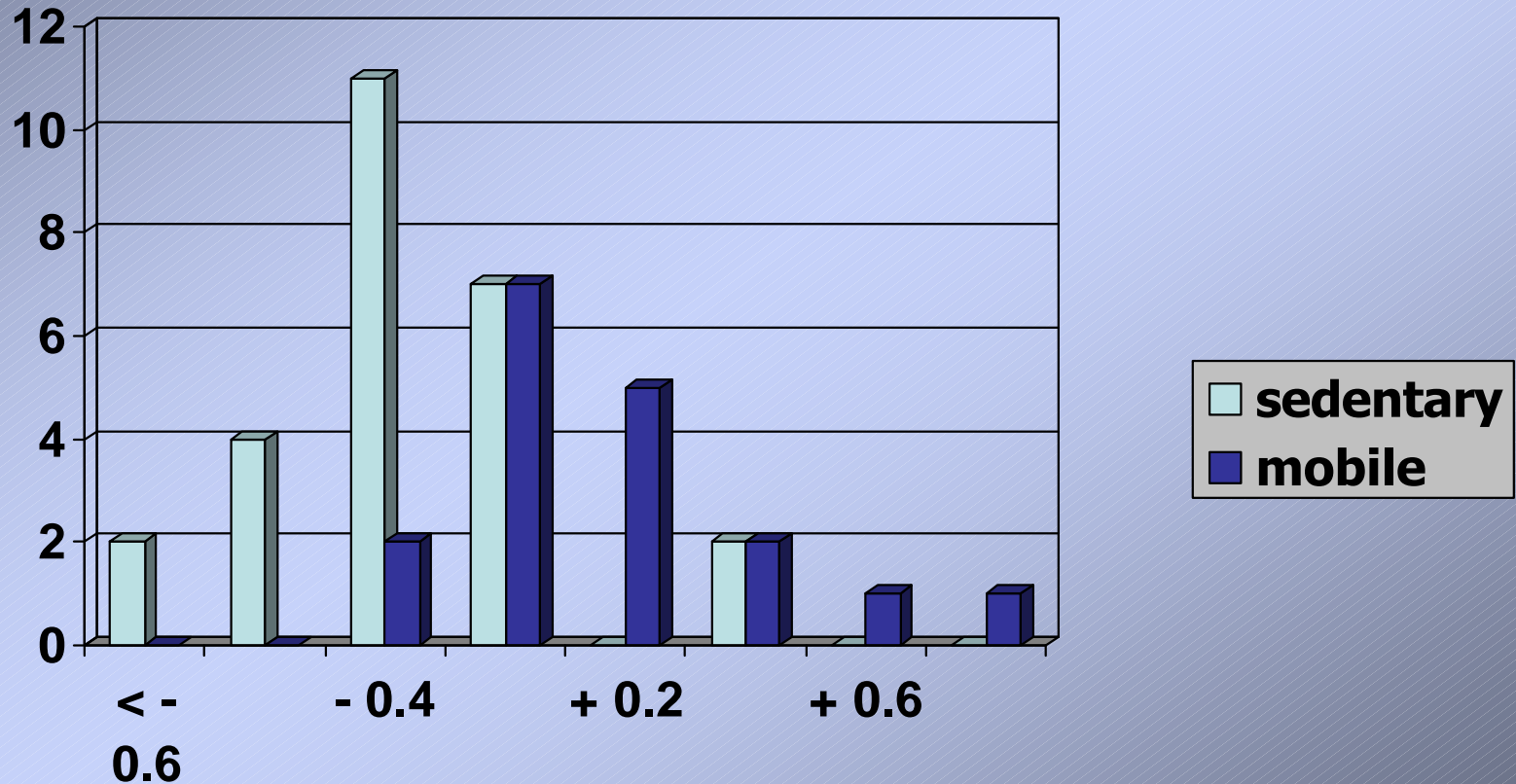


**Short-distance
disperser**



**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.

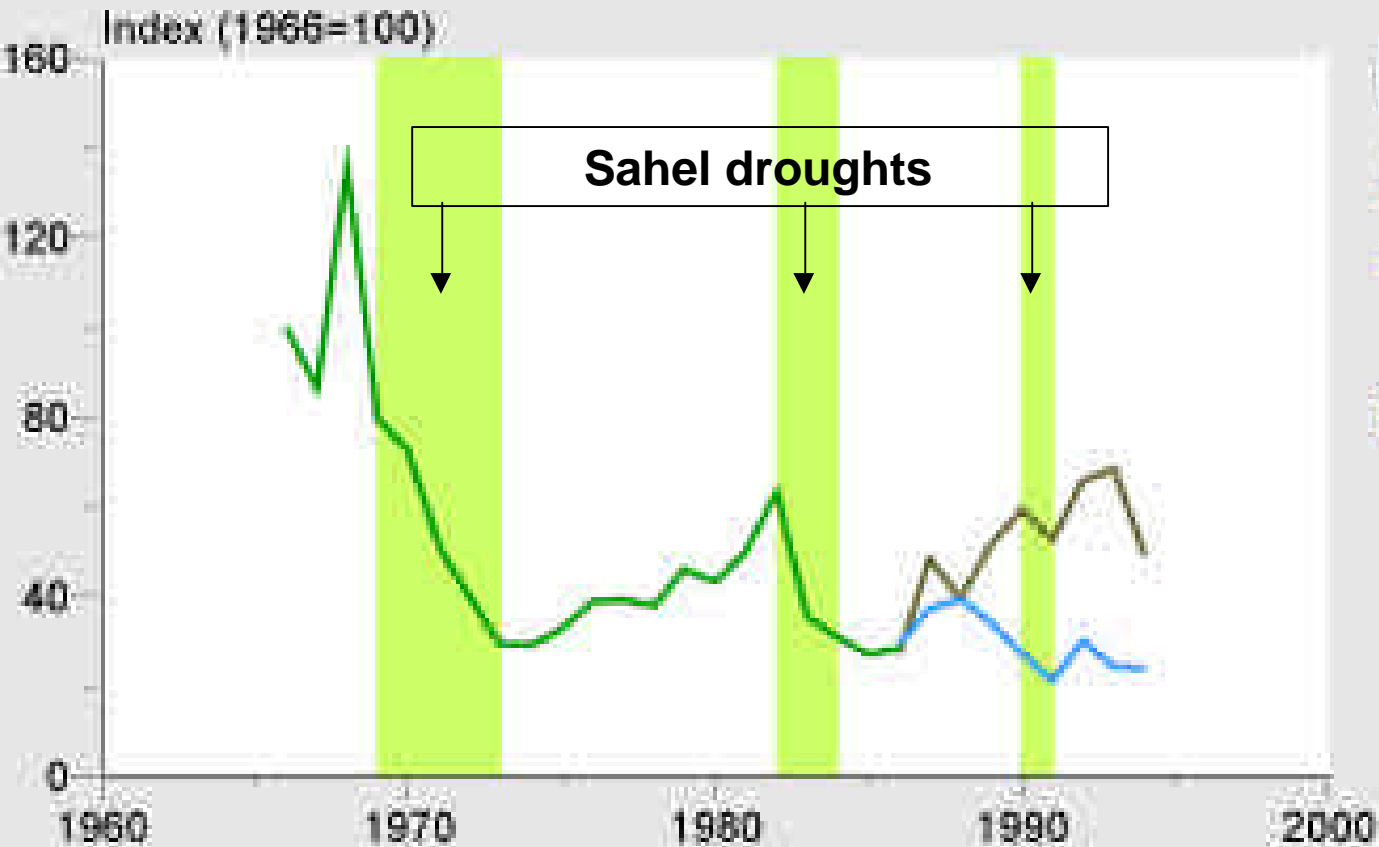
Warren et al. 2001

2.

More frequent weather extremes
means higher fluctuations in
numbers



Sedge warbler trend in monitoring data



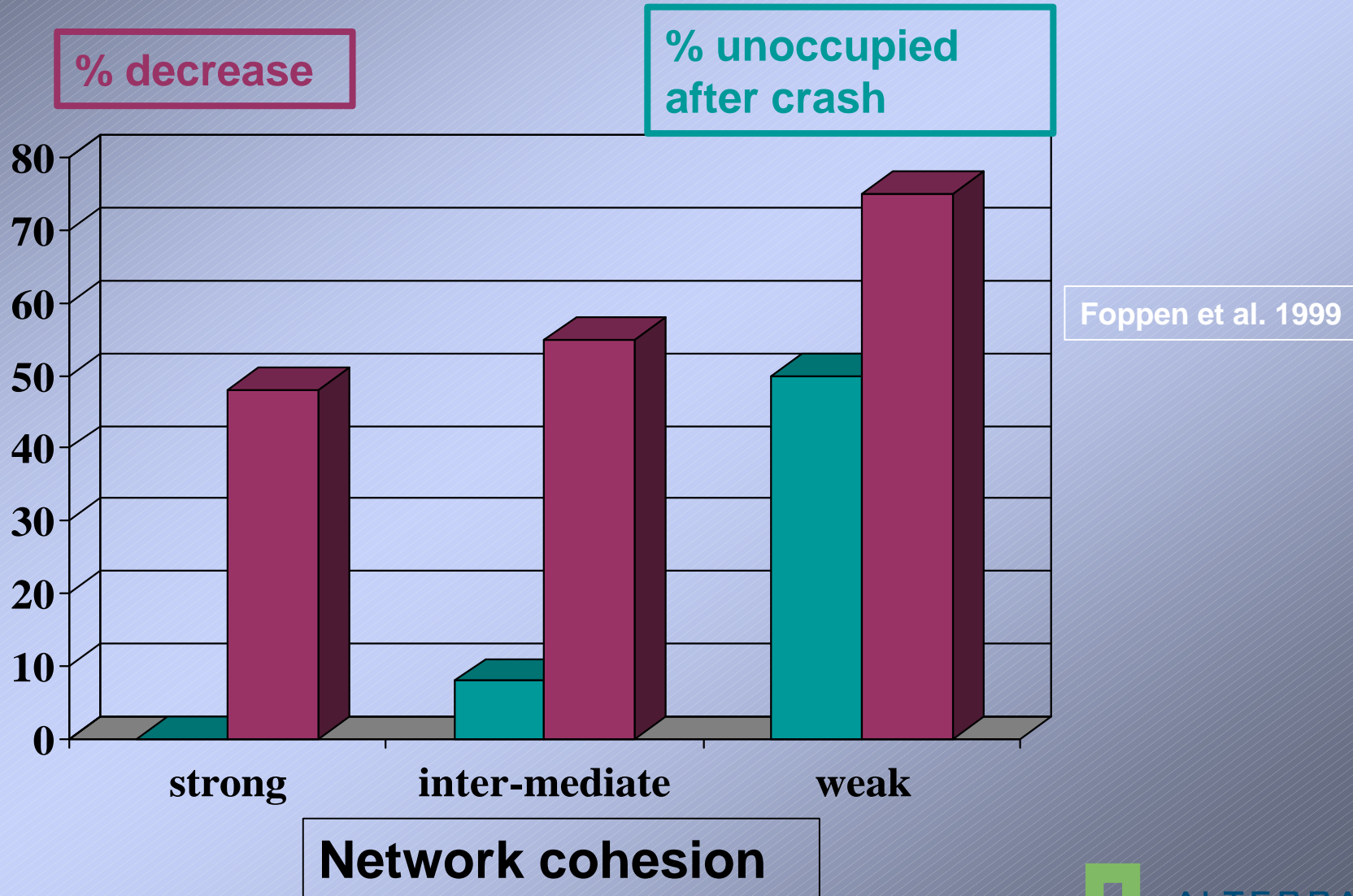
Habitat:

- Non-fragmented
- Fragmented
- Average

■ Drought in Sahel

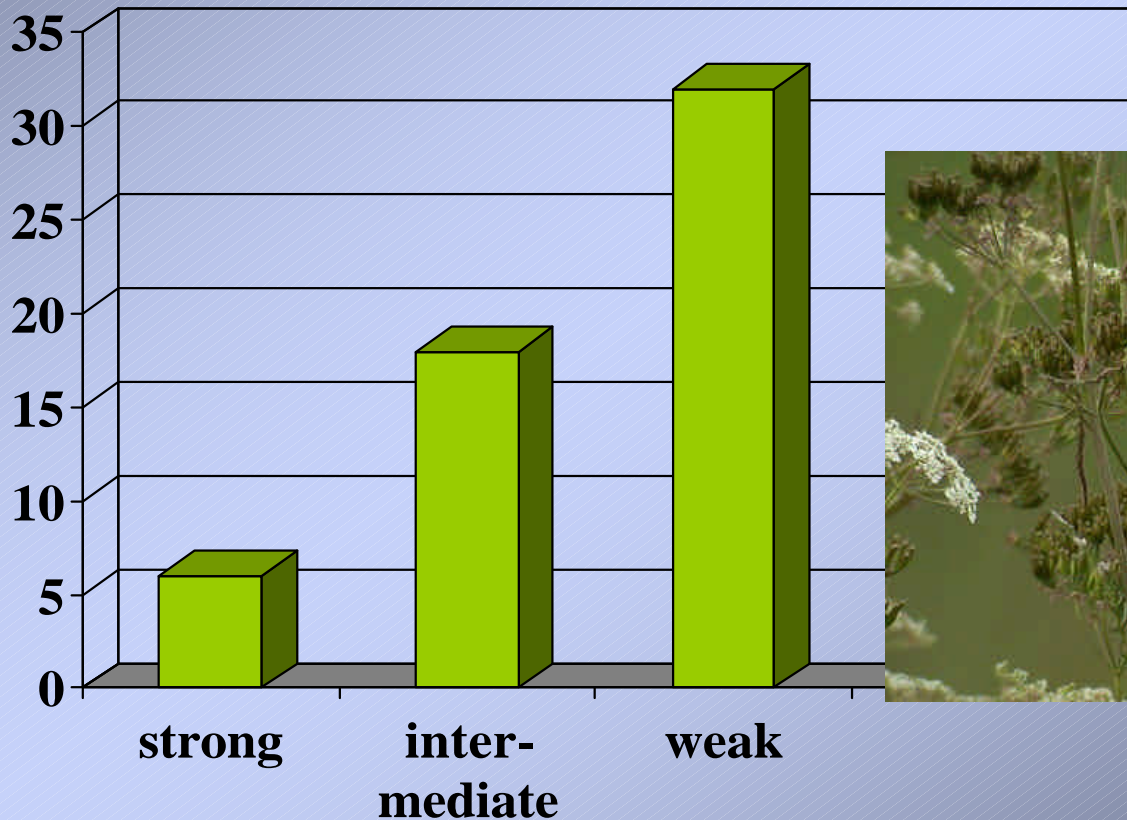
Sedge warbler crash during Sahel drought

less severe in stronger habitat networks



Predicted sedge warbler recovery: faster in stronger habitat networks

Years until recovered



Foppen et al. 1999



Network cohesion

**Natura 2000 sites should
function as an ecosystem
network**



Structure

- Why functional cohesion?
- **Principles of network cohesion**
- Diagnosis and strategies
- Perspectives



Two points:

- How to quantify?
- How much is enough?



Metapopulation persistent if:

1

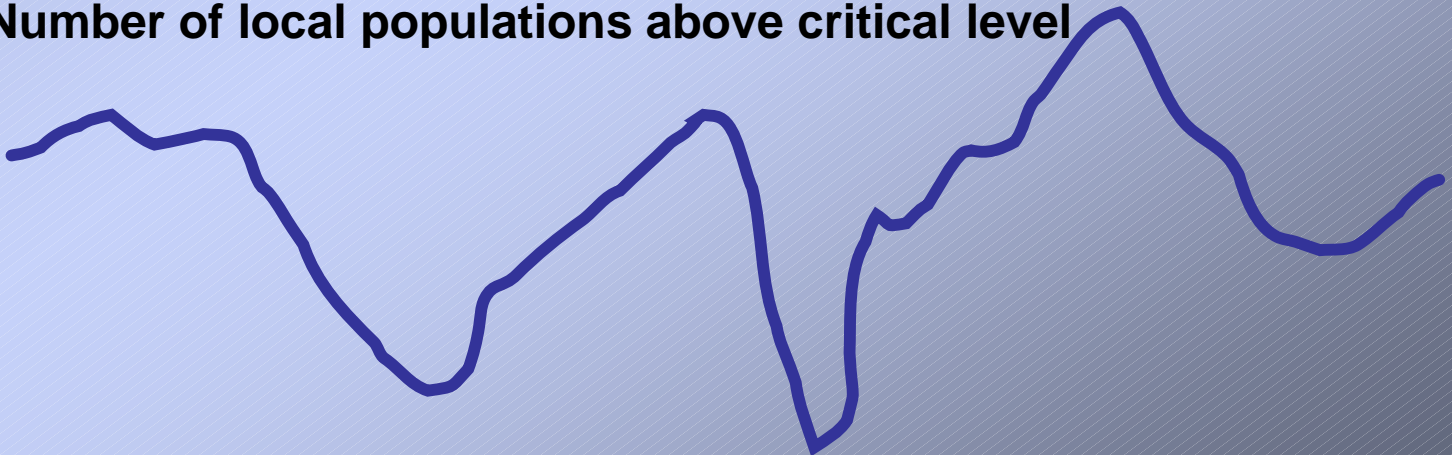
**Local
extinction
rate**

=

**Recolonization
rate**

2

Number of local populations above critical level



Key network features

1

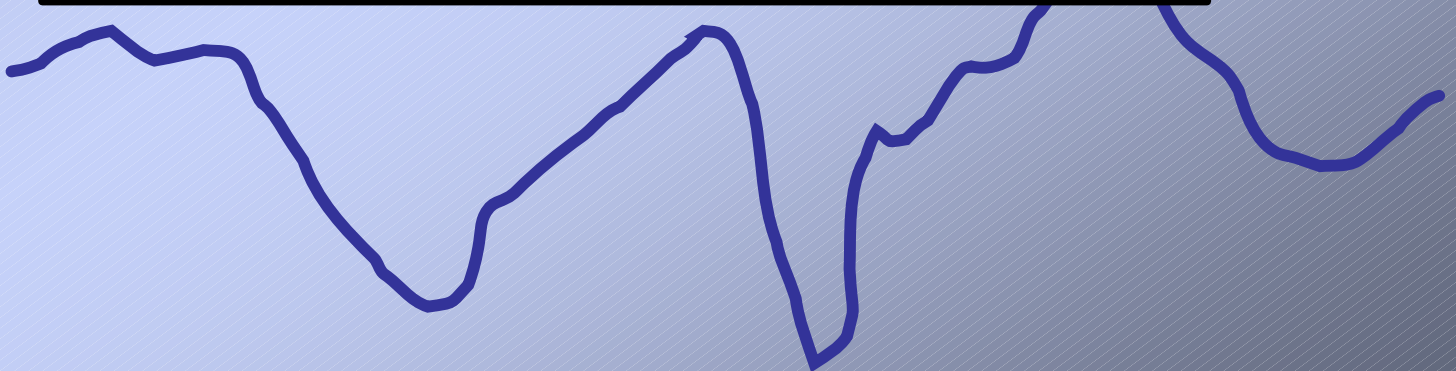
Patch
size and
quality

=

Patch density
and matrix
permeability

2

Number of patches in the network



Network cohesion

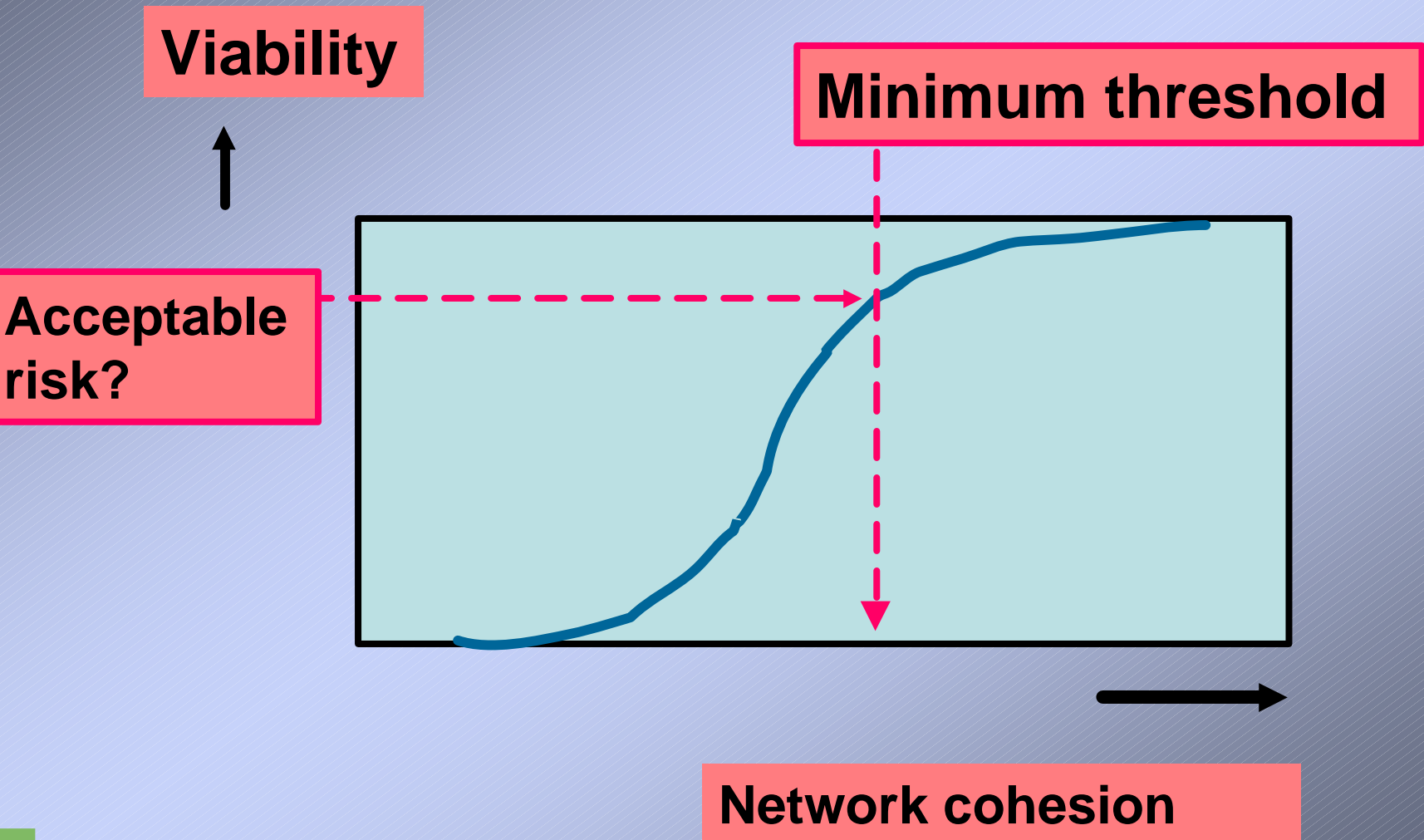
Patch
quality

Network
density

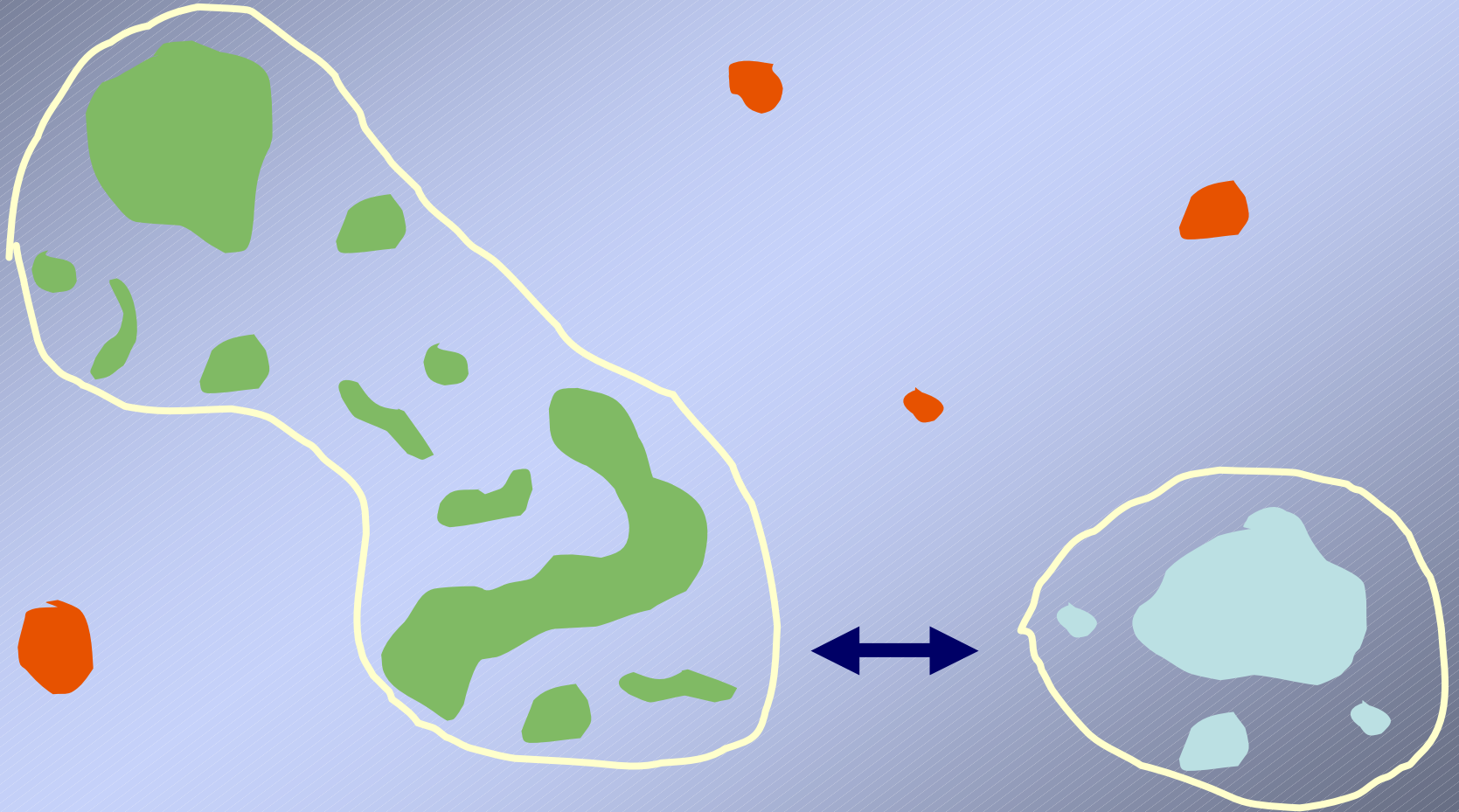
Network
area

Matrix
permeability

The challenge: to calculate the minimal required amount of cohesion

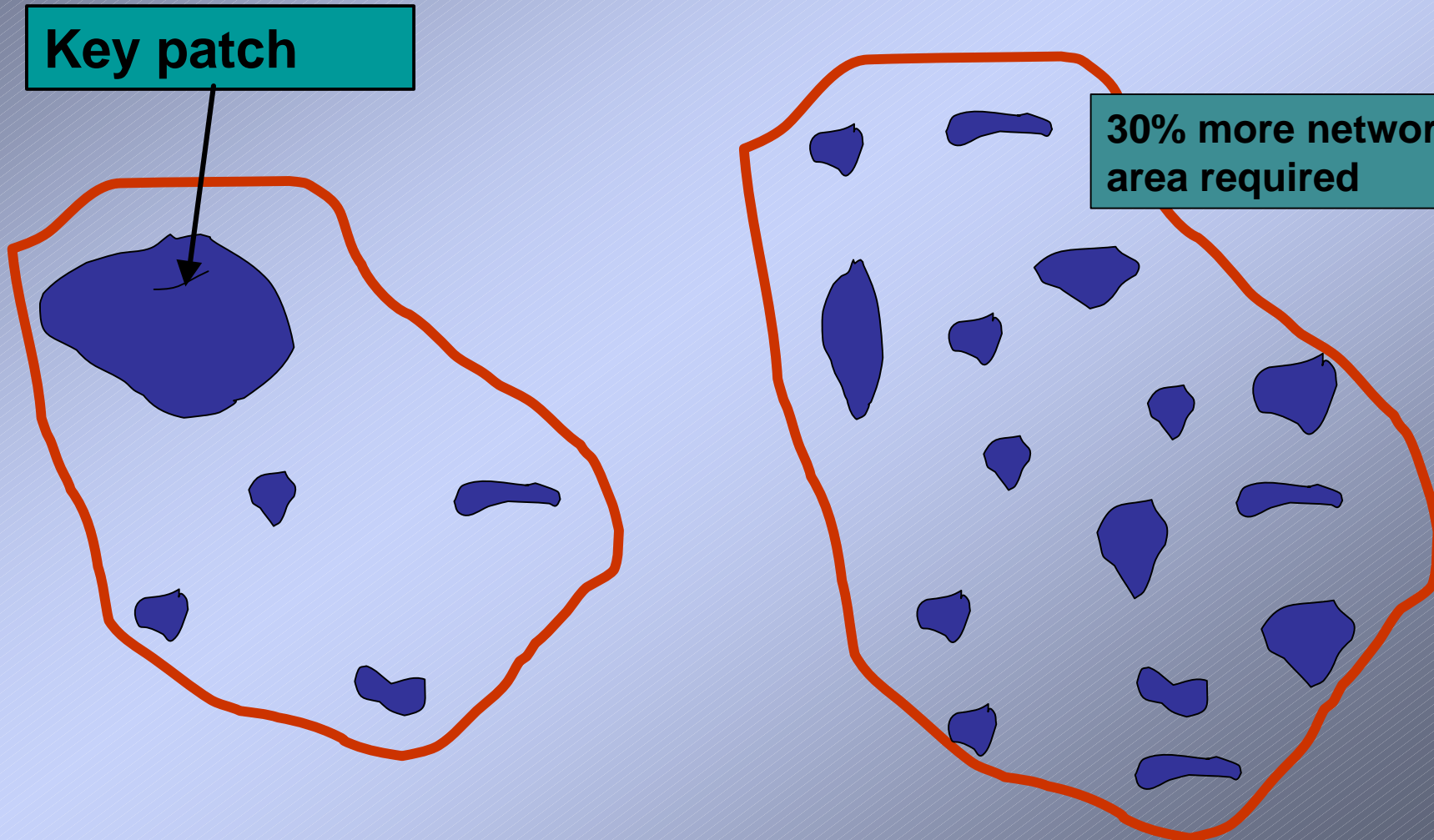


How much is enough? Delimiting networks.

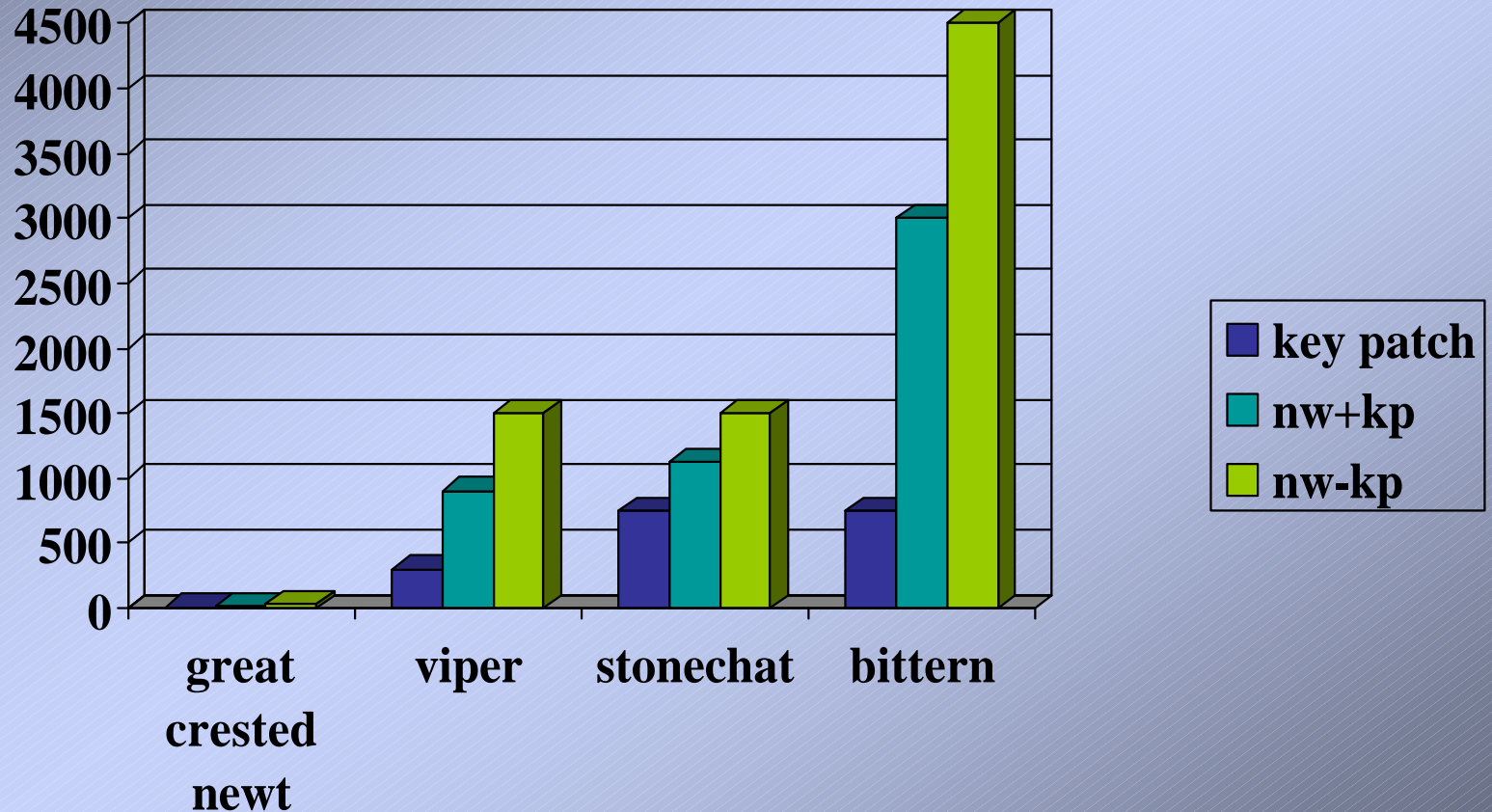


How much is enough?

Depending on distribution of habitat



How much is enough? (network area)



Principles of network cohesion

- Based on minimum threshold rules
- Network area most important
- Key patches
- Species specific



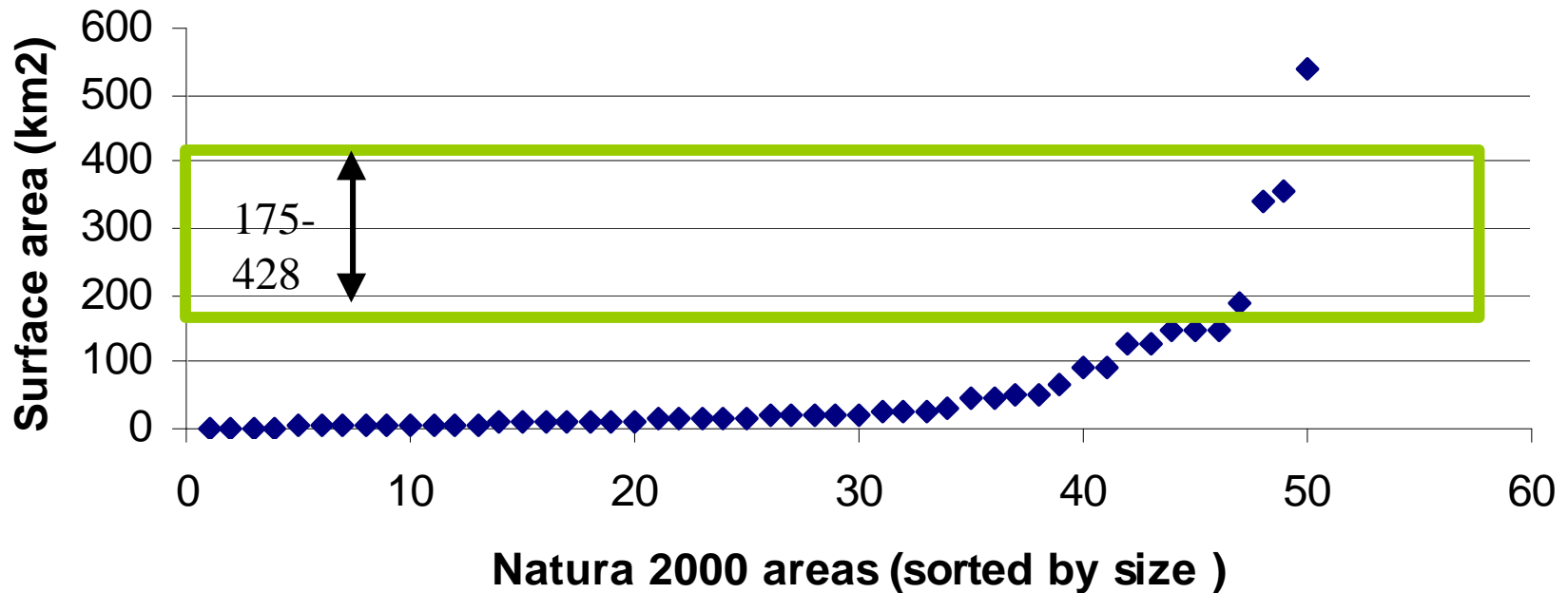
Structure

- Why functional cohesion?
- Principles of network cohesion
- **Diagnosis and strategies**
- Perspectives



Lynx in France

Surface area Natura 2000 sites in France designated for Lynx Lynx



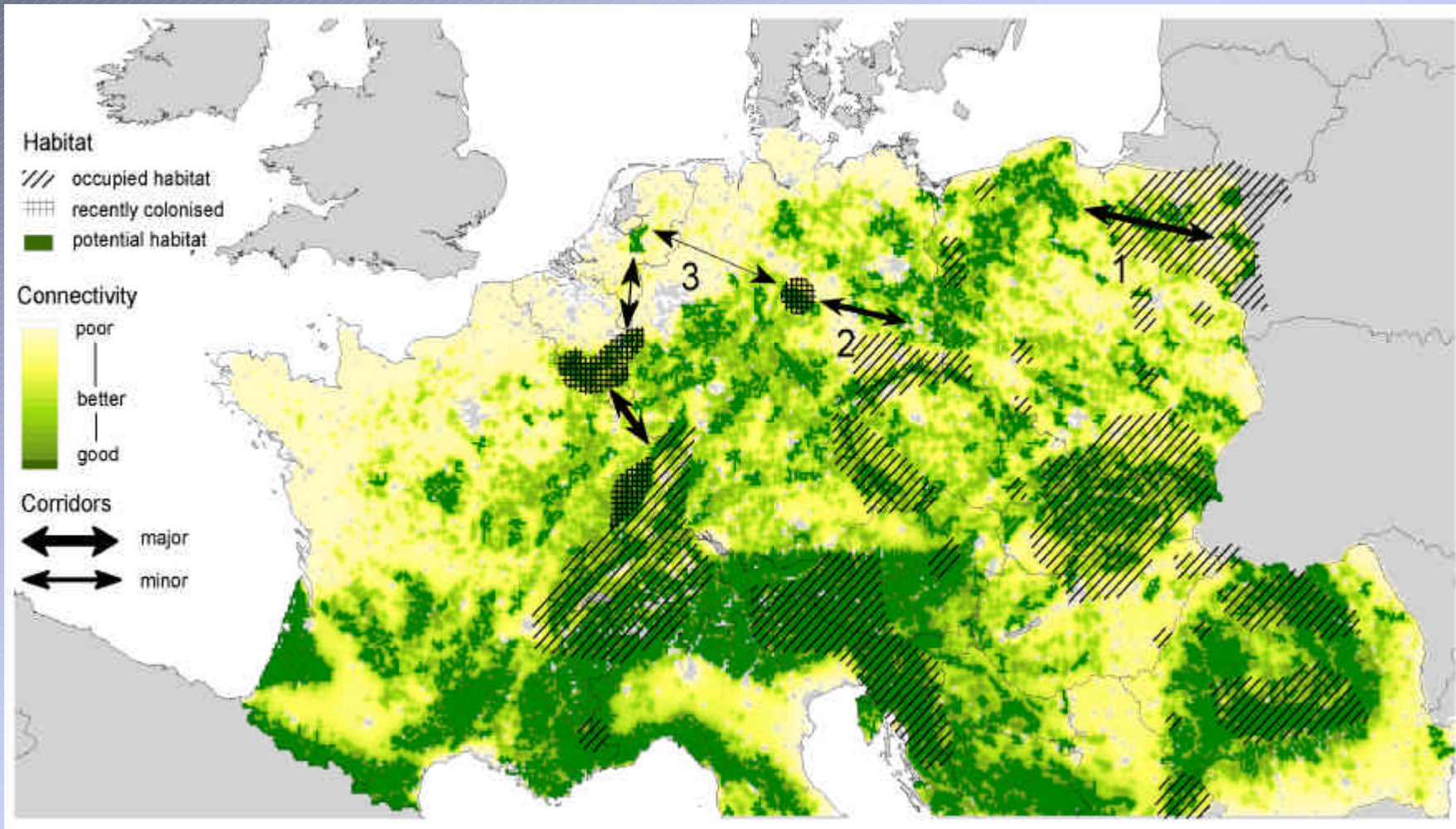
Home range

MVP (40 RE) > 2000 km2

[Http://natura2000.environment.gouv.fr](http://natura2000.environment.gouv.fr)

Groot Bruinderink in Sluis et al,

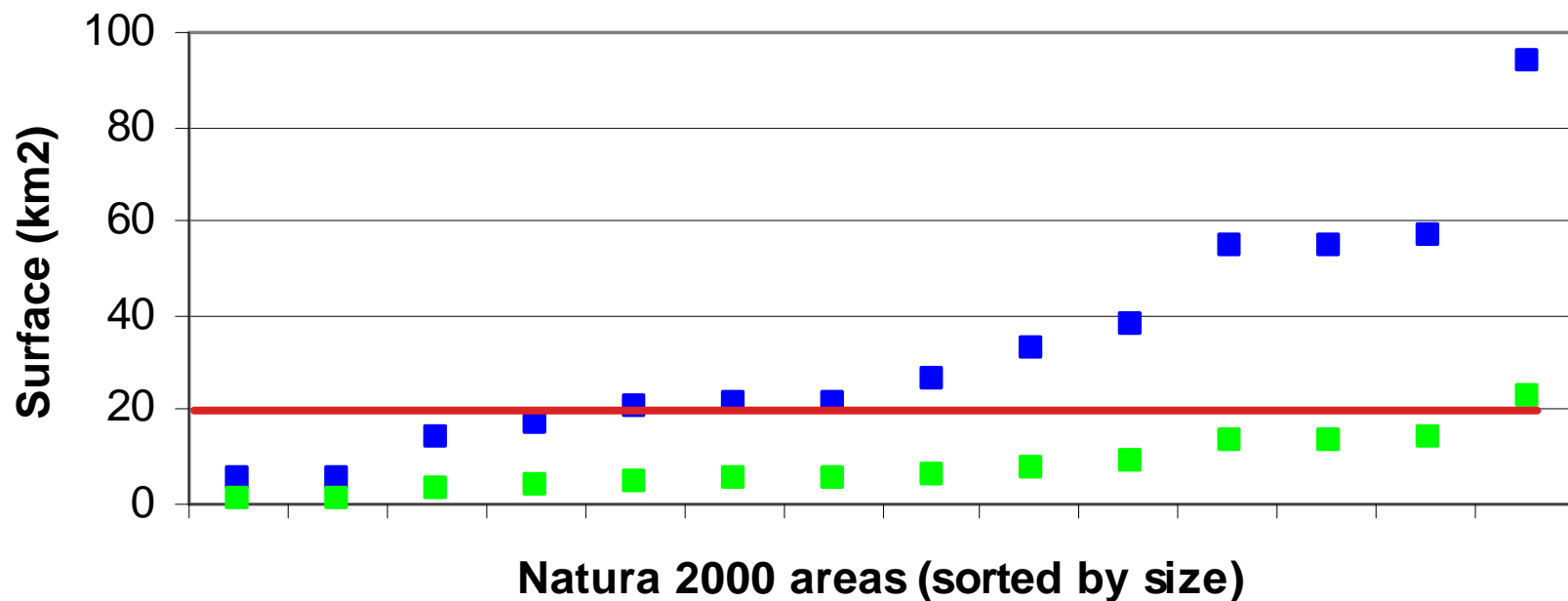
Lynx in Europe



Groot Bruinderink in Sluis et al, 2004.

Bittern in the Netherlands

Surface Natura 2000 areas designated for Bittern in the Netherlands

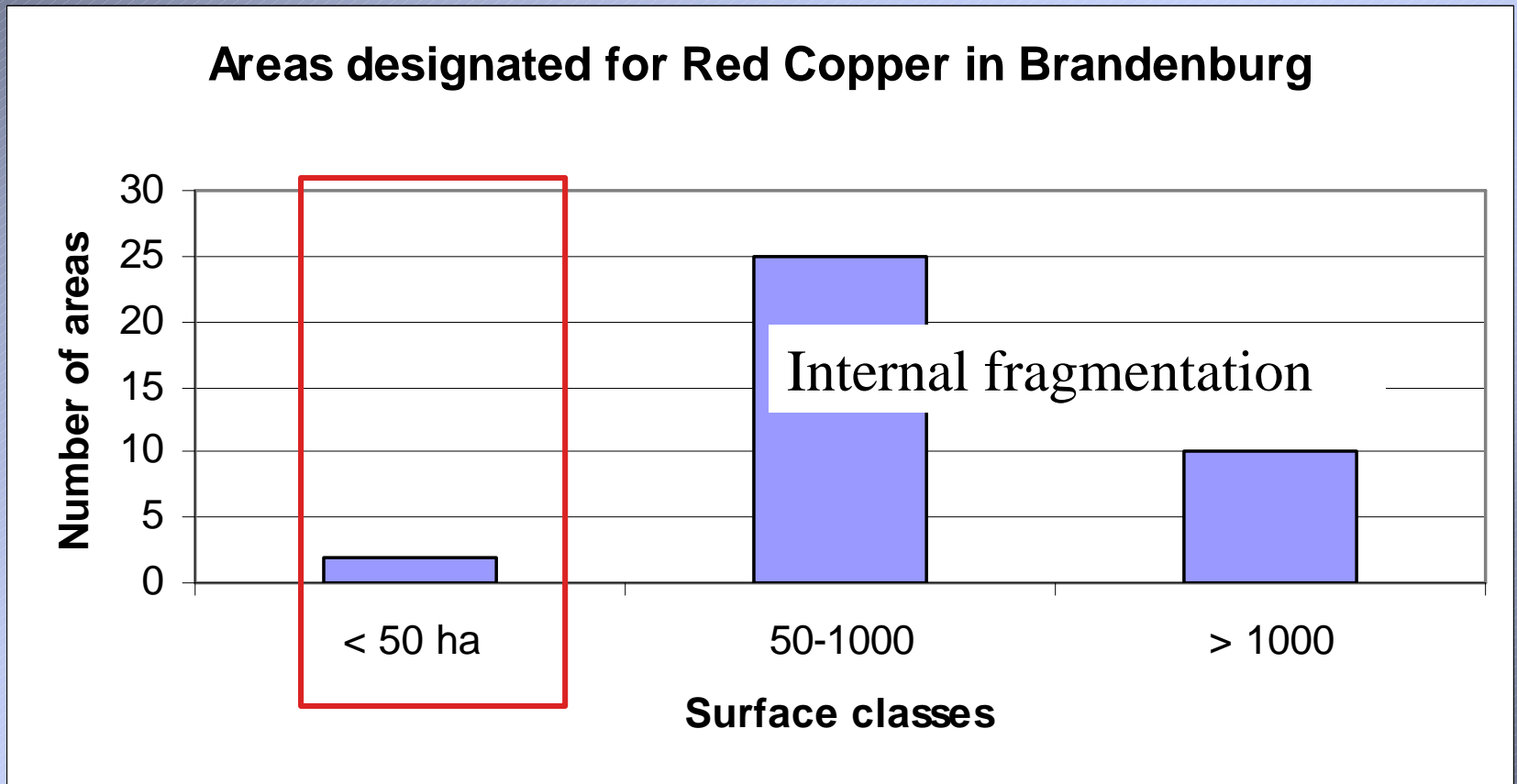


Natura 2000 database
Netherlands

MVP > 20 km²

Van der Sluis, T., S.A.M. van
Rooy & N. Geilen, 2001

Red Copper in Brandenburg

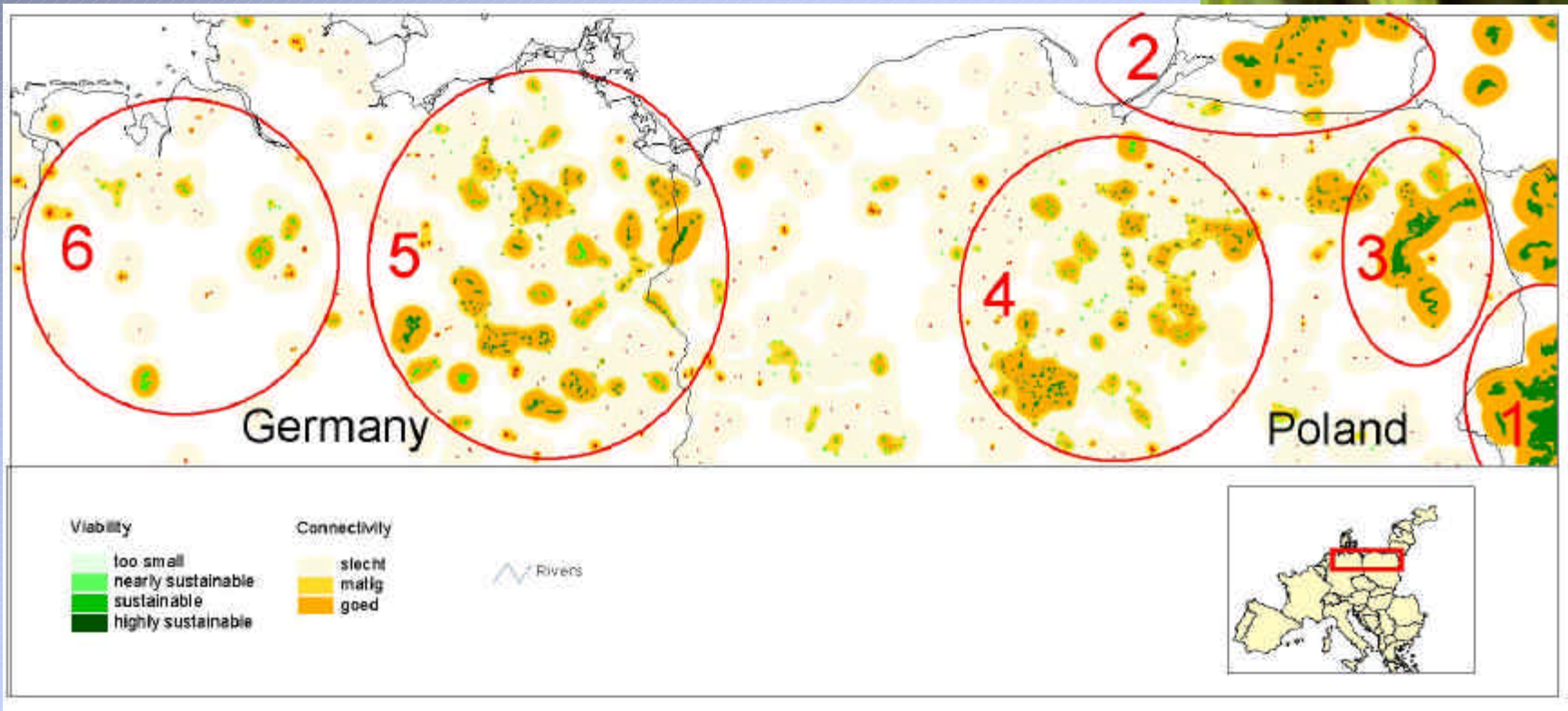


MVP > 25-50 ha

Van Swaay in: Sluis et al, 2004

www.mlvv.brandenburg.de

Red copper in Middle Europe



Movement capacity N 2000 species

Species group	Total number of species in list	Species with movement range 10-30 km	%
Mammals	41	33	80%
Birds	175	161	92%
Fish	99	10	10%
Amphibians & Reptiles	43	1	2%

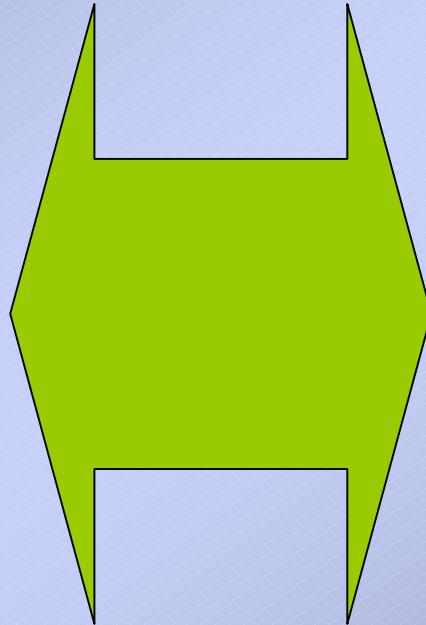
Revised from Foppen et al, 2000

Two problems

**Carrying capacity
problem**

**Areas too small
for viable
populations**

**•Larger mobile
species
•Habitat
specialists**



**Connectivity
problem**

**Areas too far apart
for responding to
climate change**

Small immobile species

4 strategies

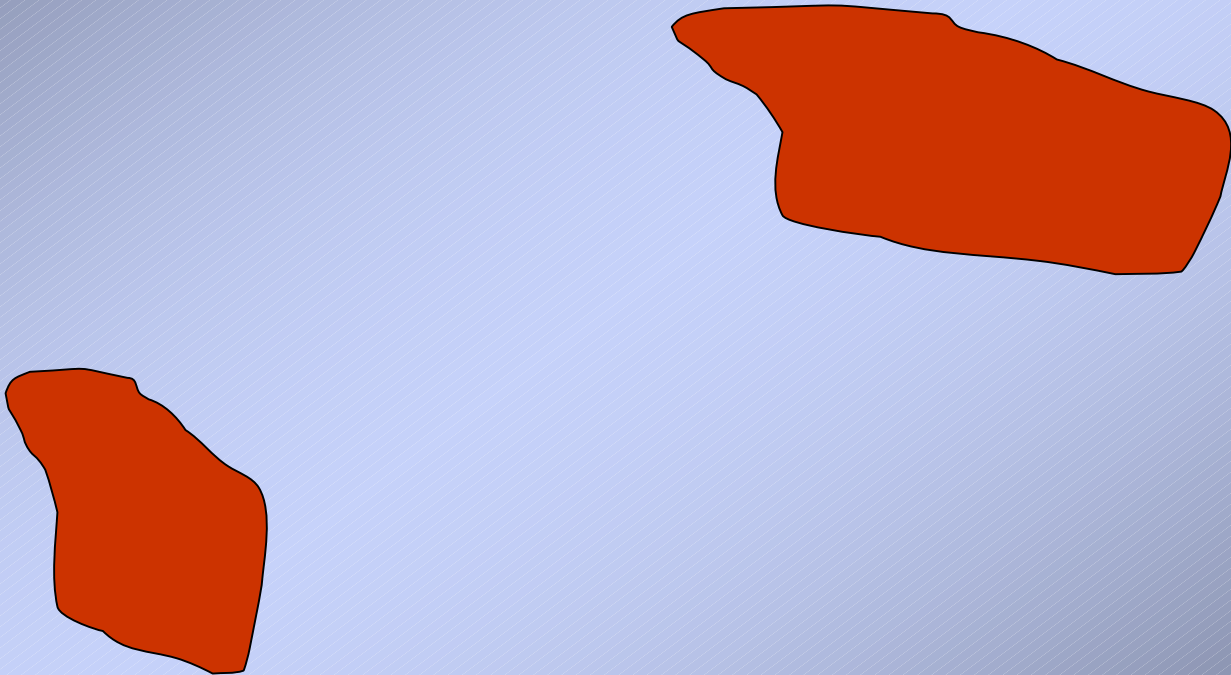
Patch
quality

Network
density

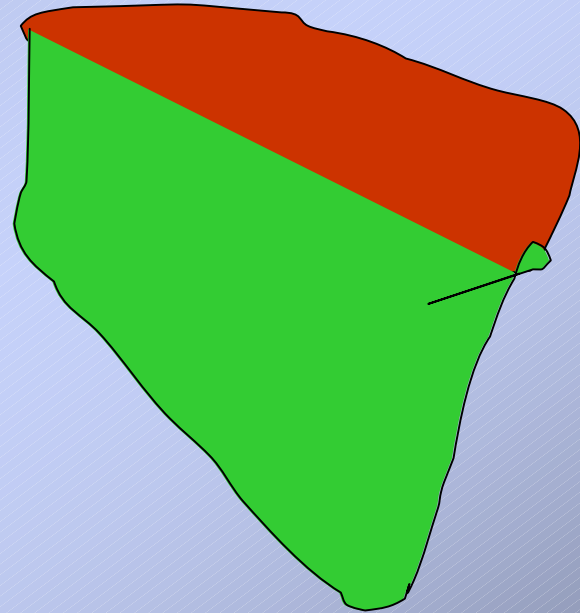
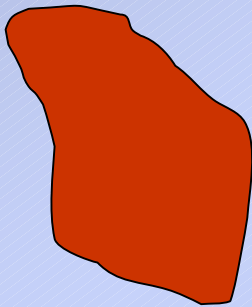
Network
area

Matrix
permeability

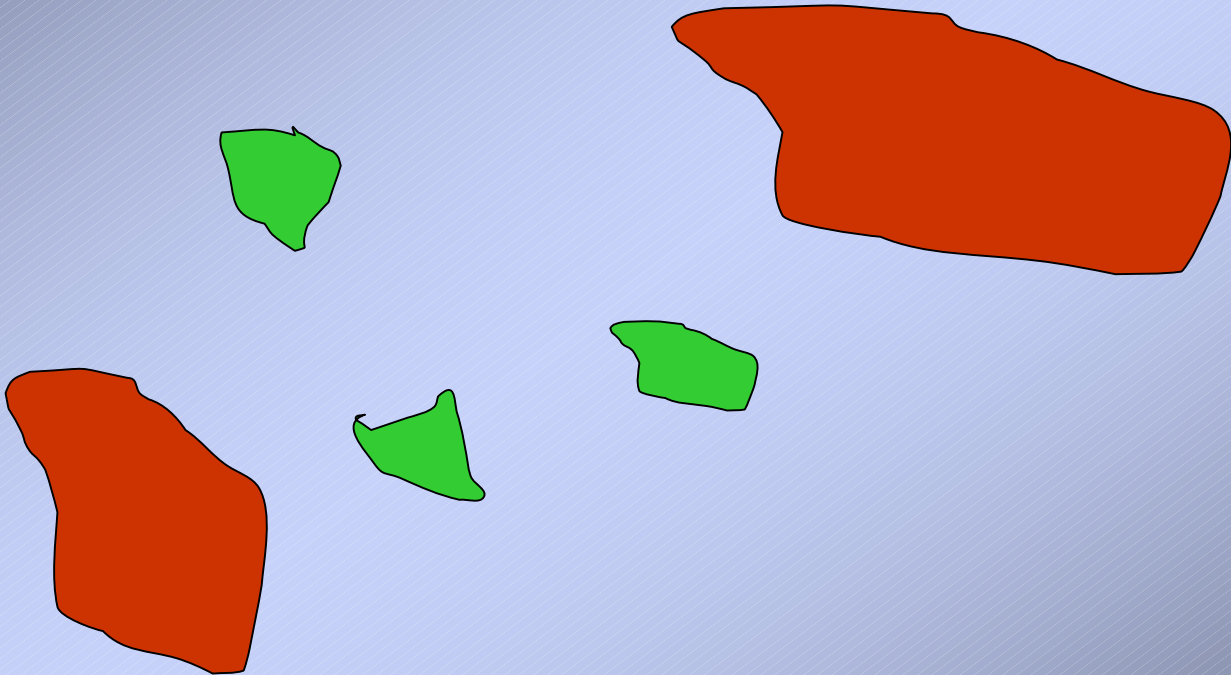
How to make a network of these
two Natura 2000 sites?



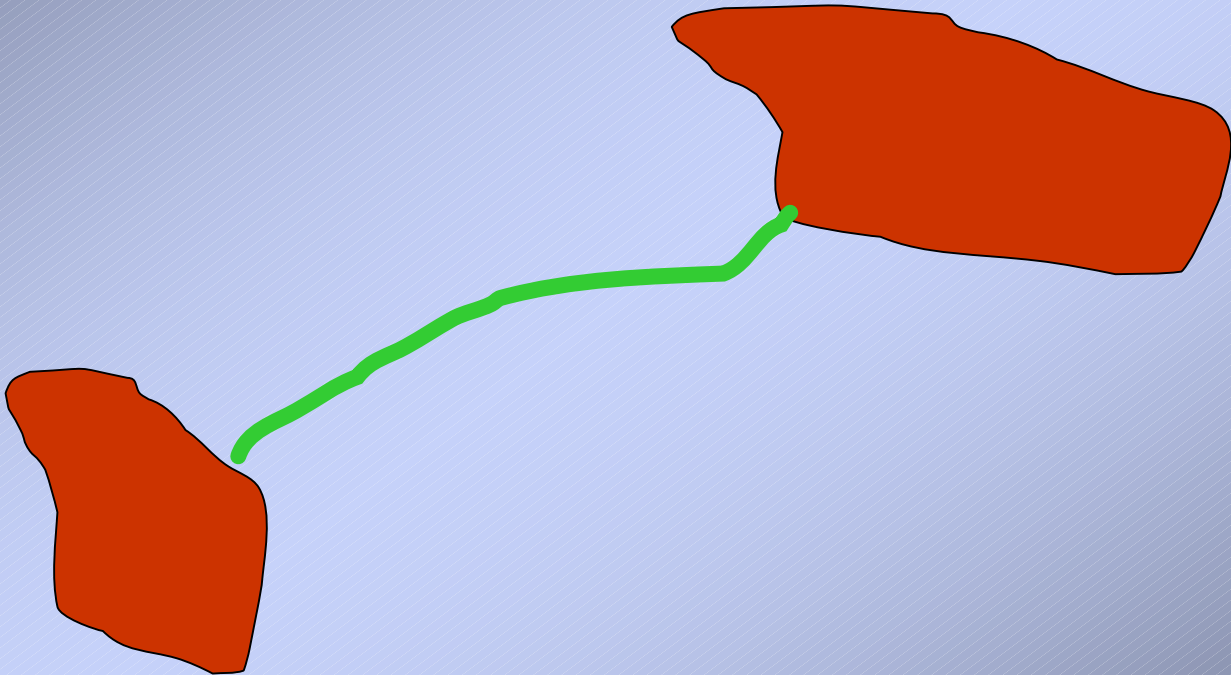
Enlarge



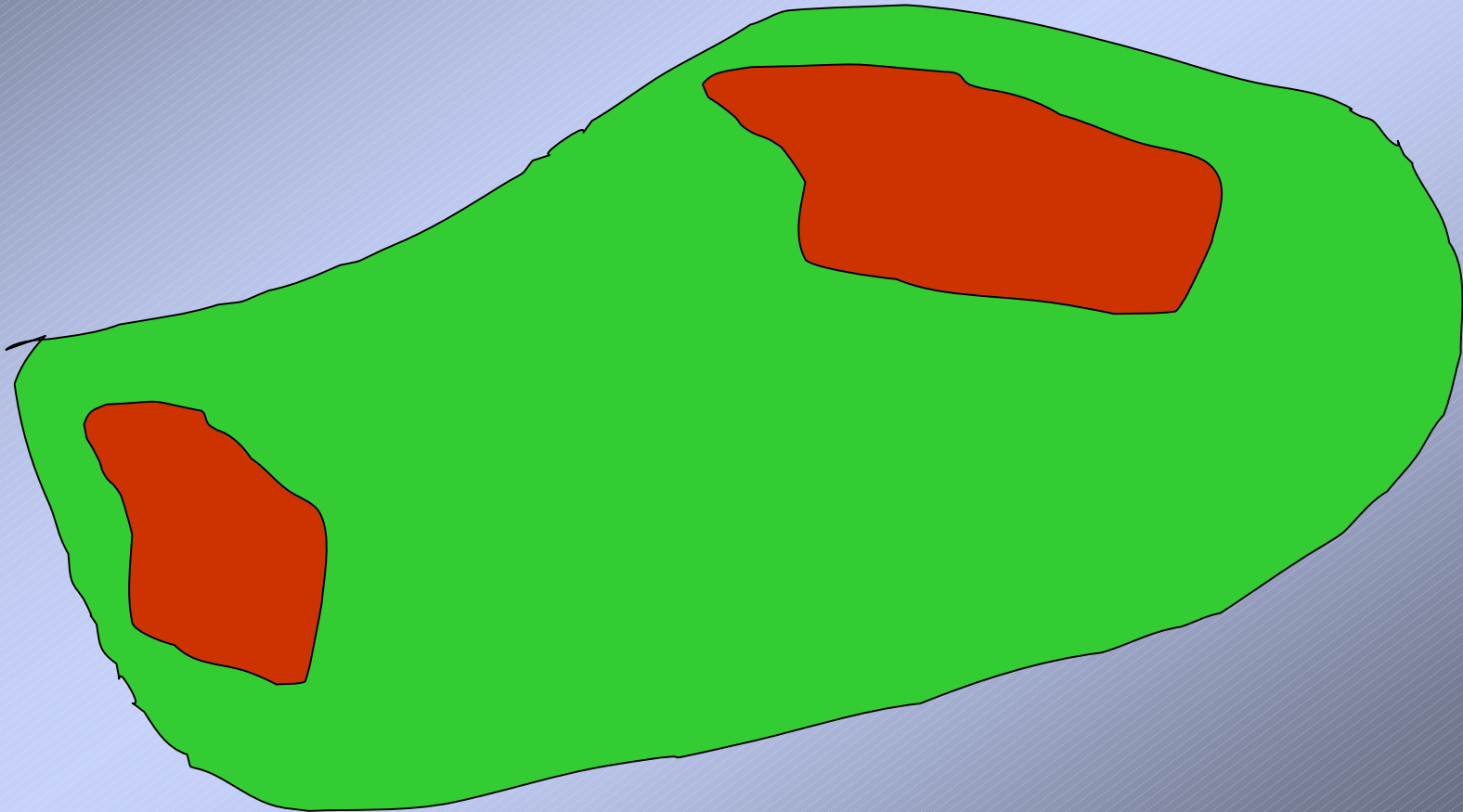
Enlarge & Increase density



Increase permeability: corridor



Increase density and permeability:
multifunctional matrix



Structure

- Why functional cohesion?
- Principles of network cohesion
- Diagnosis and strategies
- **Perspectives**



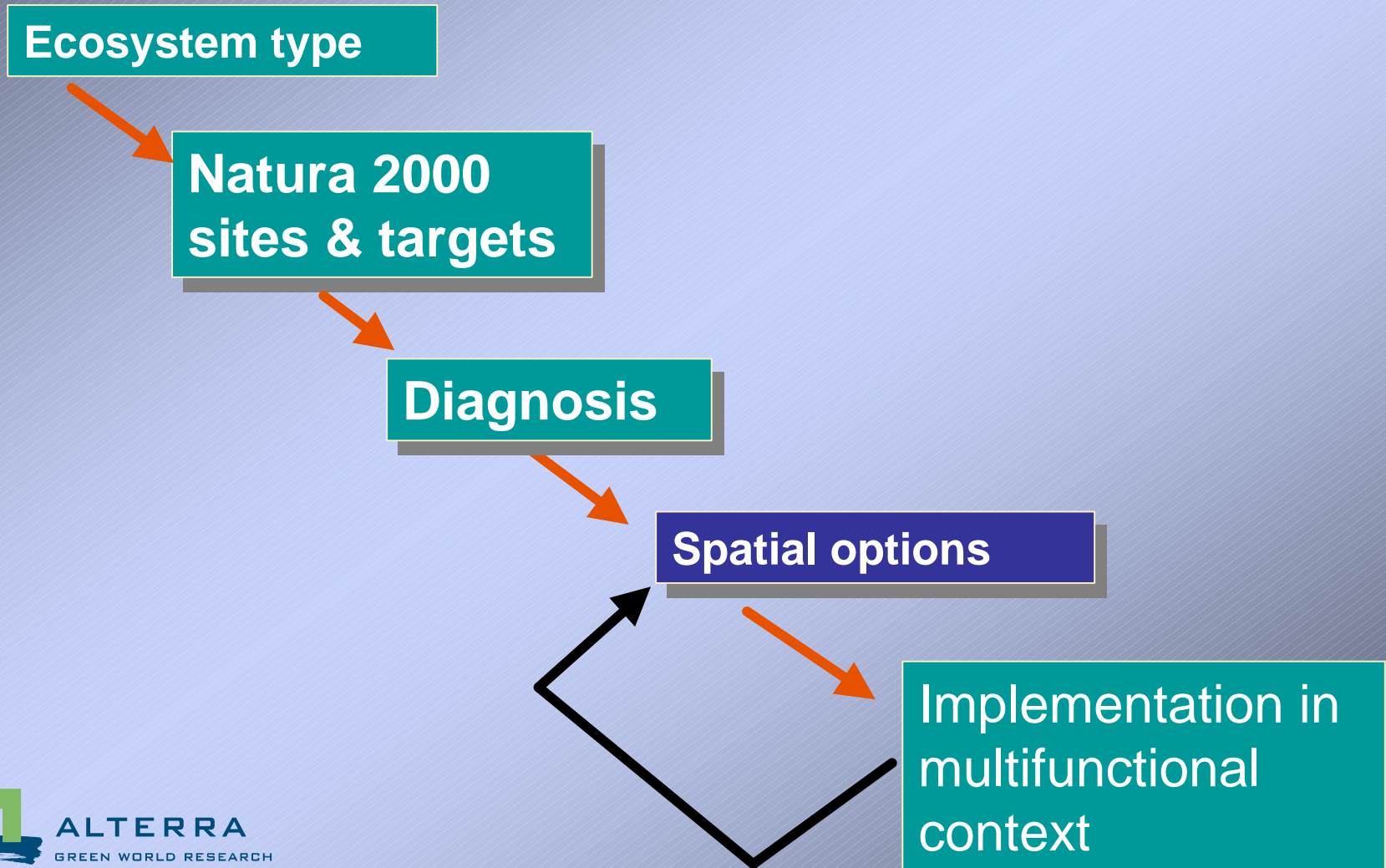
Linking species to ecosystems



Ecoprofiles



Designing Ecosystem networks

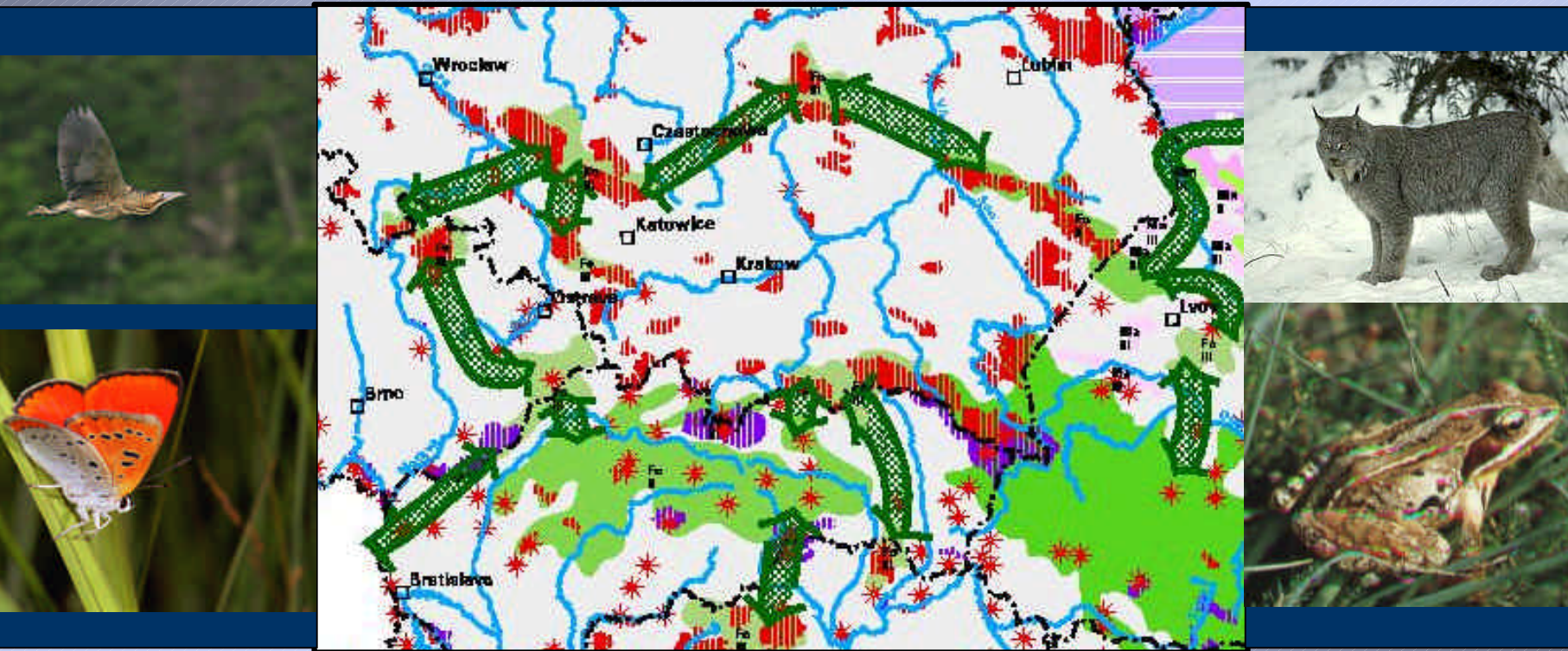


Conclusions

- Goals Natura 2000 Policy require a network
- Natura 2000: not yet cohesive ?
- Total area of cohesive network key factor
- Implementation: ecosystem level
- Various options for developing network pattern

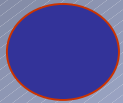


Thank you for your attention



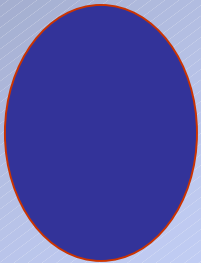
Paul Opdam & Irene Bouwma

Generalise: from species to ecoprofiles



ecoprofile 1

ecoprofile 2



ecoprofile 3

ecoprofile 4

For each Ecosystem type

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