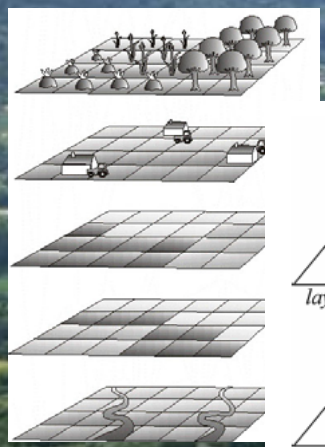
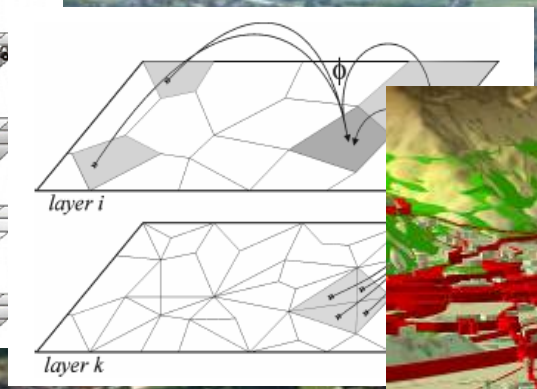
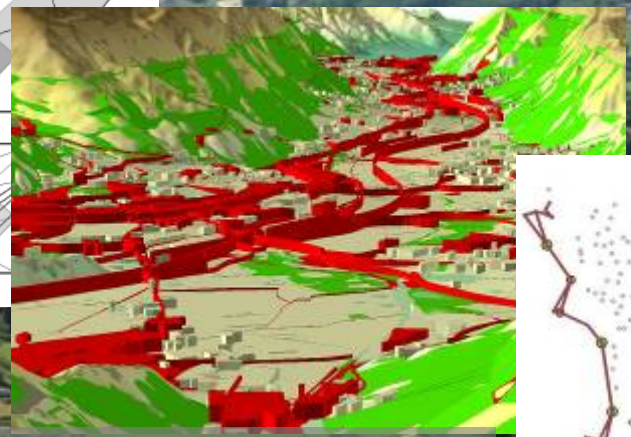
European IALE Conference,
Salzburg 2009

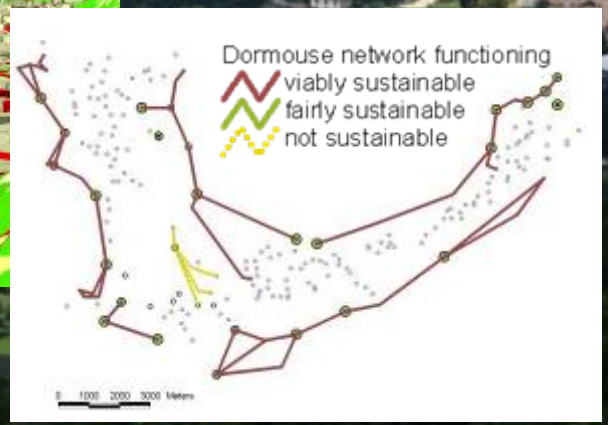
A method to assess landscape functional connectivity at local scale for target species

A case study in an Alpine valley floor









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1.The problem

Biodiversity and land-use change: a growing conflict

- **Land-use change** = main source of **global environmental change**.
- **Increasing land up-take**: 8,000 km^2 consumed in 1990-2000 by the growth of urban areas and infrastructures in Europe.

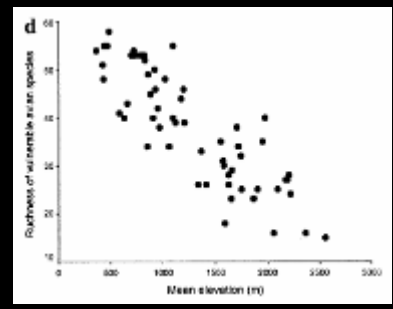
- **Habitat fragmentation and loss** = most serious **threat to biodiversity**.

1.The problem

Biodiversity and land-use change: the Alps

Especially in the **Alps**, the **biodiversity is related** to artificial and semi-natural environments and to **traditional land-uses.**

Most of the biodiversity resides in **low-elevation areas** as **Alpine valley floors.**



Biodivers Conserv (2007) 16:3243–3254

Alpine valley floors have a **morphology** that **exacerbates** human-induced habitat **fragmentation**.

Photo R. Scolozzi

2. Research objective

To develop a methodology for assessment of landscape ecological functioning within human-dominated landscapes

To develop operational knowledge framework

To assess the ecological consequences of planning

To support
environmental decision
(even with poor environmental dataset)

3. Shortcomings in environmental assessments

Habitat **functioning** loss and permeability of matrix **neglected** or not correctly considered.
(e.g. Fahrig, 2003; Lindenmayer & Fischer, 2007)

Lacking an explicit relationship with population process and **neglecting** the **scales** variation in ecological **processes**. (e.g. Opdam et al, 2002)

Generally, the assessment of ecological impacts due to land-use changes **fails** particularly in **identifying thresholds** of disruptive impacts on processes. (Vos, 2001)

4. Specific objectives

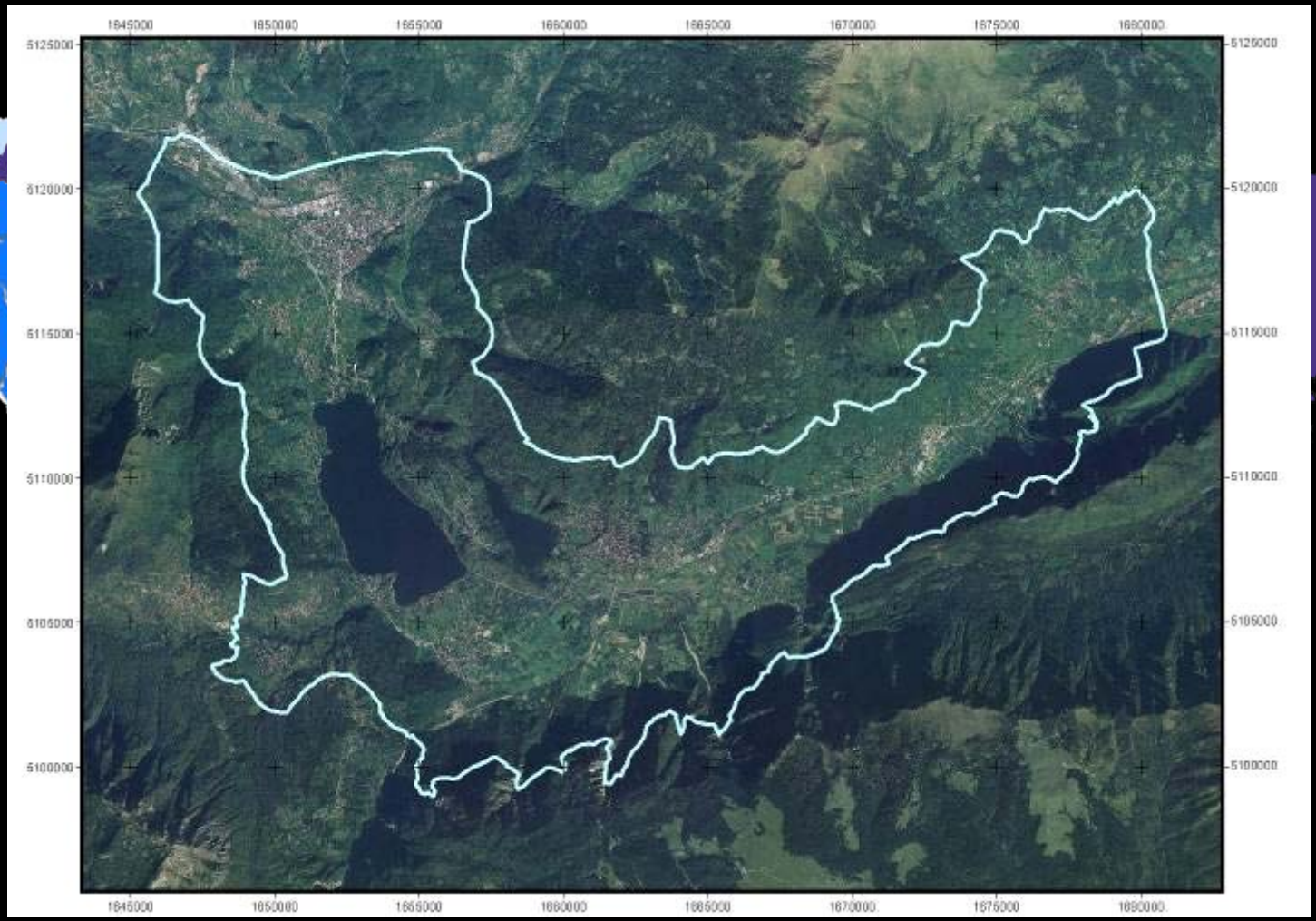
The assessment outputs should provide measurements **explicitly referring to ecological processes**, in order to improve understanding of ecological consequences of planning.

The assessments should be based on **less data as possible**, in order to provide indications even with poor environmental dataset.

The assessment outputs should be **easy to understand and communicable to decision makers**, planners and other stakeholders involved in land-use planning.

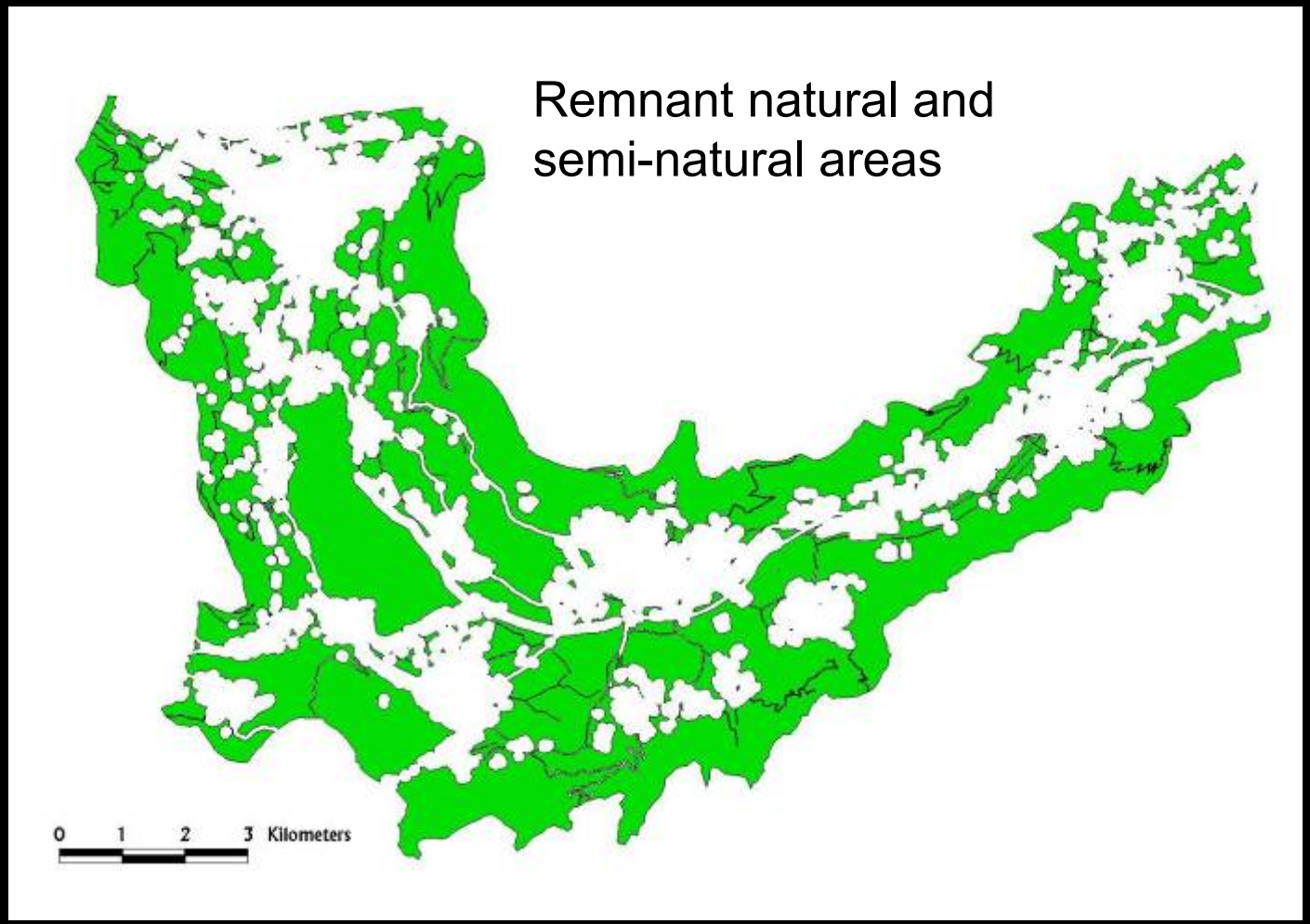
5. Study area

Valsugana Valley floor



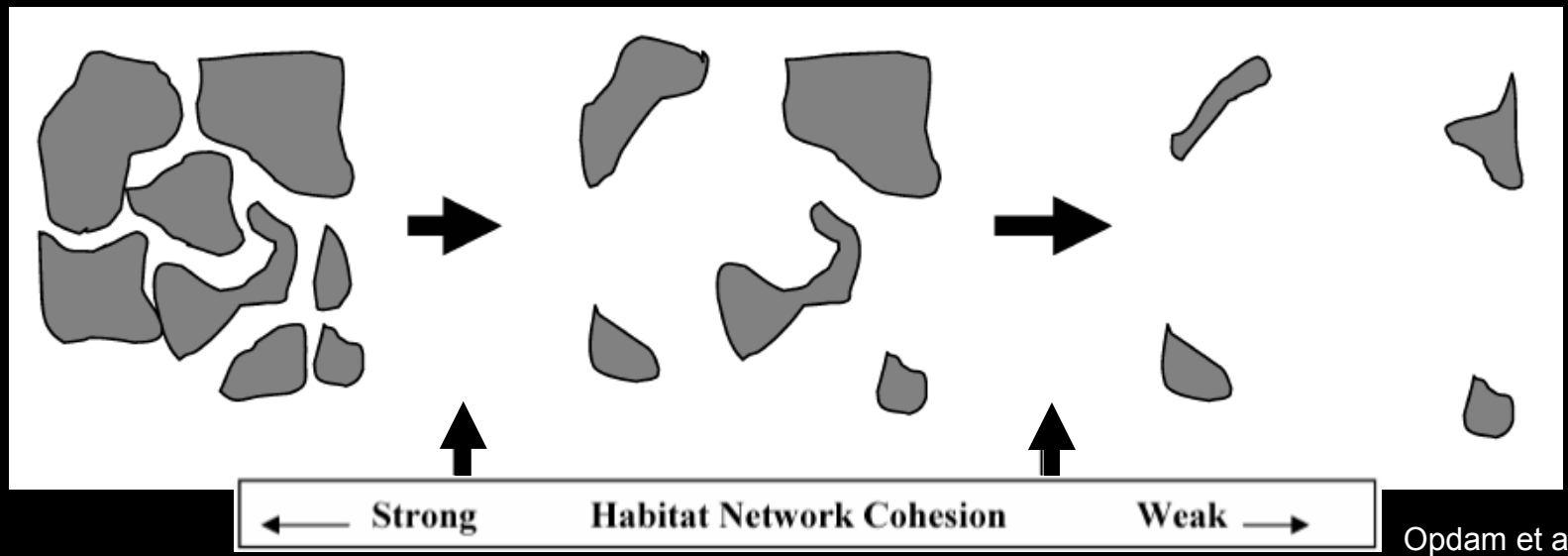
5. Study area

Valsugana Valley floor



6. Theoretical framework

Important conditions for **species persistence** are **quality**, **amount** **and** **configuration** of habitat and the permeability of landscape matrix (Opdam et al., 2003)

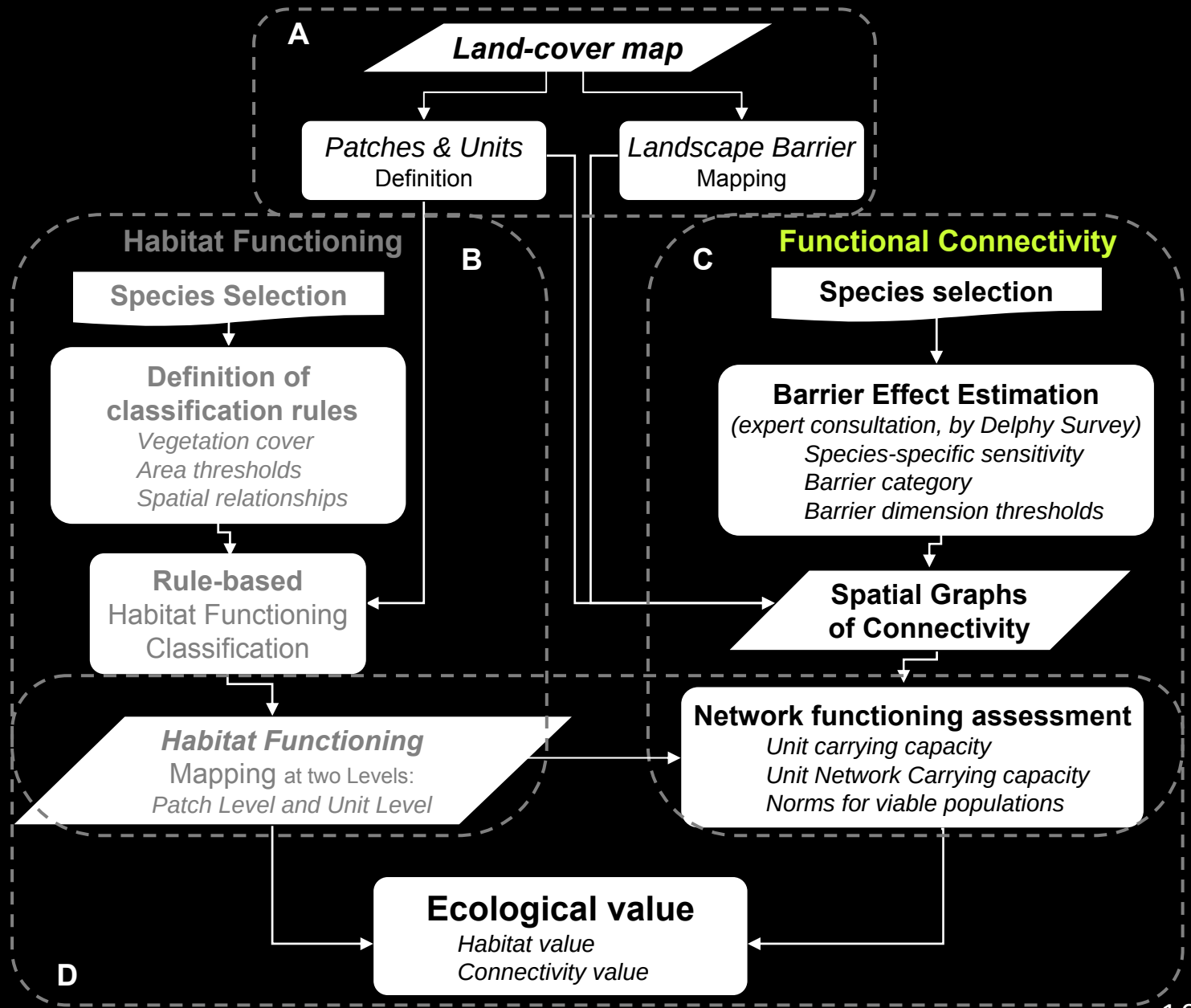


Opdam et al., 2003

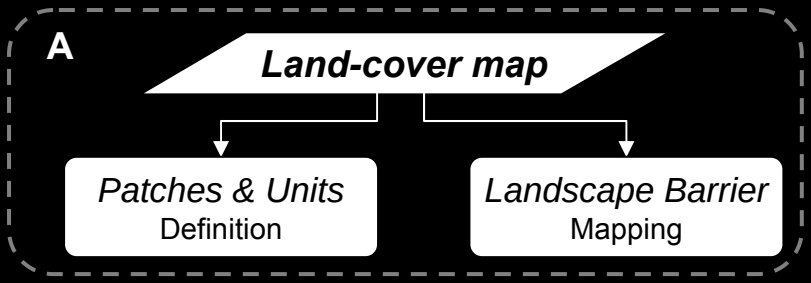
Fragmentation threshold

Extinction threshold

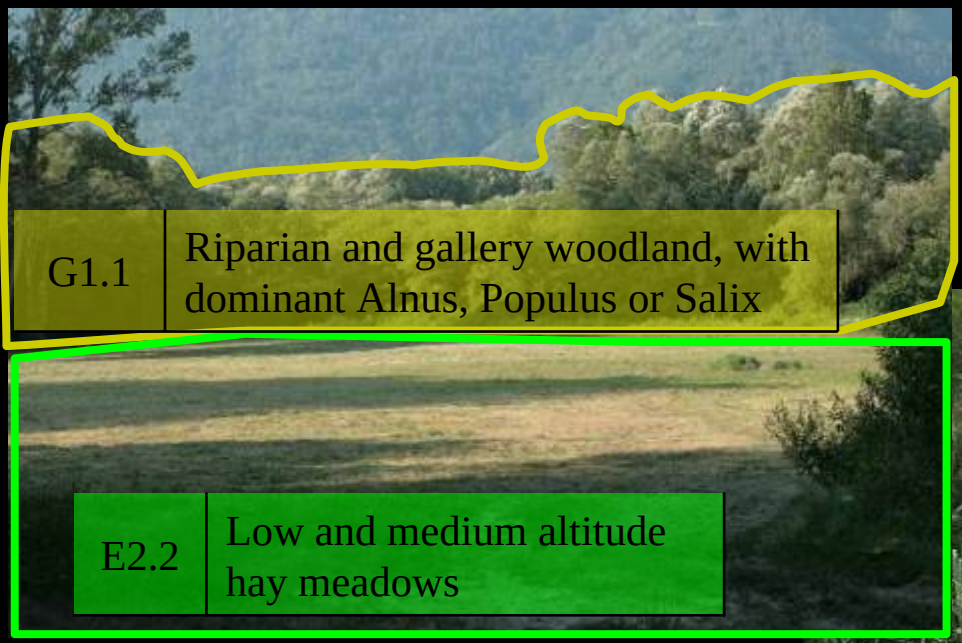
7. Methodology



7.1 Dataset preparation

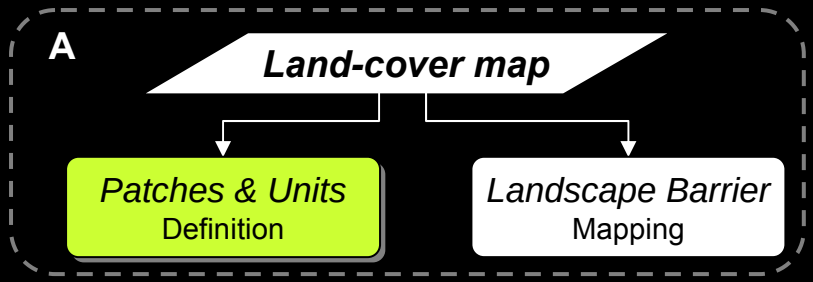


land-use/vegetation mapping
(photo-interpretation and field surveys)
barrier characterization
(field surveys)



EUNIS standard
8 classes of level 1
26 classes of level 2
74 classes of level 3

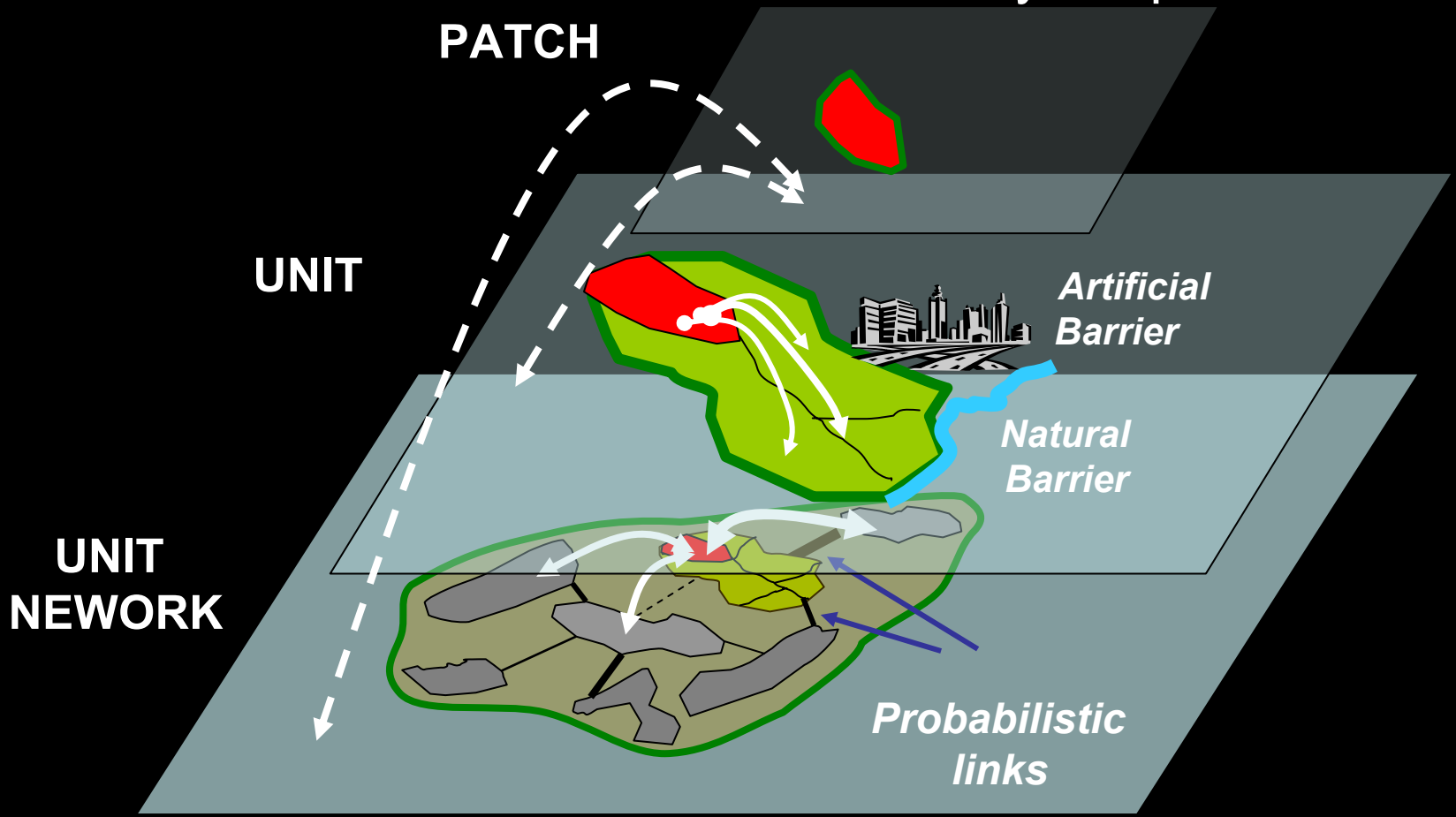
7.1 Dataset preparation

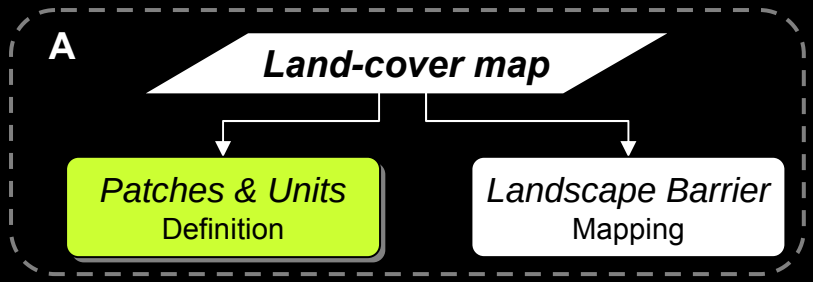


Dataset structure:

Attributes defined within

Hierarchy of spatial relationships

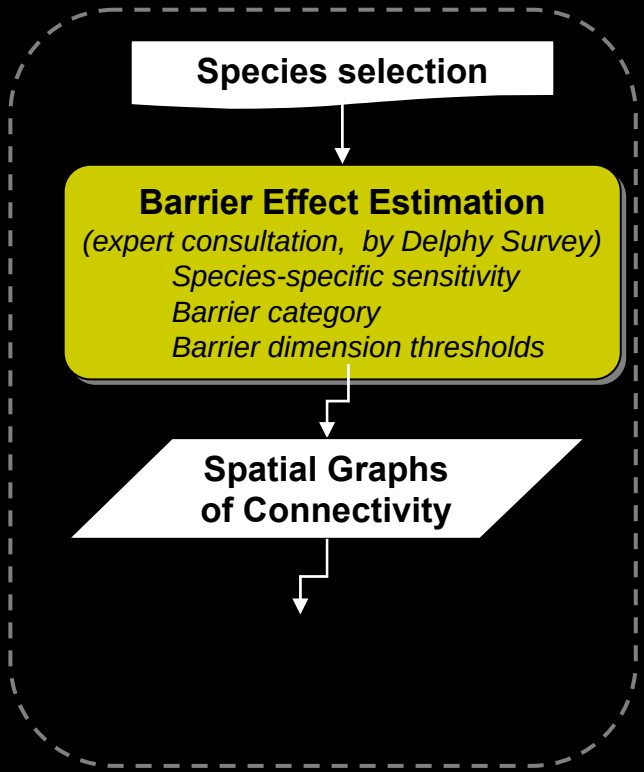




7.1 Dataset preparation

Coding	Barrier element	Notes
Mur3070	Wall (or fence, or similar) height 0.3-0.7 m	
Mur7015	Wall height 0.7-1.5 m	
Mur>15	Wall height > 1.5m	
Acq<30	Shallow water body, depth <0.30 m	
Acqlen>30	Water body, slow watercourses, depth > 0.30 m	
Acqvel>30	Water body, fast running water, depth > 0.30 m	
Strd0	Minor/rural/forestry paved roads	traffic < 50 vehicle/day
Strd1	Secondary road, one lane, or 2 lanes with low traffic	< 500 vehicle/day
Strd2	Local/urban road, 2 lanes	< 5000 vehicle/day
Strd2+	National road, beltway, highway, more than 2 lanes	> 5000 vehicle/day
Parc100	Urban park, public garden	Referring to relatively small areas: hypothetical 100 m size square
In100	Industrial area	
Udens100	Dense residential areas, vegetation cover < 30%	
Urado100	Sparse residential areas, vegetation cover > 30%	
Parc1000	Urban park, public garden	Referring to relatively large areas: hypothetical 1000 m size square
Ind1000	Industrial area	
Udens1000	Dense residential areas, vegetation cover < 30%	
Urado1000	Sparse residential areas, vegetation cover > 30%	

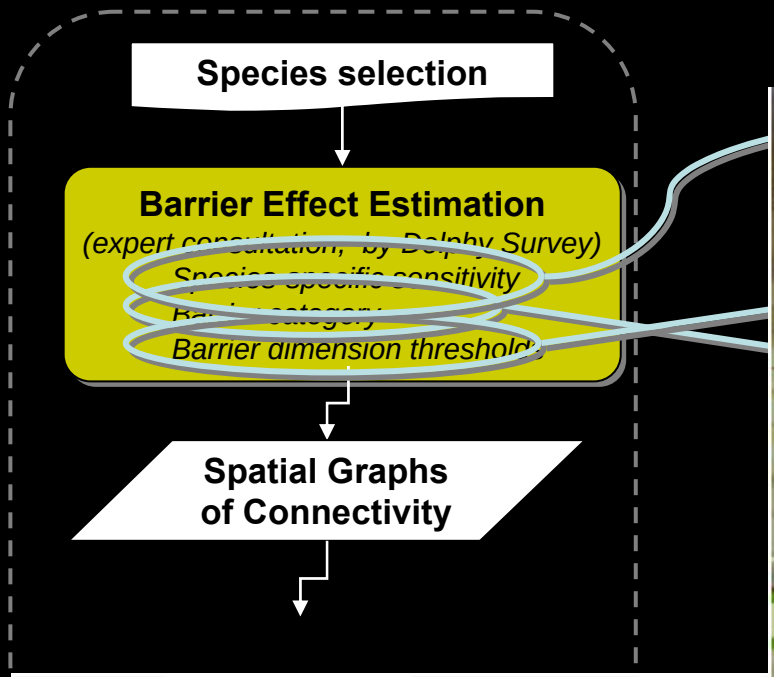
7.3 Functional connectivity



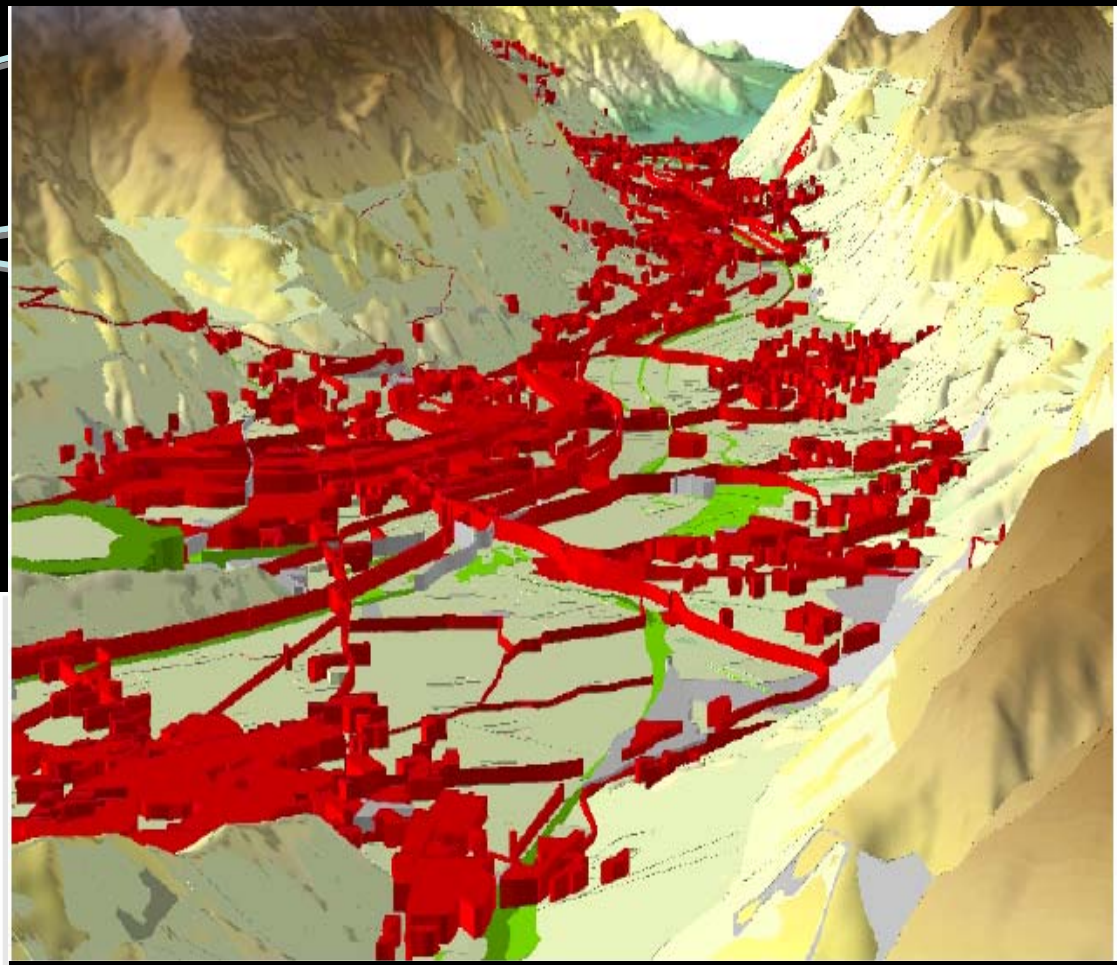
Criteria:

- sensitive to habitat fragmentation
- presence within study area
- relation with the main habitat types (woodlands, grasslands, wetlands)
- different vagility and dispersal distance
- availability of information.

7.3 Functional connectivity

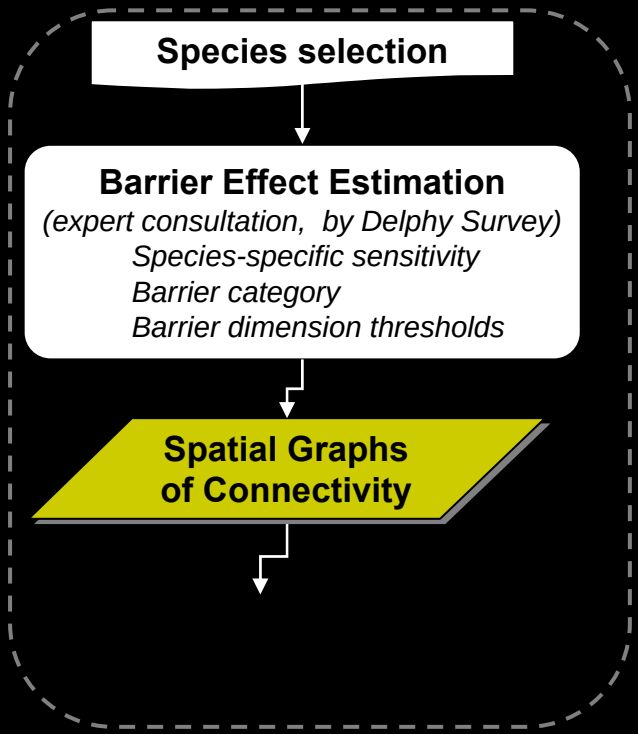


Verbal expression	Chance (per cent)	Chance (fraction)	Coding [a]
Very likely	90–99% chance that the result is true	≥ 9 out of 10 and ≤ 99 out of 100	5
Likely	66–90% chance that the result is true	≥ 2 out of 3 and ≤ 9 out of 10	4
Medium likelihood	33–66% chance that the result is true	between 1 and 2 out of 3	3
Unlikely	10–33% chance that the result is true	≤ 1 out of 3 and ≥ 1 out of 10	2
Very unlikely	1–10% chance that the result is true	≤ 1 out of 10 and ≥ 1 out of 100	1



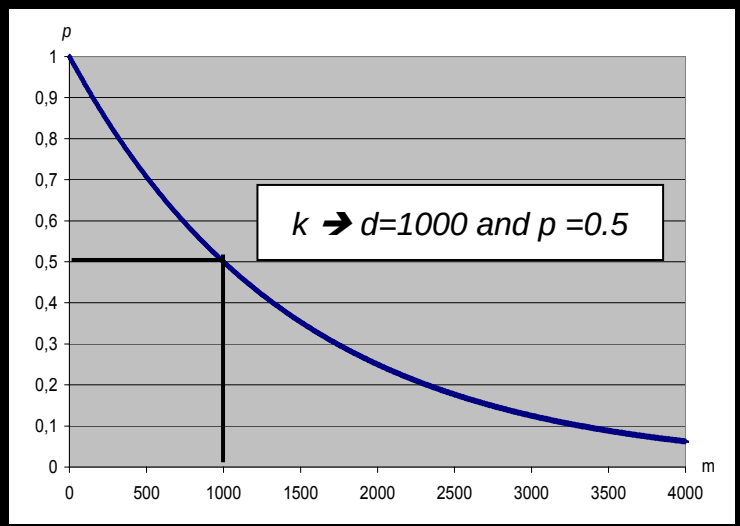
(IPPC, 2001: The Scientific Basis; cf. footnote nr. 7 of the Summary for Policy Makers)

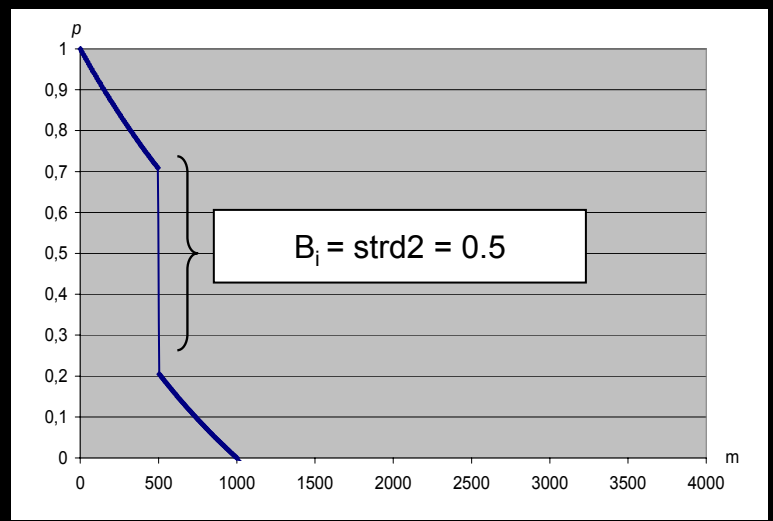
7.3 Functional connectivity



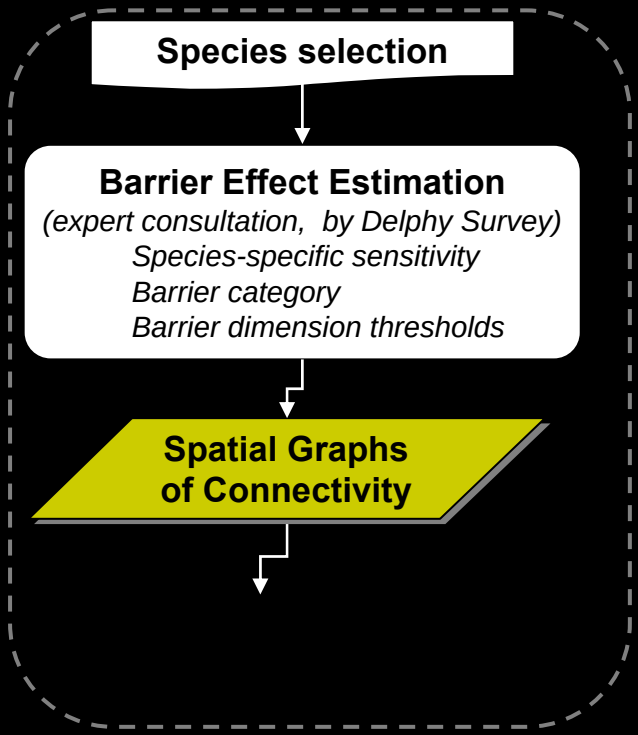
$$p_{ij} = e^{-kd(i,j)}$$

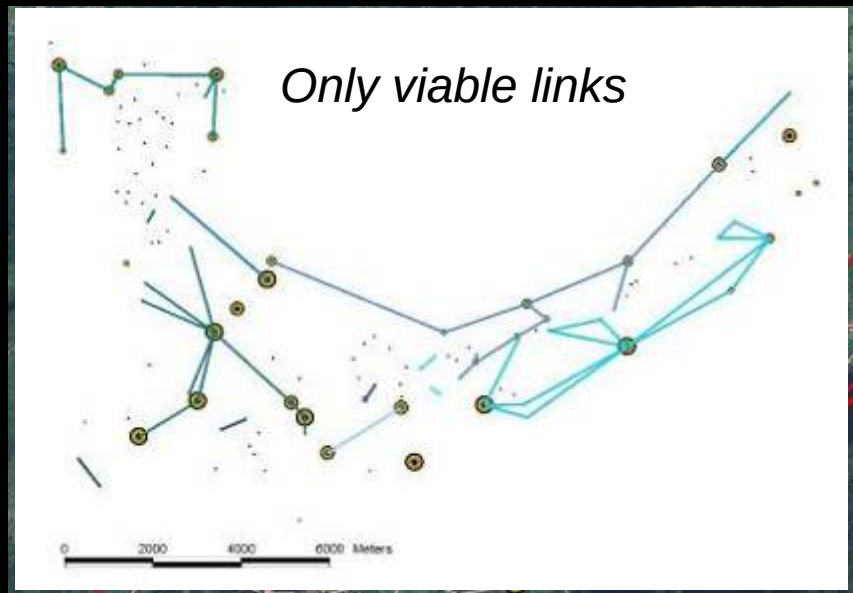
$$p_{ij} = e^{-kd(i,j)} - f_{ij}(B)$$

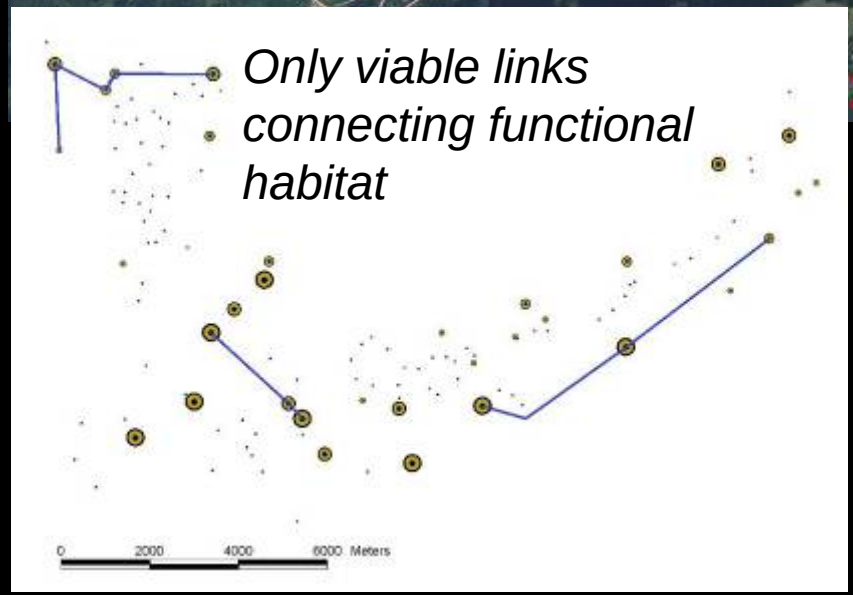




7.3 Functional connectivity



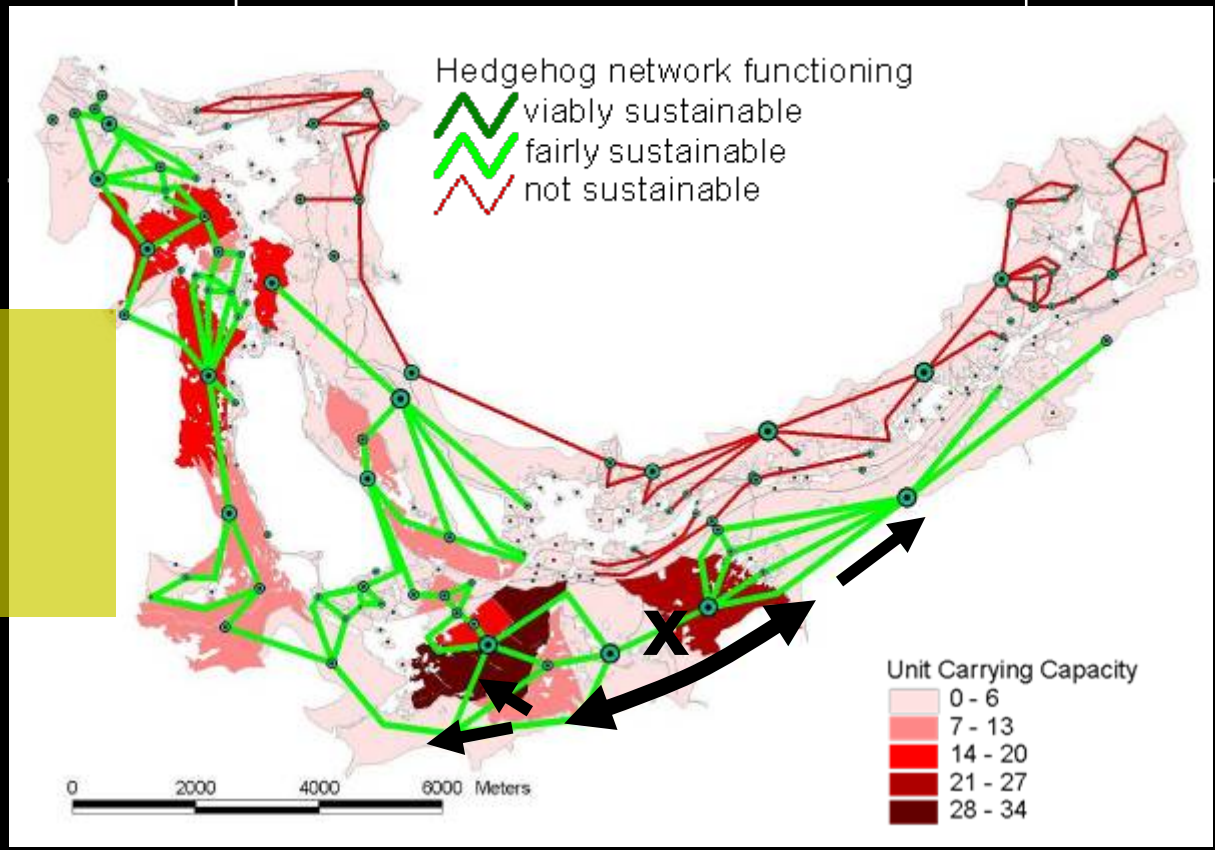




7.4 Integration

Habitat Functioning Map
at two Levels:
Patch Level and Unit Level

Network functioning assessment
Unit carrying capacity
Unit Network Carrying capacity
Norms for viable populations

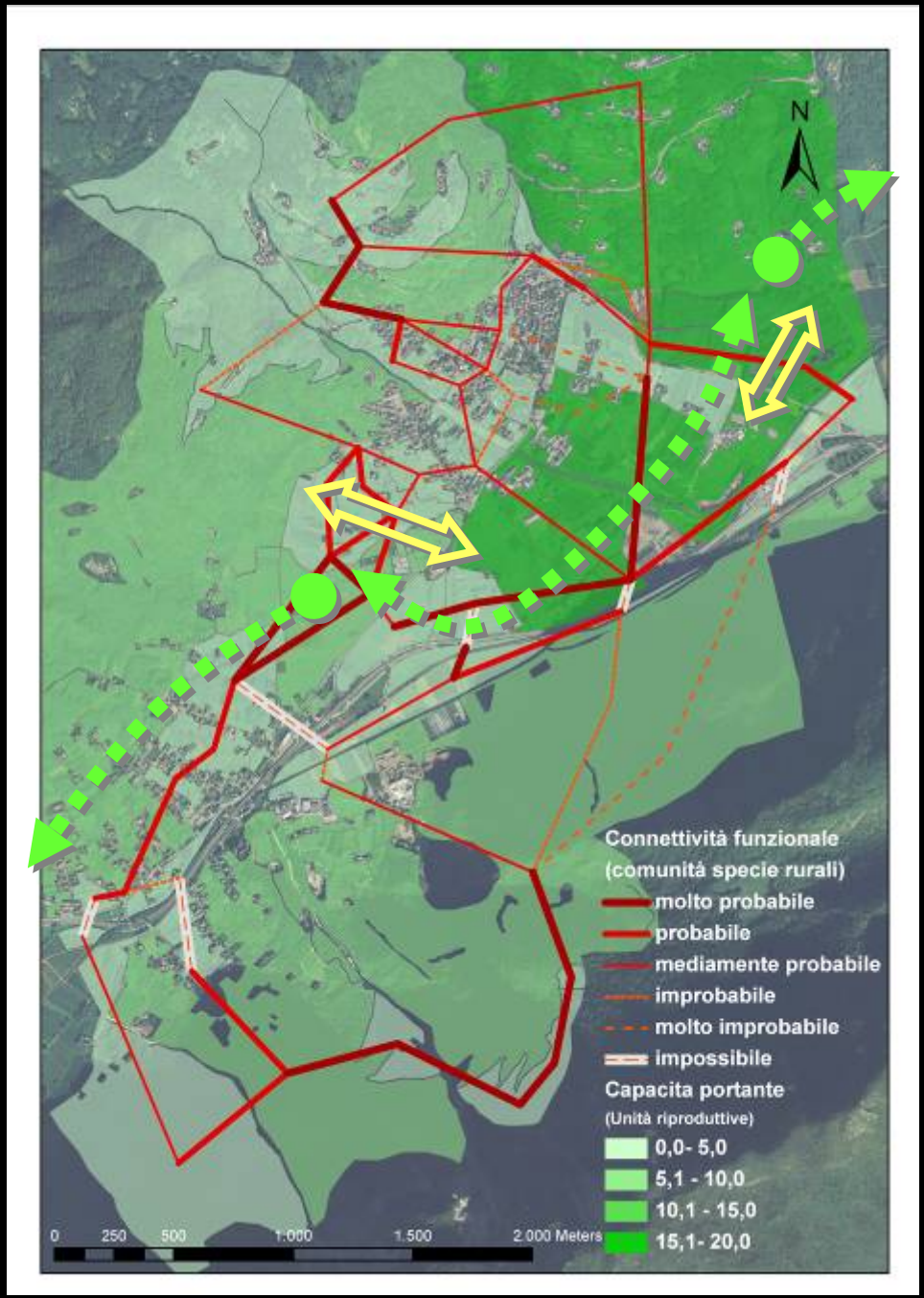


Key population for Hedgehog ≈ 40 Reproductive Units

8. Applications: Indications for planning

Guiding planning strategies

<table>
<tr><td></td><td colspan="4">CONNECTIVITY VALUE</td></tr>
<tr><td>HABITAT VALUE</td><td>High</td><td colspan="2">Medium</td><td>Low</td><td>Very low</td></tr>
<tr><td>High</td><td colspan="3" rowspan="2">PRESERVATION
Preserve from urbanisation or infrastructure development</td><td colspan="2" rowspan="2">DE-FRAGMENTATION
Redress the fragmentation (e.g. faunal artificial corridors)</td></tr>
<tr><td>Medium</td></tr>
<tr><td>Low</td><td colspan="3" rowspan="2">RESTORATION
Increase habitat functioning, create/restore habitat areas. Allow settlement without impacting connectivity (e.g. direction/orientation of plots)</td><td colspan="2" rowspan="2">No specific indications.</td></tr>
<tr><td>Very low</td></tr>
</table>



8. Applications: Indications for planning

Case application for a Spatial Plan and SEA (Roncegno, Italy)

Location for “effective” actions:

1. Management of existent habitat and habitat restoration
2. Creation of new habitats
3. De-fragmentation

9. Limits:

• **Uncertainties** affect both the data used and the evaluations (e.g. barrier effect estimation, barrier mapping).

• The methodology outputs are **not based on species presence** data, this makes the validation difficult to be carried out.

The indications provided should be seen as hypotheses open for testing, best applied in comparative assessment, as within EIAs.

10. What is new

Contribution in assessment of ecological consequences of land-use changes:

- functional connectivity based on barrier effect and at local scale.
- application of metapopulation paradigm and spatial graphs in environmental impact assessment.

Further developments

- ***Next step: LIDAR elevation data to detect landscape barriers.***

- Towards definition of ecological compensations supported by topological characterization of local functional connectivity.

- Towards graph-based and object-oriented landscape models for ecological impact assessment at local scale.


…Learning
to think *ecologically*
the relations, the landscape, the planning
F. Steiner
Thanks your attention.
Any question?