

**Webinar**

**11**

**November 2025  
09:30-12:30 CET**

# **Linking Blue and Green Infrastructure in the Danube-Carpathians: Prioritising Rivers, Wetlands, and Landscapes: An Integrated Connectivity Approach**

Credit: Hildegard Meyer



**Funded by  
the European Union**

NaturaConnect receives funding under the European Union's Horizon Europe research and innovation programme under grant agreement number 101060429

# Basic webinar guidance

- ✓ The webinar is being recorded for internal purposes.
- ✓ Write your questions and comments in the chat, indicating the speaker you address.
- ✓ All presentations & a report will be available at [naturaconnect.eu/past-events](https://naturaconnect.eu/past-events) and shared with registered participants.
- ✓ Feel free to indicate your organisation by clicking on the three dots ... next to name!
- ✓ Please start/stop your camera at your convenience :)
- ✓ We will use **Mentimeter** a lot today! :-)



# Welcome and general aims of the webinar

- **Introduce the NaturaConnect case-study methodology** to map an ecological network of green & blue infrastructure in the Danube–Carpathian Region (DCR)
- **Invite participants to share feedback** on the methodology, usability, and next steps
- Support EU biodiversity and restoration targets **through coordinated, cross-border planning approaches**
- **Raise awareness & inspire action in the DCR** on integrated restoration and connectivity conservation

# Agenda for today

- 09:30 Welcome & Introduction (WWF-CEE)
- 09:35 Welcome statements of ICPDR and CC (ICPDR, CC)
- 09:45 The NaturaConnect project (IIASA)
- 09:55 Overall methodological approach (BOKU)
- 10:05 **Deep dive 1:** The longitudinal connectivity approaches (BOKU)
- 10:20 Breakout discussion with participants & feedback to the plenum
- 10:50 **Deep dive 2:** The lateral & hinterland connectivity approaches (BOKU)
- 11:05 Breakout discussion with participants & feedback to the plenum
- 11:35 Break (10 min)
- 11:45 **Deep dive 3:** The integration and prioritisation of approaches (BOKU)
- 12:05 Open discussion (BOKU)
- 12:20 Summary, outlook and evaluation (WWF-CEE)
- 12:30 End

# Welcome statements of ICPDR & CC



Source: WWF-CEE

# Mentimeter

Type in [menti.com](https://menti.com)

Code 8828 2590





# **NaturaConnect**

## **Designing a resilient and coherent Trans European Network for Nature and People (TEN-N)**

### **July 2022 – June 2026**

Piero Visconti, International Institute for Applied System Analysis - IIASA

Image: WWF-CEE

# Knowledge support for implementing the European Biodiversity Strategy 2030



Legally protect at least 30% of the land.  
At least **1/3** strictly protected



Implement **restoration measures** on 20% of land



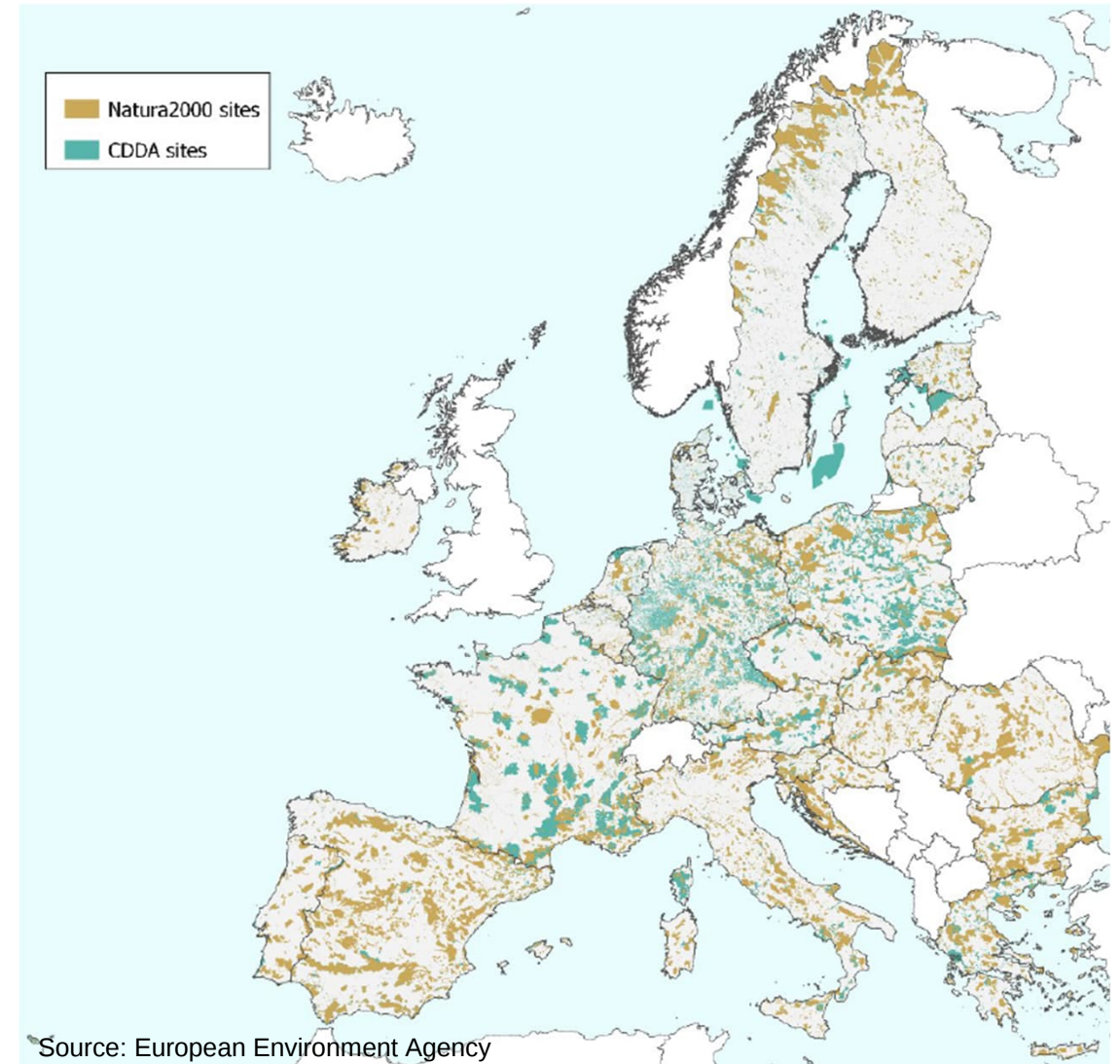
Enhance **ecological connectivity** and increase the **network resilience** to changes



# What the Trans-European Nature Network (TEN-N) is

The TEN-N builds on the existing **Natura 2000 network** and **national designated protected areas** and connecting these areas using the **green infrastructure** landscape elements important for delivering **ecosystem services**.

The coherent TEN-N will include ecological corridors “**to prevent genetic isolation, allow for species migration, and maintain and enhance healthy ecosystems**”.



# Project consortium

17 Research institutions

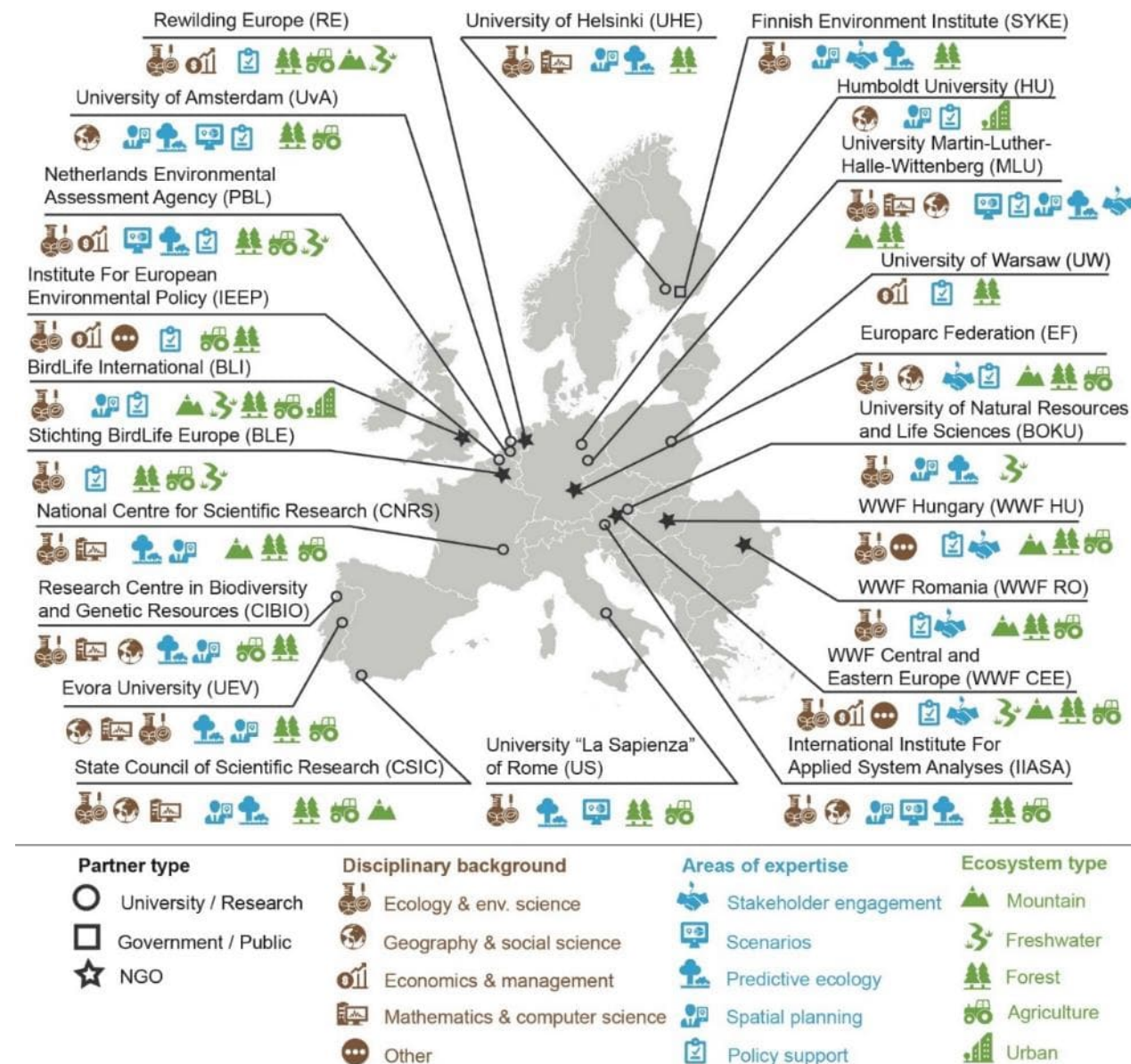
5 Policy and practitioner organisations

12 countries across Europe

**Lead:** International Institute for Applied System Analyses (IIASA), Austria

**Co-lead:** Martin-Luther-University, Germany

Co-develop knowledge, tools and capacity-building to support Member States in implementing an ecologically representative, resilient and well-connected **Trans-European Nature Network – TEN-N**



Source: IIASA, 2022

# Case studies

## Transnational case study

- Danube-Carpathian Transboundary Region

## National case studies

- Finland
- France
- Portugal

## Regional case studies

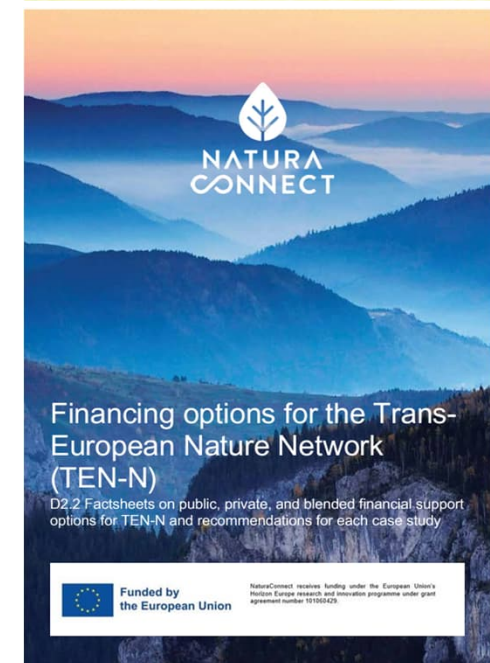
- The Doñana Region in Spain
- Leipzig-Halle Peri-urban Floodplains, Germany



Source: EUROPARC Federation, 2022

# Results up to date

- **Model-based distribution of EUNIS habitats and >10,000 terrestrial species, today and under future scenarios**
- **Current & future demand and supply of ecosystem services**
- **Priority areas for protected area expansion as well as conservation and restoration within them**
- **Priority areas for connectivity conservation and restoration**
- **Connectivity Guidelines**, project database & maps
- **Review of Protected Area and Ecological Connectivity Governance and Financing**
- **11 Finance factsheets** for public and private funding options



# Results up to date

## Towards capacity building

- **Competence assessment for nature conservation professionals** working in protected areas and ecological connectivity
- **NaturaConnect Learning Platform**, freely available for all interested people
- **Webinars and workshops on various topics**, like financing TEN-N, models for the extension of protected areas, and ecological connectivity as part of the TEN-N, etc.

All results you can find at

<https://naturaconnect.eu> under Resources



## NaturaConnect Learning Platform

The project capacity building hub supports professional development to design and implement the Trans-European Nature Network (TEN-N).

It provides easy access to training modules and learning resources for stakeholder engagement, spatial conservation planning and more.

# The Danube-Carpathian region as a case-study

## --> Integrating blue and green infrastructure



Figure: WWF-CEE

### Scientific scope (BOKU):

- Establish transboundary **freshwater** & **terrestrial** connectivity
- Develop connectivity prioritisation approaches
- Investigate multiple stressors across the landscape/realms (hinterland)
- Suggestions for conservation & restoration areas

### Practical scope (WWF-CEE):

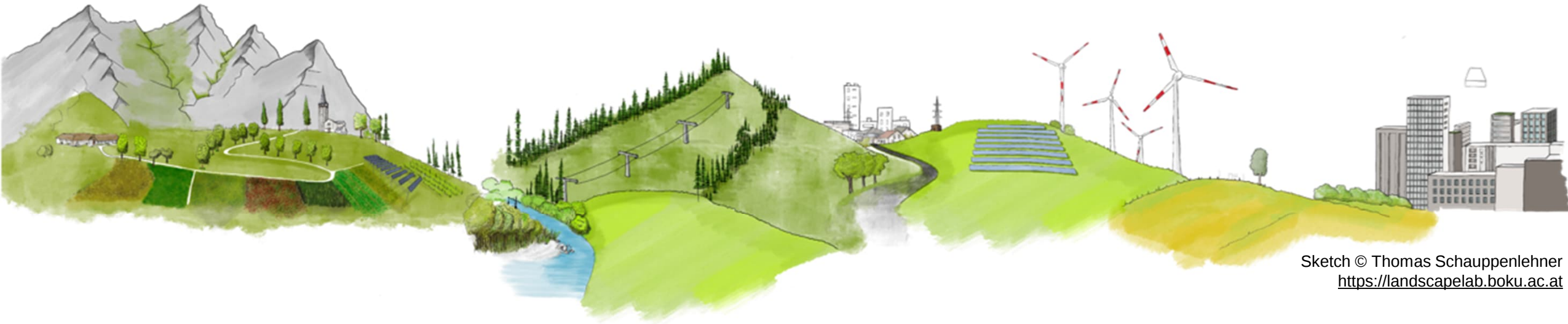
- Stakeholder consultations
- Co-design & cross-sectoral development

# Overall methodological approach

## – The 3 dimensions of connectivity

Rafaela Schinegger & Carina Seliger,  
BOKU University, Vienna, Austria

# The problem: Our ecosystems and cultural landscapes are exposed to multiple human stressors



Sketch © Thomas Schauppenlehner  
<https://landscapelab.boku.ac.at>

- Ecosystems are overexploited, polluted & fragmented or totally destroyed
  - This results in habitat loss or degradation due to land use changes, coupled with stressors from invasive species, energy production, climate change, etc.
  - The complexity of these issues demands comprehensive solutions
- But there is no integrated and strategic planning yet in Europe to address such complex problems!

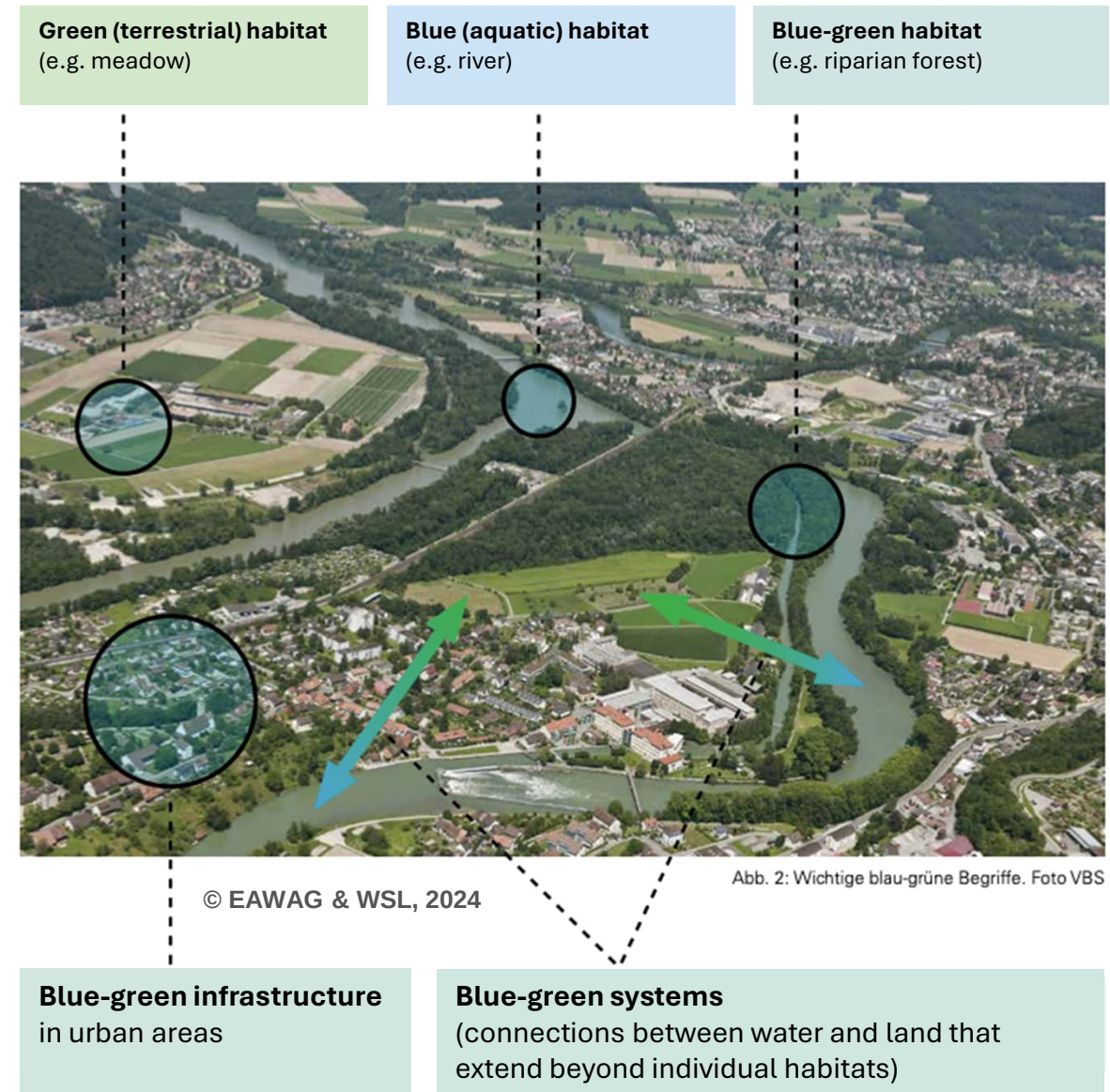
# Investigate across realms

**River landscapes are key actors across ecosystem boundaries, supporting blue-green biodiversity & multifunctional infrastructure**

*(Grill et al., 2019; Hein et al., 2019; Eawag & WSL, 2024)*

**They protect infrastructure & economies from floods and droughts, and offer recreational spaces**

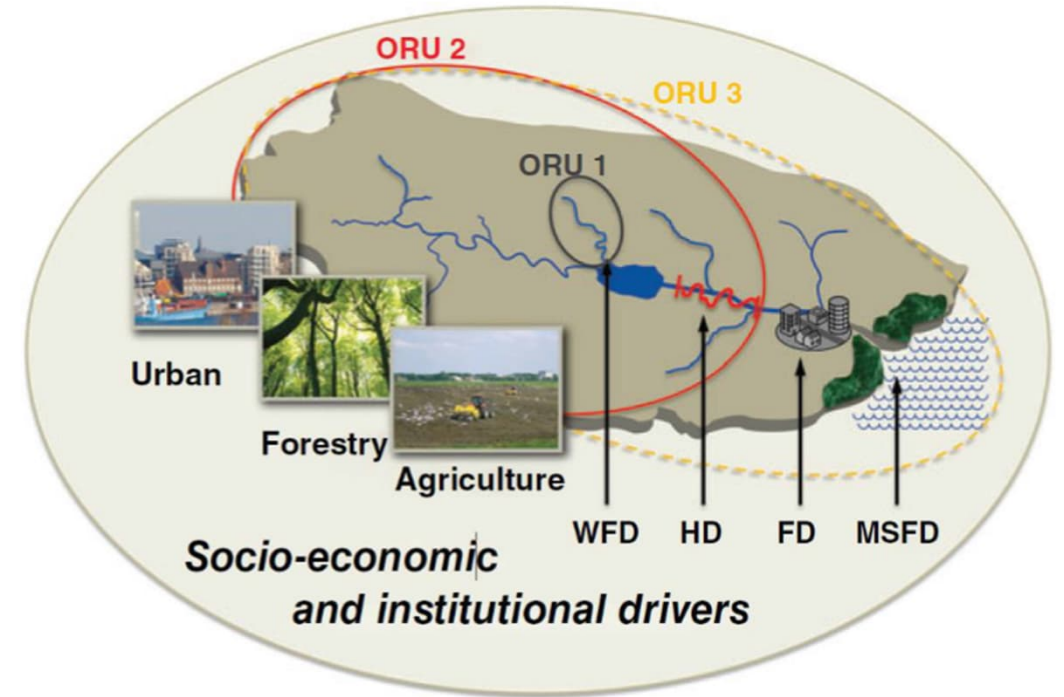
*(Muhar et al., 2007; Lynch et al., 2021)*



# Consider human activities in the entire catchment

Apply a **catchment-scale perspective** to identify multi-stressor interactions and enhance restoration **outcomes across realms**  
(Friberg et al., 2017; Schinegger et al., 2018)

**Cross-realm science and integrated planning** support **co-benefits of sectors** and enhance **landscape resilience**  
(Hermoso et al., 2021; Harper et al., 2023; Schinegger et al., 2024)



Source: Friberg et al., 2017

# The EU Nature Restoration Regulation

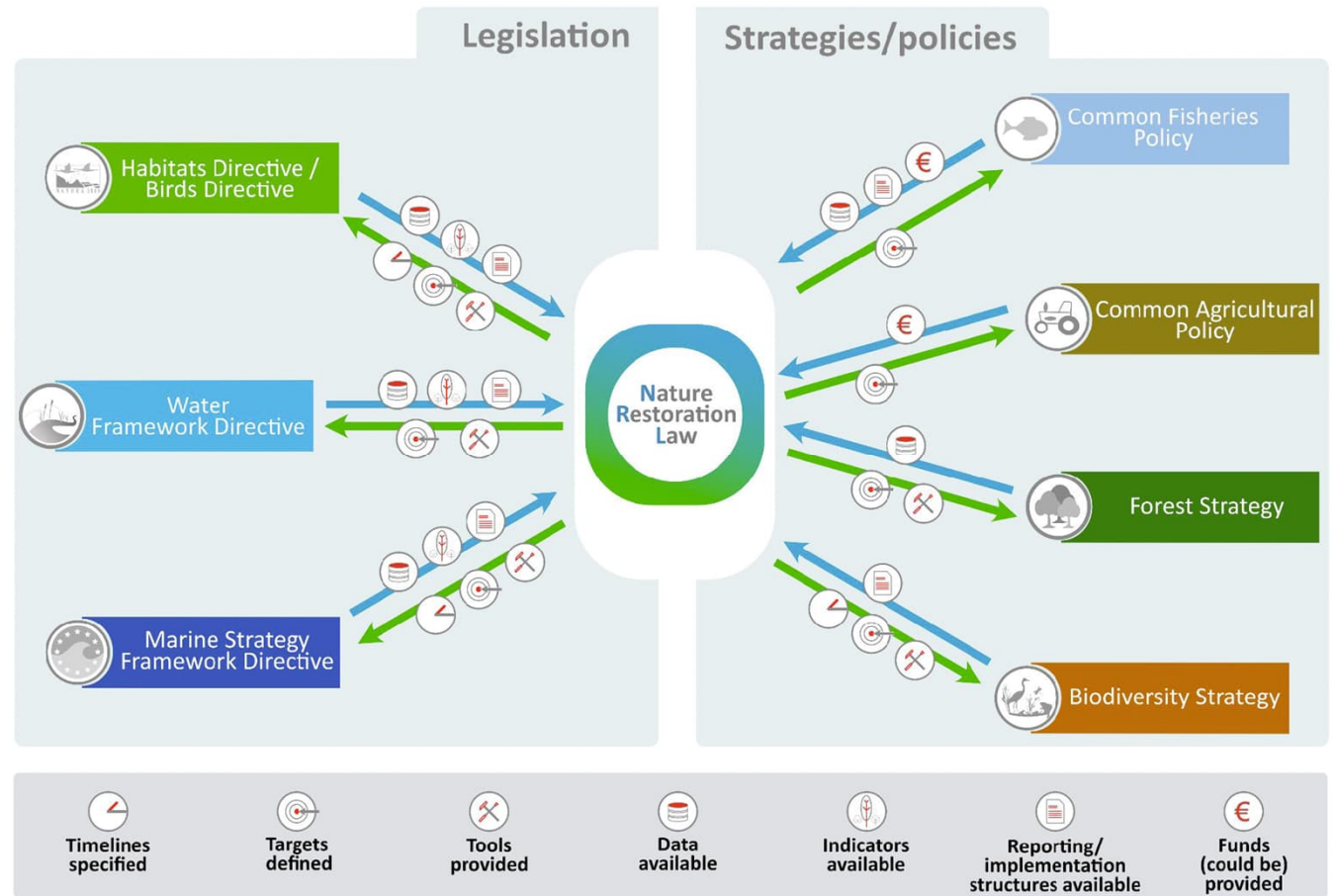
The NRR is a huge challenge & opportunity!

Relevant articles for this webinar:

- **Article 4: Restoration of terrestrial, coastal and freshwater ecosystems**
- Article 6: Energy from renewable sources
- Article 8: Restoration of urban ecosystems
- **Article 9: Restoration of natural connectivity of rivers & natural functions of floodplains**
- **Article 11: Restoration of agricultural ecosystems**
- Article 12: Restoration of forest ecosystems

Integration/paradigm shift is needed!

[https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-regulation\\_en](https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-regulation_en)



Source: Hering et al., 2023

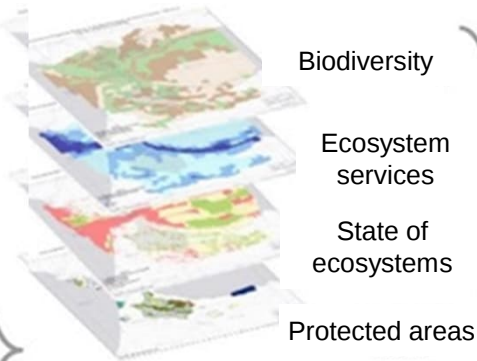
# Nature Conservation Planning: Scientific, fact-based support for decision-making and policy

Inclusion of  
stakeholders for  
co-creation from the start



1. Determining the spatial resolution and extent
2. Definition of scenarios, parameters, targets etc.

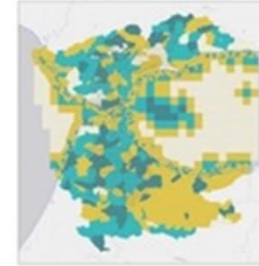
Data collection &  
GIS analyses  
for fact gathering



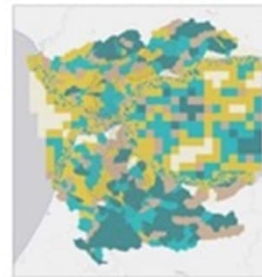
*Spatial  
conservation & restoration  
planning*

Results & scenarios  
as a basis  
for discussion and planning

Scenario 1



Scenario 2



Adapted from Barbosa et al, 2019, STOTEN

- Inter- and transdisciplinary cooperation is more successful because better accepted (Jung et al., 2024)
- Application examples: Expansion of renewables, balancing of interests & discourse on restoration, etc.

# Ecological Prioritisation for longitudinal connectivity

Simple rating approach in the Danube River Basin Management Plans of 2009, 2015 and 2021

| Criteria                                                   | Rating |
|------------------------------------------------------------|--------|
| <b>1. Migratory habitat</b>                                |        |
| - Long-distance migrants habitat (Danube)                  | 4      |
| - Long-distance migrants habitat (tributary)               | 2      |
| - Medium-distance migrants habitat                         | 1      |
| - Short-distance migrants habitat (head waters)            | 0      |
| <b>2. River Segment</b>                                    |        |
| - First river segment in Danube                            | 5      |
| - First river segment upstream of mouth (tributary)        | 4      |
| - Second river segment upstream of mouth                   | 2      |
| - Third river segment upstream of mouth                    | 1      |
| - River segments upstream of third river segment           | 0      |
| <b>3. Length of reconnected habitat (Danube/tributary)</b> |        |
| - >100 km / >50 km (tributary)                             | 2      |
| - 40-100 km / 20-50 km (tributary)                         | 1      |
| - <40 km / <20 km (tributary)                              | 0      |
| <b>4. Protected site</b>                                   |        |
| - Yes                                                      | 1      |
| - No                                                       | 0      |
| <b>5. Pressures</b>                                        |        |
| - 0 pressures                                              | 3      |
| - 1 pressure                                               | 2      |
| - 2 pressures                                              | 1      |
| - 3 pressures                                              | 0      |



Source: ICPDR 2021 (<https://www.icpdr.org/tasks-topics/tasks/river-basin-management/danube-river-basin-management-plan-2021>)

PI = migratory habitat x (1 + river segment + reconnected length + protected site + anthropogenic pressures)

# Ecological Prioritisation in the Danube River Basin Management Plan

*But since water and land ecosystems are closely interconnected and have far-reaching effects on biodiversity and the health of both systems:*

## New approach selected for NaturaConnect:

→ Assessment of longitudinal & lateral connectivity using state of the art modelling approaches

→ Combination in a **multi-dimensional prioritisation approach** to identify

- barriers where removal/fish pass brings the highest benefit to the catchment connectivity
- riparian zones/wetlands with high restoration/reconnection potential
- Co-design (ICPDR, CC) e.g. for DRBMP 2027



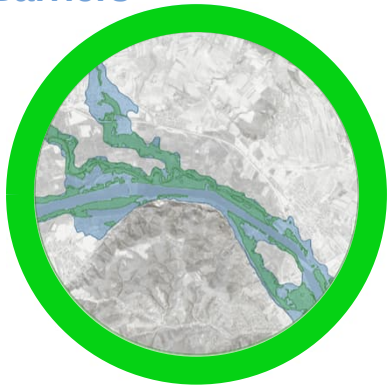
# Data availability of NaturaConnect



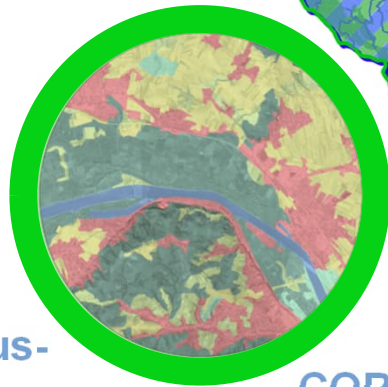
ICPDR- Database



Barriers



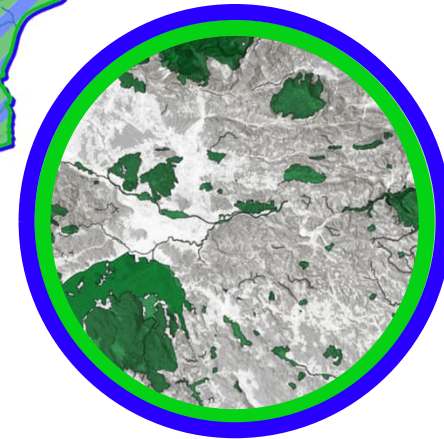
Copernicus-  
Riparian zones



CORINE-  
Land Cover

ConnectGREEN &  
other datasets

© Georg Gruber



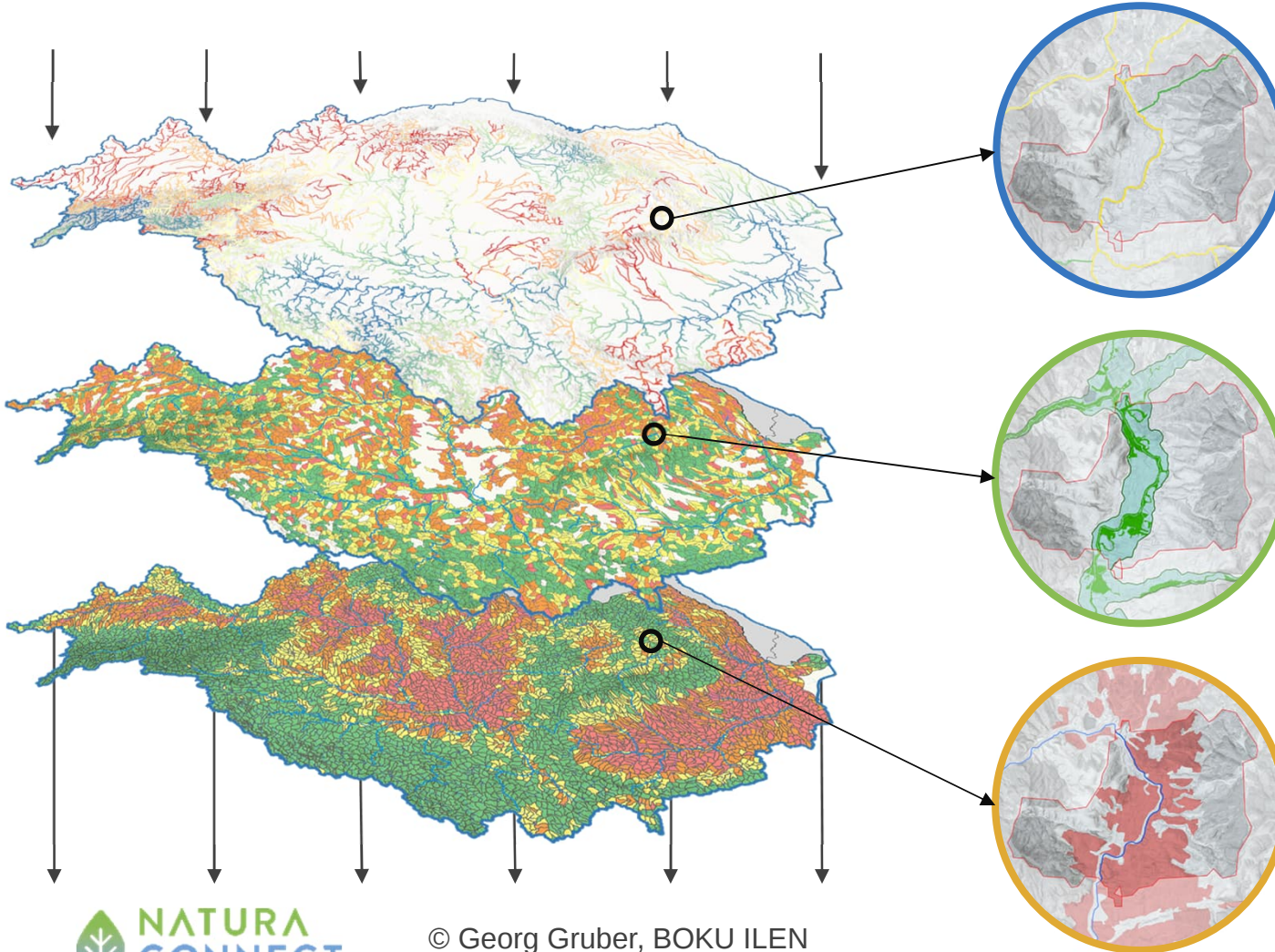
Natura 2000  
+Emerald sites



# Our methodology is multidimensional: Combination of 3 scales

## Main investigation unit:

Functional Elementary Catchments (FECs; Ø~60 km<sup>2</sup>) and associated rivers (ECRINS network; Ø~2.5 km)



- **Longitudinal connectivity (river)**

Riverconn indices

### Deep dive 1

- **Lateral connectivity (riparian zone)**

Resistance-based Omniscape approach

### Deep dive 2

- **Habitat connectivity (sub-catchment)**

Effective mesh size

### Deep dive 3

# Specific aims of the webinar

- **Gather feedback from stakeholders** on our current connectivity methodology
- **Discuss the applicability, strengths, and limitations of our approach** in different (national) contexts  
→ Basis to refine individual parameter settings
- **Identify needs and opportunities for cross-realm integration & prioritisation** in the Danube–Carpathian Region – also beyond the project horizon

# Questions and Answers



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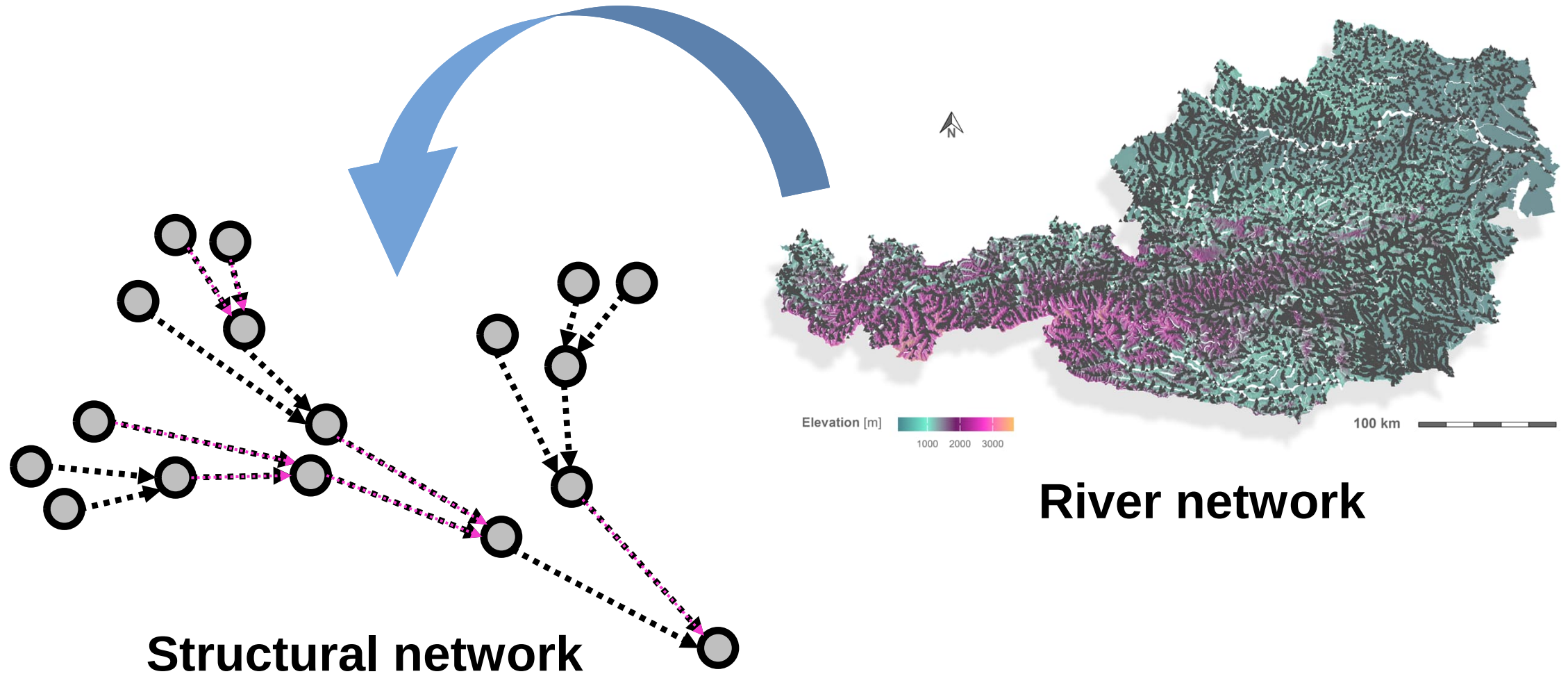
# Deep dive 1: Longitudinal connectivity approach

**Johannes Kowal & Carina Seliger**

BOKU University, Vienna, Austria,

Institute of Hydrobiology and Aquatic Ecosystem Management (IHG)

# How can habitat connectivity be assessed?



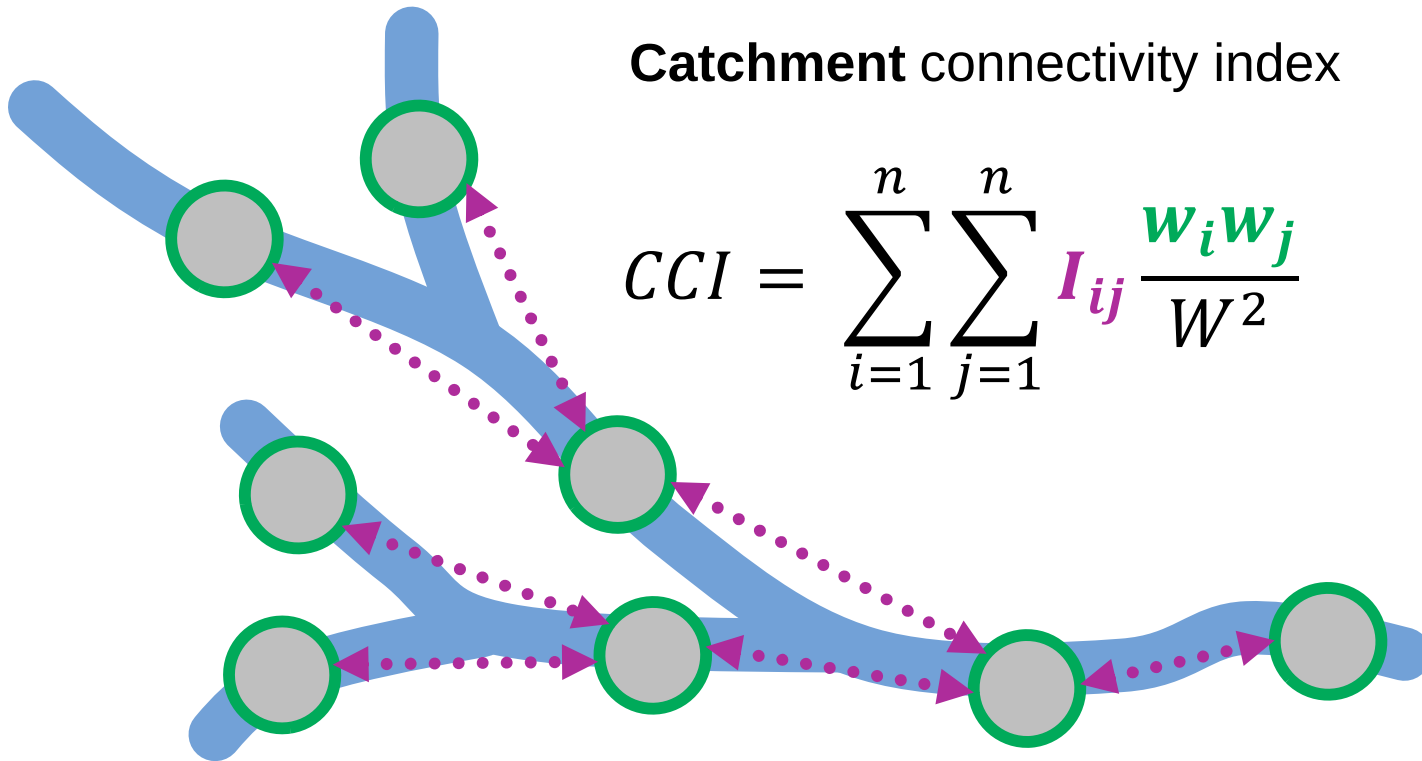
# Network approach

Reach connectivity index

$$RCI_i = \sum_{j=1}^n I_{ij} \frac{w_j}{W}$$

Catchment connectivity index

$$CCI = \sum_{i=1}^n \sum_{j=1}^n I_{ij} \frac{w_i w_j}{W^2}$$



Input parameters:

- **Habitat** availability/suitability
- **Relevance** for restoration
- **Position** of barriers
- **Passability** of barriers
- (...)

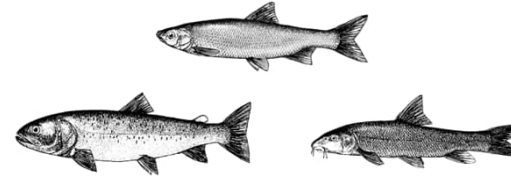
$I_{ij}$  = Probability of dispersal  
(from reach  $i$  to  $j$ )

$w_j$  = Weighting factor  
(of reach  $j$ )

# Dispersal distances & barrier passability



Long (LDM)



Medium (MDM)



Short (SDM)

Threshold (5%) of  
migration distance

3000 km

300 km

30 km

Passability **with FP**  
Passability **without FP**

↑ 15%    ↓ 30%  
0%    15%

↑ 30%    ↓ 60%  
0%    30%

Values based on Noonan et al. 2012

# Dispersal **distances** & **barrier** passability

$$RCI_{comb} = RCI_{LDM} + RCI_{MDM} + RCI_{SDM}$$



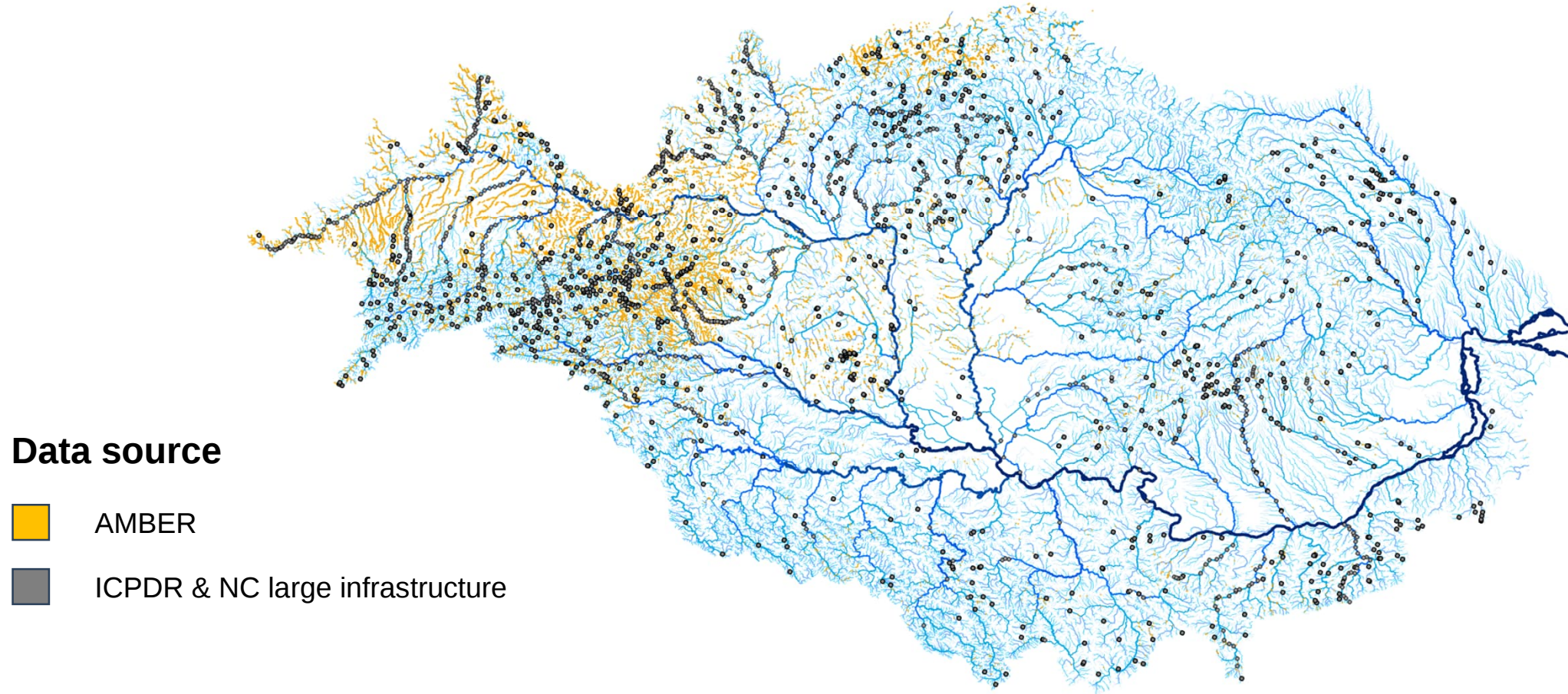
## **Application 1:**

**Prioritisation of river reaches**  
(restoration / conservation)  
Method: **Highest value**

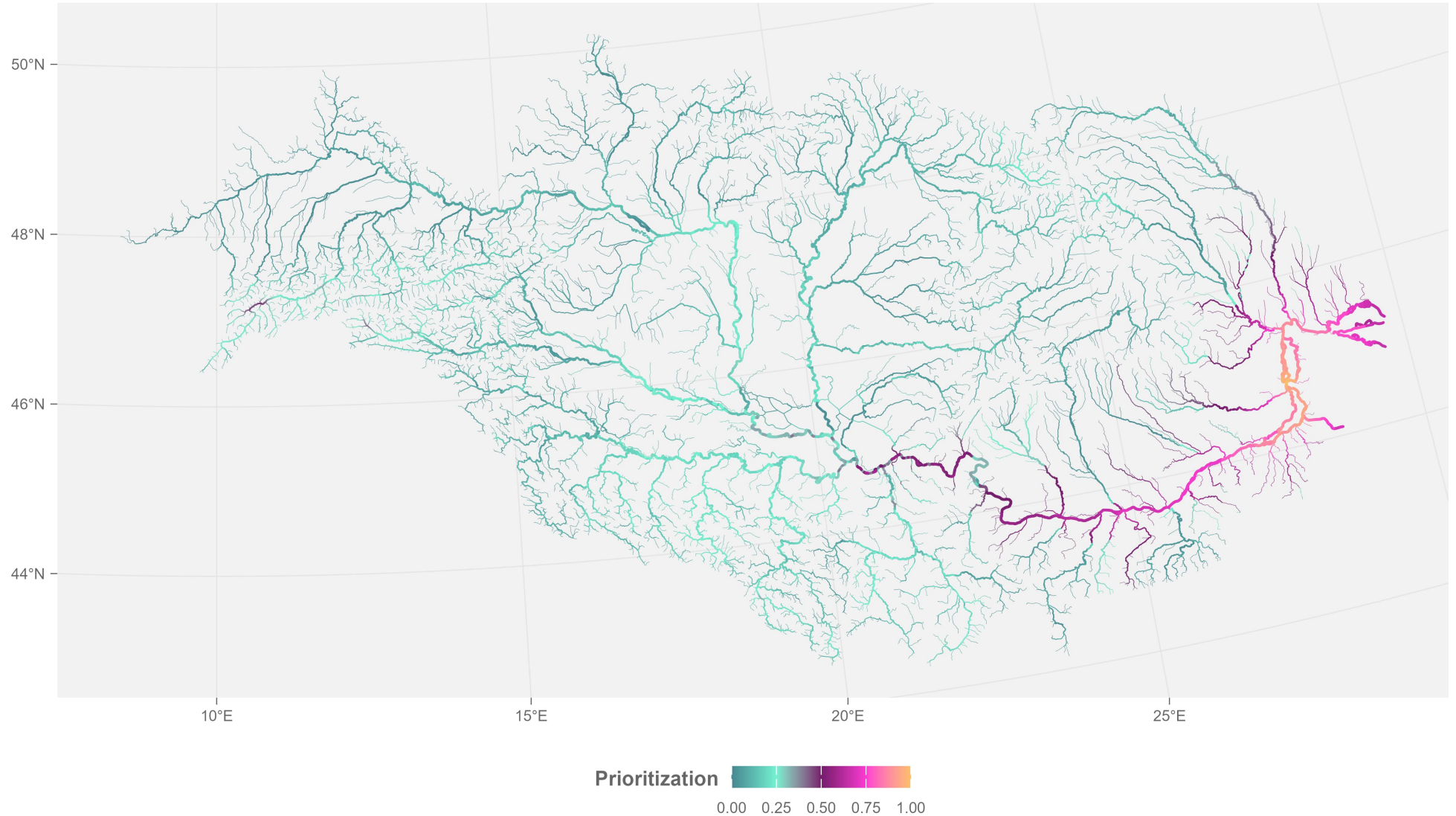
## **Application 2:**

**Prioritisation of barriers**  
(removal / migration aids)  
Method: **Leave one out principle**

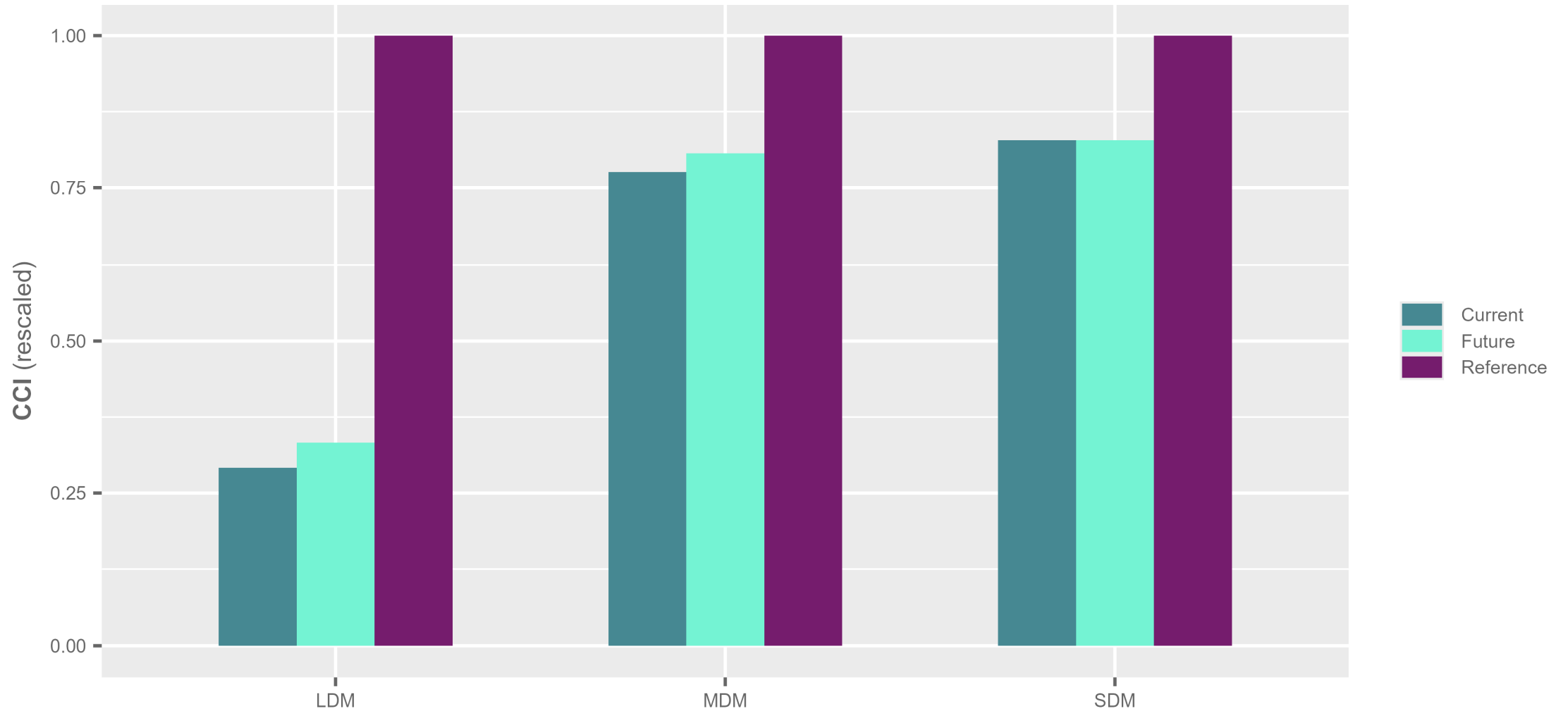
# Barrier data



# Preliminary results prioritisation



# Preliminary results CCI (catchment connectivity index)





# Questions and Answers

Copyright: CEEWeb

# Breakout session

## **Group 1: Passability**

Chair: Johannes Kowal, Notetaker: Georg Gruber

## **Group 2: Dispersal**

Chair: Carina Seliger, Notetaker: Florian Borgwardt

## **Group 3: Limitations**

Chair: Rafaela Schinegger, Notetaker: Anna Huber

# Housekeeping for breakout sessions

- 1) Participants will be **randomly distributed** into breakout groups
- 2) **Each group starts with 2–3 short Mentimeter questions**  
→ participate on preferred device – phone/computer (code in chat)
- 3) **Followed by an open discussion:** share ideas, examples, or regional insights
- 4) Our note-takers will **collect key points directly in Padlet**
- 5) **Comments or statements in the chat are also welcome** at any time
- 6) After discussions, **each group briefly reports back in plenary**
- 7) Sandra will stay in the main room for any technical or organisational questions

# Report back from breakout groups

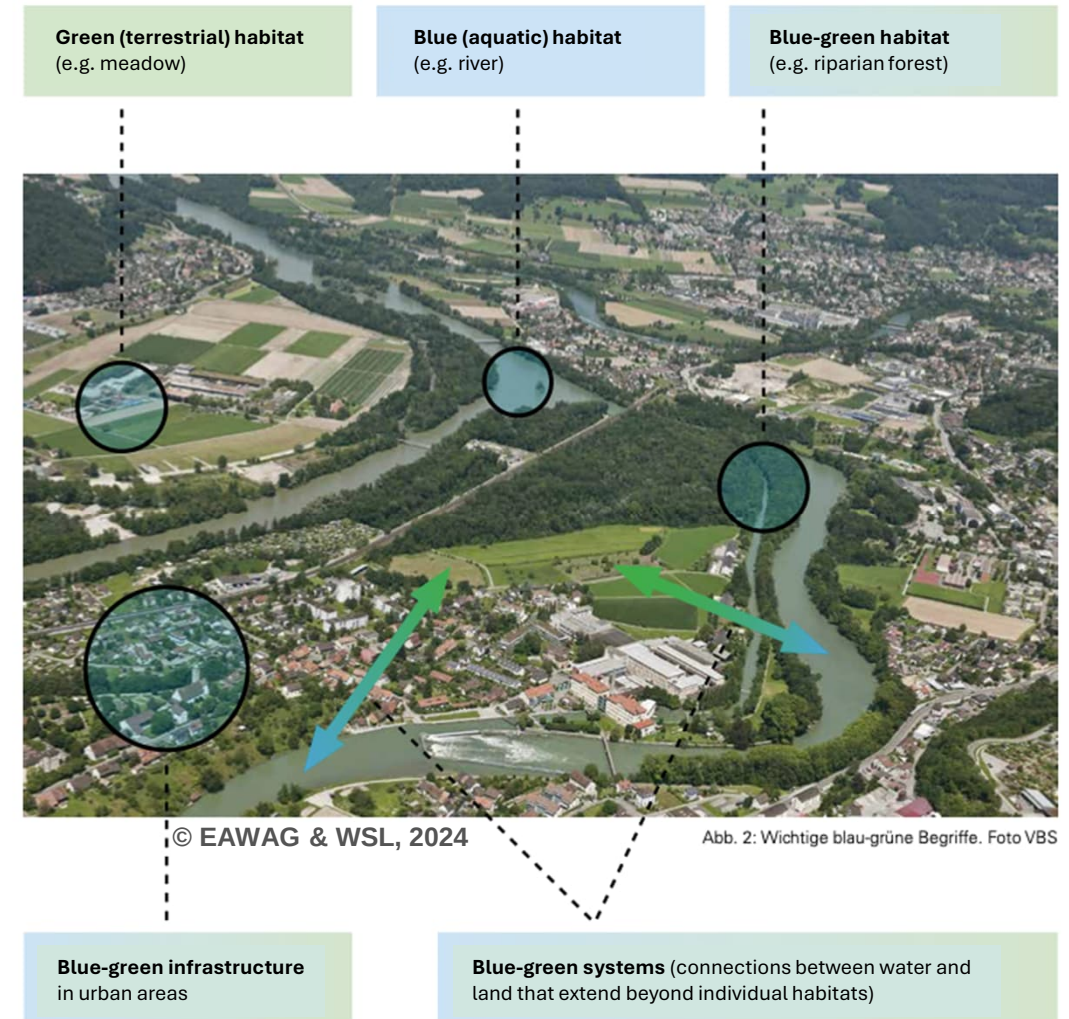
# Deep dive 2: Lateral & hinterland connectivity approaches

Georg Gruber & Rafaela Schinegger  
BOKU University Vienna, Austria,  
Institute of Landscape Development, Recreation and  
Conservation Planning

# Riparian zones

link ecosystems and support blue-green infrastructure

- River–floodplain ecosystems are essential for sustaining **high biodiversity in the landscape**
- **HIGHLY IMPACTED BY**
  - Agriculture and urbanization
  - Human activities (channelisation, impoundment etc.)
  - Climate change
- Serve a key role in connecting different landscape patches through **hydrological and ecological connectivity**



<https://www.dora.lib4ri.ch/wsl/islandora/object/wsl:37657/datastream/PDF>

# Riparian zones connectivity

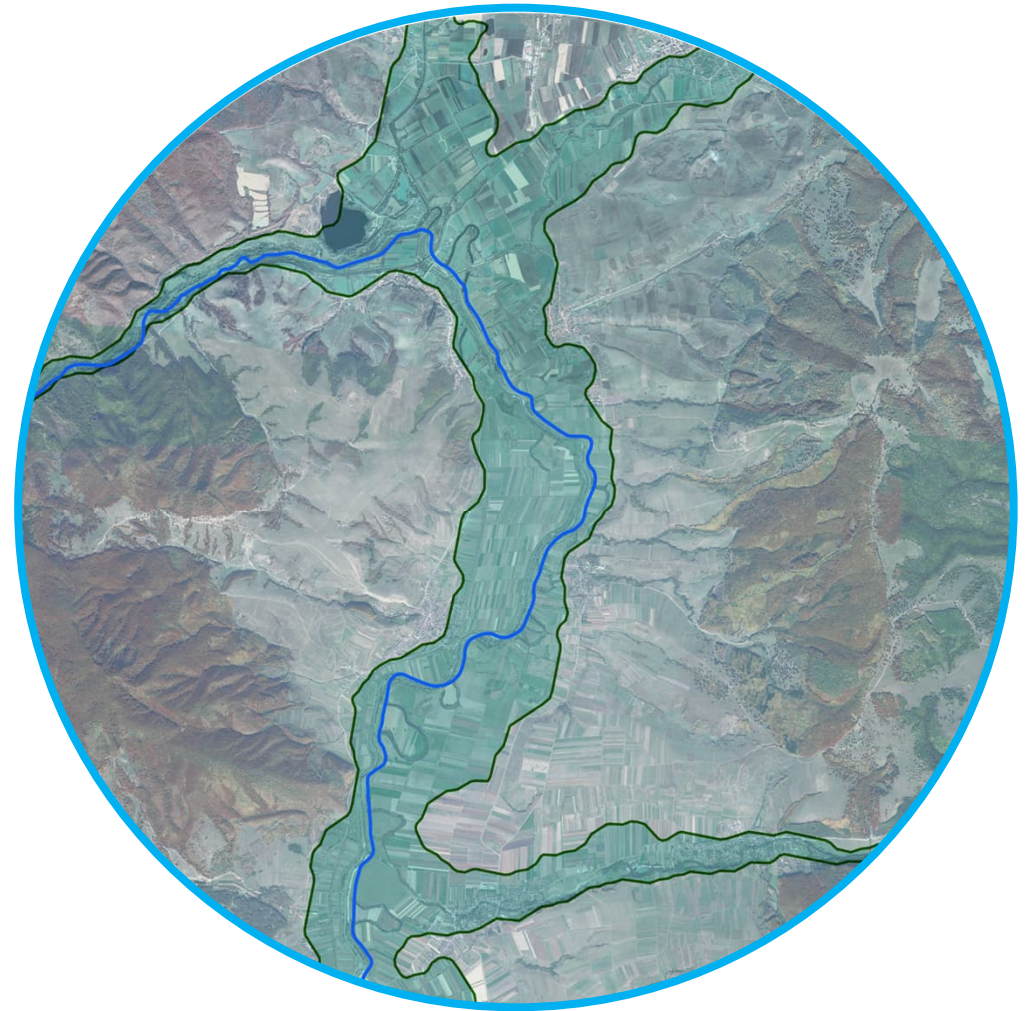
How do we define &  
how can we measure connectivity?

- **Structural connectivity** of natural habitats  
→ Areas in **natural condition** and **well-connected** with the **river waterbody**
- **Semi-functional connectivity**  
based on habitat preferences of species

Both approaches are based on

**Copernicus Land Monitoring Service datasets:**

- Copernicus Riparian Zone Landcover
- Copernicus Actual and Potential Riparian Zone

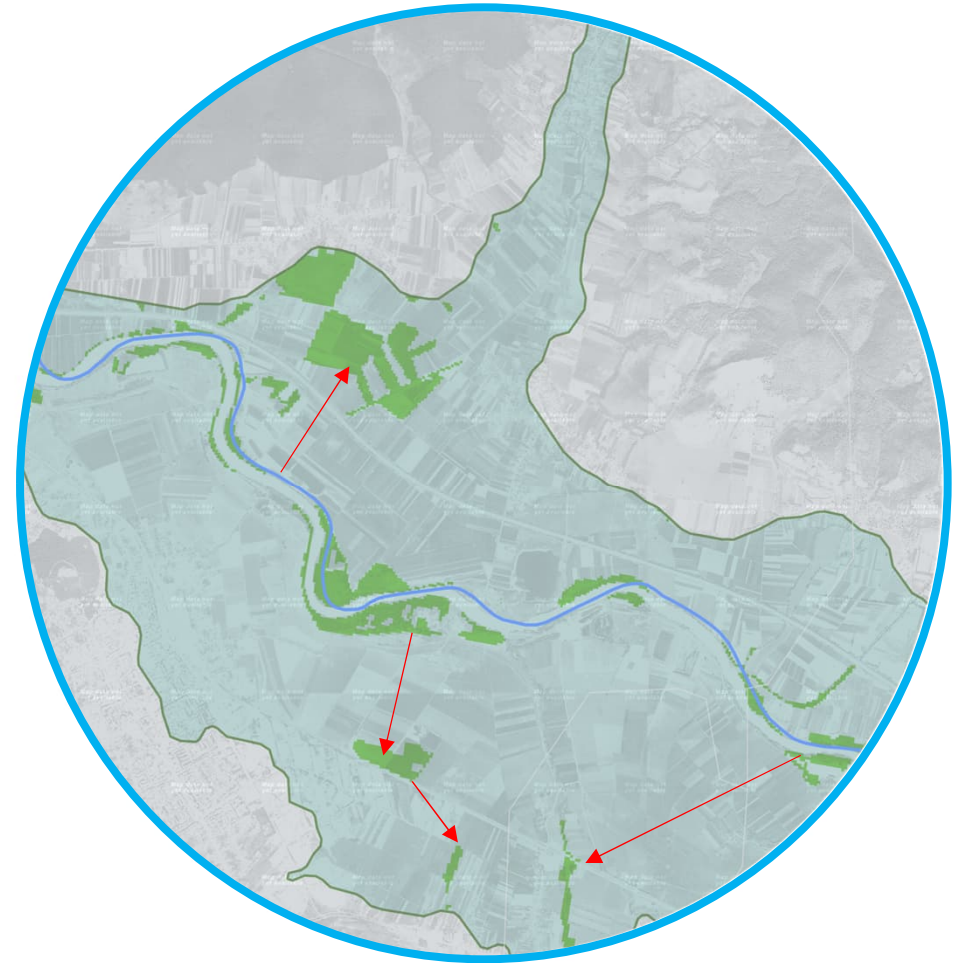


© Georg Gruber, BOKU ILEN

# Structural connectivity

➔ of actual riparian zone

- Connectivity from a more **holistic perspective**
- Creation of a **resistance matrix** based on recent literature
- **Multifunctional** connectivity of the landscape:  
--> Blue-green infrastructure

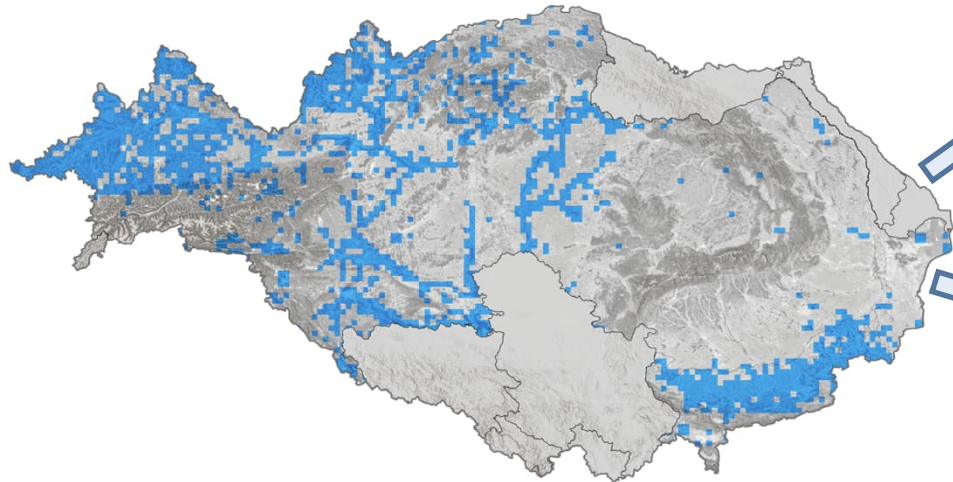


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# Semi-functional connectivity

## ► for which species?

- We identified **137 overall animal species** of freshwater and wetland ecosystems listed in the EU Habitats-Directive (Schinegger et al., 2024)
- Two **representative species groups** were modelled
- **Represent different ecology** and different home ranges



2 mammal species

20 amphibian species

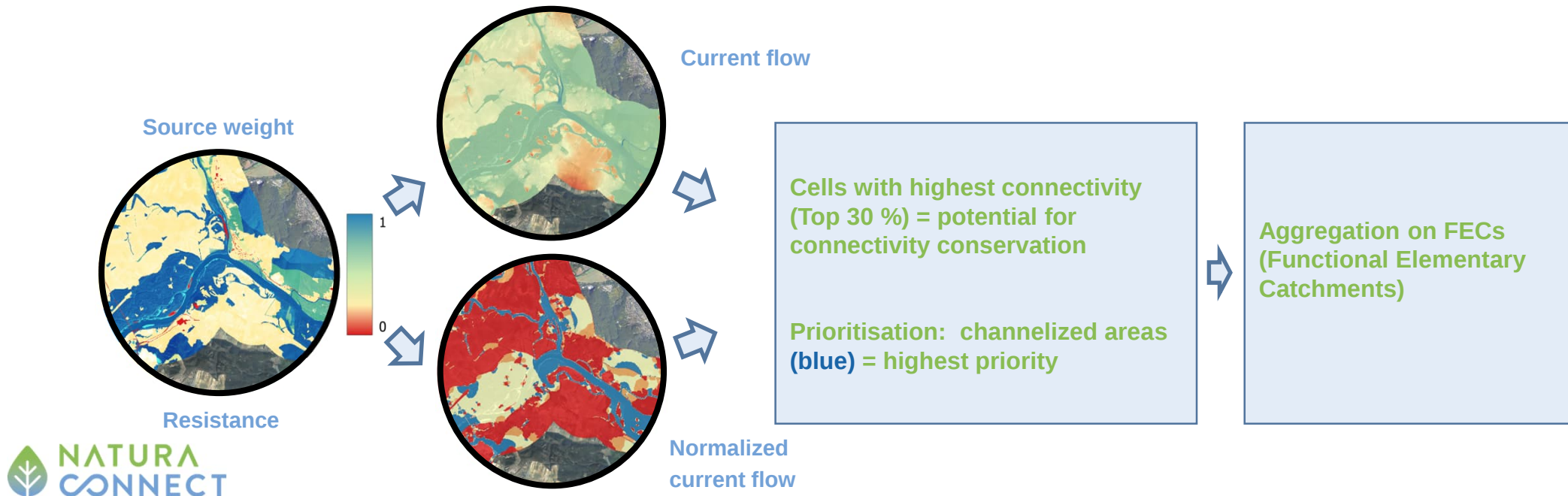
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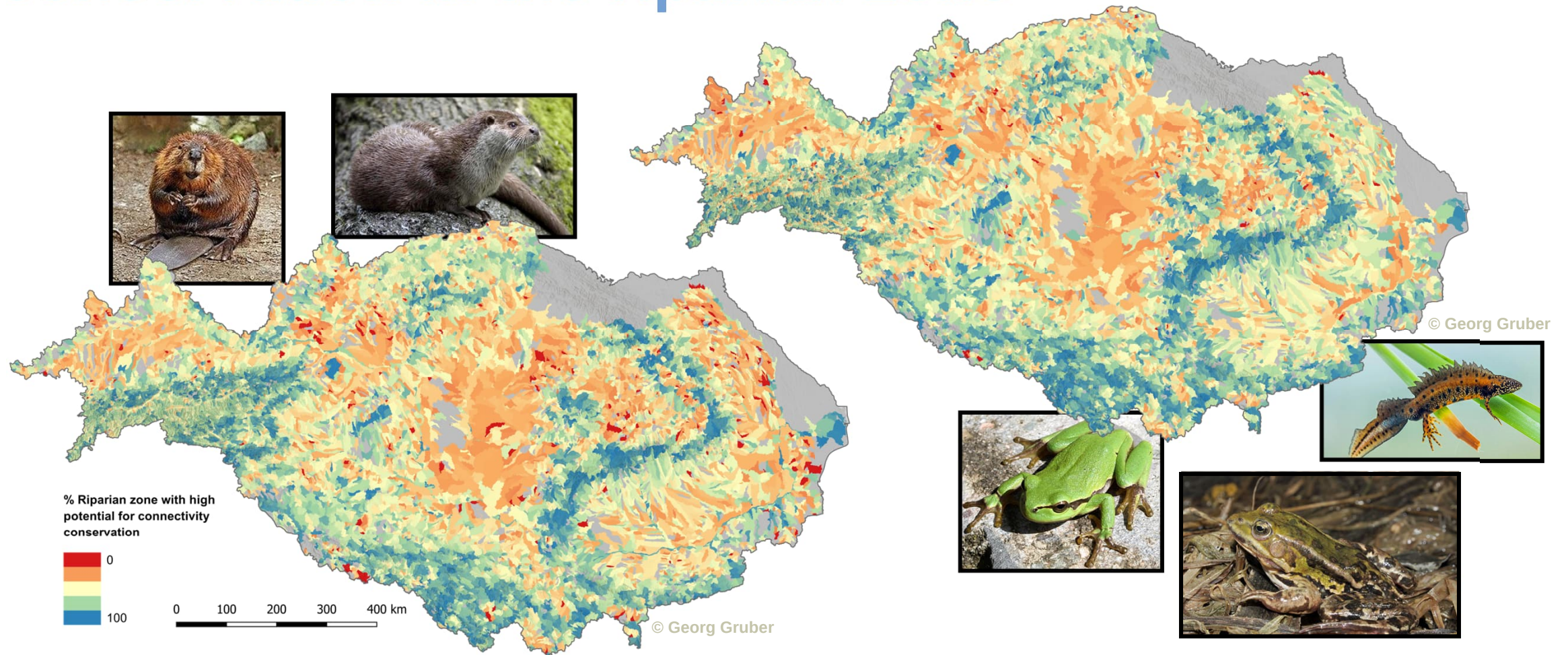
# Semi-functional connectivity

## ➡ How to measure connectivity?

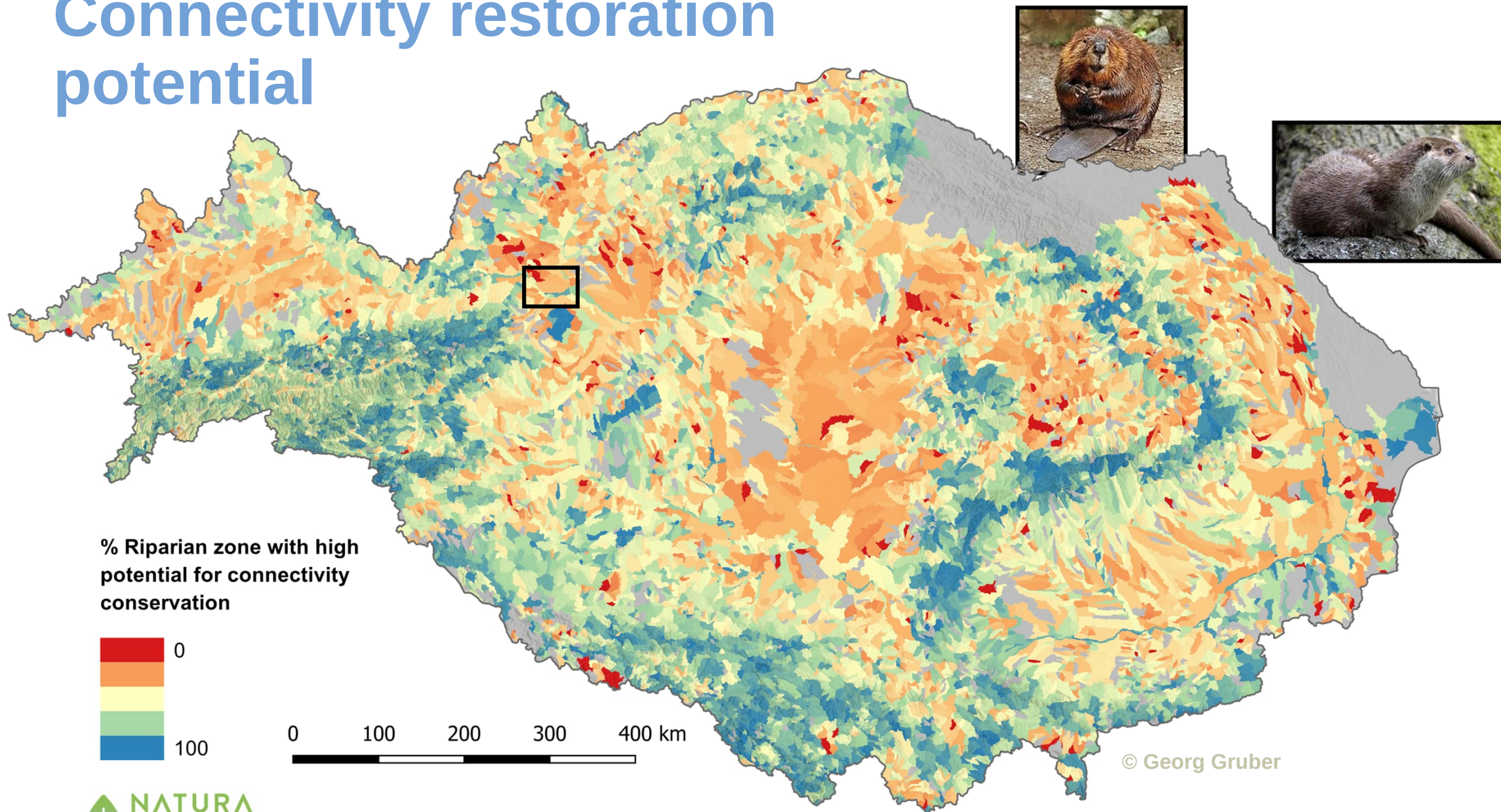
- Connectivity modelling for WL-mammals and amphibians **using Omniscape** (McRae et al., 2016).
- **Creating a source weight and a resistance raster** based on suitability of different landcover classes for the selected species (IUCN, 2024; O'Connor et al., 2024).
- Calculating the Omniscape-Model.
- Using the Omniscape outputs **to identify areas with conservation and restoration potential.**



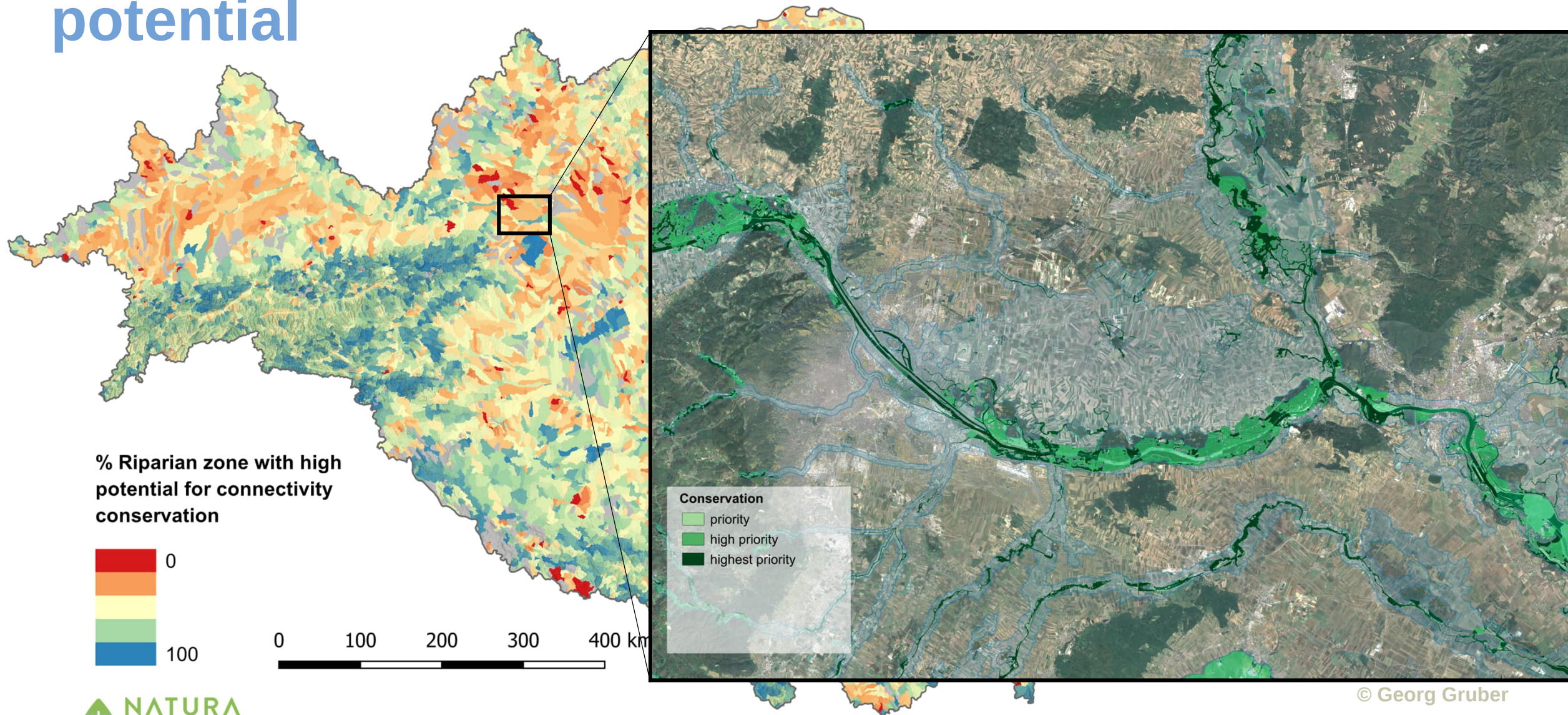
# Areas with high potential for connectivity conservation in the riparian zone



# Connectivity restoration potential



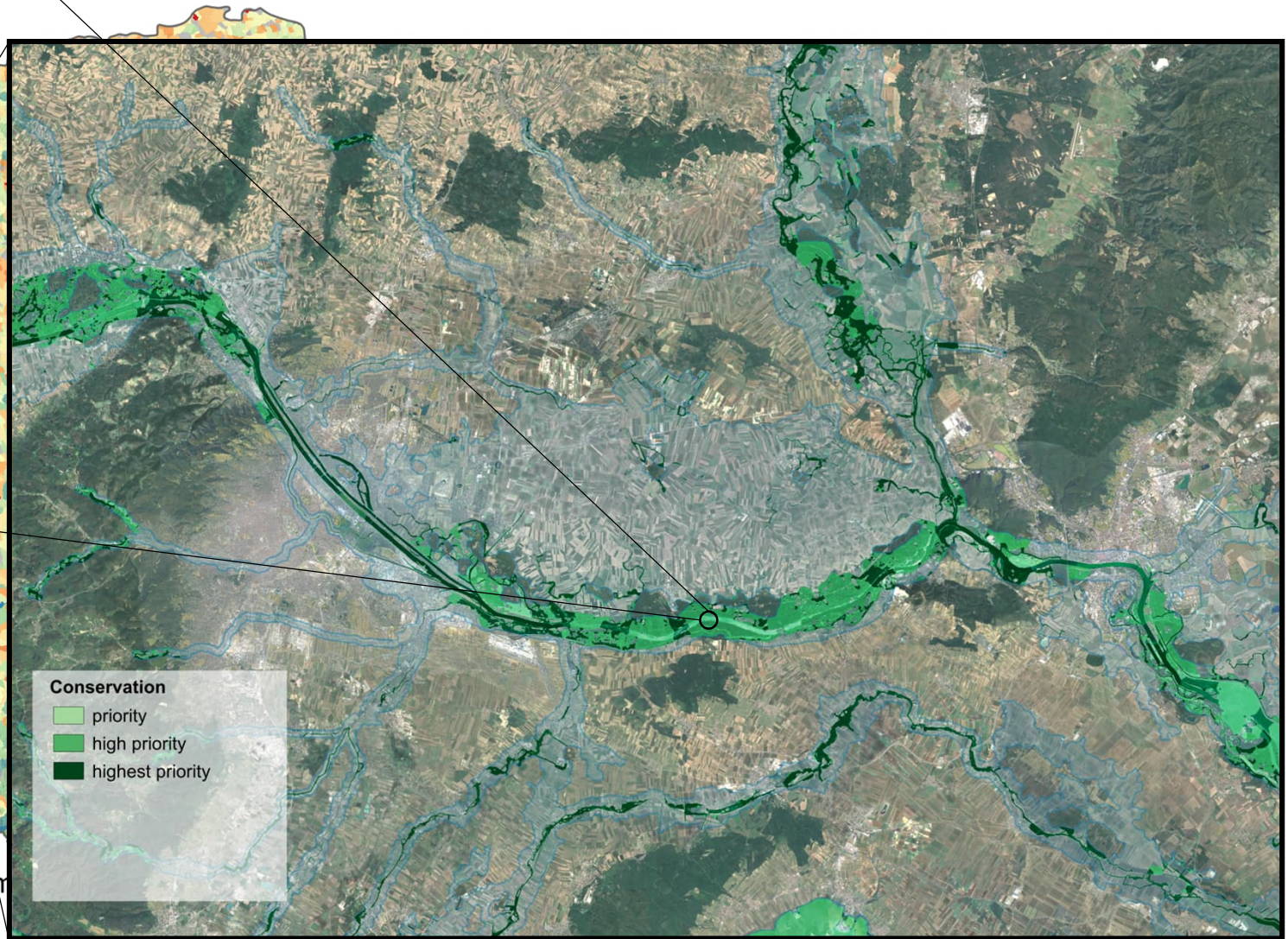
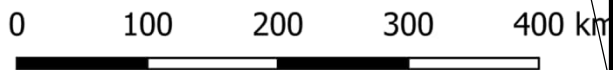
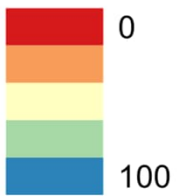
# Connectivity restoration potential



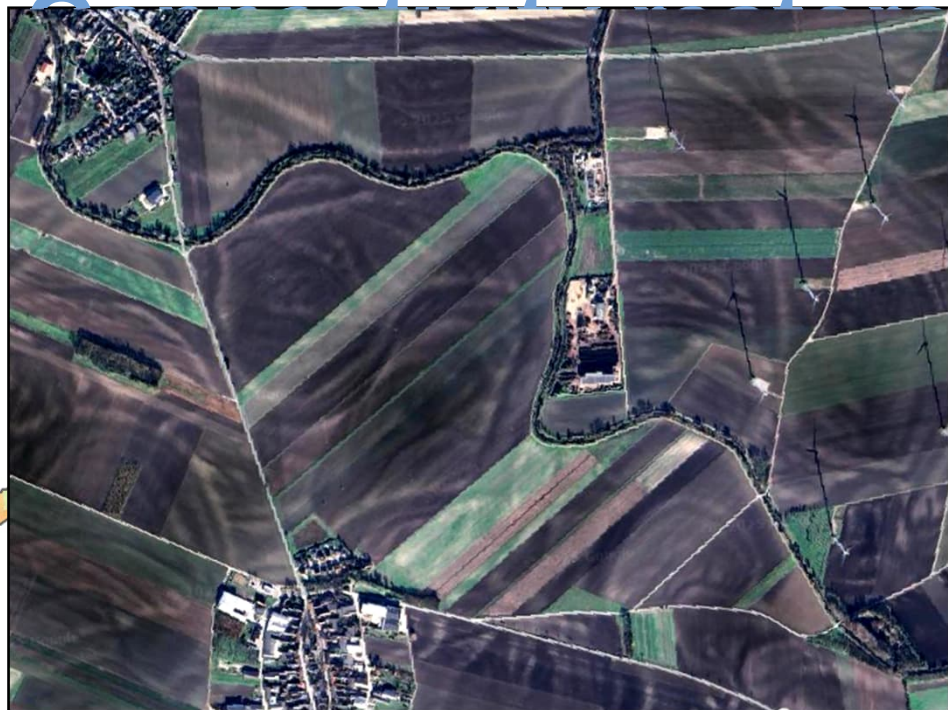
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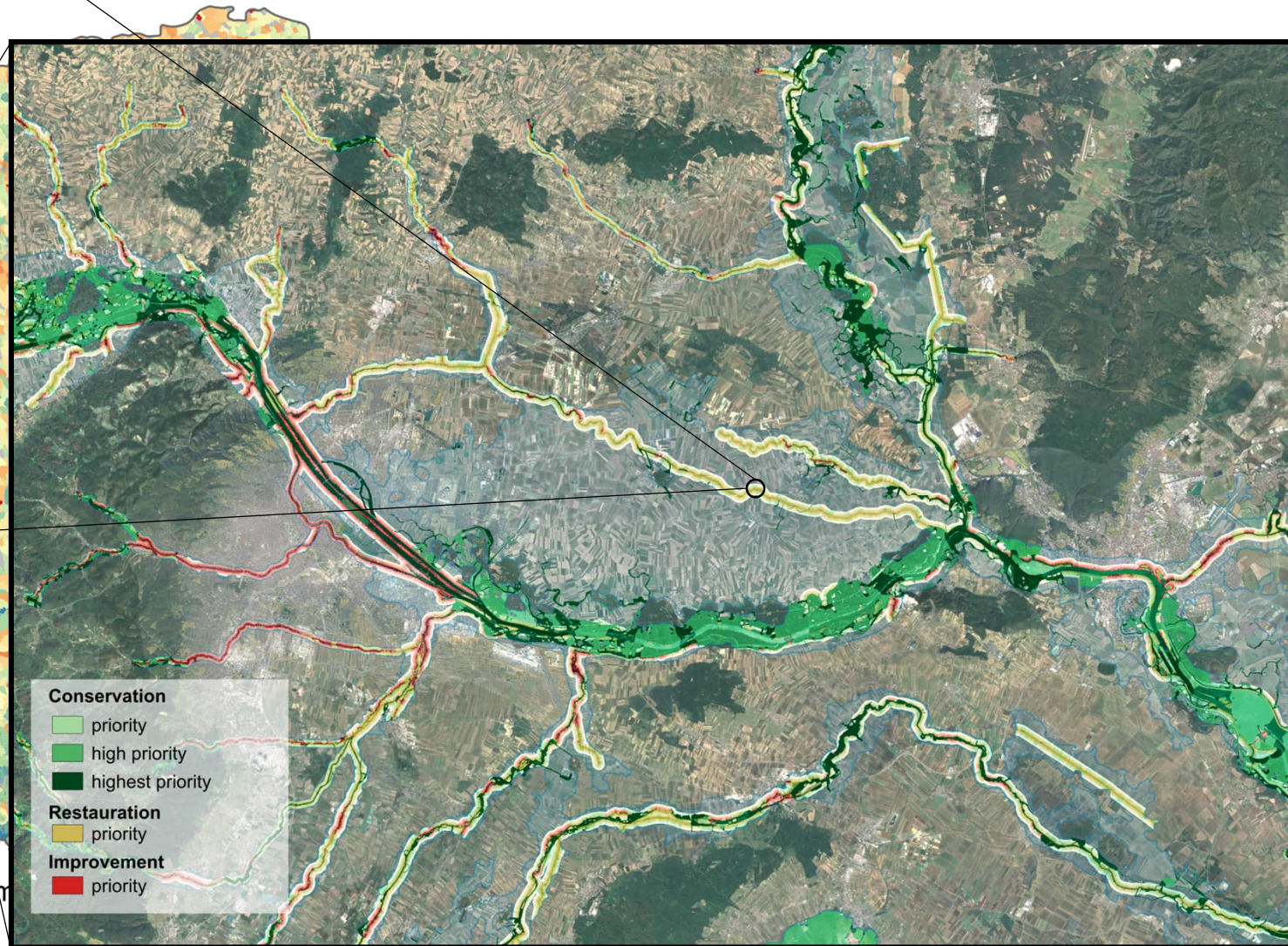
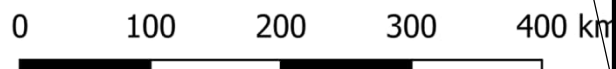
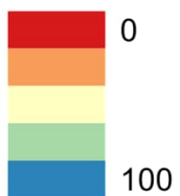
% Riparian zone with high potential for connectivity conservation



# tion



% Riparian zone with high potential for connectivity conservation



# Hinterland/sub-catchment

## NaturaConnect products

### ➡ Habitat-connectivity:

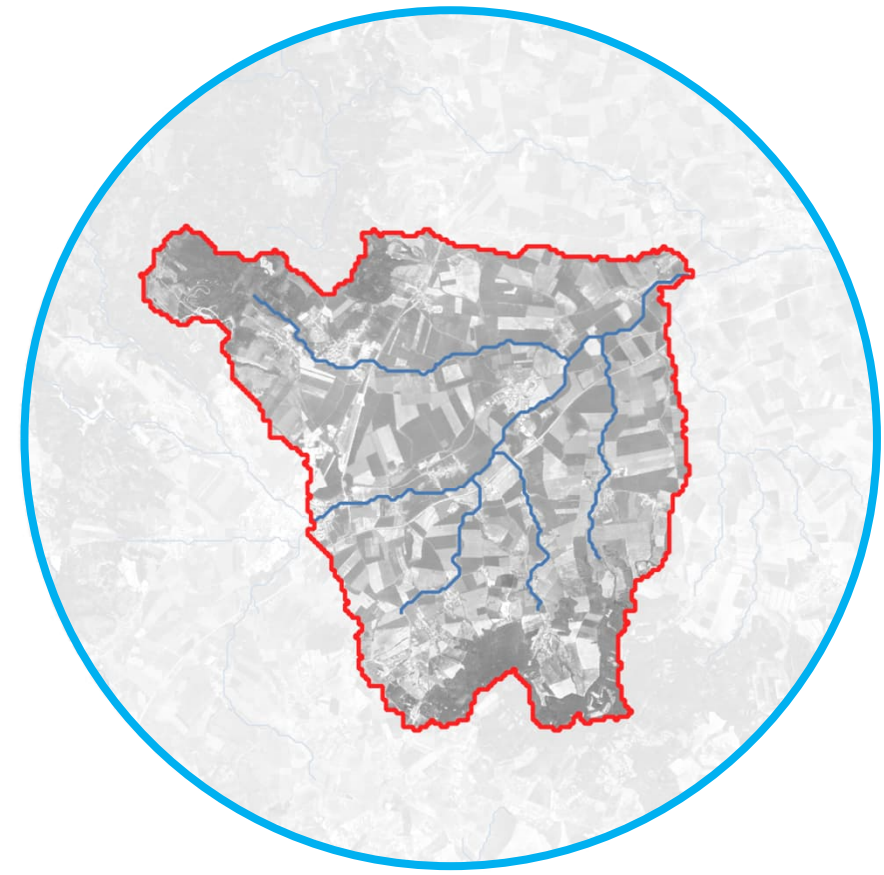
- EUNIS-Habitats

--> NaturaConnect WP 6 product  
(Nikolaj Poulsen, unpublished)

### ➡ Ecosystem services:

- Carbon storage and sequestration
- Soil retention
- Crop pollination
- Forest recreational potential
- Landscape recreational potential

--> NaturaConnect WP 3 product  
(Afke Schipper et al.)



© Georg Gruber

### ➡ Multiple pressures:

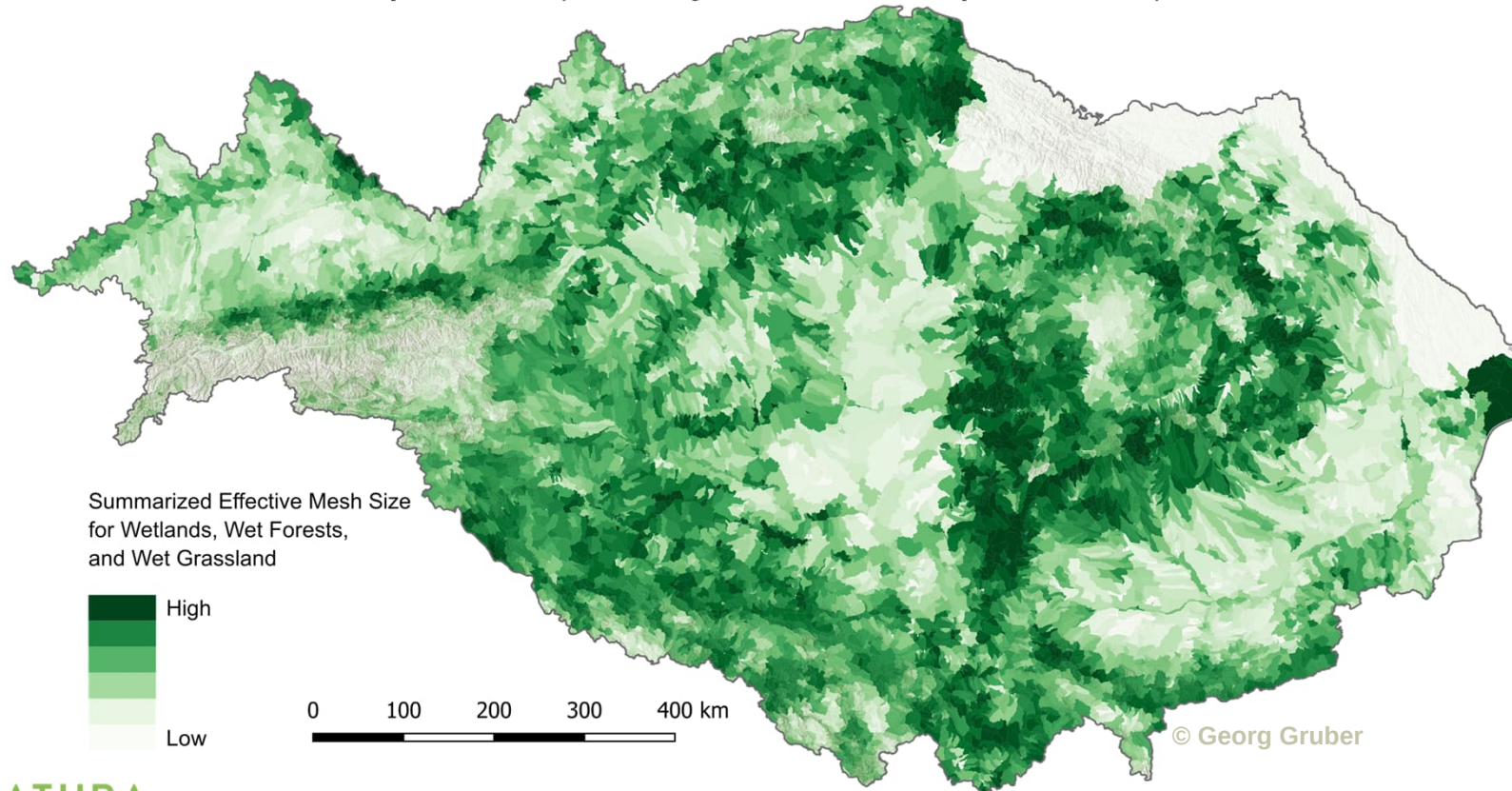
- Land Use pressures
- Road crossings density
- Climate change

--> NaturaConnect WP 5 & 8 product

# Hinterland/sub-catchment

## ➡ Connectivity of wetland habitats

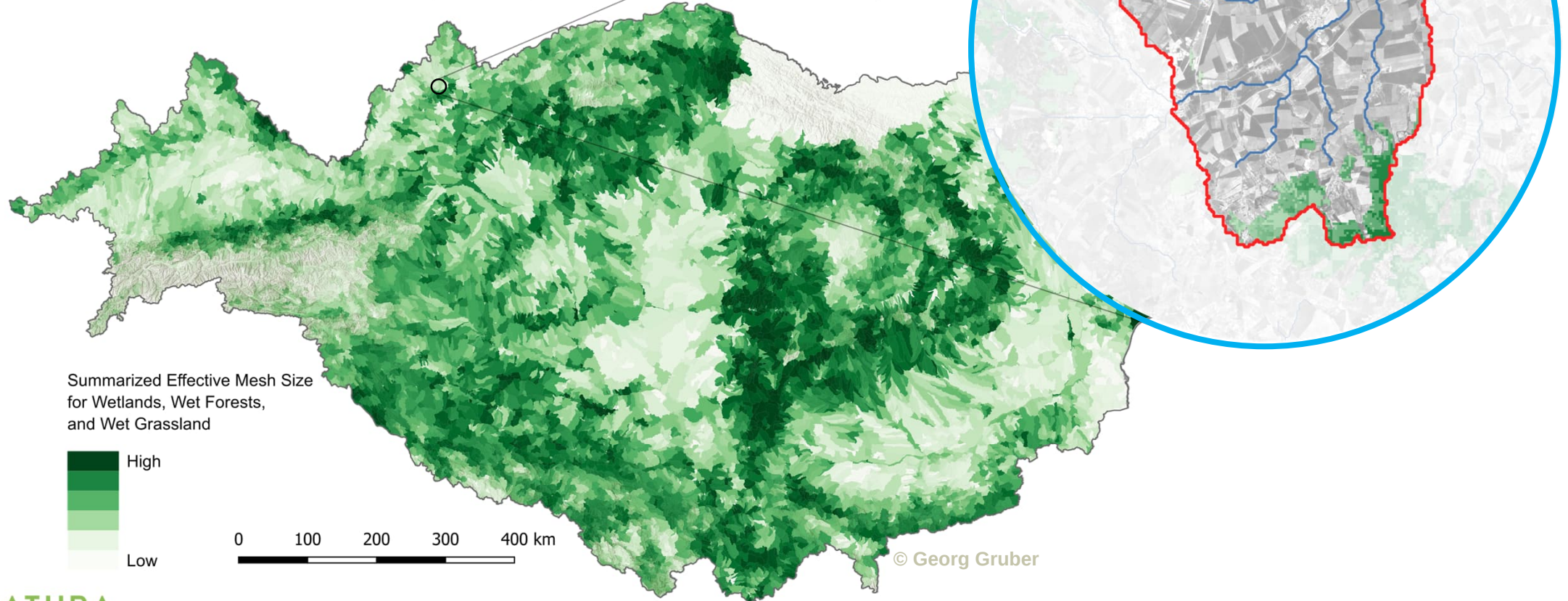
- Based on structural connectivity of EUNIS-Habitats
- Natura Connect product (Nikolaj Poulsen, unpublished)



# Hinterland/sub-catchment

## ➡ Connectivity of wetland habitats

- Based on structural connectivity of EUNIS-Habitats
- Natura Connect product (Nikolaj Poulsen, unpublished)





# Questions & Answers

Copyright: Juraj Vysoky

# Breakout session

## **Group 1: Conservation**

Chair: Georg Gruber, Notetaker: Johannes Kowal

## **Group 2: Restoration**

Chair: Carina Seliger, Notetaker: Florian Borgwardt

## **Group 3: Hinterland/Sub-catchment**

Chair: Rafaela Schinegger, Notetaker: Anna Huber

# Housekeeping for breakout sessions

- 1) Participants will be **randomly distributed** into breakout groups
- 2) **Each group starts with 2–3 short Mentimeter questions**  
→ participate on preferred device – phone/computer (code in chat)
- 3) **Followed by an open discussion:** share ideas, examples, or regional insights
- 4) Our note-takers will **collect key points directly in Padlet**
- 5) **Comments or statements in the chat are also welcome** at any time
- 6) After discussions, **each group briefly reports back in plenary**
- 7) Sandra will stay in the main room for any technical or organisational questions

# Report back from breakout groups

# Short coffee break!



**We will meet  
again  
at 11:45**

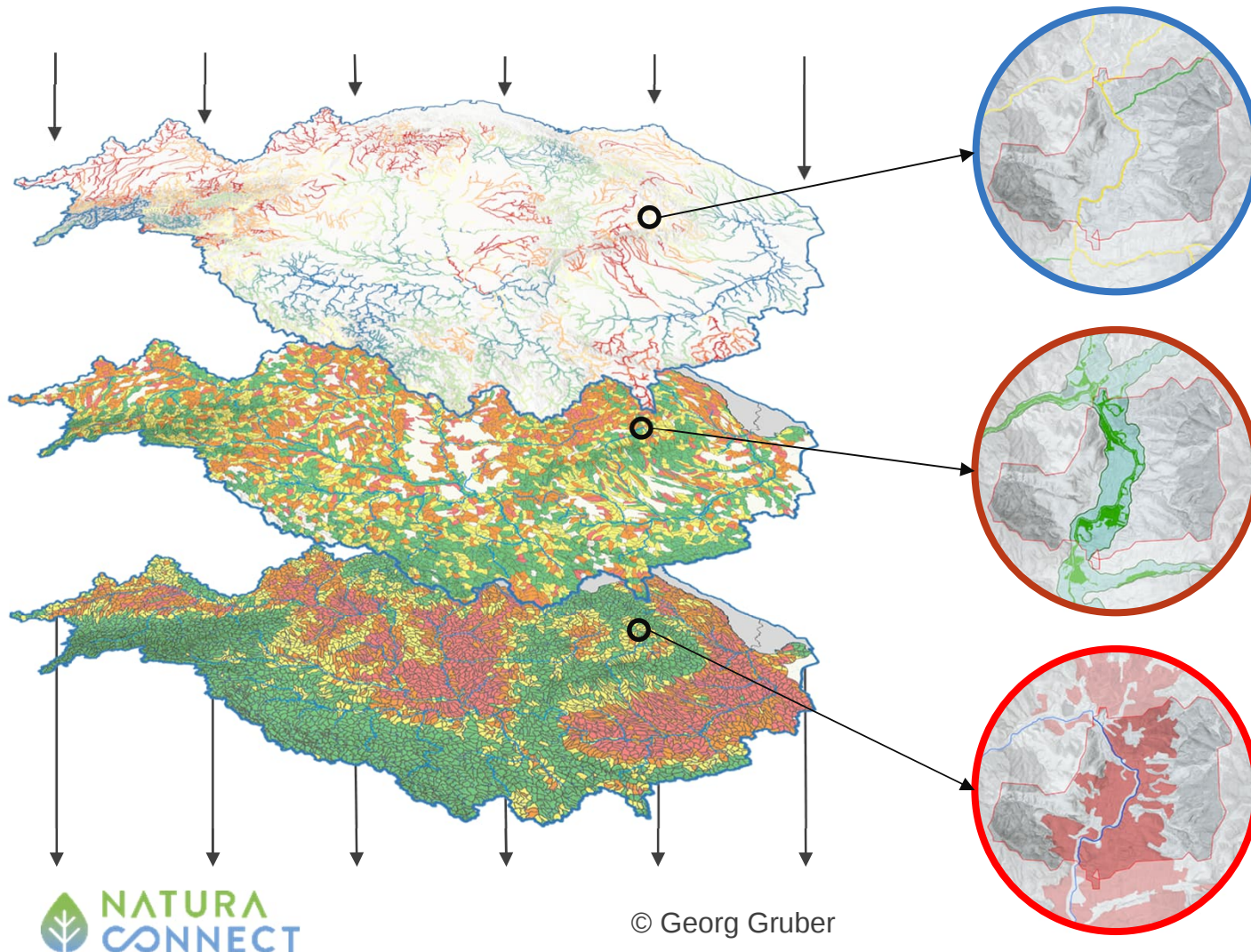
Image: Microsoft archive

# Deep dive 3:

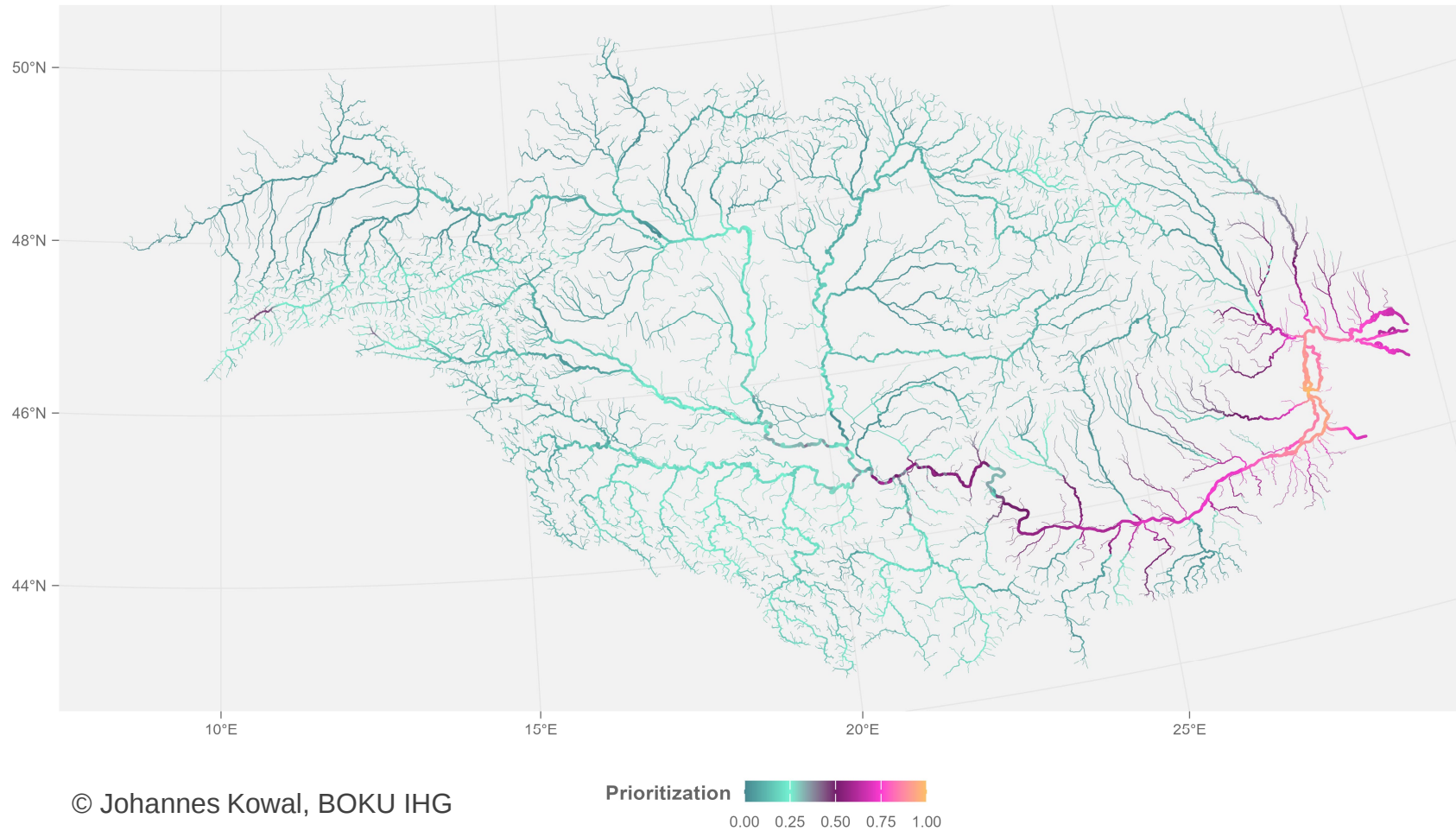
# The integration & prioritisation of our approaches

Carina Seliger, Rafaela Schinegger, Georg Gruber,  
Johannes Kowal  
BOKU University, Vienna, Austria

# Our methodology is multidimensional: Combination of 3 scales



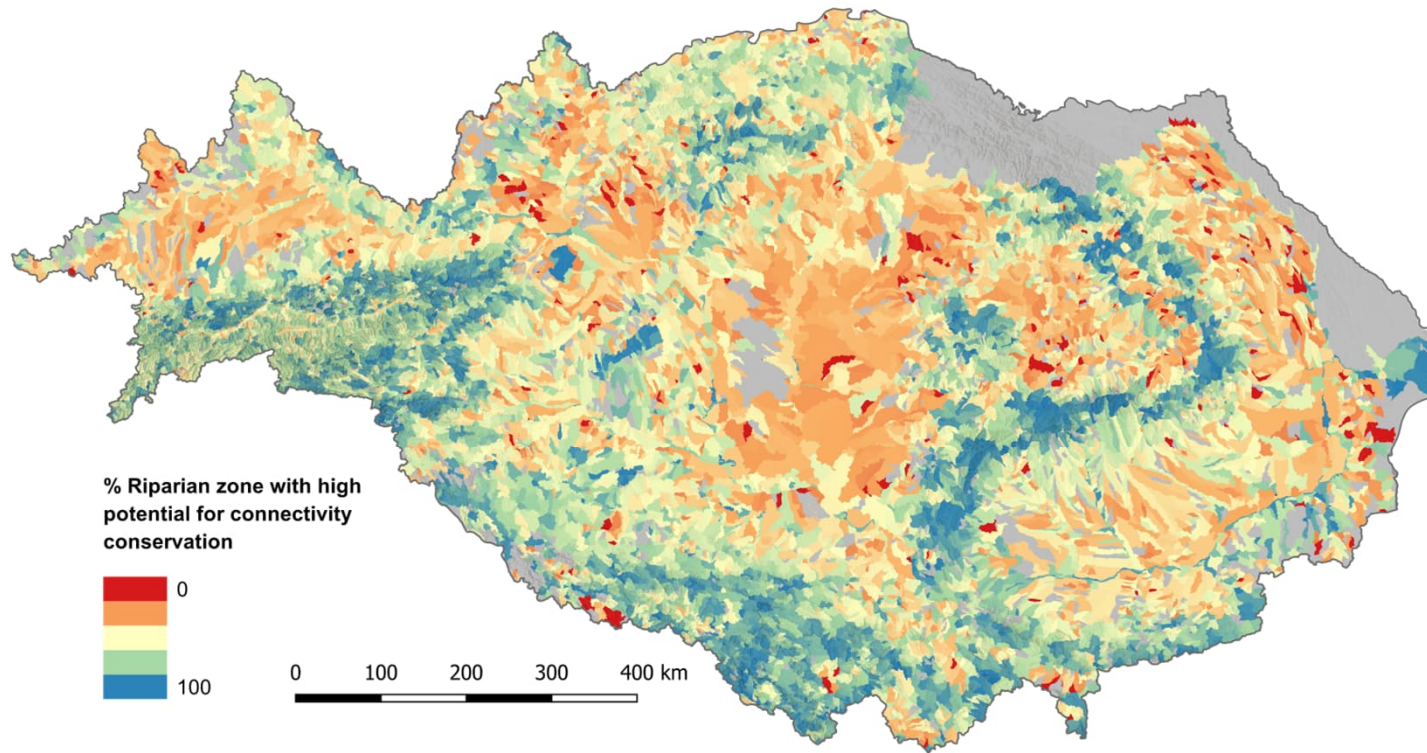
# Prioritisation of longitudinal connectivity



## Datasets available from NaturaConnect & other sources:

- **Reach Connectivity Indices** (LDM, MDM, SDM, combined)
- **Barrier prioritisation** (in progress, depending on stakeholder feedback)
- **Protected areas** (IUCN, N2000, Emerald etc.)

# Prioritisation of lateral connectivity

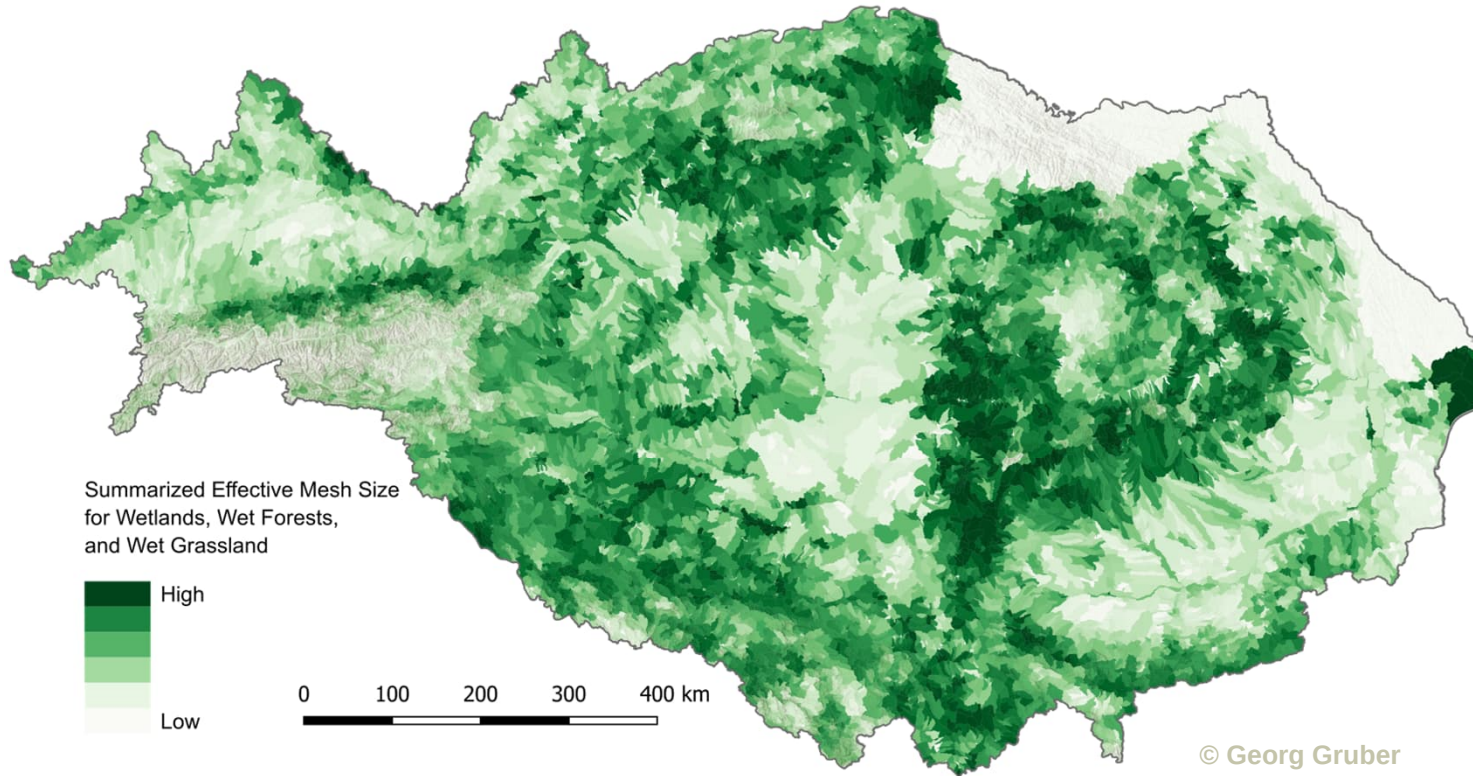


## Datasets available from NaturaConnect & other sources:

- **Connectivity of riparian zone** (structural + semi-functional)
- **HD Article 17 classifications** for wetland- and freshwater species and habitats
- **Protected areas** (IUCN, N2000, Emerald etc.)

© Georg Gruber

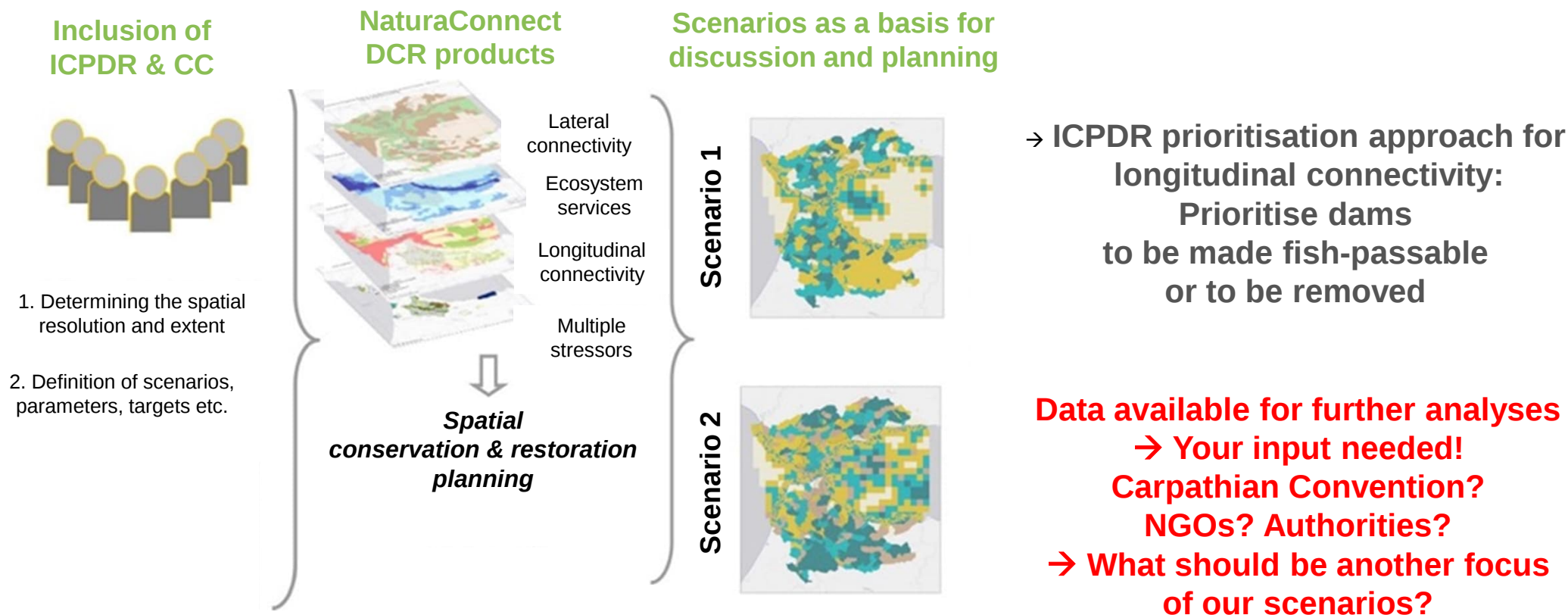
# Prioritisation of hinterland/sub-catchment



**Datasets available  
from NaturaConnect  
& other sources:**

- Catchment connectivity
- Multiple stressors
- Ecosystem services
- Protected areas  
(IUCN, N2000, Emerald etc.)

# Integration & prioritisation of NaturaConnect DCR products



Adapted from Barbosa et al, 2019, STOTEN



# Questions & Answers

Copyright: Juraj Vysoky

# Mentimeter

Type in [menti.com](https://menti.com)

Code 8828 2590



# Open discussion



Image: Mario Rumolic

A misty landscape with four cows in a field and a large tree on the right.

# Closing remarks and conclusions

Copyright: Yanka Kasakova, WWF-BG

# Next steps

- **Presentations and report** will be made accessible on the NaturaConnect website. Participants will be informed!
- Recent launch of the Learning Platform **Module 'Financial instruments'**
  - <https://tinyurl.com/ENA-NC>
- Webinars to follow on climate and land use change, and tools that are currently being developed → **NaturaConnector**

**KEEP CONNECTED WITH  
NATURACONNECT!**



Copyright: Hildegard Meyer

# Connect with NaturaConnect!

 [www.naturaconnect.eu](http://www.naturaconnect.eu)

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 [linkedin.com/company/naturaconnect/](https://linkedin.com/company/naturaconnect/)

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