Guidelines for connectivity conservation and planning in Europe

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Vienna, Austria | 17-18 June 2024

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Funded by the European Union

Topics for this slot

1. Presentation of the Connectivity Guidelines

2. What are the topics of the current Guidelines you find important to be included in practical Guidelines?

3. What would you like to see included in the NaturaConnect Learning Platform Module?

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WP6: Multi-scale nature connectivity and corridors design

- Identify ecological and landscape elements and planning instruments defining **ecological corridors across scales**.
- **Develop** a coherent methodological framework and **guidelines for mapping** structural and functional **connectivity** at the European scale.
- Support **adaptation policies** by identifying opportunities to establish connectivity in conservation and restoration plans under different **climate and land-use change scenarios**.

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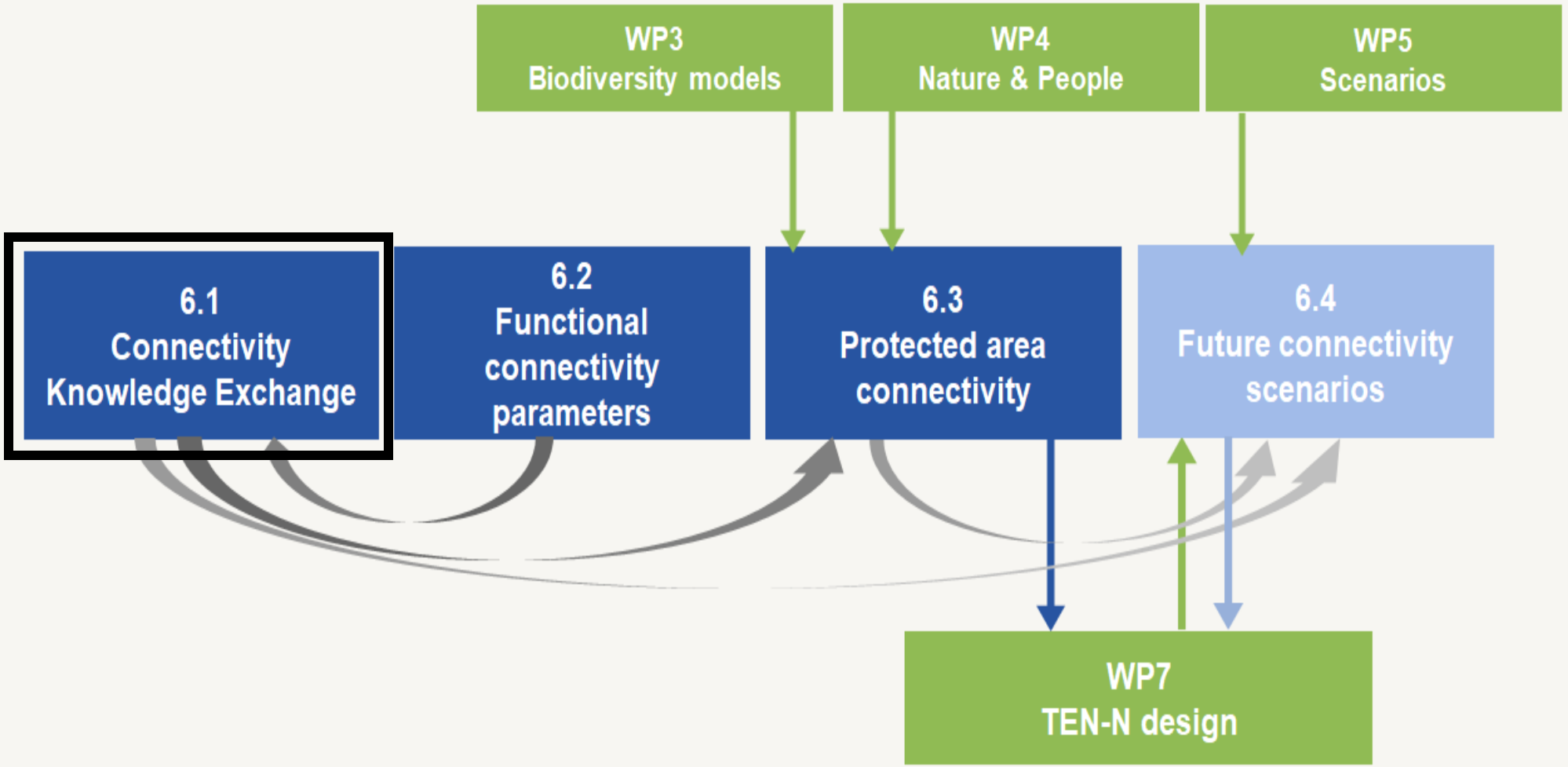
WP6 Flowchart



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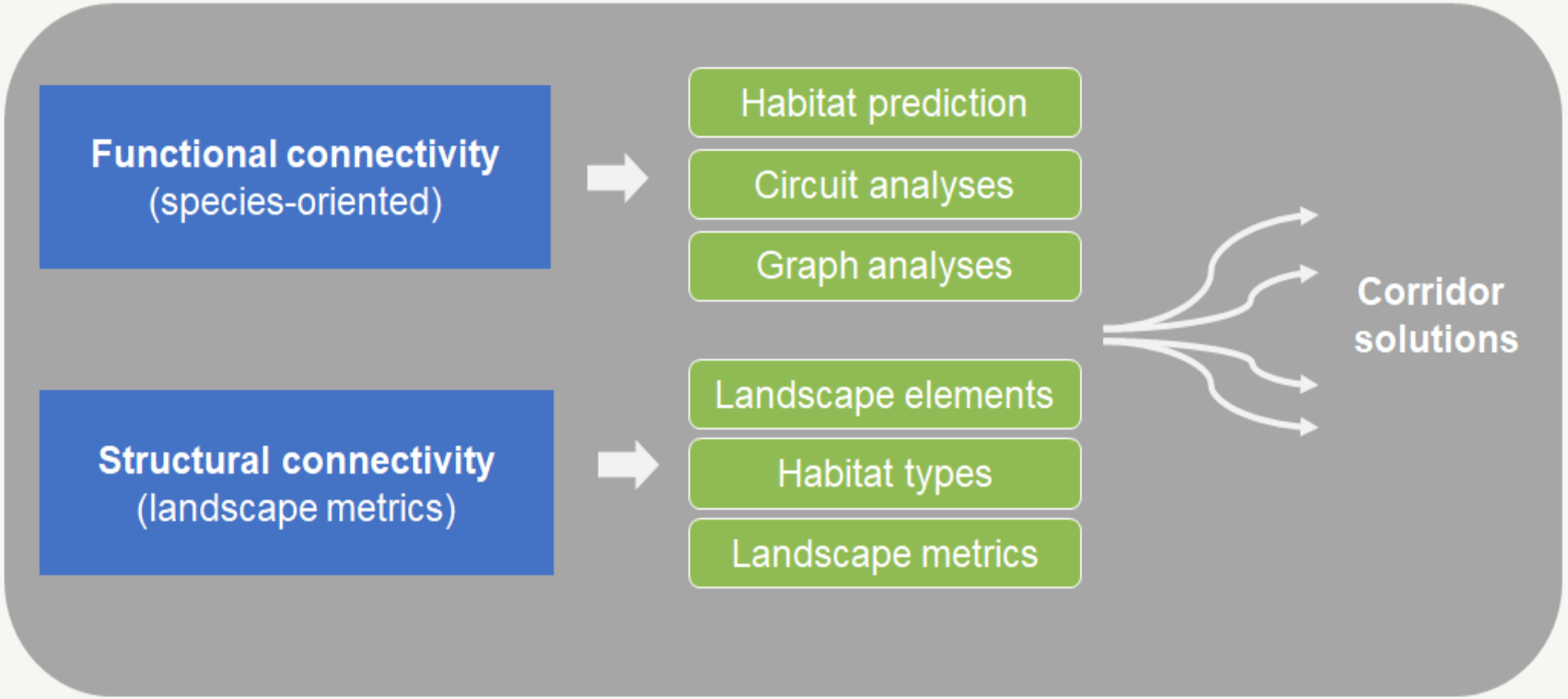
Corridors design



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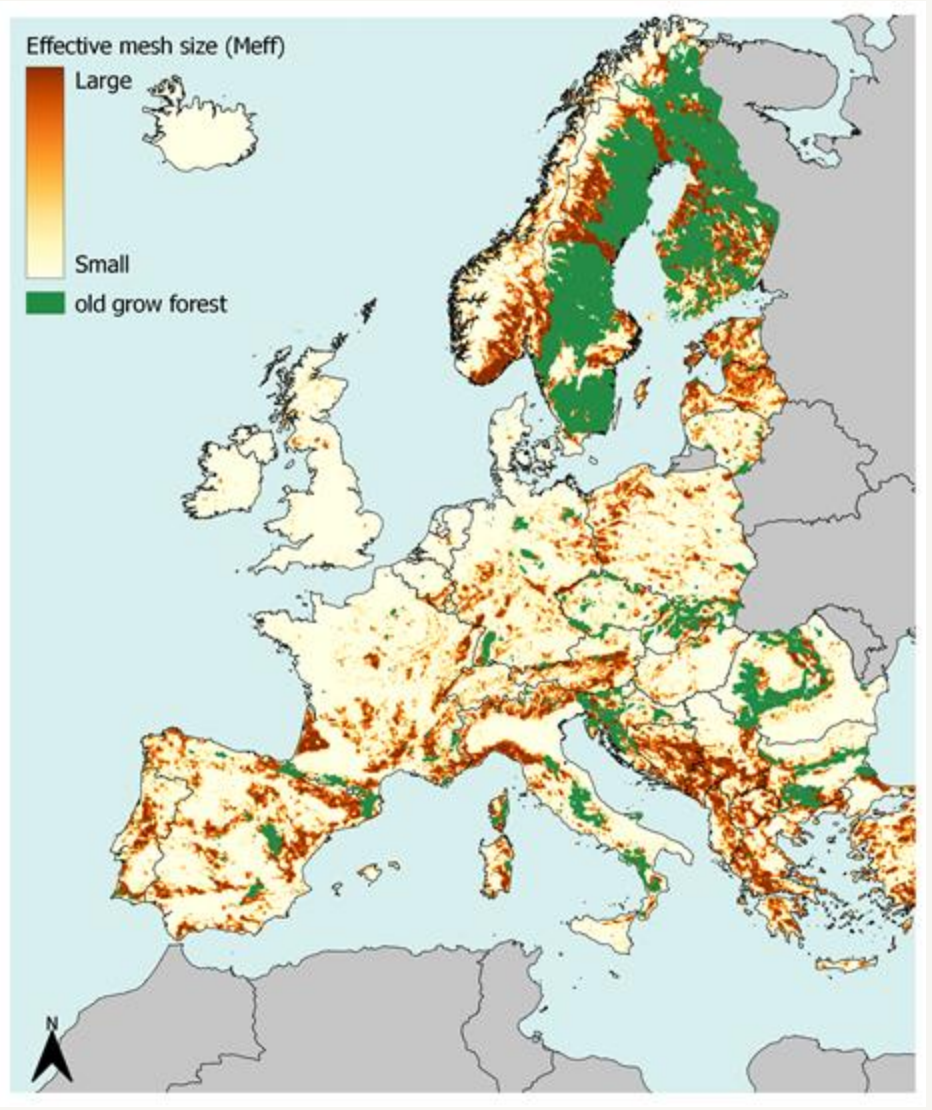
Structural connectivity analysis

- Development of analysis pipeline for assessing structural connectivity metrics
- **Data:**
  - Binary habitat maps and/or fragmentation
  - Layers containing information for patches within the fragmentation map, dependent on which connectivity metric is used
- **Moving window:** neighborhood-analysis at 1-km resolution across Europe



Connectivity probability (effective mesh size) of forests containing old-growth forests

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Functional connectivity analysis

Covariate Estimation

- Proportional land covers
- Max. Temp.
- Terrain Ruggedness Index (quadratic)
- Roads density

Species Distribution Modelling

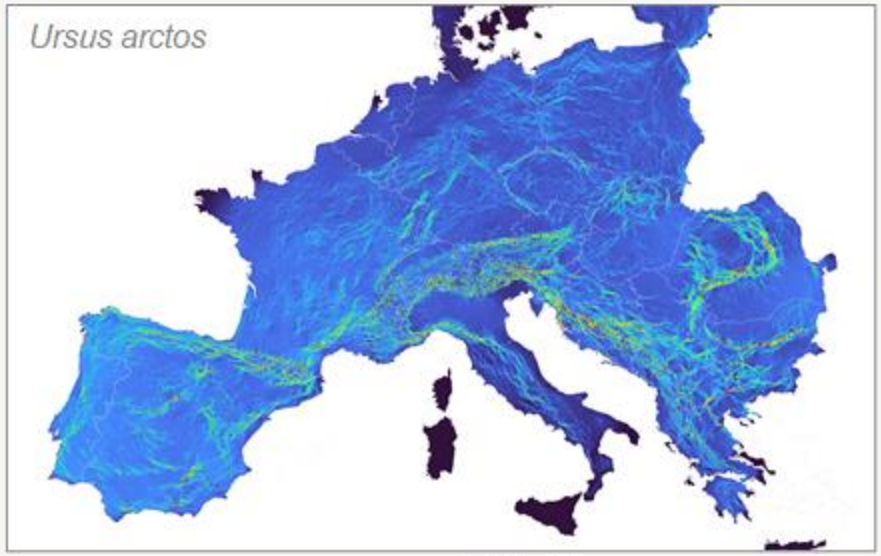
- Mammals Rewilding Data
- Generalized Linear Mixed Model
- Random effects of biogeographic region

Resistance surface and focal nodes

- SDM inverted for resistance surface
- Negative exponential transformation
- Nodes derived from Natura2000 sites > 150km^2

Circuitscape 5 Analysis

- Model ~2,000 trans-European circuit connections
- Normalize circuit densities by flow potential
- Final predictions at 1km^2 and 10km^2



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The guidelines for connectivity conservation and planning

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Connectivity guidelines

The **Connectivity Guidelines** provide spatial and land use planners with tools for planning ecological connectivity

naturaconnect.eu/guidelines-for-connectivity-conservation-and-planning-in-europe/

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Connectivity guidelines

- The document is very comprehensive
- Based on the Guidelines, the NaturaConnect Team will develop
  - **hands-on Guidelines for practical use**
  - **a module on ecological connectivity at the NaturaConnect Learning Platform**

naturaconnect.eu/guidelines-for-connectivity-conservation-and-planning-in-europe/

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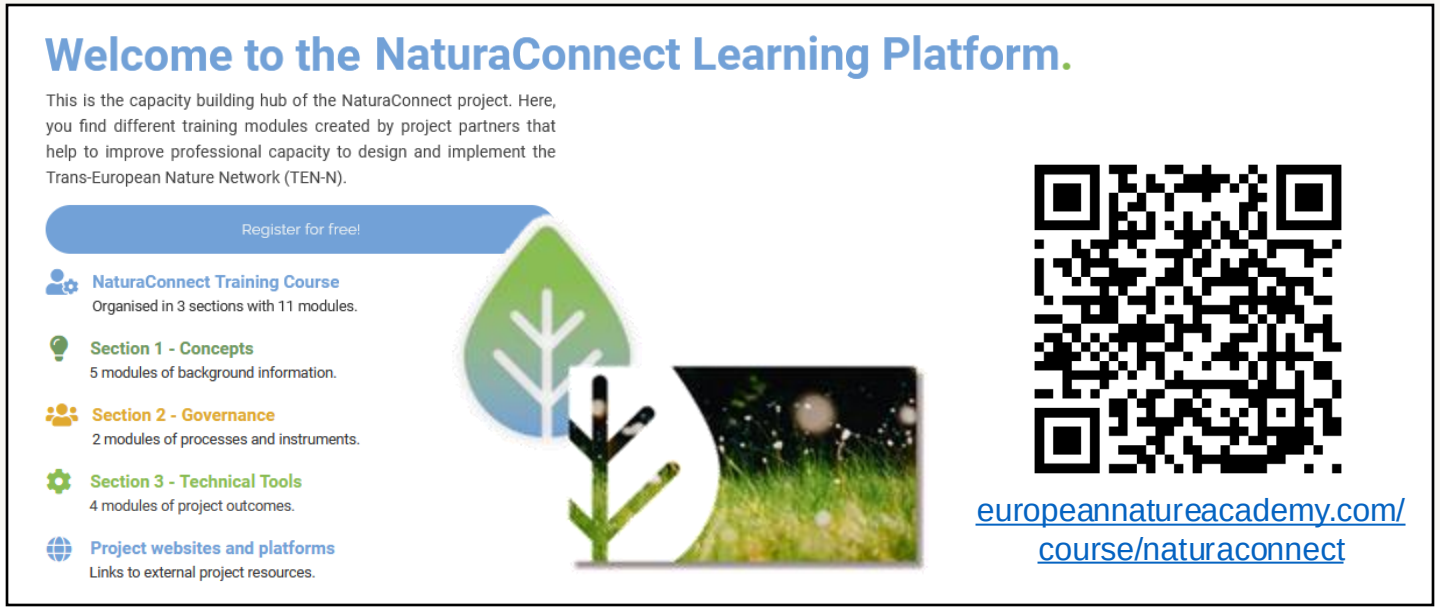
Connectivity guidelines

We are interested in the **Carpathian Convention Stakeholders' opinions**, to integrate into practical Guidelines and the NaturaConnect Learning Platform Module on ecological connectivity for capacity building



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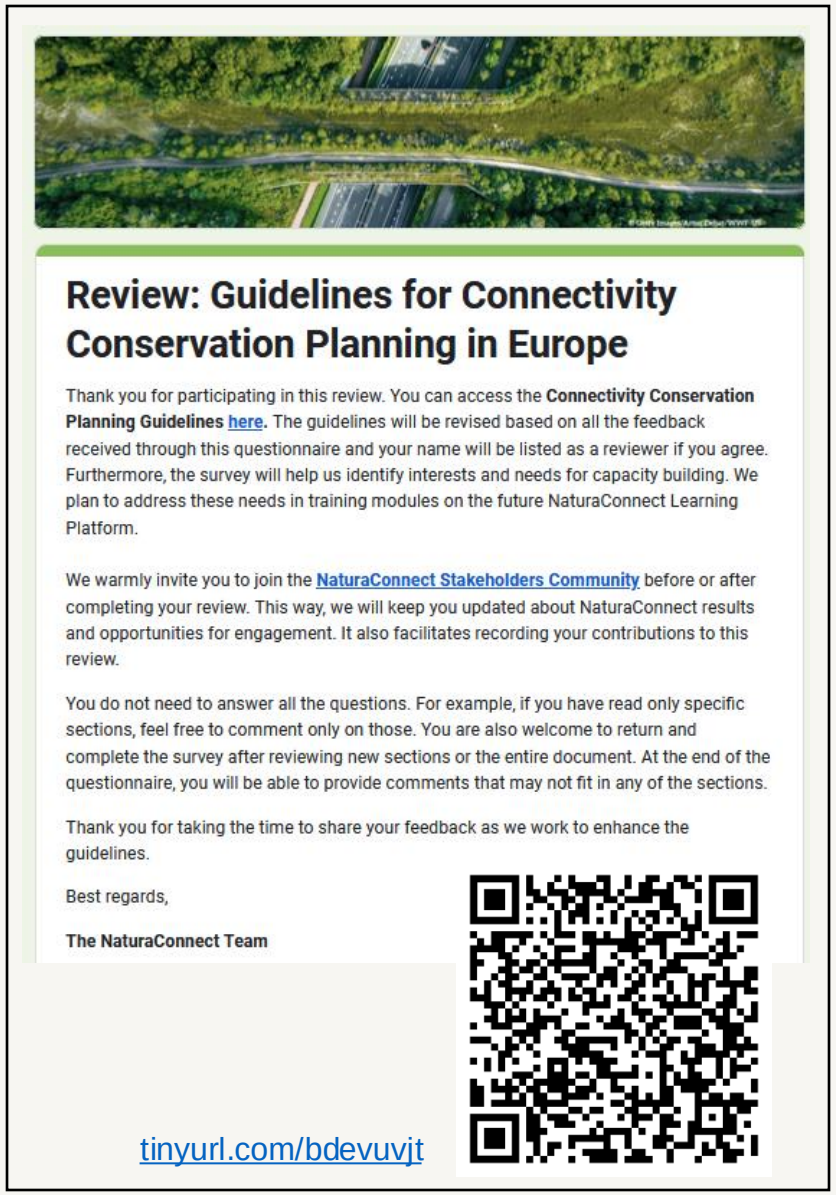

tinyurl.com/bdevuvjt

Connectivity guidelines: target audience

- **Practitioners** and **scientists** designing and managing nature conservation and restoration projects
- **Public administrations**, **planners** and **managers** within and outside protected areas, private initiatives, foundations, etc. interested in connectivity planning.

- **Tailored to meet the needs of those responsible for developing and implementing strategies, policies, and management plans**.

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How were the guidelines developed and what do they contain? (in a nutshell)

Connectivity knowledge exchange

- **Literature review** (focus: Europe)
- **Survey** on connectivity projects in Europe and public repository
- **Stakeholder workshop**
  - goals and priorities for connectivity conservation
  - knowledge gaps and technical needs

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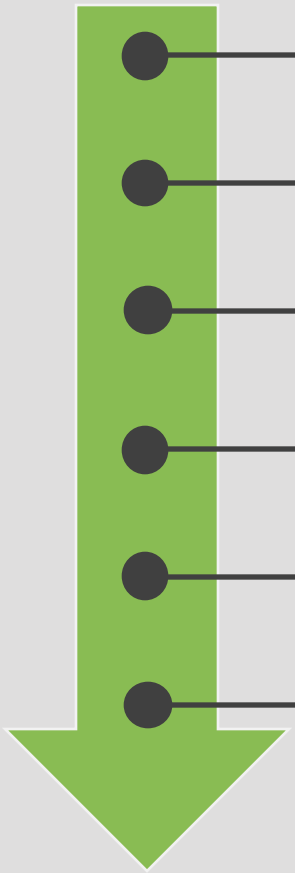
Connectivity knowledge exchange



- Connectivity concepts and approaches
- Global and EU policy instruments
- Survey of connectivity projects
- Knowledge gaps and needs
- Tools and data sources
- 5-step framework for connectivity planning

Connectivity guidelines

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Connectivity guidelines

1. **Introduction**
   - i. Why is ecological connectivity important
   - ii. Aims and target audience
   - iii. Summary of the content

Part I: Connectivity in Europe: key concepts, policy context, and implementation

2. **Connectivity concepts and approaches**
   - i. Protected areas and ecological corridors
   - ii. Structural and functional connectivity
   - iii. Connectivity in the context of Green and Blue Infrastructure
   - iv. Spatial scale issues and dispersal
   - v. Corridors and stepping stones design
   - vi. Freshwater and cross-realm connectivity
   - vii. Integration of connectivity in the process of area-based planning
   - viii. Caveats of corridor design
   - ix. Do ecological corridors work
3. **Global and EU policy instruments addressing connectivity**
   - i. Connectivity in the post-2020 Global Biodiversity Framework
   - ii. Connectivity in the EU Biodiversity Strategy
   - iii. Connectivity in the EU Forest Strategy
   - iv. Connectivity in the Green and Blue Infrastructure Strategy
   - v. Connectivity in the Water Framework Directive
   - vi. Connectivity in the EU Pollinators Initiative
4. **Connectivity projects in Europe and Information needs**
   - i. Survey of connectivity projects in Europe
   - ii. Priorities, gaps, and challenges in European connectivity planning

Part II: Tools and guidelines for implementation of connectivity projects in Europe

5. **Tools and data sources for modelling connectivity**
   - i. Introduction
   - ii. Least-cost path and resistance kernels
   - iii. Graph theory
   - iv. Circuit theory
   - v. Agent based models
   - vi. Structural connectivity metrics and moving windows analysis
   - vii. Assessing ecosystem services
6. **A framework for connectivity conservation and planning**
   - i. Introduction to the framework
   - ii. Scoping and problem assessment
   - iii. Setting of objectives
   - iv. Analysis selection and data preparation
   - v. Assessment of connectivity
   - vi. Implementation, monitoring and evaluation

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Connectivity concepts and approaches

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Connectivity concepts and approaches

i. Protected areas and ecological corridors
ii. Structural and functional connectivity
iii. Connectivity in the context of Green and Blue Infrastructure
iv. Spatial scale issues and dispersal
v. Corridors and stepping stones design
vi. Freshwater and cross-realm connectivity
vii. Integration of connectivity in the process of area-based planning
viii. Caveats of corridor design
ix. Do ecological corridors work?

Global and EU policy instruments addressing connectivity

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Global and EU policy instruments addressing connectivity

i. Connectivity in the post-2020 Global Biodiversity Framework
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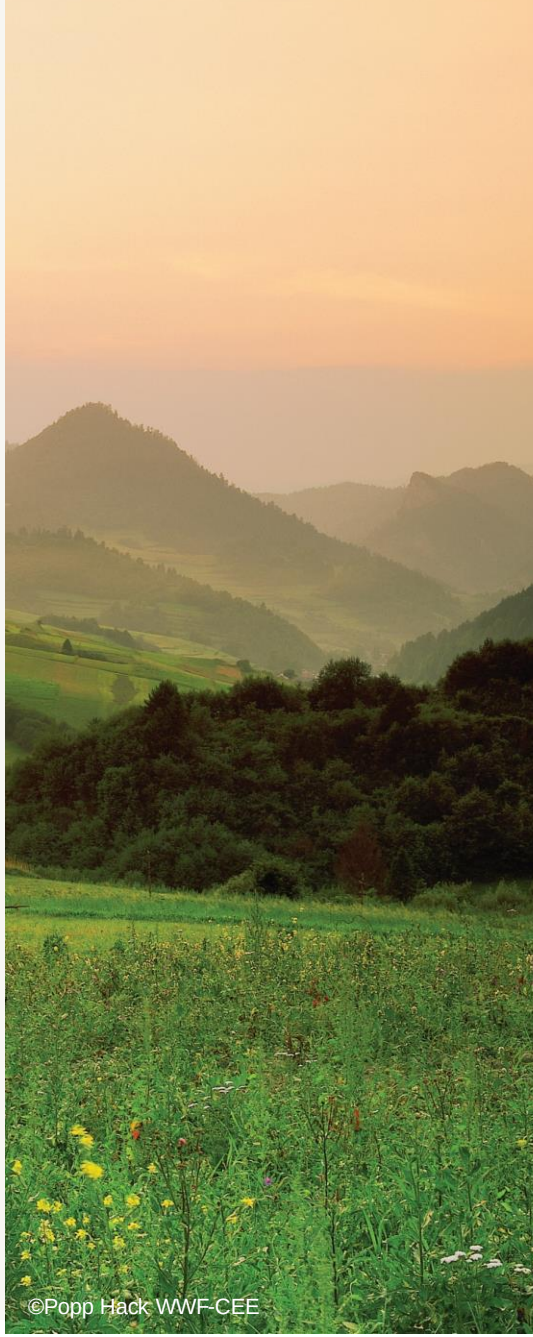

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Ecological connectivity projects in Europe (survey & repository)

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+ Add project

Public repository of ecological connectivity projects

The NaturaConnect project is an EU-funded Research and Innovation action that develops knowledge, tools, and capacity-building to support the implementation of a coherent network of protected areas across Europe - the Trans-European nature network (TEN-N).

This first version of this public repository of connectivity projects supports knowledge sharing and provides information on ecological connectivity projects in Europe undertaken at Regional to National and Pan-European levels.

Please send your suggestions for improving the site and/ or for adding features to web@naturaconnect.idiv.de.

Country

Nothing selected

Spatial scope

Nothing selected

Biogeographical region

Nothing selected

Ecosystem types

Nothing selected

Approaches for assessing connectivity

Nothing selected

Other benefits

Nothing selected

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naturaconnect.idiv.de/projects/

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Public repository of ecological connectivity projects

Displaying 80 Projects Show 25

Search projects...

Walloon ecological network design

University of Liège

No description provided

Forests | Shrublands | Grasslands | Wetlands | Rivers | Agricultural areas

Conservation of connectivity in the West Carpathians for large carnivores

Friends of the Earth Czech Republic

The project is aimed on conservation of large carnivore populations in the edge of their western distribution in the Carpathians. Activities contain detailed monitoring of wolf, lynx and bear population density and other demographic parameters, ...

Forests | Grasslands | Agricultural areas | Urban and periurban

European Biological Corridors

Eurac Research; Fondazione Capellino; Wageningen University

EuroBIOCOR combines unique, multifaceted knowledges from ecological, economic and social sciences and a communication and dissemination approach to address the current challenges in building a coherent and resilient trans-European nature network of ...

Forests | Grasslands | Wetlands | Rivers | Agricultural areas

Connectivity of riparian habitats in the Duero river basin, current situation and climate change scenarios

Catholic University of Ávila

Climate projections point to an increase in temperatures and a decrease in precipitation, a situation that may compromise the connectivity of riparian habitats and aggravate fragmentation processes. This project has analyzed the variation in the ...

Forests | Rivers

naturaconnect.idiv.de/projects/

Conservation of connectivity in the West Carpathians for large carnivores

Acronym: N/A

Friends of the Earth Czech Republic

Other participating institution(s): Czech University of Life Sciences; Mendel University in Brno

Forests | Grasslands | Agricultural areas | Urban and periurban

Country or countries of application: Czech Republic, Slovakia

The project is aimed on conservation of large carnivore populations in the edge of their western distribution in the Carpathians. Activities contain detailed monitoring of wolf, lynx and bear population density and other demographic parameters, research of movements across urbanized landscape, identification of critical sections of wildlife corridors, dealing with local authorities, participation in decision making processes and spatial planning, and in some cases also practical realization of wildlife corridors (e.g. planting of forest patches as stepping stones in wildlife corridors).

Website

Funding sources | Approaches for assessing connectivity | Other benefits

- Nature conservation funds from National and/or Regional administrations
- Development funds from National and/or Regional administrations
- European funds associated to other sustainability policies
- Private funds
- Private funds

Name of funding programme(s): N/A

Temporal information

Start - End	Duration
2008 - 2024	16 years

Spatial information

Spatial scope

- Sub-national
- Transboundary

Biogeographical region

- Alpine

Spatial information

- Locations for ecological corridors
- Locations for stepping stones
- Locations to increase permeability of linear infrastructures

Thematic scope

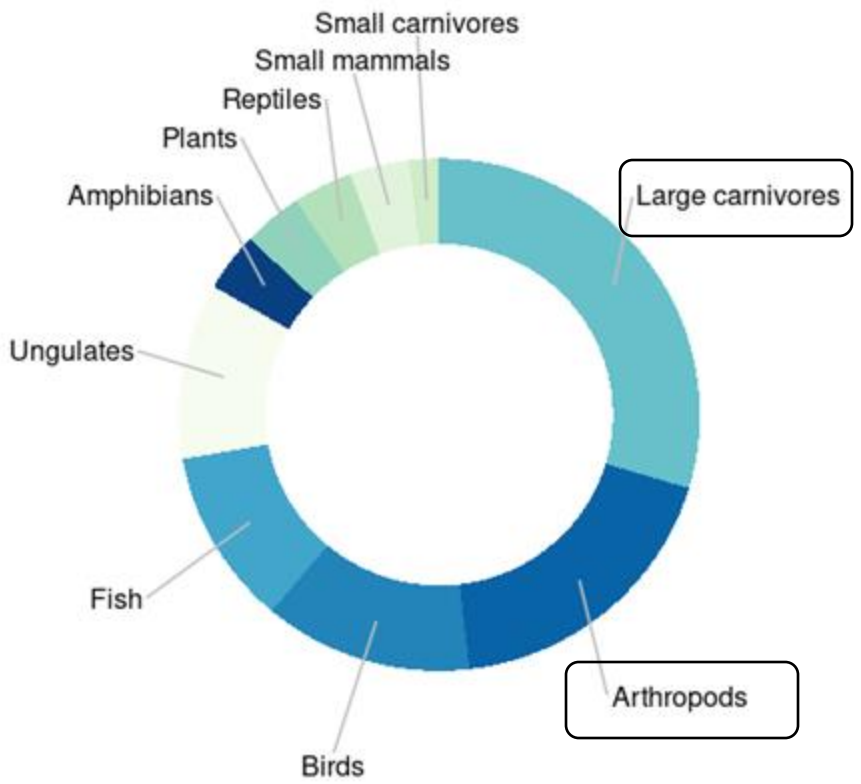
Connectivity goals

Target users of the results

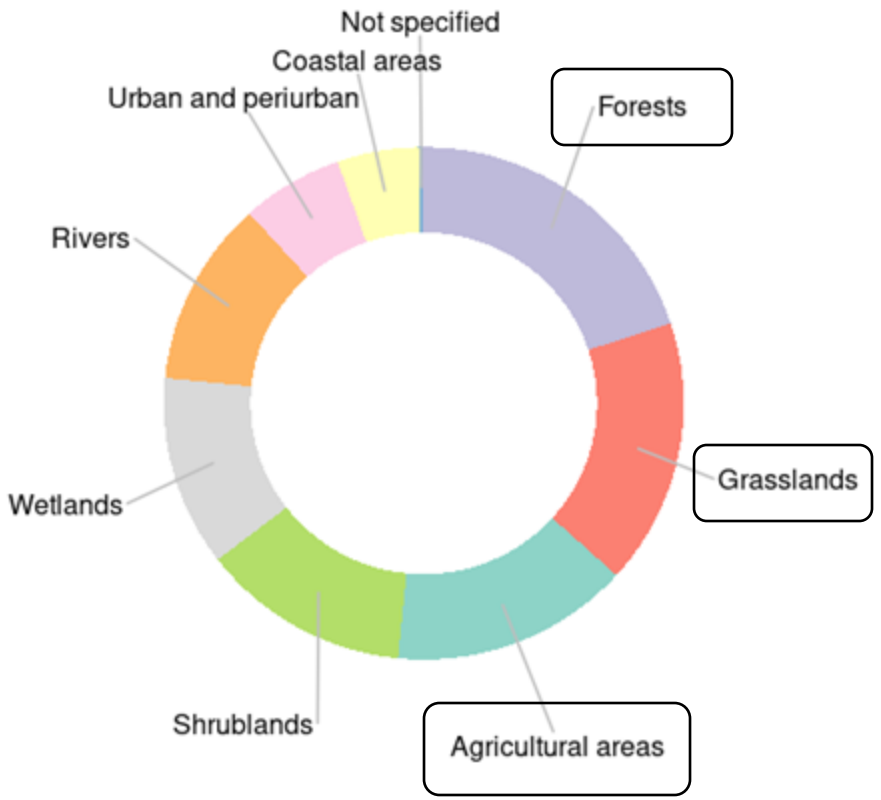
Policy support

Survey of connectivity projects

Targeted taxa



Ecosystem types



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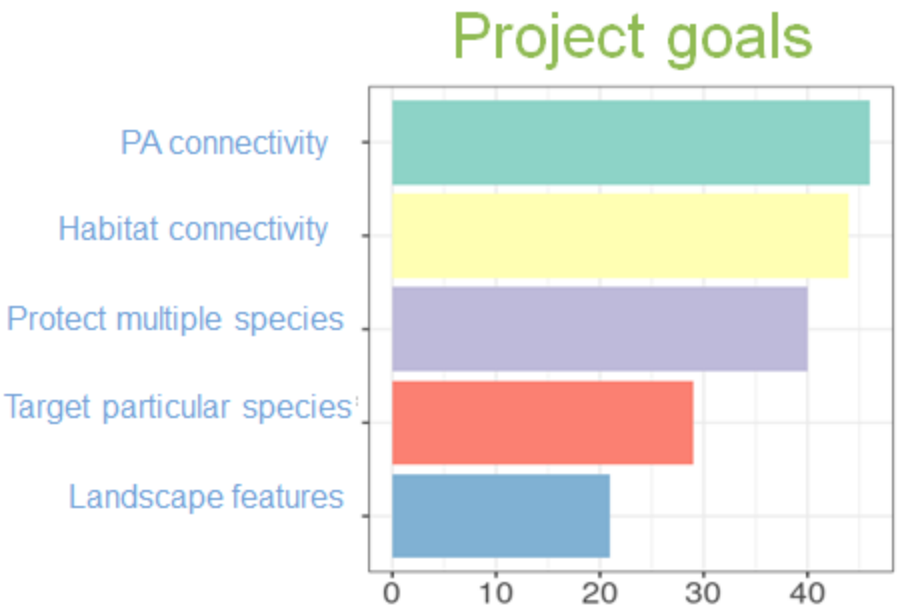
Survey of connectivity projects



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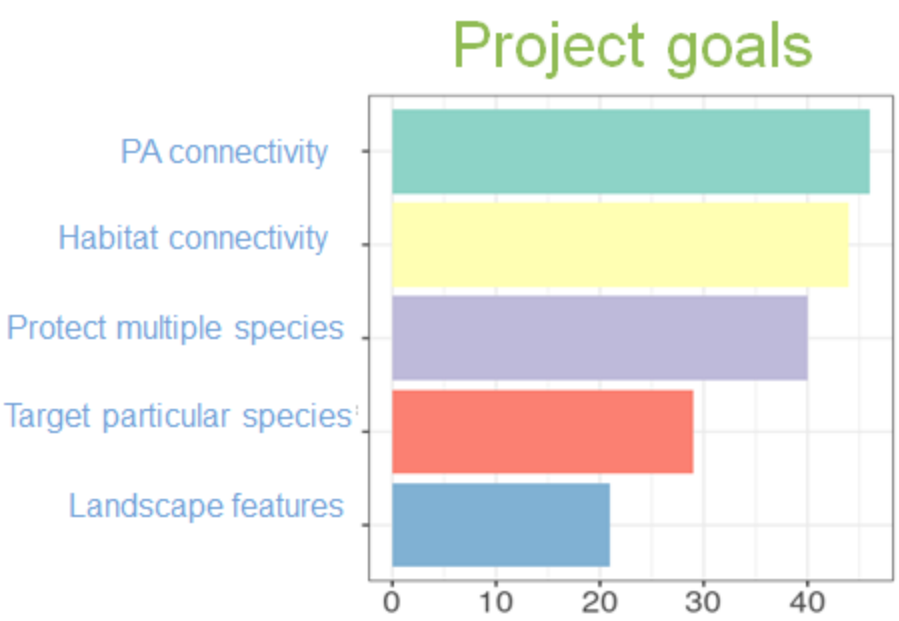
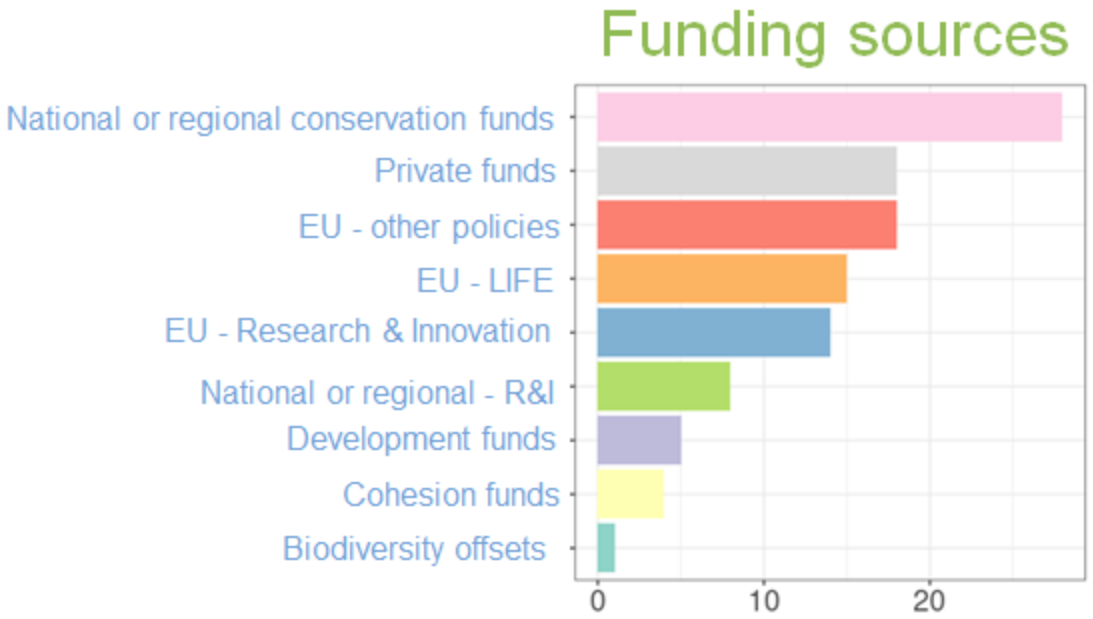
Survey of connectivity projects





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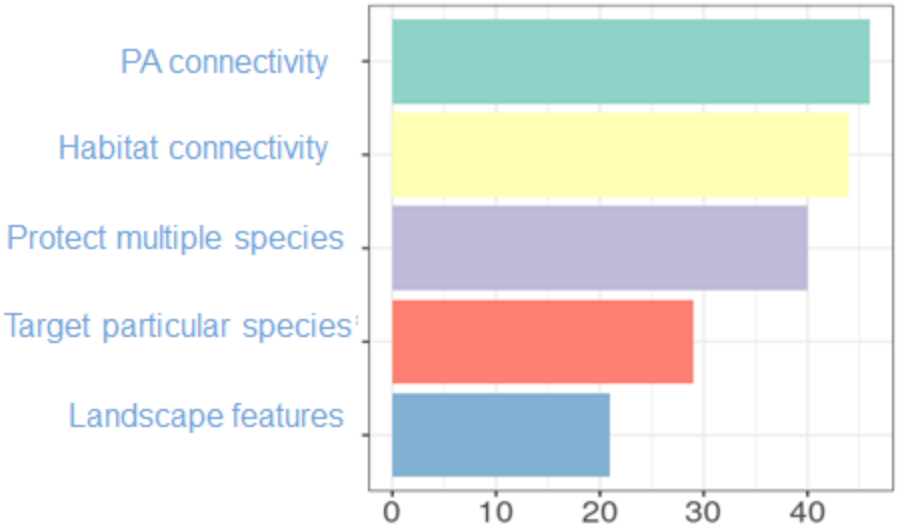
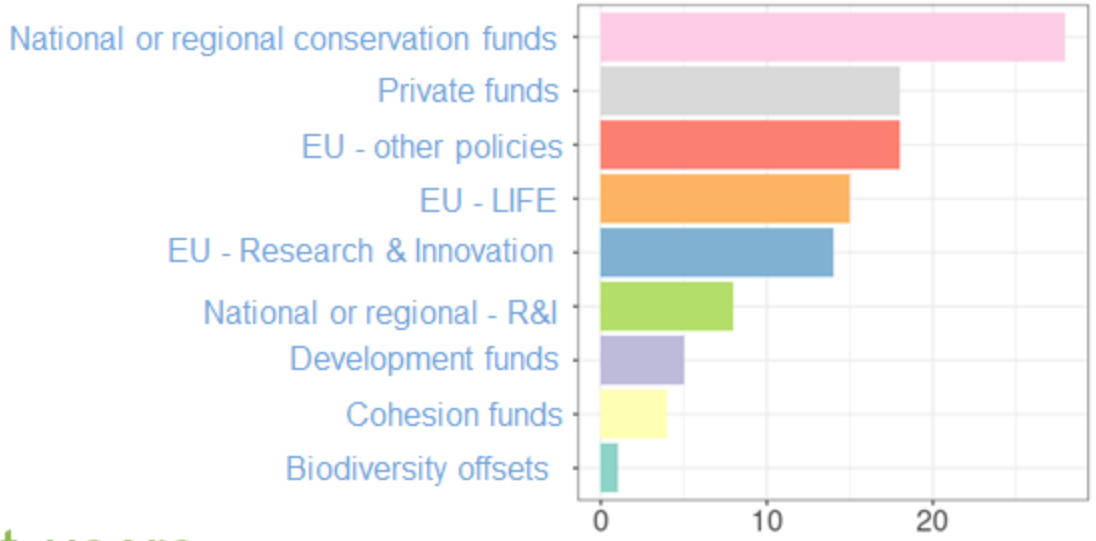
Survey of connectivity projects

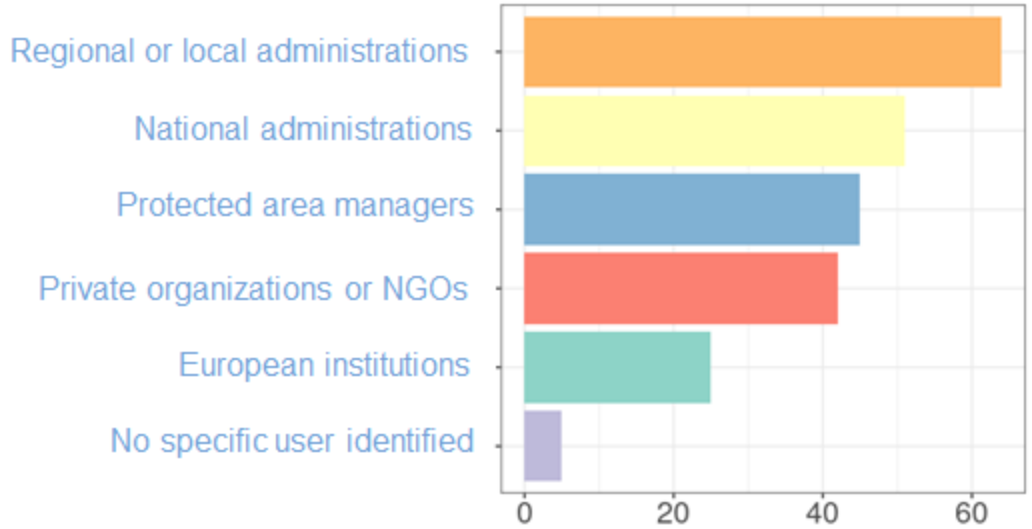
Project goals



Funding sources



Target users



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Tools and data sources for modelling connectivity

Tools and data sources for modelling connectivity

i. Least-cost path and resistance kernels
ii. Graph theory
iii. Circuit theory
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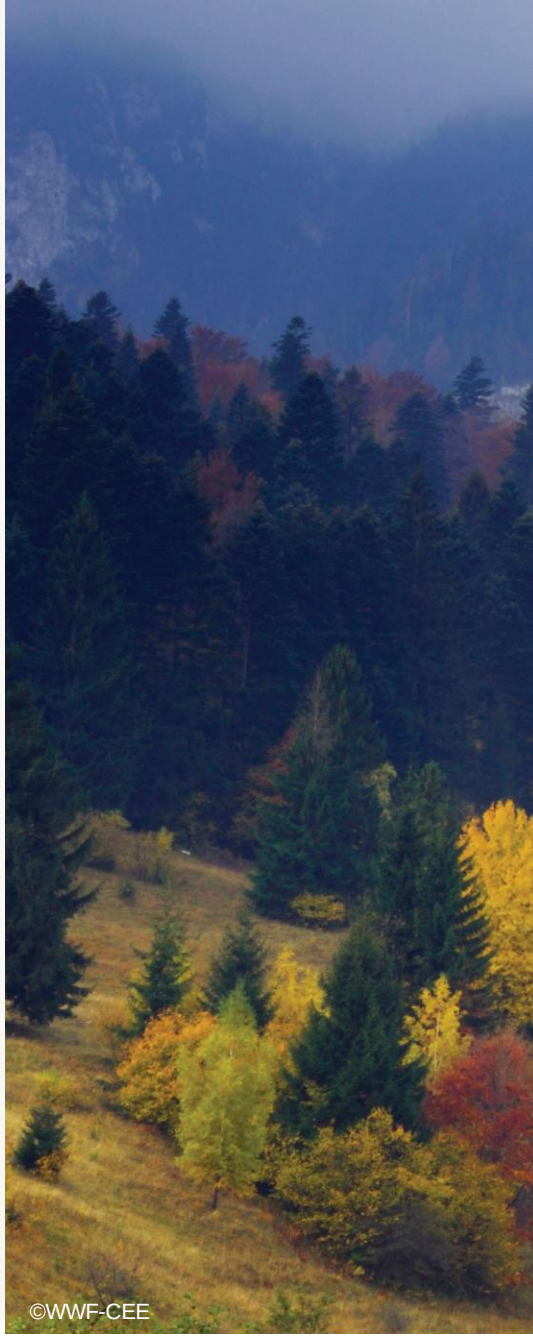
vi. Assessing ecosystem services



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Tools and data sources for modelling connectivity

- The most common modelling families for functional and structural connectivity (Table 5.1 in the guidelines)
- List is not exhaustive but demonstrates some of the possibilities with these models

Model Family	Data Needs	Applications	Software & Packages
Least-cost Path & Resistant Kernels	Resistance surface, focal nodes, and species dispersal data (RK)	Focal species corridors, population dispersal potential, area of potential use, pollinator movement, probability of human movement	LCP: ArcGIS Tools, QGIS plugin, R packages ('gdistance', 'leastcostpath'); RK: UNICOR
Graph Theory	Focal nodes & connection file of attributes between node pairs	Analysis of landscape structure and potential functionality, prioritisation of patches and connections, long-term population persistence	Conefor, ArcPro Network Analyst, R packages ('iGraph', 'riverconn')
Circuit Theory	Resistance surface & focal nodes (Circuitscape) or source weight surface (Omni)	Focal species connectivity and pinch points, water flow, pollinator movement, invasive species control	Circuitscape, GFlow, Omniscape, Linkage Mapper (multi-family)
Agent-based models	Model specific: Focal node and network data, survival rate, population growth rate, fecundity, node transition probabilities, resistance surface, etc.	Long-term population persistence, patch and connection importance, source-sink analysis	MetaIPM, HexSIM, NetLogo, R packages ('p SiMRiv')
Structural Connectivity Metrics	(*Will differ depending on the used metric(s)*) Number of patches, patch size(s), boundaries and perimeter, distance between patches, focal nodes, presence/absence of links, number of paths.	Assessing connectivity of select components in the physical landscape, e.g. protected areas, specific habitats and/or corridors. Both in relation to intra- and inter-patch connectivity.	Conefor, ArcPro Network Analyst, R packages ('iGraph', 'riverconn', 'gdistance')
Spatial prioritisation tools	Study area planning units layer, biodiversity distributions, land cover/land use, current protected areas, etc.	Identifying structural connectivity via prioritisation of landscape elements and systematic conservation planning	Marxan, Zonation, R packages ('prioritizr')

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Tools and data sources for modelling connectivity

Geospatial data sources for Europe

Sector	Data Source Name	Author	Authoring organization	Data location
Land use & Land cover	CORINE Land Cover	Copernicus	Copernicus-European Environment Agency	https://land.copernicus.eu/en/products/corine-land-cover
	High Resolution Layer Water and Wetness	Copernicus	Copernicus-European Environment Agency	https://land.copernicus.eu/en/products/high-resolution-layer-water-and-wetness
	Global Tree Cover 2010	Hansen, M.C. et al.	Global Forest Watch	https://glad.umd.edu/dataset/global-2010-tree-cover-30-m
	Forest management map for Europe	Oostdijk, Saskia et al.	Vrije Universiteit Amsterdam	https://dataverse.nl/dataset.xhtml?persistentId=doi:10.34894/HQIJN5
	Primary forest	Sabatini et al.	Nature	https://www.nature.com/articles/s41597-021-00988-7#Sec7
Roads & Linear Features	Open Street Map	Open Street Map	Open Street Map	https://www.openstreetmap.org
	EU Hydro Rivernet	Copernicus	Copernicus-European Environment Agency	https://land.copernicus.eu/en/products/eu-hydro/eu-hydro-river-network-database
Evaluation & Topography	European Digital Elevation Model (EU-DEM)	EEA	European Environment Agency	https://www.eea.europa.eu/en/datahub/datahubitem-view/d08852bc-7b5f-4835-a776-08362e2fbf4b?activeAccordion=735550
	Copernicus Global DEM	ESA	European Space Agency	https://spacedata.copernicus.eu/collections/copernicus-digital-elevation-model
Boundaries & Bioregions	Biogeographical regions 2016	EEA	European Environment Agency	https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2
	EEA Administrative Boundaries based on GISCO NUTS and EBM	EEA	European Environment Agency	https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/94438969-2dd5-4ba3-b708-e4d29a8b7699
Species Data	Global Biodiversity Information Facility (GBIF)	GBIF	GBIF	https://www.gbif.org/
Protected Areas	European network of protected sites Natura 2000	EEA	European Environment Agency	https://www.eea.europa.eu/en/datahub/datahubitem-view/6fc8ad2d-195d-40f4-bdec-576e7d1268e4
	Nationally designated areas (CDDA)	EEA	European Environment Agency	https://www.eea.europa.eu/en/datahub/datahubitem-view/f60cec02-6494-4d08-b12d-17a37012cb28

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(Annex S4 in the guidelines)

A framework for connectivity conservation and planning

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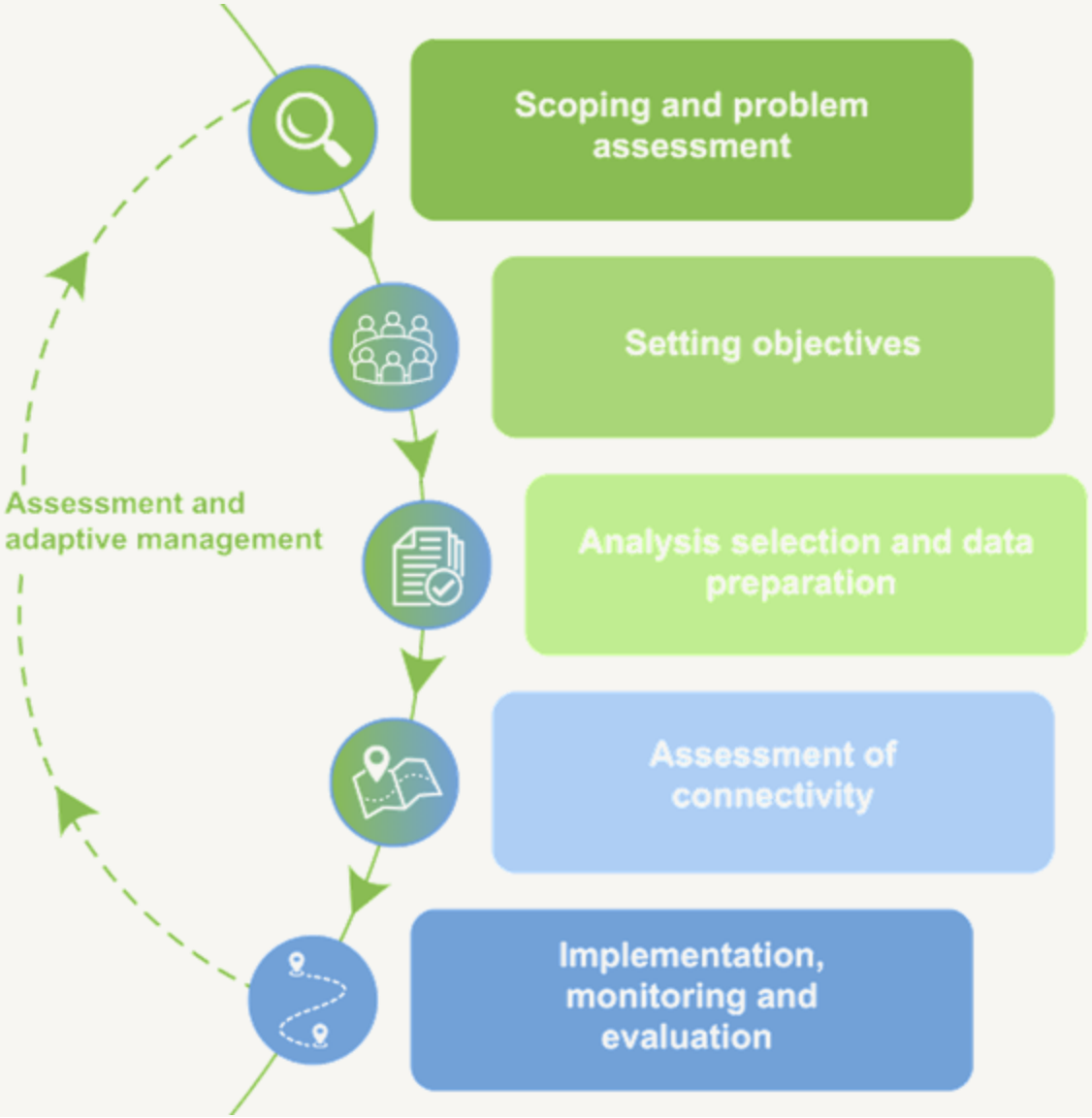
A framework for connectivity conservation and planning



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A framework for connectivity conservation and planning

While the framework is presented linearly, it should be an **iterative process** due to the continuous need to **engage and collaborate with stakeholders** to ensure the most accurate and useful plan is produced

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A framework for connectivity conservation and planning

Scoping and problem assessment

Identify all key stakeholders
Assess priorities, data gaps and management questions

Establish collaboration team
- Practitioners
- Scientific research
- Communication
- Policy makers

Assess threats, possible actions and likely impacts
Assess priorities, data gaps and management questions

Set general spatial extent

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A framework for connectivity conservation and planning

2

Setting objectives

Define specific objectives and targets

Assess priorities, data gaps and management questions

General objective requirements

- Appropriate corridor width
- Structural configuration requirements

Final spatial extent and resolution of the analysis

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A framework for connectivity conservation and planning

3

Analysis selection and data preparation

Identify appropriate connectivity model or metric

Land use patterns

Potential barriers

- Dam locations
- Linear infrastructure
- Major water features

Connectivity opportunities

- Existing habitat patches
- Potential & existing movement corridors
- Natural features
- Cultural features

Stakeholder engagement

Acquire expert knowledge on missing features

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A framework for connectivity conservation and planning

4

Assessment of connectivity

Conduct connectivity analysis

Prioritize corridors & stepping stones for conservation or restoration

- Corridor width & configuration
- Assess fine-scale conditions in proposed corridors

Present draft results to stakeholders

- Iterate new models after comments

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A framework for connectivity conservation and planning

5

Implementation, monitoring and evaluation

Organisational roles & responsibilities

Establishment of landscape designations

Land management
- Habitat restoration
- Human use & development

Monitoring & evaluation
- Species movements
- Evaluating indicators

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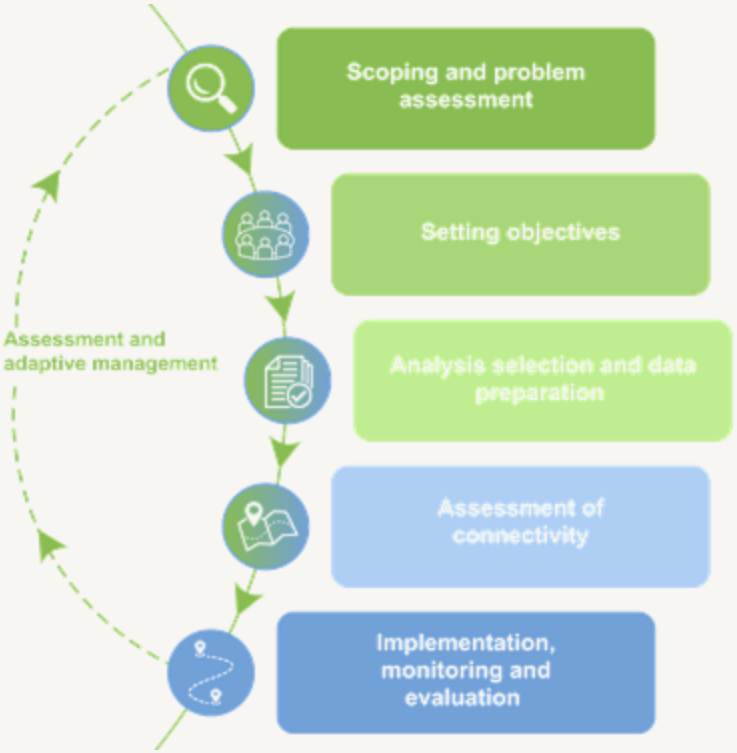
A framework for connectivity conservation and planning

While the landscape characteristics, focal species or conservation objectives of each connectivity project can be different, these **steps provide a foundation for designing a connectivity network** that may **effectively facilitate ecological connectivity**



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Which topics do you find important to be included in practical Guidelines?

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What would you like to see included in the NaturaConnect Learning Platform?

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The NaturaConnect Learning Platform

europeannatureacademy.com/course/naturaconnect

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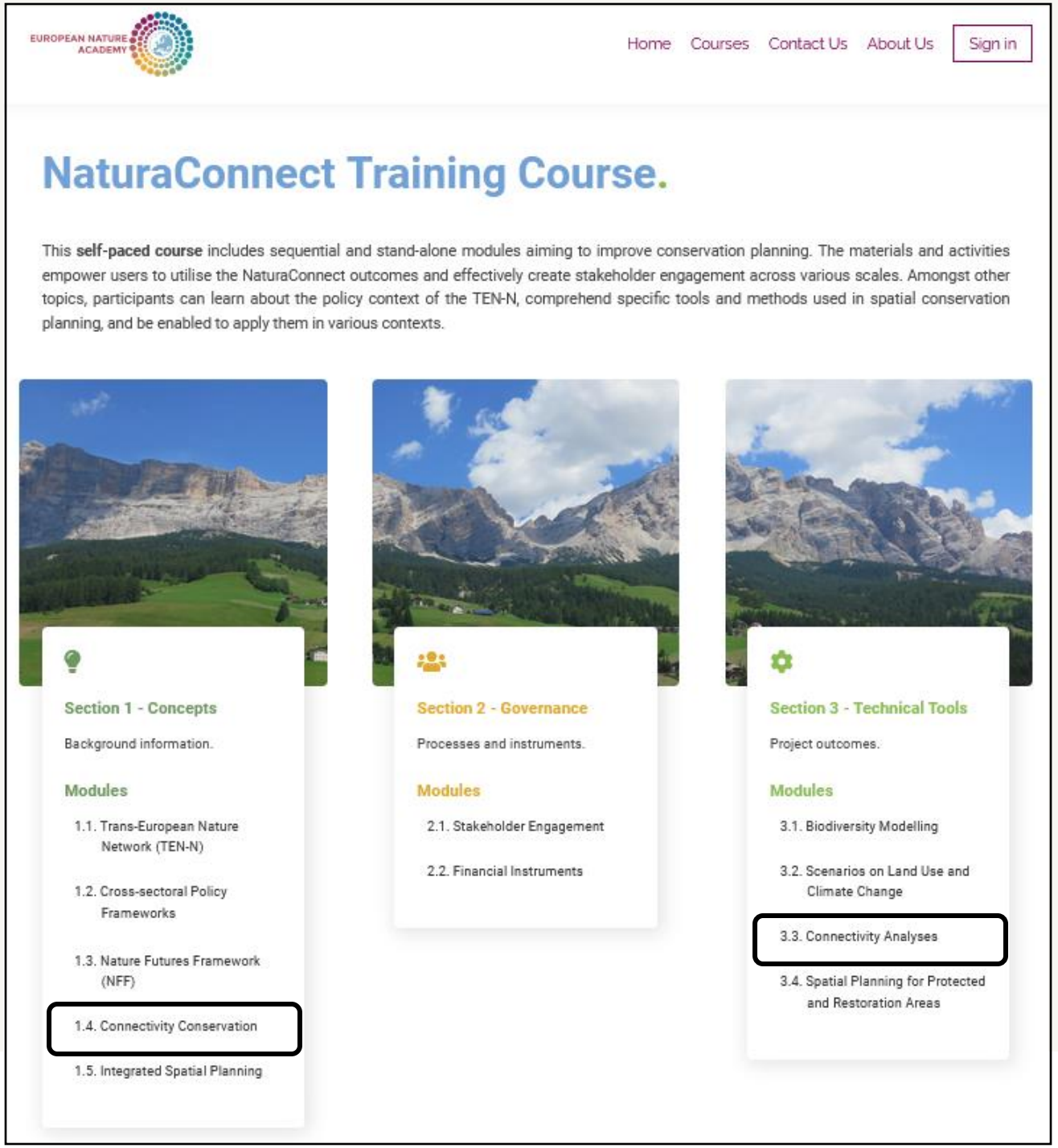
The NaturaConnect Learning Platform

https://tinyurl.com/ENA-NC



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Thank you!

Questions?
Comments?

More info

naturaconnect.eu

Join the NaturaConnect Stakeholder community

naturaconnect.eu/stakeholder-community/

ana.ceia.hasse@cibio.up.pt

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