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PlanToConnect

Integrated Planning of Green and Blue Infrastructure for Ecological Connectivity

Lessons and Insights from Partners Case Studies

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Integrated Planning of Green and Blue Infrastructure for Ecological Connectivity

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Reference in application form: Output O2.1 Case studies of integrated planning of GBI connectivity networks in pilot sites across administrative boundaries and cross-border areas

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List of Abbreviations

AECS / AECM	Agri-Environment-Climate Measures (under the CAP)
AG7	EUSALP Action Group 7 (Ecological Connectivity)
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CSRD	Corporate Sustainability Reporting Directive (EU)
EEA	European Environmental Agency
EIA	Environmental Impact Assessment
EUSALP	EU Strategy for the Alpine Region
ESG	Environmental, Social and Governance (corporate framework)
EU	European Union
GBI	Green and Blue Infrastructure
GIS	Geographic Information System
IUCN	International Union for Conservation of Nature
JPSP	Joint Paper on Spatial Planning for the Alpine Region
JRC	Joint Research Center (EU)
MAB	Man and the Biosphere Programme (UNESCO)
MAES	Mapping and Assessment of Ecosystems and their Services (EU initiative)
NBS	Nature-Based Solutions
N2K / Natura 2000	EU network of protected sites
PAF	Prioritized Action Framework (for Natura 2000 funding)
PES	Payments for Ecosystem Services
RCWG	Regional Connectivity Working Group (PlanToConnect pilot-level governance body)

SEA	Strategic Environmental Assessment
UNESCO	United Nations Educational, Scientific and Cultural Organization

Acronyms of PlanToConnect Project Partners

UIRS	Urban Planning Institute of the Republic of Slovenia (SI)
RV	Veneto Region
ALPARC	Alpine Network of Protected Areas (FR)
ASTERS-CEN74	Asters, organization for the conservation of natural areas in Upper Savoy
EURAC	Eurac Research (IT)
Ifuplan	Institute for Environmental Planning and Spatial Development (DE)
JMU	University of Würzburg
SIR	Salzburg Institute for Regional Planning and Housing (AT)
ECO	E.C.O. Institute of Ecology Ltd. (AT)
FPM	Fondazione Politecnico di Milano (IT)

Glossary

Agri-Environment-Climate Measures (AECM)
Rural-development contracts under the CAP that reward farmers for adopting environmentally beneficial land-management practices (e.g., hedgerows, extensive grasslands, buffer strips). Essential for maintaining long-term ecological permeability.

Alpine-wide connectivity scenario
A structural connectivity model developed by PlanToConnect that identifies potential transnational and regional ecological linkages across the Alpine arc and serves as a reference for harmonizing national and regional ecological networks.

Barrier
A physical or functional obstacle that disrupts the movement of species or ecological flows (e.g., roads, railways, hydropower dams, urbanized areas).

Biosphere Reserve (UNESCO MAB)
A designated area promoting balanced relationships between people and nature. In connectivity planning, it provides a long-term governance umbrella that coordinates land use, conservation and sustainable development.

Connectivity Area / Ecological Corridor
A landscape element that enables the movement of species and ecological processes between core habitats. Corridors can be structural (land cover) or functional (species movement potential, ecological processes flow). It is defined by IUCN as "A clearly defined geographical space that is governed and managed over the long term to maintain or restore effective ecological connectivity". "'Clearly defined' means a spatially defined area with agreed and demarcated borders." (Hilty et al., 2020)
"On a large spatial scale, connectivity areas facilitate the migrations of animals between breeding and wintering areas, or over daily, seasonal, and annual time-frames, even if no protected areas are specifically established for their habitat (Marra et al., in Crooks and Sanjayan, 2006, ch. 7). Hydrologic connectivity transfers matter, energy and organisms through the medium of water within or between elements of the hydrologic cycle. These functions are critical for maintaining the biological integrity of ecosystems and providing water and other ecosystem services for peoples." (Ricketts et al., in Crooks and Sanjayan, 2006, ch. 11). "On a smaller scale, connectivity conservation provides important biodiversity benefits for local areas. Hedgerows, forest belts around agricultural fields, and patches of natural vegetation interspersed in semi-developed areas are examples of connectivity conservation measures which provide habitat for locally important species (birds, butterflies, amphibians) and local ecosystem services. For example, the dominant crop pollinators worldwide are bees, which rely on natural connectivity among different habitat types, particularly floral habitats." (ibid.)

Connectivity measures

Proposed interventions—structural or management-based—designed to restore or enhance ecological connectivity within GBI networks (e.g., wildlife crossings, riparian restoration, hedgerows, land-management changes).

Corporate ESG Policies
Environmental, Social and Governance commitments voluntarily adopted by companies. They may fund restoration or connectivity actions (e.g., reforestation, carbon projects) as part of sustainability strategies or CSRD reporting
.

Ecological connectivity
The degree to which landscapes allow organisms, ecological processes and genetic exchange to move across habitats. It includes both structural (physical) and functional (behavioral/ecosystem-based) components.

Ecosystem Services
Benefits that people obtain from ecosystems, including provisioning (food, water), regulating (flood control, carbon storage), cultural (recreation, landscape identity) and supporting services (habitat provision). In GBI mapping, they are used to identify multifunctional areas of high territorial value.

Ecosystem-Service Mapping
A spatial assessment of how land provides specific ecosystem services (e.g., flood regulation, pollination). When combined with structural GBI mapping, it helps prioritize interventions where ecological and socio-economic benefits overlap.

Priority ecosystem services
Ecosystem services identified as most critical for the ecological functionality, climate resilience or socio-economic well-being of a given planning area. Used in two pilots (Sondrio alpine valley and Caorle Lagoon wetland system) to support prioritization of connectivity measures.

Protected area
"A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values“. (IUCN, 2008)

Green and Blue Infrastructure (GBI)
A strategically planned network of natural and semi-natural areas and environmental features designed to deliver ecological connectivity, ecosystem services and nature-based solutions for climate adaptation and territorial resilience.

Governance (IUCN)
According to IUCN, governance refers to the systems, processes and institutions through which decisions are made about a territory or natural resource. It defines *who* has authority, *how* decisions are taken, and *how* responsibilities and accountability are shared among

actors (public authorities, landowners, communities, NGOs, sectoral bodies). Governance concerns the *rules of the game* and the distribution of power in decision-making.

Integrated spatial planning
A planning approach that incorporates biodiversity, climate adaptation, land management, and sectoral needs into coherent strategies and zoning, based on participatory, evidence-based processes.

Macro-regional Planning
Planning coordinated across several countries within a functional region (e.g., EUSALP). It relies on cooperation mechanisms—rather than binding planning laws—to align national and regional strategies.

Nature-Based Solutions (NBS)
Actions that use natural processes (flood retention, riparian restoration, green buffers) to address societal challenges such as climate adaptation, risk mitigation and biodiversity loss.

Voluntary Agreements (River / Coast / Corridor / Ecological Network Contracts)
Non-binding, place-based governance instruments based on negotiated programming, applied to territorial systems such as river basins, coastal areas, ecological corridors or ecological networks. They coordinate policies, plans and actions related to environmental protection, climate adaptation, risk reduction and sustainable territorial development through voluntary cooperation. In the PlanToConnect case studies, these agreements represent non-binding commitments among public authorities, protected areas and sectoral agencies to recognise shared corridor geometries and connectivity objectives, integrate them into spatial and sectoral planning tools, and engage stakeholders in their implementation. They proved particularly suitable for ecological connectivity planning in multi-actor and cross-border contexts lacking a single planning authority.

Executive Summary

PlanToConnect developed an Alpine-wide ecological connectivity scenario and tested its operationalization through ten case studies across Austria, France, Germany, Italy and Slovenia. Together, these pilots explored how regional and local planning systems can integrate Green and Blue Infrastructure (GBI), ecological connectivity and ecosystem functionality to support resilient and biodiversity-rich landscapes in the EUSALP area.

All pilot areas investigated priority corridors identified by the Alpine-wide model. Using a shared methodological framework, they mapped GBI elements and barriers, analyzed pressures, identified connectivity measures, examined integration pathways into statutory planning, explored future funding instruments, and proposed governance models for planning and implementation. Although no measures were implemented, the pilots produced concrete proposals for integrating connectivity into policy and planning systems.

A key outcome of the project is the demonstration that GBI mapping is not a technical step but a decision-support tool. By combining land-use/land-cover analysis, connectivity modelling and barrier assessment, this approach produced a spatially explicit representation of core habitats, stepping stones and corridor structures, enabling stakeholders to understand how landscape configuration affects ecological connectivity. The combined use of physical and ecosystem-services-based mapping proved essential for identifying multifunctional areas, prioritizing interventions and building cross-sector consensus. Two pilots—FPM (Province of Sondrio) and Veneto (Wetlands of the Caorle Lagoon)—showed that incorporating priority ecosystem services strengthens the justification for connectivity measures and helps align biodiversity objectives with climate adaptation, hydraulic safety and sustainable land management.

Across pilots, pressures on ecological connectivity stem not only from land-use change but also from land-management practices in agriculture, forestry, river maintenance and peri-urban green areas. The project highlights that connectivity is often lost through daily management decisions rather than through formal planning decisions. This confirms that governance and funding must address land management as much as land use.

Proposals for integration into statutory planning emphasized the need for alignment across planning levels and across sectors, especially agriculture, water management, forestry and energy. Cross-border and macro-regional coordination emerged as essential for corridors that extend beyond administrative boundaries, as demonstrated by ALPARC (macro-regional focus) and ECO (cross-border AT–IT–SI).

Pilots converged toward shared governance models (IUCN Type D), with Regional Connectivity Working Groups (RCWG) serving as temporary participatory structures, intended for future institutionalization. Funding proposals cover EU, national, regional and innovative mechanisms, with CAP Agri-environmental measures, hydropower compensation schemes and water-management budgets identified as particularly relevant. Innovative mechanisms—such as Payments for Ecosystem Services (PES), carbon farming and corporate sustainability investments—offer potential for long-term continuity.

Overall, the project demonstrates that ecological connectivity can be effectively integrated into Alpine planning systems when supported by coherent GBI mapping, cross-sector governance, targeted funding and participatory processes. The case studies provide a replicable model for aligning biodiversity and climate objectives with territorial development in the Alpine region.

1 Introduction

1.1 Background and rationale

Across the Alpine Space, landscapes are increasingly affected by pressures such as urban expansion, infrastructure development, tourism intensity and the accelerating energy transition. These dynamics put biodiversity and ecosystem functioning at risk, making ecological connectivity and Green and Blue Infrastructure (GBI) essential components of contemporary spatial planning. Spatial planning provides the regulatory and strategic framework needed to identify, conserve and restore ecological networks across multiple territorial scales by ensuring the integration and management of natural and semi-natural structures that enable ecological connectivity.

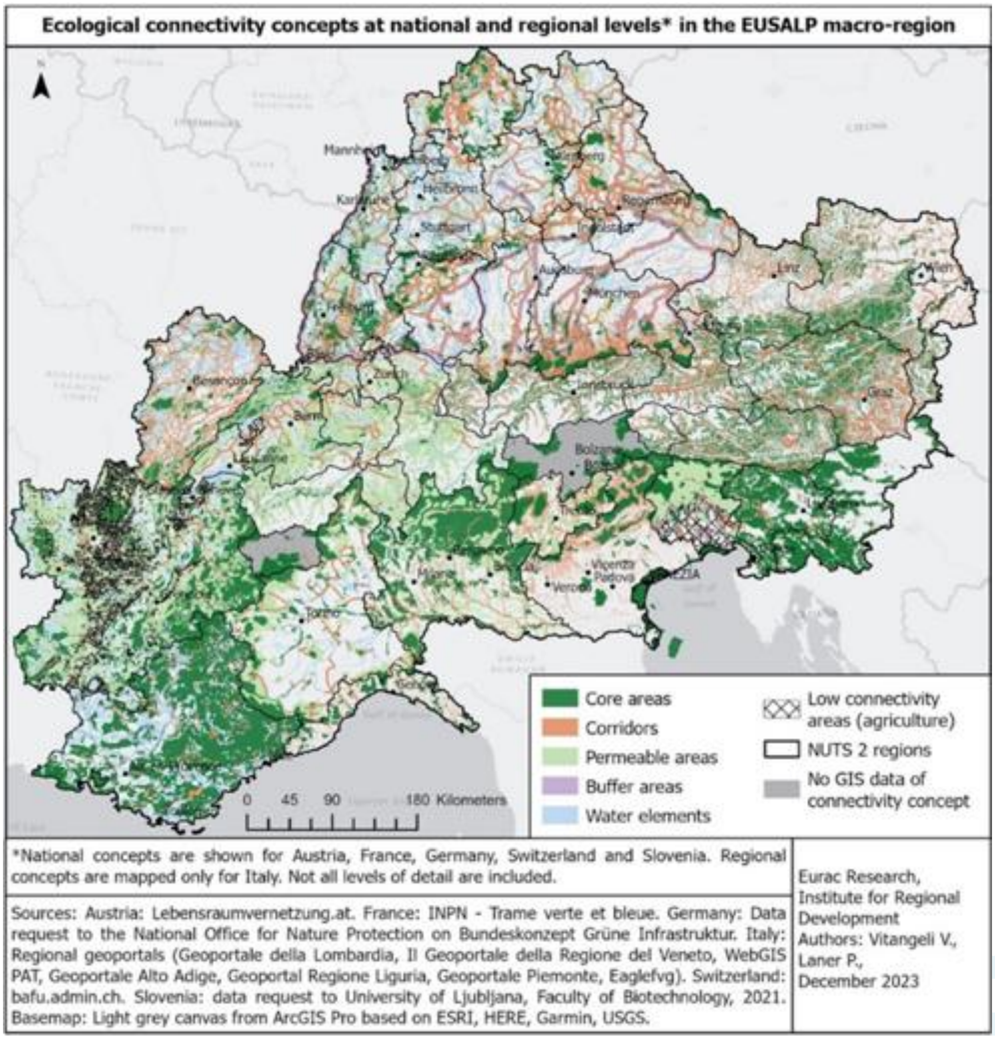


Figure 1 Existing connectivity concepts in the EUSALP macroregion (Eurac)

Although several national and regional ecological network concepts exist within EUSALP, they differ widely in scope, methodology and spatial coverage. In many cases, plans are not harmonized across borders or are missing entirely, making coherence across the Alpine arc difficult (see figure1 and reports D2.1.1 and D2.1.2). This fragmentation provided the rationale for developing a harmonized, Alpine-wide scenario to guide planning efforts and support the alignment of existing initiatives.

1.2 Alpine-wide connectivity scenario

To address these inconsistencies, the PlanToConnect project produced a scenario for an Alpine-wide ecological network based on a structural connectivity approach (see report D1.1.1). This model identifies potential transnational and regional linkages that can serve as a reference system for the alignment of national and regional network plans.

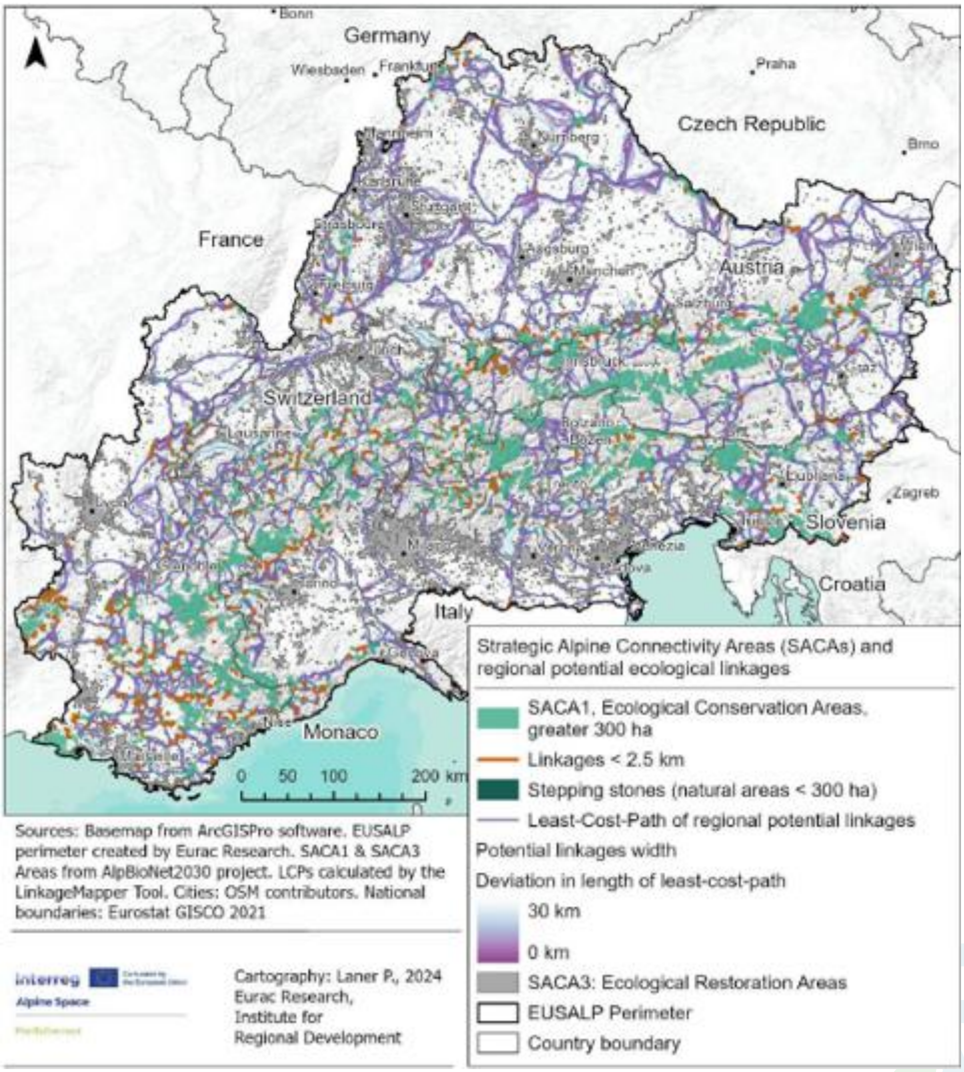


Figure 2 PlanToConnect Alpine-wide connectivity scenario (Eurac)

A comprehensive comparative analysis of existing connectivity concepts (D2.1.1 and D2.1.2) highlighted strong methodological differences among countries, further reinforcing the need for a shared Alpine-wide scenario. Figure 2 illustrates how the PlanToConnect model complements and harmonizes the heterogeneous set of national and regional concepts currently available.

1.3 Priority linkages and justification

Beyond identifying potential linkages, the project also prioritized ecological corridors according to their role in maintaining overall network coherence and their vulnerability to fragmentation, particularly from urbanization processes (see Fig. 2 and report D1.1.1). Priority linkages include those critical for holding the network together and those most threatened by land-use change.

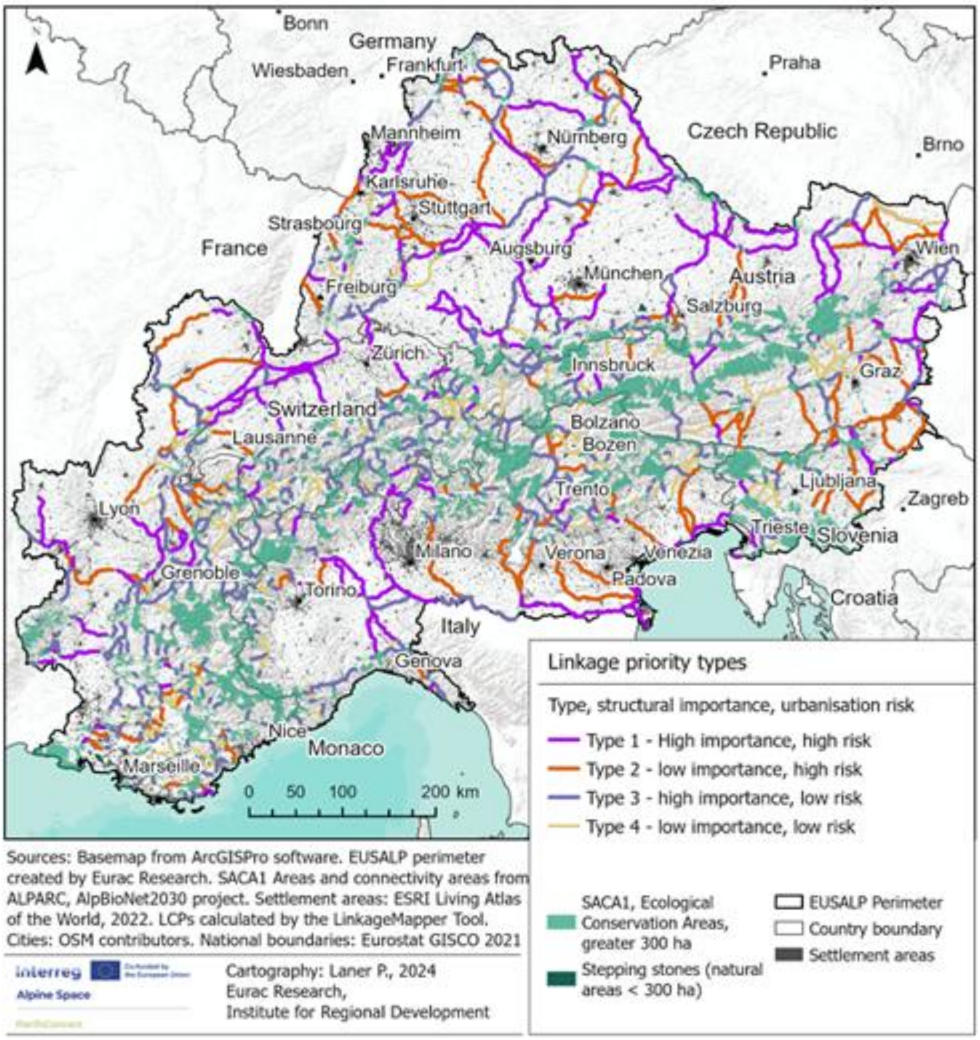


Figure 3 Linkage priority types (Eurac)

These priority corridors along with the alpine-wide connectivity scenario became a key reference for the design of the case studies, helping to focus regional explorations on linkages of Alpine-wide relevance and ensuring that local and regional analyses contribute to the coherence of the wider network.

1.4 Case study logic and role within PlanToConnect

The definition and development of the ten case studies were guided by the hypothesis that transnational bodies—such as the Alpine Biodiversity Board and the Alpine Convention Working Group on Spatial Planning—could use the Alpine-wide model to steer conservation and restoration efforts toward the most strategic linkages (Types 1 and 3). At the same time, regional and national administrations could apply the model to assess, align and harmonize their existing ecological network plans (see example in Fig. 4).

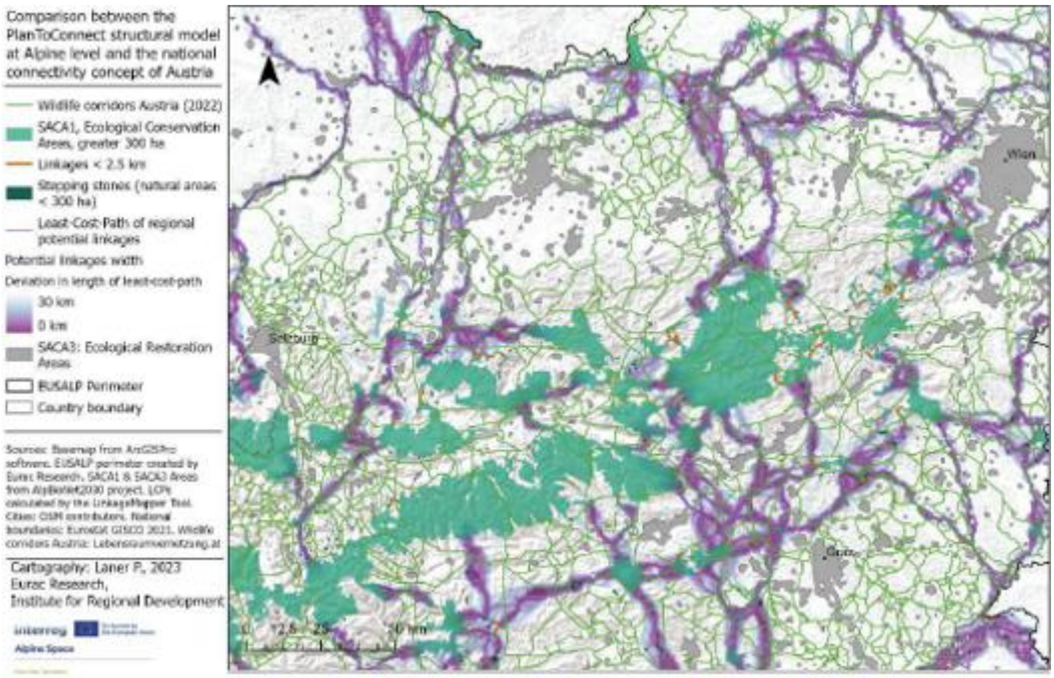


Figure 4 Comparison between the PlanToConnect structural model at Alpine level and the national connectivity concept of Austria (Eurac).

Building on this approach, ten case studies were developed in Austria, France, Germany, Italy and Slovenia. Their purpose was to explore how the Alpine-wide scenario could be translated into regional and local planning contexts and to propose appropriate governance arrangements for future implementation. One case study, led by ALPARC, went a step further by deepening and testing the model at the macro-regional scale, and producing recommendations for coordinated action across protected areas in the Alpine arc.

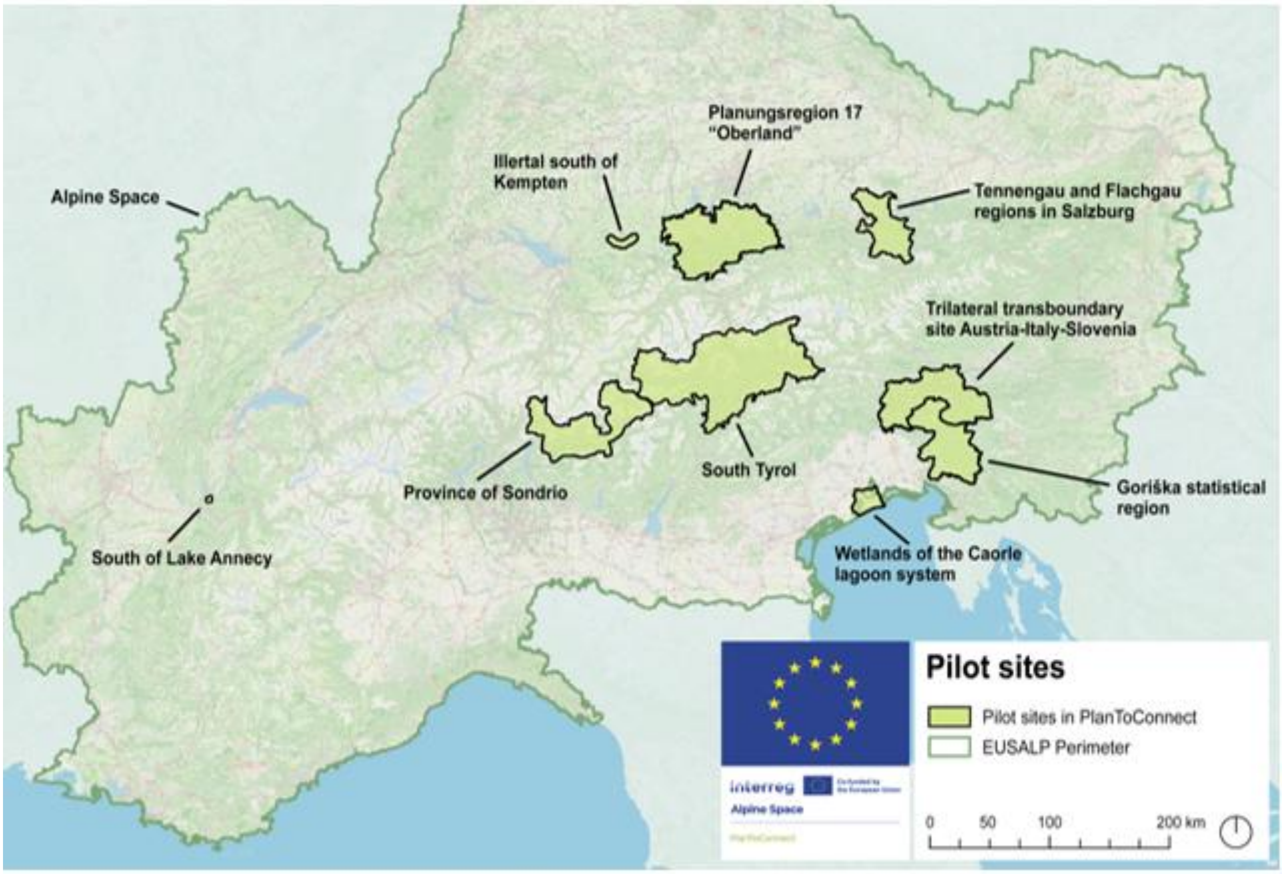


Figure 5 PlanToConnect Pilot areas (Eurac)

1.5 Integrated vs conventional planning approaches

The case studies also provided a testing ground for comparing conventional spatial planning with the integrated and participatory GBI planning approach promoted by IUCN (Lausche, 2019) and by the strategic GBI principles of connectivity, multifunctionality and spatial planning in ecosystem, restoration (Estreguil et al., 2019).

The state-of-the-art analysis of existing connectivity concepts (D2.1.1) revealed several limitations of traditional spatial planning systems: limited incorporation of biodiversity and climate-change considerations, insufficient cross-sector coordination, a predominantly top-down governance structure and weak integration of ecological connectivity into binding plans and technical norms.

By contrast, the integrated planning approach tested in the pilots emphasized:

– the mapping and assessment of GBI elements to support connectivity, multifunctionality and ecosystem restoration;

– the analysis of how land use, management practices and climate pressures affect ecological connectivity;

– participatory, cross-sector governance capable of aligning the needs and responsibilities of different authorities and land managers.

Through this approach, the case studies strengthened evidence-based decision-making and participatory governance, laying the foundation for more resilient and connected landscapes across the Alpine region.

Table 1 PlanToConnect case studies of integrated planning of Green and Blue Infrastructure networks for ecological connectivity

Pilot	Planning level
Strengthening Ecological Connectivity Across the Alps ALPARC	Transnational / multi-country (macro-regional)
Mainstreaming Ecological Connectivity Around Lake Annecy. ASTERS (FR – Annecy)	Regional + Local (SCoT / PLUi)
Ecological connectivity in the Iller river valley south of Kempten. Ifuplan (DE – Illertal)	Regional (Regionalplan)+ local
Ecological connectivity in Tennengau and Flachgau regions SIR (AT – Salzburg)	Regional (state spatial planning level)
Ecological connectivity in South Tyrol. EURAC (IT)	Provincial
International collaboration at trilateral pilot site in Austria, Italy, Slovenia. ECO AT–IT–SI (cross-border)	Cross-border (3 countries)
Multifunctional GBI for the Province of Sondrio FPM – Sondrio (IT)	Provincial + Local
Strengthening Ecological Connectivity in the Caorle Lagoon Wetland System. RV – (IT)	Regional + Local (Caorle Lagoon Wetland Contract)
Ecological connectivity in the Goriška Statistical Region UIRS – (SI)	Regional (Goriška)
Strengthening the Ecological Network in the Oberland Planning Region. JMU –(DE)	Regional (Oberland)

2 Case Study Outcomes and lesson learned

2.1 GBI network design

Across all pilot areas, the design of Green–Blue Infrastructure (GBI) networks represented the core analytical task of the case studies. GBI mapping was approached not merely as a technical step but as the foundation for strategic planning, guiding the identification of ecological corridors, permeability zones, barriers and areas of restoration potential.

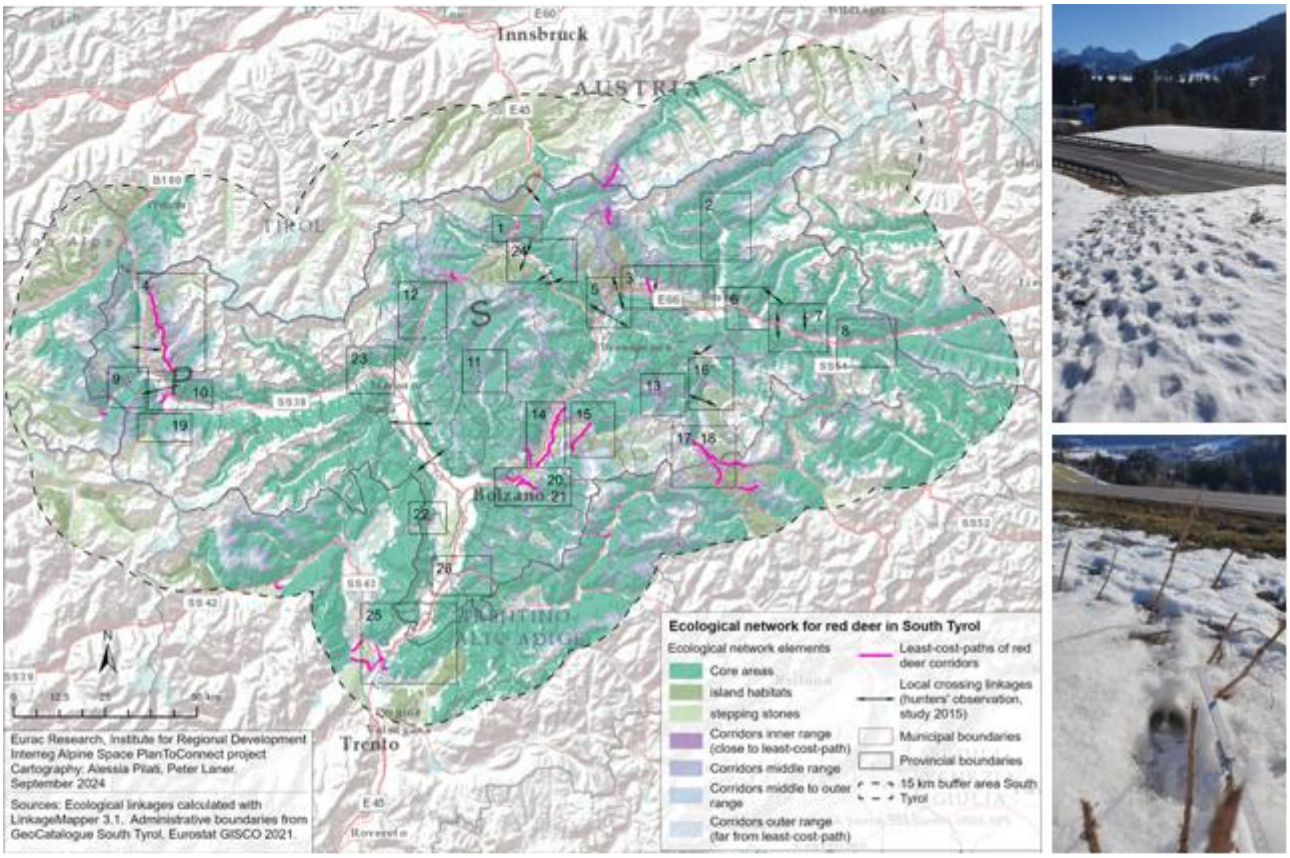


Figure 6 Ecological network model for red deer in South Tyrol (EURAC)

All pilots applied physical (structural) GBI mapping, combining land-use/land-cover analysis, connectivity modelling and barrier assessment. This approach produced a spatially explicit representation of core habitats, stepping stones and corridor structures, enabling stakeholders to understand how landscape configuration affects ecological connectivity.

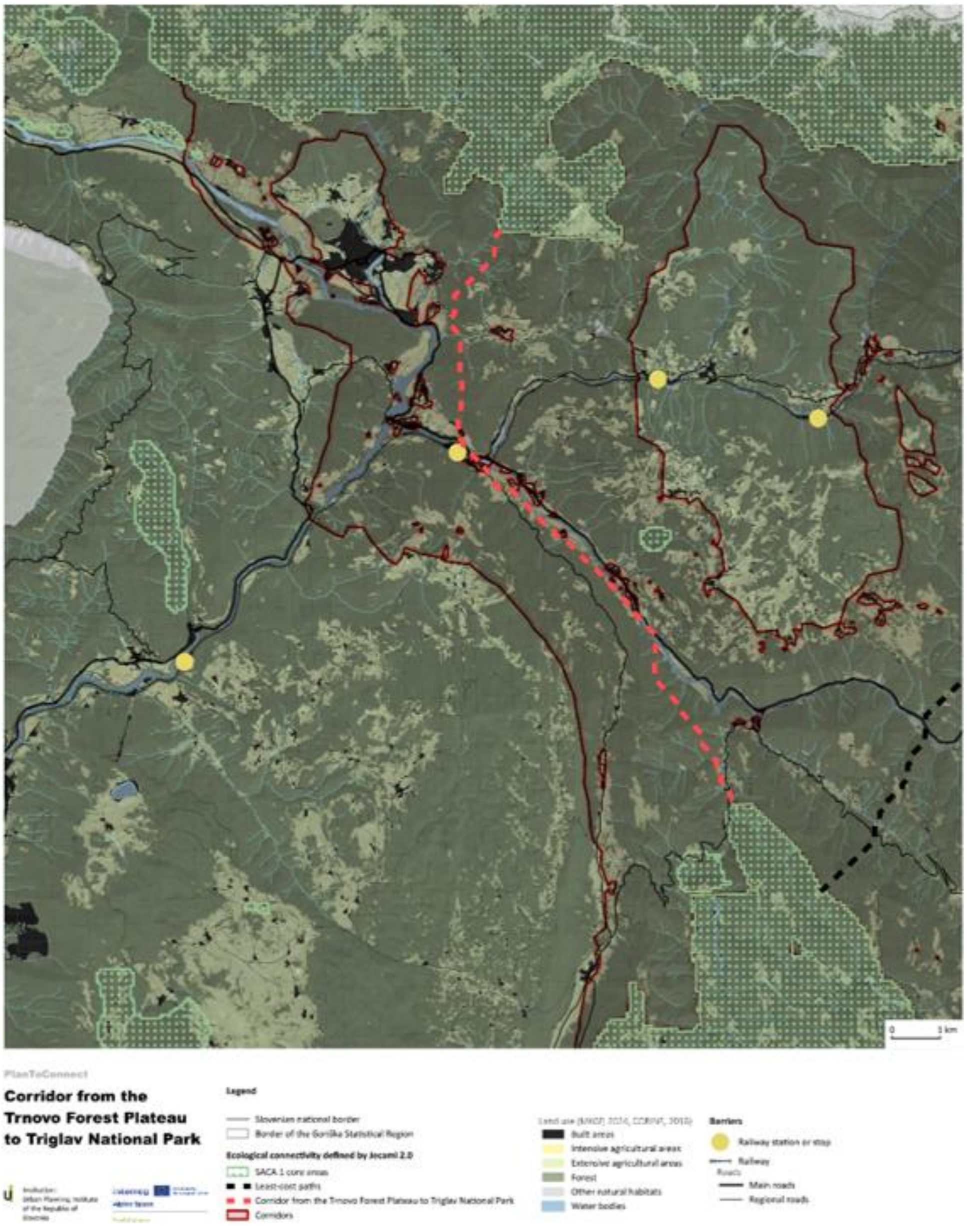


Figure 7 Corridor from the Trnovo Forest Plateau to Triglav National Park (UIRS)

Two pilots—FPM (Province of Sondrio) and Regione Veneto (Caorle Lagoon Wetland System)—advanced further by integrating ecosystem-services (functional) mapping, in line with the MAES framework and the strategic green-infrastructure principles promoted by JRC–EEA (Estreguil, C. 2019). Functional mapping assessed the capacity of landscapes to deliver priority ecosystem services such as habitat quality, nutrient retention, flood regulation, pollination, recreation, soil protection and carbon storage. Through this assessment, both pilots were able to identify priority area for conservation and restoration of GBI as well as those land uses and land management practices most critical for maintaining ecological functions and human well-being within the pilot area.

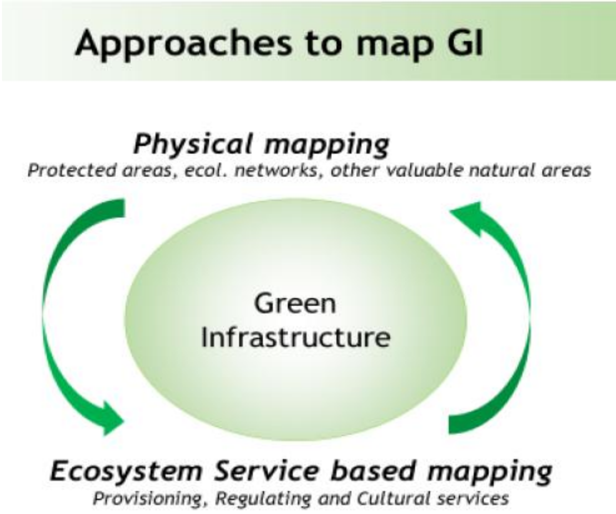


Figure 8 GBI mapping approaches (JRC-EEA)

In FPM, priority ecosystem services included habitat quality, pollination, nutrient retention and cultural services, which were essential both for biodiversity and for supporting traditional mountain landscapes. In Veneto, priority services emerged around flood regulation, water purification, soil protection, coastal resilience, agricultural multifunctionality and landscape identity, reflecting the specific vulnerabilities of lagoon and wetland systems.

Table 2: GBI mapping – selected priority Ecosystem Services for the specific multifunctional territorial frameworks of Sondrio Province and Carole lagoon pilot areas.

Pilot	Priority Ecosystem Services	Rationale
FPM – Sondrio Province	Habitat Quality, Stormwater Management, Crop Pollination, Nutrient Retention, Agricultural value, Sediment Retention and Cultural value	Reflects needs of a steep alpine valley shaped by agriculture, forestry, hydrological risk and tourism
Veneto – Caorle Lagoon System	Habitat quality; water purification; flood protection; CO_2 & microclimate regulation; water-cycle regulation; agricultural & fishery production	Reflects lagoon dynamics, climate risks, farmland-wetland interface and water quality priorities

In the alpine valley of Sondrio, the FPM pilot applied a multisystemic spatial analysis that combined corridor mapping with layers of ecosystem-service provision (habitat quality, water regulation, pollination, recreation potential and carbon storage). This analysis identified areas where ecological connectivity and high ecosystem-service value overlap, revealing multifunctional hotspots of territorial relevance.

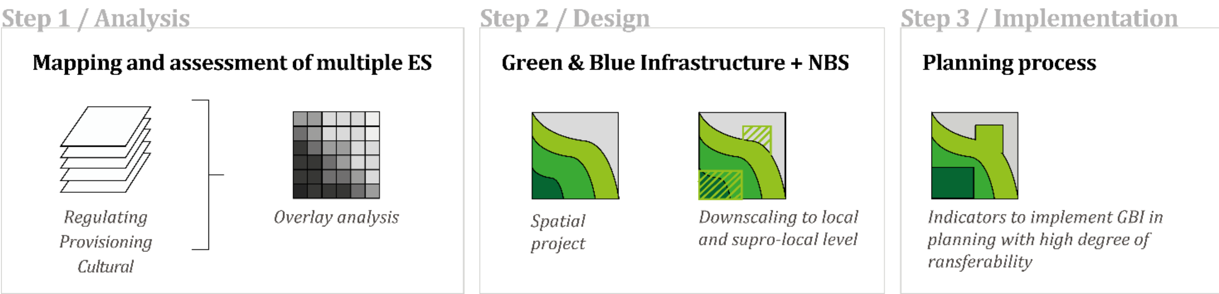


Figure 9 Methodological framework for the definition of the multifunctional green and blue infrastructure network in the province of Sondrio (LabPPTE elaboration, DAStU – Politecnico di Milano)

In Veneto, priority services mapping demonstrated how ecological corridors contribute directly to hydraulic safety, water quality and soil protection. This facilitated their incorporation into regional and municipal planning processes and into the Wetland Contract action plan ensuring that connectivity is recognized as a component of territorial resilience and sustainable land management.

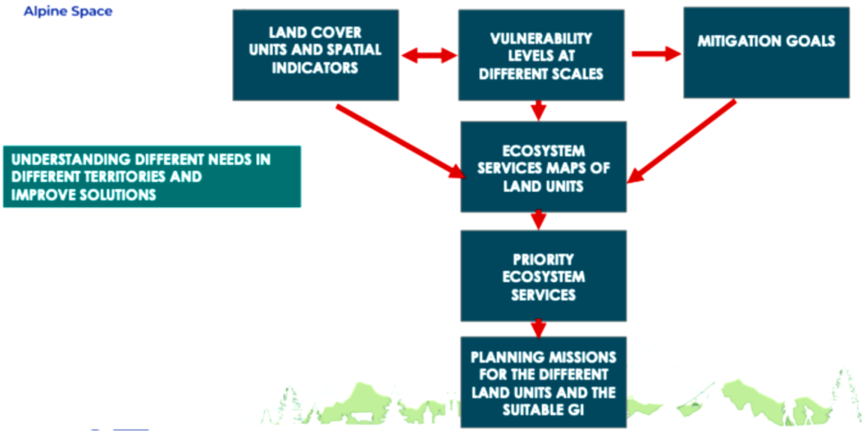


Figure 10 Methodological framework for the definition of the multifunctional green and blue infrastructure network in the Carole wetland system (Studio Gibelli)

By mapping these priority services together with connectivity structures and pressures, pilots were able to identify multifunctional hotspots where ecological restoration would generate the highest combined ecological and socio-economic benefits. This allowed authorities to visualize where restoring or protecting connectivity would also secure essential ecosystem services for communities, agriculture and climate adaptation.

Lessons learned

GBI mapping is indispensable for informed decision-making because it makes ecological connectivity visible, understandable and actionable. It provides a shared spatial evidence base for prioritizing interventions and coordinating sectors. Its effectiveness is greatest when structural connectivity is assessed together with priority ecosystem services, revealing multifunctional areas of strategic importance and strengthening the justification for integrating connectivity into planning and investment decisions.

2.2 Pressures and threats

Across all ten pilots, a largely consistent set of pressures emerged as the main drivers of ecological fragmentation. **Urban expansion and commercial or industrial development** were frequently identified as causes of land sealing, direct habitat loss and the disappearance of stepping-stone elements. **Transport infrastructure**—including roads, railways and river-regulation works—was repeatedly highlighted as a major source of linear fragmentation, increasing wildlife mortality and disrupting continuity between habitat patches.

Agricultural intensification emerged as a pervasive pressure in lowland and alpine valleys such as in Veneto lowlands (Caorle Lagoon), the Sondrio valley, South Tyrol, and the Oberland (Bavaria). Case studies reported a progressive shift toward monocultures, larger field sizes, irrigation systems and the removal of hedgerows and buffer strips, resulting in a sharp reduction in the ecological permeability of agricultural landscapes.

In mountain contexts, particularly within the Alpine protected areas network (ALPARC) and the Sondrio mountain areas, **forestry management practices** were also identified as a significant pressure. Uniform stand structures, salvage logging and reduced structural diversity were reported to weaken ecological gradients and interrupt natural connectivity along altitudinal corridors.

River and floodplain management was a recurring issue in several pilots, notably in the Illertal valley, the Salzburg region, and the Veneto lowlands (Caorle Lagoon). Channelization, bank reinforcement and vegetation removal were shown to reduce riparian habitat quality and disrupt longitudinal and lateral connectivity, even in areas that remain largely undeveloped.

In **peri-urban landscapes management** such as the Annecy peri-urban area and parts of the Oberland, connectivity loss was observed even where green spaces are abundant: intensive mowing regimes, ornamental planting and the fragmentation of small habitat patches were reported to limit their ecological function as corridors.

Some pilot areas also identified **pressures linked to energy-production infrastructure**, including hydropower plants, high-voltage power lines and ground-mounted photovoltaic systems. These installations were described as sources of disturbance and physical barriers, particularly affecting river continuity and sensitive open landscapes, notably in the Sondrio valley, the Salzburg region, the Illertal valley and the cross-border Austria–Italy–Slovenia corridors.

Beyond physical pressures, several reports stressed **institutional fragmentation** as a key indirect threat. Limited coordination between spatial planning, agriculture, forestry, water management and energy authorities often constrains the capacity to address connectivity issues in an integrated manner. As a result, pressures persist even where spatial plans formally recognise ecological corridors.

A central insight emerging across the pilots is that **connectivity loss is often driven as much by land-management practices as by land-use change**. Daily decisions by farmers, foresters, water authorities and landowners directly affect habitat quality and permeability, yet these practices frequently fall outside the direct regulatory scope of statutory planning instruments. This explains why many pressures identified in the pilots persist in landscapes that are formally designated as green or semi-natural.

Table 3 Main pressures and threats to ecological connectivity across the pilots

Pressure and threats category	Pilot areas where explicitly identified	Key observations from pilots
Urbanization & land sealing	All pilot areas	Urban growth and commercial development cause habitat loss and removal of stepping-stone elements, especially in lowland and peri-urban contexts.
Transport & linear infrastructure	All pilot areas	Roads, railways and regulated rivers act as persistent barriers, increasing wildlife mortality and fragmenting habitats.
Agricultural intensification & land management	Veneto lowlands (Caorle Lagoon), Sondrio valley, South Tyrol, Oberland (Bavaria), cross-border AT–IT–SI corridors	Monocultures, parcel enlargement, irrigation and hedgerow removal reduce landscape permeability and habitat diversity.
Forestry management practices	Alpine network's corridors (ALPARC), Sondrio mountain areas	Uniform stand structures, salvage logging and reduced structural diversity weaken forest-based and altitudinal corridors.
River and floodplain management	Veneto lowlands (Caorle Lagoon), Illertal valley, Salzburg region, Sondrio valley, cross-border AT–IT–SI corridors	Channelization, bank reinforcement and vegetation removal reduce riparian connectivity and longitudinal continuity.
Peri-urban green-space management	Annecy peri-urban area, Oberland (peri-urban sectors)	Intensive mowing, ornamental planting and fragmentation reduce the ecological function of green spaces.
Energy-production infrastructure (mainly hydropower-related)	Sondrio valley, Salzburg region, Illertal valley, cross-border AT–IT–SI corridors	Hydropower plants and associated river regulation interfere with river continuity and corridor functionality.
Institutional and sectoral fragmentation	All pilot areas	Limited coordination between planning, agriculture, forestry, water and energy sectors constrains connectivity conservation.

In this context, **ecosystem-services mapping** applied in the Sondrio valley and in the Veneto lowlands (Caorle Lagoon) **proved instrumental in strengthening pressure analysis**. In Sondrio, the integration of hydrological regulation, soil conservation, carbon storage, agro-silvo-pastoral provisioning, cultural and recreational services and biodiversity support revealed that some of the most pressured areas also deliver the highest multifunctional benefits. **Overlaying pressures with ecosystem-service hotspots helped stakeholders prioritize restoration actions where multiple benefits converge**.

In the Veneto pilot, ecosystem-services mapping within the Wetland Contract framework demonstrated that wetland restoration and ecological corridors directly address territorial pressures such as flood risk, coastal erosion and declining agricultural multifunctionality. This reframing supported a shift in stakeholder perception, from viewing connectivity measures as land-use constraints to recognizing them as solutions that deliver tangible benefits.

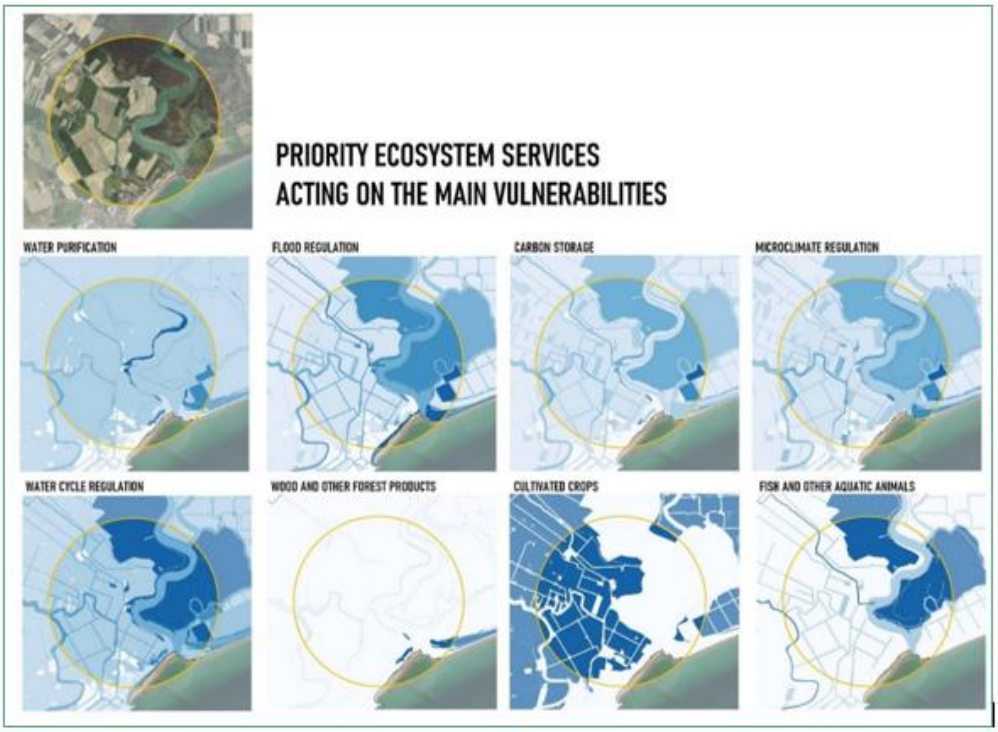


Figure 11 Priority Ecosystem Service mapping of GBI in the Caorle Wetland System (Studio Gibelli)

In both cases, the use of ecosystem-services evidence made pressures more visible, measurable and discussable, improving stakeholder engagement and the acceptability of proposed restoration measures.

Lesson learned

Connectivity is progressively eroded through the combined effect of land-use pressures and everyday land-management decisions. Mapping pressures together with ecosystem services helps make degradation visible and actionable, enabling targeted restoration measures that are more broadly understood and supported.

2.3 Integration of the GBI connectivity network into spatial and sector planning tools

All pilots demonstrated that ecological connectivity can be integrated into existing planning frameworks **without creating new planning instruments**, but by embedding the GBI network into tools that already regulate land use, development decisions, and sectoral interventions. Each pilot translated the corridor network into **planning-relevant geometries** (core areas, stepping stones, corridors, buffer zones) and linked them to the appropriate decision-making tools. Integration strategies followed a common pathway:

1. use GBI mapping as an evidence base,
2. identify which planning instrument has the authority to assign rules to the corridor areas, and
3. define how connectivity requirements are expressed (zoning rules, standards, management prescriptions, incentives).

Across the case studies, the GBI network has been proposed for integration mainly into:

- **regional and provincial spatial and landscape plans**, updating zoning or designating "connectivity areas / ecological corridors" as regulated layers;
- **municipal land-use plans and development permits**, where corridor elements become binding constraints or design requirements (set-backs, permeability rules, hedgerow/green buffer obligations);
- **Environmental Impact Assessment** adding **"**connectivity checks**"** to planning processes, meaning that any new plan or project must verify whether it affects the GBI network and, if so, compensate or redesign to avoid fragmentation;
- **sectoral plans**, especially agriculture (eco-schemes, agri-environmental measures), forestry (habitat continuity rules), and water management (floodplain and riparian corridor restoration);
- **negotiated territorial tools** (e.g., *Wetland Contract of Caorle lagoon system* in Veneto), used to formalize commitments between authorities, landowners and sectoral agencies.

Pilots highlighted that **integration succeeds when connectivity is translated into operational planning language**: maps become layers in GIS planning databases; corridors become zoning categories; management measures become planning prescriptions or incentive schemes.

Lesson learned:

Connectivity becomes real only when it enters the planning system. The turning point is when corridors stop being maps "for information" and become layers "for regulation". Integration works when spatial plans give legal weight to the GBI network and sector policies support its implementation.

2.3.1 ALPARC macro regional case

he ALPARC pilot demonstrates that ecological connectivity can be planned and coordinated beyond administrative borders, aligning with the macro-regional ambitions expressed in the *EUSALP Joint Paper on Spatial Planning* (JPSP). The JPSP calls for a common spatial development perspective for the Alpine Region, emphasizing transnational coordination, the strengthening of green and blue infrastructure, and harmonized approaches to spatial planning across borders. PlanToConnect directly contributed to these objectives by providing the first operational, Alpine-wide model of ecological connectivity and by illustrating how shared methodologies, governance platforms and protected-area networks can function as the backbone of a macro-regional ecological network. Unlike other pilots that work within a single planning authority, ALPARC operates in a governance context where no institution holds spatial planning competences across the entire Alpine arc. Therefore, integration of the GBI network relies not on statutory planning tools but on the cooperation frameworks already recognized in the JPSP—EUSALP, the Alpine Convention and transnational protected-area partnerships—which the JPSP highlights as critical for cross-border governance and coordinated territorial development.

From the pilot, three enabling strategies emerge:

1. **Using existing transnational frameworks instead of creating new instruments** ALPARC situates the GBI network within established macro-regional cooperation platforms, including EUSALP AG7, the Alpine Convention and the Alpine Biodiversity Board. The JPSP identifies these very bodies as central actors for "strengthening nature and biodiversity conservation" and for promoting a shared ecological network across the Alpine Region. The ALPARC pilot demonstrates how these frameworks can become operational drivers of harmonized connectivity planning.
2. **Working through protected areas as "connectivity anchors".** Protected areas and Natura 2000 sites are used as stable legal cores, around which ecological corridors are negotiated with the surrounding territories. The report states that protected areas function as *"nodes of stability"* from which connectivity can expand through voluntary agreements with municipalities and landowners.
3. **Soft-law and voluntary agreements instead of regulatory enforcement** At macro-regional level, binding planning regulation is impossible. Instead, ALPARC shows how integration can be achieved through shared mapping standards, common methodological guidance and voluntary corridor agreements between protected areas, municipalities and regional authorities. This approach aligns with the JPSP's emphasis on *cooperation*, *harmonization of approaches*, and *place-based coordination mechanisms* across the Alpine Region. Rather than producing binding plans, ALPARC proposes **common rules and methods that national and regional plans can adopt**.

In this pilot, the legal enforceability lies *downstream* — within each country/region — while the **macro-regional level acts as a strategic driver** that ensures harmonization, data consistency and political visibility.

The ALPARC case propose that at macro-regional scale, ecological connectivity could be integrated through cooperation frameworks (EUSALP, Alpine Convention) rather than statutory planning tools. Protected areas act as stable anchors, while corridors are co-designed and adopted under voluntarily agreements by regions and municipalities.

Lesson learned:

At macro-regional scale, integration does not mean regulating space directly, but aligning countries around shared knowledge, mapping standards, coordinated action and political commitment.

2.3.2 ECO cross-border pilot (AT–IT–SI)

The ECO pilot operates in one of the most complex governance settings of the entire project: three countries, three planning systems, three languages, and no shared cross-border planning authority. This context mirrors several of the challenges highlighted in the EUSALP Joint Paper on Spatial Planning (JPSP), particularly the need to overcome fragmented national systems and to enable functional, cross-border cooperation in areas of shared ecological significance. As with ALPARC, the integration of the GBI network in ECO cannot rely on statutory instruments. Instead, it follows the governance pathway proposed by the JPSP: **harmonized evidence, voluntary coordination and shared long-term frameworks**. The ECO pilot provides an operational example of how the JPSP's spatial-planning principles can be applied in a real cross-border landscape.

From the ECO case study emerges three key strategies:

1. **Common cross-border mapping methodology.** ECO developed a shared method for identifying core areas, corridors, fragmentation barriers and pressures in Austria, Italy and Slovenia. This directly responds to the JPSP's call for coordinated transnational datasets, harmonized spatial methodologies, and shared approaches to spatial evidence. Such harmonization prevents discontinuities that typically arise when national or regional systems use different criteria, datasets or cartographic standards. In the ECO pilot, GBI and connectivity mapping becomes the **cross-border evidence base** that each country can embed into its own statutory planning instruments.
2. **Voluntary corridor agreements instead of statutory planning tools.** Since no authority can impose binding corridor rules across borders, ECO adopted the model promoted in the JPSP: functional cooperation through soft-law mechanisms. ECO introduced the concept of: "Voluntary corridor agreements" between municipalities, parks and sectoral actors. These agreements are not regulatory documents but commitments to integrate the corridor into each local/regional planning process (urban plans, landscape plans, Natura 2000 management, agricultural measures).

   In practice:

   - each authority keeps its planning autonomy,

  - but commits to adopt the same corridor geometry and the same connectivity goals.

  This follows the JPSP's emphasis on *cooperation and coordination rather than legal harmonization*, and provides a pragmatic way to operationalize cross-border planning where competencies differ.

3. **Shared governance body for future implementation.** Rather than ending with the project, ECO proposes the institutionalization of a **cross-border working group** (derived from the project's RCWG *see paragraph 2.4 Governance and Stakeholder participation*), which remains active after the project as a permanent coordination mechanism to:
   - monitor corridor integrity,
   - coordinate small interventions (e.g., hedgerows, fauna passages),
   - resolve cross-sector conflicts.

Crucially, the ECO report proposes that the cross-border network be embedded in a future Trilateral Biosphere Reserve Austria–Italy–Slovenia, under the UNESCO Man and the Biosphere (MAB) Program. This framework would provide a permanent institutional umbrella for the voluntary agreements, ensuring long-term coordination, continuity and access to international cooperation mechanisms.

In this vision, the biosphere reserve becomes the strategic governance layer under which national and regional plans integrate the same GBI corridors as functional components of a shared transboundary landscape. Alternatively, the trilateral cooperation can be organized under the umbrella of the peace park concept. Due to the lack of a formal established structure, there is a need to give the mandate for connectivity related issues to one of the partners as permanent secretariat.

Lesson learned:

Connectivity governance succeeds when it grows from shared maps into shared commitments. Harmonized methods build trust; cooperation transforms it into joint action; and long-term frameworks, such as biosphere reserves, turn collaboration into continuity.

2.3.3 ES based integration (FPM & Veneto)

Two pilots — FPM (Sondrio**)** and Veneto Region (Caorle Lagoon – Wetland Contract) — demonstrated that **integrating GBI network into spatial and sectoral planning is most effective when connectivity is linked to the ecosystem services it provides**. By quantifying and mapping the functional benefits of GBI — such as flood regulation, soil protection, biodiversity, recreation and carbon storage — both pilots succeeded in embedding ecological connectivity into planning and policy frameworks traditionally focused on land management, risk prevention and rural development.

In Sondrio, combining connectivity modelling with the evaluation of priority ecosystem services supported the selection of priority corridors and multifunctional interventions zones under three strategic frameworks (regenerative, multifunctional, conservative) each linked to landscape units and management priorities. This provided strong justification for integrating GBI priorities into provincial and sectoral planning tools.

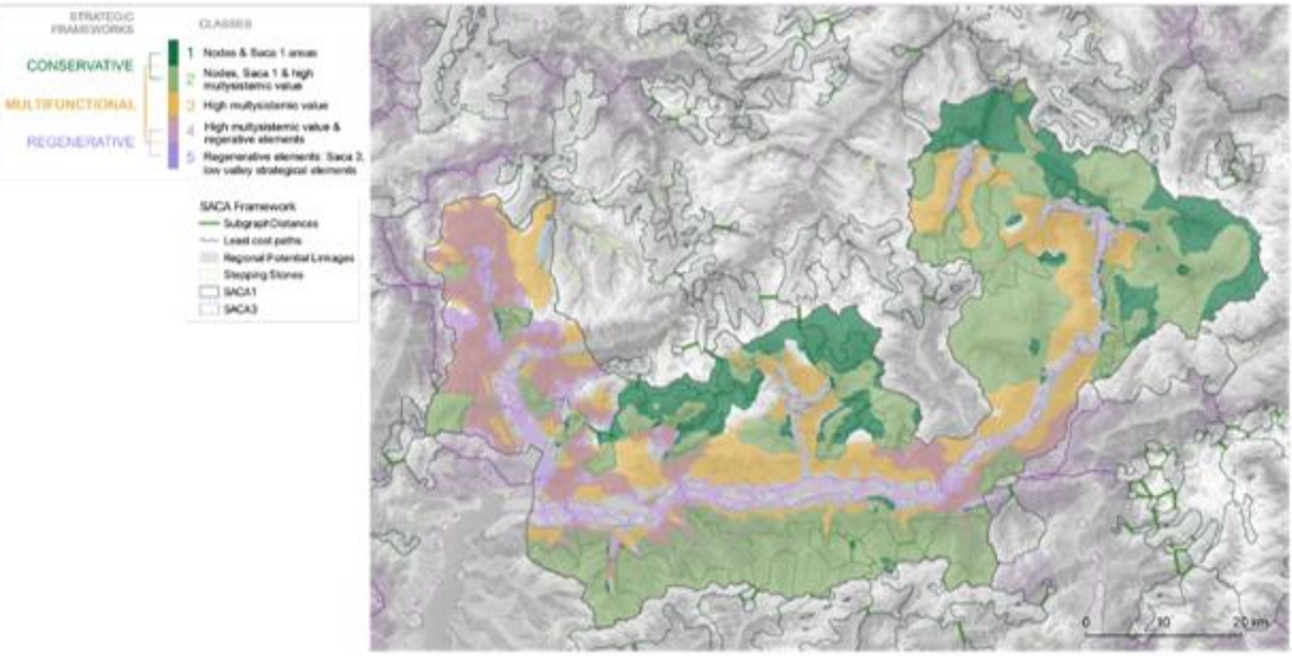


Figure 12 GBI strategic frameworks in pilot area Province of Sondrio (LabPPTE elaboration, DAStU – Politecnico di Milano)

FPM propose to use these findings to inform the integration of the GBI network into several key planning and management instruments, including:

- the Provincial Territorial Plan (PTCP), where ecological corridors could be recognized as multifunctional landscape elements;
- river basin and hydraulic safety plans, which could adopt corridors and riparian areas as nature-based solutions for flood mitigation; and
- agricultural and forestry programs, linking connectivity areas with eco-schemes and multifunctional landscape management practices.

Through this approach, corridors become not only biodiversity corridors but functional infrastructure supporting ecological and climate resilience, risk reduction and socio-economic benefits, making their inclusion in statutory and sectoral plans both technically and politically viable.

In the Veneto pilot, integration of the GBI network was achieved through the Wetland Contract (*Contratto di Area Umida*), a collaborative and negotiated planning framework connecting municipalities, water authorities, farmers, and environmental agencies in the

Caorle Lagoon and Eastern Veneto lowlands. Here, ecosystem-service mapping was used to show how ecological corridors and wetland restoration zones deliver multiple territorial functions. The analysis demonstrated that these areas:

- contribute to flood regulation and hydraulic safety, enhancing retention and infiltration in flood-prone landscapes;
- improve soil conservation and agricultural productivity, through vegetated buffers and hedgerows that reduce erosion and nutrient loss;
- and enhance biodiversity and landscape quality, strengthening the ecological identity and sustainable tourism potential of the lagoon system.

This evidence base would enable the GBI network to be formally referenced in:

- the Regional Territorial Coordination Plan (PTRC), identifying corridors as strategic multifunctional components of regional infrastructure;
- the River Basin Management Plan and Flood Risk Management Plan, which incorporate corridor zones as natural retention areas;
- municipal urban plans, linking ecological buffers with zoning and green infrastructure standards; and
- agricultural and forestry programs, aligning agri-environmental and biodiversity measures with corridor priorities.

Through the Wetland Contract, Veneto established a cross-sectoral governance platform that unites spatial, water and agricultural planning around shared objectives. By framing connectivity as a nature-based solution with measurable ecosystem benefits, the pilot transformed corridors from perceived land-use constraints into productive and protective assets for the region.

Lesson learned

Integrating ecosystem-services evidence into planning transforms ecological corridors into functional territorial infrastructure. When connectivity is framed as a provider of public services — safety, productivity, resilience — it gains legitimacy within planning systems and becomes a shared priority across sectors.

2.4 Governance and stakeholder participation in integrated GBI planning

Ecological corridors are considered governed spaces, not just mapped lines, and must have a governance model behind them. “A corridor must have a governance authority and a management approach ensuring long-term ecological connectivity.” (IUCN Guidelines for Conserving Connectivity, 2020).

IUCN distinguishes **four main types of governance** that can apply to protected areas, ecological networks, and corridors.

Table 4: IUCN governance typologies

IUCN governance typology	Who decides	Where it typically acts in planning (spatial planning levels)	Why this match occurs
A — Governance by government	National, regional or municipal planning authorities	**Higher formal planning levels** (regional plans → municipal urban plans)	Because connectivity becomes binding only if integrated into statutory planning instruments (e.g., SRADDET → SCoT → PLU in France; regional spatial plans in Slovenia).
B — Private governance	NGOs, private owners, land trusts	**Local / site level** (reserve creation, land purchase, easements)	Private actors can protect or manage land, but cannot change zoning or land-use plans.
C — Governance by Indigenous Peoples / local communities	Communities with customary or legal authority	**Local / landscape level**	Community authority applies to specific territories (e.g., community forests, ICCAs).
D — Shared / collaborative governance	Multiple actors share decision-making (parks + municipalities + agencies)	**Cross-level integration** (inter-municipal, cross-sector, cross-border)	Used when no single entity holds full authority (e.g., ecological corridors across municipalities or countries).

In each pilot, a Regional Connectivity Working Group (RCWG) was established as a temporary multi-stakeholder platform during the design of the GBI network (corridor identification, barriers and pressures, and feasible measures). These groups brought together planning authorities, protected areas, forestry and water-basin agencies, municipalities, farmers, hunters, NGOs and, in some cases, private actors. During the planning phase they provided a forum for joint analysis of corridor areas—validating mapped barriers and pressures and co-designing feasible measures—while at the same time building trust between actors who normally operate in separate policy domains. Although temporary in origin, RCWGs were conceived as future-oriented structures meant to evolve into permanent cooperation mechanisms after the project. For this reason, each pilot defined a governance model for:

- Planning the network - describing how the network design and RCWG decisions would be integrated into spatial planning instruments and sectoral policies, and
- implementation and management - clarifying how the RCWG or an equivalent permanent structure should continue coordinating future interventions, maintenance activities and monitoring of connectivity areas.

In this way, the RCWG acts as a bridge between participatory design during the project and formal governance beyond the project, supporting long-term ecological connectivity.

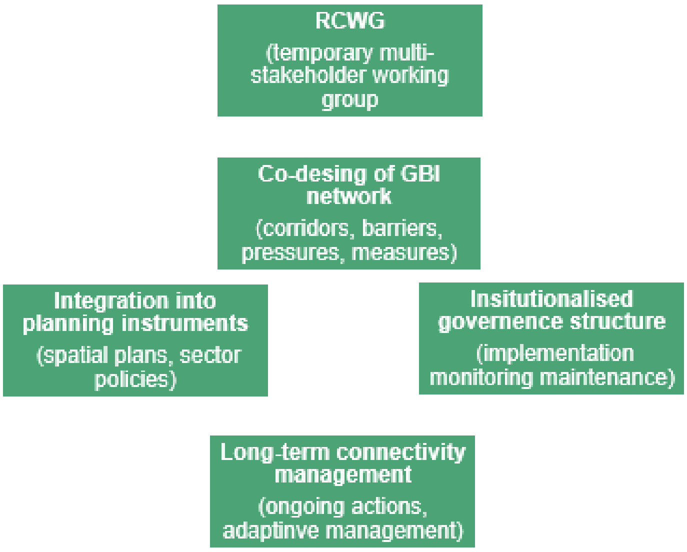


Figure 13 The RCWG as future-oriented structures meant to evolve into permanent cooperation mechanisms after the project. Its outputs feed into spatial and sector planning instruments (Regione Veneto)

In France, Slovenia, Austria, Germany case studies the integration of the GBI network into formal plans is seen as primarily driven by governmental authorities operating under IUCN governance Type A. In these cases, ministries and regional planning bodies have the legal authority to incorporate corridors into regional spatial plans, municipal land-use plans or landscape plans. However, implementation of corridor measures often depends on a much broader set of land management actors — municipalities, agricultural enterprises, forestry services, hunters and environmental NGOs—requiring shared or collaborative governance (Type D) during the operational phase. The pilots in ASTERS, ifuplan, SIR, UIRS and JMU show this duality clearly: planning is government-led, but field implementation relies on multi-actor cooperation.

Other pilots—particularly ALPARC, ECO, FPM and Veneto—operate in governance settings where no single institution holds full planning authority over the corridor area. This applies to cross-border landscapes, inter-municipal territories, protected-area networks and negotiated planning frameworks. In these contexts, both planning and implementation necessarily rely on shared governance (IUCN Type D), built on joint decision-making, negotiation and voluntary agreements.

ALPARC works through macro-regional cooperation mechanisms (Alpine Convention, EUSALP) and uses protected areas as “anchor institutions” to coordinate action across the Alpine arc. The ECO pilot formalizes collaboration through voluntary corridor agreements among parks, municipalities and sector agencies, supported by a proposal to embed the network into a future trilateral UNESCO Biosphere Reserve. FPM builds governance through territorial cooperation within a mountain community, supported by instruments such as ecological network contracts and Greenways. Veneto integrates GBI governance into the existing Voluntary Wetland Contract, a negotiated, multi-actor framework involving the region, municipalities, water authorities, farmers, aquaculture operators and tourism stakeholders.

Table 5: Proposed governance settings in pilot areas

Pilot	Governance for planning	Governance for implementation	IUCN governance typology
PP3 – ALPARC (Alpine Space / FR–IT–AT–SI)	No single state has authority over the Alpine-wide ecological corridor; planning is coordinated through ALPARC, Alpine convention and EUSALP working groups	Each protected area implements actions within its own jurisdiction; actions require concertation and partnership ALPARC facilitates coordination, the AlpPlan Network	Type D – Shared governance (collaborative networks, multi-actor, transnational)
PP4 – ASTERS (France – Annecy / Haute-Savoie)	Corridors integrated into statutory plans (SRADDET → SCoT → PLUi/PLU); decision authority is governmental	Restoration and field actions co-designed with landowners, farmers, hunters, NGOs	Planning: Type A – Governance by government / Implementation: Type D – Shared governance
PP6 – ifuplan (Germany – Illertal, Bavaria)	Corridor layer integrated by Lower & Higher Nature Conservation Authorities and Regional Planning Authority (statutory spatial plan)	Landscape Maintenance Associations (LPV), farmers, NGOs perform restoration and connectivity measures	Planning: Type A – Governance by government / Implementation: Type D – Shared governance
PP8 – SIR (Austria – Salzburg)	Regional spatial planning authority integrates connectivity into formal planning instruments; clear legal mandate	Sector agencies (forestry, mobility, hunting), municipalities implement actions	Planning: Type A – Governance by government / Implementation: Type D – Shared governance
South Tyrol – EURAC (Italy – Provincia Autonoma di Bolzano)	Provincial administration coordinates multidepartment RCWG (environment, agriculture, wildlife, infrastructure); planning responsibility shared within government	Municipalities, farmers, sector agencies implement corridor measures	Type D – Shared governance (intra-governmental + multi-actor)
ECO (Austria–Italy–Slovenia cross-border)	Protected areas + regional authorities co-design transboundary corridors; **uses voluntary corridor agreements** because no authority spans 3 countries	Voluntary commitments from municipalities and landowners; actions negotiated	Type D – Shared governance (negotiated / voluntary corridor agreements)
FPM (Italy – Sondrio Mountain Community)	RCWG connects province + municipalities; GBI integrated into PTCP and local plans; collaborative planning process	Landowners, farmers, Natura 2000 managers execute actions (regenerative agriculture, NBS)	Type D – Shared governance (intra-governmental + local actors)
Veneto – Caorle Lagoon Wetland Contract (Italy)	Planning steered by multi-actor Wetland Contract (*Contratto di Area Umida*); negotiated governance among Region,	Restoration and conservation measures depends from land reclamation consortium, (CBVO), landowners and production	Type D – Shared / negotiated governance

	municipalities and sector authorities	sectors (agriculture, aquaculture and tourism)	
UIRS (Slovenia – Goriška region)	Ministry + Regional Spatial Plan formalize corridors inside statutory planning; municipalities must adapt local plans	Municipalities, forestry, agriculture and water authorities implement management actions	Planning: Type A – Governance by government / Implementation: Type D – Shared governance
JMU (Germany – Oberland)	Regional Planning Board integrates corridors into regional plan; state authority leads planning	Implementation by forestry, water authorities and municipalities	Planning: Type A – Governance by government / Implementation: Type D – Shared governance

Across the pilots, stakeholder participation proved essential not only for designing corridors but also for anticipating conflicts, increasing local ownership and potentially enabling implementation on private or agricultural land. Participation provided a space for dialogue between sectors—urban development, agriculture, forestry, water management—that are often responsible for pressures on connectivity but are also key to restoring it. In several pilots, the participatory process also facilitated alignment between formal planning tools and voluntary commitments, allowing the GBI network to be anchored both in statutory plans and in negotiated or incentive-based management practices.

A common pattern emerges: effective governance combines statutory authority with collaborative mechanisms. Spatial planning provides the legal foundation for integrating the GBI network, but implementation requires multi-actor governance structures that mediate between ecological objectives and local land-use practices. The RCWG model helped bridge these two dimensions, acting as a platform for co-design during the project and laying the groundwork for permanent governance structures capable of coordinating future restoration and management activities.

Lesson learnt

Technical mapping identifies corridors; governance and participation make them happen. Successful implementation of ecological corridors depends on aligning formal planning authority with active stakeholder ownership. Planning authorities can integrate corridors into spatial and sector plans, but implementation happens only when those who manage the land — municipalities, protected areas, farmers, foresters, water authorities — are engaged early and co-design the solutions.

2.5 Connectivity measures, action plans

The case studies developed **action plans** proposing measures for future implementation, without executing them. The proposed measures fall into recurring categories:

– **Barrier mitigation and wildlife crossings** (South Tyrol, ifuplan, SIR, FPM, ECO)

– **Small-scale measures improving matrix permeability in peri-urban landscapes** (ASTERS, JMU)
– **Agro-ecological infrastructure**: hedgerows, field margins, buffer strips (FPM, South Tyrol, Veneto, JMU)
– **Forest-structure diversification and ecological corridors along altitudinal gradients and valley bottoms** (ALPARC, South Tyrol, FPM)
– **Riparian and floodplain restoration** (Veneto, ifuplan, ECO)
– **Wetland restoration and lagoon connectivity** (Veneto)

Several pilots combined structural measures with land-management measures (e.g., mowing regimes, riverbank vegetation management, forest thinning patterns), reinforcing the idea that connectivity depends on both habitat structure and management practices.

Transboundary and protected-area pilots (ALPARC, ECO) combine physical measures with **joint action plans, coordinated monitoring and harmonized management standards**. Actions often target shared river systems, forest corridors and cross-border ecological nodes. ECO also explores the possibility of embedding measures within a trinational Biosphere Reserve framework.

Across the pilots, action plans also include **soft measures**: governance arrangements, stakeholder engagement pathways, capacity building for municipalities. Monitoring frameworks are commonly proposed with indicators covering structural connectivity (land cover, permeability) and functional aspects (species movements, habitat condition, Priority Ecosystem Services).

Overall, while each pilot develops its own set of interventions, a clear convergence emerges: connectivity is strengthened through the combined use of structural restoration, improved landscape management, and multi-actor governance arrangements.

Lesson learned

Connectivity action plans must combine physical restoration with land-management measures. Structural interventions alone cannot guarantee long-term ecological permeability. Connectivity measures are most effective when restoration actions, permeability improvements and land management practices are integrated into a coherent, multi-actor action plan that links spatial priorities with coordinated governance and long-term stewardship.

2.6 Funding toolbox

Across the PlanToConnect pilot areas, the funding toolbox proposed for future implementation of ecological connectivity measures highlights a broad and diversified set of financial instruments operating at different territorial scales and intervention stages. The Veneto case study provides a structured framing, distinguishing between EU, national and regional sources and a growing group of innovative funding mechanisms (table 5).

Table 6 Financial instruments for funding the connectivity actions

Financial instrument		Usefulness of the tool based on the intervention phase		Applicability of the tool	
		Start-up phase (design and implementation)	Maintenance phase	Potential	Critical issues / Barriers
Direct EU public contributions	LIFE Nature and Biodiversity HORIZON	X		Awareness – Development of pilot projects	Does not ensure long-term support
Indirect EU public contribution [CAP - Agro-climatic-environmental payments]	Reduced soil tillage techniques	X	X	Agronomic management supporting ecosystems and biodiversity	SRA 10 (Maintenance often ends once the commitment period expires
	Cover crops				
	Conversion of arable land to grasslands and pastures				
	Sustainable management of permanent grasslands and pastures				
	Active management of ecological infrastructures (hedgerows and tree lines)				
	Reduction in the use of plant protection products				
	Sustainable use of nutrients				
	Support for the maintenance of afforestation and related systems				
	Payment for adopting and maintaining organic production practices and				
Fiscal instruments	Integrated water service tariff	X	X	NBS for stormwater management (SuDS) and water protection areas	Approach still little known by public authorities and professionals
	Irrigation contribution (payment to land reclamation and irrigation consortia)		X	NBS for diffuse pollution management / Restoration of rivers and irrigation canals / Flood managemen	Approach little known by consortia and professionals, to be explored
	State property concession fees	X	X	ERC internalization / Ecosystem restoration	Lack of earmarking of revenue
	Water abstraction concession fees	X	X	ERC internalization / Ecosystem restoration	Lack of earmarking of revenue
Market-based instruments.	Biodiversity credits		X	ES provision	Reference practices not yet available
	PES - Payments for Ecosystem Services		X	ES provision	Limited awareness of the tool

This framing is largely consistent with the funding options identified in the other pilots. What the Veneto scheme adds—beyond the classification of instruments—is a useful distinction between funding suitable for the **start-up phase** of connectivity interventions (planning, design and initial restoration) and those better adapted to the **maintenance phase** (long-term management, stewardship and monitoring). Although none of the pilots implemented these instruments in practice, this distinction helps clarify how funding sources could be combined and sequenced over time.
In the FPM case, proposals include optimizing these combined resources in line with the regional 2014–2020 Prioritized Action Framework (PAF), demonstrating how connectivity measures could align with existing biodiversity policy instruments.

Across all pilots, **EU programmes**—including CAP agri-environment–climate measures, forest-related interventions, eco-schemes, Cohesion Policy funds, LIFE and Interreg—are consistently identified as the primary resources that *could* support the initial stages of connectivity implementation. These instruments are well suited to finance restoration works, habitat creation, river and wetland renaturation or cross-border coordination. They are complemented by **national, provincial and municipal funding schemes**, which could support both the initial phases and smaller-scale actions embedded in local planning processes. In several pilots (South Tyrol, FPM, UIRS), domestic funding streams are also viewed as potential long-term resources to sustain connectivity through support for landscape stewardship, extensive agriculture and mountain-forestry management.

The pilots also suggest additional funding avenues not explicitly covered in the Veneto framework. In Alpine and riverine contexts (ifuplan, SIR, ECO, FPM), **water-management and flood-protection budgets** are considered particularly strategic for initiating connectivity measures, as they could finance riparian restoration, floodplain reconnection and hydro morphological barrier mitigation. Similarly, **hydropower compensation funds**, mentioned in SIR, ECO and ifuplan, are identified as potential sources for actions such as fish passages or barrier retrofitting—typically belonging to the start-up phase. These sectoral instruments are context-dependent but often represent some of the most substantial and operationally accessible funding sources for ecological restoration in Alpine regions.

Agri-environmental measures (AECM) under the CAP emerge across the pilots as one of the few instruments capable of supporting both phases. They are seen as suitable for the start-up phase—by financing hedgerow creation, buffer strips or extensive grassland management—but are especially valuable for the maintenance phase, due to multi-year contracts that sustain ecological practices over time. This dual role is evident in the Italian, Austrian, German and Slovenian pilots, where AECM are consistently suggested as the backbone of long-term connectivity management in agricultural landscapes.

The case studies also highlight **innovative funding mechanisms**, Payments for Ecosystem Services (PES), carbon farming, and emerging opportunities for corporate sustainability investments, in which companies may co-finance restoration or nature-based measures to meet their environmental and social responsibility commitments (e.g., ESG or CSRD reporting requirements). While only Veneto explicitly formalizes these tools, several other pilots point toward similar opportunities: FPM highlights carbon-related ecosystem services (a potential foundation for carbon farming schemes), and JMU mentions private co-investment through landscape partnerships. These instruments can serve both *start-up* (co-financing restoration) and *maintenance* phases (ongoing payments for ecosystem service provision), making them particularly suited for long-term connectivity governance.

Finally, some pilots highlight unique funding sources that could complement the general toolbox. The ECO pilot notes that UNESCO Biosphere Reserve funding may support cooperative governance during the early stages of connectivity planning. JMU and UIRS point to landscape stewardship funds, which are well-suited for long-term maintenance of connectivity in cultural landscapes.

Overall, the case studies indicate that while EU and national/regional programs will remain the backbone of future connectivity implementation, their effectiveness will depend on combining them with maintenance-oriented instruments such as AECM, stewardship schemes and emerging PES/ESG-based mechanisms. The phase-based approach introduced by Veneto provides a valuable structure for sequencing these instruments over time, and the additional funding sources suggested across the Alpine pilots confirm that financing ecological connectivity will require a multi-source, multi-sector strategy.

Lesson learned

Sustainable ecological connectivity relies on a combination of funding sources across phases: EU and sectoral instruments can initiate restoration, but long-term results depend on maintenance-oriented tools such as AECM, stewardship schemes and emerging PES/ESG mechanisms. Connectivity endures only when financing is continuous, diversified and multi-sector.

3 Conclusions

The PlanToConnect case studies collectively demonstrate that ecological connectivity can be meaningfully integrated into regional and local planning systems across the Alpine Space, provided that appropriate analytical, governance and funding frameworks are in place. **The Alpine-wide structural connectivity model served as an effective reference** for identifying priority linkages and for guiding regional harmonization of the network design. All case studies confirmed the relevance of the model, strengthening its applicability across diverse territorial contexts.

A major conclusion is that **GBI mapping**—whether based solely on structural connectivity or complemented with ecosystem-service evidence—**is central to informed decision-making**. All pilots showed that physical mapping of ecological structures provides the essential foundation for identifying corridors, barriers and restoration priorities, while the two pilots that incorporated priority ecosystem services demonstrated how functional evidence can further highlight multifunctional areas where ecological, socio-economic and climate-related benefits converge. Together, these approaches enhance the strategic value of connectivity measures and strengthen stakeholder acceptance.

The analysis of pressures revealed that **land management practices are as influential as land-use change in determining connectivity outcomes**. Agricultural intensification, forestry practices, river maintenance and peri-urban green-space management emerged as recurrent pressures that degrade habitat permeability. This indicates that improving ecological connectivity requires influencing how land is managed daily, not only how it is zoned. Consequently, governance models must extend beyond spatial planning authorities to include farmers, foresters, water managers, protected areas and municipalities.

The pilots also demonstrated that **integrating connectivity into planning systems requires multi-level and cross-sector alignment**. Regional and provincial plans must incorporate connectivity maps and measures, while sectoral instruments—such as river basin plans, agricultural policies, forestry management guidelines and energy planning—must operationalize them. Macro-regional and cross-border coordination is essential where corridors transcend administrative boundaries, as illustrated by ALPARC and ECO.

Governance proposals converged toward shared governance (IUCN Type D**), reflecting the distributed nature of responsibilities for maintaining ecological connectivity**. Across pilots, the participatory governance process—centered on the Regional Connectivity Working Group (RCWG)—proved particularly effective in structuring dialogue among authorities, land managers, sectoral agencies and civil society. Although established as a temporary project mechanism, the RCWG demonstrated its potential as a long-term coordination platform, and most pilots recommended its institutionalization to maintain stakeholder engagement beyond the project.

Pilots also consistently distinguished between governance for planning and governance for implementation, emphasizing that designing a GBI network and managing it over time require different constellations of actors, mandates and instruments. This underlines the need for layered and adaptable governance arrangements capable of supporting both strategic spatial planning and day-to-day land-management decisions.

The funding toolbox analysis showed that restoration and long-term connectivity management require different types of instruments. While EU and national/regional programs are vital for the start-up phase, long-term continuity depends on mechanisms such as agri-environmental measures, stewardship funds and emerging PES and carbon-based schemes. Combining multiple funding sources across phases is essential to ensure that connectivity measures endure.

Overall, the case studies validate the project's hypothesis: the Alpine-wide connectivity scenario can guide regional and local planning systems, but only when supported by integrated GBI mapping, collaborative governance, and diversified funding. The pilots provide a transferable model for embedding ecological connectivity into statutory planning and sectoral policies, reinforcing the resilience of Alpine ecosystems in the face of climate change and land-use pressures.

4 EUSALP Macro-regional Recommendations for Ecological Connectivity

he *EUSALP Joint Paper on Spatial Planning* (JPSP) calls for a common spatial development perspective for the Alpine Region, emphasizing transnational coordination, the strengthening of green and blue infrastructure, and harmonized approaches to spatial planning across borders. PlanToConnect directly contributed to these objectives by providing the first operational, Alpine-wide model of ecological connectivity and by illustrating how shared methodologies, governance platforms and protected-area networks can function as the backbone of a macro-regional ecological network.

The results of EURAC Alpine wide connectivity scenario and the ALPARC and ECO pilots—combined with the principles of the *EUSALP Joint Paper on Spatial Planning* (JPSP) —highlight several strategic directions for advancing ecological connectivity at macro-regional level. These recommendations build on evidence from PlanToConnect and offer guidance for future policy development, spatial-planning coordination and implementation mechanisms across the EUSALP area.

1. Recognize ecological connectivity as a macro-regional spatial-planning priority

Future updates of the EUSALP Spatial Perspective should explicitly designate ecological connectivity as a cross-cutting priority, equivalent to mobility, energy and climate adaptation. The Alpine-wide connectivity scenario developed under PlanToConnect provides an immediate reference model. Integrating GBI mapping and priority ecosystem services—such as flood regulation, water purification, carbon sequestration or soil protection—would reinforce the multifunctional value of these corridors, linking ecological networks to wider territorial resilience.

2. Establish a Macro-regional Connectivity Coordination Platform

Hosted by EUSALP AG7 but linked to other Action Groups, this platform would support:

- harmonized mapping standards, including *both structural connectivity and ecosystem-service layers*,
- transnational monitoring of connectivity condition and ecosystem-service provision,
- cross-border planning pilots,
- coordination between ALPARC, AGs and Alpine Convention Working Groups on topics of Biodiversity, multifunctionality, TEN-N, TEN-T, climate resilience and spatial planning

This approach reflects the lesson that **functional and structural assessments together** provide stronger evidence for coordinated planning at macro-regional level.

3. Systematically involve protected areas as macro-regional governance anchors

Protected areas and Natura 2000 sites should be officially integrated into macro-regional planning processes as key nodes anchoring the ecological network.

4. Develop a shared methodology for monitoring ecological connectivity and ecosystem services

A macro-regional monitoring system is currently missing. A shared methodology should track:

- structural connectivity,
- functional connectivity (species and ecological processes)
- priority ecosystem services linked to GBI in the alpine wide connectivity areas (e.g. flood mitigation, pollination, carbon storage, recreation),
- pressures and fragmentation trends in priority connectivity areas of the Alpine Wide Connectivity scenario proposed by PlanToConnect.

This would support evidence-based decision-making, cohesion across national systems and JPSP implementation.

.5. Encourage voluntary corridor agreements across national borders

Inspired by ECO, voluntary corridor agreements should be promoted across the EUSALP area as operational tools to align planning decisions. These agreements could explicitly include **ecosystem-service commitments** (e.g., maintaining riparian buffers for flood mitigation, sustaining agro-ecological elements for pollination, preserving cultural landscapes), making corridors relevant beyond biodiversity policy alone.

6. Promote biosphere reserves and transboundary protected areas as long-term institutional umbrellas

UNESCO MAB sites and transboundary parks can ensure governance continuity beyond project cycles. Because these frameworks recognize ecological and socio-economic functions, they are ideal containers for maintaining GBI elements that deliver ecosystem services at landscape scale.

7. Link ecological connectivity with climate adaptation and risk management strategies

Connectivity should be framed as a **nature-based solution** supporting:

- flood regulation,
- slope stability and erosion control,
- forest resilience,
- groundwater recharge,
- heat mitigation in valley floors.

This positioning increases its relevance within the macro-regional priorities identified by the JPSP

8. Integrate GBI and ecosystem service evidence into macro-regional funding strategies

Future Alpine-wide funding programs (Interreg Alpine Space and other interreg cross-border programs) should incorporate criteria that priorities:

- restoration measures in multifunctional GBI areas,
- actions that simultaneously enhance connectivity and ecosystem-service provision,
- cross-border investments producing shared ecological and socio-economic benefits.

The PlanToConnect experience shows that **ecosystem-service evidence strengthens the strategic relevance** of connectivity investments and supports multi-sector financing approaches.

5 Case study factsheets

This chapter is a compilation of case studies demonstrating integrated spatial planning approaches for the development of GBI networks for connectivity …

Case Study	Alpine wide	Cross-Border	Regional / Provincial	Inter-municipal	local
Physical mapping					
4.1.1 - Strengthening Ecological Connectivity Across the Alps: Spatial Planning Strategies for an Integrated Alpine Network (ALPARC – the Network of Alpine Protected Areas)	x				
4.1.2 - Ecological connectivity in South Tyrol (EURAC research)			x		
4.1.3 - International collaboration at trilateral pilot site in Austria, Italy, Slovenia (E.C.O. Institute of Ecology Ltd.)		x		x	
4.1.4 - Goriška Statistical Region (Urban Planning Institute of the Republic of Slovenia)			x	x	
4.1.5 - Overcoming Fragmentation: Building a Green Infrastructure Connectivity Network crossing the Iller River Valley (Ifuplan – Institute for Environmental Planning and Spatial Development)					
4.1.6 - Mainstreaming Ecological Connectivity Around Lake Annecy: A Pilot area as an example for Spatial Planning Integration (Asters, organization for the conservation of natural areas in Upper Savoy)				x	x
4.1.7 - Ecological connectivity in Tennengau and Flachgau regions (Salzburg, Austria) (SIR - Salzburg Institute for Regional Planning and Housing)			x		

Case Study	Alpine wide	Cross-Border	Regional / Provincial	Inter-municipal	local
Strengthening the Ecological Network in the Oberland Planning Region: Integrating Green Infrastructure into Regional Planning (JMU - University of Würzburg)			x		
Ecosystem Service based mapping					
Multifunctional GBI for the Province of Sondrio. Regional and local corridors driving the transnational ecological (re)connection (Fondazione Politecnico di Milano)			x		x
Strengthening Ecological Connectivity in the Caorle Lagoon Wetland System: Restoring Nature and Landscape through Shared Governance in the Caorle Wetlands (Veneto Region))				x	x

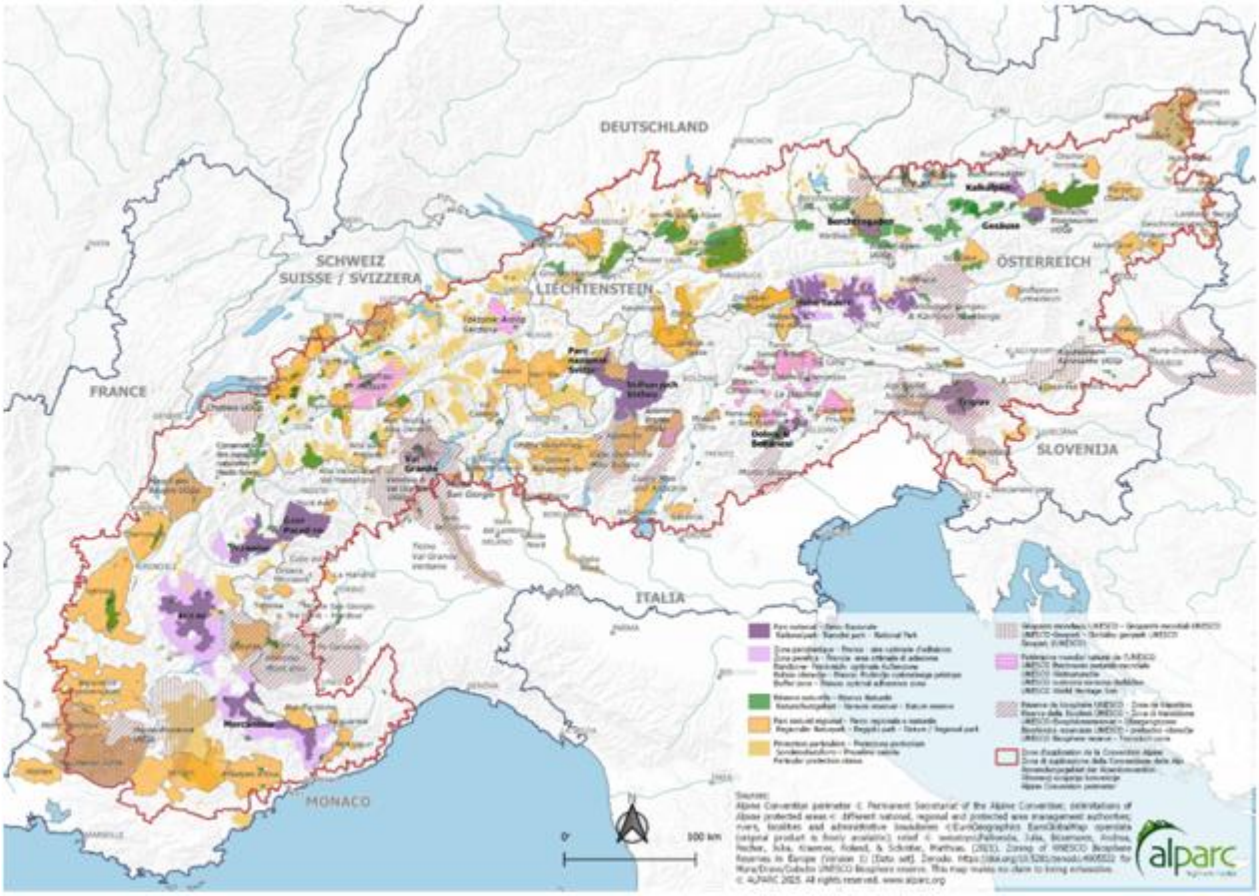
5.1 Physical mapping

5.1.1 Spatial Planning Strategies for an Integrated Alpine Network

ALPARC – the Network of Alpine Protected Areas

Why act here? - "Ecological connectivity in the Alpine space"

Ecological connectivity in the Alpine space is threatened by urban sprawl, land-use changes, infrastructure development, agricultural intensification and other anthropogenic driven factors having major implications on habitat fragmentation and creating obstacles for species movement. Alpine Protected Areas as the core zones of the ecological network cover nearly 58 581 km² within the Alpine Convention perimeter, nevertheless this coverage alone cannot allow to maintain biodiversity and sustain ecological connectivity.



About the possible land use conflicts, road infrastructure and urbanisation are the major drivers of landscape fragmentation, the development of renewable energy sources (particularly solar and wind power) is expanding within Alpine space. It is essential to establish continuous monitoring systems to track their evolution and assess their impact on the landscape and ecological connectivity.

Case study objectives

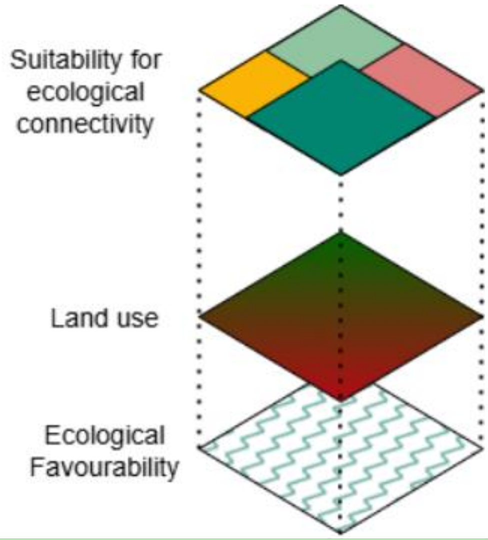
The identification and conservation of *Potential planning areas for biodiversity protection along with the corridors linking them, are strategic to prevent and reduce the effects of these threats as well as to achieve the Biodiversity COP15 30x30 goal, avoid habitat isolation within the Alps and ensure the connections with other mountain ranges.

The case study aims to identify the major barriers and threats to ecological connectivity, to provide tools and strategic recommendations for enhancing the development of a coherent connectivity network, with a focus on areas with a high value for biodiversity conservation within the Alps.

**Potential Planning Areas for Biodiversity Protection: spatial planning proposal of protected areas, distributed in nine categories combining the criteria of low fragmentation, low spatial development, and a high level of ecological favourability. (Alpine Parks 2030, ALPARC)*

Methodological approach

The Alpine space case study focuses on proposing actions to improve ecological connectivity between areas with a low level of spatial development, with favourable conditions for ecological connectivity. The proposal for implementation of actions was mapped and represented in four categories assessing the ecological value and the land use alignment with ecological connectivity.
The mapping is based on structural connectivity approach and is focused on identifying suitable landscapes, large continuities with high biodiversity value and interconnecting Alpine-wide corridors.

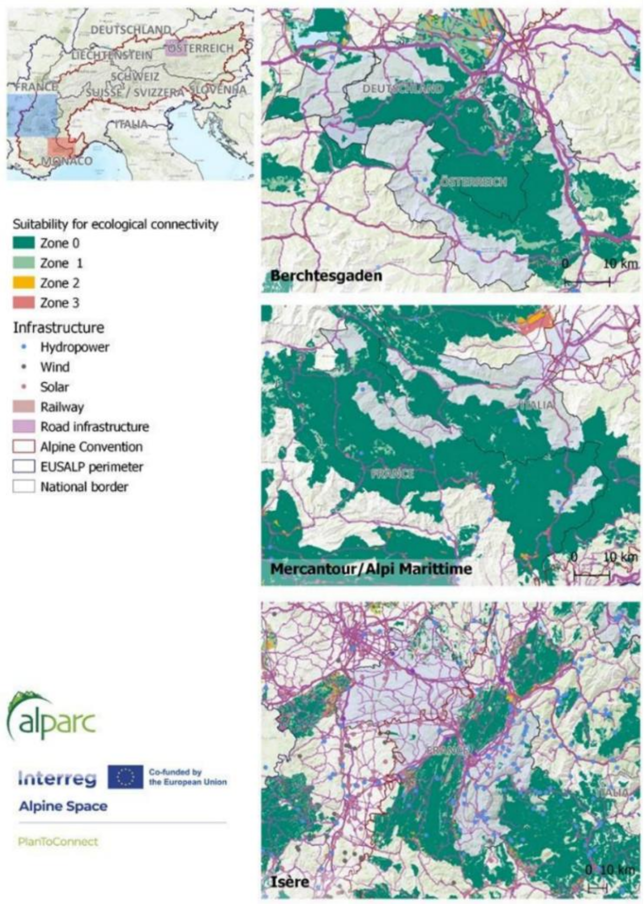


Pilot design

The zoning proposal is presented in 4 categories of suitability for ecological connectivity. The suitability for the zone 0 will be higher than the category with more challenges to overcome in order to preserve or restore ecological connectivity, zone 4. The distribution by zones allow to differentiate the territorial challenges.

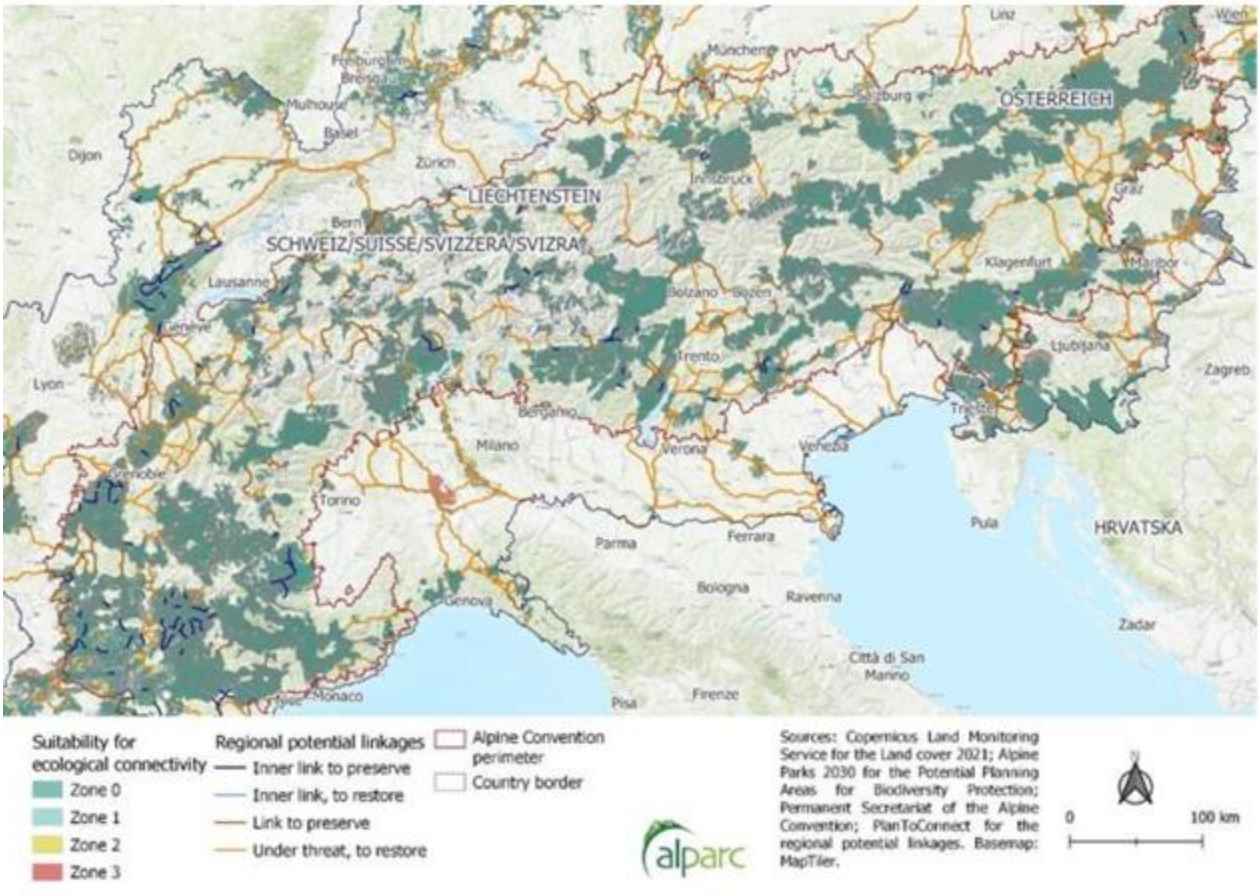
Zones 0 and 1: less modified landscapes, forests, open spaces, scrub and/or herbaceous vegetations associations. These areas have a considerable potential for ecological connectivity, as they represent continuous, large non-fragmented areas beyond the boundaries of the current protected areas.

Zones 2 and 3: landscapes heavily influenced by anthropogenic transformations, including urban areas located near both natural and near-natural areas. This proximity highlights the importance of studying potential future changes and understanding how the landscape



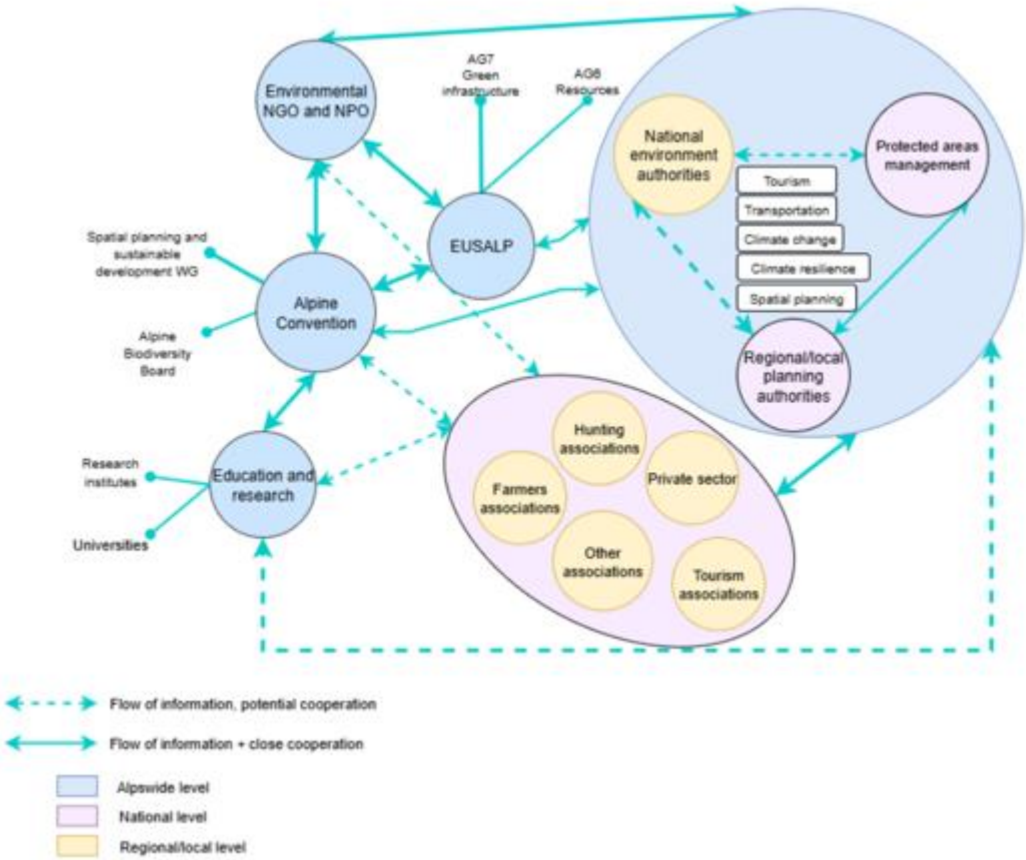
matrix may change over time, particularly if coherent and timely actions to tackle biodiversity loss are implemented.

The analysis highlights the importance of mapping and identifying priority areas to develop targeted actions, spatial planning can allow to achieve transferability from the Alpswide vision to local contexts and into local planning instruments, the zonation and the potential regional linkages are tools addressed to achieve this objective.
Further landscape fragmentation should be avoided, spatial development within territories located on the edges of the Alpine Convention and in proximity to the main Alpine valleys should be monitored.



Governance and stakeholders

The cooperation between EUSALP and the Alpine Convention (Nature protection and landscape conservation protocol - Art 3) facilitates the conceptual alignment of approaches; however, challenges remain in harmonising implementation across the different Alpine countries. The development of a formal GBI concept in the Alpine countries national frameworks is one key step to implementation at the territorial level.



Key messages for planners

Effective biodiversity conservation relies on the implementation of protection and restoration measures in areas valuable for biodiversity. Enhancing ecological connectivity of remaining large continuities and their corridors, identified on the case study, is one aspect required for achieving this goal. Mapping, expert consultation, multi-stakeholder involvement are important tools for raising awareness about the main barriers to ecological connectivity and also for targeting spatial planning actions to prevent fragmentation and build or strengthen regional networks.

Complementary implementation measures

- Strengthen multilevel governance
- Strengthen transectoral cooperation
  - Protected Areas
  - Tourism
  - Transport
  - Spatial planning
  - Agriculture
- Increase stakeholder engagement through participatory planning processes

- Promote data sharing – WebGIS Jecami

Next steps

ALPARC will continue disseminating the results of PlanToConnect among Alpine Protected Areas, relevant working groups of the Alpine Convention and EUSALP, with the aim of advancing on the strategic implementation of ecological connectivity. This will support more coherent and better-coordinated spatial planning across the Alpine space

5.1.2 Towards an ecological network concept for South Tyrol

Eurac Research

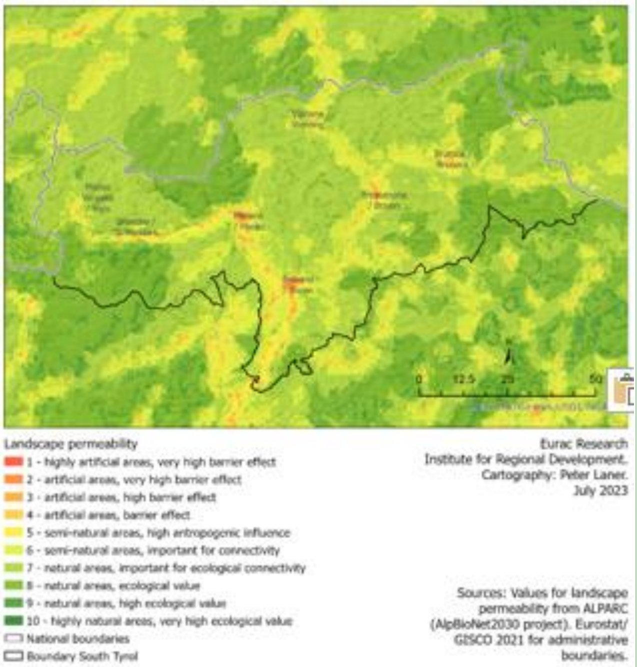
Why act here? — "Ecological connectivity in South Tyrol"

Study area: Autonomous Province of Bolzano - South Tyrol, Italy
Area size: 7.400 km²,
Altitudes: 200 - 3.905 m.a.s.l.
Problems:

- Missing provincial ecological network plan
- Missing connections between mountain slopes on different sides of the valleys.
- Main pressures in the valley bottoms: Urban sprawl, Transport, intensive agriculture

Planning "windows of opportunity" due to changing spatial planning law (since 2020):

- Revision of Provincial Strategic Territorial Plan
- Elaboration of municipal development programs



Picture 1: Barriers in the Adige Valley in South Tyrol

Case study objectives

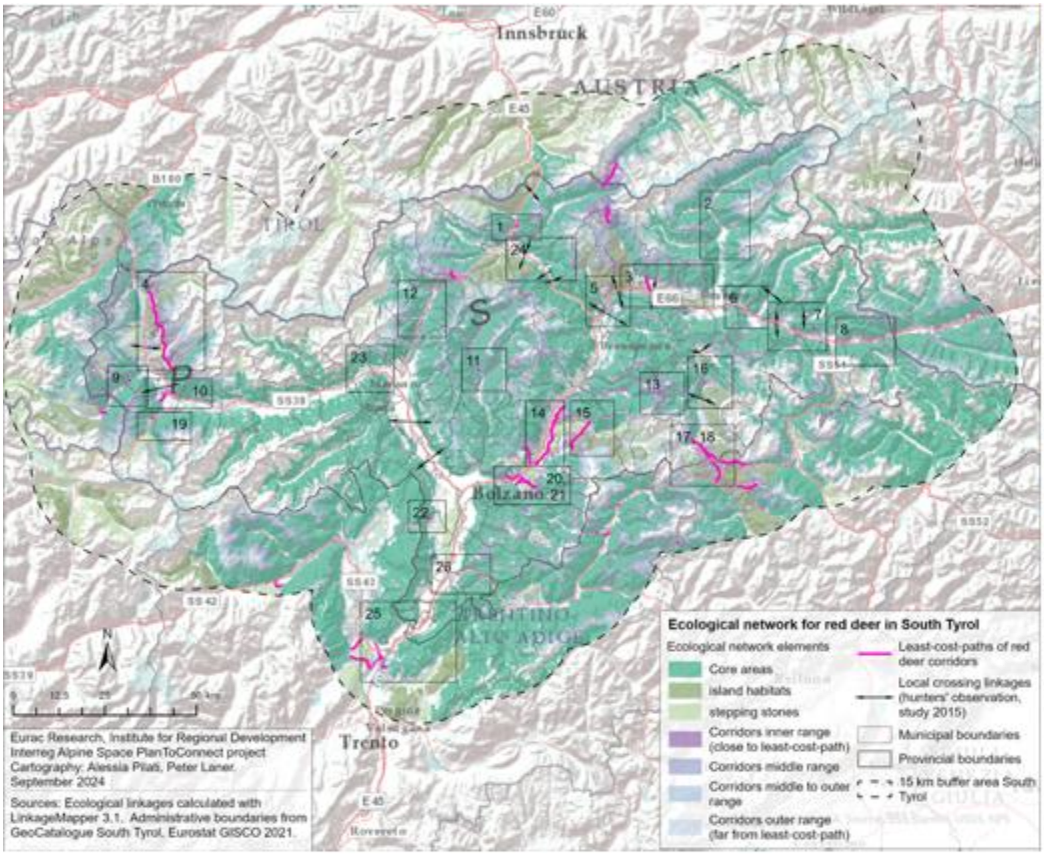
Overall goal:

- identify and protect most threatened existing corridors in the valley bottoms
- restore potential corridors in the valley bottoms of South Tyrol

Tangible output:

- To elaborate a provincial ecological network design for planning authorities (provincial and municipal) and for spatial planning professionals.
- Publish spatial data, which can be used by planners

Methodological approach




Ecological network model for red deer in South Tyrol

Species approach: Red deer ecological network

- Identification of habitat suitability: Land use - land cover, altitude, slope, and distances to roads, motorways, and settlements
- Core areas > 5.000 ha
- The Least cost – path – approach to connect core areas.

Result:

26 focus- areas at local level in valley bottoms, derived from provincial network model

Pilot design

Focus area no° 6, on corridor “Perca – Rasun Anterselva”

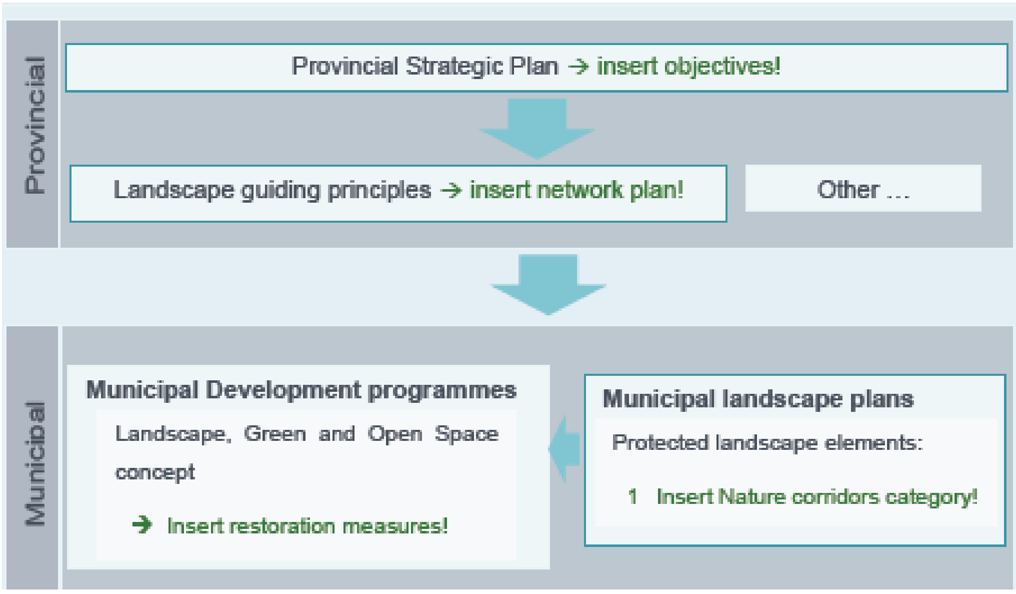
- Important corridor at alpine level, threatened by infrastructure development
- Connection of nature parks *Fanes – Sennes – Braies* with *Vedrette di Ries*
- Movement of wild animals on corridor confirmed

Proposed measures to improve connectivity for red deer on corridor 6:

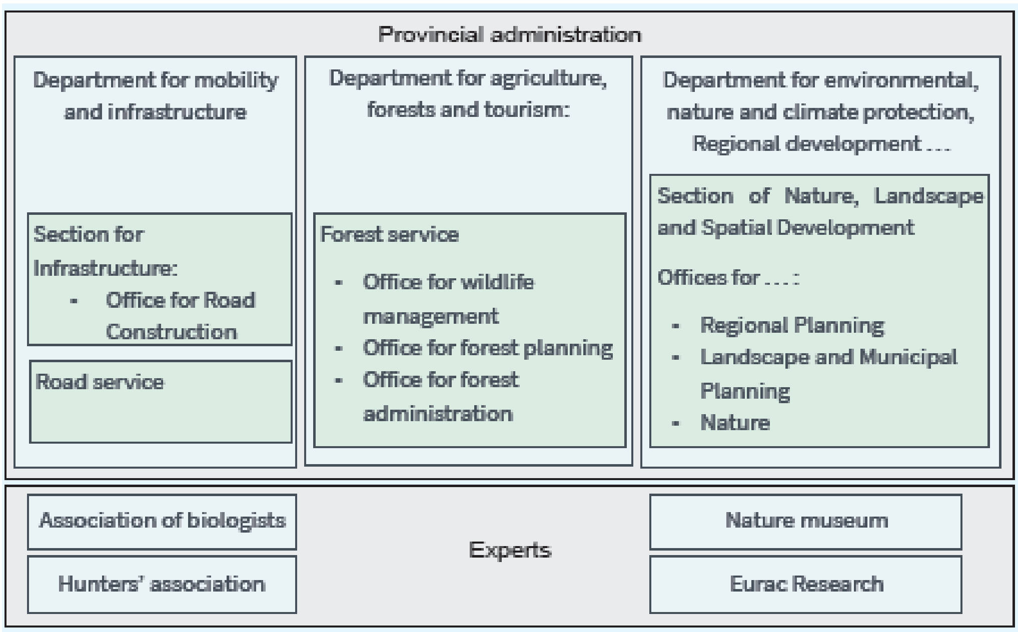
- Evaluate the construction of road overpasses or underpasses
- Protect the corridor in the Landscape Plan
- Add additional linear elements of vegetation cover

From concept to statutory plans

The network model can be used as an input for the Provincial Strategic Plan, and the Provincial Landscape guiding principles at provincial level. At local level it can be used for protection measure in municipal landscape plans and for restoration measures in Municipal Development Programs



Governance and stakeholders



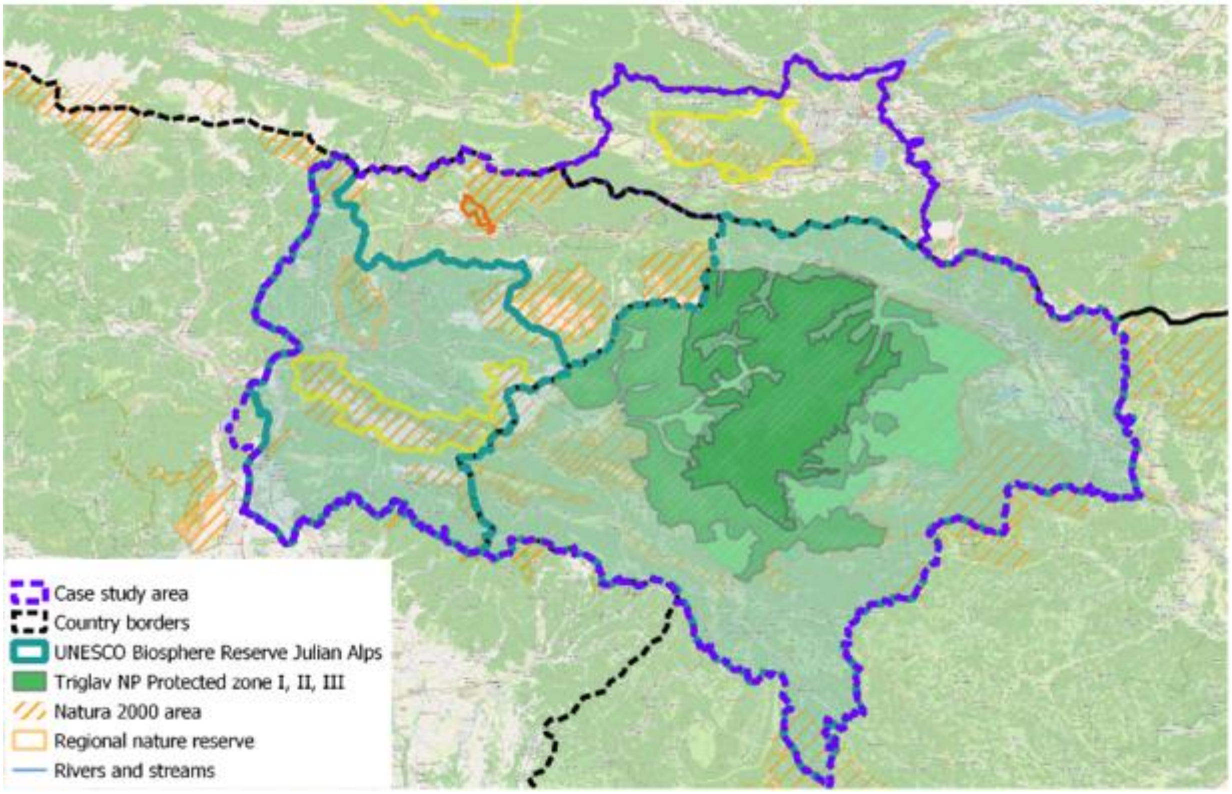
Regional connectivity working group South Tyrol (2022-2025)

Funding toolbox
- Provincial landscape fund   - Environmental compensation payments from power plants: - Rural Development Program   - Private funds. Example “Bee-save” project from regional Bank
Key messages for planners
- Check the method of the model in detail to avoid misinterpretation!   - Go out of the office to check the real situation on the site!   - Talk to provincial administration for clarifications!
Next steps
- Precise delineation and protection of priority corridors in municipal landscape plans.   - Definition of more concrete measures for corridor restoration with provincial administration.   - Implementation of pilot projects with monitoring

5.1.3 International collaboration at trilateral pilot site in Austria, Italy, Slovenia

E.C.O. Institute of Ecology Ltd.)
Why act here? — *"Ecological connectivity in a border area"*

Located at the Austria–Italy–Slovenia border, the 3,555 km² pilot area links the Julian Alps, Karawank Mountains, and Alpine national parks. It covers key protected zones, including Triglav National Park (SI), Prealpi Julie Nature Park (IT), Nature Park Dobratsch (AT), and several Natura 2000 sites. Ecological corridors—especially between the UNESCO Biosphere Reserve Julian Alps and Dobratsch forests—are vital for species migration. Yet, connectivity is threatened by highways, railways, urban sprawl, and intensive land use. Opportunities arise through cross-park cooperation, regional spatial planning in Gorenjska (SI), and local plan revisions in Arnoldstein (AT), enabling green infrastructure integration and stronger future connectivity



Pilot areas with the three parks

Case study objectives

The pilot aims to strengthen ecological connectivity between Triglav National Park, Prealpi Giulie Nature Park, and Dobratsch Nature Park through cross-border collaboration and by tackling barriers to species movement. It focusses on building a shared understanding of the international corridor's importance and on demonstrating how spatial planning can support connectivity. Key outputs include a mapped green infrastructure network, an action plan to reduce development pressures, and proposals to integrate connectivity measures into regional and municipal spatial plans and related planning documents.

Methodological approach

In the pilot region, key connectivity areas and corridors were identified using GIS-based modelling and least-cost path analysis, supported by the Alpine-wide Structural Connectivity Model, which was scaled down and compared with national ecological corridor data. The analysis integrated CORINE Land Cover (2018) for protected areas including Natura 2000 sites.

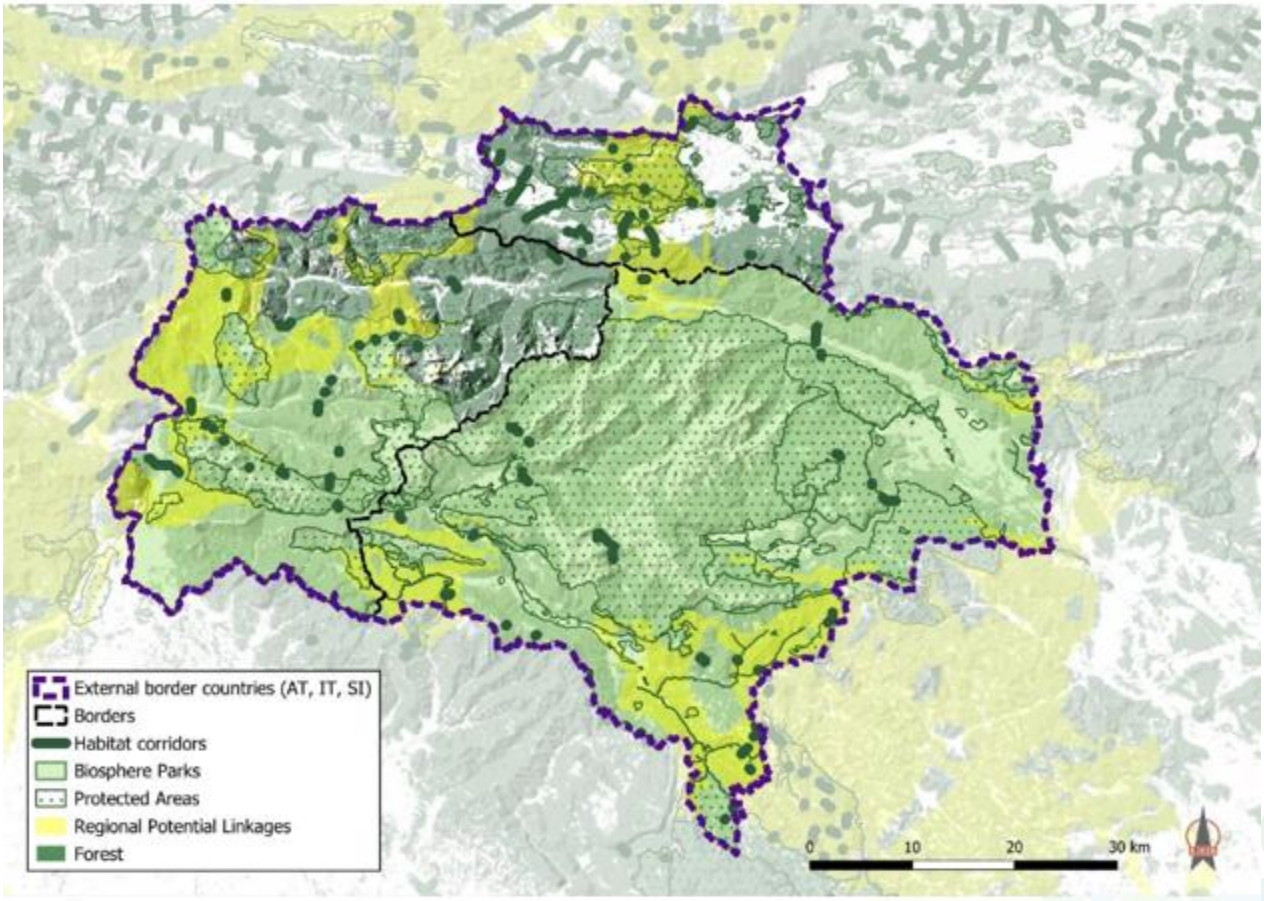


Figure 2: Green infrastructue in the pilot site (harmonized data)

one important international corridor was identified and analyzed more in detail. Stakeholder consultations and intersectoral workshops were held in the pilot region to verify the permeability within the corridor and to elaborate ideas for international collaboration and local integration of GBI into spatial plans.

Figure 3: Modelled Corridors, Protected Areas, Bottlenecks and Barriers (marked in red) in the Pilot Area)

Pilot design

The spatial analysis in the pilot area was designed to support informed decision-making in spatial planning. After a systematic review of national and regional legislation relevant spatial data, land use, infrastructure, protected areas and ecological features were processed in QGIS to produce thematic maps. These maps visualized pressures and threats reported by members of the transnational regional connectivity working group. The results offer planners a structured overview of vulnerable areas that should be considered in spatial plans at different level.
The concept of ecological connectivity is not yet present in the planning documents of the three states and international harmonizing spatial planning goals have not yet been implemented. The pilot study addresses potential entry points at the international, regional, and local scale.

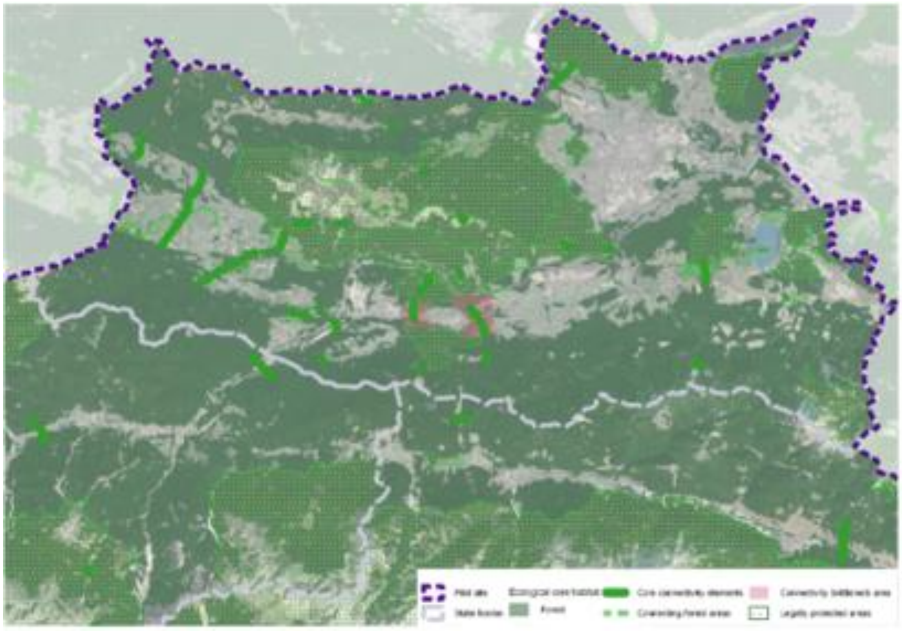


Figure 4:Detail of the corridor area in the border triangle with the bottleneck in the lower Gail valley (marked in red).

From concept to statutory plans

Planning tier	GBI integration measures
International	With no international planning structures, a formal framework is needed. Options include: (1) an international Corridor Agreement signed by national, regional authorities, the three parks, and border municipalities; (2) a European Grouping of Territorial Cooperation (EGTC) focused on connectivity; or (3) creating a Biosphere Park Component in Austria via a Dobratsch feasibility study.
National/Federal	Establishing alpine-wide ecological corridors in the spatial development strategies of the three countries.
Regional	Establishing strategic protected areas within corridors, integrating GBI in Regional Spatial Plans (SI, IT) and establishing a Biosphere Reserve Dobratsch. Enlarging the Italian component with border communities and revising zoning.
Sub-regional and inter-municipal	The existing park (Nature Park Dobratsch) and the bilateral UNESCO Biosphere Reserve Julian Alp do not have a planning mandate but can take up a role in the coordination of their member municipalities and in the formulation of regional nature conservation goals.
Municipal	Municipal development and land-use plans exist in all three countries and embed GBI through zoning regulations and protective designations. Forest areas shall be kept and incentives for preserving natural features are provided as subsidies by the sector agriculture in open areas. Pilot actions can be addressed for improving connectivity of specific barriers.

Governance & stakeholder engagement

The coordination structure is led by the three Parks (UNESCO Biosphere Reserve Julian Alps including Triglav National Park and Prealpi Giulie Nature Park and Nature Park Dobratsch) who have a strong interest in collaboration and for maintaining the connectivity working group into the future. They do not have a spatial planning mandate but are entities that follow nature conservation development goals, as well as sustainable tourism development goals within their area. They are also well connected with the respective institutions of their countries (intersectoral) and their member communities (local level). In this respect, they represent nature supportive regulations for regional development that provide guidance for developments in the area.

Transnational workshops with the regional working group (RCWG) are planned for the future. The process promotes dialogue across sectors and scales, enabling integration of ecological connectivity into regional spatial plans and future Interreg or Life projects focused on corridor implementation and landscape-level restoration.

The coordination structure is led by three Parks—UNESCO Biosphere Reserve Julian Alps (including Triglav and Prealpi Giulie Nature Parks) and Nature Park Dobratsch—committed to collaboration and continuing the PlanToConnect regional connectivity working group (RCWG). While lacking spatial planning mandates, they pursue nature conservation and sustainable tourism goals and maintain strong ties with national institutions and local communities. They thus provide guidance for regional development aligned with ecological goals. Future transnational workshops with the RCWG will foster cross-sector dialogue, supporting integration of ecological connectivity into spatial plans and future Interreg or Life projects on corridor implementation and landscape restoration.

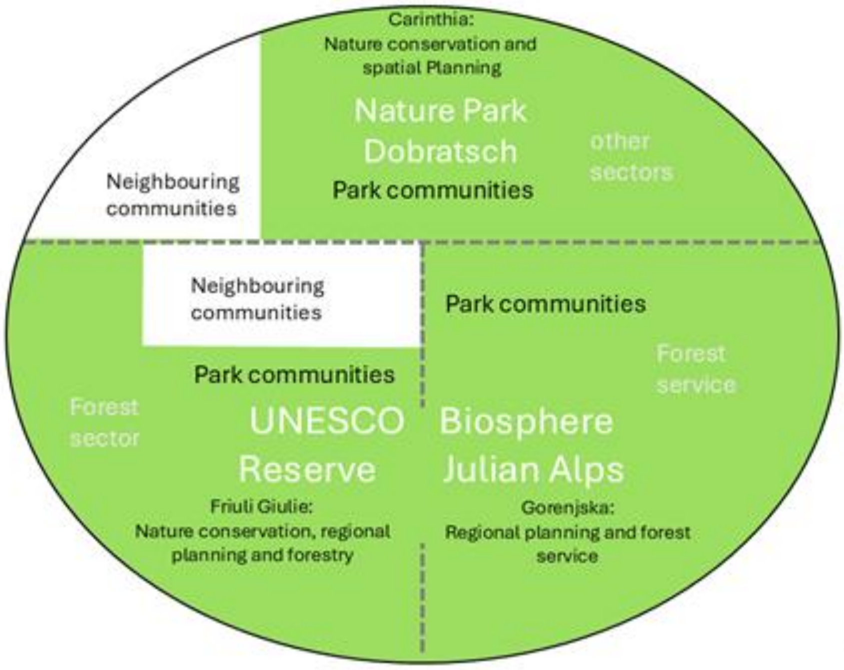


Figure 7: Simplified governance structure in the pilot area for the selected corridor

Funding toolbox

Key funding instruments for implementing ecological connectivity in the international context include EU-level programmes such as the Interreg Alpine Space Programme or Life Projects (with respective target species).

National funds are available for specific measures:

In the Slovenian Rural Development Plan are measures, specifically Measure M10 (agri-environmental and climate measures) and Measure M12 (Natura 2000 and Water Framework Directive payments), that exist for the support of habitat restoration and riparian ecosystem improvements, with prioritisation for farmers in connectivity corridors.

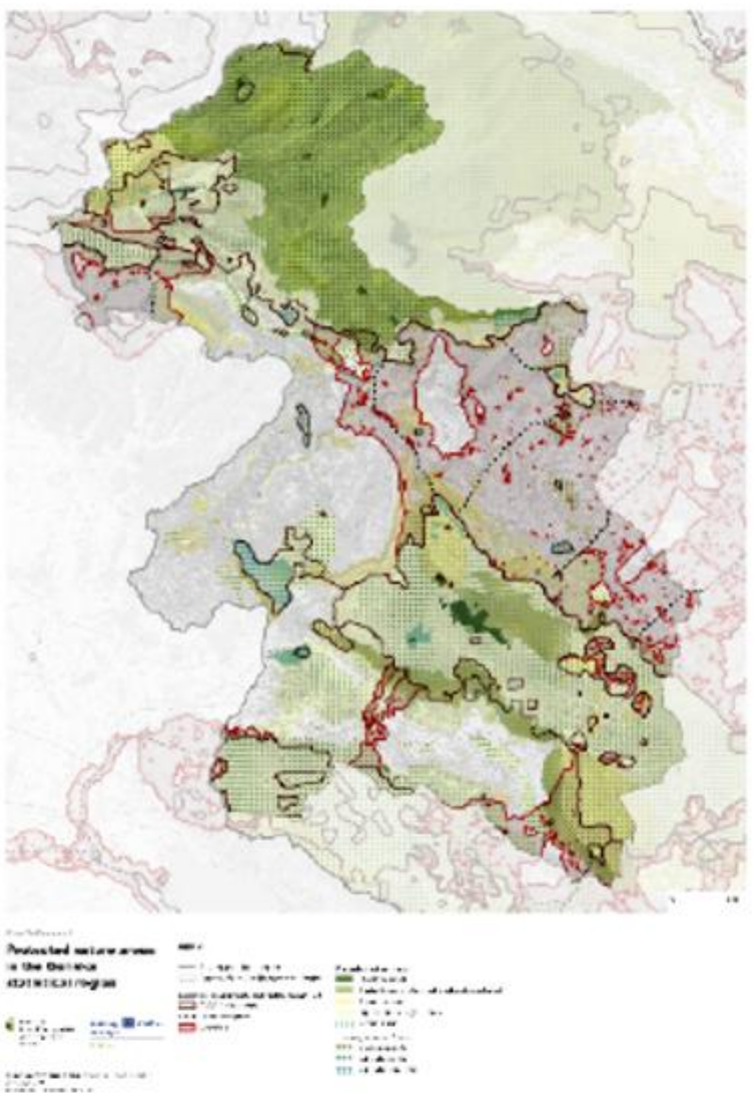
In Austria, the Biodiversity fund offer opportunities for restoring habitats. Agri-environmental schemes are also in place. The Carinthian Spatial Planning Institute offers funding for a landscape module in municipality planning.

Key messages for planners
1. Harmonize relevant or conflicting development across the border by recognizing the international importance of mapped corridors 2. Establish formal collaboration between the three parks as a coordinating entity in regional development planning 3. Integrate mapped corridors and connectivity zones into the spatial plans of each country of the pilot region as part of formal planning layers. 4. Use of detailed municipal spatial plans to secure corridor quality and to implement pilot measures. 5. Align corridor planning with sectoral instruments (e.g. water, agriculture, energy) to ensure cross-sectoral coherence and funding eligibility. 6. Linking spatial analysis to statutory planning tools ensures long-term implementation of green infrastructure.
Next steps / expected impact
Next steps include integrating the corridor into Arnoldstein's spatial plan to protect its narrowest bottleneck from development. In neighbouring countries, barriers will be managed by park administrations. Regionally, a feasibility study will explore upgrading Nature Park Dobratsch to a Biosphere Reserve, assess collaboration options, and draft a corridor agreement, supported by workshops with the RCWG. Formal cooperation among the three parks will strengthen connectivity. In Slovenia, the case study's corridor analysis will guide integration of ecological connectivity into regional spatial plans and municipal instruments.

5.1.4 Goriška Statistical Region

Urban Planning Institute of the Republic of Slovenia

Why act here? — *Ecological connectivity in the Goriška Statistical Region*



Protected natural areas in the Goriška Statistical Region

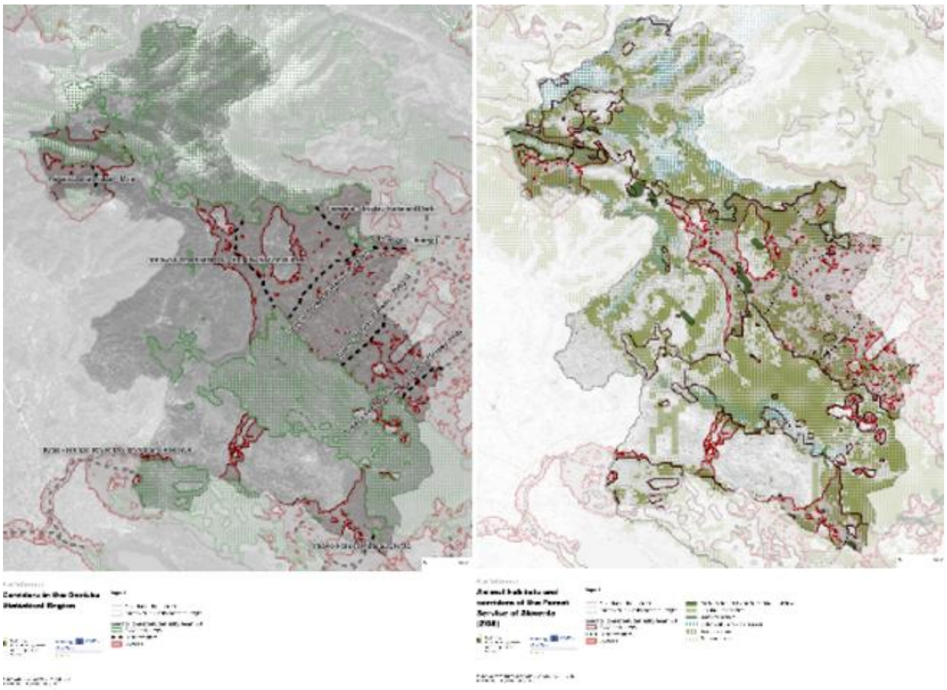
Located in western Slovenia, the Goriška Statistical Region spans 2,325 km² and bridges the Alps and Dinarides. It includes key protected areas such as the Triglav National Park, several Natura 2000 sites, and forest reserves. The region's ecological corridors, especially between the Trnovo Forest Plateau and Triglav, are vital for species migration. However, pressures from urban sprawl, intensive agriculture (notably in the Vipava Valley), and linear infrastructure (e.g. expressways) threaten the connectivity. The ongoing preparation of the regional spatial plan under Slovenia's Spatial Development Strategy 2050 is an opportunity to give more prominence to the topic of ecological networks and connectivity. Potentially, it enables integration of green infrastructure and restoration of fragmented habitats to ensure long-term ecosystem resilience.

Case study objectives

The pilot aims to analyse ecological connectivity between the core areas such as the Triglav National Park, the Trnovo Forest Plateau, and the Karst Plateau, as well as highlight areas where there is a need to reduce fragmentation caused by infrastructure and intensive land use in valley bottoms. It focuses primarily on enhancing structural connectivity to support habitat connectedness and ecosystem resilience. Tangible outputs include a mapped green and blue infrastructure (GBI) network, guidelines on integrating connectivity measures into regional, municipal spatial plans and other planning documents as well as guidelines for mitigating development pressures, such as road network expansion and energy infrastructure development.

Methodological approach

In the Slovenian pilot region, the key connectivity areas and corridors were identified using GIS-based modelling and least-cost path analysis, supported by the Alpine-wide Structural Connectivity Model. This model distinguishes three types of areas: core areas, which are relatively undisturbed natural zones; intervention areas, where biodiversity is degraded and restoration is needed; and support areas, which present possible links between the core areas through semi-natural landscapes. The analysis integrated CORINE Land Cover (2018), the Ministry of Agriculture, Forestry and Food's land use registry (2024), forest function maps, Natura 2000 sites, and data on species movements, including brown bear, red deer, and griffon vulture. Nine corridors were delineated across transnational, inter-regional, and local scales, guiding planning interventions to restore connectivity and reduce fragmentation.



Wildlife habitats and corridors designated by the Slovenian Forest Service (ZGS)

Pilot design

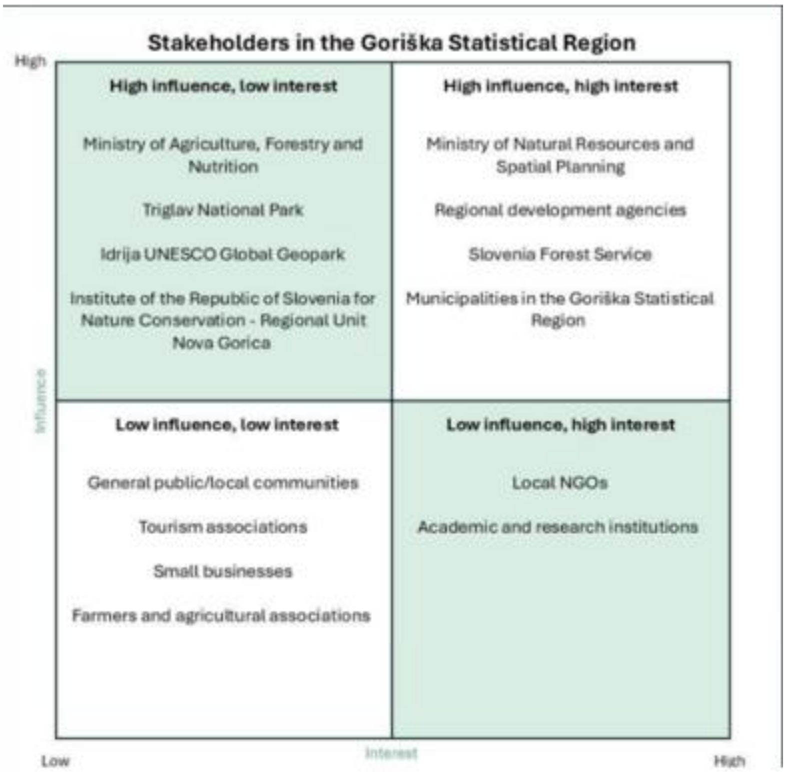
The spatial analysis in the Goriška Statistical Region was designed to support informed decision-making in the process of preparing the regional spatial plan. It began with a systematic review of national, regional, and municipal legislation and development programmes, including the Slovenia’s Spatial Development Strategy 2050 and the Slovenian Spatial Planning Act This was followed by the compilation of relevant spatial data - land use, infrastructure, solar irradiance, and ecological features processed in QGIS to produce thematic maps. These maps visualize pressures and opportunities for renewable energy facilities and transport infrastructure in relation to ecological connectivity. The results offer planners a structured overview of spatial conflicts and mitigation options and can serve as an input for the regional spatial plan. The ecological network design enables the integration of green and blue infrastructure into national, regional and local planning frameworks. The concept of ecological connectivity is not yet present in the Slovenian legal system or planning documents. The case study results thus focus on presenting a potential path for its inclusion at various scales.

Selected corridor from the Trnovo Forest Plateau to Triglav National Park. Detail of the corridor from the Trnovo Forest Plateau to Triglav National Park

From concept to statutory plans

Planning tier	GBI integration measures
Regional	Regional Spatial Plans integrate green and blue infrastructure through strategic mapping of ecological corridors and multifunctional areas. These plans are aligned with the Spatial Development Strategy of Slovenia 2050 and guide cross-municipal coordination and investment priorities.
Sub-regional and inter-municipal	Landscape plans incorporate green and blue infrastructure by identifying ecological functions and spatial pressures at a finer scale. They support targeted restoration, connectivity enhancement, and coordination across natural and administrative boundaries.
Municipal	Municipal land-use plans and building codes embed green and blue infrastructure through zoning regulations, protective designations, and incentives for preserving natural features. Pilot actions can be formalised through detailed spatial plans, enabling implementation of connectivity measures on the ground.

Governance & stakeholder engagement



The coordination structure is led by the Ministry of Natural Resources and Spatial Planning, with support from the Urban Planning Institute of the Republic of Slovenia. A regional connectivity working group includes key actors such as environmental authorities, forestry service, municipalities, farmers, NGOs, and academic institutions. Stakeholder involvement is ensured through co-design workshops, consultations, and thematic events like the Mediterranean Coast Week. The process promotes dialogue across sectors and scales, enabling integration of ecological connectivity into regional spatial plans and future projects focused on corridor implementation and landscape-level restoration.

Funding toolbox

Key funding instruments for implementing ecological connectivity in the Goriška Statistical Region include EU-level programmes such as the Rural Development Plan, specifically Measure M10 (agri-environmental and climate measures) and Measure M12 (Natura 2000 and Water Framework Directive payments). These support habitat restoration and riparian ecosystem improvements, with incentives for farmers in connectivity corridors. At the regional level, the Regional Development Programme 2021–2027 outlines strategic support for renewable energy and green infrastructure. Innovative mechanisms like Payments for Ecosystem Services (PES) and community solar projects are encouraged in municipal energy concepts, especially in the municipalities of Kanal, Tolmin, and Ajdovščina.

Key messages for planners

1. Integrate the expert-proposed mapped corridors and connectivity zones into Regional Spatial Plans as a formal planning layer.
2. Use municipal detailed spatial plans to implement pilot measures.
3. Align corridor planning with sectoral instruments (e.g. water, forestry, agriculture, energy, transport) to ensure cross-sectoral coherence and funding eligibility.
4. Linking spatial analysis to statutory planning tools ensures long-term implementation of green infrastructure.

Key messages for planners

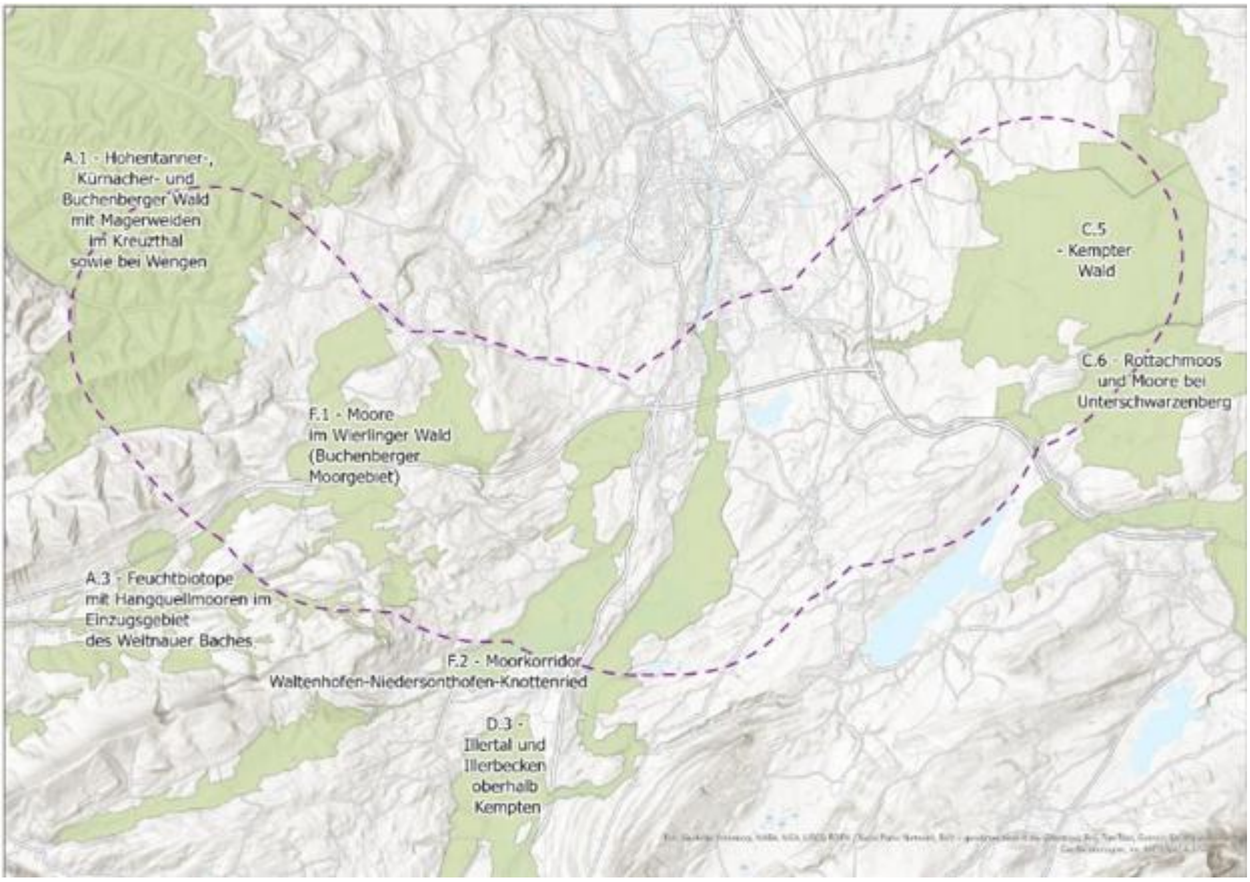
1. Integrate the expert-proposed mapped corridors and connectivity zones into Regional Spatial Plans as a formal planning layer.
2. Use municipal detailed spatial plans to implement pilot measures.
3. Align corridor planning with sectoral instruments (e.g. water, forestry, agriculture, energy, transport) to ensure cross-sectoral coherence and funding eligibility.
4. Linking spatial analysis to statutory planning tools ensures long-term implementation of green infrastructure.

5.1.5 Overcoming Fragmentation: Building a Green Infrastructure Connectivity Network crossing the Iller River Valley

(Ifuplan – Institute for Environmental Planning and Spatial Development)

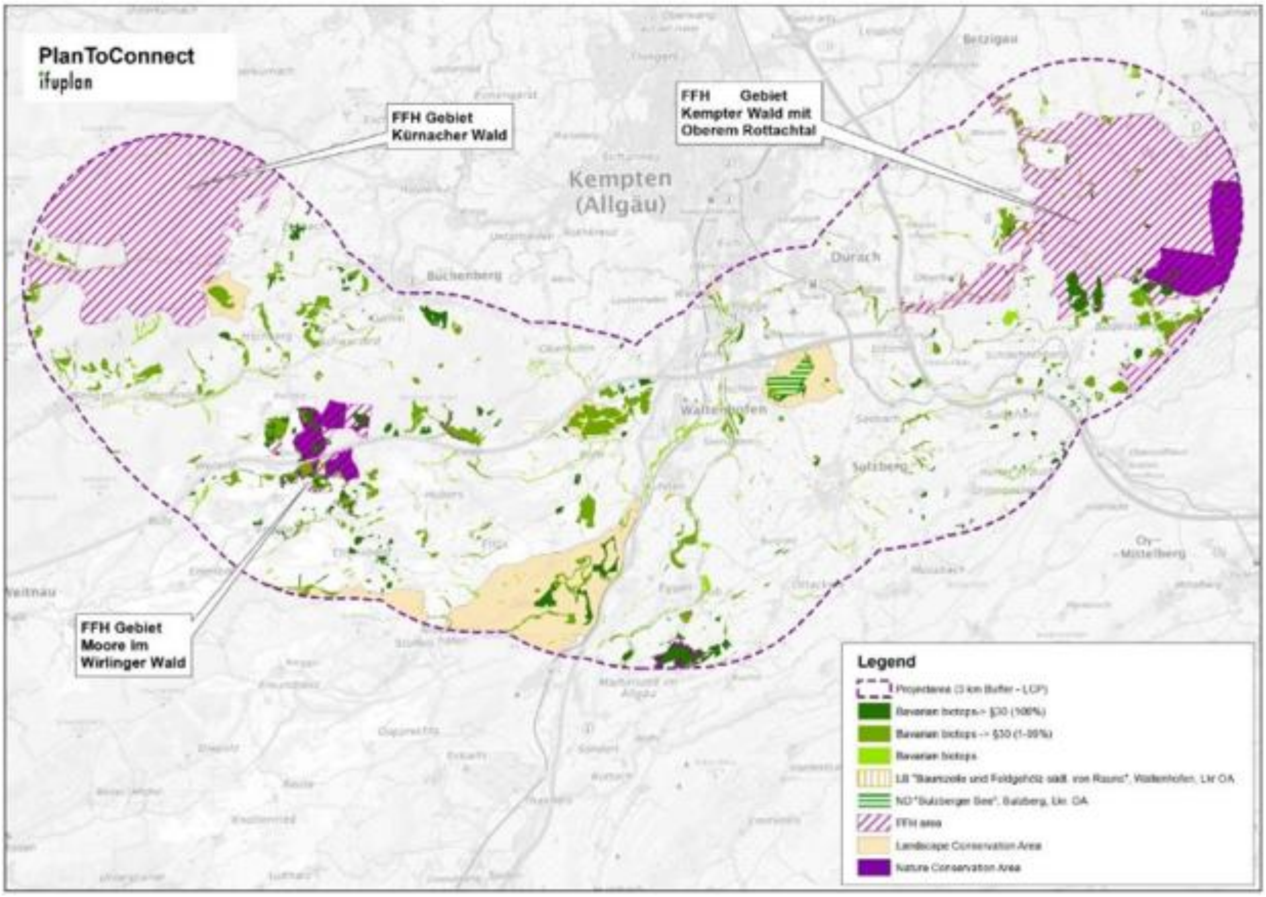
Why act here? — *"Ecological connectivity in the Iller river valley south of Kempten*

The pilot region "Iller valley" is located south of Kempten in the county of Oberallgäu in the southern Bavarian governmental district of Swabia. Its size is 16,000 ha with a total length of 23 km and a width of about 6 km, with elevation ranging from 690 m in the valley floor to 915 m. The area is characterized by a strongly moving and irregular relief of peri-Alpine glacial elements (moraines, molasse hillls).



The Iller river valley cuts through a corridor that – as part of a larger connectivity corridor along the Bavarian Alpine foothills – connects two larger FFH-site on both sides of the Iller valley. Main pressures for connectivity include linear urban sprawl along the Iller river valley that encroaches on remaining settlement gaps, fragmentation through higher-ranking road infrastructure and intensive grassland agriculture.

By 2030, the federal state of Bavaria has committed to establishing a functional network of connected habitats on at least 15% of open landscapes. Consequently, regions such as the mostly non-forested Iller valley will need to initiate a process to enlarge and functionally connect their habitats in the near future.



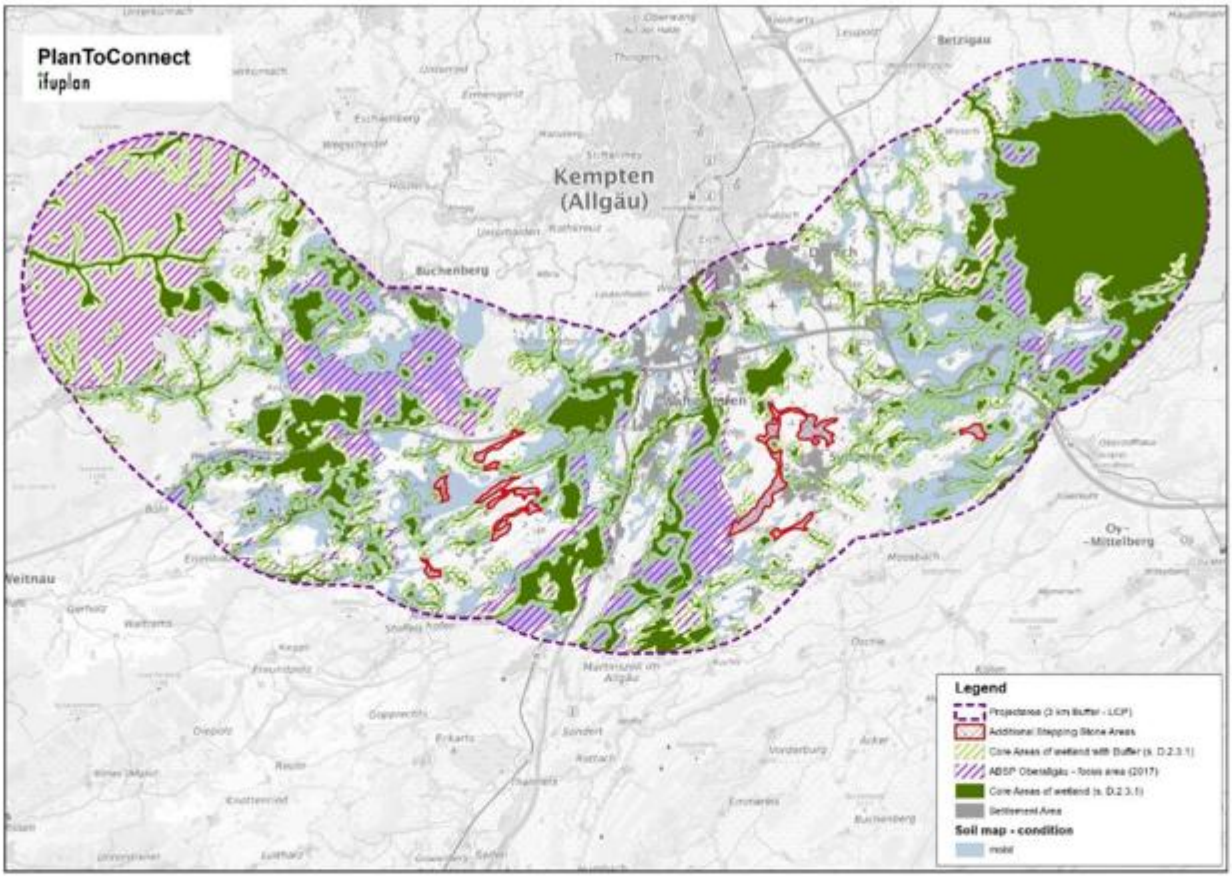
Case study objectives

The objective is to design a network of green infrastructure focusing on creating a semi-open connectivity corridor and to identify priority areas for conservation and restoration efforts (spatially and thematically). These priority areas include enlargements of existing ecological core areas as well as stepping stones in agricultural areas to improve connectivity between habitats. The focus is on improving structural connectivity and rather supporting structural diversity than a necessarily continuous ecological corridor. In the course of the case study, technical foundations for a regional ecological connectivity framework were elaborated and key stakeholders for a governance scheme were sensitized.

Methodological approach

The case study area was derived from the Alpine-wide Structural Connectivity model and represents one of its identified regional linkages. Its delineation is based on a buffer of 3,000 m along the regional linkage between the two FFH-areas.

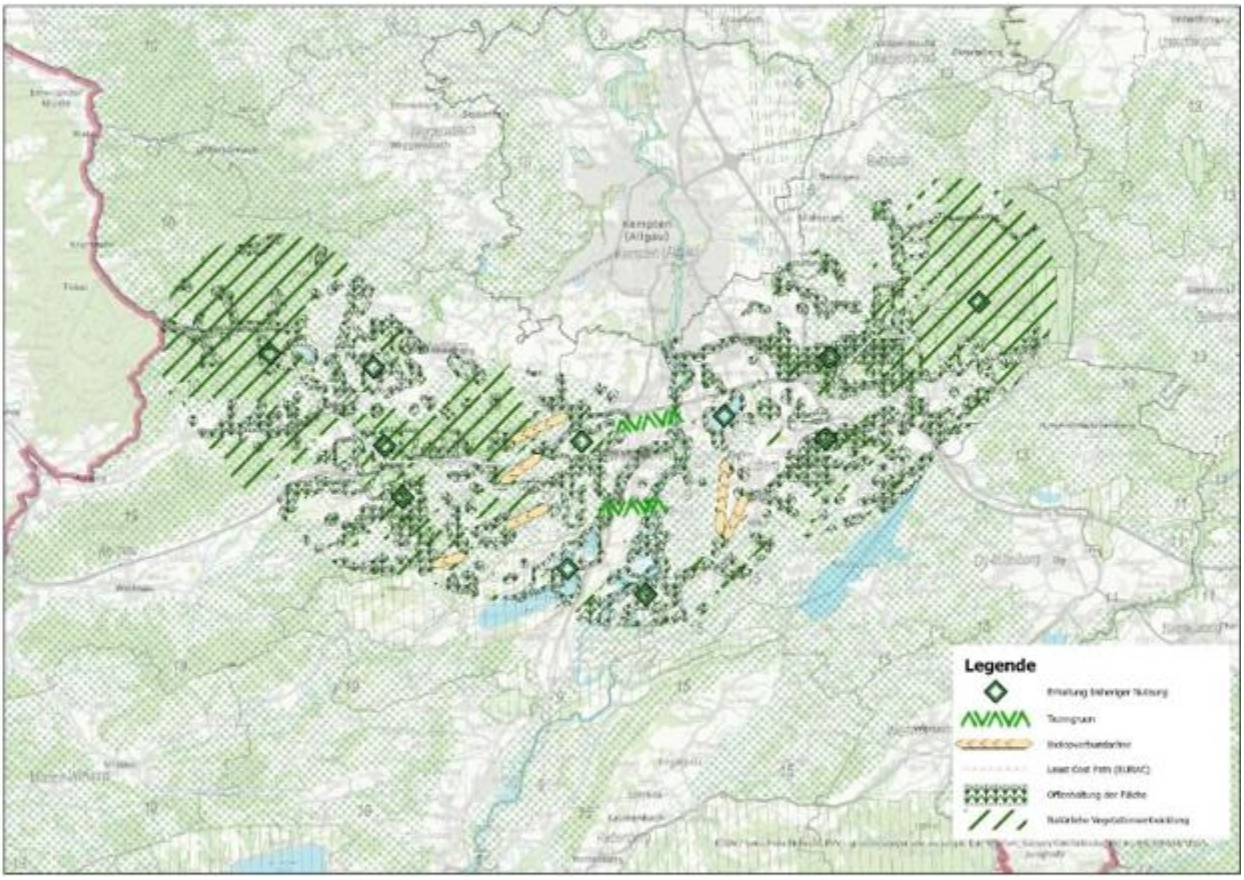
The methodological approach was guided by the federal and national concepts for habitat networks and green infrastructure as well as principles for area-based biodiversity conservation to identify core and expansion areas. Based on a range of regional data on biotopes, protected areas, land use and soil type, GBI elements, objectives for ecological connectivity and barriers within the local-level corridor were identified and analysed. Additionally, a distance analysis of areas of high nature conservation value was conducted to evaluate existing connectivity and consequently formulate recommendations for suitable and unsuitable areas for conservation and restoration.



Pilot design

More than a quarter of the pilot area is under some type of protection status. Of the total pilot area, site conditions qualify roughly 1/6 of the area as core areas, an additional 1/3 as expansion areas and another 1/6 as area suitable for stepping stones.

Key actions include protecting and enlarging core areas, strengthening functional zones with diverse conditions, and creating stepping stones to improve connectivity. Expansion areas are vital, as the small-scale core areas are vulnerable to edge effects like nutrient input and scrub encroachment. Buffer zones enhance resilience to climate change by supporting species exchange and migration. Restoration measures align with the Species and Biotope Protection Plan for Oberallgäu, though this plan currently lacks structured implementation and funding.

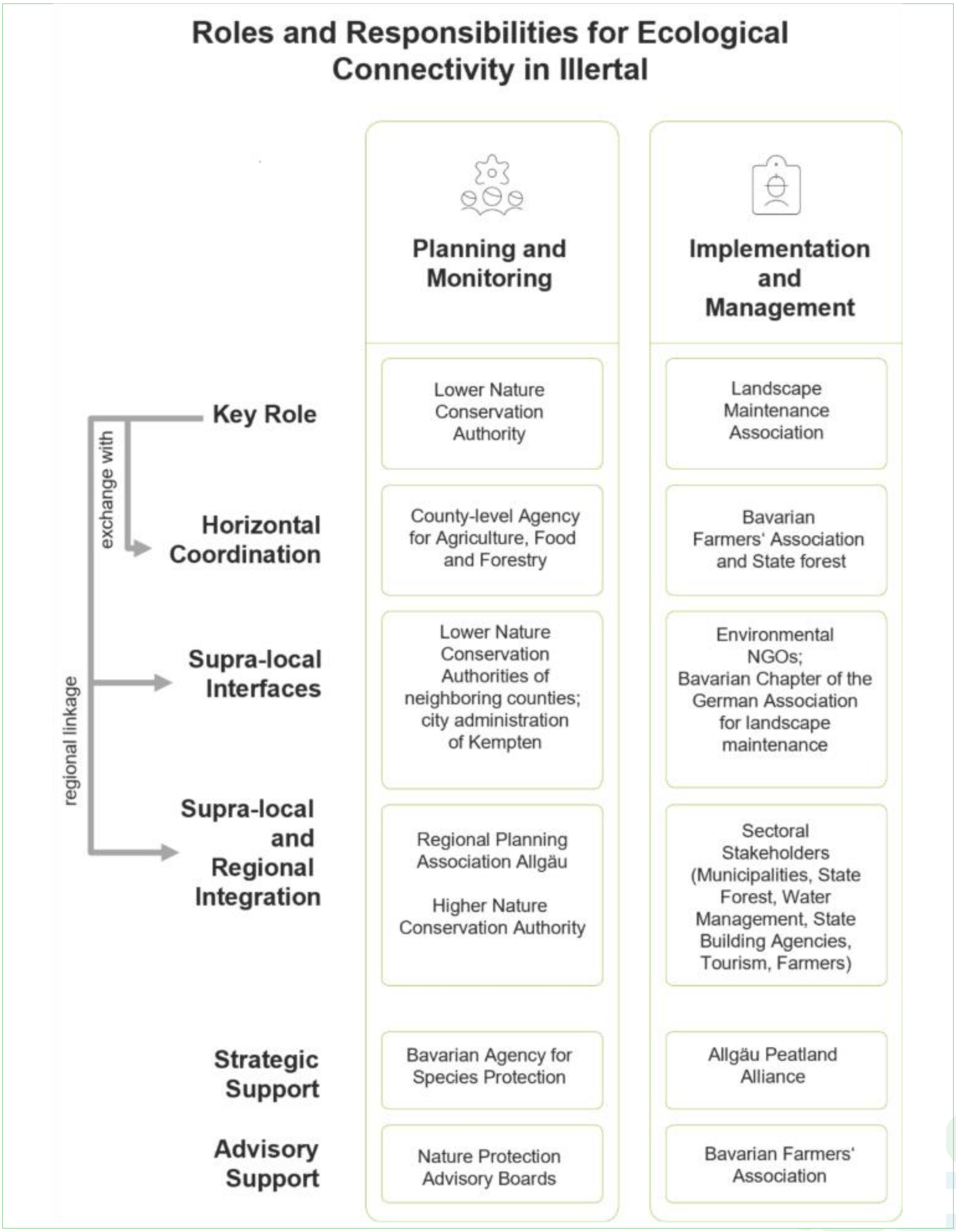


From concept to statutory plans

Planning tier	GBI integration measure
Regional planning level (Regionalplan Allgäu)	Add references for mapping connectivity axes, maintenance measures, and natural vegetation. Strengthen "principles" of biotope network preservation into binding "objectives." Include provisions to protect and enhance stepping-stone areas and classify suitable zones around existing habitats to improve ecological connectivity.
Municipal landscape planning	Draft a harmonised target concept that differentiates areas and structural elements that are either in already good condition (target-conform areas) or which contain valuable elements to be developed or restored (development potential). Updating existing municipal landscape plans with proposals to secure a supra-local green infrastructure network
Municipal land use planning	Delineate habitats and biotopes relevant for connectivity using proposed signatures. Adapt land use plans to promote connectivity under the National Building Law, designating areas for renaturation and ecosystem services. Apply future compensation measures to strengthen local and regional ecological networks and identify suitable compensation sites.

Governance & stakeholder engagement

The proposed coordination structure covers planning/monitoring and implementation/management tasks, relying on existing institutions. The Lower Nature Conservation Authority plays a key role, coordinating with the county Agency for Agriculture, Food and Forestry and relevant agencies in neighboring counties. The Regional Planning Association integrates the ecological network into the Regional Plan Allgäu. Implementation and management are led by the Landscape Maintenance Association Upper Allgäu, which negotiates long-term agreements with farmers on measures, funding, and technical support. Municipalities, public agencies, and environmental NGOs further support implementation within their responsibilities, strengthening regional collaboration for ecological connectivity.

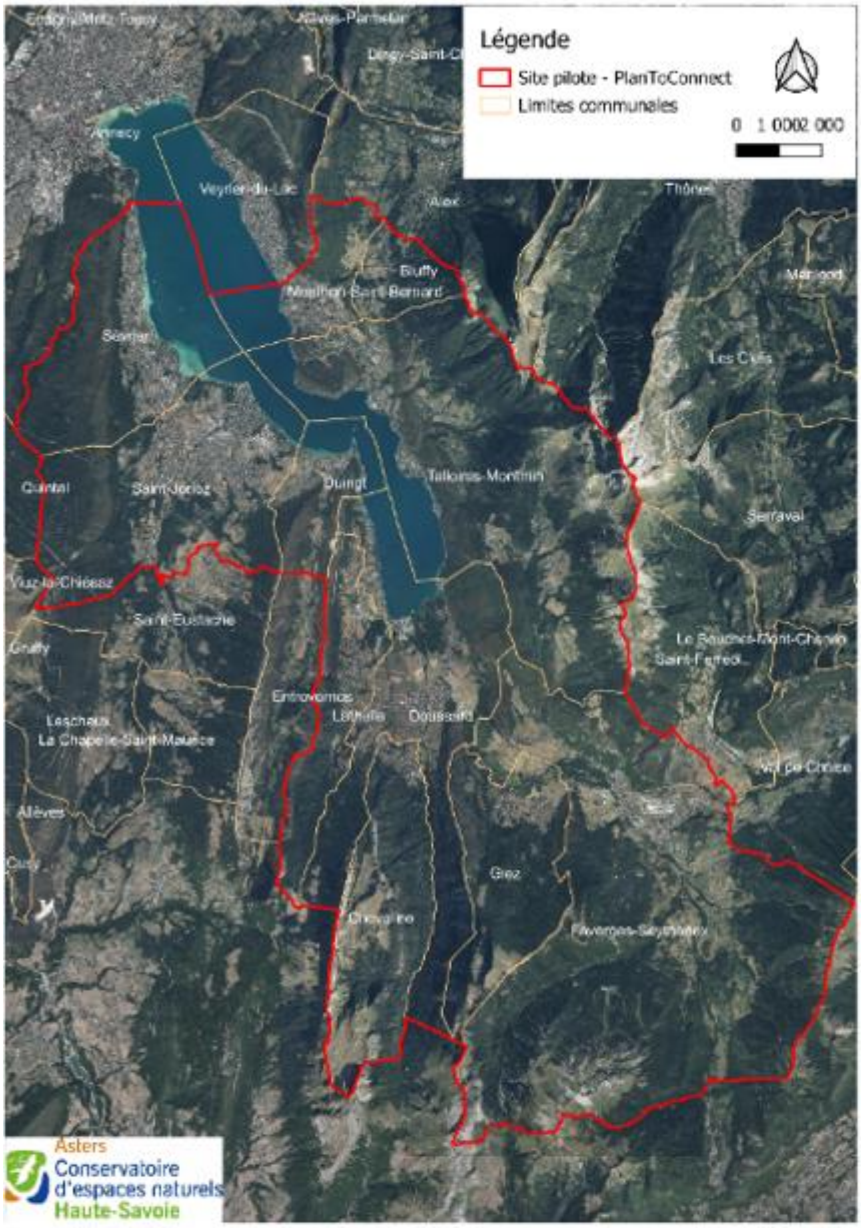

Roles and Responsibilities for Ecological Connectivity in Illertal
Planning and Monitoring
Implementation and Management
Key Role
Horizontal Coordination
Supra-local Interfaces
Supra-local and Regional Integration
Strategic Support
Advisory Support
exchange with
regional linkage
Lower Nature Conservation Authority
Landscape Maintenance Association
County-level Agency for Agriculture, Food and Forestry
Bavarian Farmers' Association and State forest
Lower Nature Conservation Authorities of neighboring counties; city administration of Kempten
Environmental NGOs; Bavarian Chapter of the German Association for landscape maintenance
Regional Planning Association Allgäu
Higher Nature Conservation Authority
Sectoral Stakeholders (Municipalities, State Forest, Water Management, State Building Agencies, Tourism, Farmers)
Bavarian Agency for Species Protection
Allgäu Peatland Alliance
Nature Protection Advisory Boards
Bavarian Farmers' Association

Funding toolbox
Funding opportunities at the European level exist in the form of EFRE-funds 2021-2027 for Bavaria, LIFE Living Natura 2000 Project for Bavaria. At the national level, funds include the Federal Nature Conservation Fund, which combines the existing programmes Federal Biological Diversity Programme, Germany's Blue Belt Programme, chance.natur and testing and development projects as well as the Wilderness Fund and the new National Species Recovery Programme. At federal state level, funding opportunities include the Bavarian Contractual Nature Conservation Programme, the Rural Development Programme, Landscape Conservation and Nature Parks Funding, and the Bavarian Nature Protection Fund.
Key messages for planners
Based on the case study, the following conclusions can be drawn: For the promotion of ecological connectivity, increasing the general structural diversity in our landscapes a more feasible and realistic approach than the creation of seamlessly continuous ecological corridors. Ecological connectivity depends strongly on land-use outside of protected areas. Therefore, reliable and long-term arrangements with land users, most notably farmers, are of crucial importance. Existing spatial planning instruments are not applied to a sufficient degree to support ecological connectivity. Nonetheless, the capacity of current spatial planning tools to influence land use remain limited and requires a much stronger integration with effective funding mechanisms to have a tangible impact.
Next steps / expected impact
By the end of 2025, a proposal for a state-wide Biotope Network System will be made public that includes sites for expanding and closing gaps in the existing biotope network. Additionally, the Nature Restoration Plans and their national and federal-level implementation will create tailwinds for the preparatory work on ecological connectivity for the Iller valley conducted in PlanToConnect.

5.1.6 Mainstreaming Ecological Connectivity Around Lake Annecy

Asters, organization for the conservation of natural areas in Upper Savoy

Why act here? — *“Ecological connectivity in the south lake of Annecy”*



Location of the pilot site

Asters CEN74 conducted a case study on the South of Lake Annecy to improve the consideration of ecological connectivity in the central and southern parts of Lake Annecy.

The main issues in the pilot site is the presence of major natural areas with rich biodiversity surrounded by urban areas and an anthropic great lake that can create barriers and even insulating effects on some sites. Poor connectivity of corridors can be caused by urban sprawling, downgrading of agricultural and natural lands into urban one in local urban planning and an increase of road users.

Several urban planning documents were elaborated during the passing years for which we analysed the outcomes to incorporate methods inspired from the pilot site.

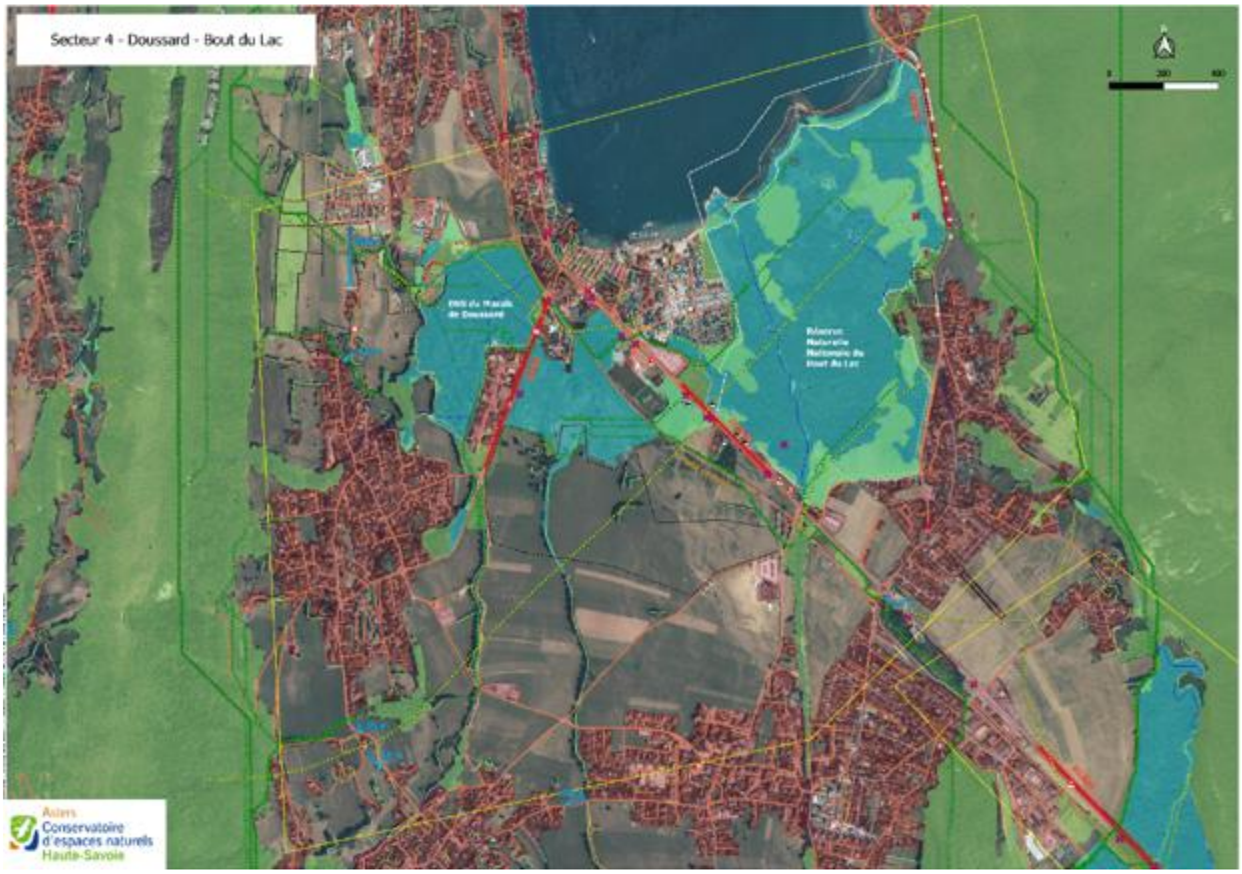
Case study objectives

The pilot site faces an administrative boundary between the Urban Community of Great Annecy and the Source du Lac's Council of Community. The purpose of the study was to harmonise local planning between these two distinctive organisations by creating urban planning tools, grid of understanding, raise awareness on the topic towards local councillors, etc…

Methodological approach

The regional planning document (SRADDET) is already well composed with main regional corridors. However, at a smaller scale such as the one of our pilot site, mapping local corridors could help to adapt spatial planning to each local specificity. We used the software Graphab to model possible paths of local corridors within the territory by using different grading of permeability.

The outcome of modelling was to assess if local corridors needed to be maintained, protected or restored. We also forecasted to use them as a tool for decision makers and planners to identify more precisely places where corridors are located and what are the potential issues of their functioning in the territory.



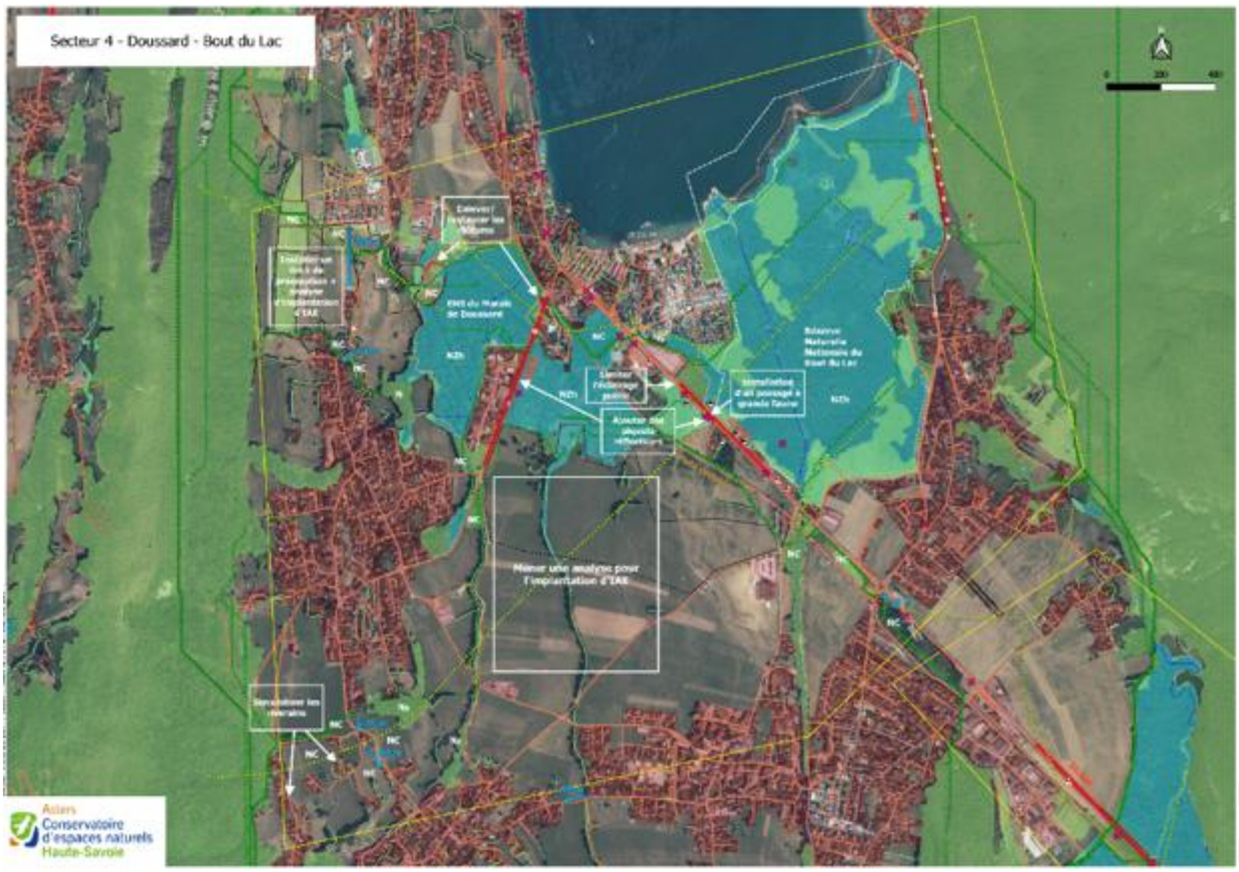
Pilot design

The South of lake Annecy plays a strategic role by its geographic position for local to regional connectivity. The lake can represent a natural structural barrier for some terrestrial species and urban areas are narrowing the possible paths in an East/West direction from one mountain range to another. It leads to few but very important corridors at a local scale to be maintained into a functioning state.

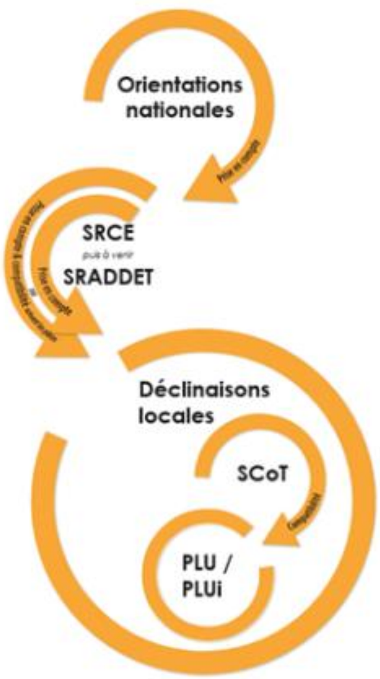
Several local measures could be implemented to improve local connectivity such as:

- Applying road traffic regulations in favour of local corridors (warning signs, speed limits, etc.),
- Set up infrastructures around roads (under or overpass, removal of guardrail, etc.),
- Reduce local obstacles (fences, walls, etc.)
- Restore green and blue infrastructures (plant hedges, create ponds, etc.)
- Managed local sites with environmental reasoning methods (mowing, scheduled of maintenance, etc.)
- Clearly identify and protect corridors into local urban plans

The map shows in white different measures that could be implemented in this territory, based on local council ideas.



From concept to statutory plans



In France, green and blue infrastructures are well considered in urban planning due to a national impulse from the Environmental ministry in 2007. This project allows to create a national scale mapping analysis of corridors that is mandatory to use in urban planning documents. It frames urban rules and gives legal boundaries for local connectivity toward urban plans at different scales.

Source : Environnement paysage, 2018

Governance & stakeholder engagement

We wanted to include the majority of local actors concerned by local connectivity to better understand spatial and social dynamics around the territory and to receive feedback on local use of the territory.

Main local actors were:

- Local council community,
- State institutions (Department, municipalities, Agriculture agency, forest agency, Regional Park, environmental conservatory, etc…)
- State representatives within the territory (DDT)
- Local associations (environmental protection, hunters, water institutions, etc…)

Funding toolbox

Several types of funds could finance ecological connectivity, coming from different territorial scales and funding infrastructures: National, Departmental, Environmental Ministry, local national action plan, water agency, etc…

Key messages for planners
Despite environmental laws encouraging to consider corridors in urban planning, the monitoring of the quality of application within urban planning documents is essential to make sure that requirements are met and not overlooked. Ecological connectivity should be analyzed and worked at different scales from European to local ones, since each level have its own issues and rely on each other's. For example, protecting a corridor at a regional scale does not assure that it is functional at a local scale.
Next steps / expected impact
Asters CEN74 is planning to follow its local actions to raise awareness directly to political representatives. This approach is essential to identify their level of interest into some projects, engage future projects that could rehabilitate local connectivity and have local actions that can contribute to a large scale of corridor rehabilitation programs. Monitoring work will also be continued to make sure that laws toward connectivity are well applied in each urban documents. The work in PlanToConnect will be used as an example and its methods reused to serve other territories in Upper Savoy.

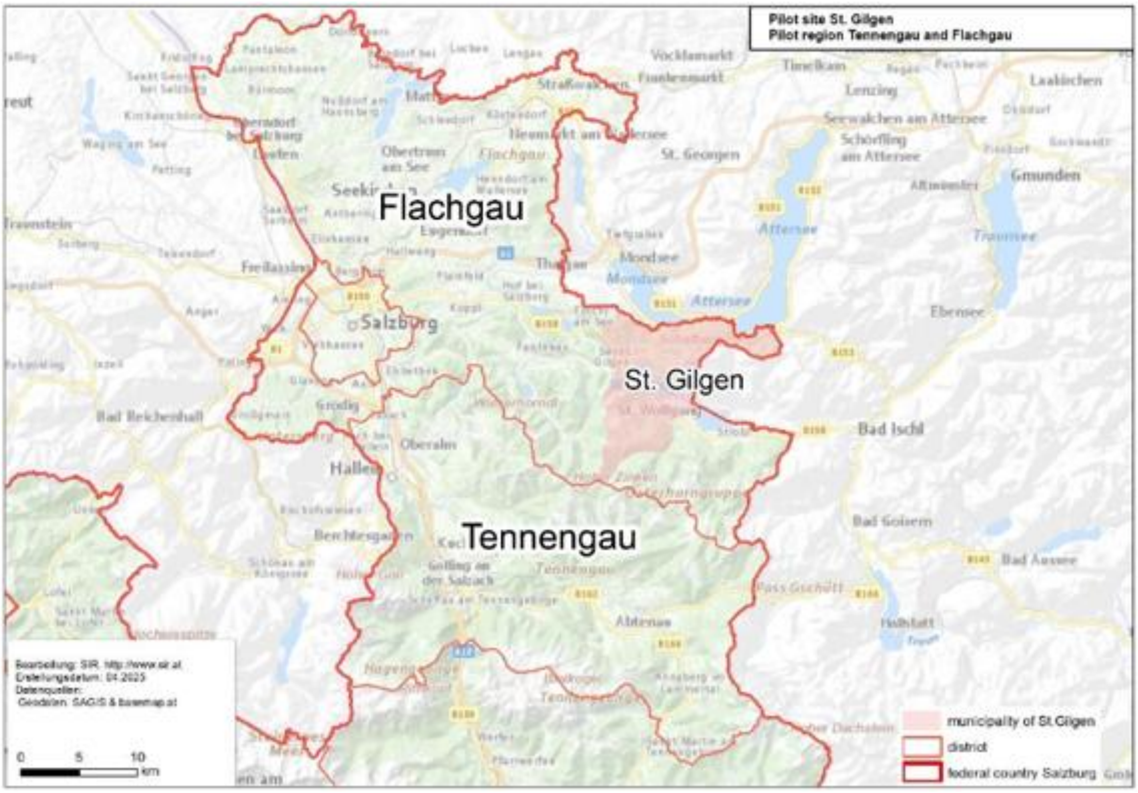
5.1.7 Ecological connectivity in Tennengau and Flachgau regions (Salzburg, Austria)

SIR - Salzburg Institute for Regional Planning and Housing

Why act here? — Ecological connectivity in Tennengau and Flachgau regions (Salzburg, Austria)

The pilot region Tennengau–Flachgau (1,672 km²) lies in the Alpine and Continental biogeographical zones and forms a key corridor between the Northern Alps and pre-Alpine lowlands. The focus area, **St. Gilgen**, in Flachgau borders Upper Austria, allowing cross-municipal and interregional planning perspectives.

While several protected areas exist, ecological **connectivity is fragmented** and threatened by **urban sprawl**, **infrastructure**, **tourism**, and **climate change**. A favorable window of opportunity arises from the ongoing revision of St. Gilgen's Spatial Development Concept (REK) and the potential to use the Integrated Urban Development Concept (ISEK) for raising awareness and integrating connectivity goals.



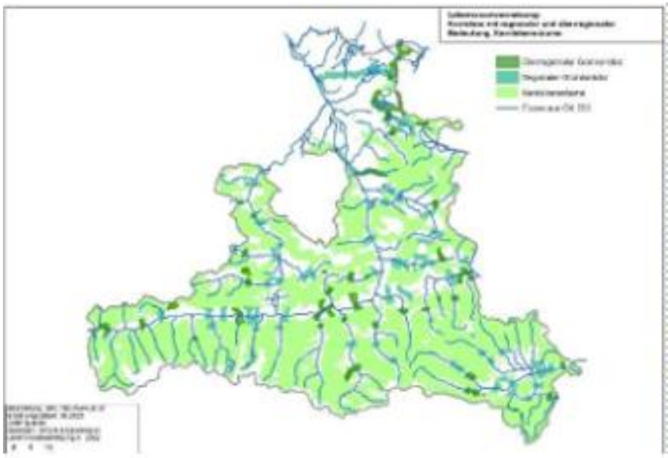
Pilot Region Tennengau and Flachgau with the municipality of St. Gilgen (geodata source: SAGIS & basemap.at)

Case study objectives

The pilot project in Tennengau and Flachgau, focusing on St. Gilgen, aims to develop and test an Alpine spatial planning strategy for ecological connectivity. The main objective is the **integration of Green and Blue Infrastructure (GBI) networks** into existing spatial and sectoral planning instruments to enhance ecological connectivity and long-term biodiversity, landscape resilience, and sustainable development. This includes developing concrete proposals for adapting planning documents and strengthening the implementation of connectivity goals at all levels.

Methodological approach

The identification of connectivity areas was based on the foundational "Lebensraumvernetzung Salzburg 2014" study by Leitner et al., supplemented by concepts such as SACA. The defined network connects core habitats, habitat islands, and stepping stone habitats via green space and migration corridors. These corridors were categorized as **local (~150m width), regional (~300m width), and interregional (500-1000m width)** and prioritized. Analyses were conducted at both the regional level for Tennengau and Flachgau and the municipal level for St. Gilgen to identify ecological, spatial, and governance challenges. A qualitative assessment of the corridors was carried out by developing a **connectivity index**, which considers the permeability of the landscape structure and the presence of landscape elements.



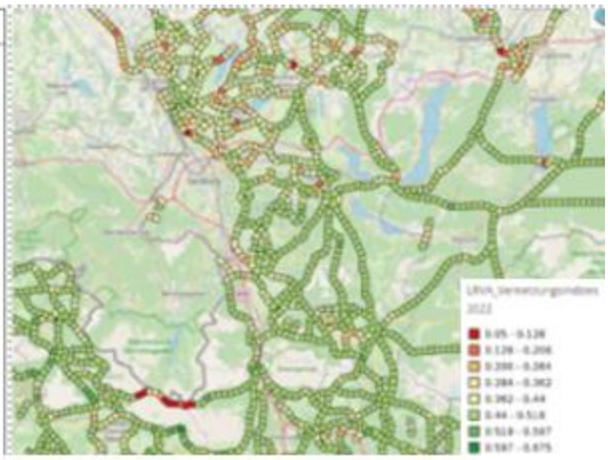


Figure 2: Interregional and regional habitat corridors and core habitats in Salzburg (geodata source: SAGIS, basemap.at & Lebensraumvernetzung.at)
Figure 3: Connectivity index (*Absicherung und Etablierung der Lebensraumvernetzung in Österreich* Grillmayer et al. 2023)

Pilot design

The pilot zone encompasses the Tennengau and Flachgau regions, with St. Gilgen as a specific focus. Here, existing **core habitats and habitat islands are connected via local, regional, and interregional corridors**. Specifically, the interregional corridor in the north and the regional corridor in the west of St. Gilgen are essential for connection in the east-north-east direction. The pilot design focuses on integrating the GBI network into spatial and sectoral planning by strengthening instruments such as the Federal Development Programme (LEP), regional programmes, the Spatial Development Concept (REK), and the Integrated Urban Development Concept (ISEK). Further key actions include **improving monitoring** using standardized indices to assess corridor functionality and coordinating sectoral plans to minimize land use conflicts. The project builds on previous work like "Lebensraumvernetzung Salzburg".

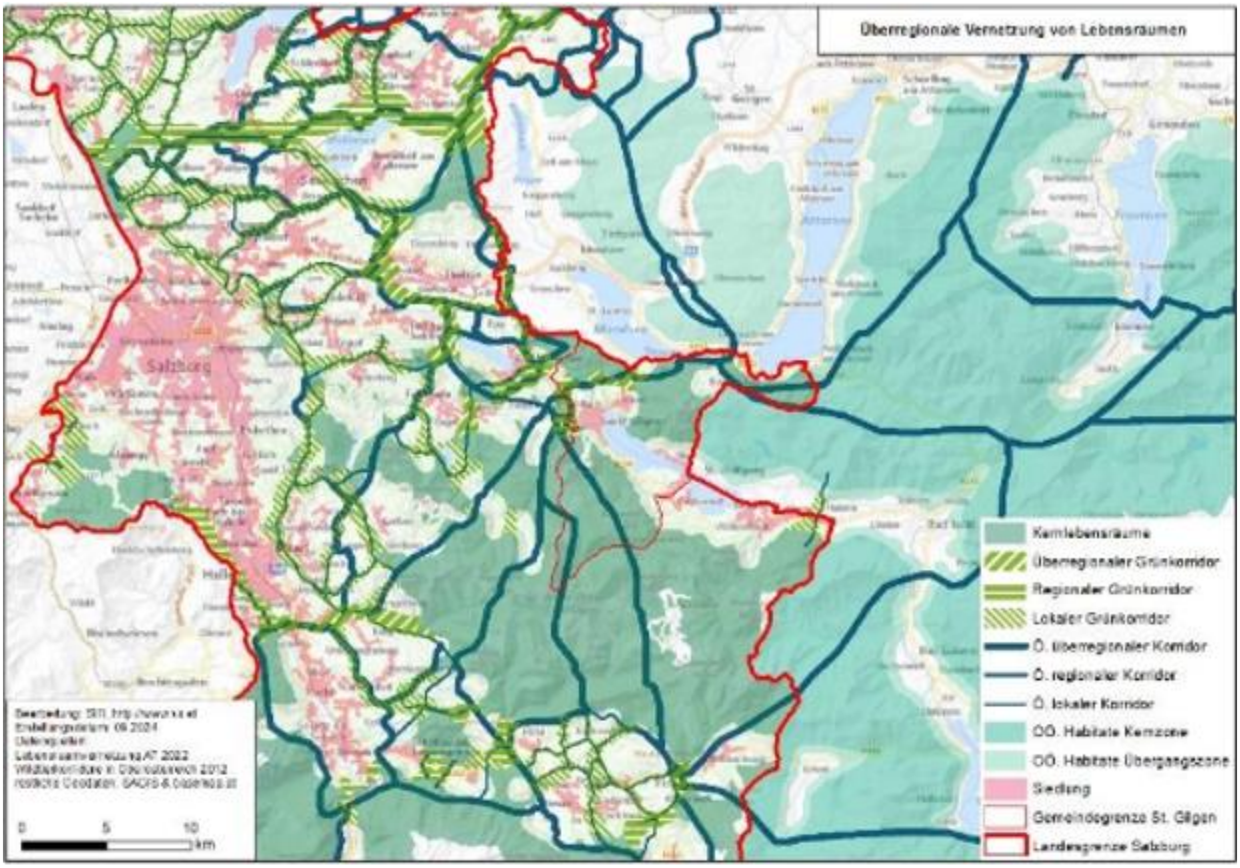


Figure 4: Interregional habitat connectivity in the case study area (geodata source: lebensraumvernetzung.at, Wildtierkorridore in Oberösterreich 2012, SAGIS & basemap.at)

From concept to statutory plans

Planning tier	GBI integration measures
Federal state Level	The Federal Development Programme (LEP) should make the protection of green space and migration corridors more binding and allow for clearer cartographic representation of all corridors (interregional, regional).
Regional Level	Regional associations should integrate green space and migration corridor designations into their programmes. Existing examples, like green linkages in Salzburger Seenland, show how regional planning can support connectivity, even where binding programmes are lacking.
Municipal Level	Municipal spatial development concepts (REKs) should explicitly define and map green space and migration corridors. In St. Gilgen, the upcoming REK revision offers an opportunity to align with LEP 2022 and regional goals by integrating corridors both textually and cartographically to support long-term habitat connectivity and safeguard open spaces.

Governance & stakeholder engagement

Stakeholders	*Influence*	*Interest*
Key stakeholders		
Spatial Planning Department Land Salzburg	*high*	*high*
Local planner St. Gilgen	*high*	*low*
Municipal council St. Gilgen	*high*	*low*
Primary stakeholders		
Naturschutz Land Salzburg	*low*	*high*
Landwirtschaft / Landwirtschaftskammer	*high*	*low*
Landesumweltanwaltschaft	*low*	*high*
Naturschutzbund	*low*	*high*
Further stakeholders		
Naturschutzbeauftragte:r	*low*	*high*
land owners	*high*	*low*
Salzburger Jägerschaft	*low*	*low*
Fachbereich ländliche Entwicklung / Agrarwirtschaft	*low*	*low*
Fachbereich forstliche Raumplanung	*low*	*low*

Connectivity management requires strong institutional anchoring and ***interdisciplinary coordination*** *across all planning and sectoral levels. Key actors such as the Spatial Planning Department of Land Salzburg, the St. Gilgen Municipal Council, and local planners play a central role and were involved in the process* ***through Regional Connectivity Working Groups (RCWG)****. Other important stakeholder categories include nature conservation organizations, agricultural representatives, private landowners, and other specialized departments. The co-design process aimed to develop a common strategy through dialogue and workshops and to* ***raise awareness for the importance of habitat connectivity****.*

Funding toolbox

Various **EU funding programs** can be mobilized to secure, maintain, and improve habitat connectivity such as LIFE, ERDF, Horizon Europe, and EAFRD or national agri-environmental schemes like the Austrian **Agri-Environmental Programme (ÖPUL)** and subsidies under the Common Agricultural Policy (CAP). Additionally, the integration of nature conservation measures through **contract-based nature conservation programs** and compensatory measures is envisioned. These instruments aim to create incentives for the protection and enhancement of corridors, particularly at the municipal level and for landowners and farmers.

Key messages for planners

1. **Ecological connectivity must be bindingly integrated into all planning levels:** Current regulations are often non-binding, hindering implementation.
2. **Standards and indices are crucial for monitoring and evaluation.**
3. **Sectoral plans must be coordinated:** Conflicts between connectivity goals and sectoral plans (e.g., for renewable energies) must be actively managed to minimize land use conflicts.
4. **Awareness-raising at the local level is essential:** The Integrated Urban Development Concept (ISEK) is an effective instrument for involving local actors and strengthening awareness of connectivity.
5. **Utilize existing data and maps:** Unified datasets facilitate integration into planning instruments like the Forest Development Plan.

Next steps / expected impact

Post-project timeline	
1.	ISEK St. Gilgen
2.	Integration of connectivity goals into planning documents
3.	Revision of the REK St. Gilgen
4.	Regional programme Osterhorngruppe 2033

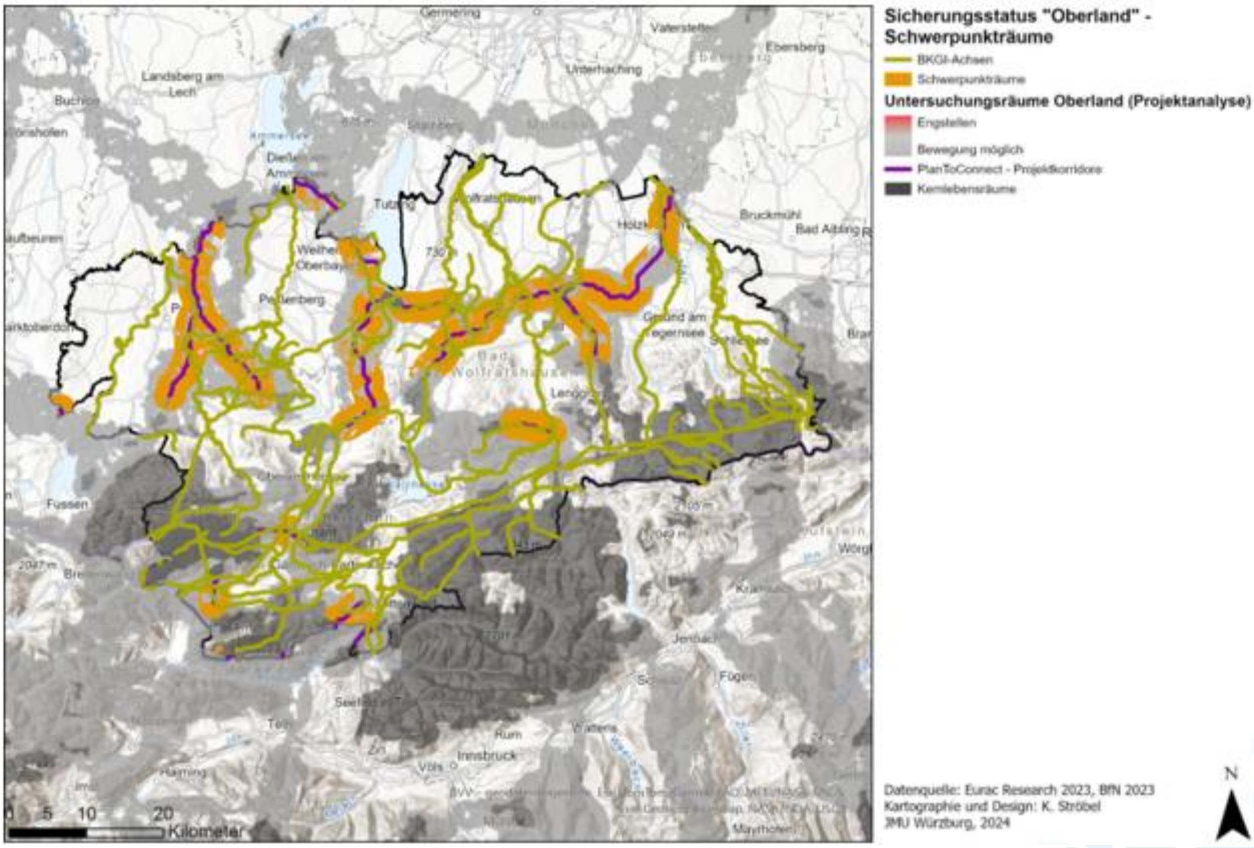
The next steps focus on the **binding integration of connectivity goals into planning documents**. The ISEK in St. Gilgen offers a great opportunity to ensure the safeguarding of connectivity in the municipality. The ongoing revision of the REK in St. Gilgen is a primary target for comprehensive anchoring of GBI networks. Regional programs are expected to develop corresponding guidelines by 2033. **Continuous monitoring** of corridor functionality, based on standardized indices and guidelines, should be established to ensure long-term success and landscape resilience. The developed proposals serve as a **replicable model** for other Alpine regions.

5.1.8 Strengthening the Ecological Network in the Oberland Planning Region

JMU - University of Würzburg

Why act here? — *"Ecological connectivity in Oberland"*

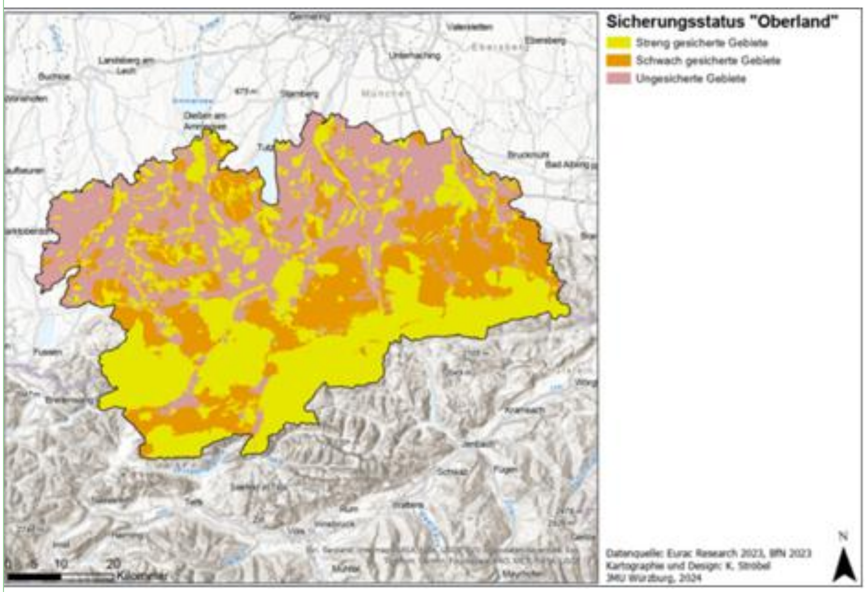
The Oberland region of Upper Bavaria stretches between alpine peaks and peri-alpine farmland, linking natural habitats under strong development pressure. The landscape ranges from peri-alpine lowland in the north to valley floors around Garmisch-Partenkirchen to the Zugspitze massif. It is crossed by alpine-wide ecological corridors identified by PlanToConnect, with 62.2 % of priority areas outside any statutory protection. These consist mainly of open spaces (58.46 %) and forests (41.92 %). Pressures derive mostly from settlement growth and transport infrastructure, leisure and tourism but also from renewable energy installations and changes in water regimes. The ongoing revision of the regional plan provides the opportunity to safeguard open spaces and reconnect habitats through the design of a coherent network of green and blue infrastructure.



Case study objectives

The pilot seeks to establish a regional open-space network that restores ecological permeability, integrates alpine-wide corridors into statutory planning, and reduces fragmentation from settlement and energy infrastructure. It aims to deliver practical proposals for embedding connectivity into the Oberland regional plan and to prepare operational guidelines for planners and authorities.

Methodological approach

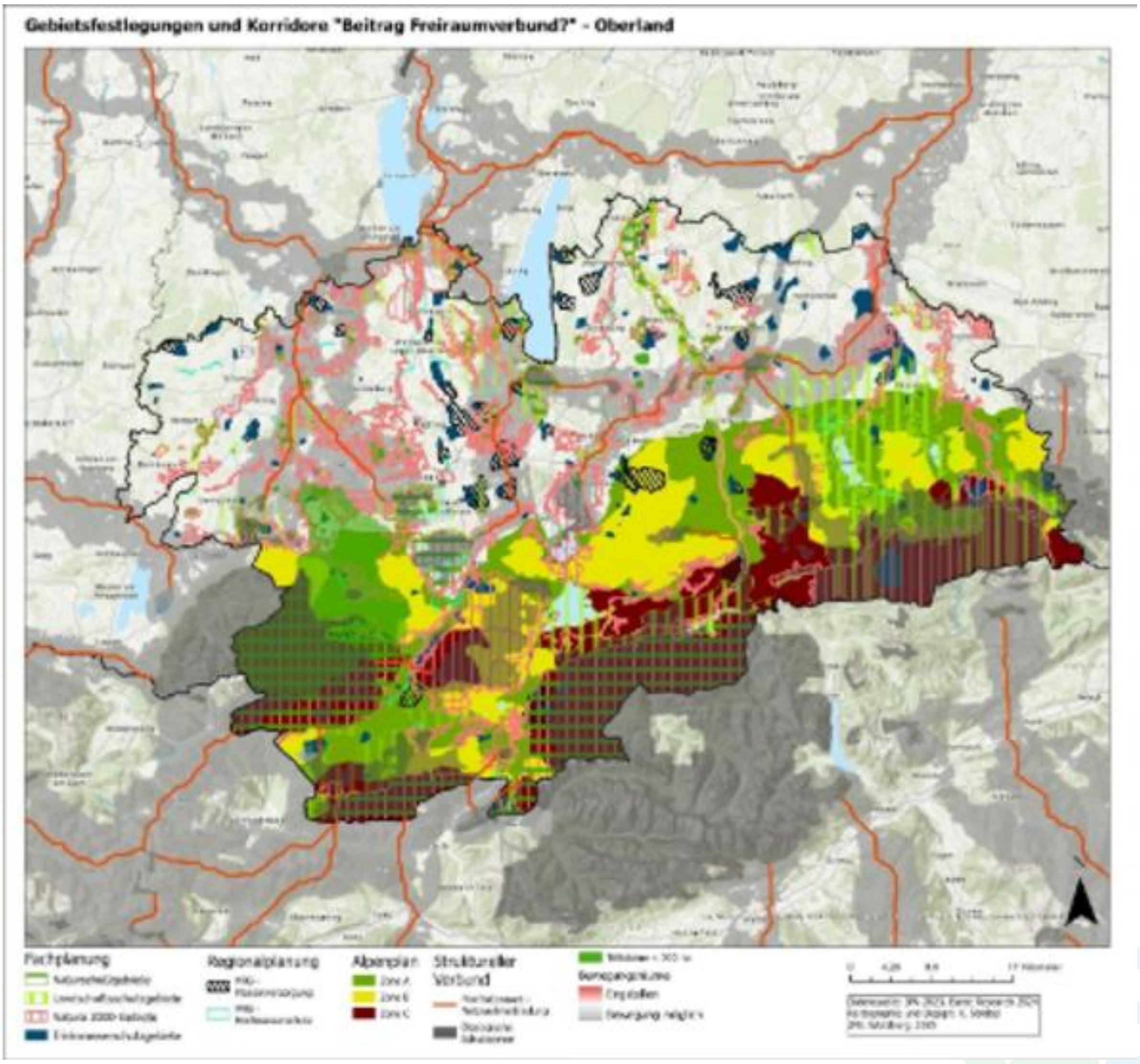


Connectivity areas were delineated through a geoanalytical study that overlaid PlanToConnect Alpine-wide corridors with existing national green infrastructure concepts. Priority zones were identified as buffer areas around threatened corridors, focusing on open spaces, forests and agricultural land that safeguard ecosystem functions such as soil retention, water storage, and climate regulation. Indicators concerned permeability, land-take and harmonisation of open space and renewable energy. The analysis classified protection levels of corridors areas into strong, medium, and absent, resulting in a map of binding status by spatial and sectoral plans revealing that a majority of priority areas remain unprotected. This evidence shaped operational proposals tailored to regional planning instrument.

State of binding protection	*Spatial instruments*
Strong protection	*“Alpenplan Zone C”, Nature protection/conservation areas, Natura2000-areas, Priority areas for Water supply, priority areas for flooding areas, priority areas for drinking water*
Medium protection	*Landscape protection areas, “Alpenplan Zone B”, Priority areas for landscape protection*
No protection	*Remaining areas (incl. “Alpenplan Zone A” and Nature Park Ammergauer Alpen)*

Pilot design

The Oberland pilot concentrates on alpine-wide priority areas and corridors crossing the northern valleys laking effective protection, where open spaces and forests face conversion into settlement or intensive agriculture. The design prioritizes safeguarding these ecological cores by aligning with existing Natura 2000 sites and protected landscapes while proposing new reserved areas for agriculture, climate adaptation, and landscape protection. Measures include the preservation of riparian zones, reducing settlement pressure, restoring wetlands and bogs, regulation of photovoltaic expansion, and securing multifunctional open spaces that simultaneously serve biodiversity, flood retention, and cultural landscape values. The pilot connects with the Bavarian Nature Protection Law, the Bavarian Landscape Development Programme and the Federal Green Infrastructure Concept, complementing sectoral instruments such as Natura 2000 and water protection areas

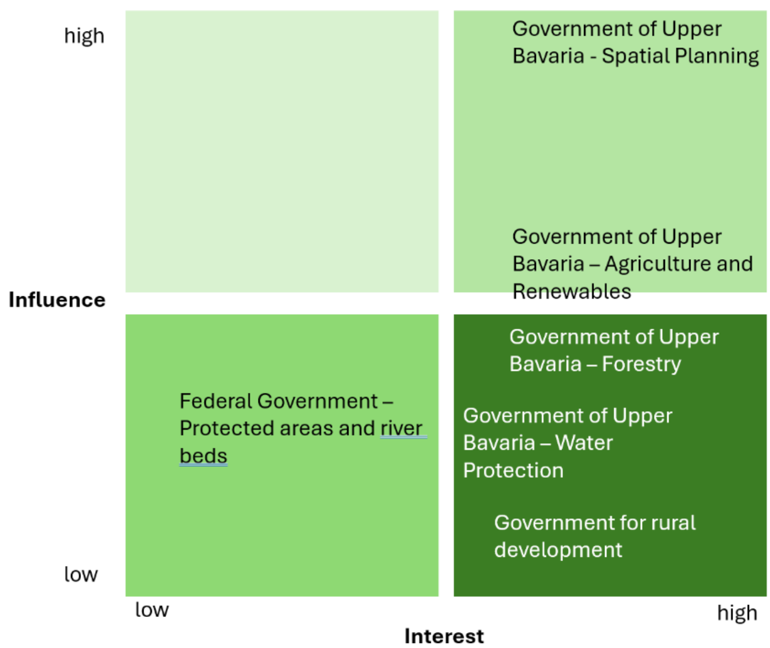


From concept to statutory plans

At regional level, the analysis suggests an updated Oberland Regional Plan that will introduce a new chapter on open-space networks (GBI network) or elaborate further on the existing chapter for nature and landscape, drawing on the Bavarian Federal Development Program and state-level biotope strategies. At sub-regional scale, our analysis highlights the importance of landscape framework planning that can foster integration of connectivity maps and further sectoral instruments (e.g. flood protection zones) with a specific focus on open space connectivity. New fragmentation should be avoided at all costs, ensuring that connectivity principles cascade through every tier of planning.

Planning tiers	GBI Integration measures
Provincial / regional	Inclusion of a dedicated chapter on open-space networks in the Oberland Regional Plan; reserved areas for agriculture, climate adaptation and climate protection; adaptation to the Bavarian federal development programme.
Sub-regional (basin, landscape plan)	Landscape framework planning integrating climate adaptation, nature conservation and open spaces; flood protection priority areas; retention zones for water management.
Municipal (land-use plan, building code)	Zoning for dividing green (“Trenngrün”) and settlement management; ecological design standards for renewable energy and agricultural uses.

Governance & stakeholder engagement



The Government of Upper Bavaria leads the regional plan revision process, supported by sectoral authorities in agriculture, forestry, water management and nature protection. Stakeholders were involved through workshops, surveys and expert interviews. Institutions included regional planning, agriculture and energy departments, forestry authorities, water protection agencies, rural development services, and environmental bodies. Their role was to validate the analysis and co-develop proposals, ensuring integration of open spaces into statutory planning. Ecological data and perspectives should be integrated into planning processes in a more prominent way to ensure long-term connectivity.

Stakeholder's institutions	Areas of responsibility and Affectedness
Government of Upper Bavaria, Regional planning	Focus point and Regional public planning authority in charge of elaborating chapters for the regional plan
Government of Upper Bavaria, Agriculture and environmental aspects in agriculture, renewable energy transformation in agriculture	Public authority for environmental discussion in agricultural fields, especially photovoltaic installations in Greenland areas
Government of Upper Bavaria, Forestry and renewable energy transformation in forestry	Public authority involved in forestry, forest functional plans, wind power installations in forest areas
Government of Upper Bavaria, Water protection	Public authority overseeing the implementation and management of water protection areas
Government for rural development Upper Bavaria ("ALE")	Protection of the cultural landscape, mediating and facilitation of local projects
Federal Government for the Environment, Protected Areas and river beds (meadows)	General perspectives on the protection of nature and the importance of ecological connectivity

Funding toolbox

Implementation can be achieved through EU programmes such as LIFE or Interreg projects, supported and in coordination with the Bavarian or regional planning authorities. Linking spatial instruments with existing targeted funding will enable the permanent safeguarding of priority open spaces. Examples include compensation measures within open-space networks, local and municipal funding instruments, and distribution mechanisms based on specific areas of need for action ("Räumlich basierter Handlungsbedarf"). Regional and federal schemes can support climate adaptation, flood protection and biodiversity measures. EU funding schemas under the CAP can support agri-environmental and biodiversity measures in agricultural areas

Key messages for planners

The Oberland case demonstrates that safeguarding open spaces is the most effective entry point for securing ecological connectivity. Connectivity is not yet safeguarded in the Oberland regional plan and relies only on coincidental overlaps with sectoral instruments. Reserved landscape areas are too broad and ineffective without clearer criteria. New categories for agriculture, climate adaptation and climate protection offer an entry point to secure

multifunctional open spaces. Integration of federal instruments and scientific mapping (e.g. “Schutzgutkarten”) can support a coherent framework. Sectoral and regional planning must cooperate more closely, especially in agriculture, renewable energy and water management
Next steps / expected impact The next step is to feed the proposals into the ongoing update of the Oberland Regional Plan. The objective is to adopt a new chapter on GBI networks (or upgrading existing chapters) and to integrate new spatial categories, including agriculture, climate adaptation and protection. Implementation will have to focus on safeguarding corridors and multifunctional open spaces, while monitoring will have to address fragmentation risks, renewable energy conflicts and water management functions

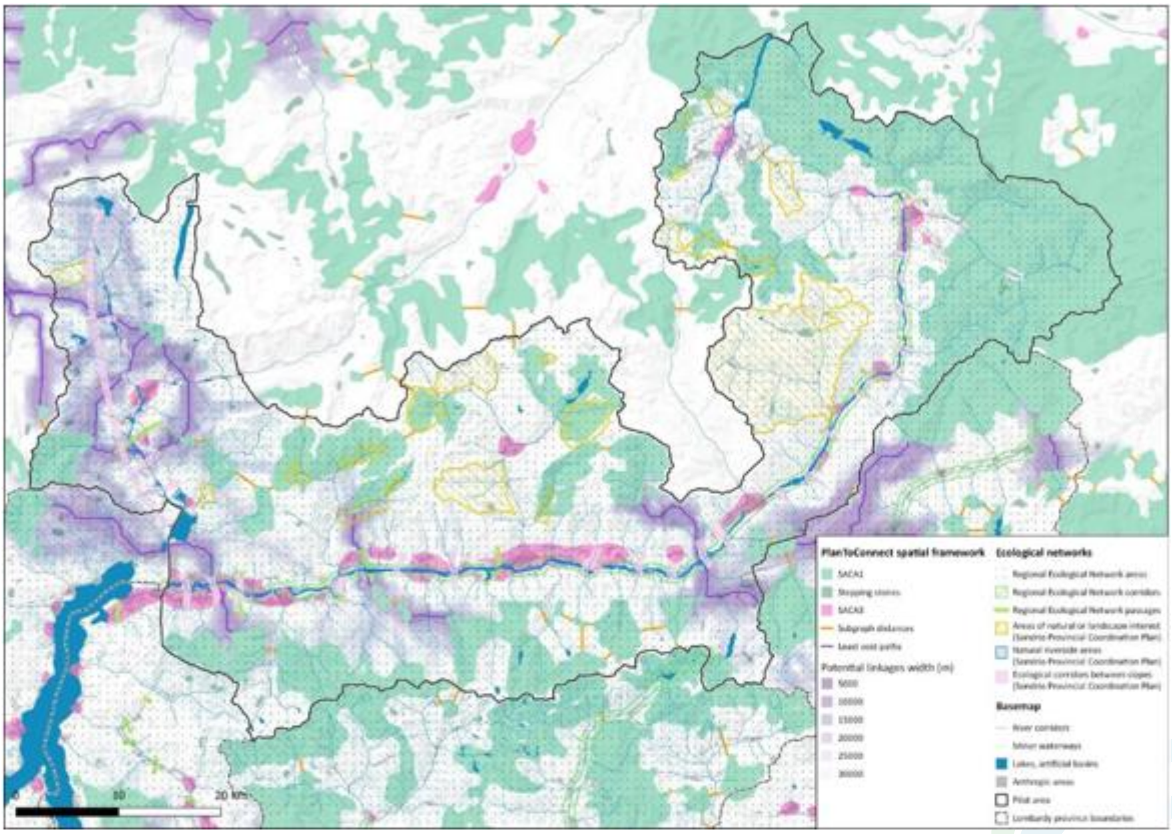
5.2 Ecosystem service-based mapping

5.2.1 Multifunctional GBI for the Province of Sondrio

Fondazione Politecnico di Milano

Why ecological connectivity matters in Sondrio

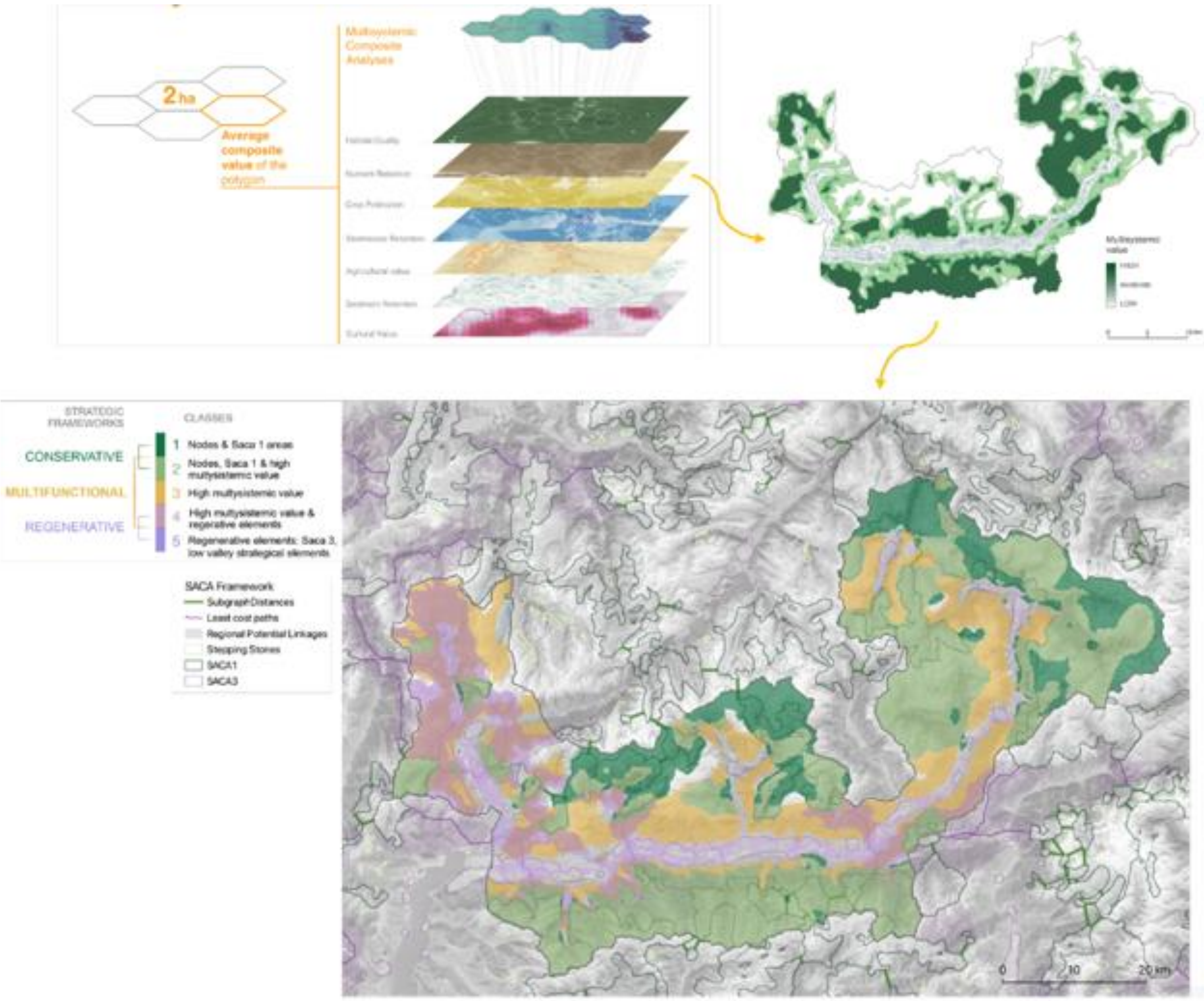
The Province of Sondrio, located in Lombardy (Italy), is an entirely mountainous territory extending over 3,000 km², with nearly half of its surface above 2,000 m and a maximum elevation of 4,050 m on Mount Bernina. It encompasses the upper basin of the Adda River, its lateral valleys, and the Alpine slopes, which host a rich mosaic of habitats and protected areas of regional and transalpine relevance. Preserving and strengthening the ecological connectivity among these protected sites and the surrounding alpine space is essential to maintaining biodiversity and ecosystem functions. However, the territory is increasingly exposed to pressures from urban expansion, linear infrastructures, intensive agriculture, tourism, and climate change. The ongoing revision of the Provincial Territorial Coordination Plan (PTCP, 2010) provides a strategic opportunity to embed multifunctional green and blue infrastructure, enhancing ecological networks and aligning local planning with regional and Alpine-scale strategies.



Project goals

The pilot case adopted a multifunctional approach aimed at enhancing ecological integrity, natural assets, recreational opportunities, cultural values, and landscape quality through an integrated design perspective. Meeting this objective required innovative planning methods that combine evidence-based knowledge with strategic framework design to coordinate and harmonize diverse territorial functions (Arcidiacono et al., 2016). An ecosystem-based model was applied, integrating biotic and abiotic components to strengthen and restore ecological connectivity through a GBI project designed to enhance local knowledge and contribute to the drafting of the Provincial Green Plan currently under revision.

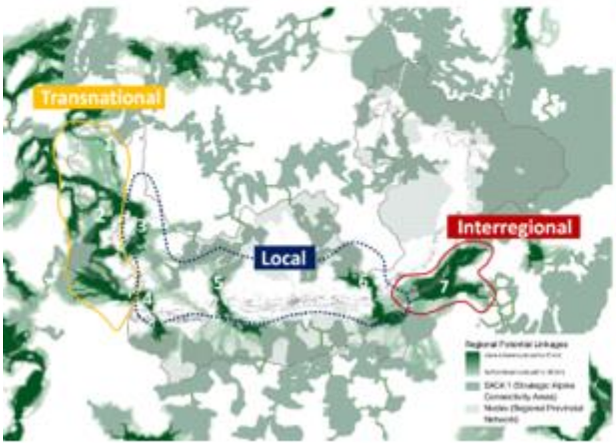
Methodological approach

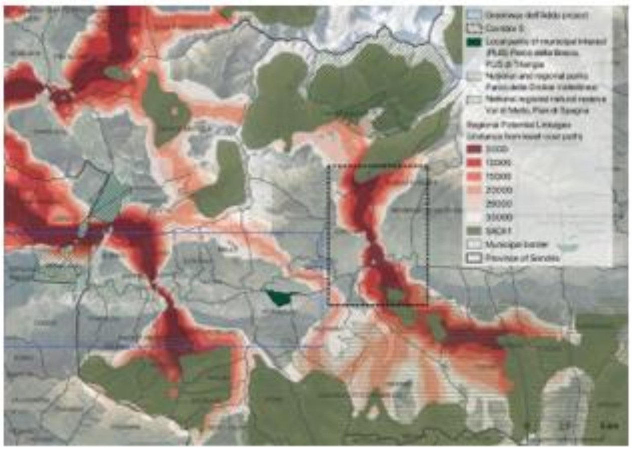


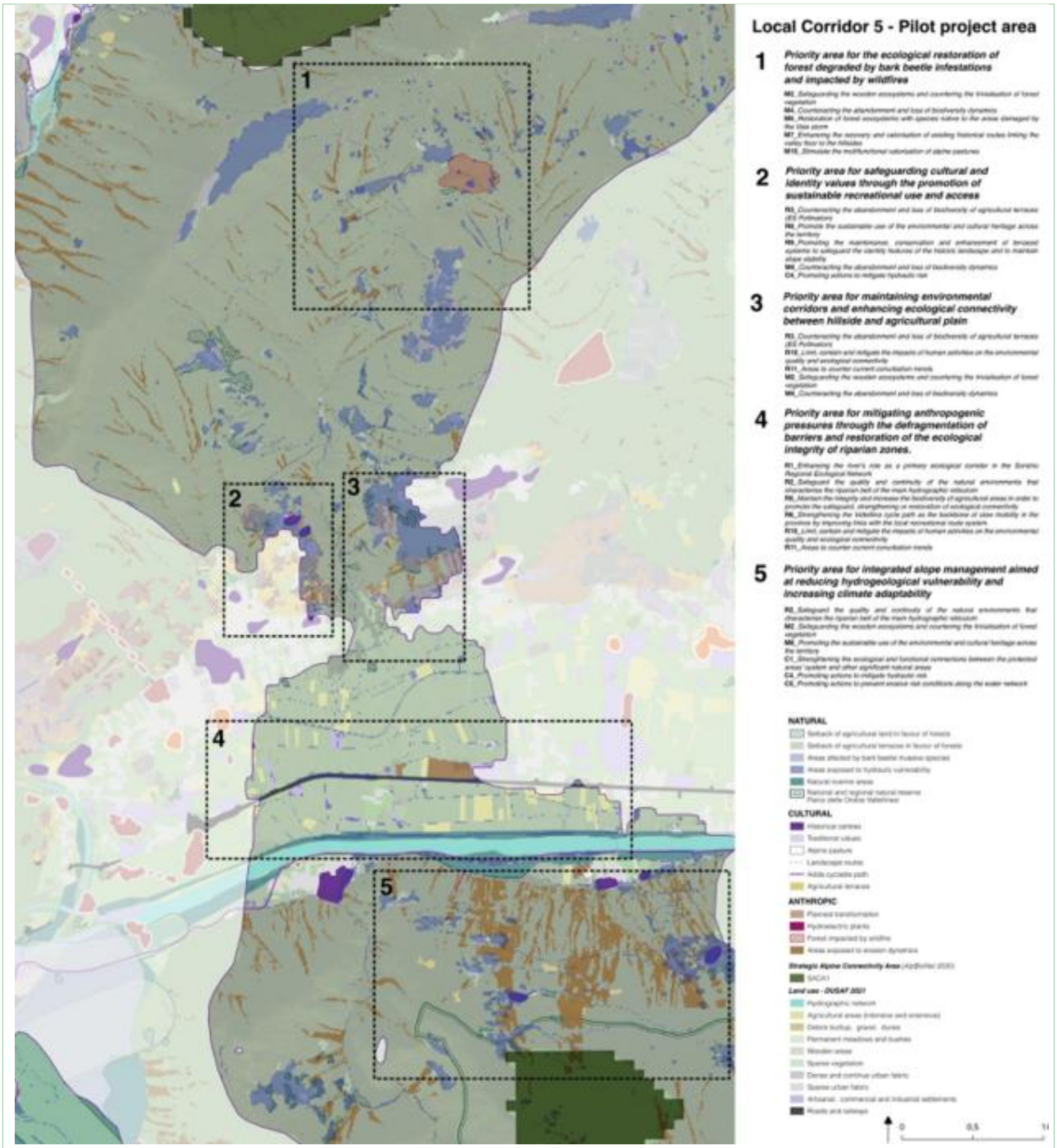
The ES-based methodology began with the modeling and interpretation of seven ecosystem services across the provincial territory to establish a robust scientific foundation for the GBI strategies. By overlaying biophysical information with both natural and anthropic territorial elements, analyzing threats to ecological connectivity, and mapping protected areas, three strategic frameworks were identified from the outset: *conservative, multifunctional, and regenerative*. These frameworks were subsequently articulated into sub-strategies and targeted actions for each relevant component of the GBI. Moreover, data on potential regional ecological corridors (Saca framework, AlpBionet 2030) enabled the inclusion of an additional information layer, which played a central role in addressing ecological fragmentation and safeguarding potential connections within the highly urbanized and pressured valley floor.

Pilot design: Corridor 5

Within the strategic design of multifunctional Green Infrastructure (RVB) for the entire province, a specific focus was developed on Corridor 5, located in the Valtellina valley between Morbegno and Tirano. This pilot was selected to ensure continuity with the previous "Greenway of the Upper Adda" project (LIFE IP Gestire, Action C21, and the Adda River Basin Contract), which addressed ecological rehabilitation and public access along the lower valley. Corridor 5 connects Alpine SACA1 cores across a highly anthropized valley floor, supporting ecological defragmentation. Five priority macro-areas were identified: 1) Ecological Restoration of Forests Degraded by Bark Beetle Infestations and Impacted by Wildfires; 2) safeguarding cultural and identity values through the promotion of sustainable recreational use and access; 3) maintaining environmental corridors and enhancing ecological connectivity between hillside and agricultural plain; 4) mitigating anthropogenic pressures through the defragmentation of barriers and restoration of the ecological integrity of riparian zones; 5) integrated slope management aimed at reducing hydrogeological vulnerability and increase climate adaptability







From vision to statutory plans

The Sondrio province pilot demonstrates how the multifunctional GBI strategy can be embedded across different planning levels. At the provincial scale, the Provincial Territorial Coordination Plan (PTCP)—currently under revision—provides the primary framework for integration. The PTCP already includes a multifunctional ecological network, conceived as both a conservation tool and a driver of territorial regeneration and landscape valorization.

Instrument	Mandatory Voluntary	Relevance for connectivity in pilot area. Gaps or inconsistency	Recipient and content of the integration proposal
Provincial Coordination Territorial Plan (PTCP)	M	*Ecological connectivity:* Provincial ecological network project: integration of currently planned corridors, and of widespread actions on the territory according to the characterisation of RVB frameworks and priorities *Multifunctionality:* Possible PTCP contents integrations concerning • Assessment of: the abandonment state of terraces; fruitive routes, elements of decay and landscape values of the territory; hydrogeological instabilities	Province of Sondrio, Territorial Planning Sector • Methodological proposal for the assessment of the ecosystem performance for the provincial territory; of pressure and threat elements for ecological connectivity; • Proposal of new corridors able to connect the two valleys and characterisation of corridors; and of priority actions for ecological connectivity and extensive actions to safeguard and increase the ecosystem performance of the provincial territory.
Territorial Plan for the Upper and Central Valtellina	V	*Ecological connectivity:* MAV ecological network project, Lanscape of silence (Valli del silenzio) ecological core and possible updates and additions concerning the strategic objective of promoting environmentally compatible energy actions *Multifunctionality:* Possible integrations with respect to the following PTRA objectives, in particular: Restore skiing domains; Developing the Adda Greenway; Supporting the multifunctional value of rural landscape activities; Enhance the identity of the historical landscape.	Lombardy Region, General directory Territory and Green System • Methodological proposal for the assessment of pressure and threat elements for ecological connectivity; • Proposal of new valley interconnection and characterization corridors; • Proposal of actions for the promotion of sustainable tourism and deseasonalisation.
Municipal Urban Plan (PGT)	M	*Ecological connectivity:* Municipal ecological network project (REC): possibility of identification of new PLIS and integration at the local scale of the strategic orientations of the GBI project; Plan Document and NTA: definition of settlement forecasts and related compensation and mitigation measures. *Multifunctionality:* • Identification of strategic agricultural areas at the local scale; • Identification of the network of recreational routes and slow mobility in connection with the Adda Greenway and SUDs implementation	Municipalities involved in RCWG dissemination activities: • Identification of areas unsuitable for the location of new settlements or human activities; • Indications for the identification, maintenance and defragmentation of crossings at the local scale; • Indications for the activation of integrated projects oriented towards multifunctionality; • Guidelines for the activation of innovative tools (PES) for the implementation of the GBI project.

The GBI proposal could strengthen this framework by incorporating the strategic-design guidelines of the pilot and aligning them with broader objectives of ecological connectivity and climate adaptation. At the sub-provincial scale, the Territorial Area Plan (PTRA) for Middle and Upper Valtellina represents a complementary entry point. The PTRA defines its own ecological network, later integrated into the PTCP, and its scope extends toward Valle Camonica, a key SACA1 connectivity area of Alpine relevance. At the transnational scale, the GBI strategy aligns with the PlanToConnect project, embedding large-scale connectivity axes into local planning instruments. This multi-tiered integration enhances synergies between strategic visions and regulatory frameworks, supporting multifunctionality and connectivity.

Governance and stakeholders

Stakeholder engagement in the Sondrio pilot is structured through a multi-level coordination system mainly supported by the Province of Sondrio and regional/national parks. The Regional Connectivity Working Group (RCWG) acts as the core coordination body, bringing together public authorities, farmers' associations, NGOs, businesses, and academic institutions. This structure is complemented by steering committees and river contract experiences, ensuring continuity with existing governance models. A co-design process based on workshops, targeted consultations, and participatory seminars fosters dialogue and knowledge exchange, enabling integration of scientific expertise, local knowledge, and sectoral interests into the strategic design of the multifunctional green-blue network.

Funding toolbox

The implementation of the Sondrio GBI strategy relies on mobilizing diverse financial resources. Key sources include European instruments (Cohesion Fund, ERDF, Horizon Europe, LIFE, EAFRD/NRDP), national and regional funds linked to landscape restoration, biodiversity, and climate adaptation, as well as innovative mechanisms such as public–private partnerships and Payments for Ecosystem Services.

Connectivity measure	Funding Instrument	EU, National, Innovative	Description
Protection and enhancement of biodiversity and ecological connectivity of the environmental system (protected areas)	LIFE Programme	EU	EU financial instrument to protect, maintain and restore natural capital, contributing to the achievement of the objectives of the EU Biodiversity Strategy 2030, the Birds and Habitats Directives and the Invasive Alien Species Regulation.
	Prioritized Action Frameworks PAF	EU	Chapter 2.b - identify priority measures necessary for maintaining or restoring the favorable conservation status of habitats and species of community interest within Natura 2000 sites and provide an estimate of the related financial requirements and identify to the most appropriate EU funding instrument
Protecting and enhancing the biodiversity and ecological connectivity of the rural system	PAC	EU/ National	Financing measures for the implementation of the priority objectives of the PAC, in particular: (i) combating climate change by reducing greenhouse gas emissions and improving carbon sequestration in the agricultural sector; (ii) protecting the environment through efficient management of natural resources (water, soil, air); (iii) preserving the landscape and halting biodiversity loss
	Funds for Small Reservoirs and Water Collection and Storage Systems	National/ Lombardy region	Call for contributions to improve water resource management in mountain areas through the construction, restoration, and maintenance of small reservoirs and water collection/distribution systems.
	PES	Innovative tools	Public-private agreement for the management and enhancement of the natural capital
Restoring the naturalness of watercourses and riparian strips (Adda river and water reticulum)	LIFE programme	EU	* See category Protection and enhancement of biodiversity and ecological connectivity of the environmental system (protected areas) A dedicated instrument exists for dam removal and river connectivity https://www.ern.org/en/openrivers/

Extensive land maintenance and prevention of hydrogeological risks	Call for agricultural terraces 2023	National/ Lombardy region	Grants for the extraordinary maintenance and recovery of terraces and structural elements of the rural landscape in the mountain context.
	Hydrogeological Instability – Lombardy region	National/ Lombardy region	Non-repayable financing is available from the FOSMIT fund (Fund for the Development of the Italian Mountains) to support soil protection measures in mountain areas through ordinary and extraordinary maintenance.
	ERSAF Convention - Lombardy region 2025-2027	National/ Lombardy region	Convention for the financing of hydraulic defense works on the main water reticulum of regional competence.
	PES	Innovative tools	Public-private agreement for wooden areas management
Mitigation of the existing/planned anthropic activities	Green area fund	National/ Lombardy region	This fund collects proceeds from increased construction contributions for new urbanization projects on agricultural land. .
	Cariplo Foundation Fund – Climate strategy	National	Supporting territorial alliances in initiating pathways to climate neutrality and community resilience by 2040. The aim is to establish partnerships between entities to drive climate transition processes in various action areas.
Promotion of sustainable touristic and recreational	Sustainable Tourism Fund 2024	National	The fund is intended to support initiatives aimed at mitigating tourist overcrowding, creating innovative tourist itineraries, promoting intermodal tourism, and desaisonising tourism.
	FOSMIT – Development of Italian Mountains' Fund	National	Fund for the development of the Italian mountains (FOSMIT) for local authorities, public mountain entities and private entities involved in trail development.

Key messages for planners

- An ES-driven strategic framework allowing spatially explicit identification of territorial strengths and vulnerabilities, highlighting climate risks and the need for adaptation measures in the Alpine region.
- Emphasizing the multifunctionality of GBI enables an integrated project that addresses the complex ecological interface between natural/rural and urban environments.
- Broad stakeholder involvement through working groups and participatory workshops improves ownership and knowledge exchange.

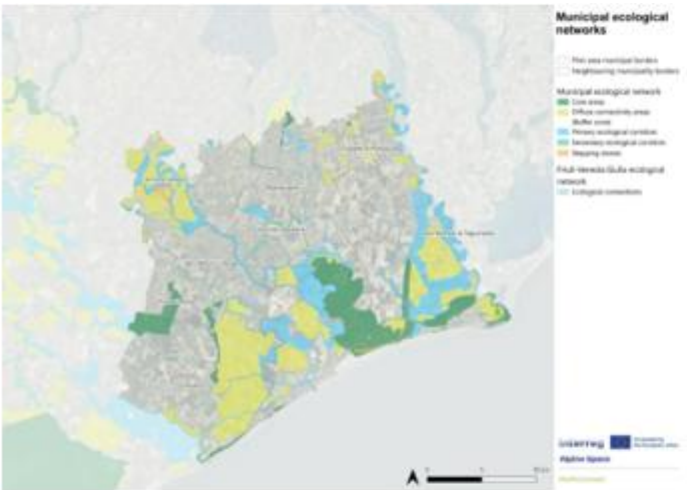
• Mobilising several funding sources, from EU programmes to PES, ensures the feasibility of different actions.
Next steps The next phase of the project targets key stakeholders involved in co-developing and refining the GBI framework. The primary goal is to provide materials that support local planning decisions, while raising awareness of climate change, ecosystem preservation, and the importance of maintaining local traditions to safeguard environmental, ecological, and social heritage. Future steps include disseminating results, informing PTCP development, and continuing research in multifunctional green-blue networks.

5.2.3 Strengthening Ecological Connectivity in the Caorle Lagoon Wetland System

Veneto Region – Territorial planning department

Why ecological connectivity matters in Carole Wetland System

The pilot area lies in the eastern Veneto Region, within the Metropolitan City of Venice and the lower Livenza and Lemene river basins. It extends from the Adriatic coastline and lagoon systems (Vallevecchia, Caorle Lagoon) to inland agricultural plains, with altitudes from sea level to 20 m. The zone is a strategic hinge between coastal wetlands, river corridors and agricultural mosaics. Main pressures include sprawling seaside urbanization, linear infrastructures, intensive monocultures, mass tourism and growing climate risks (floods, salinization, heat waves). Strengthening ecological connectivity is vital to secure biodiversity, reduce hydrogeological risk and safeguard ecosystem services. A window of opportunity is offered by the revision of the regional planning law, the ongoing Wetland Contract of the Caorle Lagoon system for the preservation of the natural capital, and forthcoming updates of landscape, metropolitan and municipal plans.

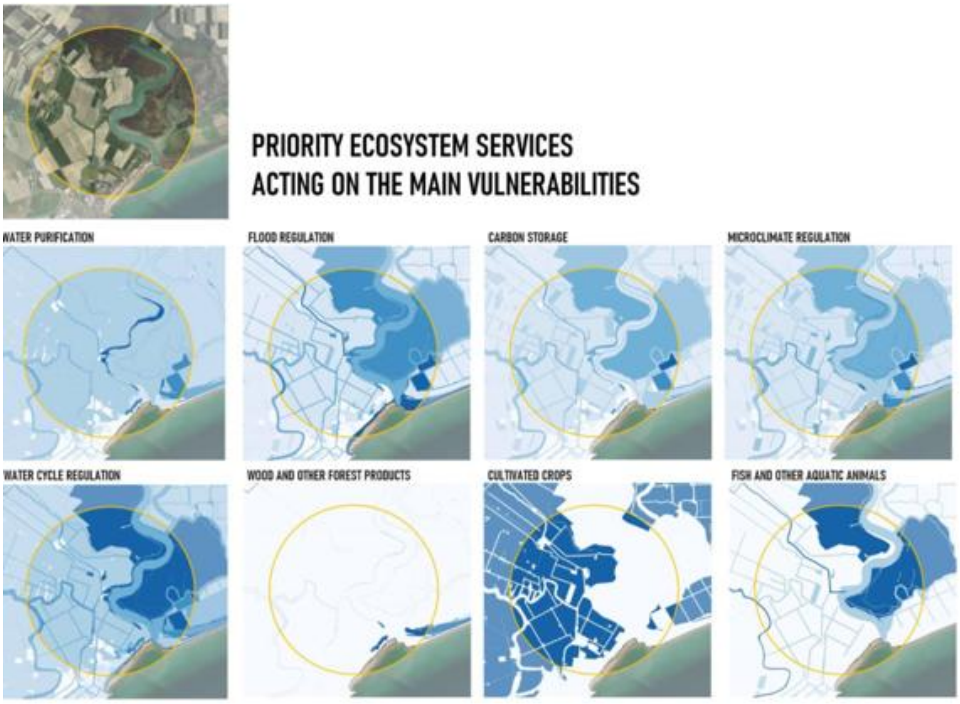


Case study objectives

The pilot aims at restoring continuity between coastal wetlands and inland river corridors, reinforcing the role of agricultural land and the hydrographic network as ecological connectors. Its goal is to reduce fragmentation, strengthen core-to-core links and secure ecosystem services such as flood retention, microclimate regulation and biodiversity support. The tangible output is a shared Green and Blue Infrastructure (GBI) network design, integrated into statutory plans and supported by planning guidelines and an updated Wetland Contract action plan with operational measures for implementation.

Methodological approach

Connectivity analysis combined land-use and habitat quality maps with existing ecological network plans, overlaid with priority ecosystem service layers such as provisioning services, carbon storage, flood regulation, microclimate regulation, water purification, water cycle regulation and sediment retention identifying priority vulnerabilities and possible actions based on the different landscape patches. This integrated approach enabled the identification of multifunctional corridors where biodiversity and ecosystem services converge. Three scales of connection were mapped: (i) regional corridors linking Natura 2000 coastal sites with each other and with the transnational Alpine network, (ii) inter-municipal corridors along the Livenza and Lemene rivers, and (iii) local ecological buffer strips within farmland. The outcome is a coherent vision of nodes and links, usable both for statutory planning amendments and for site-level restoration projects.

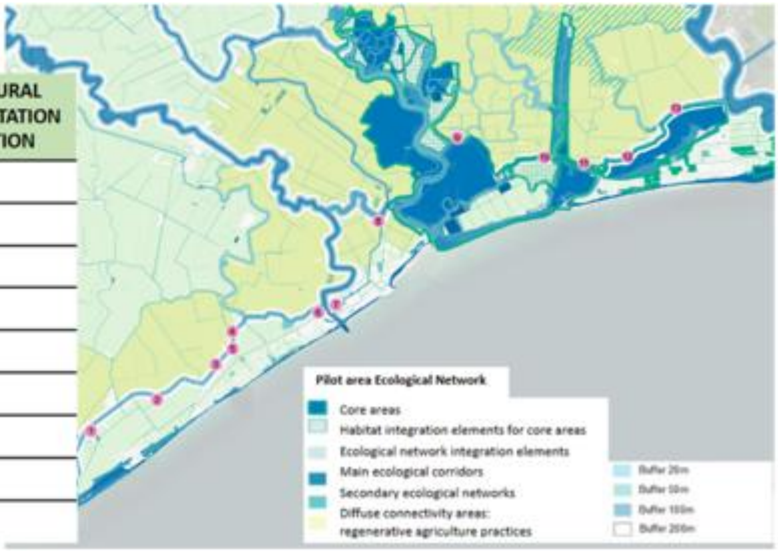


Pilot design

The pilot zone connects Vallevecchia, the Caorle Lagoon and the Livenza–Lemene corridors. The rationale is to re-establish inland–coastal permeability and ensure the resilience of wetland habitats under climate change. Key measures include restoration of riparian belts, planting of hedgerows and tree rows in farmland, re-naturalization of canal banks, creation of small wetlands and buffer strips, and ecological passages across infrastructures. The pilot builds on synergies with the LIFE REDUNE and GREVISLIN projects, current Ecological Network plans, and the Wetland Contract of the Caorle Lagoon system. It also aligns with the initiatives of the Veneto Orientale Reclamation Consortium (CBVO) on sustainable water management. These converging efforts turn the area into a living laboratory for integrating ecological connectivity into ordinary land-use and territorial governance.

GBI Network Action Plan

AREA	REVITALIZE BANKS	BUFFER ZONE	AGRICULTURAL AREAS VEGETATION INTEGRATION
1			✓
2	✓	✓	✓
3-5		✓	
6-7	✓		✓
8	✓		✓
9	✓	✓	✓
10	✓		✓
11-12		✓	
13		✓	

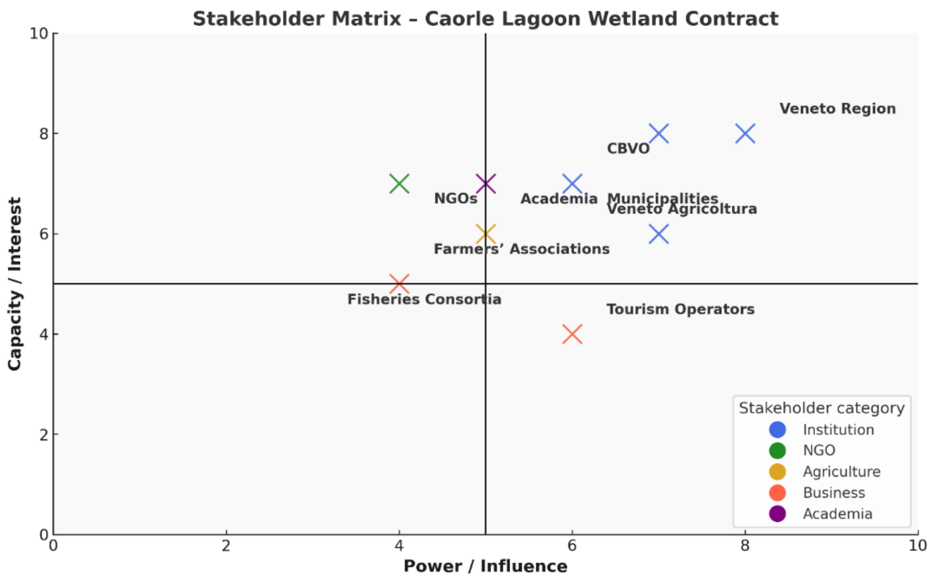


From concept to statutory plans

Planning tier	**GBI integration measures**
Regional / provincial	Integration of the pilot connectivity network into current Ecological Network plans; consistency with the Climate Adaptation Strategy, and forthcoming Nature Restoration plans.
Sub-regional	Embedding GBI into River Basin Management Plans and land reclamation schemes, with coordination across irrigation and flood-control programmes.
Municipal	Updates of land-use plans and building codes, as well as the drafting of Green Plans, to designate ecological strips and buffer zones, while promoting de-sealing measures, GBI and NBS for climate adaptation and biodiversity.

Governance & stakeholder engagement

Governance of the pilot is centred on the Wetland Contract of the Caorle Lagoon system, a voluntary agreement that brings together regional and local authorities, the Veneto Orientale Reclamation Consortium (CBVO), municipalities, the Regional Agency for Innovation in Agriculture (Veneto Agricoltura), environmental NGOs, farmers' associations, fisheries consortia, and tourism operators. The Contract provides a shared framework to coordinate ecological restoration, water management and biodiversity actions, ensuring continuity beyond project boundaries. Stakeholder engagement is implemented through working groups, thematic workshops and participatory consultations, fostering co-design of measures. This inclusive structure strengthens legitimacy, mobilises local knowledge and integrates ecological connectivity goals into existing territorial governance.



Funding toolbox

Financing options include a mix of EU, national–regional and innovative instruments. EU programmes (LIFE, Horizon Europe, Interreg, ERDF, CAP/EAFRD) support ecological connectivity, habitat restoration and cross-border cooperation. National and regional schemes provide funds for afforestation, land management, biodiversity and climate programmes, complemented by provincial and municipal initiatives. Innovative sources add flexibility: Payments for Ecosystem Services (PES), carbon farming schemes, crowdfunding platforms, and corporate ESG policies (e.g. WoW Nature) mobilise private resources, diversify farmer income and strengthen long-term support for Green and Blue Infrastructure.

Key messages for planners
The pilot demonstrates that combining ecosystem service mapping with habitat analysis vulnerabilities definition and territorial needs identification makes the multifunctionality of landscapes explicit and measurable. Embedding Green and Blue Infrastructure and ecosystem services mapping across all tiers of planning, from regional strategies to municipal land-use plans, ensures ecological continuity and spatial coherence. Agricultural land and the hydrographic network can act as effective ecological corridors when supported by targeted incentives and agri-environmental measures. Integrated planning and synergies with innovative governance tools—such as the Wetland Contract of the Caorle Lagoon System and similar voluntary agreements—enhance impact, facilitate implementation and secure long-term resilience.
Next steps / expected impact
Pilot measures (hedgerow planting, wetland restoration, riparian works) will be integrated into the action plan of the Caorle Lagoon Wetland Contract by 2025. The GBI network plan will serve as reference for updating municipal ecological networks. The expected impact is a replicable model for embedding ecological connectivity into statutory planning in Veneto and other Alpine Space regions. Guidelines developed from this experience will be promoted to planning authorities, while ecosystem service mapping will support climate adaptation policies and environmental impact assessments.

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PlanToConnect
Mainstreaming ecological connectivity in spatial planning systems of the Alpine Space

Project partners:

Urban Planning Institute of the Republic of Slovenia (SI)
Veneto Region (IT)
ALPARC – the Network of Alpine Protected Areas (FR)
Asters, organisation for the conservation of natural areas in Upper Savoy (FR)
Eurac Research (IT)
ifuplan - Institute for Environmental Planning and Spatial Development (DE)
University of Würzburg (DE)
Salzburg Institute for Regional Planning and Housing (AT)
E.C.O. Institute of Ecology Ltd. (AT)
Fondazione Politecnico di Milano (IT)

Integrated Planning of Green and Blue Infrastructure for Ecological Connectivity
Lessons and Insights from Partners Case Studies

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