Interreg
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Alpine Space

PlanToConnect

Planning and implementing Strategic Green and Blue infrastructure networks for ecological connectivity
Case Study: Border triangle Austria, Slovenia, Italy

Inputs for the Cross-Boundary Regional Connectivity Working Group

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Glossary

GBI – Green and Blue infrastructure

RCWG – Regional connectivity working group

CB-RCWG – Cross border regional connectivity working group

SACA - Strategic Alpine Connectivity Areas

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Executive Summary

The Interreg Alpine Space project “PlanToConnect” aims to integrate biodiversity, climate adaptation and ecological connectivity into spatial planning systems and territorial policies in the Alpine countries (Austria, Italy, Slovenia, France, Germany). It aims to bridge the gap between ecological corridor planning and spatial planning by developing solutions for integrated planning and increasing mutual understanding. Further information can be found on the project website at https://www.alpine-space.eu/project/plantoconnect/.

There are a total of ten case studies within the project. For one of them, namely the cross-border region between Triglav National Park (Slovenia), Prealpi Giulie Nature Park (Italy) and Dobratsch Nature Park (Austria), the project will establish a cross-border, cross-sectoral Regional Connectivity Working Group (RCWG) composed of stakeholders from the fields of spatial and territorial planning, nature conservation, wildlife management, forestry, water management and public administration. As part of the project, we will:

- (1) address and compare the current (spatial and ecological) planning practices,
- (2) work on the main ecological corridors and stepping stones and key elements of blue and green infrastructure
- (3) jointly develop and discuss potential solutions.

The latter include, for example, governance, pilot projects, recommendations for spatial planning and more integrated planning with existing planning instruments. As we are aware of the integrated dimension, we want to facilitate an intersectoral and cross-border exchange of experience. The aim of the CB-RCWG is to build and secure a transboundary network of GBI embedded in an Alpine-wide macro-regional ecological corridor.

The RCWG provides a platform for the exchange of experiences with colleagues from relevant sectors from Italy, Slovenia and Austria. The participants are stakeholders from the fields of nature conservation, regional planning, natural resource management, forestry and wildlife, water management and spatial planning. During several workshops, they will receive inputs from the project results on ecological corridor planning, possible solutions and improved guidance through the training materials developed in the project. They will also have the opportunity not only to discuss the project results, but also to share their perspectives and practical challenges.

1 Introduction

1.1 Nature needs room to move

In order to preserve the natural heritage of the Alps in the future, open and interconnected spaces, the so-called green and blue infrastructure, are of crucial importance. Ecological connectivity within the Alps is not only important for animal species that can move freely in healthy ecosystems, but also for people living in an environment where the natural heritage of the Alps is to be preserved in the future. Over hundreds of years, the Alpine environment, with its rugged mountain regions characterised by rock formations, deep river valleys and vast forests, has been shaped by man through traditional agriculture, resulting in today's small-scale model landscape. The huge forests were interspersed with alpine pastures, meadows and cereal fields on the gentle slopes. The agricultural areas were in turn structured by hedges, stone walls, orchards and groups of trees. The beauty of the landscape binds people to their places and keeps them emotionally connected to their habitat in the Alps.

The survival of wildlife depends on movement, whether through daily migrations in search of food, shelter or mates, dispersal of offspring (e.g. seeds, pollen, young birds) to new home ranges, gene flow, migration to avoid unfavourable weather conditions during certain seasons, recolonization of abandoned habitats after environmental disturbance, or the shifting of a species' geographic range in response to climate change. Movement patterns that are disrupted in habitats that have been fragmented by human activities can alter vital ecological services such as gene flow, natural seed dispersal and pollination patterns. When species are unable to migrate between and within their natural habitats, they are more likely to go extinct and are more vulnerable to environmental disturbances such as floods, disease, fire and other natural disasters. It has long been recognised that the maintenance of natural ecological processes and biodiversity requires the connectivity of natural areas.

Especially in the Alps, where urbanisation is increasing and human activities and economic developments are concentrated in the limited space of permanent settlement areas, it is becoming increasingly important to safeguard connected natural and semi-natural areas. In the dynamic development of the Alpine valleys, especially in the current debate on renewable energy, the integration of GBI into planning systems and the safeguarding of natural areas is of great importance. The ecological network should therefore become a cross-cutting issue in various sectoral planning processes and be considered and integrated in a broad consensus.

1.2 A Transalpine Vision

In October 2022, the Interreg Alpine Spece programme approved the transalpine project PlanToConnect, which brings together urban, environmental and spatial planning institutes, regional governments, protected area networks, non-governmental organisations and development institutes to describe transnational natural corridors and habitat connections that are crucial for the conservation of biodiversity in the Alps.

The working group has ranked the potential corridors/connections between natural areas (protected or not) according to their ecological importance (Figure 1) and identified the threats to conservation from anthropogenic impacts as well as the opportunities. An Alpine-wide ecological macro-corridor was modelled and should be tested and integrated into the planning environment of 10 case studies.

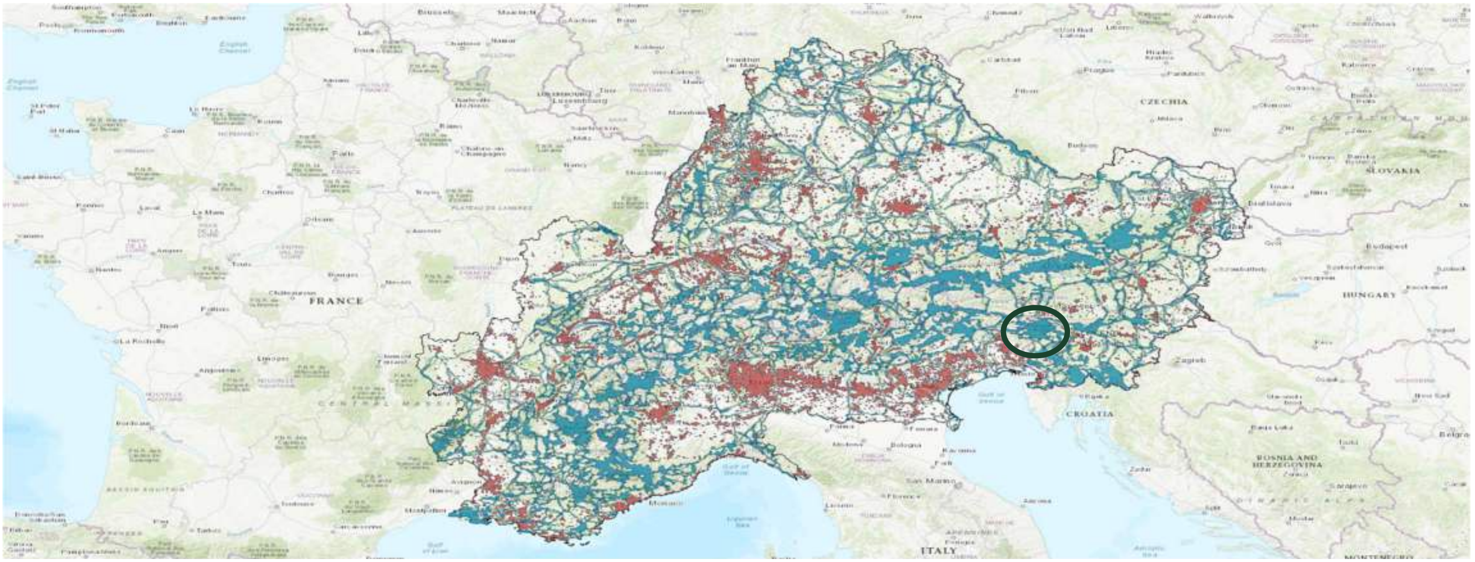

Figure 1: The macro-regional corridor of the alps – Modelled by Eurac, Bozen in the year 2023 and location of the case study. In blue: the main natural protected areas, in red the areas dominated by human activities and urbanism.

2 Connectivity planning in the Border triangle Austria, Slovenia, Italy

2.1 Ecological significance of the pilot area Border triangle Austria, Slovenia, Italy

The pilot area in the border triangle between Austria, Slovenia and Italy comprises the recently recognized bilateral UNESCO Biosphere Reserve Julian Alps (in Slovenia around the Triglav National Park) and the Julian Pre-Alps (Italy). To the north, on the Austrian side, the Dobratsch Nature Park connects with the Karawanken in the east and the Carnic Alps in the west. Separated by the Gailtal valley, which is connected to the Italian side via the Slizza/Gailitz river, the Dobratsch with its steep southern slopes offers habitats that are also found on the other side of the border. While the mountain areas are only used extensively, the valley areas such as the Gailtal valley, the valley canal, the Sava valley or the (peri-)urban area of Villach are used intensively and are under constant development pressure (economic and land use changes). The Dobratsch Nature Park is an important link in the ecological corridor system that connects the Balkans and the Karawanken with the Hohe Tauern / central Eastern Alps. The area is part of the Alpine biogeographical region and is characterized by Illyrian elements typical of the Southern Alps.

The pilot area was selected because of the specific features that distinguish it from the more northern parts of the Alps, starting with the presence of the steep and rugged limestone mountains of the Southern Alps (e.g. Triglav, Mangart, Montasio, Mittagskogel, to name but a few), extensive Illyrian and thermophilic beech and pine forests, clear rivers such as the Sava, the Slizza/Gailitz, the Gail, the Fella, the Tagliamento and their tributaries), the flower-rich calcareous alpine meadows and pastures and the typical small-scale model landscapes of traditional agriculture. The extensive forests and mountain ridges provide a habitat for animal species such as chamois, capercaillie and black grouse, red deer and stags, brown bears and lynx. Green lizards and horned vipers can be found in warm and structured forests and along the rivers. Various invertebrates such as German scorpions are also found, and some rare species such as the lemon finch occur; it is also an important migration route for the honey buzzard, which migrates here.

In addition, there are cultural (language, customs) and historical links that still exist despite the two world wars that significantly affected the region in the last century by destroying existing links. In the last thirty years, however, the region has grown together more and more as the northernmost and most mountainous part of the Alps/Adriatic region.

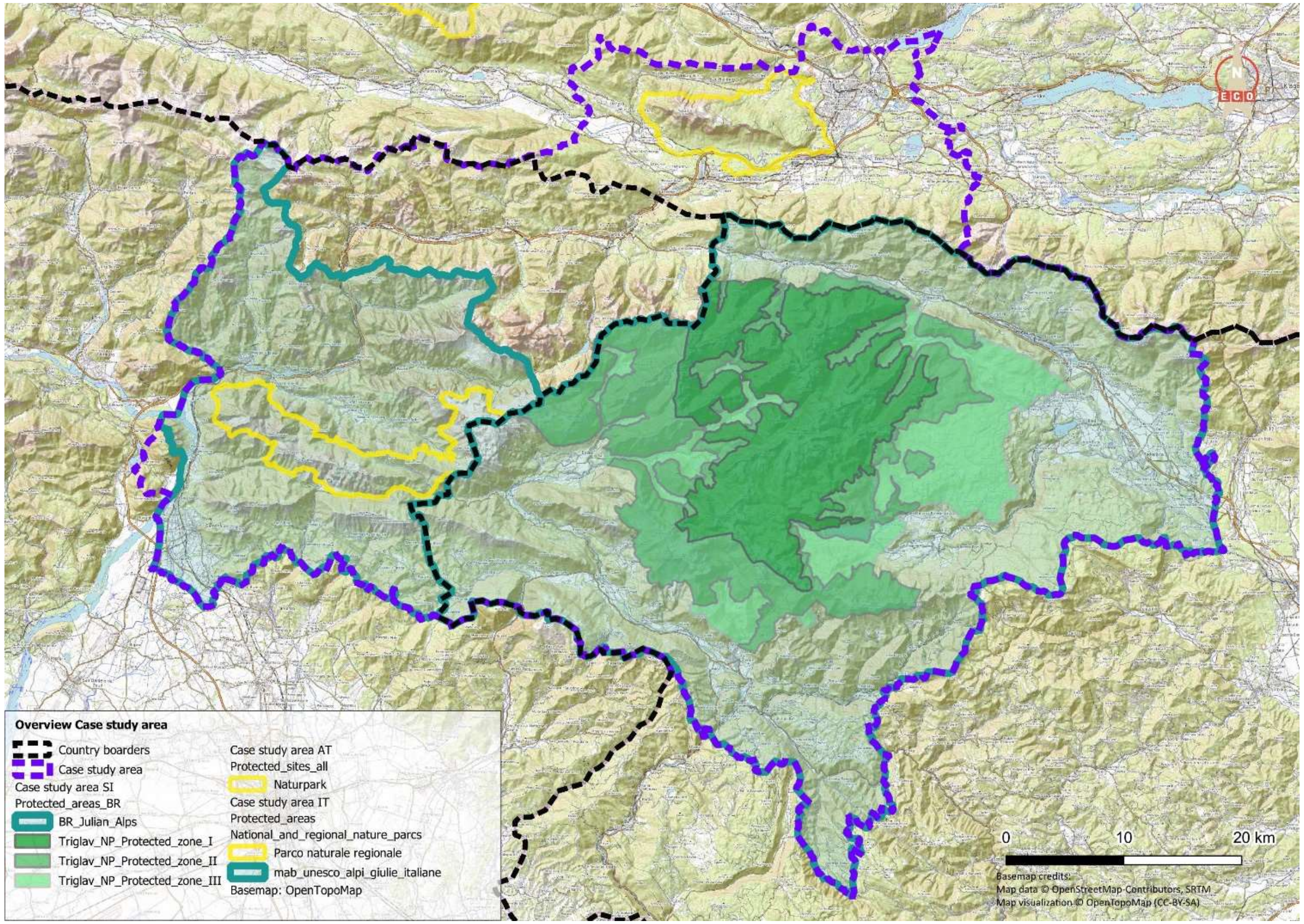

Figure 2: Overview of the case study area: Nature Park Dobratsch (Austria) Triglav National Park (Slovenia), Nature Park Prealpe Giulie (Italy) and Biosphere Reserve Giulian Alps

The project aims to find integrated and shared solutions for the enhancement of collaboration between the three countries in terms of habitat connection.

Figure 3: Dobratsch at nature Park Dobratsch

Figure 4: Hiking in National Park Triglav

Figure 5: Slope in Prealpi Giulie Nature Park

Figure 6: The capercaillie occurs in all three parks

Figure 7: The lynx at least passes through

Figure 8: The green lizard likes warm habitats

2.2 Existing conservation establishments

The area still offers vast natural spaces with varying degrees of protection, with the Triglav National Park and the Prealpi Giulie Natura Park representing an important core area that should be connected. They already cooperate as a bilateral UNESCO biosphere reserve, which is recently approved by the UNESCO. The biosphere reserve consists of a quite strict protected core zone (without human use), a buffer zone (where traditional use in terms of habitat maintenance takes place) and a transition zone (where sustainable uses should be achieved in the communities of the reserve). The biosphere reserve is a model region for sustainable regional development and therefore also means also a promising base for careful handling of upcoming projects in the communities. There are also several Natura 2000 areas in both countries.

In Austria, the Dobratsch Nature Park was established on the basis of the Schütt-Dobratsch Natura 2000 site, a natural area created by a huge rockfall in the 14th century. In addition, wetlands, limestone meadows alpine pastures and vast beech and fir forests on the mountain slopes of the Karawanks complement a rich natural and semi-natural heritage.

Additional core areas are some smaller Natura 2000 sites (like western Karawanks and Kokra) that should not be isolated from similar habitats in neighbouring countries. The steep forest slopes of the Karawanks are basically dedicated as protective forests according to forest function plan of the county, which means the economic function is less important. However, they are not protected in the sense of being a protected area, and economic use of the forest is possible.

The analysis of ecological corridors and their formal integration into regional and territorial planning takes place at a different level. Previous studies have identified numerous corridors in all three countries, sometimes transboundary and mostly based on ecological models. Nevertheless, they often end at the border.

Figure 9: The Natura 2000 area is situated on the southern slopes of Dobratsch Mountain

2.2.1 Ecological corridor approaches in Slovenia

In Slovenia, the Ministry of Environment and Spatial Planning has presented a national concept for connectivity. It identifies core habitats and connecting corridors for selected wildlife species in the case study region. The target species considered are ungulates, in particular red deer, bears and white-headed vulture. For fish and some other species groups, guidelines were drawn up instead of maps. The concept of potential ecological corridors for the model species covers the need for ecological connectivity for other important species. Guidelines and a hierarchy have also been developed for integrating the needs of each species group into spatial planning and the assessment of planned spatial developments, as well as into the design of management plans for the use of natural and other resources.

The core areas for the bear are basically all forested ridges of the Julian Alps in the centre, the Karavanke mountains in the north and the mountains east of Idrija in the south of the study area. The core areas for ungulates cover mostly the same areas, except for higher ridges.

Within the case study area, the national concept identifies four main corridors for ungulates: The first runs from the Triglav area to Škrlatica and Kukova, the second through the Sava valley north of Tolmin. The third crosses the Bohinsjsko Valley east of Bohiniska Bistrica and a fourth crosses the Sava Valley northwest of Lake Bled. As for the bear, the national concept indicates fourteen corridors crossing the valleys in the case study area (see Figure 10 below).

The Slovenian Forest Service (ZGS) provides a corridor model with a further 27 corridors that complement the national concept for connectivity. Six of the corridors run from south to north through the upper Sava Valley and connect the Julian Alps with the Karavanke. The first runs between Rateče and Podkoren. The second east of Gozd martuljek. The third east of Moistrana, which is also designated as a bear corridor in the national concept. The fifth is located west of Jesenice around the confluence of the Sava Dolinka and Radovna rivers next to the Moste and Potoki area. The sixth is located southeast of Begunje. Another large corridor is indicated around the area of Zgoma Dobrava and Ljubno. Three corridors are indicated in the Sava Bohinjka valley, one east of Log v Bohinju, one in the middle and the third south of Blejsko jezero at the entrance to the valley. In the Soca Valley, two main corridors are indicated between Kobarid and Tolmin. Another corridor is located west of Grahovo ob Bači. The last modelled corridor is located south of Idrija – this will be addressed in another case study conducted by UIRS in the Goriška administrative region.

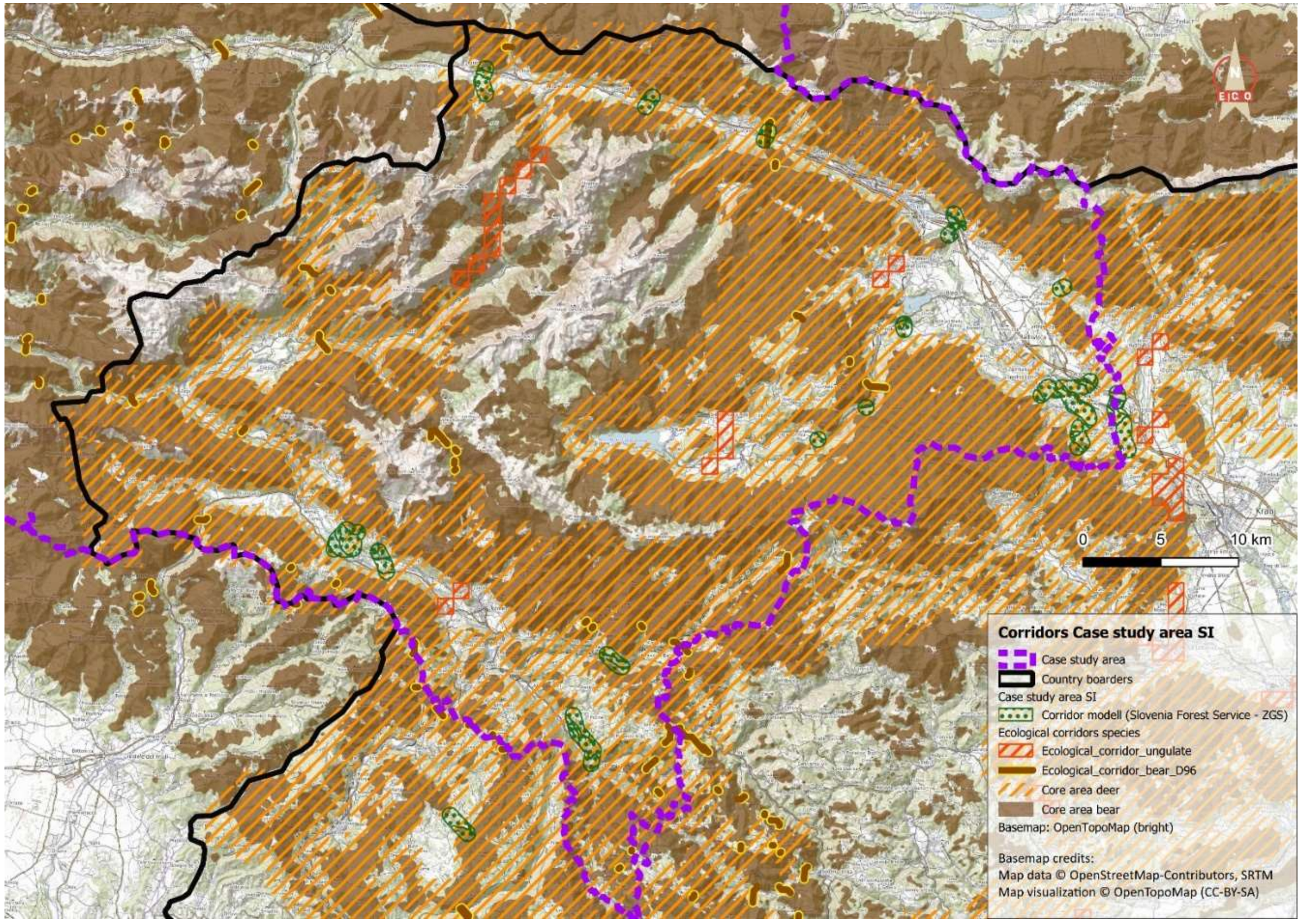

Figure 10: Ecological corridors of the case study area in Slovenia modelled by forest service.

2.2.2 Ecological corridor approaches in Italy

In Italy, there are essentially two models that deal with ecological connectivity. The first is a functional assessment of ecotopes (the spatial component of an ecosystem, consisting of different biotops) in the Friuli-Venezia Giulia region/province. It identifies good connectivity for the entire study area, apart from the area around Tarvisio in the Chanal Valley. The regional landscape plan (PPR; Piano paesaggistico regionale) aims to halt and reverse the process of landscape fragmentation and to improve and restore the ecological connectivity of the regional territory (Friuli Venezia Giulia region), taking into account the Habitats (92/43/EC) and Birds (2009/147/EC) Directives. The identified elements of this connectivity are summarized in the regional ecological network and are considered essential for the migration, geographical distribution and genetic exchange of wild species due to their linear and continuous structure (e.g. watercourses with their banks) or their connectivity function (e.g. ponds).

The regional ecological network itself (RER, rete ecologica regionale) is an interconnected network of landscapes (natural and semi-natural ecosystems) for the protection of the region's biodiversity. The landscape is divided into large homogeneous territorial units, the so-called ecotopes, which are equipped with different functionalities. For each ecotope, the PPR contains guidelines that are based on the general instruments of urban planning. Each ecotope (ecotopi funzionali) is characterized by a name and an identification number, two of which are located in the study area:

Table 1: Areas of regional ecological network within the study area

01	Carnia (alpine an prealpine zone)
02	Val Canale, Canal del Ferro, Val Resia (alpine an prealpine zone)

A distinction is made between core areas, contiguous forest areas, contiguous rural areas, stepping stones, links along rivers and areas with poor connectivity. Core areas are defined as predominantly natural areas of large size and high functional and qualitative value for the conservation of target populations of inhabited species of flora and fauna. They represent a dispersal source for mobile individuals that are able to colonise or colonise new habitats.

Within the case study area, core areas are identified in the north along the Carnic Alps north of Malborghetto, on the border around Monte Carnizza/Garnitzenberg and in the catchment area of the Torrente Pontebbana. In the centre of the study area, the core areas around Mount Montasio and its surrounding peaks and the mountains east of Moggio Udinese are defined.

The connectivity areas are defined either as forest connectivity fabrics – dense and continuous fabric of forest areas, including secondary grasslands, also containing stepping stones of open environments - or as rural connectivity fabrics – connectivity especially in the uplands and lowlands along random movements and explorations of the territory with different functional ecotypes. Almost the entire study area is classified as a continuous forest area in the regional ecological network. Linear connections in the hydrographic network – These are the linear connections between core areas along watercourses. Within the study area, the Tagliamento River and the Fella River are classified accordingly. Poor connectivity is defined as extensive "humanised/urbanised" areas (intensively farmed areas and areas with diffuse, discontinuous, often low-density urbanisation and high land consumption) that significantly hinder and reduce the possibility of movement and relationships between meta-populations of wild terrestrial animals, especially the smallest and least mobile species. This category is found around Tarvisio and in the southwest of the study area around Gemona. However, the categorization at regional level only provides a rough overview, so that implementation in a local ecological plan is required to safeguard existing micro-corridors and plan mitigation measures. This step is still pending and has not yet been done for the municipalities in the study area.

A further level of connectivity was examined with regard to species: Important corridors for ecological connectivity were identified in the regional ecological network for the species smooth snake and green lizard (see also Annexes 1).

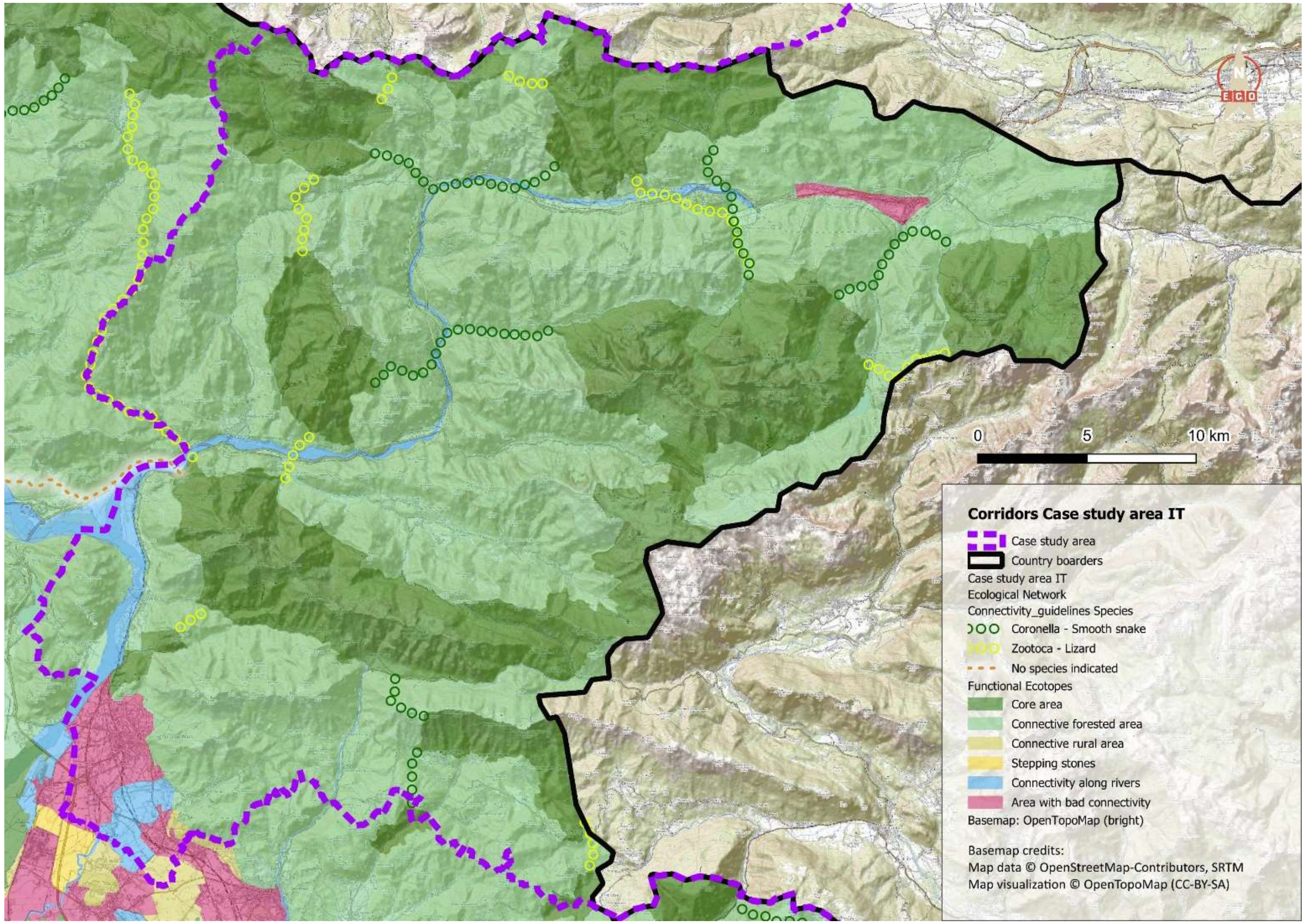

Figure 11: Ecological corridors according to the regional ecological network in Italy

2.2.3 Ecological corridor approaches in Austria

There are several smaller nature conservation areas (Natura 2000, protected wetlands) in the study region. In 2006, the “Open Space Concept” (Bogner et al.,) was drawn up for Carinthia, which contains proposals for the evaluation of potentials for open spaces outside settlements and identifies instruments for the preservation of important green corridors. It was commissioned by the Department of Spatial Planning.

With regard to connectivity, GIS modelling of wildlife corridors was carried out in 2008 (Leitner et al., 2009). In a first step, twenty ecological core areas (so-called "open space cores" - “Freiraumkerne”) were defined and in a second step, around 280 wildlife corridors between these core areas were modelled. The target species was defined as “anything larger than a hare”. The model essentially shows ten corridors connecting the four mainly forested core wildlife habitats in the Carinthian part of the case study area. The following four core areas were defined:

- Dobratsch in the northern part (1),
- Karawanken in the south-eastern part (2),
- Carnic Alps in the south-western part (3) and
- some parts of the Sattnitz in the eastern part (4) (see Figure 12).

In most cases, the corridors of the case study area are oriented in a north-south direction: Seven corridors cross the Gailtal valley in the southwestern part of the case study area, two others are located in the eastern part of the case study area around Lake Faak and one crosses the Drautal valley in the northern part of the case study area. As part of the project "Habitat connectivity as a contribution to safeguarding biodiversity in Austria", the most important regional and national habitat corridors in Austria were mapped on the basis of landscape permeability models (Leitner et al., 2018). They are the essential basis for the conservation of networked habitats. The results are available on the website www.lebensraumvernetzung.at, an online information portal of the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK). It offers existing geodata and further information on ecological networks in Austria. The Austrian Coordination Platform for Ecological Networks is an association of 13 experts who support the objectives of the platform with their specialist knowledge. The Austrian habitat corridor model for the case study area is very similar to the Carinthian model, with the difference that corridor polylines are also drawn within the Carinthian core areas. Supra-regional and local corridors are located within the case study area. The corridors were reviewed in workshops with key stakeholders (Grillmayer et al., 2023).

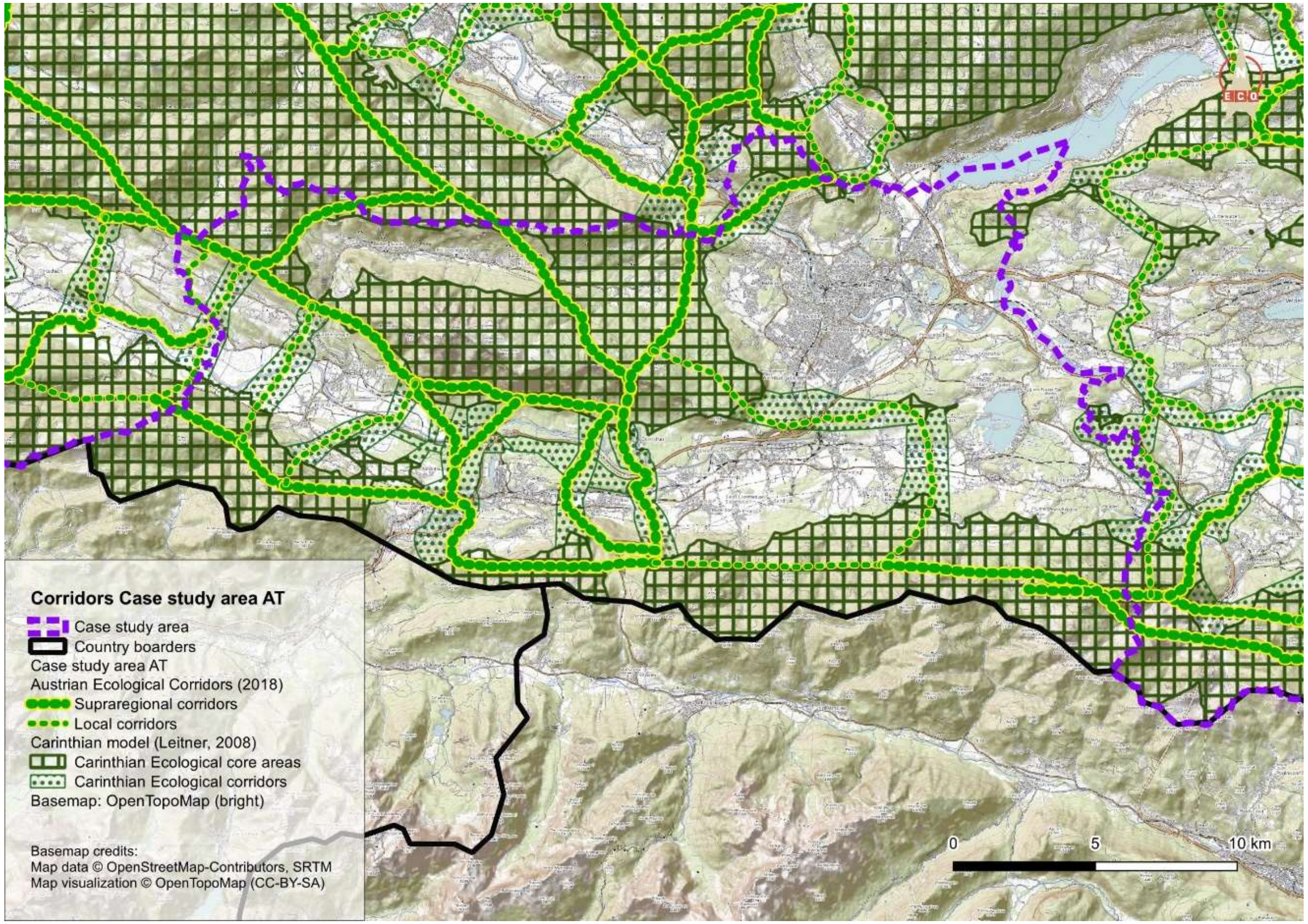

Figure 12: Ecological corridors in the case study region of Austria modelled by the platform lebensraum.at

2.3 Macroregional model PlanToConnect

Within the project, a macroregional corridor model was elaborated by Eurac, by linking SACA-areas (Strategic Alpine Connectivity Areas, namely huge protected areas with typical species and habitats) with least cost path. The model shows core areas (in green) and potential linkages (in yellow). For the study area, several linkages cross the study region and the borders and will be evaluated during the case study by comparing them with national and regional concepts.

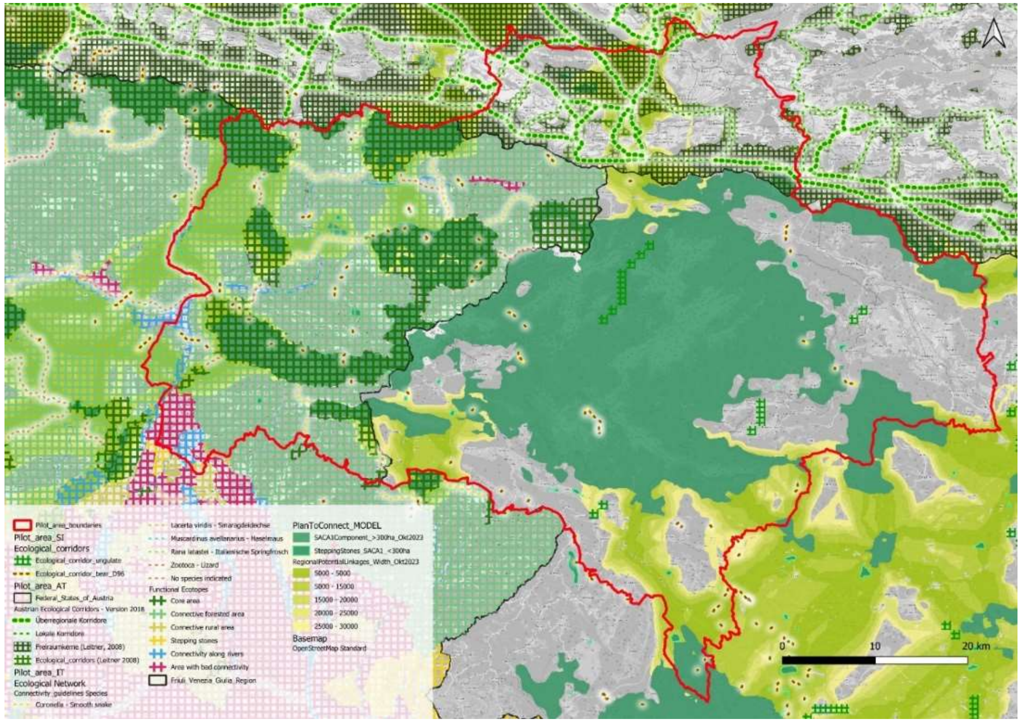

Figure 13: Draft map of Macroregional corridor and existing national/regional corridor concepts

2.4 Typologies of barriers and threats to connectivity

Following the assessment of existing macro-regional and regional corridors within the study area, potential obstacles and threats to connectivity will be evaluated and investigated in expert workshops. There are different types of barriers that will be assessed. Barriers include 1. infrastructural developments that fragment the area (e.g. dams, road infrastructure); 2. other direct pressures on the habitat: human-induced actions or events that directly affect the function of habitat connectivity in the corridors. (e.g. unsustainable logging, intensive agricultural practices, pressure from tourism); 3. indirect pressure/contributing factor: an economic, cultural, social or institutional factor that enables or favors the occurrence of direct pressure (e.g. income needs, lack of knowledge, lack of enforcement). The potential pressure of climate change on habitats can also be an obstacle.

In the pilot region, the situation is still quite porous, but some potential barriers have already been identified. Natural barriers (ravines, steep mountain slopes) exist to a certain extent depending on the target species. However, wildlife experts believe that natural barriers are generally not a major problem as many species are able to cope with natural barriers such as steep mountains and large rivers and highly mobile species such as bears or ungulates can find their way as long as there are no artificial barriers. There are artificial barriers in the study area that should be investigated further. These include 1. infrastructural developments that fragment the area (e.g. dams, road infrastructure); 2. other direct pressure on the habitat: human-induced actions or events that directly affect the function of habitat connectivity in the corridors. (e.g. unsustainable logging, intensive agricultural practices, pressure from tourism); 3. indirect pressure/contributing factor: an economic, cultural, social or institutional factor that enables or favors the occurrence of direct pressure (e.g. income needs, lack of knowledge, lack of enforcement). The possible pressure of climate change on habitats could also play a role.

Settlement obstacles are located around Jesenice, Tarvisio and Villach, which are growing urban areas with typical infrastructure and scattered settlements in the surrounding area. Road infrastructure includes the highways (Villach-Udine and Villach-Ljubljana as well as Villach-Hermagor), where fences ensure safe transportation for human traffic. However, one of the first wildlife bridges over the A2 highway in Austria near Arnoldstein was built as part of a Life project in 2006. Frequent road casualties are also reported in the parts of the study region in Italy. Railroad infrastructure leads to potential barriers southwest of Villach and Tarvisio. Dams on the Sava and dams and drains on the Gail and Drava represent potential barriers for fish and wildlife. However, the first fish ladders have been installed along the Drau and Gail in recent years. Tourism pressure is particularly noticeable around Lake Bled and Lake Faak, resulting in scattered settlements and disturbance to wildlife from hiking and cycling activities. Agriculture is still quite traditional, which is reflected in smaller fields and meadows. However, structural elements such as hedges and trees are being lost and the early mowing of silage grass instead of hay is leading to a severe loss of suitable habitats for insects and birds.

The mountain ridges are still predominantly forested, but climate change with storms and bark beetles is leading to open forest areas and, in particular, to an increase in the density of forest roads in the Austrian part.

Indirect pressures arises in the study area from economic demand and, above all, from the search for suitable locations for the expansion of renewable energies such as wind turbines, hydroelectric power plants and huge solar panels in open spaces. Their impact on connectivity depends very much on the exact location and the mitigation measures applied. Climate change plays a major role when it comes to habitat modification, water scarcity in spring and heavy rainfall in summer, lack of snow and the increasing need for migration of certain species.

		
Figure 14: Fenced outlet to power plant at river Gail is a significant barrier.	Figure 15: Fish lift at river Gail.	Figure 16: Wildlife bridge across the highway A2

2.5 Connectivity conservation and restoration objectives and linkage design goals

The objective of the case study is to create a harmonised transboundary GBI network to connect loose ends and different corridor approaches to support efforts to improve transboundary coordination of nature conservation. A second objective is to establish administrative and technical contacts for the exchange and coordinated spatial development of the area.

The approach is to identify and address the need for connectivity in the border areas and to establish an international expert platform to avoid loose ends in macro-regional and regional corridors. Sufficient areas should be made available for a metapopulation of species inhabiting the corridor to move through the landscape over several generations.

The technical proposal should provide a basis to close the main bottlenecks and gaps based on current and future developments. It should also outline options for a) better integration of the GBI network into local planning (through awareness raising), b) highlighting existing spatial planning tools that lend themselves to integration, and c) creating mechanisms for cross-border coordination.

The highest pressure is limited to the individual valleys, where different land uses are concentrated and transportation infrastructure is present, acting as a barrier to migratory species. Ecological connectivity between the three neighbouring countries should not only be linked to the most cost-effective route (distance), but rather be determined by topography (e.g. along valleys such as the Channel Valley).

Common species and their typical habitats should remain connected around the border triangle. Typical habitats of the Southern Alps should be preserved and occur on all three sides of the border. Corridors for typical species of the Julian Alps are addressed in the border communities, and in particular rare mammals such as the brown bear and lynx, which still occur in the bilateral biosphere reserve, should be able to cross over into Austria. Animals and plants should also be able to migrate in all three countries in response to climate change. International core and connectivity areas should be taken into account in regional and local planning processes in order to maintain and secure connectivity in the future. Therefore, buffer zones against edge effects such as pets, lighting, noise, nest predators and parasites as well as invasive species should be provided.

The objectives can be summarized as follows:

1. To create a common and coordinated (spatial) planning basis for main cross-border corridors, including stepping stones and barriers based on existing corridors, in order to communicate ecological connectivity to spatial planning actors (cross-border level) and to develop concrete measures for long-term implementation.

2. Identification of “hotspots” and core zones to ensure connectivity in these corridors.

3. Identify territorial/spatial planning instruments and appropriate levels to integrate these corridors in the long term (cross-border/international; national/sectoral).

4. proposed solutions for selected hotspots a) type of interventions/actions needed + b) proposals for consideration in the most relevant instruments for spatial planning.

2.6 Connectivity planning in the pilot area - three countries, three systems -one network

Various methods will be used for the pilot region as part of the project. The first step is a literature review on characteristic habitats and species of the transboundary pilot region. The three national and sectoral approaches for ecological corridors will be compiled and compared. In a GIS project, the available relevant data will be compiled and harmonised. The model of the macro-regional Alpine-wide corridor will serve as a backbone for opening the discussion on relevant transboundary corridors. Ecological experts will be consulted in all three countries. The proposed corridors will be presented at an international workshop (which took place in Bled in April 2024). The RCWG experts had the opportunity to add their knowledge on existing data, functional corridor elements and possible obstacles. The first result is the identification of core areas and potential links for ecological connectivity with a focus on transboundary situations. The actual land use on the modelled corridor is analysed by means of areal image interpretation. Potential threats to connectivity will be collected and discussed in workshops. A 5-point action plan will be developed within the stakeholder groups on how to integrate the corridors into their planning.

Proposals for future measures to implement the corridors in the specific planning instruments of the three countries will be developed. Together with local exporters, barriers will be identified and measures proposed to remedy them. Proposals for future cooperation will be made.

A total of two international workshops and three local workshops are planned to present, secure and improve the ecological network within the tri-border region.

2.6.1 Spatial planning tools and incorporation and GBI in Slovenia

In Slovenia major strategies and regulations in the context of spatial planning and other relevant sectors for ecological corridors are worked out at national level. In the Spatial Development Strategy of Slovenia 2050 (published in 2023) Green Infrastructure and its functionality and connectivity of habitats play a big role. Chapter 4.4 of the Spatial development strategy 2050 deals with the concept of spatial development regarding green infrastructure: "*At national level, green infrastructure includes larger forest complexes, mainly Natura 2000 sites, the Alpine and Dinaric Mountain ranges, protected areas, first-order waters and their associated permanent or intermittent lakes or tidal areas, and the sea and naturally preserved coastline. …The system of green infrastructure at national level will also include characteristic landscape areas, which are of national importance. Connectivity between these core green infrastructure areas will be ensured by natural linear (e.g. rivers) and point (stepping stones) landscape elements, or by creating or restoring such links where necessary*." Also linking ecologically important areas across national borders is mentioned as an aim.

The regional spatial planning was introduced in 2018 in Slovenia. Out of the 12 development regions, the two regions Goriška (NUTS3: SI043) and Gorenjska are relevant for the study area. The Regional spatial strategy is in work progress, but there are no regional spatial plans ready yet. At local (municipality) level, spatial planning documents will be elaborated, which must be in line with the regional spatial strategy. A municipal spatial strategy (OPP), a municipal spatial plan (OPN) and a municipal spatial detailed plan (OPPN) are instruments which will mandatorily consider the guidelines of different sectors, and harmonize the goals.

Nature protection planning is done at national level and includes ecological important areas, Natura 2000 sites and Nature Parks. Corridors to maintain wildlife and habitat connectivity are elaborated and planned by forestry sector at national level. Functional corridors, forest reserves and protective forest are mandatory to be considered in spatial planning. There is also a national water management strategy (published 2021) which provides aims and regulations for water management and ecological improvement of water bodies.

Despite the other sectors, agriculture does not regulate mandatorily the aspects for ecological connectivity. However, there is actual use monitoring of agricultural land and forests and there are Agri-ecological schemes provided where individual farmers can participate.

Overall, the diagram underlines the importance of national regulations and strategies for planning, also with regards to management and conservation of ecological corridors.

Slovenia

	Spatial Planning	Nature protection	Forestry	Agriculture	Water
National level	Spatial Planning Strategy of Slovenia 2050 (2023)	Ecologicaly important areas Natura 2000 areas Nature parks (NP, RP, KP)	Corridors to maintain wildlife habitat connectivity Forest reserves Protective forests	Actual use monitoring (agricultural land, forests) Agri-ecological scheme (individual farm)	Water management strategy
Province/Region	*Regional spatial strategy following in 2025 (RPP)**				
Local (Community/ Municipality)	Spatial planning documents on municipal level Municipal spatial strategy (OPP) Municipal spatial plan (OPN) Municipal spatial detailed plan (OPPN)				

reccomendation | mandatory | *In progress**

Figure 17: Plans, and strategies in the planning system of Slovenia

2.6.2 Spatial planning tools and incorporation and GBI in Italy

The following graphic provides a detailed overview of the multi-level framework for nature conservation and ecological corridors in Italy, with a focus on the Friuli Venezia Giulia region. The structure is divided into national, regional and local levels, each responsible for different aspects of spatial planning, natural resource management, forestry, agriculture and water. At the national level, the laws regulating protected areas are the General Law on Protected Areas (L.394/91), the Law on Cultural Heritage and Landscape in spatial planning and the Forestry Strategy (TUFF) in forestry.

The regional government plays a key role in the development of specific conservation plans, including landscape, wildlife management and forestry programs. Regulation in the five sectors (spatial planning, nature conservation, forestry, agriculture and water) at the regional level is more complex and requires coordination and harmonization between the different sectors. The arrows in the diagram show the need for harmonization between the different legal documents. In the area of spatial planning, two main regulations are in force: the regional urban planning law and the regional landscape plan. The coordination of programs and plans is supported by a law and they serve as a basis for the development of plans at the local (municipal) level.

In the area of nature conservation, there are several regional laws and programs, such as the law on regional protected areas, the conservation and development plan for nature parks and reserves, and wildlife and hunting plans. At this level, the regional ecological network is coordinated with the regional landscape plan. In the area of nature conservation at local level, the ecological corridors are dealt with in the local ecological network plans.

Overall, the diagram underlines the importance of multi-level cooperation in the planning, management and conservation of Italian natural landscapes.

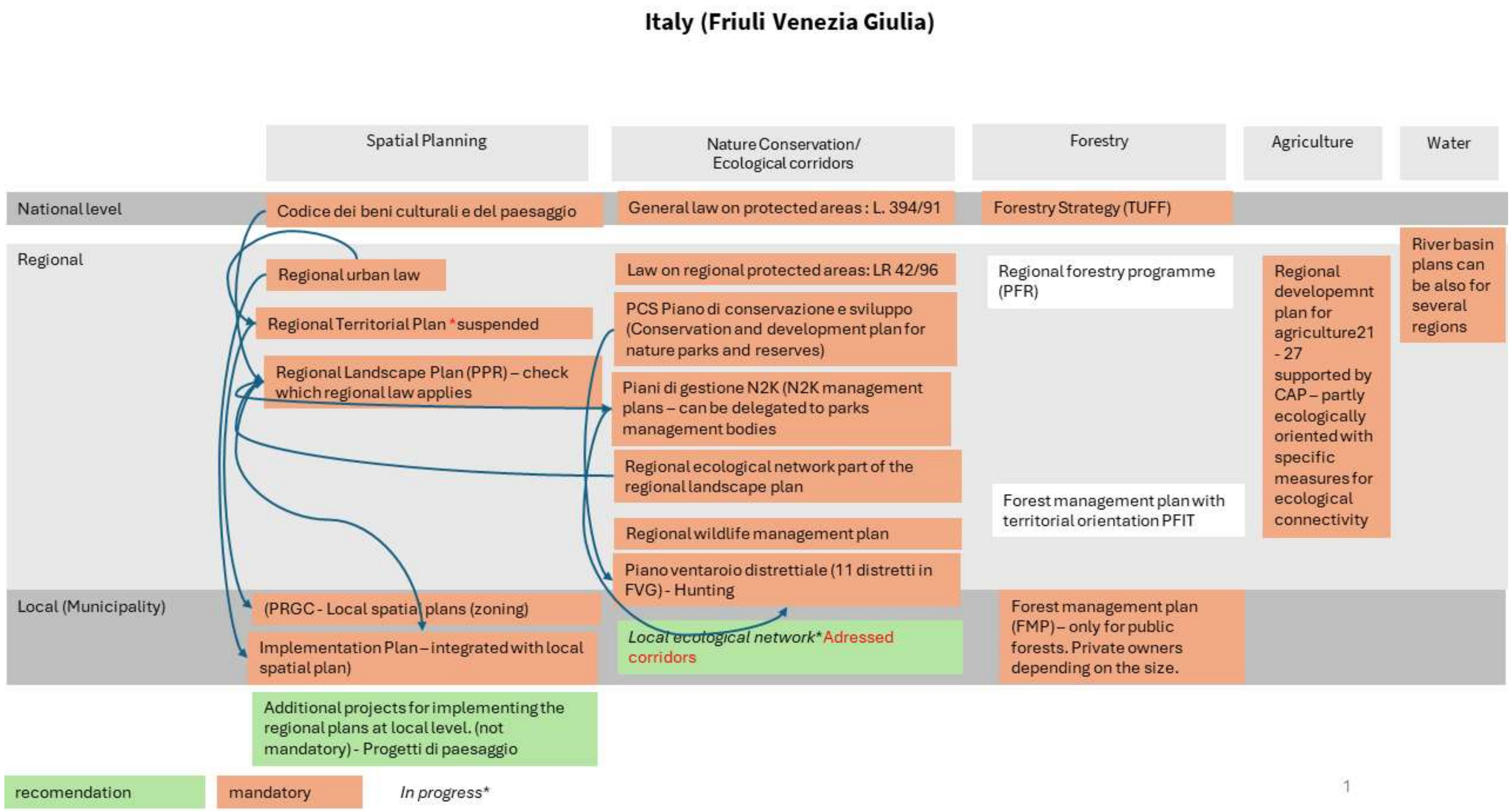

Figure 18: Plans, laws and programs in the planning system in Friuli Venezia Giulia

2.6.3 Spatial planning tools and incorporation and GBI Austria

In Austria, pursuant to a decision by the Constitutional Court of 1954, spatial planning is not a matter belonging to a specific sphere of administration, but rather a matter that concerns many sectors. In Austria, the different authorities at the federal, provincial and municipal level have planning remits. Different sectors are responsible for sectoral planning (Fachplanung) both at the federal and county levels. Therefore, there is no spatial planning law at national level. A spatial planning law exists at federal level. The Carinthian spatial planning law was revised 2021, saying that the nature, biodiversity and characteristics of the Carinthian landscape and identity must be preserved. Rather strong decisions are made at local level, in municipality development and municipality plans. They must go in line with the federal spatial planning law. They are elaborated by contracted spatial planning experts, who is contracted by the respective community.

Ecological corridor planning exists as an expert platform at national level but is not mandatory. It is an attempt to harmonize and legally establish corridors. Nature conservation does also not exist at national level. There are federal nature conservation laws, dealing with protected areas (§21-28), protected species and regulations with regards to red list habitat (§9). As a speciality in the Carinthia nature conservation law, the free landscape (outside settlements) is protected (§5) and projects need a permission. There is also a rather strong protection of all wetlands (§8), the zone above the closed forest (§6).

At national level, there is a strong forest law, regulating that forest areas must remain forests. There is also a national water management law, regulating the blue infrastructure. With regards to agriculture, there is a national programme for biodiversity friendly farming. It is not mandatory; farmers can voluntarily participate. There is also a nitrate regulation, which says that there should be 3 m distance to wetlands and water bodies.

Municipality spatial planning must consider sectoral planning guidelines at federal level. The content with regards to ecological corridors is rather limited. However, local wildlife corridors are more and more considered. Legally established nature conservation areas and natura 2000 sites nature need to be shown and are considered in the natural conditions analyses. Also, other protected elements of forest (protective forest, danger zones and water reserves are considered. However, spatial planning basically seeks for suitable areas for construction and development and does not actively plan for the connection of natural areas. Landscape planning or Landscape plans as a base for spatial planning do not exist in Austria. Overall, the diagram underlines the importance of multi-level cooperation in the planning, management, and conservation of Austrian natural landscapes.

Following plans, laws and programmes of relevant sectors deal with planning tools at different levels in Austria:

Austria (Carinthia)

	Spatial Planning	Ecological corridors and Nature Conservation	Forestry/Hunting	Agriculture	Water management
National Level		Lebensraum.at (Expert plattform)	Forest Law (2023)*	ÖPUL Nitrat Regulation	Water Law* National Water Management Plan Ecology quality target regulation
Province	Provincial Spatial Planning Law Open Space Concept (2006) *(GBI Concept (2023) in Progress)*	Nature Conservation Law §8, §9, §6 §5 and Protected area system (§ 23 to §28) Wildlife corridors	Hunting Law Forest Development Plan (County) Wildlife ecological plan (County)		Alluvial vegetation (public water body)
Local (Municipality)	Örtliches Entwicklungskonept (Municipality development concept) Flächenwidmungsplan (binding local plan)	Biotop inventory (partly)		Agri-ecological schemes (individual land owner)	

recommendation | mandatory

(2023)* Ecological function integrated

Figure 19: Plans, laws and programs in the planning system in Carinthia.

2.7 Case study implementation

The border region between Slovenia, Italy and Austria is a valuable area for ecological richness, special habitats and scenic beauty. The three countries should work together with regards to ecological connectivity to preserve the natural heritage, traditional land use and also their culture. Therefore, a strong connection of the Nature Park Dobratsch with the neighboring bilateral UNESCO biosphere reserve is seen as an opportunity to promote the ecological characteristics of the area also in the future. The trilateral network should include the strong ecological component of open spaces without barriers for migratory species, but also a strong connection of the cultural aspects of the trilateral Alpe-Adria border region.

Objectives:

- Establishment of the necessary cross border connectivity with regards of ecological connectivity
- Establishment of a cross-border platform for ecological connectivity and exchange of knowledge on the migration of species and the functions of habitats
- Harmonization of management objectives in the adjacent forest areas
- Minimization of barriers effects of the transport infrastructure
- Harmonization of spatial planning objectives in the region

The main actors involved are the administrative bodies of the three parks (Triglav National Park, Prealpi Giulie Natura Park and Natura Park Dobratsch), national and regional ecologists and spatial planning experts from all three countries who dealing with the municipalities, as well as the border municipalities themselves. They will be involved in international and regional workshops and discuss the network design based on the macro-regional model, obstacles and threats to connectivity as well as suitable and unsuitable uses.

Existing planning instruments and processes are addressed to find out the right option for implementing the international corridors. An international governance setting with a corresponding expert platform should improve cross-border cooperation in the future.

Cross-border cooperation is already taking place within the framework of several Interreg and CLLD projects. The three parks have already signed a memorandum of understanding for collaboration in the fields of biodiversity and climate change, sustainable development and involving the young generation.

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Annexes

Annex 1 Communities of the pilot regions

Table 2: Communities of the pilot regions with their number of inhabitants and area

Community	Bezirk/Provincia	population	Year	Fläche (ha)
Arnoldstein	Villach Land	7.036	2020	6.739,73
Bad Bleiberg	Villach Land	2.184	2020	4.480,71
Villach	Villach Stadt	63.253	2020	7.108,59
Treffen am Ossiachersee	Villach Land	4.539	2020	13.492,09
Nötsch im Gailtal	Villach Land	2.297	2020	4.272,32
Malborghetto Valbruna	Udine	910	2022	12.421
Pontebba	Udine	1.322	2022	9.966
Moggio Udinese	Udine	1.621	2022	14.243
Tarvisio	Udine	3.997	2022	20.836
Dogna	Udine	154	2022	7.037
Chiusaforte	Udine	614	2022	10.020
Venzone	Udine	1.953	2022	5.455
Resiutta	Udine	259	2022	2.036
Resia	Udine	93	2022	11.931
Bordano	Udine	710	2022	1.490

Gemona del Friuli	Udine	10.544	2022	5.606
Artegna	Udine	2.882	2022	1.122
Montenars	Udine	483	2022	2.059
Lusevera	Udine	585	2022	5.305
Taipana	Udine	565	2022	6.544
Kobarid	Celje	4.044		19.266
Bovec	Celje	3.178		36.788
Kranjska Gora	Brežice	7.689		25.654
Jesenice	Brežice	21.758		7.590
Žirovnica	Brežice	4.479		4.267
Bled	Brežice	8.250		7.226
Tolmin	Celje	10.953		38.232
Radovljica.	Brežice	19.325		11.878
Bohinj	Brežice	5.676		33.372

Annex 2: Relevant ecotopes for the Study Area in Italy

Table 3: Relevant ecotopes for the Study Area in Italy

Code	Name	Landscape Area	Function of the ecotype regarding the RER
02001	Val Alba	Val Canale, Canal del Ferro, Val Resia	Core area
02002	Alpi Giulie	Val Canale, Canal del Ferro, Val Resia	Core area
02003	Torbiera Scichizza	Val Canale, Canal del Ferro, Val Resia	Core area
02004	Conca di Fusine	Val Canale, Canal del Ferro, Val Resia	Core area
02005	Alpi Carniche	Val Canale, Canal del Ferro, Val Resia	Core area
02006	Torbiera di Pramollo	Val Canale, Canal del Ferro, Val Resia	Core area
02007	Monte Auernig e Monte Corona	Val Canale, Canal del Ferro, Val Resia	Core area
02008	Valloni di Rio Bianco e di Malborghetto	Val Canale, Canal del Ferro, Val Resia	Core area
02009	Lago Minisini e Rivoli Bianchi	Val Canale, Canal del Ferro, Val Resia	Core area
06001	Rio Bianco di Taipana e Gran Monte	Valli Orientali e Collio	Core area
06002	Forra del Cornappo	Valli Orientali e Collio	Core area
06003	Torrente Lerada	Valli Orientali e Collio	Core area

06006	Lago Minisini e Rivoli Bianchi	Valli Orientali e Collio	Core area

Ecologcial connectivity for relevant species

Code	**Type**	**Species**	**Connection between …**	**Description of the connectivity**[1]
134	Ecological connectivity	*Zootoca sp.** *(Carniolan Lizard and Viviparous Lizard)*	Alpi Carniche (02005) –Val Alba (02001)	Connection between the “Val Alba” and “Alpi Carniche” core areas. The route runs between **cliffs and macerations**, the vegetation of the **gravels of a tributary of the Aupa torrent**, and **rare pastures** undergoing **scrubland**, interspersed with **mugozoea.**
135	Ecological connectivity	*Zootoca sp.** *(Carniolan Lizard and Viviparous Lizard)*	Alpi Carniche (02005) – Torbiera di Pramollo (02006)	Connection between the core areas "Alpi Carniche” and "Torbiera del Pramollo". The route encounters a **few open areas**, represented by the **meadows** in the vicinity of the Winkel brook and other open areas along the road up to the Pramollo pass; these areas **require maintenance work**
136	Ecological connectivity	*Zootoca sp.** *(Carniolan Lizard and Viviparous Lizard)*	Monte Auernig e Monte Corona (02007) - Valloni di Rio Bianco e di Malborghetto (02008)	Connection between the core areas "Monte Auernig and Monte Corona" and "Valloni di Rio Bianco and Malborghetto". In consideration of the species used, the connecting route between these two core areas mainly uses **rocky habitats**, which do not **require management interventions.**

[1] Piano Paesaggistico regionale del Friuli Venezia Giulia. Parte Strategica. E1- Art 43 Dele norme techniche di attuazione. Scheda della rete ecologica regionale, online: https://www.regione.fvg.it/rafvg/export/sites/default/RAFVG/ambiente-territorio/pianificazione-gestione-territorio/FOGLIA21/allegati/BUR/18_SO25_1_DPR_111_70_ALL70.pdf

137	Ecological connectivity	*Zootoca sp.* (Carniolan Lizard and Viviparous Lizard)*	Torbiera Scichizza/ Conca di Fusine (02003/02004) - Alpi Giulie (02002)	Connections between the "Conca di Fusine" and "Alpi Giulie" core areas. Also in this case, the elaborations carried out return two alternative routes, a more northern one that exploits the **herbaceous vegetation** of the **gravels of the river Freddo** and the **river Slizza** and then flows eastwards, skirting the **mowing meadows** that surround Rutte piccolo, and a more southern one that crosses the **cliffs and screes** present on the ridge along the State border. The main management measures for these areas, which are **scarcely anthropised**, concern the **maintenance of the meadows**. The route interferes with some road axes, which, however, do not represent a barrier.
139	Ecological connectivity	*Coronella austriaca**	Alpi Giulie (02002) - Rio Bianco di Taipana e Gran Monte (06001)	Connection between the "Rio Bianco di Taipana and Gran Monte" and "Alpi Giulie" core areas. The route initially runs westwards **along the Gran Monte pastures** and then crosses the **compact woodland formations** on the **northern slopes**, which are not very permeable to the species considered. The size of the core areas, their proximity and the very pronounced morphology make this route of minor importance compared to the maintenance and strengthening of the grasslands where and if the infrastructural and socio-economic conditions to do so exist.
140	Ecological connectivity	*Coronella austriaca**	Alpi Giulie (02002) – Torbiera Scichizza/ Conca di Fusine (02003/02004)	Connections between the "**Conca di Fusine**" and "**Alpi Giulie**" core areas. Also in this case, the elaborations carried out return two alternative routes, a more northern one that exploits the **herbaceous vegetation of the gravels of the rio Freddo** and the **Slizza torrent** and then flows eastwards, skirting the mowing meadows that surround **Rutte piccolo**, and a more southern one that crosses the **cliffs and screes** present on the ridge along the State border. The main management measures for these areas, which

				are scarcely anthropised, concern the **maintenance of the meadows.** The route interferes with some road axes, which, however, do not represent a barrier.
141	Ecological connectivity	*Coronella austriaca**	Val Alba (02001) - Alpi Giulie (02002)	Connections between the 'Alpi Giulie' and 'Val Alba' core areas. The route runs along the **gravel banks of the Dogna** and **Fella** torrents as far as the Vidali locality, from here it climbs a **pine forest slope**, encountering some **meadow areas**, to be maintained and improved, in the Costamolino locality. The last section crosses some **screes and macerations** along the **river Molino**. A second route runs between Povici, Resiutta and Ovedasso. For the open area species, the **preservation of mowing meadows** and **the restoration of bushes to grassland** is very important. For both routes, there is the significant **barrier** of the **motorway**, in respect of which the local ecological network will have to identify and enhance the most suitable crossings.
143	Ecological connectivity	*Zootoca sp.* (Carniolan Lizard and Viviparous Lizard)*	Alpi Giulie (02002) – Alpi Carniche (02005)	At the outlines of the pilot region
144	Ecological connectivity	*Zootoca sp.* (Carniolan Lizard and Viviparous Lizard)*	Alpi Giulie (02002) – Lago Minisini e Rivoli Bianchi (06006)	Connections between the core areas "Alpi Giulie" and "Lago Minisini and Rivoli Bianchi". The environments crossed by this route appear **unsuitable for species linked to open areas,** except for **some screes and boulders** that develop along some **minor streams**. However, the distance between the two areas is minimal.

145	Ecological connectivity	*Zootoca sp.* (Carniolan Lizard and Viviparous Lizard)*	Rio Bianco di Taipana e Gran Monte (06001) – Torrente Lerada (06003)	Connection between the core areas "Torrente Lerada" and "Rio Bianco di Taipana e Gran Monte". For the species linked to the open areas, it is advisable to **improve the permeability of the guideline by resuming mowing and possibly clearing the neo-formations on former meadows**; some **meadow formations to be upgraded** are to be found along the **Natisone river.** The **reinforcement of grasslands** around built-up areas already constitutes a useful **stepping stone** system to maintain general connectivity.
147	Ecological connectivity	*Coronella austriaca**	Rio Bianco di Taipana e Gran Monte (06001) - Forra del Cornappo (06002)	Connection between the core areas "Rio Bianco di Taipana and Gran Monte" and "Forra del Cornappo". This is an **entirely theoretical route** as it crosses wooded habitats that are not very permeable to species linked to open areas. In these contexts, it is therefore appropriate to **favour the recovery of grasslands** where and if the infrastructural conditions to do so are available.
148	Ecological connectivity	*Zootoca sp.* (Carniolan Lizard and Viviparous Lizard)*	Val Alba (02001) – Alpi Giulie (02002)	Connections between the 'Alpi Giulie' and 'Val Alba' core areas. The route runs along the **gravel banks of the rivers Dogna and Fella** as far as the Vidali locality, from here it climbs a **pine forest slope**, encountering some **meadow areas**, **to be maintained and improved**, in the Costamolino locality. The last section crosses some **screes and macerations** along the **river Molino**. A second route runs between Povici, Resiutta and Ovedasso. For the open area species, the **conservation of mowing meadows and the restoration of bushes to grassland** is very important. For both routes there is the significant **barrier** of the **motorway**, with respect to which the

				local ecological network will have to identify and enhance the most suitable crossings.
155	Ecological connectivity	*Coronella austriaca**	Alpi Carniche (02005) - Valloni di Rio Bianco e di Malborghetto (02008)	(interfered by infrastructures). Connection between the "Alpi Carniche" and "Rio Bianco and Malborghetto valleys" core areas The **mowing meadows** between Studena Bassa and Pontebba guarantee a good permeability for the species linked to the open areas, the Pontebba area is more critical, in particular due to the presence of **numerous infrastructures**, which can, however, be crossed at the **bridges and viaducts on the watercourses**. From San Leopoldo the route follows the **gravel of the river Clusca**, a **tributary of the river Fella.**
159	Ecological connectivity	*Zootoca sp.* (Carniolan Lizard and Viviparous Lizard)*	Valloni di Rio Bianco e di Malborghetto (02008) - Alpi Giulie (02002)	(interfered by infrastructures). Connections between the core areas "Rio Bianco and Malborghetto valleys" and "Alpi Giulie". Two possible connection routes are identified, a more westerly one, which passes west of Malborghetto and follows for a certain stretch the **gravels of the Fella** and then the **meadows corresponding to the pipeline route**, and a more easterly one, which passes immediately east of Ugovizza, following for the first stretch the **course of the river Uqua**. Both routes converge in the **mowing meadows** to the north and west of Valbruna and from there follow the **gravel of the river Saisera**. The crossing of the **Fella valley** and the **infrastructure** running parallel **to the river must be verified in detail.**
160	Ecological connectivity	*Coronella austriaca**	Valloni di Rio Bianco e di Malborghetto (02008) – Alpi Giulie (02002)	(interfered by infrastructures). Connections between the core areas "Rio Bianco and Malborghetto valleys" and "Alpi Giulie". Two possible connection routes are identified, a more westerly one, which passes west of Malborghetto and follows for a certain stretch the **gravels of the Fella**

				and then the **meadows** corresponding to the **pipeline route**, and a more easterly one, which passes immediately east of Ugovizza, following for the first stretch the **course of the river Uqua**. Both routes converge in the **mowing meadows** to the north and west of Valbruna and from there follow the **gravel of the stream Saisera**. The crossing of the Fella valley and the infrastructure running parallel to the river must be verified in detail.

*The first approach to building the network is therefore based on analysing the suitability of the soil for the identified species. Suitability is attributed independently of the actual presence of the species in the entire reference area. These areas are identified as nodes. Then the connecting lines between these points are calculated for each species using the open-source software Graphab. The software analyses all possible connections and selects the shortest/least costly route. Finally, only connections between the optimal environments within the protected areas were identified and filtered from this.

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Case Study: Border triangle Austria, Slovenia, Italy

Inputs for the Cross-Boundary Regional Connectivity Working Group

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