Strategy for improved ecological connectivity throughout the Dinaric Mountains and connecting them with the Alps

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1. Introduction

The deterioration and fragmentation of natural ecosystems are key causes of the global biodiversity crisis and can ultimately endanger life on Earth (ClimateAdapt, 2019). Several national and international policies and treaties, such as the Convention on Biological Diversity (CBD, 1992), have highlighted the challenge of safeguarding connectivity in a fragmented world. Ecosystem fragmentation and need for connectivity is one of the indicators used by the CBD to monitor progress toward its biodiversity goals (CBD, 1992). Many protected areas have been established to preserve sites of high biodiversity value. However, protected areas alone will not effectively conserve biodiversity without ecological connectivity with their environment (ClimateAdapt, 2019; Crooks and Sanjayan, 2006). The Conference of the Parties (COP) as well as the EU and several conservation organizations are promoting national and even international ecological connectivity networks, although their implementation faces many obstacles (Jongman et al. 2011).

Ecological connectivity describes the movement of organisms as gene flow, migration and dispersal of species or processes in a landscape; the more movement there is, the better the connectivity (Crooks and Sanjayan, 2006). Inter-linkage of land surface features, climate characteristics and human activities are influencing the Ecological Connectivity. All these elements actively interact and constantly change over time. Human population growth and the resulting need for space and natural resources have led to anthropocentric systems that set aside the required conditions for the preservation of biodiversity.

The Dinarides and the Alps are exceptionally rich in biodiversity which is threatened by fragmentation and habitat loss. The DINALPCONNECT project, supported by ADRION transnational programme, aims to improve ecological connectivity between these mountain ranges to enable sustainable protection of biodiversity in the face of current and future climate change. Eleven DINALPCONNECT partners from seven countries are establishing a network of Pilot regions to jointly develop transboundary linkages. The project delivered and published various reports with accurate analysis on the current situation, examine ongoing policies and practices, and provided guidelines and suggestions for harmonisation of the current EU legislation. Spatial data have been collected and analysed in order to define macro regional corridor, linkages and stepping stones.

Based on accurate and tailored knowledge in the DINALPCONNECT project area and its pilot regions, the Strategy for ecological connectivity represents a next step toward implementation of proposed solutions in favour of enhanced ecological connectivity.

2. Objective

The *Strategy for improved ecological connectivity throughout the Dinaric Mountains and connecting them with the Alps* aims to raise the level of ambition for biodiversity conservation and improved ecological connectivity in the entire Adriatic-Ionian microregion. The Strategy seeks to promote the cohesion of all the existing biodiversity policies in forming a merged vision with additional identified guidelines in favour of Ecological Connectivity. Different sub-objectives have been identified with the project partners, associated partners and stakeholders:

- ✓ raise the level of ambition for improving ecological connectivity,
- ✓ design a roadmap to facilitate the cohesion among existing policy initiatives,
- ✓ propose key interventions for improvement of the current situation,
- ✓ propose responsive, concrete and operational actions,
- ✓ identify short and long terms benefits for ecological connectivity,
- ✓ promote the strategy towards stakeholders and decision makers.

The strategy will be, by the project partners and associated partners, addressed to decision makers and all stakeholders concerned with the ecological connectivity of the DINALPCONNECT project. Any stakeholder interested in this topic within the ADRION microregion or further, will also be able to re-use the contents of the strategy report**.**

Transnational cooperation of different sectors and experts within the DINALPCONNECT project is an important opportunity to raise the level of ambition for improved Ecological Connectivity by shaping a coherent and responsive strategy with concrete and operational benefits. The strategy focuses on spatial, social and economic aspects. For each identified thematic field, practical guidelines on how to achieve desired (improved) state are provided on macro regional, national and local level.

3. Methodology

The Strategy is based on the key findings of the previous reports elaborated under the DINALPCONNECT project:

- Situation analyses (Premelč et al. 2021 WP2-A.1),
- Spatial data overview (Laner and Favilli 2021 WP1-A.3),
- Policy overview (Agricultural University of Athens, 2021: WP1 – A.1).
- Examination of current agricultural and forestry practices affecting Ecological Connectivity (Nève Repe A., and al. 2021WP3-A.2),
- Guidelines for sectoral practices and transboundary management (Premelč et al. 2021).

From aggregated findings of previous report, the Strategy addresses the gap between existing objectives and required ones, needed to improve ecological connectivity. This analysis includes spatial observations of the land cover distribution within the macro regional corridors and Strategic Connectivity Areas models developed by EURAC (Laner and Favilli 2022). Glance at the current situation and the desirable statement consider the most strategic areas in land management from the point of view of both sectoral practices and land uses.

The strategy aims to improve ecological performance of the following sectoral areas which are developed in dedicated chapters: forestry, agriculture, wildlife management, water management, tourism, role of protected areas, spatial planning and infrastructure. Each of the identified themes is examined with regard to its importance, the current situation and the gap with the desirable state, examples of good practice and appropriate guidelines divided on three (administrative) levels.

In addition to the literature, benchmarking of best practices with the help of project partners and associated partners of DINALPCONNECT project was supported by a call for comments on draft report and the organisation of two workshops. The first workshop was held online on 11 May 2022 with lead partner, partners and associated partners of the DINALPCONNECT project to discuss the first draft of the strategy. The second workshop was organized on the 7th of June 2022, embedded in the Conference on Ecological Connectivity (organized within the DINALPCONNECT project) in Velenje, Slovenia. This conference was an opportunity to collect additional scientific expertise of the Conference participants (as they were not only limited to the representatives of the

project partner institutions). 31 participants took part in this workshop and provided valuable input for the strategy (WP T1.4.1 Report on consultation workshop for strategy).

Figure 1: Timeline of the Strategy preparation

The participants took an active part in the workshop and made many recommendations to improve the report on the Strategy for improved Ecological Connectivity throughout the Dinaric Mountains and connecting them with the Alps. The comments provided and notes taken have been critically revised, explored and if considered relevant, included in the Strategy. The interaction and sharing of expertise and scientific knowledge that took place during the workshop, comparing the views of participants from different countries, organizations and disciplines, was an important added value for the DINALPCONENCT project.

Figure 2: Workshop stations. Conference in Velenje on the 7th of June 2022

4. Overview of ongoing strategies for improved ecological connectivity

World and European level

The concept of Ecological Connectivity has been indirectly incorporated in various sectoral policies on national and EU level. Ecological Connectivity is mainly promoted through environmental policies. On global and European level, among the most important policy initiatives that involve the DINALPCONNECT area, the following ones have been identified:

- Convention on Biological Diversity (CBD, 1992),
- Habitats and Wild Birds Directives,
- Water Framework Directive,
- EU Nature Restoration plan,
- EU Strategy on Green Infrastructure,
- EU Green Deal (EU Biodiversity Strategy for 2030, Farm to Fork Strategy),
- European Green Belt.

The policy-makers and the stakeholders responsible for the strategic development of Ecological Connectivity networks are usually addressing this topic on European level, national level or regional authority, and also within municipal boundaries. Research institutions and NGOs have less chance to participate intensively to the Ecological Connectivity governance. Nevertheless, a stream of cross-border cooperation is triggered by some Environmental NGOs (EcoAlbania, EuroNatur Foundation, RiverWatch, IUCN ECARO, MedINA, Pindos Perivallontiki, Tour du Valat, Wetlands International – European Association). The business community is usually low ranked in commitments on ecological connectivity leadership (Agricultural University of Athens, 2021).

At the EU level, policies in favour of Ecological Connectivity are formalized through sectoral ambitions (Habitats and Wild Birds Directives, Water Framework Directive, Green Deal, CAP, the EU biodiversity strategy, the EU Green Infrastructure, the EU forest strategy), transnational agreements (EUSAIR, EUSDR), protected areas and management plans but also throughout operational projects for restoring natural habitat such as LIFE programme projects.

The agreement on reform of the Common Agricultural Policy (CAP) was formally adopted on 2nd December 2021. The CAP 2023-27 is a step forward from the previous period. The

new ambitions aim at a sustainable agricultural model that will support smaller farms and adapt measures to local conditions. To enable successful implementation, national strategic plans are required for each EU country and the CAP will be based on result-oriented monitoring through pre-defined indicators. In addition, advisory services, financial instruments, and research and innovation support.

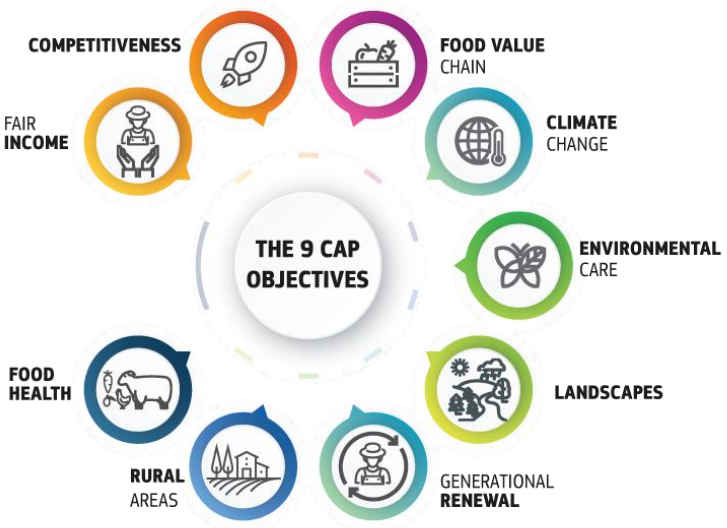
9 key objectives are defined for the period 2023-27 (European Commission, 2021):

- to ensure a fair income to farmers,
- to increase competitiveness,
- to rebalance the power in the food chain,
- climate change action,
- environmental care,
- to preserve landscapes and biodiversity,
- to support generational renewal,
- vibrant rural areas,
- to protect food and health quality.

The report *Using Eco-schemes in the new CAP* produced by the Institute for European Environmental Policy and the Research Institute of Organic Agriculture in February 2020 has explored solutions and system-based approaches in order to perform eco-schemes in the next CAP. New CAP legislation has been also based on the conclusions of Farm to Fork strategy which claimed for sustainable food systems.

Among adopted measures in the CAP 2023-27, it would be required for each farm to dedicate at least 3% of arable land to biodiversity and non-productive elements, with a possibility to receive a support via eco-schemes to achieve 7%. Beyond this percentage, all wetlands and peat-lands would be protected. Ecoschemes will be mandatory for Member States to offer by allocating at least 25% of their sectoral spendings to it. Farmers will be rewarded for implementing climate and environmentally friendly practices (organic farming, agroecology, integrated pest management, etc.). At least 35% of rural development funds will be allocated to agri-environment commitments, which promote environmental, climate and animal welfare practices. In the fruit and vegetables sector operational programmes will allocate at least 15% of their expenditure towards the environment.

Figure 3: The 9 CAP objectives adopted on 2 December 2021



The E.U. Green Deal has targeted objectives that could contribute to sustainable agricultural practices such as (EU Green Deal, 2019):

- *Reduce by 50% the overall use and risk of chemical pesticides and reduce use by 50% of more hazardous pesticides by 2030.*
- *Achieve at least 25% of the EU's agricultural land under organic farming and a significant increase in organic aquaculture by 2030.*
- *Reduce sales of antimicrobials for farmed animals and in aquaculture by 50% by 2030.*
- *Reduce nutrient losses by at least 50% while ensuring no deterioration in soil fertility; this will reduce use of fertilisers by at least 20 % by 2030.*
- *Bring back at least 10% of the agricultural area under high-diversity landscape features by 2030.*

The EU Biodiversity Strategy recommends actions to ensure sustainable agriculture and forestry practices: enhance CAP direct payments to reward crop rotation, permanent pastures, improved cross-compliance standards for Good agricultural and environmental conditions (GAEC) and for including the Water Framework in these standards, provides

tools to practitioner, conserve and support genetic diversity in Europe's agriculture, raise biodiversity awareness among forest holders and in forest management plans.

The European Green Belt Initiative (https://www.europeangreenbelt.org/), developed on the former Iron Curtain, which divided the European continent into East and West for nearly 40 years is an initiative to harmonize human activities with the natural environment and to increase opportunities for the socio-economic development of local communities.

Macro Regional level:

At the macro regional level, among the most important policy initiatives that involve the DINALPCONNECT project area, are identified the following ones:

- Alpine Convention,
- ALPBIONET project,
- DINALPCONNECT project,
- EUSAIR,
- Big Win II for Dinaric Arc,
- LIFE projects,
- LUIGI (Linking Urban and Inner-Alpine Green Infrastructure - Multifunctional Ecosystem Services for more liveable territories.

The Alpine Convention is the first international treaty aimed at the sustainable development and protection of an entire mountain range. The year 2021 marked the 30th anniversary since the Convention was first signed, laying down the international commitment to protect the Alpine region. The challenges faced by the Alps are often cross-border in nature, and can be solved best through cooperation. Recognising this, the eight Alpine countries (Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia, and Switzerland), together with the European Union, formed the Alpine Convention to address these challenges together (Alpine Convention 1991).

ALPBIONET2030 project started in November 2016 and is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme. Participant countries from the Alpine Region developed a multi stakeholder and cross-border concept for integrated wildlife management in the Alps. Toolbox and Strategic Alpine Connectivity Areas (SACA) mapping provided a common Alpine biodiversity conservation approach with specific focus on Ecological Connectivity Pilot Regions 8 ALPBIONET2030, 2019).

The DINALPCONNECT project aims to improve ecological connectivity from the Dinarides to the Alps to enable sustainable protection of biodiversity in the face of current and future climate change. Cross-border coordination is crucial on the issue of connectivity in order to strengthen an efficient and coherent permeability at the level of a bioregion. The DINALPCONNECT project was developed for this purpose. This initiative leads to identify current practices, assess environmental balances, define common biodiversity concerns, create collective synergies between the interests of each local and transnational stakeholder. The final outcome would contribute to overcome administrative and institutional boundaries for a better cross boundaries management and a trans-disciplinary cooperation.

The EU Strategy for the Adriatic and Ionian Region (EUSAIR) is a macro-regional program scaled for the Adriatic Ionian Region countries. EUSAIR has been adopted by the European Commission and endorsed by the European Council in 2014. The Strategy was jointly developed by the Commission and the Adriatic-Ionian Region countries and stakeholders, which agreed to work together on the areas of common interest for each country and the whole region. The EUSAIR covers nine countries: four EU member states (Croatia, Greece, Italy, Slovenia) and five non-EU countries (Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia). In 2013, Albania, Bosnia and Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia and Slovenia approved an agenda to preserve the Dinaric Arc environment entitled Big Win II for Dinaric Arc. This agreement set quantifiable national objectives. The European constituting the Mediterranean coastal zone agreed for a Protocol on integrated Coastal Zone Management in the Mediterranean (Official Journal of the European Union L 28, 4 February 2009, pp. 19–28). This international accord aims to facilitate rational planning of human activities in favour of the sustainable littoral zone development. This protocol includes the preservation of natural resources, reasoned water use, safeguarding of coastal ecosystems, landscapes and geomorphology, prevent natural hazards. Unfortunately, the results of this political agreement have not yet been realized in practice.

Many LIFE projects organized interventions on the habitats of threatened species in order to strengthen populations through genetic exchange. Beyond the Natura 2000 network, some of the actions are also including stepping stones areas for migrating birds and consider corridors linking habitats (https://op.europa.eu/en/publication-detail/-/publication/49904334-8f6b-4406-8791-4fba31f2ddbb/language-en).

LIFE 99 NAT/GR/006498 carried out an analysis on connectivity in Greece and Albania border areas (part of the Pindos range) and in Rhodope bear population in Greece and

Bulgaria. Seminars and training sessions has been organized with Balkan NGOs and other stakeholders in the regions (Agricultural University of Athens, 2021).

In 2010, a new agreement was signed by Albania, Greece, FYROM (now Northern Macedonia) and the EU, to create a standing, formal coordination body concerning the "protection and sustainable development of the Prespa Park (Agricultural University of Athens, 2021).

The Interreg Alpine space project LUIGI (Linking Urban and Inner-Alpine Green Infrastructure - Multifunctional Ecosystem Services for more liveable territories) gathers 14 partner institutions and 26 observers from Austria, France, Germany, Italy, Slovenia, and Switzerland with the aim of strengthening the link between mountain ecosystems and urban centres at the foot of the Alps through sound economic and social exchanges. The project's objective is to identify and enhance the joint benefits of a Green Infrastructure network between mountain/rural and urban areas, as well as their potential for sustainable economic development based on natural resources and ecosystem services, ensuring a higher quality of life and better urban environments for people living in urban centres (Hladnik et al. 2020).

National and local level

Overall, national, regional and municipal levels have the most legitimacy to implement concrete measures to increase the multi functionality of protected areas on the field. Implementation and financing of management plans vary from country which is challenging for transboundary management. Related policies to ecological connectivity can also be split between different sectors or vertical level that challenges its implementation.

5. The gap between the ongoing policies and interventions and the desirable state of ecological connectivity

Indirectly or directly related, sectoral policies in the field of biodiversity, agriculture, forestry, tourism and spatial planning at the macro regional, national and local level are contributing in favour of ecological connectivity. Nevertheless, ecological connectivity approach is not often clearly established as a specific objective in legislation framework, and might be missed consider among potential financial instruments. Research projects, European macro regional programme and advisory services are developed and provide the opportunity to re-drive policies and related actions plan for an improved state of ecological connectivity.

Among the identified main gaps that can be pointed out in previous chapter, there is a lack of accurate spatialized (in site) implementation. Even though good practices are identified, and objectives are qualitatively and globally quantitatively defined, the policy framework for agriculture, biodiversity and forestry does not include a **spatial distribution to better target priority interventions for ecological connectivity**.

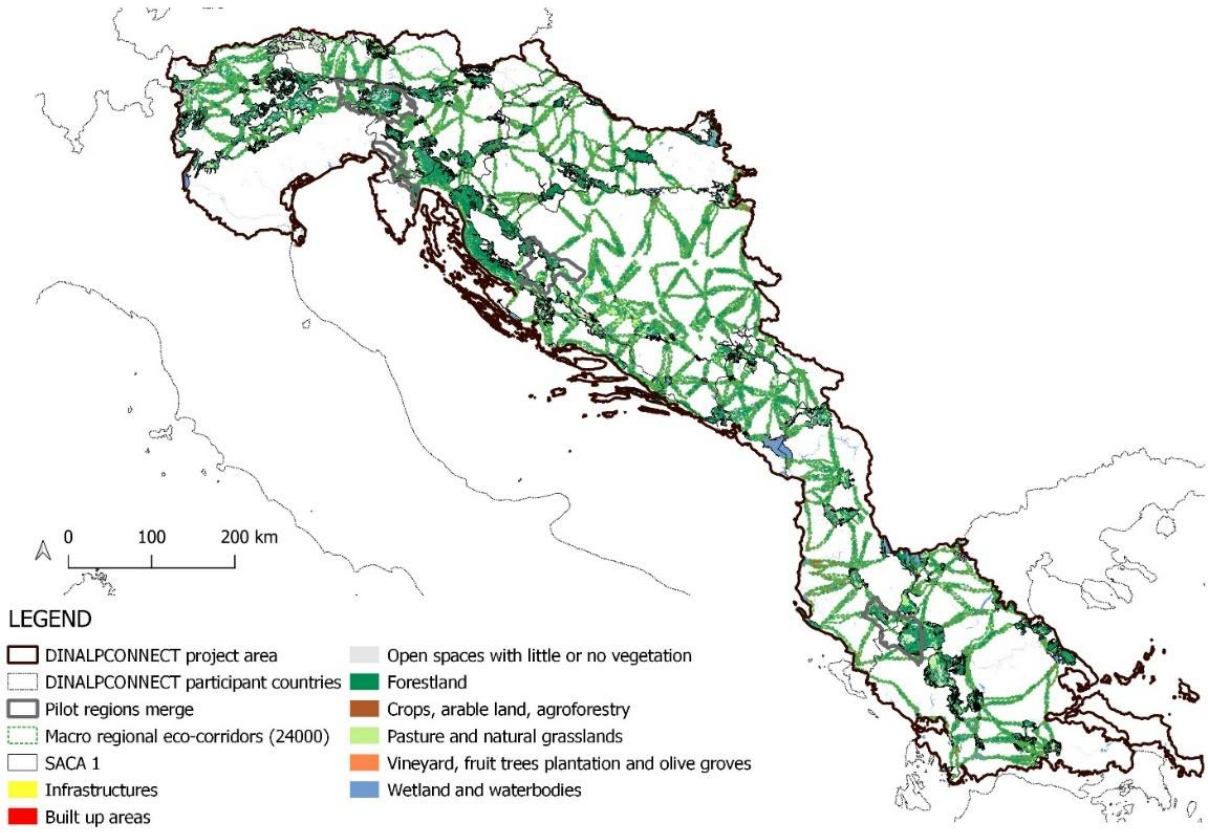
DINALPCONNECT project outputs represents an opportunity to implement spatial models of macro regional eco-corridors (EURAC, 2022). Spatial planning is strategic area for coordination and cohesion of land use management and spatial oriented interventions in favour of ecological connectivity. Spatial arrangements help to foster well balanced implementation and develop cohesion of local initiatives.

Another important key gap is identified between written existing objectives, operational initiatives and sustainable implementation. Awareness raising among policy makers and all stakeholders from all levels is still required to set biodiversity preservation a high ranked priority. When decision makers would support ecological connectivity objectives, action plans could be conceived as a matrix between objectives/expected results and existing resources. EU structural funds and specific Programmes and Instruments can provide support even though administrative procedure for applications are not always reachable for small organizations at the local level. Sustainability of implementation is either a matter of keeping the focus over time than a matter of resources.

Finally, strategies are requiring **well defined and harmonized indicators and monitoring tools based on scientific knowledge** more than on administrative jurisdiction.

EURAC research (project partner in the DINALPCONNECT project) has performed spatial data analysis by implementing a range of indicators that investigate the level of permeability regarding population pressure, environmental protection, fragmentation of landscapes (road and infrastructure obstacles), land cover assessment and topography. The Continuum Suitability Index (CSI) has been then computed by pondering the influences of each preliminary indicator from their weight as to ecological effects (Affolter 2020). The CSI as umbrella indicators provides a notation from 1 to 10 about the porousness of an area in favour of ecological connectivity. 1 corresponds to a low ecological connectivity and 10 a very efficient one. From this computing process has been designed SACA 1 areas that have good conservation statement for biodiversity and macro regional eco corridors to connect them (Laner and Favilli 2021).

Map 1: Land cover distribution within the macro regional eco corridors and Ecological Conservation Areas with high ecological value.

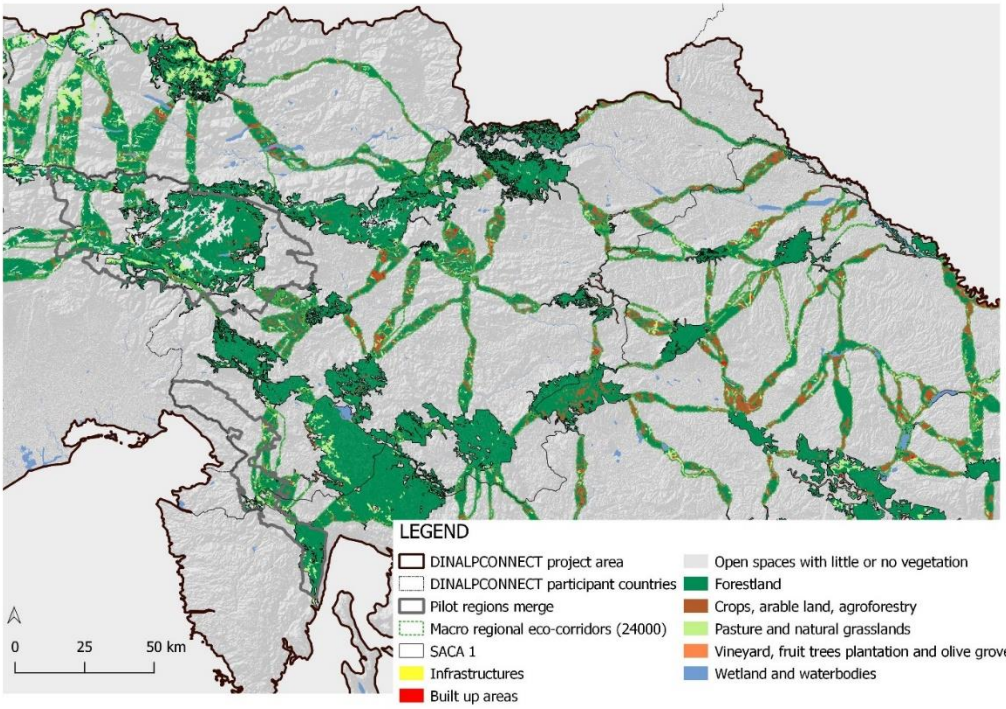


Sources: Corine Land Cover 2018, EURAC 2022

An overview of the land cover distribution of 2018 within the macro regional eco corridors and SACA 1 areas (Corine Land Cover, 2018, EURAC 2022) is a good starting point to set the current situation for further comparative analysis in the future and rank the sectorial priorities for the strategy. Sectoral practices can be ordered according to the preponderance of land covers identified within the macro regional eco corridors and SACA 1 areas as following: forestry (66,2%), agriculture (18.7%), open spaces with no or little vegetation (7,6%), wetlands and water bodies (7,4%), infrastructure (0,07%), built up areas (0,025%). Forestland is the most predominant land cover for the territorial macro regional corridors and SACA1 areas in the DINALPCONNECT project areas as wheel as for pilot regions (66,3% of corridors and SACA1 areas within pilot regions).

Scientific papers stated that 2 km can make some species become “corridor dwellers”. On the maps, the corridor width with a normalized distance up to 2,4 km has been selected to be overlayed with Corine Land Cover dataset of 2018. Corine Land Cover classes has been gathered in 8 categories in order to link the visualisation with the sectorial recommendations.

Map 2: Land cover distribution within the macro regional eco corridors and Ecological Conservation Areas with high ecological value (SACA1)



Sources: Corine Land Cover 2018, EURAC 2022

6. The Strategy

The strategy aims to improve ecological performance of the following sectoral areas which are developed in dedicated chapters: forestry, agriculture, wildlife management, water management, tourism, role of protected areas, spatial planning, and infrastructure.

6.2 Forestry

6.1.1 Why is it important ?

Maintaining high standards of quality forests (i.e. sustainable managed with rich biodiversity) is challenging. This is indicated by a wide range of forest management practice within the countries of the DINALPCONNECT project. Objective factors that hinder sustainable management of all forest land are: high share of privately owned forests, uncontrolled logging in some parts of the project area, rise of destructive consequences of natural hazards (predominately fires). Additionally, invasive species, ongoing changes in ecosystems, emissions in soils, deforestation, fire incidents, increasing number of natural disasters (mostly due to climate change) are increasingly stressed out (Agricultural University of Athens, 2021).

Fragmented forest properties remain an important obstacle for ecological connectivity management.

6.1.2 Glance at the current situation and desired future state

Primary forest remains to the same extent for each DINALPCONNECT countries on the same period (FAOSTAT, 2021). The forestland use is extending in Italy in parallel of the agricultural land decline previewed in the first figure. Greece is slowly increasing the forestland in a more moderate extent. The other DINALPCONNECT participant countries are conserving the same forestland areas over time since 1992 (FAOSTAT, 2021). Forest regeneration is the process by which new tree seedlings are performed after the trees in the forest have been harvested or have died due to fire, insects or disease. Regeneration is the key to sustainable forestry and can be achieved by restricted clearcutting, seed-tree, shelterwood, selection, and coppice. The percentage of forest regeneration is therefore a good indicator of the assessment of the forest. Albania and Greece have a

lower share of regenerating forest (90% in 2018) that they use to have in 2000. Montenegro is the country with the highest share of regenerating forest (98,5). Forests Management Plans are covering all forestlands except in Bosnia and Herzegovina for private forestland while they exist for state owned forests and Montenegro.

Nevertheless, there are gaps between their objectives and the effective implementations, especially because managers on the field are missing in some of the pilot project areas. The lack of awareness among all users of the forests might also explain the unsuccessful management in some of the pilot regions (Agricultural University of Athens, 2021).

The table below calculates the overlapping protected natural areas with the macro regional corridor model developed by DINALPCONNECT (EURAC, 2021). The purpose of this table is to measure the influence of well-managed forestland areas on the effectiveness of ecological connectivity.

Table 1: Calculation of forestland areas within macro regional corridors and Ecological Conservation Areas with high ecological value

Forest land (CLC: 311,312,313, 322,323,324)	Within the macro regional eco corridors (ha / % of the corridors areas)	Within the Ecological Conservation Areas (ha / % of the areas)	Total (ha / % of the Ecological Conservation Areas and Regional corridors project areas)
DINALPCONNECT project area	2 210 542 ha (61%)	2 726 917 ha (71%)	4 937 459 ha (66,2%)
Pilot regions	6 519 ha (8,6%)	303 877 ha (77%)	310 369 ha (66,3%)

Sources: Corine Land Cover 2018, EURAC 2022.

6.1.3 Examples of good practices from DINALPCONNECT project area

Nat2care project

Figure 4: Intervention area (Source: Parco naturale Prealpi Giulie)

Location: Natura 2000 area ZPS IT3321002 (Julian Prealps Natural Park) in the area of Ungarina, Confin and Campo in Municipality of Venzone (Ud.), Italy.

Goal: Conservation and restoration of habitats in support of biodiversity.

Stakeholders: Julian Prealps Natural Park

Pilot action: Support the growth of typical herbaceous species through wildlife management projects, key interventions and species monitoring.

Results: The interventions carried out in the area of 10 ha have led to the increase of the most suitable habitat for the Corn crake and other animals present in this area. A generalized intervention was carried out on the surface as a whole, removing the herbaceous and shrubby vegetation present (including Genista sp. Robus. Sp. Etc.), in order to favour the growth of typical herbaceous species with the new spring season of the area. Local areas with bushes and small trees have been preserved (Alnus incana, Sorbus aucuparia, Juniperus sp., Salix sp., Etc.) in order to better diversify the landscape and with the aim of preserving important ecological niches for different avifauna species (in particular Laniuscollurio), significantly present in the Ungarina-Confin area.

Mašun forest house and forest educational trails

Figure 5: Mašun forest house *(Photo: Q. Drouet)*

Location: Forest area at the foot of Snežnik, Postojna area, Slovenia.

Goal: Raise awareness and understanding of the public and the forest owner's awareness to help them to develop a more responsible attitude to it.

Stakeholders: Slovenia Forest Service

Pilot action: Developing an information and educational centre to inform the public and forest owners about wildlife preservation, forest protection, sustainable forestry and hunting management practices.

80 marked trails through the forest equipped with educational texts has been established with the two first one since 1974.

The educational centre and trail contribute to promote biodiversity among forest users and owners and develop interaction for efficient inclusive forestry management plan. The Slovenia Forest service is actively developing public relations and sharing knowledge on forestry technique with forest owners.

6.1.4 Guidelines on how to achieve desired state on:

Local level

- **Reinforcing the communication** with all local stakeholders (forestry services, visitors, hunters, forest owners, biologists, etc.) and promote a fundamental knowledge on the issue of Ecological Connectivity to ensure long term cooperation.

- **Developing inclusive forestry management plans** with researchers, parks' managers, forestland owners, hunters, bikers, mushroom pickers, farmers, local communities, tourist visitors from the start of the elaborating process to enable long-term sustainable practices. It is a current practice in Slovenia and this initiative should then be pursued across borders. All the forest users can play a role to respect wildlife but could also contribute for referencing an interactive map on accidents/predations as it has been demonstrated in Rediafor projects (2021). This initiative could involve associations and cooperatives in the implementation as well to facilitate the interactions and efficiency.

- **Provide tailored advice to forest landowners** prior to harvesting, where this has not already been done.

- **Harmonizing Forestry management plan criteria** (contributing to the national and macro-regional objectives, i.e. a transnational monitoring.). Existing forest management plans could be updated with ecological connectivity approach including Green Infrastructures and biodiversity conservation issues ensure to implement related objectives on the field.

- **Supporting resilient forest** taking into consideration various habitat types within the forestland in order to enable various species groups to survive. For examples: trees of different ages and indigenous species reduces vulnerability to fire and pests. Leaving stumps and trunks on the ground also helps prevent landslides.

- **Interconnecting** spatial planning, funding opportunities (ex: LEADER), hunting and forestry management plan (to be shaped considering also EC, other). When forestland don't benefit from a Natura 2000 protection regime, planning tools, forest service and Structural Funds should support individual taking care of the forest (providing seedlings and seeds for forest regeneration, marking tree for felling, silvicultural work).

- **Performing the Landscape disturbance and succession models (LDSMs):** it is predictive and analytical tools that can provide essential information for decision-making (Gustafson and al. 2010). Forest landscape managers have to take into account multiple and interactive ecological phenomena occurring at large spatial and temporal scales. These interactions can be so complex that predictions of future forest ecosystem conditions are beyond the analytical capacity of the human brain.

- **Preventing forest damage** caused by fires, natural disasters or catastrophic events, and restoring damaged forests *(information measures to forest visitors, fire breaking zones, monitoring flammable forest biomass and water stress area (Bassi 2007).*

- Benefiting if needed (i.e. where a lack of adequate national legislation and funding) by introducing sustainable forest management practices by developing forestry management plans in participative manner through **LAG Action Plans (LEADER) of relevant issues.**

National level

- Develop **regional neighbourhood consulting** process of forestry management plan, contributing to a transnational monitoring system.
- **Adopting/upgrading the legislation** to set a limit for parcel fragmentation when inheritance of forestland. Coordinating ***forestland re-parcelling*** or to enter into ***easements*** contract with landowners for conservation strategic areas.
- Adapt national data and protocols to **develop common scoring tools** for forestry service provider and contribute to macro-regional monitoring system scaled for the maintenance of eco-corridors.
- **Promote the role of the State as gate keeper** for the integration of ecological connectivity into forestry management plan and impulse updating when the current *Forestry management plan* have long term renewal.

Macro regional level

- **Studying the importance of forest age and structure** and related species that are using macro regional eco corridors.
- **Develop a common monitoring wildlife species** *on the level of mountain range*, river basin more than national administrative boundaries. One such example is the project Life DinAlp Bear that could be duplicated to other key species. A *macro-coordination* to the level of mountain range is crucial for a coherent ecological connectivity and could be designed on the experience of collaboration between Italian and Slovenian bodies.
- Developing harmonized tools for forest management plans in border areas at **facilitate mitigation large scale events**.
- **Promoting close-to-nature forest management** across macro-region for translation to national legislation.
- Identification of innovative good practices and help for **multiplying good practices** already in force.

6.3 Agriculture

6.2.1 Why is it important ?

Conventional agricultural practices are major causes of biodiversity and habitat loss, and can be partly attributed to the general population growth and the associated increasing demand for food on the one hand, and to unsustainable agricultural practices of overproduction (e.g. monoculture, excessive use of soil nutrients, pesticides and herbicides, inappropriate farming techniques) on the other. Overproduction is also due to an unbalanced spatial distribution of settlement between population growth areas or depopulated areas. These circumstances lead to unbalanced land use, with over-exploited fields in populated areas and abandoned land in depopulated areas.

In addition, where the Adriatic Ionian region is subject to agricultural land abandonment, there is an accelerated proliferation of invasive alien plants. Invasive species put additional pressure to ecological connectivity and reduce ecosystem services (Gazoulis, 2022).

Improved ecological connectivity within agriculture can be achieved through ***agro-biodiversity systems***, that perform mixed cropping and crop rotation, reduce the use of nutrients, herbicides and pesticides, low intensity grass-based livestock system, husbandry and animal welfare plans, hedgerows, create buffer strips from valuable trees, rock walls, retention ponds, swales and other small landscape elements. These positive arrangements would bring the following benefits also to the agricultural sector: pollination, water provision for plant and animal farming, regulation of soil quality, erosion prevention, disaster and fire risk reduction. Intensive farming system has production cycles with relative low inputs (Pienkowski 2011).

Meadows and grasslands are strategic areas for biodiversity as they are part of biotopes for several key species of DINALPCONNECT project area: *Orchid, Freshwater crayfish, Daisy, Eastern eggar, Ortolan bunting, Meadow viper, Eurasian eagle-owl, etc.*

Even though dry grassland habitats in pilot regions predominantly benefit from protection regimes or legal specifications, their statement is currently in poor condition. Negative demographic trends, fragmented land properties and lack of financial support for farmers jeopardise the sustainability of the livestock breeding which has a major role to maintain the dry grasslands. Some rural development measures don't match with some of the local features over the project area and are not attractive to farmers. Additional pressures on

biotopes and species will continue to intensify with the impact of climate changes in term of hydric stress and spread of invasive species.

6.2.2 Glance at the current situation and desired future state

From 1992 to 2020, agricultural areas for Italy, Greece and Montenegro are decreasing while they remain stable in Bosnia and Herzegovina, Albania, Slovenia and Croatia (FAOSTAT 2021). However, a trend of decline in grasslands and pasture is identified in some countries (e.g. in Croatia), while in other countries, they remained stable. Intensive Agriculture practices contribute to habitat fragmentation (e.g. in Italy).

Excessive use of fertilization affects meadows in some area of DINALPCONNECT project areas such Montenegro, Bosnia Herzegovina (FOASTAT 2021). Transhumance is reducing in Greece in favour of intensive agricultural practices. Valuable grasslands are used for grazing without assessment of suitability in Croatia. Negative trends of farmer population in the DINALPCONNECT project participant countries might lead to a lack of pasture in the near future. A marked process of depopulation in inner areas is leading to an alteration of traditional eco-pastoral and eco-agricultural systems.

EURAC has conducted spatial analysis to intersect the corridors with intensive agricultural areas. (See draft report on ecological connectivity assessment T1.3.1). It is observed that nearly half of the corridors are passing through “intensive agriculture”.

In addition, the table below calculates the overlapping protected natural areas with the macro regional corridor model developed by DINALPCONNECT (EURAC, 2021). The purpose of this table is to measure the influence of well-managed agricultural areas on the effectiveness of ecological connectivity.

The agricultural land represents 24% of the regional corridors and 12% of SACA 1 areas. This is the second most predominant land covers in these strategics areas for ecological connectivity. We observe that pastures and natural grasslands are more represented in SACA1 area (11%) while the crops, arable land and agroforestry are more frequent within macro regional corridors (19%). Agricultural practices deserve therefore an important consideration in those locations to enable functionable ecological connectivity.

Table 2: Calculation of agricultural land areas within macro regional corridors and Ecological Conservation areas with high ecological value.

	Total Agricultural land	Crops, arable land and agro forestry (211,212,241, 242,243,244)	Pastures and natural grasslands (231,321)	Vineyard, fruit trees plantation and olive groves (213,221,222,223)
within the macro regional eco corridors located in the DINALPCONNECT project area (ha / % of the corridors)	849 291 ha (24%)	681 146 ha (19%)	128 351 ha (4%)	39 794 ha (1.1%)
within the macro regional eco corridors located in the pilot regions (ha / % of the corridors within Pilot regions)	18 243 ha (24%)	7325 ha (10%)	10 846 ha (14%)	72 ha (0%)
within the Ecological Conservation Areas in the whole DINALPCONNECT project area (ha /% of the Ecological Conservation Areas)	543 953 ha (14%)	122 573.4 ha (3.2%)	418 868 ha (11%)	2512 ha (0.6%)
within Ecological Conservation Areas in the whole pilot regions areas (ha / % of the Ecological Conservation Areas within pilot regions)	46 329.6 ha (12%)	12 285.6 ha (3.1%)	34 027 ha (8.6%)	17 ha (0%)
Total in the whole DINALPCONNECT project area (ha / % of the Ecological Conservation Areas + Macro regional Corridors)	1 393 244 ha (18.7%)	803 719.4 ha (10.8%)	547 219 ha (7.3%)	42 306 ha (0.57%)
Total in the whole pilot regions areas (ha / % of the Ecological Conservation Areas + Macro regional Corridors within pilot regions areas)	64572.6 ha (13.7%)	19 610.6 ha (4.1%)	44 873 ha (9.5%)	89 ha (0.01%)

Sources: Corine Land Cover 2018, EURAC 2022.

6.2.3 Examples of good practices from DINALPCONNECT project area

Pro Përmet Biodiversity Business

Figure 6: Consortium "Pro Përmet" in Albania that promote pro biodiversity business products

(Source : http://www.visitpermet.org/permet/index.php/en/pro-permet)

Location: Albania (Përmet District)

Goal: Developing ecological labelling under certification that promote culinary products to support *pro-biodiversity business* in the framework of a local chain.

Stakeholders: The institution involved were Municipality of Përmet, the Gjirokastra Conservation and Development Organization (GCDO), Ministry of Agriculture, Food and Protection of Consumers (MBUMK), and Development of Mountains Area Forum.

Pilot action: This Consortium of Pro-Permet is a voluntary association among active Albanian entities in the sector of tourism and accommodation, producers of agro-food, entities of artisan activities. Pro Përmet provides an opportunity to producers and artisans to market their goods in a more effective and efficient manner while all help one other simultaneously. Success of Pro-Permet Consortium is based on the method by which it was organized and on a prior deep statistical investigation performed with regard to social-economic situation before innovation implementation.

Results: This initiative enabled promoting of production and marketing of typical, high quality, Albanian products. Pro Përmet has 15 members currently, 11 of which are manufacturers of regional products and the other 4 work in the field of hospitality and service. From the social-economic viewpoint, the most telling data responding to success of Pro Përmet Consortium are the increased profits and number of employees of all participants in the group.

Wildflower strip and hedges in Croatia

Figure 7. Hedges on the right side, and on the left side is agricultural land. *(Picture: Marina Grgić, BIOM)*

Location: Croatia

Goal: Reduce negative impact of large monoculture on habitat fragmentation. Large, continuous monocultures represent types of the desert for a large number of organisms and in that way reduce ecological connectivity.

Stakeholders: The government in cooperation with farmers.

Pilot action: In order to encourage this way of planting flower strips and hedges, the government has issued a series of rural development measures where it offers farmers an incentive to plant flower strips and maintain hedges on their agricultural land. Plant flower strips and maintained hedges can stretch over large areas and provide refuge, but also serve as corridors that allow the movement and exchange of genes of many organisms that inhabit this type of habitat. Rural development measures that encourage this way of management are M10 - Agriculture, Environment, and Climate Change (https://ruralnirazvoj.hr/mjera/m10/).

Results: Planted flower strips and maintained hedges on agricultural land contribute to preserve the following species: small mammals, birds, insect, amphibians

6.2.4 Guidelines on how to achieve desired state on:

Local level:

- **Reduce the pressures** on biotopes (promoting use of organic fertilizer, erosion prevention, mixed cropping and crop rotation protecting water resources).

- **Promote ecological corridor**, and **stepping stones sites** among farmers, notably their wider benefit, with transfer of knowledge, inter-active communication and financial support (grants).

- Develop **Agro-biodiversity**, **High Nature value (HNV) farming, Carbon farming** with agro-environmental practices such as:

  - **Diversified local agrarian system**, mixed cropping, crop rotation, precision farming, organic products and fertilizers, agroforestry practices (e.g., maintaining /improving hedges among land parcels).

  - **Planting flower strips, maintaining hedges** along agricultural parcels, enhancing tree lines and flower beds should allow the connection of habitats for small mammals and pollinators.

- Coordinate prevention measures regarding the spread of **invasive plants.** The use of herbicides with different SOAs in the rotational view and bio stimulants composting organic fertilizers should be favored by farmers.

- Preserving **traditional eco-pastoral systems** (semi-extensive or transhumant livestock farming adapted to available pasture resources), implement **assessment of pasture** to adjust the livestock size to the conditions of the lawn (husbandry and animal welfare plans), and mowing from the center of the lawn outwards, drying hay on the lawn.

- Raising **awareness of the local communities** about pollution of water resources and biomass while burning polluted pesticide, fire consequences over grassland.

- Developing **Pro biodiversity business products** by certification, guidance, consortium between farmers and tourist operators. This guideline is to be developed with ***sustainable rural tourism policies.***

- Develop quality schemes for sustainable tourism and agrobiodiversity preservation.

- Develop **agreement with landowners** to improve land management; (Easements of land use, re-parcelling,) this formal agreement is a voluntary and contractual system, based solely on the will of the actors.

National level

- Promote Ecological Connectivity in **legislation framework** related to agriculture and drive financial support in favor of extensive agriculture and grassland protection.

- **Promote, support and control labelling** of Pro Biodiversity Business products.

- Support **education and career in favour ecological connectivity** friendly agriculture (special focus on the agro-ecological manipulation of weed flora in crops should be transmit).

- **Restoring abandoned pastures** by reseeding native species, providing watering systems and infrastructures.

- Replace any existing national assistance (including subsidies) for agricultural practices that are not currently Ecological Connectivity friendly **by exclusively oriented agrobiodiversity support.**

- Promote Macro Regional Corridor and Stepping stones sites.

- **Bring back at least 10% of the agricultural area** under high-diversity landscape features by 2030, notably on the path of identified ecological corridors.

Macro regional level

- Develop **joint and inclusive European policies** that would clearly combine European Biodiversity strategy, Green Infrastructure, Bird Directives and Common Agricultural policy (CAP).

- **Providing financial support for ecological connectivity friendly farming** (Based on business development plan that contribute to biodiversity and agricultural land, improving water management on agricultural land, preventing soil erosion and improving soil management).

- Designing common monitoring methodology and tools. In the perspective of the next CAP and Good agricultural and environmental conditions (GAEC), **Result Based Payments** would be established and would require **harmonized scoring system** (number of plant species and insects on a meadow). Monitoring tools scaled at the DINALPCONNECT project area level and additionally to its pilot regions would facilitate both comprehensive monitoring for CAP implementation and Ecological Connectivity.

- Increasing **peer to peer communication** between farms and breeders such as Agricultural Knowledge and Innovation Systems (EU SCAR AKIS 2019), or PLAID Peer-to-Peer learning: accessing innovation through demonstrations site and practices (Horizon 2020 EU Research & Innovation programme).

- Making sure that the EU Green Deal that plans to **reduce pesticide inputs** by 50% until 2030 is respected at the national legislation framework level.

- Preventing soil erosion and **soil quality maintenance** (soil micro-organisms, organic elements soil pHm) especially with micro plastic spread, waste management in fertile soil.

6.4 Wildlife Management

6.3.1 Why is it important ?

Wildlife management is about managing the interactions between and among wildlife, their habitats and people to achieve predefined impacts. It attempts to balance the needs of wildlife with the needs of people using scientific knowledge. Wildlife management refers to wildlife conservation, game keeping and pest control.

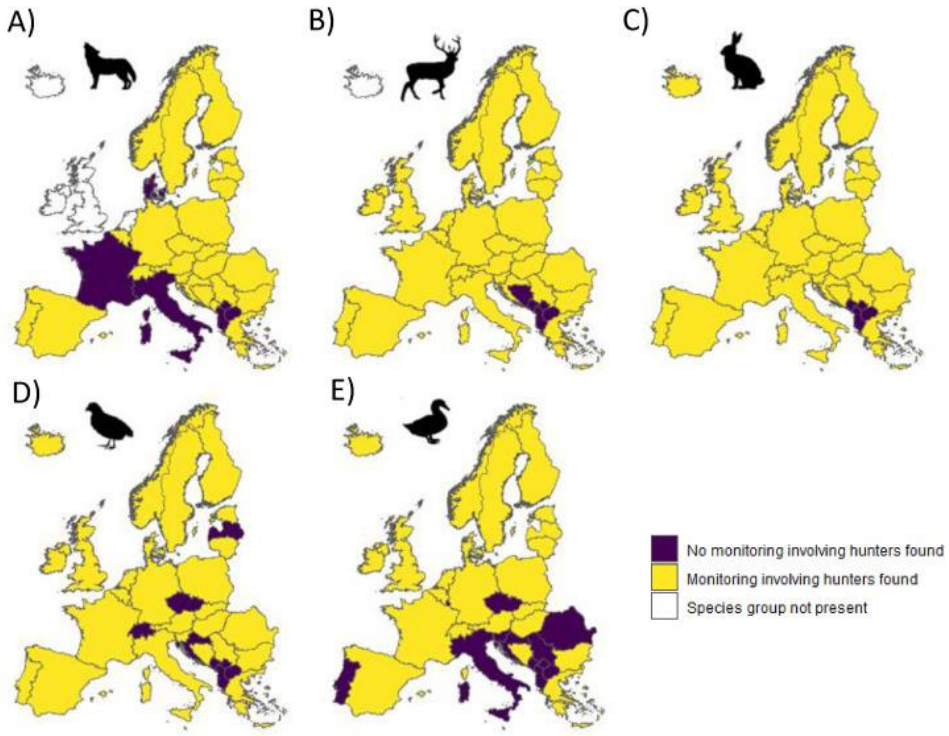
Hunting is one of the oldest ways of game management and use of renewable natural resources, and has always been part of the cultures and traditions of European rural society. Unsustainable hunting can drastically affect biodiversity and is therefore a key sectoral activity to regulate. Governance arrangements need to be built up to ensure that hunting in Europe is sustainable from ecological, socio-cultural, and economical aspects (Brainerd, 2008).

„While hunting is commonly mentioned as a threat to species listed in the IUCN Red List, it is not always clear whether the threat is from legal forms of hunting or from poaching (i.e., illegal hunting) "(Di Minin at al, 2021).

6.3.2 Glance at the current situation and desired future state

The European Charter on Hunting and Biodiversity is the product of two years of work carried out by a Working Group set up within the framework of the Convention for the Conservation of European Wildlife and Natural Habitats (Bern, 1979). The Bern Convention addresses sustainable use as well as conservation issues and, with this initiative, highlights the critical importance of monitoring and hunter involvement in the conservation and sustainable management of biodiversity in Europe and beyond. The Standing Committee of the Bern Convention, which includes Contracting Parties to the Convention, as well as Observer States and organisations, discussed and adopted the text of the Charter at its 27th meeting in Strasbourg, 26-29 November 2007. The Charter thus represents a collective effort of governments, hunters and environmental organisations to discuss and facilitate sustainable hunting in a biodiversity conservation context (Brainerd, 2008).

Figure 8. Geographic extent of hunter-based monitoring per species group. A) Large carnivores, B) ungulates, C) small game, D) other game birds and E) waterfowl.



Sources: Cretois et al 2020.

Significant difference in conservation status of Alpine ibex. The chamois population trend has turned downward: Assessments on the interactions between recreational hunting and anthropogenic threats to biodiversity remains crucial even in cases where hunting is considered Sustainable (Di Minin at al, 2021).

6.3.3 Examples of good practices from DINALPCONNECT project area

Habitat restoration for Black grouse (Tetrao tetrix)

Location: Italy (Municipality of Prato Carnico, Julian Alps)

Goal: Promote suitable habitats for reproductive success of the black grouse

Stakeholders: the Prato Carnico Hunting association

Figure 9: Manual mowing of the blueberry heath *(source : Parco naturale Prealpi Giulie)*

Pilot action: Annual interventions on the heats and alpine pastures of the Prato Carnico Hunting association.

Results: 3 hectares of blueberry and rhododendron heath ere reintroduced using brush cutters to create a mosaic of habitats suitable for the species. Abandoned pastures are mowed to prevent scrubbing. In August the reproductive success of the black grouse is monitored with the use of pointing dogs.

LIFE Lynx project

Figure 10: Realising the lynx Emil in Croatia (*source: https://www.lifelynx.eu/*)

Location: The Dinaric arc

Goal: Rescuing the Dinaric-SE Alpine lynx population from extinction and to preserve it in the long term.

Stakeholders: The project is co-financed by the LIFE Programme of the European Union under contract number (LIFE16 NAT/SI/000634).

Pilot action: Before the start of the project, the population was small, isolated, and extremely inbred. It was urgently needed reinforcement by introducing additional, healthy animals from another population. Projects participants are reinforcing the Dinaric-SE Alpine population with lynx from the viable source population in the Carpathians, while maintaining high public support. A collaboration across all EU countries sharing this population help to develop and implement a systematic approach to ensure long-term viability of the reinforced population.

Results: Science-based management tools for strategic planning to ensure long-term viability of lynx have been developed. These include using computer modelling based on data from the project to understand how to genetically and demographically manage the population for the long term. This scientific information will be incorporated into management plans and other strategic documents. Natural gene flow of lynx within this population will be increased, in order to avoid additional reintroductions in the future

6.3.4 Guidelines on how to achieve desired state on:

Local level:

- **Implementation of Wildlife management** considering habitat features of individual species and implementation of biotechnical measures.
- **Raise awareness of hunters** on ecological connectivity and the role of large carnivores.
- **Involving hunters** in the design of forestry management plan and implementing agreements between protected areas managers and hunters.
- **Preventing illegal hunting** with pragmatic hunting bag checks.
- **Framing targeted hunting** when there is contrast proliferation of certain species in absence of predators, in agreement with protected areas managers and/or environmental authorities.

National level:

- **Regulate the practice of hunting** under exclusive state authorization with a legal status for hunters.

- Developing **communication tools between hunters** to monitor the species catching and avoid over hunting practices in some areas.
- **Designate national eco-corridors** for individual species where hunting practices are prohibited.
- Identify and regulate **no shooting zone on bird migration routes.**
- Ensure that regulations are understandable and respected with **campaign of information** towards the whole hunters' community.
- **Guiding wildlife management plan** that establish the spatial distribution of species, in particular in eco-corridors, defining clear objectives and preparing the monitoring of population trends.

Macro regional level:

- Establishing **joint management plans for transborder populations** (cross-border, transnational) of game species where appropriate.
- Focusing on **multi-level governance** that maximizes benefit for biodiversity conservation and society.
- **Develop macro-regional monitoring** of hunted species and population trends for species with large migratory movements (e.g. flyways of birds, large carnivores, etc.).

6.5 Water management

6.4.1 Why is it important ?

Waters, namely alluvial river ecosystems are especially important in relation to the ecological connectivity. They are considered as one of the hotspots of biodiversity provide many crucial ecosystem services that are crucial for survival of many species. However, the connectivity of different biotopes is under pressure due to flow regulation by dams which are often accompanied by other modification of the river system such as levee construction, which can be observed across the ADRION microregion and further.

„Because the numerous pressures arising from the various uses of land and water within river basins are exerting widespread effects detrimental to riverine fish

communities, and the fisheries that depend on them, it is clear that careful management is needed if the fisheries are to be maintained" FAO, 1983.

6.4.2 Glance at the current situation and desired future state

Commercial fishery is regulated through different level of regulation according to the countries. With the approval of Directive 2000/60/EC (Directive 2000/60/EC) on 23 October 2000, the European Union has provided a framework for the protection of inland waters, transitional waters, coastal waters and groundwater. Recreational fishery is also meant in this chapter as key sectoral area to be involved in ecological connectivity friendly practices.

River systems can be developed and managed for fisheries at several levels. Firstly, at the basin level priorities must be set among a number of competing uses, of which fisheries is but one. Secondly, at the level of the fishery direct management techniques aim to control the types and amounts of fish being caught.

Table 3: Calculation of wetland and water bodies areas within macro regional corridors and SACA1

Wetland and water bodies (CLC:411,412,421, 422,423,511, 512,521,522,523)	within the macro regional eco corridors (ha / % of the corridors areas)	within the SACA1 eco corridors (ha / % of the SACA1 areas)	Total (ha / % of the SACA1 + Regional corridors project areas)
DINALPCONNECT project area	408264.6 ha (11%)	153 094 ha (4%)	561 359 ha(7,4%)
Within pilot regions	1627 ha (2,2%)	846.4 ha (0,2%)	2473.4 ha (0,5%)

Sources: Corine Land Cover 2018, EURAC 2022.

6.4.3 Examples of good practices from DINALPCONNECT project area

Realization of a fish ladder in the Isonzo River

Figure 11: Fish ladder operating

Location: Italy (Isonzo River near the cross of Sagrado).

Goal: Develop a ladder for the fish to go up from the valley to the mountain.

Stakeholders: Consorzio di Bonifica Pianura isontina, GREVISLIN project (Ita-Slo).

Pilot action: The Consorzio di Bonifica Pianura isontina manages the water withdrawn from the Isonzo River for irrigation purposes and distributes it through a network of canals, plants and basins to the countryside of the entire area. Irrigation is managed according to the principles of saving water resources and recovering rainwater. The water pumps also carry out hydraulic remediation activities aimed at preventing flooding of the Isonzo plain.

Results: This intervention, perfectly integrated into the natural environment, allow continuity in the river for the passage of trout and sturgeon in autumn and carp in spring.

6.4.4 Guidelines on how to achieve desired state on:

Local level:

- **Maintaining an appropriate levels of groundwater** and normalized water flow should be ensured (control of hydropeaking).

- Monitoring the flow of sediment while **assessing longitudinal habitat and lateral river connectivity**.
- **Protecting fish species** by preserving key habitat features (e.g. spawning grounds).
- **Preventing the proliferation of alien species.**
- Performing **renaturation of deprived river sections.**
- Supporting environmental protection campaigns conservation through environmental **educational programmes** for anglers and the general public.

National level:

- **Incorporation of ecological connectivity** into strategic and action water management plans (Water Directive).
- **Designation of river reserves** (protected areas without planned damming projects).
- **Lobbying on ecosystem development projects**.
- **Reducing the burden on fish stocks** by shifting the exploitation of fish from intensive commercial fishing to recreational fishing in inland and coastal waters.
- Developing **national fishing management plans** when it doesn't exist.
- **Monitoring of aquatic weeds** (*Elodea nuttallii*) that kills fish communities should be addressed at the national level.

Macro regional level:

- **Joint river basin management planning.**
- **Joint recreational fisheries planning** in border areas.
- **Adopt an ecosystem approach** to fisheries management to better balance recreational fisheries and conservation objectives.

6.6 Tourism

6.5.1 Why is it important ?

Tourist attractions and ongoing development represent significant pressures on wildlife and habitats in the DINALPCONNECT project areas. Increasing numbers of visitors to high value landscapes make it difficult to maintain biodiversity in the face of human disturbance such as land taken for tourism infrastructure, additional roads and paths, waste management, fire prevention and noise pollution.

Sustainable tourism and eco-tourism have become a prominent concern among tourism policies. However, while it can be a major lever for the economy, competition can hamper concrete initiatives. Beyond the ecological management of tourism activities within natural areas, ecological connectivity is an important aspect to be taken into account in tourism policies. Tourism that is properly and adequately managed can be stimulating and supportive especially on rural areas by supporting pro-biodiversity businesses and using the services and products of the local people and therefore supporting their work in sustainable management of the land.

Challenge remains the development of tourist infrastructure and roads as they commonly try to be in or as close as possible to the natural areas with valuable landscapes and high tourist attractiveness, which may hinder important ecological corridors.

6.5.2 Glance at the current situation and desired future state

Almost two hundred million international visitors (domestic ones are not included here) have visited the DINALPCONNECT countries participants in 2018 (World bank). Apart from the COVID situation, numbers of visitors are increasing in all countries which allow us to think that pressure will also be more important on the biodiversity in the next years. In addition, domestic visitors and excursionist that are visiting their own countries are not included in those statistics.

Table 4: Number of arrivals of international visitors

DINALPCONNECT participants countries	Number of arrivals of international visitors (thousands)
Italy	93,228
Slovenia	4,425
Croatia	57,668
Bosnia in Herzegovina	1,053

Montenegro	2,077
Albania	5,927
Greece	33,072
Total	197,450

Sources: World bank, 2018 available at:
https://data.worldbank.org/indicator/ST.INT.ARVL?end=2018&most_recent_year_desc=false&start=1995

6.5.3 Examples of good practices from DINALPCONNECT project area

The Škocjan Caves Regional Park

Figure 12: The Škocjan Caves *(Photo: Q. Drouet)*

Location: Slovenia (Karst region, Divača).

Goal: Supporting sustainable development of local community.

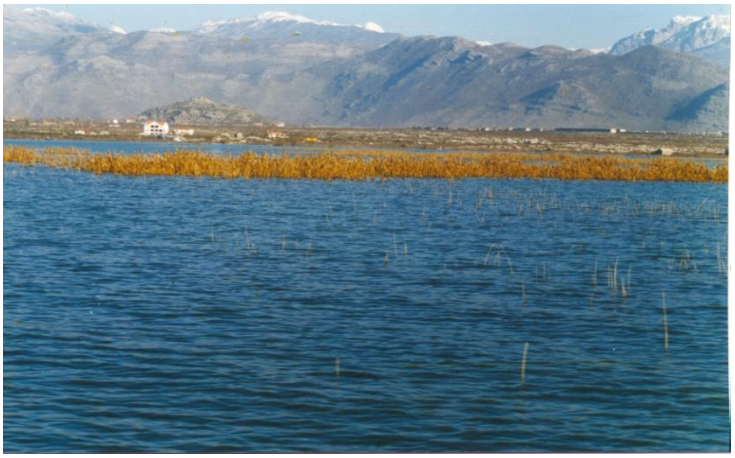
Stakeholders: The Škocjan Caves Regional Park, local community.

Pilot action: the board administrative unit of the the park play an important role in supporting people that live in the park, their business ideas, investment opportunities and sustainable practices. The Škocjan Caves Regional Park have diversified management objectives and task: remapping habitat types, registration of pollutant in buffer zones, encourage the mowing, monitor the status of cultural heritage, restore the damage and demolished dry walls, contribute to spread tourist flows and regulate the pressure on the cave, create trademark to promote local pro biodiversity business, etc.).

Results: The Park has set a long-term management extending beyond the strict perimeter of nature conservation area. The benefits of the nature conservation are multiplied by active cooperation with local stakeholders and cross-border management.

Scutari Lake and Lovćen

Figure 13: Scutari Lake: Rocky West Coast *(Picture: Tili)*



Location: Albania (Scutari Lake) and Montenegro (Lovćen).

Goal: Preserve the natural heritage sites from tourism pressure The presence of two important cities on the lake shores (Shkoder) or near to it (Podgorica) heavily affects any conservation effort by pollution and tourism.

Stakeholders: National Parks of Montenegro Government Agency (Nacionalni Parkovi Crne Gore), Ministry of Tourism and Environment of Montenegro (MoTE) Ministry of Environment, Forests and Water Administration of Albania (MEFWA), Global Environment Facility, World Bank.

Pilot action: Cross boundary spatial planning Lake Skadar region since 2006 to coordination of conservation efforts in environmental protection and sustainable development.

Results: The coordination of conservation efforts, environmental protection and sustainable development between Albania and Montenegro is quite limited and has been mostly sustained by international projects, such as “Lake Skadar/Shkodra Integrated Ecosystem Management Project”, financially supported by GEF. Regulation of investments related to tourism activities on lake shores with Cross boundary spatial planning Lake Skadar/Shkoder region between Albania and Montenegro.

6.5.4 Guidelines on how to achieve desired state on:

Local level

- **Increase the communication** between tourist operators and natural parks area managers.

- **Enhancing linkages** between farmers, breeders, environmental heritage preservation and sustainable tourism (example of transhumance as tourist attraction).

- **Conducting carrying capacity studies** on high frequency of visitors in sensitives areas and its linkages with eco corridors areas.

- **Promote alternative sustainable tourism destinations** than overcrowded ones and develop alternatives of low-carbon tourism activities.

- **Valuing the ecological heritage and labelling destinations** and activities that respect biodiversity and ecological connectivity.

- **Involving local communities on po/biodiversity business** and sustainable tourism.

- Developing career and jobs opportunities for **nature specialist to perform touristic guides.**

- **Raising awareness of visitors** on the presence of the species and habitat in order to turn them into biodiversity ambassadors and reinforce waste management regulation.

National/ regional level

- **Developing strategy of cooperative tourism** with harmonised marketing initiatives between high tourist spots, and even re-allocation of tourism revenues.

- Define zones for intensive tourism (with cable cars, hotels, etc.), zones for sustainable tourism (hiking paths) and zones with no tourism by spatial **planning instruments to avoid intensive tourism** on corridors.

- **Regulate new tourism infrastructure** and competitive market with a legal framework in spatial planning and environmental act that set reinforced preconditions for preserving habitat and ecological connectivity locations.

- Promoting respectful tourism regarding the biodiversity and ecological connectivity and provide legal framework of **quality schemes for sustainable tourism** (based on Global Sustainable Tourism Council (GSTC).

- **Develop education** for biodiversity management in tourism business school and universities.

- Using promotion tools for tourism to **drive flows of visitor** towards lower biodiversity issues areas.

- **Monitoring flow of tourism according to biodiversity indicators** (tracking dashboard tools).
- **Raise awareness of visitors** on the presence of the species and habitat in order to turn them into biodiversity ambassadors.

Macro regional level

- Developing **touristic offer packages in cross-border protected areas** to raise awareness of ecological connectivity across national borders.
- **Raise awareness of visitors** on the presence of the species and habitat in order to turn them into biodiversity ambassadors.

6.6 Role of protected areas

6.6.1 Why is it important ?

Protected natural areas constitute a rich reservoir of biodiversity to be protected from long term perspective and enhanced, particularly in the face of human pressures, natural risks and climate change. Protection measures under legal framework enable the conservation of natural core areas with high biodiversity value. For example, on a European scale the European Natura 2000 network ensure the maintenance of biodiversity through the conservation of natural habitats and species of wild fauna and flora that are rare or even threatened.

6.6.2 Glance at the current situation and desired future state

Within the regional eco corridors in the DINALPCONNECT project area, are identified 161 182 ha of open spaces with no or little vegetations (Corine Land Cover 2018: Sparsely vegetated areas, bare rocks, burnt areas, EURAC 2022). It is 4,5% of the regional corridors.

Within the SACA1 areas in the DINALPCONNECT project area, are identified 402 222.5 ha of open spaces with no or little vegetations (Corine Land Cover 2018: Sparsely vegetated areas, bare rocks, burnt areas, EURAC 2022). It represents 10,5% of the SACA 1 areas.

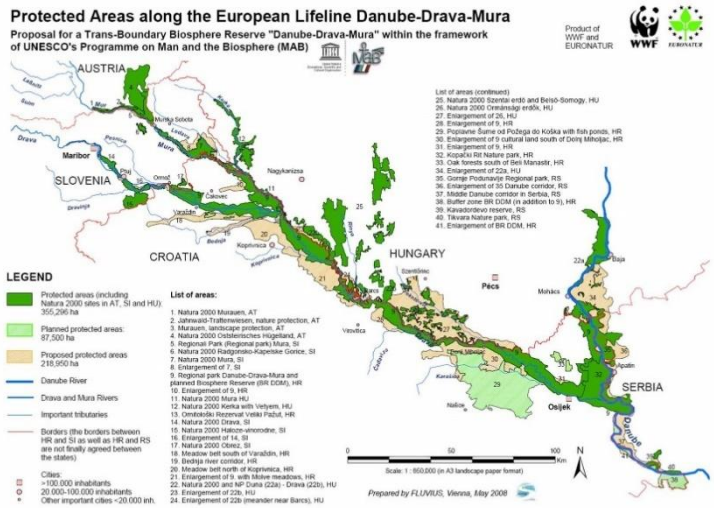
Theses land cover types aren't used for sectoral practices as forestry, hunting, fishery or agriculture. Therefore, the maintenance of their ecological function depends solely on the natural preservation policies. The good condition of these land cover types determines the ecological performance of SACA1 and macro regional corridors up to 7,6% of their area. This percentage is significant to justify full consideration of these spaces in their monitoring and maintenance.

6.6.3 Examples of good practices from DINALPCONNECT project area

Transboundary biosphere reserve Mura-Drava-Danube

Figure 14: Map of transboundary biosphere reserve Danube – Drava – Mura.

(Map taken from: https: //priroda-vz.hr/podrucja/prekogranicni-rezervat-biosfere-mura-drava-dunav/)



Location: Mura-Drava-Danube biosphere reserve, Austria, Slovenia, Croatia, Hungary and Serbia.

Goal: Preserve biodiversity and sustainable development of the biosphere reserve making the "European Amazon" the largest protected river area in Europe. The goal of the biosphere reserve is to preserve biodiversity and sustainable development of that area.

Stakeholders: a network of 13 protected areas highlighting the importance of rivers for the ecosystem, including the world-famous Kopački rit Nature Park and the Mura-Drava Regional Park in Croatia, the Gornje Podunavlje Special Nature Reserve in Serbia and the Danube-Drava National Park in Hungary, as well as Natura 2000 sites in Slovenia and Austria.

Pilot action: Establishing a declaration to improve cooperation between states and to jointly manage this river area with habitat restorations.

Results: Transboundary networking and cooperation for nature protection and restoration that contribute to ecological connectivity in the reserve area**.** The total area of the reserve is 931,820 ha and 42% of the area is located in the Republic of Croatia. Habitat restorations are already underway in the area of the reserve and new ones are planned. This is an excellent example of transboundary networking and cooperation for the purpose of nature protection and restoration, and it also affects the improvement of ecological connectivity in the reserve area.

Transboundary Prespa Park (Ramsar) and Ohrid-Prespa Transboundary Biosphere Reserve (UNESCO):

Figure 15: Aerial view over three borders from D: Panovski and Transboundary Prespa Park

(Picture: D.Panovski)

Location: North Macedonia, Albania, Greece (Ohrid-Prespa area).

Goal: Strengthening governance for wildlife and habitat conservation by knitting together different countries environment protection initiatives.

Stakeholders: Four protected areas in three countries are included: Galičica National Park (N.Macedonia); Pelister National Park (N.Macedonia); Prespa National Park, Albania; Prespa National Park, Greece. The area includes two of the three Northern Macedonia National Parks. Trans-boundary cooperation is covered by partially overlapping initiatives: Prespa Park (Ramsar) and Ohrid-Prespa Transboundary Biosphere Reserve (UNESCO).

Pilot action: Different and uncoordinated administrative and management rules in the three countries creates an immaterial barrier which is more impacting than a physical one. Physical border limitations do not represent any more an important limit to ecological connectivity. The project developed transboundary coordination between state administrations.

Results: Preservation of a large variety of species: fish, amphibians, birds, big mammals such as the Balkan lynx, the Brown Bear, the Wolf and the Balkan Mole. This transboundary coordination between Albania, Macedonia and Greece administrations demonstrates how cross borders governance and interconnected natural parks might strengthen wildlife and habitat conservation.

6.6.4 Guidelines on how to achieve desired state on:

Local level:

- **Defining and preserving core areas** with suitable size and appropriate land cover (i.e. SACA 1 areas).
- **Raising awareness regarding ecological connectivity** to encourage the inter-connection between protected areas.
- **Restraining the number of visitors** on natural site with closer relation with tourist operators.
- **Monitoring of species, gene flow** and spatial monitoring on site search in order to better understand game movements. Facilitate open data collection between researchers and wildlife managers communities.
- **Developing transparency and contribution to local communities** of incomes provided by visitors. (For example, some percentage of the entrance fees income from tourist attraction within the protected areas could support Pro Biodiversity Business for instance). This will support sustainable practices for ecological connectivity in the surroundings of the protected core areas.

National level:

- Promoting the **collaboration of management authorities** between neighboring protected areas, based on the revealed regional ecological linkages (corridors), to guarantee the movements of wildlife species.
- Supporting financially **protected areas on preservation** and monitoring efforts.
- Accompanying the initiatives of **establishment new protected areas** in order to conserve core zones or stepping stones.

- **Acquiring and monitoring data of species and gene flows** from local level in order to identify regional and national context. Ministries can play an important role to centralizing data from local initiatives.

- **Re-establishing of eco-connectivity** through implementation of green infrastructure.

Macro regional level:

- **Formalizing transboundary agreements and promote active cooperation** for cross/border protected areas with harmonized status of species, harmonized protected areas categories and related regimes and conservation of rare and endemic species.

- Monitoring of species and gene flows with open data between researchers and wildlife managers communities. **Common tools for monitoring species** and ecological connectivity should be developed and shared between protected areas.

- **Networking events and transnational cooperation projects**, especially between neighboring protected areas, in order to monitor the state of identified corridor, gene flow and species movement and to realize the regional ecological linkages.

- **Setting common orientations** on how to respond to the pressures of infrastructure and challenges of climate change in relation to species movement.

- **Raising awareness regarding** the topic of ecological connectivity and recognizing it as a priority in funding programmes, notably in relation to green deal objectives and climate change mitigation measures.

6.7 Spatial Planning

6.7.1 Why is it important ?

Ecological connectivity is rarely explicitly expressed in terms of goals or vision in spatial planning documents (University of Athens, 2021). However, spatial planning is the only horizontal tool that can first implement (reserve space) for identified ecological corridors and secondly (legally) preserves them. The content of spatial plan reflects a lack of consideration and awareness of political decision-makers on Ecological Connectivity.

In addition to friendly sectoral practices in favour of ecological connectivity, regulatory and strategic spatial arrangements are determinant for a comprehensive coordination of improvements and interventions. Future development designed in the municipal or regional plan should consider ecological connectivity in the same way as any other infrastructure as water, electricity, digital & road network related to human facilities and activities. Municipal plans generally provide an accurate overview of current land use, which could then confirm or specify the spatial model of macro-regional corridors produced under the DINALPCONNECT project. Regarding preliminary studies for developing Municipal plan and local goals of development, appropriate land-use regulation would enable effective ecological connectivity in the right and determinant places.

6.7.2 Glance at the current situation and desired future state

In practices, spatial planning is mainly designed to regulate the future use of space of designated area and frame the development of new infrastructure. Depending on the legislation in force, planners are required to carry out Strategic Environmental Assessments (SEA) or Environmental Impact Assessments (EIA) regarding the scope and scale of the planned build up area. In this approach, biodiversity issues are consulted after the decision of land-use planning choices and lead to only implement adjustment and/or mitigation measures.

Public bodies have an important role in integrating ecological connectivity in national planning legislation. Spatial planners need to be better informed about ecological connectivity and corridors. In order to improve the visibility and legitimacy of ecological connectivity, a national or regional ecological cohesion plan could be produced with accurate maps and an action plan to be integrated into the municipal spatial plan. The framework for the production of the national plan and the spatial plan, the consultation process with associated stakeholders and the legal documents may need to be revised into the legislation according to the context of participants countries of DINALPCONNECT.

Lowland areas and eastern provinces of Slovenia and eastward part of Croatia are affected by population pressure and land cover fragmentation (Laner P:, and Favilli F, 2021). Population strain, road infrastructure and topography have on limited impacts on ecological connectivity in Bosnia and Herzegovina but protection level is almost non-existent (Laner P., and Favilli F., 2021). Albania have contrasted assessments between eastern part of the country that displays efficient permeability while the eastern side is

affected mostly by inappropriate land use and transport infrastructure along the coast. In Greece, anthropological land use jeopardises ecological connectivity on the coastline to the Ionian Sea and the eastern part of Greek project.

Through the GIS model, EURAC has revealed urbanization threats. 71 linkages of the designed macro eco corridor are passing near urbanized areas, which could interrupt connectivity, if urban growth would close the remaining open natural corridor. In such circumstances, spatial planning is needed to keep such corridors free from built environment (Laner P., and Favilli F., 2021).

In addition, the table below calculates the overlapping built up areas with the macro regional corridors model developed under the DINALPCONNECT project. The purpose of this table is to measure the influence of built-up areas on the effectiveness of ecological connectivity. Numbers of ha has been computed through Corine Land cover dataset from 2018 and macro regional eco corridors and SACA1 areas designed by EURAC (CORINE Land Cover, 2018 EURAC, 2021).

Table 5: Calculation of built-up areas within macro regional corridors and SACA1

Built up areas (CLC: 111,112,121,131, 132,133,141,142)	within the macro regional eco corridors (ha / % of the corridors areas)	within the SACA1 eco corridors (ha / % of the SACA areas)	Total
DINALPCONNECT project area	197 ha (0,11%)	1636,5 ha (0,47%)	1833 ha (0,025%)
Pilot regions	0 ha (0%)	59 ha (0,001%)	59 ha (0,001%)

Sources: Corine Land Cover 2018, EURAC 2022.

6.7.3 Examples of good practices from DINALPCONNECT project area

Life Dinalp Bear project

Location: Slovenia, Croatia, Austria, Italy and Switzerland.

Goal: Preserve biodiversity and sustainable development of the biosphere reserve.

Stakeholders: Slovenian Forestry Service, University of Ljubljana, Autocesta Rijeka-Zagreb d.d., ERICo Velenje, Ecological Research & Industrial Co-operation Ltd., Research Institute of Wildlife Ecology University of Veterinary Medicine, Vienna, Veterinarski fakultet, Sveučilište u Zagrebu, Provincia Autonoma di Trento – Servizio

Foreste e Fauna, Progetto Lince Italia, Regione del Veneto – Unità di Progetto Caccia a Pesca.

Figure 16: The transport network is one of the most important factors threatening the viability of brown bear populations in Europe *(Picture: Hlačer J.).*

Pilot action: Comprehensive analysis of the suitability of bears habitats to prevent fragmentation and to introduce mitigation measures into spatial planning. Three systems of dynamic traffic signs were installed on sensitive sections:

- On the main road Ljubljana - Kočevje, three systems of dynamic traffic signs were installed on three problematic sections. The result is a significantly reduced speed at these locations when dynamic characters are activated.
- Installation of sound deterrents on critical sections of the railway on the route Rakek - Postojna and Postojna - Prestranek, and on road pillars along the main road Ljubljana - Kočevje.

Results: Mortality on the roads has been reduced by more than 50% in 5 years due to the installation of acoustic devices, and by 50% on railways.

Source: https://dinalpbear.eu/wp-content/uploads/Life-Dinalp-Bear_Prirocnik-za-vkljucevanje-medveda_SI_low-res.pdf

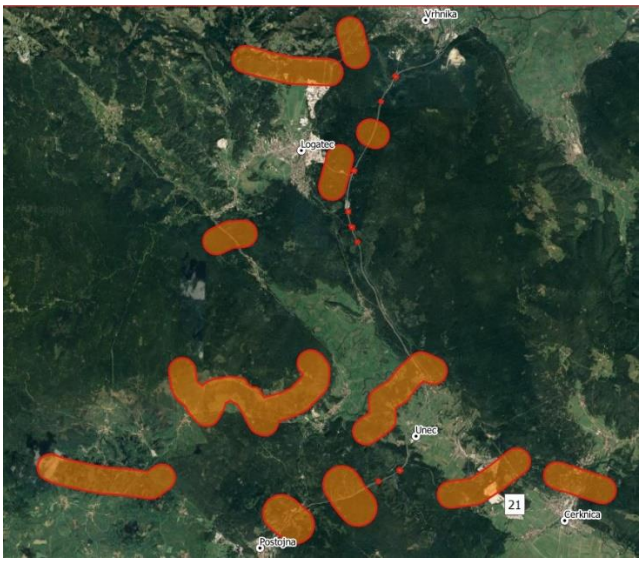
Wildlife corridors in the Ljubljana-Postojna area

Location: Slovenia (Notranjska region).

Goal: Create wildlife corridors to connect four main forested mountainous plateaus (Menišija and Javorniki in the south and Nanos and Idrijsko hribovje in the north).

Stakeholders: Slovenia Forest Service (ZGS)

Figure 17: Established wildlife corridors in the Ljubljana – Postojna area (Screen shot: Jernej Javornik).



Pilot action: Important wildlife movement corridors were identified in the process of the revision of the strategical forest and hunting managements plans. The area is suitable for ecological connectivity. Spatial planning approach to target appropriate location for green bridges.

Results: a construction of a green bridge between Unec and Postojna is currently underway.

6.7.4 Guidelines on how to achieve desired state on:

Local level

- **Raise awareness of local authorities** (municipalities) on spatial model of ecological connectivity.
- **Positioning ecological connectivity as a pre-condition** of human development in spatial planning policies and instruments. Infrastructure projects and building zones would then be relegated to areas with low biodiversity and Ecological Connectivity features. A starting point would be to implement biodiversity inventory with spatial distribution of species to show to municipalities and inhabitants what resources they have and invite them to conserve them.
- **Framing new build-up areas**, with regulatory tool: a minimum **Biotope Area Factor (BAF),** which gives the possibility to safeguard ecological important areas, when it comes to spatial planning decisions. The biotope area factor defines the share of eco-developed surface area (vegetated or favorable to the ecosystem) on the total surface area of a plot considered by a construction project (new or renovation): It is a tool used to measure the green coverage and absorbent properties of a surface. BAF = eco-friendly developable area / plot area.
- **Delamination of Ecological Corridor within Municipal Spatial Plans or Regional Spatial** Plan depending of the country: 3.610.797 ha of Macro Regional

ECO Corridors and 3 843 959 ha of SACA1 areas has been identified in the whole DINALPCONNECT project area (EURAC 2021). This DINALPCONNECT output can be a first step to be integrated into Spatial Plans documents with local adjustment regarding local assessment. In concrete terms, **ecological corridor delimitation** should be identified with land use regulations adapted to their preservation (natural areas or strict agricultural area that ban farming building). It is also a question of systematizing the delimitation of zones in land-use plans beyond which there can be no development.

- Assessment of the status of ecological corridors in the **Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA).**

- **Recognition of environmental landscape as green infrastructure,** such as forests and rivers, which will be given the same consideration as man-made infrastructure in planning (infrastructure must not damage each other to function properly) and strategic environmental assessment.

National/ regional level

- **Empowerment, awareness raising and dissemination of knowledge** related to ecological connectivity to spatial planners and SEA&EIA experts.

- **Recognition of environmental bodies as Green Infrastructure** such forest river that will benefit for the same consideration of anthropic infrastructure regarding spatial planning (infrastructures shouldn't damage on one other for proper functioning) and Strategic Environmental Assessment.

- Designing **Regional Ecological Connectivity Scheme** with legal forces for implementation of regional eco corridors.

- **Promote neighborhood consultation** among municipalities/regions/countries and monitor compliance of municipal plan with Regional Ecological Connectivity Scheme.

- **Monitoring the land cover and land use** within the Ecological corridors.

- Developing the **visibility and legitimacy of ecological connectivity** into legislation regarding spatial planning.

Macro regional level

- **Promote continuous spatial approach** taking into account biogeographical extend and habitat types rather than administrative perimeters.

- **Establishing a Dinaric Convention** with similar agreements to the Alpine Convention with spatial planning protocols.

- **A European directive to incorporate a common legal administrative definition of ecological connectivity** could facilitate interventions and legislation improvement at the national level.

- **Encouraging inter municipal planning** for better coordination of Ecological Connectivity between national border. This would increase the chances of determining common objectives for ecological connectivity and avoid inconsistent planning.

6.8 Infrastructure

6.8.1 Why is it important ?

Infrastructure is part of spatial planning but deserved a dedicated focus chapter of the strategy as the existing network of roads, railways, powerline, and dams represents significant obstacles for movements of species and therefore ecological connectivity. Through the cutting effect, i.e. a physical barrier, and the destruction of habitats that it creates, a linear transport infrastructure profoundly degrades the balance of the environments in place and constitutes a potentially high source of impact on the maintenance and quality of ecological continuities. Researchers have pointed out the negative effects of road on species that are attracted to roads and unable to avoid cars, species with large movement ranges but low reproductive rates, species that avoid habitat near roars due to traffic disturbance. Evidences are strong enough to engage mitigation measures and prevent those effects (Fahrig, L., and T., Rytwinski 2009). Fluvial infrastructures required also distinct consideration with the effects of equipment for hydroelectricity such dams on the species (Jansson, R. 2006).

6.8.2 Glance at the current situation and desired future state

The publication *COST 341 Habitat Fragmentation due to Transportation Infrastructure: The European Review* provides an overview of the scale and significance of the problem of fragmentation of natural habitats by roads, railways and waterways in Europe and examines solutions that are currently applied. The Infrastructure and Ecology Network is an expert group consisting of researchers, policy makers, planners and implementers for the discussion of the conflict between conservation of biodiversity and increasing habitat fragmentation due to transport infrastructure (Tillmann J.E. 2005).

In the DINALPCONNECT project area, the project partner Eurac has identified 60 motorway intersections with the identified ecological linkages/ corridors, that are a real physical barrier. As it was already shown in the chapter 6.7, a high number of ecological linkages is passing through highly fragmented areas (Laner P., and Favilli F., 2021).

Currently, generally the ecological connectivity is not a (significant) factor that is taken into consideration when planning infrastructure. In the process of planning of the infrastructure (i.e. road, railroad, pipeline, power plants, etc.), green infrastructure should be taken in adequate consideration as all other types of infrastructure in order not to destroy or damage one another.

6.8.3 Examples of good practices from DINALPCONNECT project area

Green Brigdes on motorway in Croatia

Figure 18: Green bridge on motorway in Croatia. (Photo: Krunoslav Bošnjaković, BIOM)

Location: Croatia (Gorski kotar county).

Goal: Enable unhindered communication of wild animals across the highway, i.e. daily and seasonal migration, which is a basic condition for maintaining complete and stable populations of most wild animals.

Stakeholders: Croatian highways (HAC)

Pilot action: Wildlife crossing are built for safe passage of red deer, wild boars, roe deer, small mammals, rabbits, foxes, bears, wolfs, lynx. The green bridges are located over roads but it can also be tunnels and viaducts. It is especially important that they are located in specific selected places and that they meet the criteria that determine their shape and size. After construction, the green bridge is afforested with indigenous

vegetation so that it fits perfectly into the landscape. Ordonnance on crossings for wild animals specifies that human activities are prohibited.

Results: Eleven green bridges have been built in Croatia so far. There are 10 green bridges on the A1 motorway route and 1 on the A6 motorway.

Protection measure regarding electric power lines

Figure 19: Eurasian eagle-owl. (Photo source: https://www.regionalobala.si/novica/elektro-primorska-zascitila-110-kilometrov-daljnovodov-cilj-je-ohraniti-to-zivalsko-vrsto)

Location: Slovenia (Primorska region)

Goal: Protect birds, especially the Eurasian eagle-owl, which is the most vulnerable species in terms of death by touching the wire and thus electric shock (electrocution).

Stakeholders: Park Škocjanske jame, Environmental Service of the Republic of Slovenia, Birdlife Slovenia Association (DOPPS), Elektro Primorska, Municipality of Divača, Agricultural and Forestry Service of Nova Gorica.

Pilot action: As part of the ZA KRAS project, the electricity distributor Elektro Primorska secured live parts on 1,254 poles for electric power lines in the Karst in 2020, which in nature represents 110 km of transmission lines.

Results: In less than a year, researchers estimated 12 owl males which were radio tracked were electrocuted in the area. With these and other nature protection measures, they will help to improve the condition of the three most endangered habitat types and thus help to preserve 27 endangered plant and animal species in the Karst.

6.8.4 Guidelines on how to achieve desired state on:

Local level

- **Defining clear goals** in a mitigation plan and identify strategic locations (identification of wildlife roadkill hotspots).

- **Assessing and monitoring road, rail, or powerlines infrastructures** to develop crossing and adapt it if necessary. This monitoring can be carried out with photographic traps that are triggered when an animal passes through. It enables to know whether the crossing is suitable, which species use it, and possibly to understand why some do not use it.

- **Raising awareness on traffic nuisance** (light, noise, speed) while valuing the crossing of road infrastructures also for pedestrians and cyclist.

- **Developing inclusion of citizen science** with digital devices.

- **Incorporating Ecological Connectivity in Environmental Impact Assessment** of new infrastructure.

- **Programming multi-annual investments** for ecological permeabilization operations on priority sections of infrastructures (Eco ducts, Eco bridges, wildlife crossings, vegetated crossings, Landscape overpass, fauna overpass, multi-use overpass, adapted viaduct and river crossing, Fauna underpass, multi-use under pass, small fauna underpass, fish and amphibian passages, fences along the highway to prevent accident).

- **Selecting permeabilization devices based on scientific knowledge**. Some devices are ineffective or require more research like road signs of drivers, bushes on the edges of the road.

National level

- **Restoring or creating** ecological continuity at the infrastructure level prior to any new project of infrastructure (SEA and EIA including ecological connectivity analyses).

- **Ensuring long-term maintenance** of the system for long term functionality of Eco bridges. On this aspect, special training needs to be addressed to the road maintenance keepers especially for small scale measures.

- **Improving the legislation in construction acts** that take Ecological connectivity into account when building new infrastructure (to incorporate Ecological Connectivity in Environmental Impact Assessment EIA).

- **Conducting a promotional campaign** on the problem of road-kill and habitat fragmentation should be highlighted.

Macro regional level

- **Anticipate the need to take ecological connectivity** into account from the outset of projects in order to integrate this issue into project studies and general planning. The project developer must assess the need to restore or create ecological continuity at the infrastructure level.

- **A European directive to incorporate a common legal administrative definition of ecological connectivity** could facilitate interventions and legislation improvement at the national level.

7. Conclusion

In the Dinarides, many fragmented initiatives between different administrative levels, organizations, networks that cover various disciplinary erupted in the past, but are lacking adequate visibility and a common strategy for ecological connectivity. This strategy enabled to incorporate diverse ongoing policies and consult key stakeholders in order to benefit from the existing expertise and know-how and to initiate a consensual impulse for a common strategy in the Dinarides, with a further implementation potential.

The DINALPCONNECT project was triggered to develop knowledge and identify major issues for ecological connectivity in the Dinarides area and pilot regions. Willing to have coordinated and effective interventions at all levels of governance, this report proposed a strategy structured in eight themes: Forestry, Agriculture, Wildlife Management, Water management, Tourism, Role of protected areas, Spatial planning and Infrastructure. Many of the guidance encourage joint interventions between those thematic to perform inter-disciplinary, transboundary and horizontal approach.

Across all themes, there is a crucial need for **awareness raising, communication and dissemination of information** to all stakeholders in areas addressed by ecological connectivity. The strategy is also an invitation to **wider inter-consultation** between agricultural policy, forest and wildlife management, land use planning, national park management, tourism strategies between local and regional cross-border authorities and coherent planned protection (ecological corridor, boundaries of natural protected areas).

Harmonization of legislation that will clearly identify Ecological Connectivity will be an important step to legitimize and engage needed actions. The benefits of developing ecological connectivity are not evident in the current general economic and social model and need to be legislated beyond demonstration and communication efforts. Otherwise, there is a risk of not having a sustainable involvement of the stakeholders.

Furthermore, the proposed Strategy contribute to the development of a **new economic model** considering ecosystem services and landscape connectivity as economic agents to be taking into account in the business plans of stakeholders (Pro Biodiversity Business, reallocation of natural parks income to local communities, agrobiodiversity-oriented subsidies). Funding opportunities might help stakeholders to achieve the transition of previous business model to new ones such as LEADER.

Overall, land use and land cover management would become more effective through a **continuous and participatory spatial approach** that takes into account biogeographical extent and habitat types rather than administrative perimeters. Therefore, one of the key recommendations of this strategic report is to put in place a formal agreement in the form of the Dinarides Convention with a governance unit to implement it, along the lines of the Alpine Convention and Carpathians Convention.

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