Guidelines for agricultural and forestry practices and policies to harmonize and promote transboundary management for improved ecological connectivity

FINAL VERSION

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Acronyms

CAP	Common Agricultural Policy
CBD	Convention on Biodiversity Diversity
COP	Conferences of Parties
CSI	Continuum Suitability Index
CRA	Connectivity Restoration Areas
ECA	Ecological Conservation Areas
EIA	Ecological Intervention Areas
EC	Ecological Connectivity
EURAC	EURAC research - European Academy of Bozen-Bolzano
EUSAIR	European Union Strategy for the Adriatic and Ionian Region
EUSDR	European Union Strategy for the Danube Region
FAOSTAT	Food and Agriculture Organization of the United Nation Statistics
GAEC	Good agricultural and environmental conditions
GI	Green Infrastructure
HNV	High Nature Farming
SACA	Strategic Alpine Connectivity Areas
SWOT	Strengths Weaknesses Opportunities Threats

1 Challenge

From core biodiversity conservation areas to ecological connectivity.

Habitat loss and fragmentation have been recognized as major threats to life on Earth since the 1990's (ClimateAdapt, 2019). The deterioration and fragmentation of natural ecosystems are key causes of the global biodiversity crisis. Several national and international policies and treaties, such as the **Convention on Biological Diversity** (CBD, 1992) stressed the challenge for safeguarding the connections in fragmented world. One of the CBD's indicators for monitoring the progress towards its biodiversity goals is **connectivity/fragmentation** of ecosystems (CBD, 1992). Many protected areas have been established to this day in order to preserve sites with high biodiversity values. However, according to scientific discussions (ClimateAdapt, 2019; Crooks and Sanjayan, 2006), protected areas alone will not succeed in addressing efficiently the conservation of biodiversity without connectivity of their surroundings. The Conference of Parties (COP) as well as the EU and several conservation organizations are promoting national and even international networks of ecological connectivity, although their implementation is facing numerous obstacles (Jongman et al. 2011).

Ecological connectivity describes the movement of organisms 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.

Two main components characterize ecological connectivity. The first one is **structural connectivity** (Tischendorf and Fahrig, 2000). It means the spatial arrangement of different habitat types and other elements of the landscape, which is directly dependent on habitat fragmentation. The second one is **functional connectivity** that refers to the behavioural response of species or ecological processes to that physical structure of landscape (Crooks and Sanjayan, 2006). Functional connectivity is generally more difficult to measure as it requires not only the spatial information on landscape elements, but also the knowledge on movement of organisms or processes through that landscape. However, the functional component is even more relevant as it reflects the capacity of a

landscape to promote the movement of species. Establishing or enhancing connectivity goes a step further, and if successful, creates an interconnected system of habitat, which integrates conservation efforts at several levels, such as local, regional, continental, or even global scale. Ecological connectivity improves the resilience of the habitat (and consequently species) to the challenges related to regional and global changes, such as anthropogenic pressure and climate change.

Isolated wildlife population are more susceptible to extinction., In fragmented habitat, several demographics, environmental and genetic forces, which may act independently or synergistically, are direct mechanisms affecting the species richness and abundance (Laura R. Prugh and al., 2008). These include inbreeding depression due to loss of genetic diversity within the population. This results in loss of fitness, increased sensitivity to edge effects (such as pollution, encounters with predators), depletion of necessary ecological flows (such as seed dispersal or nutrients), inability to disperse from natal ranges or migrate to foraging or breeding sites, altered environmental conditions, etc (Gilpin, M. E., and M. E. Soule´. 1996, Crooks and Sanjayan, 2006).

The ecological connectivity can be best ensured by mitigating fragmentation in the first place and by maintaining large populations within large quality habitats (Crooks and Sanjayan, 2006). Space is often subject to conflicts of land use among different sectors of activity. Apart from areas with protected status, the needs of ecosystems can easily be the last aspect considered in spatial planning, which focuses primarily on anthropological needs. While many approaches exist to explicit the advantages of the nature, new tools are required to interpret the available information and integrated assessment to support planning (Grêt-Regamey, 2017). On a long-term perspective, preservation and restoration of ecological connectivity provide resources and benefits that actually offset the costs incurred for the human society. While ecological connectivity contributes to biodiversity and habitat provision, it benefits result in healthy ecosystems that reflect human needs. That should be considered and supported in every sector of sustainable human development. Such positive synergy effects should be a priority focus of policy makers, land managers and planners.

The scope of the DINALPCONNECT

The EU has agreed upon sectoral policies that contribute to ecological connectivity (Habitats and Wild Birds Directives, Water Framework Directive, EU Biodiversity Strategy for 2030, EU Strategy on Green Infrastructure) and established the legitimacy of protected

core areas (NATURA 2000 sites, Ramsar wetlands, national parks, hunting refuges, natural reserves, etc.). The remaining challenge is to connect those areas with green infrastructure (corridors, buffer zones, green bridges, water sources, lakes, ponds, etc.) and ensure their sustainable managed land use (forestry, organic farming or extensive grazing systems, prevention of deforestation, prevention of land impoverishment). In 2013, the EU Commission drafted a Green Infrastructure Roadmap (COM(2013) 249 final) with the aim of producing recommendations and supporting investments. The green infrastructure is defined as follow: a network of strategically planned natural and semi-natural areas and other strategically planned environmental features, designed and managed to produce a wide range of ecosystem services. It includes green spaces (or aquatic in the case of such ecosystems) and other physical features of land areas (including coastal areas) and marine areas. Green infrastructure can be addressed to rural and urban areas.

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 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. The biodiversity is higher in the Dinarides and some species as the brown bear are migrating from south to north due to climate changes (Bartol, 2016). The management of land devoted to agriculture and forestry has a major impact on the condition of biodiversity. Existing agricultural and forestry policies and practices that affect ecological continuum between the Dinarides and the Alps were examined in all countries. Apart of the legislative and institutional context, these *Guidelines for agricultural and forestry practices and policies to harmonize and promote transboundary management for improved ecological connectivity (Guidelines)* fosters ecological agricultural and forestry practices with a special emphasis on four pilot regions and explores opportunities for better cross-border cooperation:

- Prealpi Giulie Natural Park (Prealpi Giulie Natural Park and the Tarvisio Hunting District) and Triglav National Park (Triglav Hunting Management Area and part of the Gorenjska Hunting Management Area) (Italy – Slovenia)
- Natura 2000 Kras and Natura 2000 Učka and Ćićarija (Slovenia – Croatia)
- Natura 2000 Lisac – Una NP and Drvar Municipality (Croatia – Bosnia and Herzegovina)
- Northern Pindus – Frasher Village, Permet – Vikos (Albania – Greece)

Based on previous achievements from the DINALPCONNECT project, this document elaborates guidelines for agricultural and forestry practices and policies to harmonize and promote transboundary management for improved ecological connectivity.

2 Objectives

These *Guidelines for agricultural and forestry practices and policies to harmonize and promote transboundary management for improved ecological connectivity* were developed through an inclusive process within the framework of the DINALPCONNECT project. They aim to be a reference providing general technical and policy recommendations on agricultural and forestry practices for transboundary management for improved ecological connectivity. The target audience of this report are partners across the DINALPCONNECT area, policy makers from European bodies, ministries to municipalities, regional and cross-border managers of the pilot areas and any other interested parties facing similar problems elsewhere.

The objectives of the Guidelines are: to present widely accepted, practically proven and scientifically based principles that promote ecological connectivity and serve as a guidance to stakeholders on how to translate these principles into practice, be it for farming, pastoralism, forestry or more general natural resources management.

The Guidelines are of voluntary nature and are not legally binding.

3 Methodology

Insights

In its first stage, this report is reviewing the key findings from available dataset from the Food Agricultural Organization (http://www.fao.org/faostat/en/#compare) in the field of agricultural and forestry practices and gathering the main conclusion from the previous reports elaborated under the DINALPCONNECT project:

- situation analysis (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 et al. 2021 WP3-A.2)

The report includes several maps representing the spatial distribution of biotopes and related species within the DINALPCONNECT project area and its pilot regions. The maps have been created through QGIS by using CORINE Land Cover dataset from 2018 with a rearrangement of the land use categories to better focus on the habitat types located in forestry and agricultural areas (from 44 classes to 13). A Digital Elevation Model is overlaying the CORINE Land Cover to better visualize the topographic context which is part of the ecological connectivity indicator.

Guidelines based on habitat types approaches

Weaknesses and threats expressed by local stakeholders' trough a SWOT analysis elaborated under the DINALPCONNECT project were the starting point for reasoning appropriate recommendations to improve ecological connectivity when obstacles (Leonetti and al. 2021, Kostelić et al. 2021). Workshops participants in the framework of DINALPCONNECT project have already highlighted a large number of opportunities and solutions, which are capitalized on a pragmatic way in this document (Leonetti and al. 2021, Kostelić et al. 2021, Premelč et al. 2021, Agricultural University of Athens 2021 Kostelić et al. 2021, Leonetti and al 2021, Laner and Favilli 2021). Guidelines are exclusively focusing on agricultural and forestry practices and transboundary management. The recommendations have been drafted from habitat types and species approach in a comprehensive table and contextualized for each pilot regions in a written chapter. Priority habitat types-oriented measures contribute to considering biodiversity at the heart of the actions. Guidelines to address consistent cross border management in

favour of ecological connectivity and sound base for policy-making and legislation are introduced in the last chapter.

Moreover, recommendations from good practices outside the project area or other initiatives are also mentioned when appropriate. This good practice has been selected from the following literature:

- Swiss National Park, 2019. JECAMI 2.0 –User Guide. Integrative Alpine wildlife and habitat management for the next generation. INTERREG Alpine SPACE - AlpBioNet2030
- EU Forestry strategy, 2021. Project REDIAFOR Multifunctional Forest in the Alps Reinforcing. Alpine Region Preparatory Action Fund
- Lampkin N, Stolze M, Meredith S, de Porras M, Haller L, Mészáros D, 2020. Using Eco-schemes in the new CAP: a guide for managing authorities. IFOAM EU, FIBL and IEEP, Brussels.
- Lee-Ann Sutherland & Fleur Marchand 2021 On-farm demonstration: enabling peer-to-peer learning, The Journal of Agricultural Education and Extension,27:5,573-590, DOI: 10.1080/1389224X.2021.1959716.

The figure below enables us to better understand the methodological process how the guidelines were elaborated.

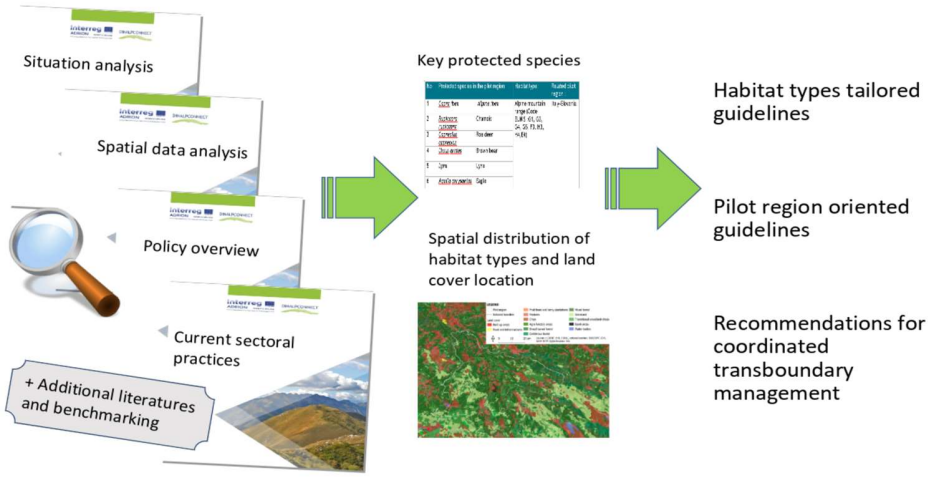


Figure 1: Methodological process on elaborating the guidelines

This method aims provide concrete and tailored recommendations in line with the characteristics of biodiversity. The structure of this report contributes to a better readability and convenient use in practice of the Guidelines. Guidelines for each DINALPCONNECT pilot region and at wider scale (applicable also in other parts of the Adriatic-Ionian macro region and further) are provided in the final section of the report.

4 Retrospective on agricultural and forestry land use in project area

The Food and Agriculture Organization of the United Nations update a dataset on sectoral practices and land use called FAOSTAT that helps to view the ongoing tendencies. Their online comparative data interactive module provides an overview of the sectoral practices and related land use over time (http://www.fao.org/faostat/en/#compare). Data are directly gathered from the countries through questionnaires, and some years have been figured out through own FAOSTAT estimations. Figures focused on the evolution of agricultural land, organic agricultural land, forest terrain and fertilizer indicators are produced to provide a retrospective of the situation in the DINALPCONNECT countries. It shows that cultivated areas for Italy, Greece and Montenegro are decreasing while it remains stable for Bosnia and Herzegovina, Albania, Slovenia and Croatia since 1992. This relative related stability is questionable regarding the feedback from stakeholders in the framework of the DINALPCONNECT project. The young depopulation of rural areas has been a recurring topic as it directly influences agricultural decline. It is assumed that the chart is reflecting only a quantitative aspect (number of hectares) of practices but it can also be considered a lack of qualitative information on the land cover type, or even a time gap between ongoing practices and coming consequences on land cover.

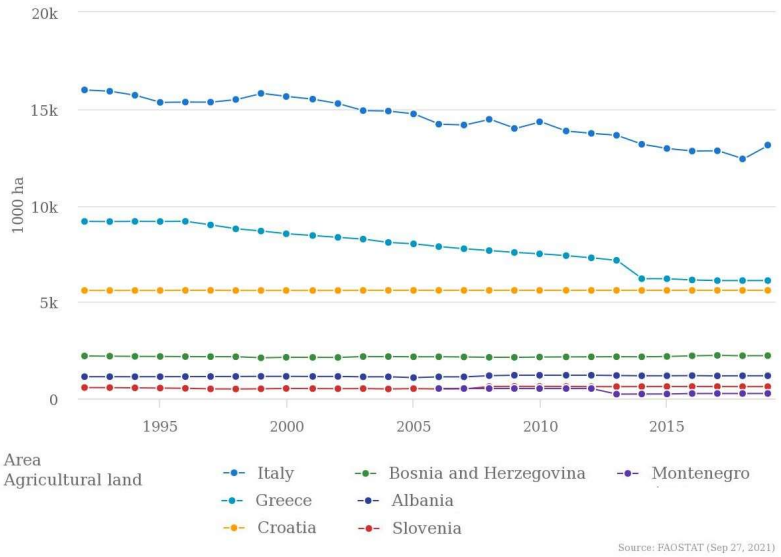


Figure 2: Agricultural Area for each country taking part in DINALPCONNECT project

During the same period, the land use of permanent grassland and pasture remained stable in most countries except Greece and Italy, which recorded a slight decrease. This trend is therefore comparable to the global agricultural land review in the previous figure (figure 1). The impact of depopulation is obviously not visible yet in those national statistics but a declined number of cultivated and grazed lands might be expectable in the near future according to feedbacks from local stakeholders (Kostelič B, 2021).

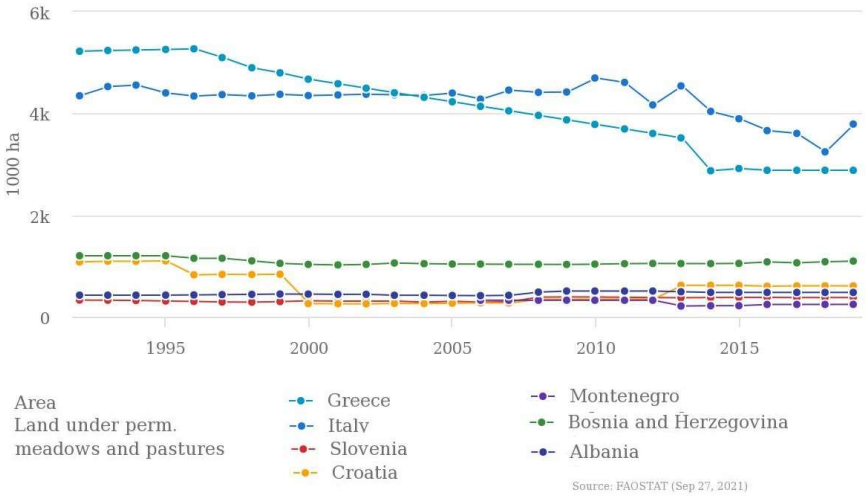


Figure 3: Meadow and pastures area for each country taking part in DINALPCONNECT project

Organic agricultural land use based on declarative certification shown in the figure 4 allows us to appreciate the trends for each country. Nevertheless, the quantity of hectares cannot be interpreted as a ranking between countries. The different country sizes omit any ranking between countries in this figure as evolutions corresponds to the number of hectares and not the share of agricultural land (figure 3). Since 2012, organic farming area is rising significantly in Italy and Greece with a very soft upward trend for other DINALPCONNECT countries. In perspective with the total agricultural areas shown in the figure 2, the number of organic hectares remains very limited. Undoubtedly, thriving eco responsible practices are under way in all countries but are relatively far from a major shift. Nevertheless, higher share of ecological agricultural land use seems unavoidable to undertake biodiversity conservation challenges.

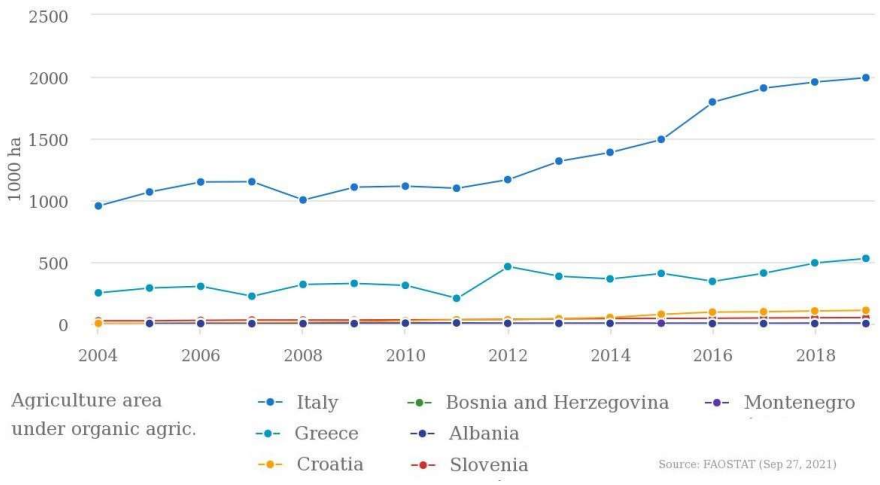


Figure 4: Organic Agricultural area for each country taking part in DINALPCONNECT project

As indicated in Figure 5, 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 countries are conserving the same forestland areas over time since 1992. Primary forest remains to the same extent for each DINALPCONNECT countries on the same period (FAOSTAT).

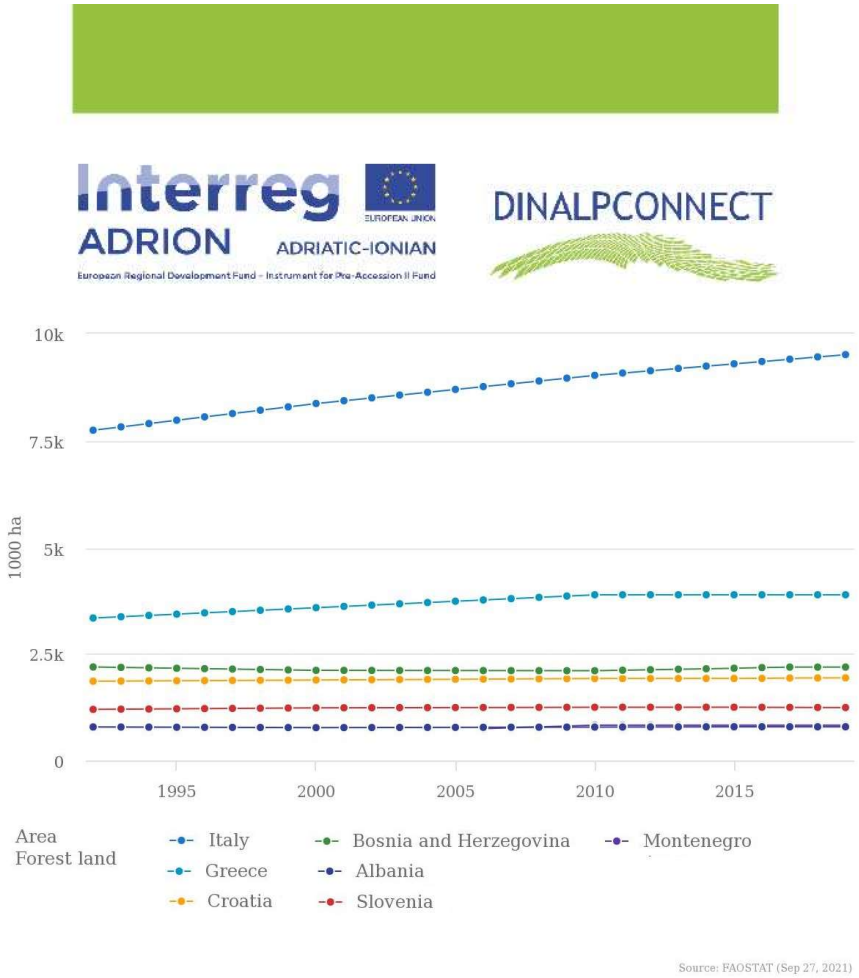


Figure 5: Forestland area for each country taking part in DINALPCONNECT project

This retrospective of agricultural and forestry land use, enable by the extraction of the FAOSTAT database, does not fully confirm the threats identified locally by the institutions and stakeholders in the pilot regions of DINALPCONNECT project (Premelč et al. 2021). Agricultural decline is not systematic to all the countries. This is potentially due to a time lag. However, these graphs show that in a short period of 30 years, phenomena of agricultural and pastoral abandonment can be seen on a national scale with the example of Italy and Greece (see figure 2 and 5). The issue of preserving grasslands from urban sprawls or the forest extension in the absence of agricultural maintenance is therefore significant in the project area according to the figures 2 and 5. In addition, the remaining efforts to rebalance the rate of organic farming to conventional farming is considerable and invite us to mind guidelines on the matter.

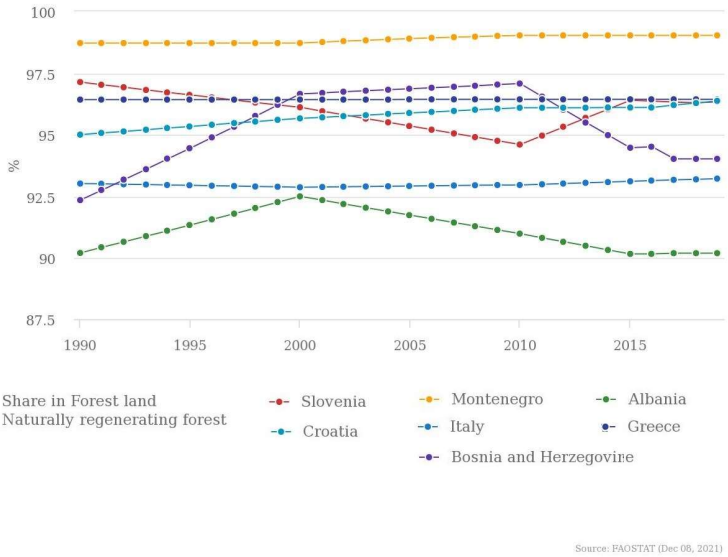


Figure 6: Share of Naturally regenerating forest in forest land in DINALPCONNECT project area

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 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).

A planted forest is defined as a forest that, at maturity, consists mainly of trees established by planting and/or deliberate seeding. The following graph then completes the previous one with the share of planted forest. Therefore, we can see that Albania and Greece are doing the most tree planting within the participating countries of the DINALPCONNECT project.

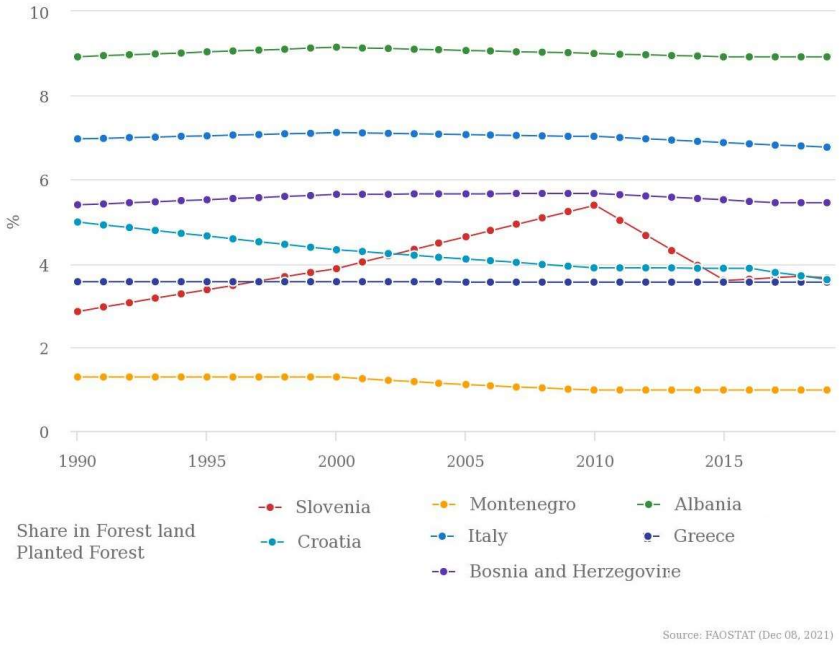


Figure 7: Share of planted forest in forest land in DINALPCONNECT project area

5 Main conclusions from previous reports

5.1 Situation analysis

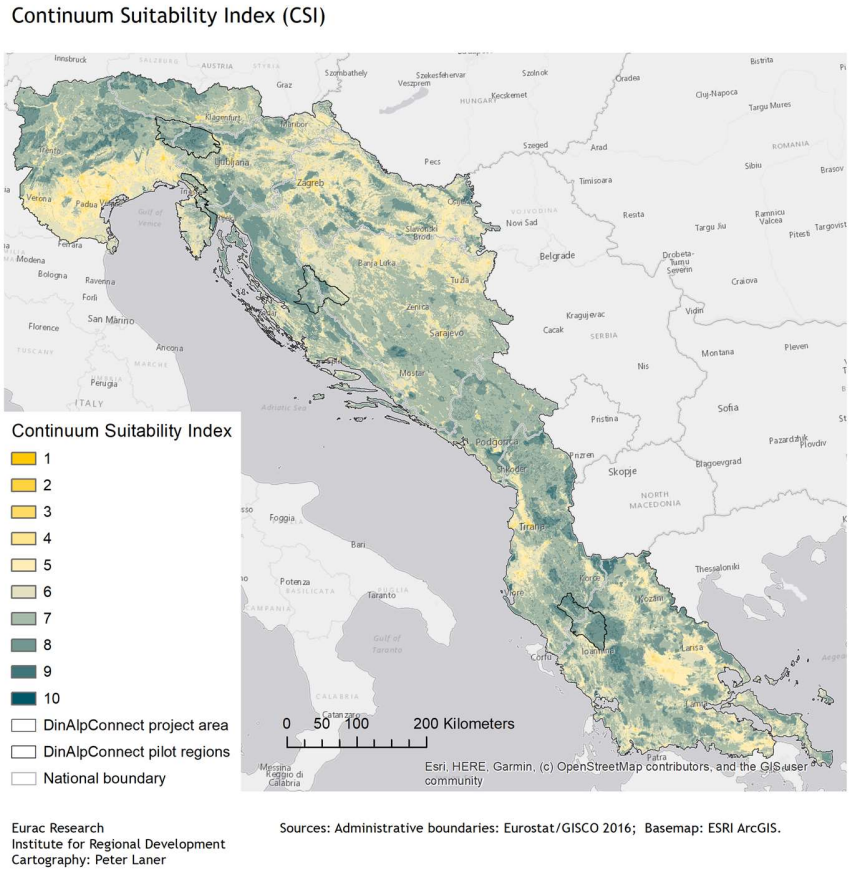
Meadows and grasslands are strategic areas for biodiversity conservation and economic activities, as they enable agricultural activities. Even though dry grassland habitats in pilot regions predominantly benefit from protection regimes or legal specifications, their statement is currently in poor condition. 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. Managers in some of the national parks in the project area have an interesting experience and represents an opportunity for knowledge exchanges and innovative diffusion from a cross-border and transnational perspective. Inclusive management considering all users of agricultural area is required to implement policies (Premelč et al. 2021). For instance, hunters have been identified as key players for supporting the concrete actions. In addition, municipalities are willing to facilitate re-parcelling land plots that would stimulate appropriate land use and facilitate agriculture practices (Kostelič B, 2021). Agroforestry is promoted in Slovenia, Croatia and Greece and represents an opportunity for adjacent uncultivated land (Agricultural University of Athens, 2021).

Agroforestry is defined as a land-use systems and practices where woody perennials (tree, shrubs) are deliberately used on the same land-management units as agricultural crops or pasture in different form of spatial arrangement of temporal cycles. Agroforestry systems are multifunctional systems can increase social, economic and environmental benefits for land users. (FOA, 2015).

It remains complex to maintain high standards of forests, while they are mostly privately owned and subject to uncontrolled logging in some parts of the project area. Additionally, invasive species, ongoing changes in ecosystems, lack of permanent land cover, emissions in soils, deforestation, fire incidents, increasing number of natural disasters (mostly due to climate change) are stressed out (Agricultural University of Athens, 2021). Forests Management Plans are covering forestlands except in Bosnia and Herzegovina and Montenegro. Nevertheless, they are gaps between their objectives and the effective implementations, especially because manager is missing in some of the 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).

5.2 Spatial data analysis

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. The draft map 1 below has been produced by EURAC as preliminary result (Laner P., and Favilli F., 2021):



Source: Draft map produced by EURAC (September 2021)

Map 1: Continuum Suitability Index of the DINALPCONNECT project area

In the framework of Interreg Alpine Space project AlpBioNet2030 a methodology for mapping three types of strategic connectivity areas with different required measures have been developed and applied to the perimeter of the Alpine Macroregional Strategy (Swiss National Park, 2019). EURAC research is re-using the methodology that will contribute to harmonize outputs in Adriatic Ionian macro region between the Alps and the Dinarides (Laner P., and Favilli F., 2021). Thus, the DINALPCONNECT project capitalizes the results of previously implemented project and resulting in better quality and comparability of its results, which will also bring greater impact.

The Strategic Connectivity Areas (SACA), that were developed within the AlpBioNet2030 project, consist of Ecological Conservation Areas (ECA), Ecological Intervention Areas (EIA) and Connectivity Restoration areas (CRA). They have been delineated according to CIS values and allow us to better visualize the spatial distribution of the conservation province, potential zone for ecological connectivity improvement and restoration area from a harmonized spatial assessment. The various features of regions, and diverse protection regime challenged the ability to establish a homogeneous map for a comparative study (Laner P., and Favilli F., 2021).

The Italian part of the DINALPCONNECT project area is characterized by an important physical barrier due to high altitudes and face strong population pressure between the Alps and Adriatic Sea. The Italian landscape is highly fragmented by road infrastructure, dense network of urbanized areas and intensive agriculture practices on the south. Ecological connectivity in Slovenia is less affected in terms of topography except on the northern part. Lowland areas are impacted by population pressure and fragmentation, especially in Ljubljana and eastern provinces where the land cover is not supportive for ecological connectivity (Laner P., and Favilli F., 2021).

Population pressure, fragmentation process and some land use compromise the ecological connectivity in the eastward part of Croatia while western areas benefit of established protected regimes. A potential connection could be enhanced between the pilot region Slovenia-Croatia and Croatia - BIH. Population strain, road infrastructure and topography have limited impact on ecological connectivity in Bosnia and Herzegovina but protection level is almost non-existent (Laner P., and Favilli F., 2021).

The Emrald Network is an ecological network created by the Council of Europe with the Bern Convention in 1989. Contracting Parties agreed to consider Areas of Special Conservation Interest through the Emrald Network (Bern Convention 1989). Montenegro

records the best land cover statement regarding ecological connectivity indicators but some important natural areas identified by Emerald Network are not yet safeguarded. This asset could be therefore compromised in a long run.

Albania have contrasted assessments between western part of the country that displays efficient permeability while the eastern side is affected mostly by inappropriate land use and transport infrastructure.

In Greece, anthropological land use jeopardises ecological connectivity on the coastline to the Ionian Sea and the eastern part of Greek project. However, the mountain range area is characterized by land use in favour of connectivity for species.

5.3 Policy overview

The concept of Ecological Connectivity has been incorporated in various sectoral policies on national and EU level. Ecological Connectivity is mainly promoted through environmental policies. The policy-makers and the stakeholders responsible for the strategic development of ecological connectivity networks are usually acting on the European echelon, national level or regional authority but are also handled on municipal boundaries. Research institutions and NGOs participate less 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 levels, policies 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 LIFE projects.

Regarding agricultural practices, it is important to mind the draft plan of the next Common Agricultural Policy that could slightly evolve in favour of ecological connectivity. 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 (Lampkin et al., 2020). A principle of ecological conditional measures has

been defined but not approved yet. Among proposed measures, 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. Eco-schemes 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.

The E.U. Green Deal has targeted objectives that could contribute to sustainable agricultural practices such as (EU Green Deal, 2021):

- *« 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 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 been published.

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.

5.4 Analysis of current agricultural and forestry practices affecting EC (WP2-A.2)

Drainage of wet grasslands, tourism, recreation, abandonment of agrarian land, introduction of non-native species, unsustainable exploitation of plant protection products and excessive fertilization of meadows are ongoing agricultural practices affecting ecological connectivity. These pressures are altering the statement of the environment, and generate overgrowing, degradations in soil quality, emissions (in water, earth, and air), variations in biodiversity, reduced pastoral areas and depopulation of the young local household. The forest has many ecosystem services and is subject to various human uses from different stakeholders (forestry managers, hunters, walkers, mushroom pickers, loggers, bikers, owners, visitors) and the various related expectations might challenge the preservation of biodiversity. Regarding forestry areas deforestation

(however not in Slovenia), new constructions or public roads, climate changes, natural hazards, urbanization, tourism, human activities and economic development, pollution and fertilization are the main factor degrading ecological connectivity. These pressures are causing an altered state of the environment, which cause emissions in water, soil and air, in changes in biodiversity, in the presence of invasive species and in the changes in forest ecosystems. Those practices have immediately or long-term consequences such as the reduction of biodiversity, loss of indigenous plant and animal species (introduction of new/non-native species) and the collapse of ecological connectivity. Therefore, responses could be adapted as sustainably as possible to relieve stresses on ecosystems.

6 Priority habitats and species

Several classifications of habitats have been framed over time in order to describe them accurately and better target conservation objectives. The listed habitat species below is referring the EUNIS habitat categorization that has been developed by the European Environmental Agency and its European Topic Centre on Biological Diversity (ETC/BD). EUNIS is suitable for this as it covers the whole of the European land and benefit of significant recognition (Douglas, 2012). Moreover, EUNIS habitat classification has been designed to provide common European description of habitat units and support colloquial references in monitoring habitat and species. The definition of habitats used for the EUNIS habitat classification is *"a place where plants or animals normally live, characterized primarily by its physical features (topography, vegetation or animal physiognomy, soil characteristics, climate, water quality, etc.) and secondarily by the species of plants and animals that live there"*. The key species listed below are a selection of protected or endangered species that have been discussed in previous workshops because of their significant link to sectoral activities and cross-border management issues concerning ecological connectivity. Therefore, the list is not comprehensive and targets umbrella species subject to active human wildlife interaction in the pilot regions and project area.

Table 1: selection of key protected or endangered species that have been discussed in previous workshops of EU Interreg Adrion; DINALPCONNECT project

No	Protected species in the pilot region:		Habitat type:	Related pilot region :
1	*Capra ibex*	*Alpine ibex*		Italy-Slovenia

No	Protected species in the pilot region:		Habitat type:	Related pilot region :
2	*Rupicapra rupicapra*	Chamois	Alpine mountain range (Code EUNIS: G1, G3, G4, G5, F3, H3, H4,E4)	
3	*Capreolus capreolus*	Roe deer		
4	*Ursus arctos*	Brown bear		
5	*Lynx*	Lynx		
6	*Aquila chrysaetos*	Eagle		
7	*Erinaceus europaeus*	Brown breasted Hedgehog		
8	*Sciuridae*	Squirrel		
9	*Canis lupus*	Wolf		
10	*Parnassius apollo*	Mountain apollo butterfly		
11	*Anisoptera*	Dragonfly		
12	*Coleoptera*	Beetle		
13	*Proteus anguinus*	Olm	Caves not open to public (Code EUNIS:H1)	Slovenia - Croatia
14	*Bubo bubo*	Eurasian eagle-owl	Eastern sub-Mediterranean dry grasslands (Scorzoneratalia villosae) (Code EUNIS: E1) Broad-leaved deciduous woodland (Code EUNIS G1)	
15	*Hymantoglossum adriaticum*	Orchid		
16	*Austropotamobius pallipes*	Freshwater crayfish		
17	*Serratula lycopifolia*	Daisy		
18	*Eriogaster catax*	Easern eggar		
19	*Emberiza hortulana*	Ortolan bunting		
20	*Vipera ursinii*	Meadow viper	Eastern sub-Mediterranean dry grasslands	Croatia-Bosnia and Herzegovina

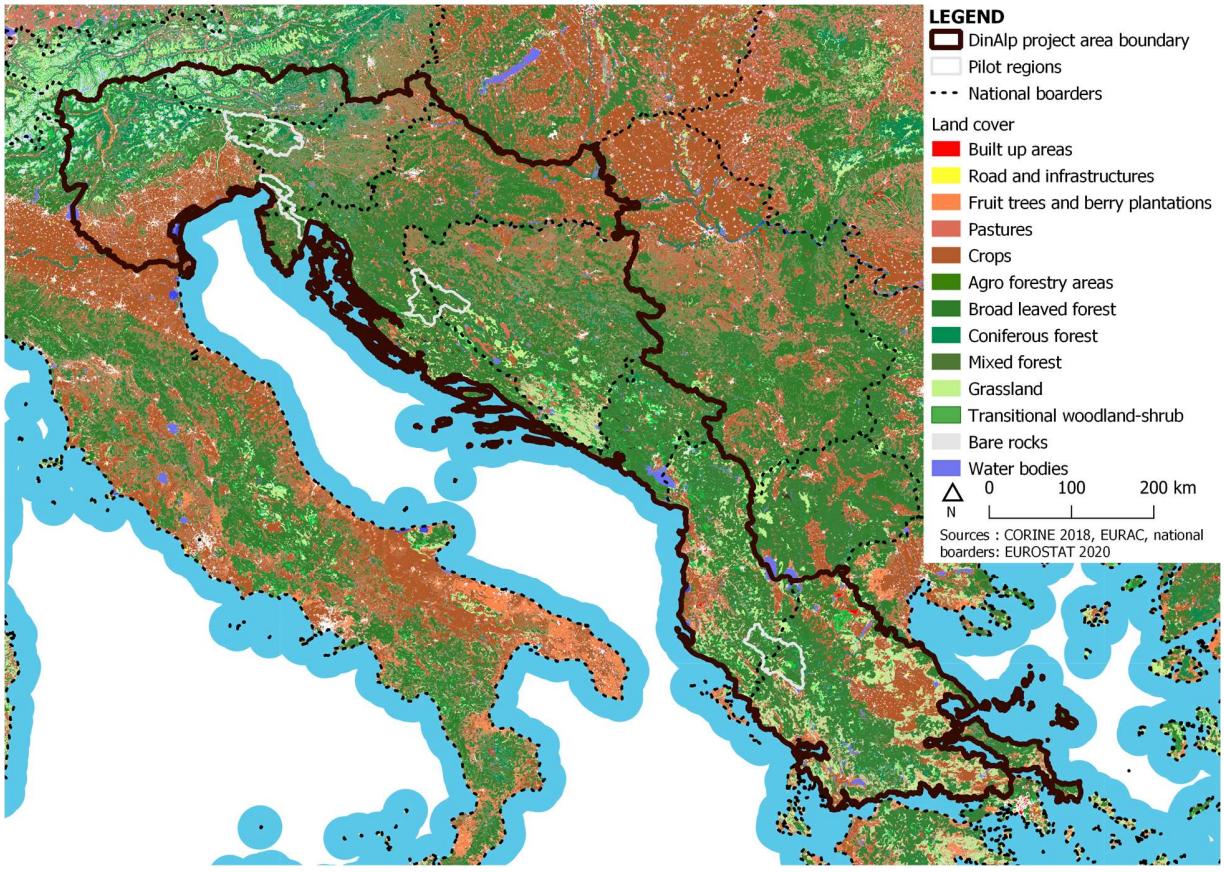
No	Protected species in the pilot region:		Habitat type:	Related pilot region :
			(Scorzoneratalia villosae) (Code EUNIS: E1)	
21	*Ursus arctos*	Brown bear	Mixed broadleaf and coniferous forest (Code EUNIS G3, G5)	Croatia-Bosnia and Herzegovina
22	*Vipera ursinii macrops*	Meadow viper	well-drained alpine and subalpine meadow (Code EUNIS: E3.3) beech and oak forests (Code EUNIS: G1.6)	Albania-Greece Croatia-Bosnia and Herzegovina Montenegro
23	*Bombina variegata*	Yellow-bellied toad	ponds, swamps (Code EUNIS: C1)	Albania-Greece
24	*Euphydryas aurinia*	Marsh Fritillary		
25	*Rana graeca*	Greek stream frog		
26	*Aethriamanta brevipennis*	Scarlet marsh hawk	lakes (Code EUNIS: C1)	
27	*Paraliparis hystrix*		shallow rivers lakes (Code EUNIS: C2)	
28	*Lutra lutra*	Otter		
29	*Vipera ursinii*	Meadow viper	beech and oak forests (Code EUNIS: G1.6)	
30	*Dendrocopos syriacus*	Syrian woodpacker		
31	*Aegithalos caudatus*	Long tailed tit		
32	*Frinillidae* spp.	Finches		
33	*Sitta europaea*	European Nuthatch		
34	*Ursus arctos*	Brown bear		
35	*Circaetus gallicus*	Short-toed snake eagle		
36	*Accipiter gentilis*	Northern goshawk		

No	Protected species in the pilot region:		Habitat type:	Related pilot region :
37	*Accipiter nisus*	Eurasian sparrowhawk		
38	*Aquila pomarina*	Lesser spotted eagle		
39	*Falco peregrinus*	Peregrine falcon		
40	*Bubo bubo*	Eagle Owl		
41	*Buteo rufinus*	Long-legged Buzzard		
42	*Accipiter brevipes*	Levant Sparrow hawk		
43	*Aquila chrysaetos*	Golden Eagle		
44	*Pernis apivorus*	European Honey Buzzard		
45	*Accipiter gentilis*	Northern goshawk		
46	*Neophron percnopterus*	Egyptian Vulture		
47	*Picus canus*	Grey-headed Woodpecker		
48	*Tyto alba*	Barn Owl		
49	*Falco tinnunculus*	Kestrel		
50	*Origanum vulgare*	Wild Morjoram	Grasslands (CODE EUNIS 2019: E1, E3)	
51	*Asperula clorantha*	Woodruff		
52	*Valeriana bertiscea*	Bertisk's valerian		
53	Valeriana officinalis	Common Valerian		
54	*Symphytum officinale*	Common Comfrey		
54	*Orchis* spp.	Orchids		

DINALPCONNECT project area

In the following sections, maps have been created through QGIS by using CORINE Land Cover dataset from 2018 with a rearrangement of the land use categories to better focus on the habitat types located in forestry and agricultural areas (from 44 classes to 13). A Digital Elevation Model is overlaying the CORINE Land Cover to better visualize the topographic context which is part of the ecological connectivity indicator.

The first cartographic representation about the DINALPCONNECT project is very illustrative for presenting the current state of ecological connectivity between the Dinarides and the Alps. The predominant cultivated land in upper part of Italy, northern Croatia and Bosnia and Herzegovina leave a restricted circulation beam for species. The transition from dominating mixed broad-leaved and coniferous forest area in Slovenia, Austria and northern Croatia towards numerous grasslands in south of Bosnia and Herzegovina, Albania and Greece are clearly visible at this scale. The maps sized to each pilot regions will help to observe the local features, as shown in Map 2.



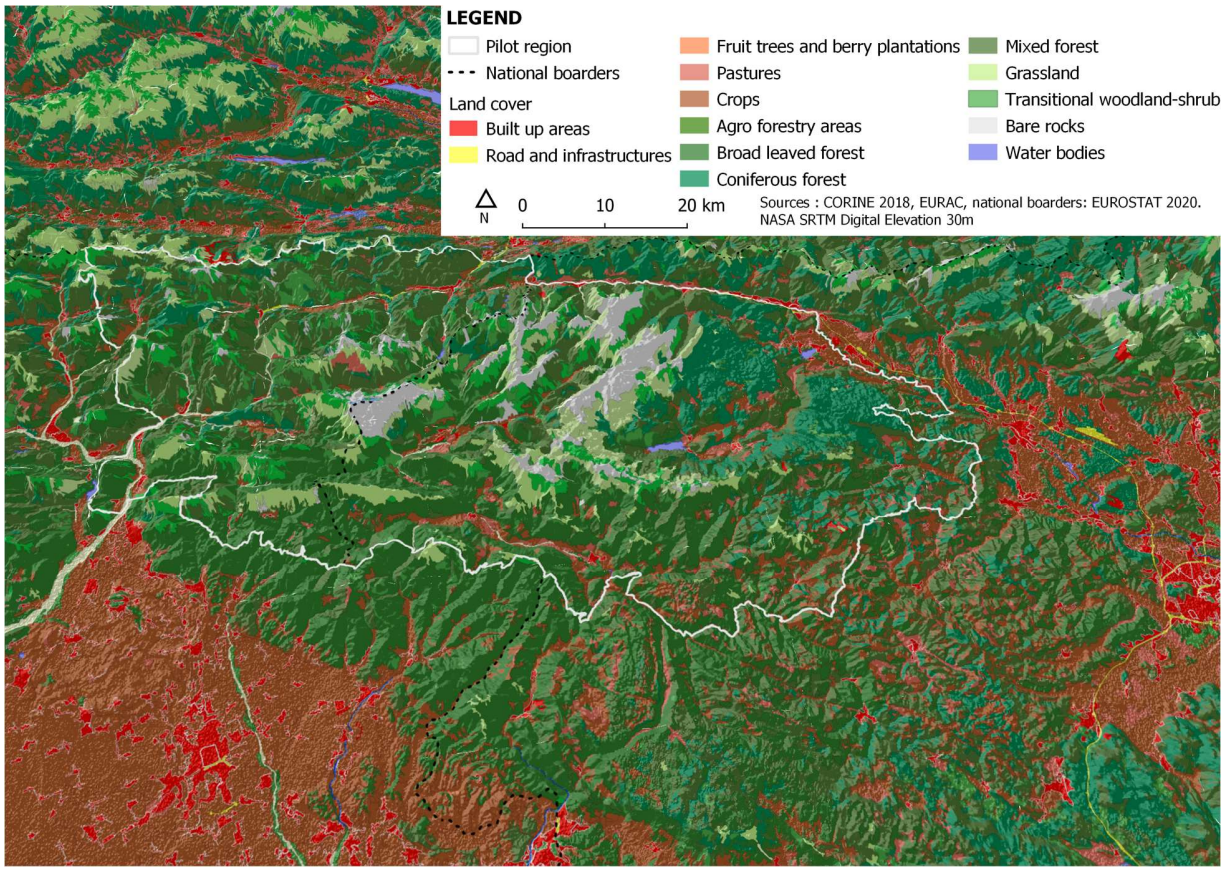
Map 2: Location of land cover and related habitat types on the DINALPCONNECT project area

Pilot region Italy-Slovenia

The land cover in the pilot region Italy-Slovenia is dominated by high terrain and shows up obvious physical barrier with important rocky bars by the ridge mountain range, that omits the movement of some species. They are surrounded by alpine grasslands

downwards, while lower altitudes are mostly covered by large areas of forest. We can distinguish broad leaved, mixed forest and coniferous forest on the Slovenian part of the pilot region while Italian side is hosting mixed forest. In the south, broad-leaved forest is marking a shifting transition between Alpine range towards agricultural Italian plains, and Goriška brda vineyards on the east part.

Within the Italian and Slovenian urbanized land, the road and airport infrastructures stand out in yellow on the map 3 as an obvious barrier to permeability.

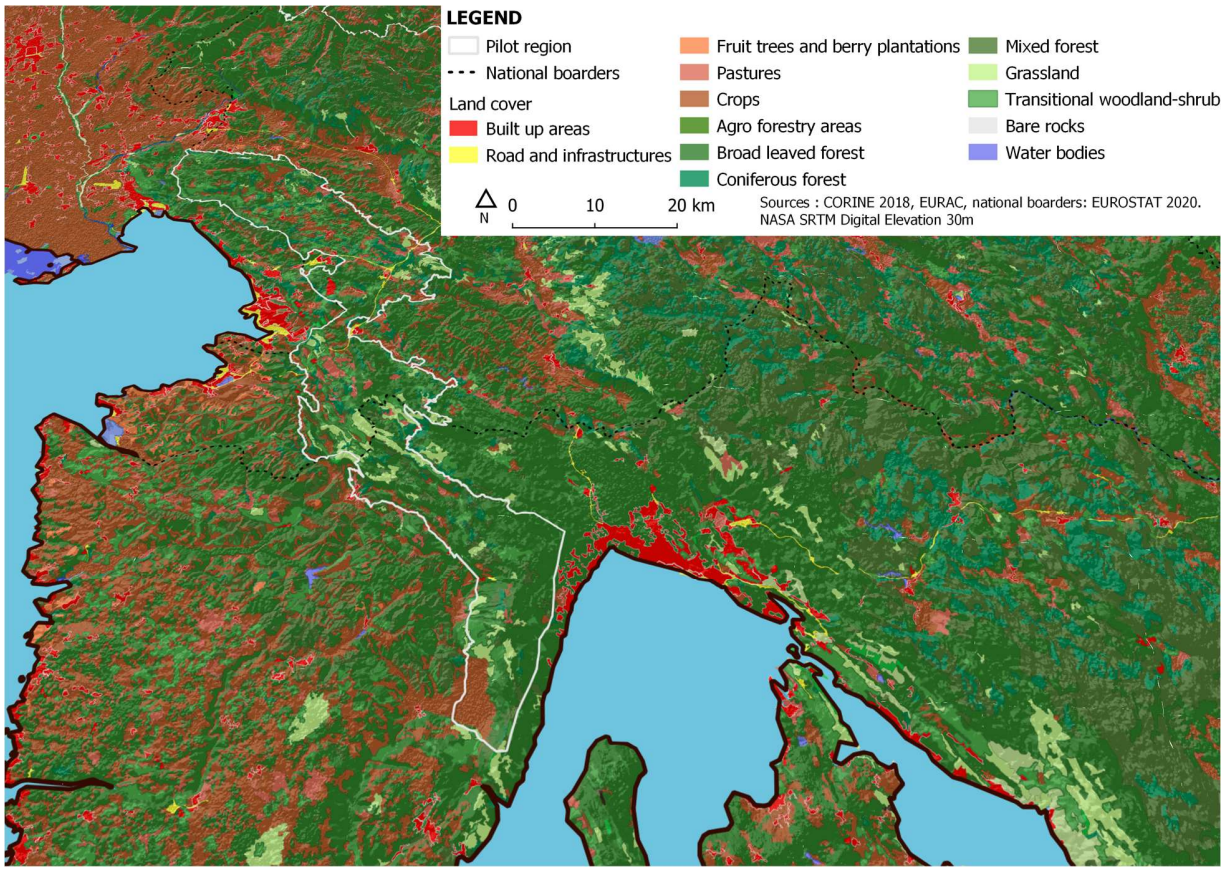


Map 3: Location of land cover and related habitat types on the pilot region Italy and Slovenia

Pilot region: Slovenia Croatia

The pilot region Slovenia-Croatia is characterized by many different land cover such broad-leaved, coniferous, mixed forestlands, grasslands, pastures, woodland, shrub-land. Road infrastructures are linearly omitting the connectivity on the Slovenian side. Since fertile soils are mostly found at valley bottoms, the map 4 shows clearly Italian and Slovenian plains that enable cultivation. Along the border are frequently located mixed

forest, transitional woodland-shrubs, forests and high grasslands that confirm the challenge of transboundary management in agricultural and forestry practices for a better cross-border permeability.



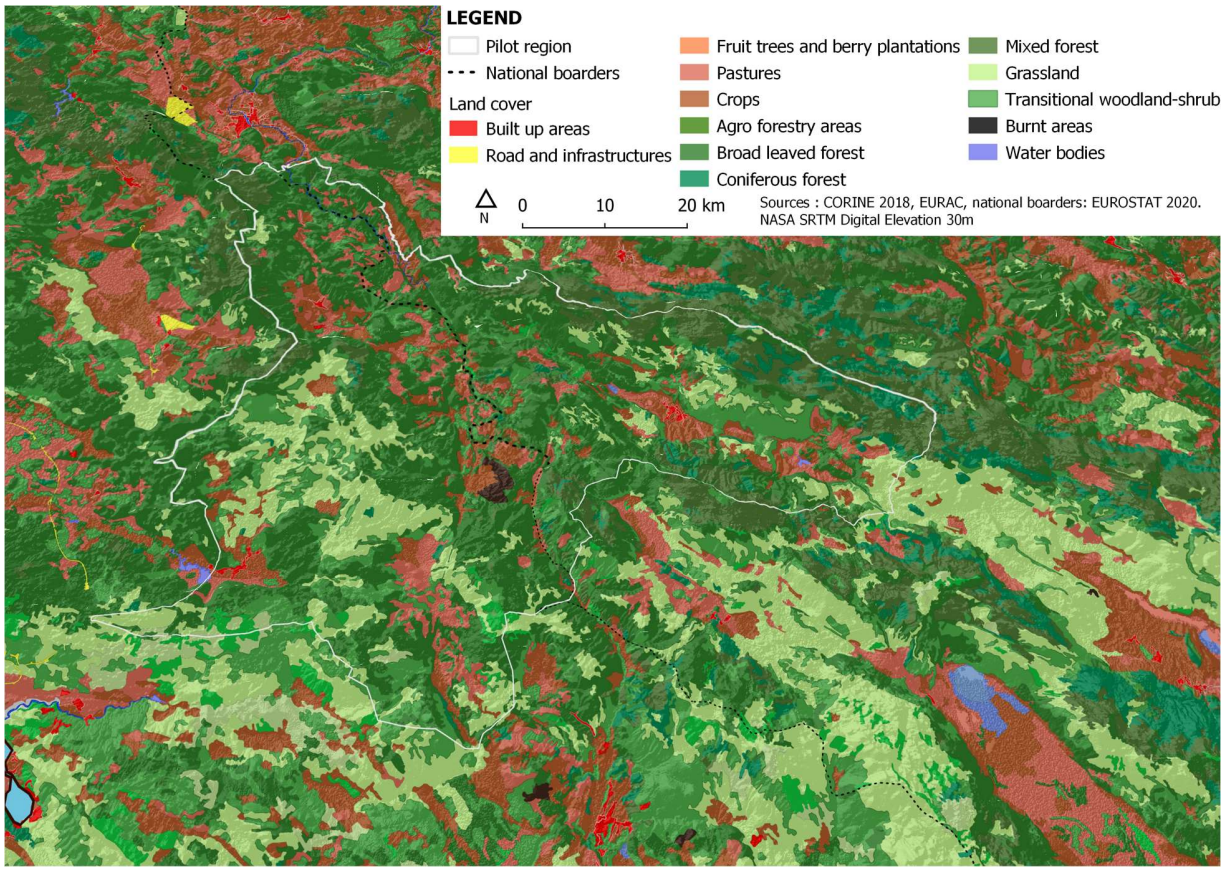
Map 4: Location of land cover and related habitat types on the pilot region Slovenia and Croatia

Pilot region: Croatia-Bosnia and Herzegovina

Broad-leaved forest, transitional woodland and shrub-land and grassland are the main land cover of the pilot region Croatia-Bosnia and Herzegovina. Una river delimits the international border on the northern part of the pilot region and is enclosed by broad-leaved forest.

The land cover assessment shown in map 5 illustrates the need to coordinate forestry practices to ensure transboundary ecological connectivity in this region. The abundance of grasslands in the interior highlights the sensitive issue of sustainable pastoralism.

Managing the ecological connectivity of this area from north to south is essential to maintain the backbone that structures the DINALPCONNECT project area. A burnt area of 875 ha in Croatia should be mentioned and reminds the issue of fire prevention.

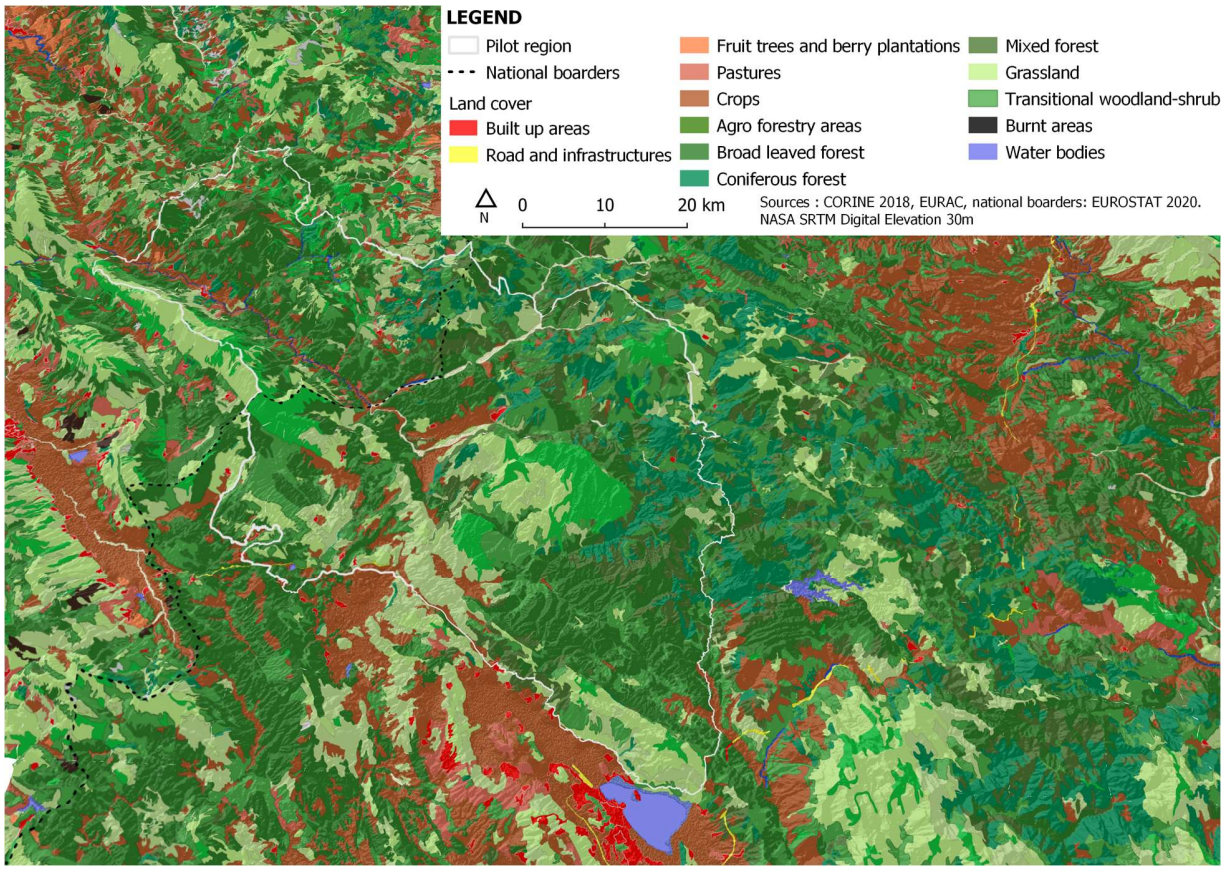


Map 5: Location of land cover and related habitat types on the pilot region Croatia and Bosnia and Herzegovina

Pilot region: Albania Greece

The pilot region Albania - Greece is characterized by a Southern-Europe continental climatic pattern, mountain ranges and Mediterranean forest biome, composed by forests, shrubs and grasslands. Due to low population density, the presence of forests and shrubs create an extensive and typical eco-pastoral system, whose traditional economy was based on small ruminants. The administrative border delimitation is mostly following mountain ridges and goes partly through the lower part of the valley. Mixed forest and broad-leaved forest are frequent on both sides which enhances the issue of forestry management in this pilot region beside important dry grassland areas in Greece (see map

6). The Aoos-Vjosa river basin represents a natural green infrastructure and corridor for riverine habitat. Big mammals such as the brown bears are moving from Northern Macedonia to the Greece-Albania cross border (Leonetti and al. 2021).



Map 6: Location of land cover and related habitat types on the pilot region Albania and Greece

7 Guidelines for improving ecological connectivity of habitat types

The following table brings together the main relevant results from previous DINALPCONNECT outputs and other sources (research papers, other EU projects) to develop appropriate guidelines in line with priority habitat types. A full table is available in the appendix as it was too large to be included in the core of the Guidelines. Narrative and detailed explanations of the guiding ideas listed below are provided in the following chapter of the Guidelines, elaborated for each pilot region.

Table 2: Guidelines for improving ecological connectivity of habitat types

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
Alpine mountain ranges and mixed broad-leaf and coniferous forest – *Alpine ibex,* – *Chamois,* – *Red deer,* – *Black grouse,* – *Capercaillie,* – *Ural owl,* – *Brown bear*	• Significant difference in conservation status of Alpine ibex, • The chamois population trend has turned downward, • Interactions with large mammals are causes of conflict, • Unified data collection is required for species and forest management, • Excellent historical collaboration between the PNPG and the TNP, • High involvement of	• Efficient permeability regarding land use, road infrastructures and population pressure, • Important barriers with high and steep elevation and rocky bars, • Valuable alpine grassland. Broad-leaved and coniferous forests are predominant, • Few species decline has been identified in Rediafor	•EU project (AlpBionet2030, DINALPCONNECT, Bionalp, Rediafor, Links4Soil, LIFE program and Interreg framework), •EU Forest and Biodiversity Strategy, Common Agricultural Policy 21-27 draft plan, Green Deal, ***In Italy:*** National Biodiversity Strategy (2010), the National Ecological Network (REN, 2002) and the transposition of the Habitats Directive, • Prealpi Giulie Natural Park, • RegionalLandscape Plan of Friuli Venezia Giulia,	•Mostly pasture with strong tradition of extensive self-sufficient agriculture, • Forestry management pass by the very fragmented private properties, which challenge a proper planning of forestry operations, • Forestry work does not take nesting times into account, • In Croatia, a large part of forests in Istria is privately owned without Forests' Management Plans.Outcome	• Design mountain range strategy, • Develop inclusive management plan cross-sectoral institutions, • Perform communicative campaign with shepherds, researchers, parks' managers, hunters, farmers, local community, visitors to respect wildlife, farmers, hunters, bikers and mushroom pickers, • Develop common protocols to monitor wildlife species and similar data frame (like Life DinAlp Bear) and maintain regular workshops to facilitate multi-stakeholders dialogue, • Mobilization of private properties on biodiversity issues, • Lead sustainable forests management, prevent deforestation/degradation (not in Slovenia) with conservation of extensively managed grasslands along forest edges, with agroforestry practices, with greater consideration

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
	stakeholders in the local and transnational management process, • Biodiversity in timber oriented managed forests is significantly lower than in alternative management area from clear-cut dominant practice (2010, Paillet), •The demand for wood products as a renewable energy source and for building materials is increasing (Source: Links4Soil), •The frequency of drought at shorter intervals weakens forest since water stress reduce resiliency to insect pathogen attacks (Rediafor project),	project: the white fir at foothill level, spruces at the mountain level (~ 1,500 m), the scots pine, The Scots pine could progress starting at 1,000 m in altitude, • The least drought tolerant tree species are moving to the north and to higher elevation replaced by deciduous trees (Rediafor project),	***In Slovenia:*** • TNP Act • Forest, Game and Hunting Acts and Plans with indicators to determine trends in populations for 10 years, • Natura 2000 management plan 2015-2020, • The Slovenian Ministry of Agriculture is preparing a Strategic Plan for the CAP 2023-2027, ***Croatia:*** • Forestry and Hunting Act in Croatia in favour of sustainable management of forests that reflects its biodiversity, productivity and regeneration capacity, • The decision maker belongs too often to different sectors,	is uncontrolled logging in this area (Croatia),	of nesting time, and soil and water protection, • Raise public awareness of the importance and sensitivity of forest ecosystems and with promotion of sustainable tourism, • Prevention of 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),* • Support resilient forests with trees of different ages and indigenous species, and thus reduces vulnerability to fire and pests. Leaving stumps and trunks on the ground also helps prevent landslides, • Develop compensation and prevention measures for livestock breeders and crop producers, • Develop regional consulting process prior to adoption of new management or spatial plan, •Transfer knowledge about the models of succession when appropriate, control ignition, • Develop sustainable tourism and define thresholds for tourism capacity

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
Caves not open to public – *Olm*	« Human activity on the karst surface results in inorganic acids pollution that has an important influence on water quality. Water with contaminants can penetrate faster and deeper into the vadose zone» (Kogovšek J. 2011).	Caves not open to public are mostly located in the Karst region between the northeastern shore of the Adriatic Sea.	• The Adriatic caves charter of caves (Interreg Adrion), • Council Directive "Habitat" n. 92/43/CEE, • EU Water Framework Directive (2000/60/EC), • River Basin Management Plans.	• Good practices in Škocjan Caves Park to supervise limitation of sources of pollution and other intrusions into the soil.	• Rise awareness of landowners and farmers about the karst surface to prevent fertilization use, groundwater pollution and soil degradation in buffer zones from the caves (signs on the earth surface, pedagogic map), • Transfer management and monitoring model of Škocjan Caves Park to other karst regions, • Implement measures tools from Common Agricultural Policyto the Karst area: direct payments for areas with limited possibilities for agricultural activity (OMD), KOPOP, animal welfare measure (DŽ).
Eastern sub-Mediterranean dry grasslands – *Orchid,* – *Freshwater crayfish,* – *Daisy,* – *Easern eggar,* – *Ortolan bunting,* – *Meadow viper* – *Eurasian eagle-owl,*	• Some rural development measures don't match with some of the local features over the project area and are not attractive to farmers, • Lack of direct financial resources for farmers (BiH and Albania), • Very fragmented private property, • Negative demographic trends that lead to a lack of pasture: livestock farming is crucial	Predominant grassland along the Croatian Adriatic coast from the southern Istrian peninsula to south of Croatia, • Numerous dry grasslands are located in south of BIH but less frequent in Montenegrin relief. Albania has scattered grasslands surrounded by various type of adjacent land covers, • Land use, road	• CAP on programming period 2021-2027, . • Many LIFE and Interreg projects deal with ecological connectivity, • Conservation areas are covered by different type of protection such Natura 2000, Ramsar site, UNESCO area, special reserve, national park, strict nature reserve, Habitat species management area, Legislation to promote biodiversity in Italy, Slovenia, Legislation for friendly environmental	• Emissions in water, soil, air, • Overgrowing with bush vegetation, • Loss of indigenous species and introduction of non-native species, • Excessive fertilization of meadows, • Drainage of wet grassland, • In Slovenia, Ecological Connectivity is indirectly supported by protection of linear hedges within the	• Diversify the measures of Rural Development to correspond with local features and informs farmers about advantages, • Perform agreements with landowners to gather interventions for ecological connectivity or create digital platform, events or communicative campaign to facilitate land transaction and re-parcelling process of private property that will support coherent land use (perform pre-purchasing rights for agricultural purposes), • Development of sustainable agro-tourism (focusing on food ecological production, and hiking trails that include producers), • Mowing from the middle of the lawn outwards (first mowing after 31st of May), • Drying hay on the lawn and sowing seeds into the soil, • Establishment of peaceful zones and corridor, • Use of organic fertilizer,

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
	for grassland maintenance, • Valuable grasslands are used for grazing while there is not much grassland left in the Ćićarija area (Croatia), • Grasslands are rented for grazing - without prior condition and assessment of suitability for grazing.	infrastructure and population pressure do not generally affect the functional permeability of dry grasslands in the project area. Croatia, Bosnia, and Albania, that are the most endowed in dry grasslands have particularly good land use indicator with low population pressure and low fragmentation of landscapes.	agriculture in Croatia, BiH, Montenegro, Albania and Greek.	agricultural landscape though Cross sectoral compliance, •Transhumance is reducing in Greece, • Montenegro has a low use of fertilizers and pesticides per hectare, and small scale and mixed production, • Since 2005, fertilizers consumption in nutrients increased drastically in Bosnia (FAOSTAT).	• Rational use of plant protection product, • Preventive succession and grassland protection, • Raising awareness of local population and farmers about pollution and water resources, • Conservation of extensively managed grasslands along forest edges, with preservation of borders and other shrub-lands in the cultural landscape (hedge have to be more than 20 m long and 2-4 m wide), • Promote agrobiodiversity preservation (adjusting the number of grazing animals, support the breeding of autochthon bovine, caprine and bovine domestic breeds, installing pheromone, visual and feeding traps, preservation of dry-stone walls), • Providing funding for interested farmers with higher support for pro biodiversity business, • Develop family farms (development of sustainable rural tourism) and high nature value farmland, • Revitalization of old mills (along the Una for instance), • Promote Result Based Payments offered by GAEC by harmonized scoring system (number of plant species and insect on a meadow). (D.T1.1.1 p12), • Connecting researchers, experts of different professions(biology, economics, agriculture, veterinary medicine, landscape architects, etc.) on cross border and transnational level,

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
Well-drained alpine and subalpine meadow *- Meadow viper*	• In Italy, Croaitia, the biggest problem is property - legal relations, which means that meadows cannot be rented out, • Hunters are willing to cooperate in removing shrubs from meadow, • Negative demographic trends that lead to a lack of pasture: livestock farming is crucial for grassland maintenance, but is in poor condition in the pilot region (significant decline between 2001 and 2011), • there is no separation between dry and wet meadows.	• According to CORINE Land Cover data, the meadow is sparsely spread all over the countries of the project. Pilot region 1 and Pilot Region 2 contains more pasture in the Slovenian side, • On the Pilot Region Croatia Bosnia and Herzegovina, the meadows are located in both side of the border area, • Just few meadows are located in Albania side of the pilot region Greek Albania. No pasture is identified on the Greek side according to CORINE Land cover data.	• Common Agriculture Policy on programming period 2021-2027.Refer to the legislation per country listed for the Mediterranean Grassland habitat.	• Agro-environmental practices: - pasture maintenance - provisions for forestry preservation - organic farming - small-scale bee-keeping - traditional transhumance small ruminants breeding management -livestock system, • Land under meadow and pasture is the same for 30 years (FOA data).	•Provide funding for interested farmers, • Restoration of meadows and encourage regeneration of characteristic native: support cooperation with hunters in removing shrubs from meadows and in maintaining revitalized areas, • Attract young generation in depopulated areas with sustainable education agriculture sessions, • Develop local chain: connecting producers (farmers) and consumers (gastronomy, tourism), • Seasonal grazing with (mix of) stock types including local breeds appropriate to maintain habitat, • Adjust grazing intensity e to habitat, • shepherding on open grazing, and folding where appropriate, • fertilisers and lime not used or only in limited quantities, • Maintaining structural and florist diversity, including shrubs and trees where present: meadows mown after flowering period, normally one cut only, different parcels on different dates, and manual mowing, when possible, • Recognition of High Nature Value Farming semi natural habitat, • Land lying fallow with species composition for biodiversity purpose

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
					(pollination, birds, game feed-stocks, etc.) (c, e, f).
Pond, swamp - *Yellow-bellied toad,* - *Marsh Fritillary,* *Greek stream frog*		• Pond and swamp are not clearly visible through the classification of CORINE Land Cover, • River basins and at smaller scale watersheds are draining water and snow on the whole DINALPCONNECT project area.	• EU Water Framework Directive (2000/60/EC), • the European Pond Conservation Network (EPCN), • River Basin Management Plans, • Waters Act of Slovenia.(12 July 2002), • Ramsar Site, Wetland of International Importance in Greece, • Strategy and action plan for biological diversity in BIH 2015-20: Restore 30 strip mine lakes into wetland habitats.	• Inadequate fertilization, improper cleaning and maintaining of ponds, drying and abandoning of wet meadows in Slovenia and Croatia, • Emissions in water, soil, air.	• Prevent irrigation system based on pond /swamp water use for agricultural, • Promote the awareness, understanding and conservation of pond and swamp, • Develop the means for Basin River Management.
Lakes – *Scarlet marsh hawk*		• Pond and swamp are not clearly visible through the classification of CORINE Land Cover.	• EU Water Framework Directive (2000/60/EC), Nitrates Directive (Nitrates action programme), • River Basin Management Plans, • Strategy and action plan for biological diversity in BIH 2015-20: Restore 30 strip	• Emissions in water, soil, air, • The protection of the fish fauna in the Artificial Lake of the Aoos springs from alien species.	• Develop the means for Basin River Management, Prevent the spread of alien species towards lakes, • Tackling the phenomenon of the use of poisoned baits for fishering, • Establishment of buffer strips along water bodies and networking organic farming and eco pastoralism at the lake shore,

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
			mine lakes into wetland habitats, • Transboundary Prespa Park and Environmental Protection and Sustainable Development of the Prespa Lakes and their Surroundings signed by Greece, Albania and northern Macedonia (Oct 2011), • Shkodra lake Albanian Side proclaimed Ramsar Site (2nd February 2006).		• Connect water bodies with protected corridor (the opportunity of Pljevica Nature Park as a way of connecting NP Una and NP Plitvice Lakes) and network grassed waterways, grassed buffer strips and retention ponds in the catchment area, • Clean-up operations (of wastes and muddy floods better downstream water quality).
Shallow rivers		• River basins and at smaller scale watersheds are draining water and snow through shallow rivers on the whole DINALPCONNECT project area.	• EU Water Framework Directive (2000/60/EC), •Establishment of buffer strips along water courses supported by GAEC, • River Basin Management Plans.	• Emissions in water, soil, air.	• Establishment of buffer strips along water courses, • Networking organic farming and eco pastoralism in the surroundings of shallow rivers.
Beech and oaks forest, Broad-leaved deciduous woodland *- Meadow viper,* *- Syrian woodpacker,* *- Tits,* *- Finches,* *- European,*	•In a meta-analysis conducted in 2010, Paillet et al. showed that species diversity in timber oriented managed forests was significantly lower than in unmanaged forests,	• Sessile oaks could replace beeches at lower altitudes (Rediafor project 2021).	•EU Forest Strategy, GAECs, Green Deal, • Many LIFE and Interreg projects deal with ecological connectivity• Directives for forest resources 9/2007 in Italia that promote diversity of genes in reforestation agroforestry and	• Emissions in water, soil, air. • Forestry management pass by the very fragmented private properties, which challenge a proper planning of forestry operations,	• Lead sustainable forests management, prevent deforestation/degradation, • Develop regional neighbourhood consulting process prior to adoption of new management or spatial plan, • Design inclusive forest management plan with shepherds, researchers, parks' managers, hunters, farmers, local community, visitors to respect wildlife,

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
- Nuthatch, *- Brown bear,* *- Short-toed snake eagle,* *- Northern goshawk,* *- Eurasian sparrowh hawk,* *- Lesser spotted eagle,* *- Peregrine falcon,* *- Eagle Owl,* *- Long-legged,* *- buzzard,* *- Levant Sparrow hawk,* *- Golden Eagle,* *- European Honey Buzzard*	• In Croatia, a large part of forests in Istria is privately owned without Forests' Management Plans. Outcome is uncontrolled logging in this area, •The demand for wood products as a renewable energy source and for building materials is increasing (Source: Links4Soil), •Uncontrolled logging, (Croatia), •The frequency of drought at shorter intervals weakens forest since water stress reduce resiliency to insect pathogen attacks. (Rediafor project), • The least drought tolerant tree species are moving to the north and to higher elevation replaced by deciduous trees		integrated forest fauna management, • Forestry and Hunting Act in Slovenia and Croatia in favour of sustainable management of forests that reflects its biodiversity, productivity and regeneration capacity, • **Federation of BiH, Republika Srpska, Brčko District :** Regulation on the content of plans against forest fire.(01 March 2004), • Document of Forestry policies (Forestry inventory and management plans) in Albania and law on wild fauna protection, • Forest law, Game and hunting law in Montenegro which ensure protection stability and natural regeneration, • Law for the protection of forests of Greece with tools for implementing ecological networks, • Core zone in national woodland	• Forestry work does not take nesting times into account	• Develop common protocols to monitor wildlife species and maintain regular workshops to facilitate multi-stakeholders dialogue, •Transfer knowledge about the landscape disturbance and succession models (Gustafson E.J. 2010), • Protection of soil and water to prevent negative impacts, • Prevention of forest damage caused by fires, natural disasters or catastrophic events, and restoring damaged forests (information measures to forest visitors, firebreaking zones, monitoring flammable forest biomass and water stress area). (Bassi 2007), • Establishing resilient forests with natural tree composition of different ages and species, and thus reduces vulnerability to fire and pests. Leaving stumps and trunks on the ground also helps prevent landslides, • Perform consultation, respect for uses, and dialogue back at the heart of the forest (Tool kit of communication of Rediafor project).

Priority habitat type *Species*	Outputs from SWOT with special emphasis on weaknesses and threats *(SWOTs and scientific literatures)*	Outputs from spatial data analysis *(WPT1.2.1 - EURAC)*	Outputs from policy overview *(WPT1.1.1)*	Outputs from current agricultural forestry practices affecting EC *(WPT2.2.1)*	Tailored guidelines to improve ecological connectivity
	(Rediafor project).		park (Greece), UNESCO Mab biosphere reserve.		

8 Guidelines for sectoral practices and policies for each pilot region

In the following sub-chapters, narrative explanations of the before mentioned (see table 2) guidelines are provided for each pilot region. This will facilitate the implementation of the recommendations by the relevant stakeholders of each pilot region.

8.1 Pilot region Italy-Slovenia

- Prealpi Giulie Natural Park (Prealpi Giulie Natural Park and the Tarvisio Hunting District) and Triglav National Park (Triglav Hunting Management Area and part of the Gorenjska Hunting Management Area) (Italy – Slovenia)

The diagram below gives an overview of the main guideline for the pilot area. The similar colours of the legend of the previous maps in these Guidelines are reused in this diagram. The left column addresses agriculture, the right one forestry and the middle column states overlapping forestry and agricultural practices.

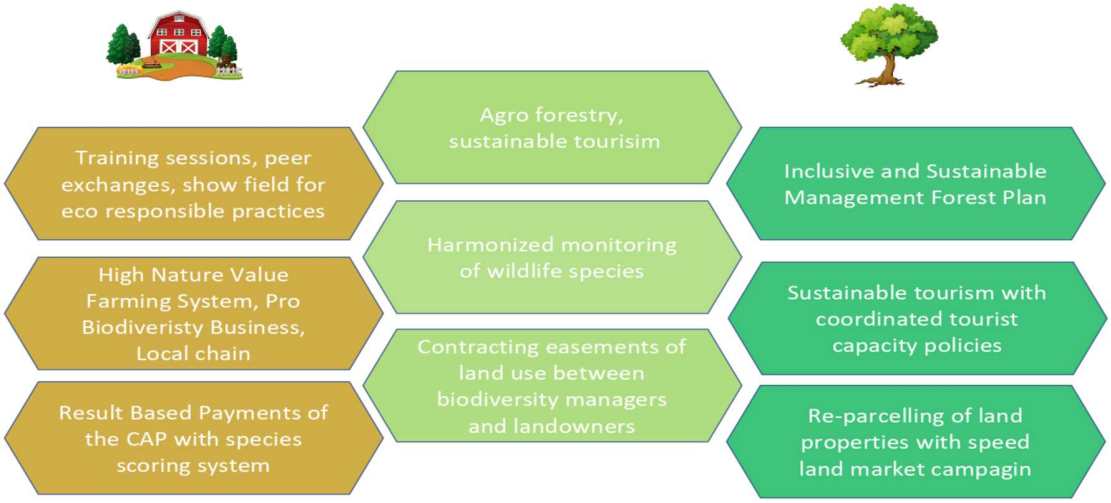


Figure 8: Guidelines for the pilot region Italy- Slovenia

Conventional agricultural practices are a major cause of biodiversity and habitat loss, and can be partly attributed to 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.

Ecological connectivity within agriculture will be achieved through ***agro-biodiversity systems***, that reduce the use of nutrients, herbicides and pesticides, 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 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). Existing know-how about succession prevention in the form of mechanical removal of bush vegetation, controlled ignition, programs for removing black pine forest areas is a resource to be shared through networking between stakeholders (DINALPCONNECT project report about situation analyses).

The ***High Nature Value farming system (HNV)*** is an opportunity to combine sustainable practice. According to Beaufoy and Cooper (2014), HNV farmland offers an advantageous combination of low intensity land use, a rich patchwork of semi-natural vegetation area and cultivated land. ***Training cycles*** on HNV farming could be organized at regional level for wide and free access to professionals followed by ***show model sites***

sessions on a principle of ***peer exchange*** between farmers and shepherds. Peer-to-peer communication is a great medium for knowledge transfer and emancipatory practices. Listening to stakeholders who face the same difficulties is more effective than awareness campaigns from institutions that might be considered from far removed from the realities on the field (Lee-Ann Sutherland & Fleur Marchand 2021).

Additionally, local legislation could set ***strict ban***s on cutting hedges and trees during the bird breeding and rearing season, on converting or ploughing permanent grassland in Natura 2000 sites.

Forestry management should **consider nesting time**, prevent tree species and soil degradations, and support repopulation of various tree species and ages to reconstitute resilient forests from fire and pests. Apart from natural disaster scenario, in protective forests leaving higher stumps and trunks on the grounds remind a key measure for ecosystem preservation in addition to preventing landslides. Where fallen trees have started to rot, forestry studies showed how it prevent erosion and stimulate the underground soil fungal networks (Popkin 2021).

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). ***Inclusive forestry management plan*** that takes into account as researchers, parks' managers, hunters, bikers, mushroom pickers, farmers, local communities, tourist visitors in the drafting process enable efficient and more long-term sustainable practices. It is a current practice in Slovenia and this initiative should then be pursued across borders.

Fragmented forest properties remain an important obstacle for ecological connectivity management. The act of Slovenia is already tackling the land market in favour of land consolidation.

Article 23 Agricultural land Act Official Gazette of the Republic of Slovenia. 27november 2020:

When purchasing agricultural land, a forest or a farm, pre-emption beneficiaries may exercise their pre-emption right according to the following order of priority unless otherwise provided by other Acts:

a co-owner;

a farmer whose land, which is his property, borders the land that is put up for sale;
the lessee of the land that has been put up for sale;
another farmer;
an agricultural organisation or a sole proprietor requiring land or a farm to carry out its agricultural or forestry activity;
the Farmland and Forest Fund of the Republic of Slovenia for the Republic of Slovenia;

To go beyond the regulation of future transactions, taking initiatives with municipalities is recommended to coordinate ***forestland re-parcelling*** or to enter into ***easements*** with landowners for conservation and face fragmentation process.

Conservation of extensively managed grassland on the edge of forest is also a significant matter of forest protection in addition to main focus on the inner part. Adjacent pastoral or agrarian land represents great potential for agroforestry to benefit from the combined ecosystem for agricultural practices (landscape connectivity, pollen and nectar providers, refuge from pesticides, reduced wind speed).

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. Landscape disturbance and succession models (LDSMs) are predictive and analytical tools that can provide essential information for decision-making (Gustafson and al. 2010).

A ***macro-strategy*** 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. In order to ensure the efficient implementation of the management plan, common protocols and data frame would help to ***monitor wildlife species on the level of mountain range*** that is characterizing this pilot region. One such example is the project Life DinAlp Bear that could be duplicated to other key species.

Recreational activities in nature are extending and diversify usage with higher potential conflicts regarding living species. Tourism is therefore directly connected to forestry management. ***Sustainable tourism*** becomes then imperative with the involvement of Tourist Board Office and tourist operators to promote awareness on biodiversity care. Methodology and settings to define thresholds for tourism capacity should be shared over the whole pilot areas. The spatial distribution of visitors can evolve when the number of visitors will be regulated per nature tourism destinations. In lack of coordination between

tourist destination, rerouted flows of tourists could undergo towards more permissive natural areas and causes immediate pressures on environment.

8.2 Pilot region Slovenia-Croatia

- Natura 2000 Kras and Natura 2000 Učka and Ćićarija (Slovenia – Croatia)

The diagram below provides an overview of the main guideline for the pilot area. Similar colours from the previous map legend established in these Guidelines are re-used in this diagram. The left column addresses agriculture, the right one forestry and the middle column states overlapping forestry and agricultural practices. The blue tile refers to guideline for water bodies that interacts with the adjacent forest and agricultural land cover.

Figure 9: Guidelines for the pilot region Slovenia-Croatia

The depopulation of the younger generation has been identified as a significant threat that affects the preservation of grasslands in this pilot region. In order to maintain farming and pastures settlements, ***promoting the farming vocation and lifestyle*** within education sector and unemployment centre could raise interests and stimulate

professional transition. Those targeted campaigns could already incorporate the concept of High Nature Value Farming, Pro Biodiversity Business and Sustainable Agro tourism system. In terms of spatial planning, in response to the decline of agricultural activity, it is imperative to ***safeguard the agricultural land use*** and the function of agrarian buildings in spatial planning documents in order to maintain proper heritage conditions and avoid that they turn to a purely residential use. The initial building locations are most of the time corresponding to an agricultural holding territory, with relevant distance with meadows and with means of irrigation or watering capacity that could be preserved to ensure a transfer of activity.

To generate collective dynamics between farmers and shepherds and efficient coordination for ecological connectivity it is also recommended to technically and financially support the ***creation of an agrarian cluster of joint exploitation*** that will gather resilient business entities over time. The sharing of the costs of agricultural equipment, watering facilities is also one advantage to this legal entity as it will contribute efficiently to a sustainable cooperation. It will facilitate biodiversity management and the implementation of ecological connectivity measures, as it allows interacting with this organization as representative instead of all the single farmers.

It is recommended to ***seize the opportunity on implementing Result Based Payment*** of the Common Agricultural Policy 2023-2027 when approved through the use of species scoring system. The existing databases from the NARCIS project (Institute of the Republic of Slovenia for Nature Conservation) could be a starting frame to upgrade a common monitoring tool of species for the whole pilot region.

The quality and characteristics of dry grassland habitats needs to be set up prior to grazing or mowing practices. The absence of ***dry grassland management*** in the pilot region is an opportunity to hire a common manager for a uniform and tailored approach. The manager may identify intervention priorities for deprived meadows that could be eligible to the coming restoration fund call from the EU Biodiversity Strategy.

Rural Development Plans with biodiversity-oriented actions could diversify measures to corresponds with local features with skilled institutions able to provide sound advice. The public institution of Učka Nature Park should be consulted prior to new farming and husbandry settlements when it concerns valuable sites within the park perimeter and surroundings. As existing farmers are mostly not aware about the

opportunities of the RDP, it would be important to develop a campaign towards farmers and shepherds, preferably through face-to-face meeting.

About agricultural practices, adjusting the number of grazing animals, mowing from the middle of the lawn outwards, drying hay on the lawn and sowing seeds into the soil, use of organic fertilizer, rational use of plant protection products remains the requirement for preservation. ***Agro-biodiversity*** takes place with additional measures such breeding of autochthon bovine, caprine and bovine domestic breeds, installing pheromones, visual and feeding traps, preservation of dry-stone walls. It is also necessary to safeguard extensively managed grasslands along forest edges, with preservation of borders and other shrub-lands in the cultural landscape (hedge has to be more than 20 m long and 2–4 m wide).

Raise awareness of landowners and farmers ***about the existing karst surfaces and its permeability*** around to prevent fertilization use, groundwater pollution and soil degradation in buffer zones from the caves (visual signalling on the earth surface, pedagogic map).

Project coaching support could be offered by municipalities and tourist board offices to promote ***sustainable agrotourism*** (focusing on food ecological production, agrotourism offer such thematic and hiking trails that include producers) and eco responsible outdoor tourism.

The segmentation of forestland property reminds a major issue to solve for a sustainable management of the forest. The share of private forest in Croatia is quite high and this private public cooperation is unavoidable to face ecological connectivity challenges. It is recommended taking initiatives with municipalities to coordinate ***active re-parcelling*** or to enter into ***conservation easements*** with landowners.

According to workshop feedback, municipalities from this pilot region are willing to support re-parcelling of land properties as it is very fragmented and still under further segmentation especially when heritage situation multiply plots. Updated real estate register with landowners' identification is important prior to carry out an active campaign for formal re-parcelling or promote easement of land use agreement. This public service could consist by providing land pricing estimations, putting potential buyers and sellers in touch with each other in order to facilitate the sale, purchase or exchange of forest plots. Contracting transactions will involve notarial duty fees that remain an obligation among

landowners and could therefore represent a break. Alternatively, easements of land use can be contracted between the landowners and biodiversity managers.

Beside agricultural and forestry practices in the pilot region, general campaign for raising awareness could be regularly organized to educate about pollution and water resources.

8.3 Pilot region Croatia-Bosnia and Herzegovina

- Natura 2000 Lisac – Una NP and Drvar Municipality (Croatia – Bosnia and Herzegovina)

The diagram below provides an overview of the main guideline for the pilot area. Similar colours from the previous map legend established in these Guidelines are re-used in this diagram. The left column addresses agriculture, the right one forestry and the middle column states overlapping forestry and agricultural practices. The blue tile refers to guideline for water bodies that interacts with the adjacent forest and agricultural land cover. The black tile refers to the burnt land cover identified in the pilot region as shown on the previous map in the first part of these Guidelines. The fire prevention represented by one tile is addressed to any land use.

Figure 10: Guidelines for the pilot region Croatia-Bosnia and Herzegovina

The attraction of young householders in depopulated area is a major issue of this pilot region. To raise awareness and stimulate new farming settlements from the younger generation, it is therefore proposed to ***promote agricultural vocation and lifestyle*** among high school or facilitate professional transition. Those introduction to the professional can already incorporated the concept of ***High Nature Value Farming, Pro Biodiversity Business*** and Sustainable Agro tourism system. This revival necessarily involves in Bosnia and Herzegovina, the ***allocation of funds*** to stimulate the interest of breeders or farmers with a financial conditionality for biodiversity preservation. Revitalization of old mills (along the Una for instance) is as well a perspective to maintain traditional landscape features and restore ecological connectivity. To induce collective dynamics between farmers and shepherds and efficient coordination for ecological connectivity it is thus recommended to technically and financially support the creation of ***pastoral cooperation*** that will gather business entities. It is crucial to provide direct funding to ecological connectivity objectives for interested farmers.

In terms of agricultural practices, seasonal grazing with diverse local breeds appropriate to maintain structural and flowers variety could be organized. Limited use of fertilizers and lime, manual mowing must, limiting the spread of alien species, prevent succession would be the minimal standards in order to fully preserve ecosystems. Resting land on the principle of fallow would foster the biodiversity (pollination, birds, game feedstock, etc.).

Shepherding can be settling on open spaces and between permanent crops, transhumance and common grazing. Semi natural habitat and peaceful meadows could be systematized to all agricultural holdings in line with the coming CAP policy that might expect at least 3% of arable land to biodiversity and non-productive elements. ***A local flowering meadow competition*** on the model of western European countries could be organized to stimulate farmers for sustainable practices. The aim of this competition is to promote the diversity of livestock farming by rewarding grasslands with the best agro-ecological balance and which benefits to the fodder autonomy of farms. Flowering meadows, in the sense of the competition, are species-rich grasslands that are not sown and are mown or grazed to feed livestock. Floral diversity contributes directly to livestock production, with fodder appreciated by the animals. It also improves the quality of the landscape and the preservation of biodiversity, by encouraging the presence of birds, reptiles, small mammals and insects, particularly those that ensure pollination (honey bees, wild pollinators) and the natural protection of crops.

The spread of alien and invasive species is impacting ecological connectivity. Initiatives for the ***restoration of meadows*** to provide pastures can be led between protected area managers, hunters and landowners to encourage regeneration of characteristic native tree and shrub species. Basic equipment need to be set up in order to monitor waste dump activities in the area.

When the pilot region on the Croatian side will set a sustainable strategy of the tourist activities, it is necessary to include sustainable agritourism (focusing on food ecological production, agritourism offer such thematic and hiking trails that include producers). ***Local chains*** by connecting producers (farmers) and consumers (gastronomy, tourism) are a recommended model for resilient and sustainable settlements.

Special care to water bodies are actually dedicated with special emphasis to this pilot region with the establishment of natural protection entities to connect water frames (the opportunity of Plješivica Nature Park as a way of connecting NP Una and NP Plitvice Lakes). Concretely, it would lead prevention against the spread of alien species towards lakes, tackling the phenomenon of the use of poisoned baits for fishing, systematized buffer strips along water bodies and networking exclusively organic farming and Eco pastoralism on the surroundings of Lake Shore. Lack of ***interdisciplinary cooperation*** has been pointed out for this pilot region, and therefore head to encourage linkages between researchers, experts, different professions from BiH and Croatia in the field (biology, economics, agriculture, veterinary medicine, landscape architects, etc.)

It is proposed to apply ***sustainable forest management*** beyond a simple regulatory level, through objectives on formal documents, but also through the concrete implementation with active managers on the field. Sustainable forest management consists in the prevention of deforestation/degradation (not in Slovenia), in the conservation of extensively managed grasslands along forest edges, in the preservation of borders and other shrub-lands in the cultural landscape. Carrying out forestry work to reconstitute resilient forests with trees of different ages and species, will reduces vulnerability to fire and pests. Leaving stumps and trunks on the ground also helps prevent landslides.

In addition, a ***communication plan*** to stimulate a raising public awareness on the sensitivity of forest ecosystems and grasslands with a special emphasis on fire consequences. Tourists' operators should be included in the communication plan.

8.4 Pilot region Albania Greece

- Northern Pindus – Frasher Village, Permet – Vikos (Albania – Greece)

The diagram below provides an overview of the main guideline for the pilot area. Similar colours are from the previous map legend established in these Guidelines re-used. The left column addresses agriculture, the right one forestry and the middle column states overlapping forestry and agricultural practices. The blue tile refers to water bodies claiming a guideline that interacts with the adjacent forest and agricultural land cover.

Figure 11: Guidelines for the pilot region Albania Greece

In common with the two previous pilot regions, pastoral decline needs to be addressed by boosting the attractiveness of the agricultural profession. It has been claimed during a SWOT workshop than pasture management has limited financial support from the IPARD programming period 2021-27. Decision makers in Albania would then need to ***plan financial resources*** as a major lever of improvement. This initiative can be enhanced by the different International Development Agencies such FAO to benefits from know-how and technical assistance support.

The small ruminants farming and extensive orchard farming, vineyard and medicinal and aromatic plants growing are the main agricultural activities in the area that can be supported in compliance with ecological issues. The breeding of autochthonous cattle, goats and domestic cattle breeds, the installation of pheromone traps, visual ruses and food set-ups, the preservation of dry-stone walls are important conditions for a biodiversity-friendly management. Moreover, the milk-oriented production as to be prior to the meat-oriented production for new breeding activities for the ***return of transhumance***. It would have positive effect by limiting over-exploitation of pastures near to settlements, supporting abundant flourishing periods while grazing is spaced over time, enhance attractive scenery landscape for eco-tourism.

Unbalanced grazing pressure (livestock units/ha) in the highland pastures in Southern Albania is due to limited access to water in many areas. It could be regulated by providing additional watering facilities such as rainwater tanks, water piping systems, in unused summer pastures to avoid overgrazing practices in other areas. Investments in water points could be made between local authorities and livestock owners according to contracted livestock holding capacity in order to make sure about coherent share of water resources and assess the appropriate grasslands to develop new settlements of husbandry breeding. Current initiatives in favour of ecological labelling under certification that promote culinary products such as the Consortium "Pro Përmet" in Albania are an opportunity for ***pro-biodiversity business*** in the framework of a local chain.

The Aoos-Vjosa river basin represents a natural corridor for the movement of species that need to be preserved through buffer strip zones along the river shore.

The current development of non-timber forestry products noticed in this region is an advantageous basis to enhance pro biodiversity business. Environmental participatory funding through the sale of tourism products could help carry out forestry work to reconstitute resilient forests with trees of different ages and species. This project reduces vulnerability to fire and pests. This suggestion could find interests among visitors from western countries that increasingly trying to sign up for tree planting offsets because of their in-flight CO2 emissions.

Regular campaign on fire caution is crucial in this area to limits the risk for agro-biodiversity resources.

This pilot region benefits from regular studies about natural resources conservation. It is an opportunity to develop ***monitoring species tools linked with the agricultural policies*** on the principle of biodiversity Results Based Payments ecological connectivity intervention areas with researchers, experts, professions and decision makers from sectoral activities.

9. Recommendations for coordinated transboundary management

On the basis of policies overview with national and local experts in agriculture and forestry, outputs on the performed SWOT analysis in the pilot regions, current European initiatives (Draft plan CAP 2021-27, Green Deal) and feedback from experimented practices, we have elaborated the following recommendations for coordinated transboundary agriculture and forestry management in favour of Ecological Connectivity.

The listed recommendations are transferable also in other regions of the Adriatic-Ionian basin as in other macro-regions.

9.1. Reduce the pressures on biotopes

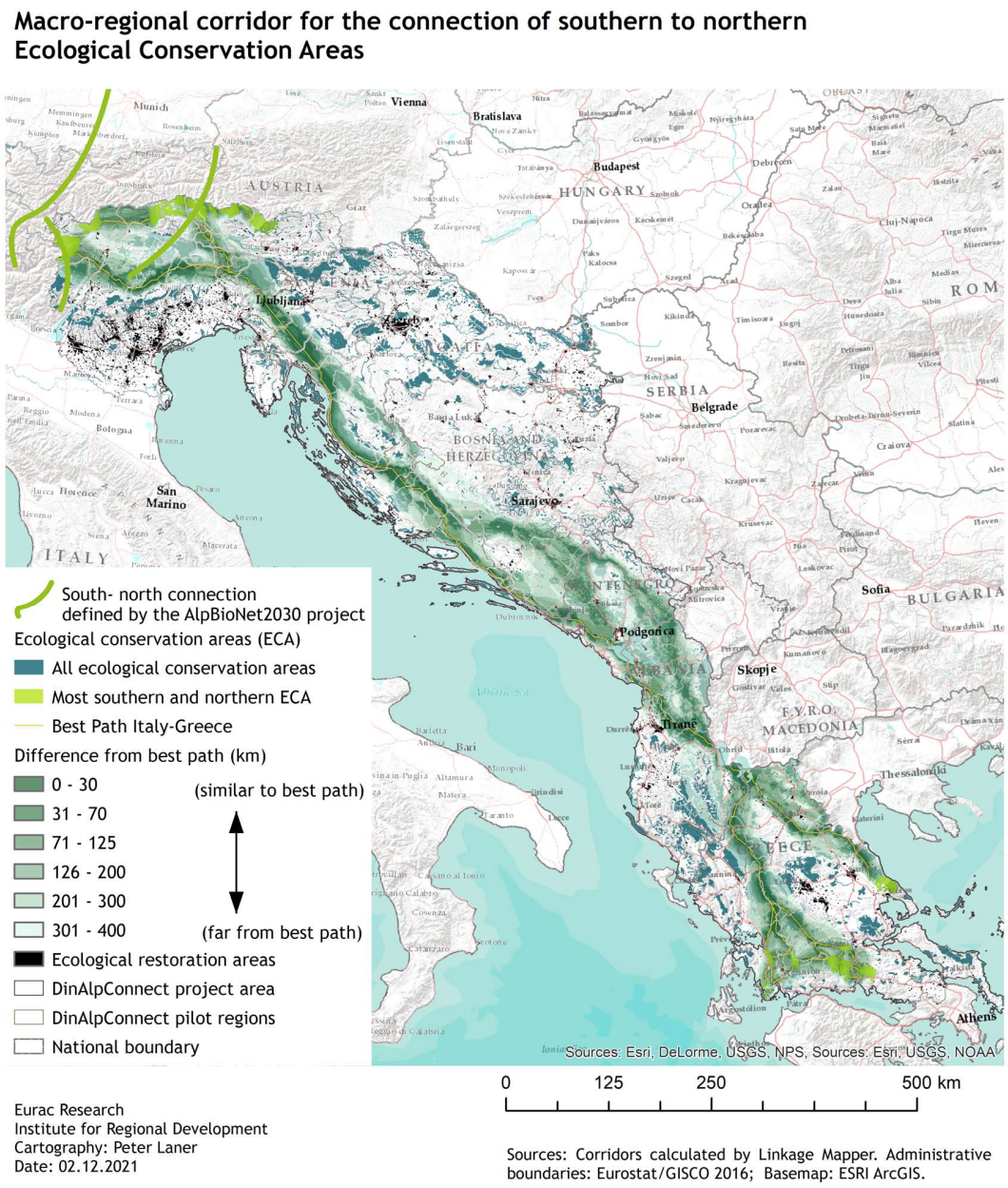
The pressures will continue to intensify and there is clearly a need to handle the socio-economic challenges faced by sectoral practices at the same time as addressing the environmental land management issues, since the two are closely linked.

In the field of agriculture, an improved ecological connectivity can be achieved by adjusting the number of grazing animals to the conditions of the lawn, by mowing from the middle of the lawn outwards, with drying hay on the lawn (sowing seeds into the soil), by using organic fertilizer and with sustainable use of plan protected products. In parallel, initiatives to raise awareness of the local population about pollution of water resources, fire consequences over grassland should be triggered with a dedicated campaign for tourist visitors. In the backdrop of ***a sustainable rural tourism*** policy, the agricultural and forestry practices would be supported to sell pro biodiversity products.

It is crucial to encourage forest holders to protect and enhance forest biodiversity. Forest management plan could also integrate the aspects of fire prevention and the preservation of wilderness areas. Forestry connectivity can be improved through carbon credit schemes, urban forests, mixed forestry systems, restored forests, etc. Benefits to forestry sector include habitat provision, reduced vulnerability to pests, provision of raw material, carbon storage, climate and water cycle regulation.

Regular mapping assessments of Continuum Suitability Index (CSI) is welcomed. Relevant example of this is mapping Strategic Connectivity Areas 2 (SACA) performed

by EURAC in DINALPCONNECT project could be monitored and renewed in a couple of years to check the improvements.



Map 7: Macro regional corridor for the connection of southern to northern Ecological Conservation Areas.

By the end of 2021 the EU Commission should launch an ***EU nature restoration plan*** belonging to the EU Strategy Biodiversity (Communication from the European Commission of 20th may 2020 - EU Biodiversity Strategy for 2030: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX:52020DC0380). The required restoration of habitats identified during the DINALPCONNECT could pretend to this financial support by enhancing the ecological connectivity value from the Dinarides to the Alps in line with the EU Strategy on Green infrastructure.

9.2. Enhanced ecological connectivity on the macro-level

Preserving protected areas is not enough. Protected areas are islands and stepping stones on migration routes. Species need greater areas in order that their population can survive. Since such macro-regions vary substantially in the need for connectivity interventions, strategies for reconnecting fragmented parts are needed, thus the approach that the AlpBioNet2030 and DINALPCONNECT project has set is tailored in the right direction since it will trigger transnational cooperation. Thriving initiatives are required for joint solutions to common problems and foster the exchange of good practices and approaches. ***Rural Development could target biodiversity needs and develop legal tools and cooperation bodies to help farmers and foresters working together towards biodiversity conservation.*** Coordinated transboundary wildlife management - Hunting in the Alps was a recommendation of AlpBioNet2030 that could be implemented to the DINALPCONNECT area.

9.3 Increasing the awareness of stakeholders (notably decision makers) on ecological connectivity and its benefits

In order to increase the awareness of stakeholders on ecological connectivity and its benefits, strong successful demonstration projects are needed, where motivated stakeholders will be able to see how such practices and methods can be incorporated into key sectors (e.g. Agriculture, farming, spatial planning, etc.). ***Show model farming sites on a principle of peer-to-peer exchange*** between farmers, shepherd, forestry managers, representatives of hunters and more widely also between spatial planners are highly recommended (Lee-Ann Sutherland & Fleur Marchand 2021). For instance, they have been a bunch of demonstrative projects in the field of peer-to-peer communication in farming such Agricultural Knowledge and Innovation Systems (EU SCAR AKIS 2019),

or PLAID Peer-to-Peer learning: accessing innovation through demonstrations (Horizon 2020 EU Research & Innovation programme).

9.4 Maintaining traditional extensive human activities

Local communities, which are often less agile and find it more difficult to acquire financial support, should be supported for their role in protecting and sustaining important ecological corridors. Developing pro biodiversity business opportunity could also contribute to maintaining or attract young farmers. Training cycles on HNV farming could be organized at local and regional level with show model sites on a principle of peer exchange between farmers and shepherds. Education system could be targeted by a campaign ***enhancing sustainable agricultural career opportunities***.

9.5 Providing ecological connectivity service as key part of biodiversity conservation strategy

The beneficiaries of this service are usually the community while the providers are the users of the land such as land owners, farmers, local village communities, etc. ***Ecosystem manager in a role of facilitators and moderators*** could actively advice land users that might be out of time or far from ecological concerns.

The payments for these services from the international and national to local communities should evolve from the present project-based approach that relies heavily on the studies and expertise towards direct payments based on standardized conservation measures and verification of performance. Some elements of EU Common Agricultural Policy (direct payments, LEADER) can serve as a model to learn from.

9.6 Promote cross border ecological connectivity

Large differences between countries in legislation and strategic environmental vision cannot be mitigated in a short term because time consuming process in the framework of internal political organization. Harmonization of data frameworks and ***common monitoring tools*** on trans-boundary sensitive environmental areas such as pilot regions are more flexible initiatives to set. Standard monitoring tools and frequent data exchange would improve joint management in practice. Furthermore, mutual ***cross border studies on species*** could be carried out to update old data and adjust perimeters with harmonized results and shared cost benefits. Cross-border and trans-national projects would help to lead recurring time for dialogue across borders.

In the perspective of the next CAP and Good agricultural and environmental conditions (GAEC), ***Result Based Payments*** could be established and would require harmonized scoring system (number of plant species and insects on a meadow). Monitoring tools are then a priority in order to anticipate this possible implementation of the policy.

9.7 Facilitated knowledge transfer on biodiversity issues

As the segmentation of forestland property remains a major issue to solve for a sustainable management of the forest, it is recommended to take initiatives with municipalities to coordinate active re-parcelling. ***Speed land marketing tool*** to promote coherent forest plots in favour of EC have been attempted in Western part of Europe. A communicative platform allows facilitating land transaction, purchase, exchange to remember plots and raise awareness of owners about their forest heritage. Such initiative provides estimation tools and may offer subsidies to owners for operating restoration. A manager is required in order to actively promote the platform service towards the numerous owners. Costs sharing for the online-platform maintenance could be applied per pilot regions.

Concerning agricultural re-parcelling, in respect of the local legislation, all transactions involving agricultural areas could be subject to a system of ***pre-purchase rights*** which allows agricultural organization or neighbours to purchase a land for sale prior to other purchasers.

Easements of land use could be negotiated among landowners as an alternative to re-parcelling and thus reach short term effect in favour of biodiversity management. Inspired

from conservation easements in England or Environmental Real Obligations (EROs) in France, this formal agreement is a voluntary and contractual system, based solely on the will of the actors.

Property owners may enter into a contract with a public authority, a public institution or a private legal entity acting for the protection of the environment in order to impose on them and on subsequent owners of the property such obligation is the maintenance, conservation, management or restoration of elements of biodiversity or ecological functions. From the landowner side, it allows sharing the obligations regarding biodiversity with a skilled public or private entity. The implementation of an ORE contract by an owner on his parcel gives technical assistance, financial compensation in proportion to the loss of income or investment made by the farmer, etc. Environmental protection mechanism involving both private and public legal entities and individuals.

For example, the establishment of environmental property bonds may contribute to this purpose:

- by protecting certain species of wild fauna or flora identified on the property, whether they are highly patrimonial or more common
- by conserving, managing or restoring certain elements of biodiversity or supports for ecological functions attached to the property (hedges, trees, water bodies, wetlands, water tables, ecological corridors, etc.);
- by maintaining constructions that shelter elements of biodiversity (granaries, low walls, etc.);
- by acting as a buffer zone between an urbanized area and a natural area with ecological issues, etc.

The real environmental obligations continue for the duration of the contract, regardless of any changes in ownership.

9.8 Develop strategies for Ecological Connectivity in policies and spatial planning

The report prepared by the Agricultural University of Athens, 2021, highlighted, through a review of current policies in the DINALPCONNECT project area, that ecological connectivity is rarely explicitly expressed in terms of goals or vision.

The awareness of political decision-makers on Ecological Connectivity could be translated into a formalisation of objectives and strategies in national policies and future bills. Harmonization of legislation and means would facilitate cross-border management of ecological connectivity especially in pilot area of DINALPCONNECT. Conservation status of species and biotopes, environmental acts, legitimacy of environmental authorities will become more efficient if they have common bases.

The integration of ecological connectivity into spatial planning policies would be a good entry field with its concrete spatial dimension and the cross-disciplinary approach it provides. Wider consultation of spatial plan between transborder local and regional authorities are necessary to implement coherent planned protection (ecological corridor, Protected Natural Areas boundaries). Land use management within a spatial plan becomes more effective through a continuous spatial approach that takes into account biogeographical extend and habitat types rather than administrative perimeters. Municipalities could, when elaborating spatial plan, notably in the phase of public consultations, share the draft also with neighbouring municipalities, thus involving them in the consultation process. That would increase the chance of determining common objectives regarding ecological connectivity and prevents incoherent planning. Spatial planning is mainly designed to regulate areas of future constructions and frame the development of new infrastructure. Depending on the legislation in force, planners are required to carry out local environmental assessments regarding the scope and scale of the planned build up area. In this approach, biodiversity issues are consulted at the end of the land-use planning process and lead to only implement adjustment and/or mitigation measures. This recommendation proposes to reverse the approach in order to position ecological connectivity as a priority and a structuring factor. Infrastructure projects and building zones would then be relegated to areas with low biodiversity and permeability features. In concrete terms, **ecological corridor delimitation** should be identified with legal regulations adapted to their preservation. It is also a question of systematizing the demarcation of areas in spatial plans beyond which there can be no over development.

10 Conclusions

Agricultural and forestry practices are crucial for biodiversity and enable the existence of many habitats and species. The entire DINALPCONNECT project area consists largely of forests, agricultural lands, pastures, and water bodies whose quality and sustainable use will ensure a resilient ecological continuum in the face of the ongoing fragmentation process. However, outside of the core protected areas, which already benefit from their conservation status, the degree of permeability of the intervening land depends on sustainable practices with special consideration for ecosystems. A legal framework, stakeholder collaboration, and substantial funding are prerequisites for effective ecological connectivity.

Strategies for ecological connectivity also led to a rethinking of approaches in favour of transdisciplinary and increased levels of transboundary cooperation. Harmonized legislation and monitoring tools could facilitate partnership development, stakeholder engagement, and transboundary management. Each pilot region of the DINALPCONNECT project reflects a different context in terms of equivalence of national legislation, cross-border cooperation commitments and beneficiaries of the Common Agricultural Policy.

Appropriate spatial planning could create the conditions for demographic and economic attractiveness of areas threatened by depopulation. This means ensuring the viability of the area with affordable and available housing, appropriate transportation infrastructure, and public services.

Sectoral agricultural policies such as the draft Common Agricultural Policy 2021-2027 (CAP) offer good prospects for promoting biodiversity and ecological connectivity. Although more ambitious targets for the percentage of agricultural land managed with sustainable agricultural practices would have been welcome. A closer link between agriculture and agro-meteorologists should be encouraged as vulnerabilities related to climate change increase. The Republic of Slovenia Environment Agency has developed a website and reporting tools to support agriculture. This initiative is an example of the prerogatives that all regions have (ARSO Vreme 2021).

The Rural Development Plan and the Forest Management Plan are local strategic documents that allow structuring local actions. In addition, various land intervention tools and contractual protocols for appropriate land use in favour of biodiversity could be mobilized by local actors. It is important to point out that ecological connectivity on a large scale is only possible if social connectivity is improved and social barriers are removed. Therefore, ecological connectivity should be addressed at all levels of

planning and understood as one of the most important prerequisites for any future development of human activities.

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