Interreg

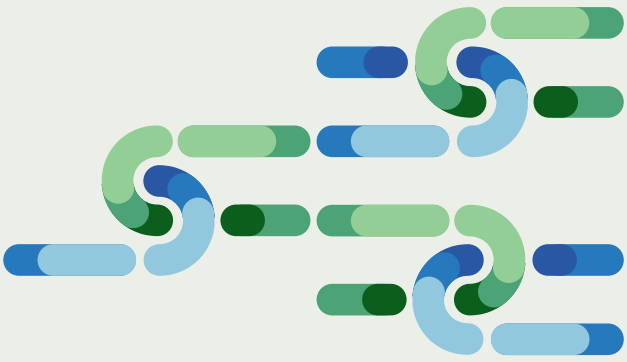
Co-funded by the European Union

Alpine Space

PlanToConnect

Transnational inventory of alpine GBI network elements with compatible and conflicting uses

Identification of the main compatible and incompatible anthropogenic uses posed to different GBI network elements in priority connectivity areas. Description of synergies and conflicting uses. (Activity 1.2)



This project is co-funded by the European Union through the Interreg Alpine Space programme.

Transnational inventory of alpine GBI network elements with compatible and conflicting uses

Main authors:

Laner Peter, Vittoria Vettorazzo – Eurac Research (IT)

With contributions from:

Andrea Omizzolo, Valeria Vitangeli, Federica Maino, Filippo Favilli – Eurac Research (IT)
Sergeja Praper, Andrej Gulič, Damjana Gantar, Tilen Jurca, Tim Gerdin - UIRS (SI)
Claudio Chiapparini - Veneto Region (IT)
Héloïse Venaut, Marie Gourbesville - Asters (FR)
Guido Plassmann, Oriana Coronado – ALPARC (FR)
Florian Lintzmeyer, Monika Marzelli - ifuplan (DE)
Kerstin Ströbel, Constantin Meyer - University of Würzburg (DE)
Philipp Vesely - SIR (AT)
Susanne Glatz-Jorde - E.C.O. (AT)
Luisa Pedrazzini - Fondazione Politecnico di Milano (IT)

Acknowledgements:

We thank Felicita Pedevilla from the Statistics Office of Eurac Research for the support in the elaboration of the questionnaire and all experts that responded to the online survey for their collaboration.

Bolzano (IT), April 2025

Reference in AF: D.1.2.1

Table of Contents

List of Tables

List of Figures

List of Annexes

GLOSSARY

Ecological corridors: (implemented)

“A clearly defined geographical space that is governed and managed over the long term to maintain or restore effective ecological connectivity. The following terms are often used similarly: ‘linkages’, ‘safe passages’, ‘ecological connectivity areas’, ‘ecological connectivity zones’, and ‘permeability areas’.” … “ ‘Clearly defined’ means a spatially defined area with agreed and demarcated borders.” (Hilty et al., 2020).

Ecological focus areas (EFA)

An Ecological Focus Area (EFA) is an area of land subjected to agricultural practices that are beneficial for the climate and the environment. […] EFAs can be features such as fallow land, field margins, hedges, trees, buffer strips and land sown with catch crops (fast-growing crops planted in the space between two main crops or when no main crops are being grown) or nitrogen-fixing crops (JRC in EC 2017).

EFA land cover types include both productive and non-productive habitats, such as fallow land, agroforestry, green covers, nitrogen (N)-fixing crops, and landscape features, like hedges, field margins, ponds, ditches or traditional stone walls (Concepción et al. 2020).

Green and Blue Infrastructure (GBI)

“*Green Infrastructure (GI) are defined as ‘strategically planned networks of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings*.” (European Commission 2013 & 2021). This network of green (land) and blue (water) spaces can improve environmental conditions […] and enhances biodiversity. The Natura 2000 network constitutes the backbone of the EU green infrastructure. (EC 2021)

1 How to use the report and activities conducted

This report is dedicated to spatial and landscape planners, as well as wildlife managers, biologists and naturalists and related disciplines, that deal with the mitigation and compensation of anthropogenic interventions in landscapes belonging to ecological networks.

It can be used to specify land management prescriptions in spatial and landscape planning documents to guarantee the functionality of ecological corridors. Secondly, it supports the consideration of ecological connectivity in environmental assessments, or the elaboration of place-based mitigation and compensation measures in land management plans, spatial development plans, or for single connectivity projects.

The report provides an inventory that should serve to identify incompatible and suitable **land use and landscape management practices** within typical ecological corridors in the Alps.

The present report on anthropogenic uses, together with the threats report (D.1.3.1), provide an extensive list of mitigation and compensation measures for infrastructural interventions in landscapes that are part of ecological networks. Additionally possible incentives for ecological connectivity measures were collected.

Activities conducted, methods used and description of content:

The official list of key pressures and threats from Natura 2000 reporting was used as a framework for potential conflicting anthropogenic uses in ecological networks, that can be considered in spatial planning instruments (section 3.1 and 3.2). Through various queries of the most important anthropogenic pressures in Natura 2000 sites, in section 3.3 the most important groups of pressures in the Alps were revealed. Those were put in relation to spatial planning competences (section 3.4). More detailed potential incompatible anthropogenic uses were identified based on the top 8 most reported specific pressures of the Natura 2000 list (section 3.5). The analysis of existing anthropogenic pressures was conducted in two different ways:

1. Firstly, in section 4, a GIS analysis revealed the presence of intensive agricultural and forestry practices, as well as ski resorts, on important ecological linkages, based on the structural network model at alpine-wide level (D.1.1.1).
2. Secondly, in section 5, based on priority connectivity areas of the Alpine Space, which were defined in the mapping activity of the project (D.1.1.1), typical ecological corridors in nine pilot sites of the PlanToConnect project were defined. Referring to these typical alpine corridors, anthropogenic pressures were evaluated through an explorative expert survey by an online questionnaire. In total, 65 spatial and landscape planning experts as well as experts coming from the nature conservation sector (biologists, environmental scientists, wildlife managers, etc.) responded to the questionnaire.

Through a collection of literature, it was possible to collect potential mitigation and compensation measures of the identified most important anthropogenic pressures in the fields of agricultural areas, forestry, extraction of resources, recreational infrastructure, areas for tourism, as well as alien and problematic species (see section 6). The list of mitigation measures on transport infrastructure, settlement development and energy installations in the threats report (D.1.3.1), complete the picture of potential mitigation and compensation measures. Possible incentives were collected by the experiences of the project partners in pilot sites and are listed in section 7.

2 The need for a GBI inventory with compatible and conflicting uses

For maintaining biodiversity, it is crucial to preserve and establish a coherent Green and Blue Infrastructure (GBI) network in the landscape, with permeable elements for wildlife species. Several connectivity projects and studies are giving recommendations regarding the structure, anthropogenic land use, and management practices of GBI elements and ecological linkages:

According to the Department of Biology of the University of North Texas and the Center for Large Landscape Conservation in Bozeman (USA), the functionality of an ecological linkage depends on how it is managed, once a design has been implemented, because a linkage design is simply a hypothesis that conserved patches of natural or semi-natural land will sufficiently promote wildlife and plant movement Gregory et al. (2021). In line with this hypothesis, the general IUCN guidelines on ecological connectivity are recommending that "*the plan for an ecological corridor should describe management actions required to retain, restore or enhance ecological connectivity. The allowable activities within a corridor should relate directly to its purpose and therefore will be context specific*" (Hilty et al., 2020). A very similar conclusion is making the study on an ecological network in Salzburg from 2014: "*A prerequisite for maintaining the functionality of the designated biotope network system is that it is considered in regional spatial planning, so that the permeability of each biotope network axis can be checked in the case of a planned project*" (Leitner et al., 2014). Recognizing the need of standards for such checks and evaluations of infrastructure projects, Austria recently elaborated guidelines for the assessment of regional permeability for the preservation and establishment of a habitat network in the whole country (Grillmayer et al., 2023a & b). Moreover, transnational projects in other European countries recognise the need for managing ecological corridors and possible anthropogenic land use conflicts through spatial planning procedures. Guidelines of the Interreg Danube ConnectGREEN project on "How to use spatial planning tools in integrative management of ecological corridors" are not only focusing on the land-use structure of ecological networks, but also on the question "how" to cover ecological demands during the phases of scoping, planning, designing and development of ecological linkages. In the scoping phase, the "*identification of the conflicts between the existing land-use/spatial arrangement and sustainability of ecosystems in the territory"* should be conducted, and the "*identification of the potentials for sustainable use of ecosystem services in the territory reflecting the identified demands of society*" should be considered. In the planning phase, the question: "*How is it possible to cover the identified demand in the most efficient and sustainable way with minimum conflicts? / how to avoid conflicts? (which alternative/ variant under which conditions)?*" should be posed (Finka et al., 2021).

Conflicting uses:

Breaking these recommendations down to the PlanToConnect project, we can consider the elaborated potential structural ecological network in the Alpine Space (Laner et al., 2024) as an ecological network design, that need management actions. The link between the

structural model and more concrete identification of conflicting uses and appropriate management measures is the elaborated catalogue of GBI elements, which is based on the concept of Bennett et al. (2011) which was developed for a European level. The concept recognises near-natural areas without anthropogenic influence, like core areas of high biodiversity and natural connectivity features to assist species movement, but other GBI elements are including anthropogenic uses, or they are even made by humans, like artificial connectivity features or urban green areas e.g. This group of GBI elements has a semi-natural character.

Besides the restoration of anthropogenic and artificial infrastructure with a strong barrier effect (like transport infrastructure) in highly natural areas, semi-natural GBI elements are important as well to be managed in an appropriate way to guarantee landscape permeability. Sustainable land use management practices especially in forest areas, forested landscape elements, and agricultural areas outside of protected areas are important for the maintenance of ecological connectivity (DINALPCONNECT project, 2023). In the context of the Alpine Space with its highly touristic attractiveness, areas with recreational and tourism activities should be considered, because the numerous ski resorts and other areas of high altitudes with cable car installations are covering wide areas. Due to their disturbance factor for wildlife species (Rixen & Rolando 2013). but their relatively permeable characteristic, we considered them in the analysis of conflicting uses.

Relation to spatial planning and gaps:

Spatial and landscape planning as cross-sectoral disciplines should consider management actions for ecological linkages and integrate them into effective spatial planning instruments, as far as possible. Even though spatial planning is not able to intervene in each management practice, like hunting, forestry practices or the use of pesticides in agriculture, existing examples already emerged from experiences in the pilot sites of the PlanToConnect project, where spatial planning regulations conserve green infrastructure elements, intervening in sectoral policies. This shows an example in South Tyrol, where a provincial landscape planning authority used a landscape planning instrument to prevent deforestation of a green corridor in the valley bottom at detailed local level.

Not only plans and programs at regional and local level have an important effect to intervene in these management practices, also environmental evaluations and assessments are important procedures to consider ecological connectivity in spatial planning at regional and local level (Chiapparini et al., 2024), especially when it comes to new infrastructure projects and future land use changes, as it is stated in the PlanToConnect project report on current "*Planning instruments and processes for GBI network planning and implementation in the Alps"* (D2.1.2). The EU Guidance on Screening in Environmental Impact Assessment (EIA) in coherence with Art.6 of the habitat directive requires member states to assess the potential environmental impacts of public and private projects, including infrastructure developments that may affect the connectivity function of ecological corridors outside of protected areas. The aim is to ensure that such projects are carried out in a manner that minimizes adverse effects on biodiversity (ibid.).

However, studies and recommendations in former projects explain, that for spatial planning and environmental assessment procedures, there is a lack of information, knowledge, guidelines, best practices, and standards to consider the land use conflict between ecological connectivity and the development of anthropogenic needs and human infrastructure:

A special issue on "*advancing the consideration of ecological connectivity in environmental a*ssessment" from the Impact Assessment and Project Appraisal journal on behalf of the International Association for Impact Assessment collected studies worldwide, with a focus on Europe, and South and North America. Based on these findings, Torres et al. (2022) revealed important factors that influence the consideration of ecological connectivity in environmental assessments:

- How connectivity is measured and assessed:

  Most assessments of connectivity are qualitative and there is a poor consideration of landscape-scale impacts on connectivity, while multi-scale analysis would be required.

- Lack of guidelines, best practices, and standards:

  Sophisticated analysis should be supported by guidelines and a continuous science-practice knowledge exchange. There is an urgent call for best practices, guidelines, and reliable standards and continuous science-practice knowledge exchange to improve the treatment of ecological connectivity in environmental assessment processes. Main open standards here are the identification "*(1) in which cases a connectivity analysis is needed, (2) at what scales of analysis, (3) with what kind of information, and (4) what methods are most appropriate"*.

- Environmental assessment legislation and regulation:

  "Including connectivity in environmental assessment legislation would help address the lack of policies, standards, and assessment guidelines." (Patterson et al. 2022 in Torres et al., 2022).

- Political will:

  It is stated that connectivity depends largely on the presence of interested people, rather than an institutionalized approach to environmental matters. To strengthen the treatment of connectivity in environmental assessments is to encourage governments to articulate a vision and high-level strategy for landscape conservation that can be used to inform environmental assessments. In this way decision-making processes can respect sustainable development goals and biodiversity commitments (Torres et al., 2022).

In line with these recommendations the strategy for ecological connectivity of the Dinaric Alps states, that with the environmental assessments approach, *"biodiversity issues are consulted after the decision of land-use planning choices"* which leads to *"only implement adjustment and/or mitigation measures"* (Premelč et al., 2022). The DINALPCONNECT project came to the conclusion that "*public bodies have an important role in integrating*

ecological connectivity in national and regional planning legislation. *Spatial planners need to be better informed about ecological connectivity and corridors"* (ibid.).

The IUCN guidelines for conserving connectivity through ecological networks recommend that in best case, the *"management documentation for an ecological corridor should* ***list prohibited or permissible activities*** *and* ***describe*** *any* ***restoration needed*** *to achieve connectivity"* (Hilty et al. 2020). The guidelines propose to specify a level for some anthropogenic activities, which can have a classification for the compatibility with the connectivity objective. A simple range with three categories (e.g. 'high', 'medium' or 'low') might be sufficient. The creation of a decision framework for allowable activities might be one approach. For areas of poor habitat quality within an ecological linkage, restoration plans and metrics of success are recommended. **However, management recommendations in spatial planning documents are often missing, remain vague or are just interfering on a single and specific anthropogenic threat.**

The current activity therefore aims to provide an inventory that should serve to identify suitable **land use and landscape management practices** for ecological connectivity.

Landscape planning *is a planning method based on finding the most suitable location for an individual activity. It is a way of finding a consensus between the development needs (of society and the economy) and the need to protect the (human living and natural) environment and its resources* (University of Ljubljana, 2021). Various planning instruments have developed for this scope:

- Regional and municipal development programs
- Regional and municipal landscape plans
- Environmental assessments: Environmental impact assessments (EIA) and strategic environmental assessments (SEA).

Landscape management *means operating from the point of view of sustainable development, which should ensure regular maintenance of the landscape and direction, and coordination of changes brought about by social, economic and environmental processes* (European Convention on Landscape in University of Ljubljana, 2021). Here, other management tools and instruments needs to be used to steer the developments of the landscapes, such as agreements or economic instruments.

The task is to identify anthropogenic pressures for wildlife corridors, which should be considered for spatial planning instruments, impact assessment tools (EIA/SEA), and land management instruments, and to identify possible solutions for compensation or mitigation measures. The inventory does not claim to be exhaustive.

The guiding question for this investigation is:

Which anthropogenic land uses can be allowed on regional potential ecological linkages in the Alpine Space, and which are problematic to guarantee the functionality of the linkages?

Several sub-questions and tasks arise here, (which are also included in a standard questionnaire):

1) What are the most important potential anthropogenic pressures towards ecological networks at EU level?
2) Which of these anthropogenic uses are the most relevant ones in the Alpine Space?
3) Which of them can be managed by spatial planning instruments and for which ones additional sectoral policies are needed?
4) What are the most important potential anthropogenic pressures on priority corridors, outside of protected areas, and based on the identified GBI typologies/ GBI elements?
5) What are possible mitigation and compensation measures?

3 Framework for potential conflicting anthropogenic uses in ecological networks

For the selection of anthropogenic uses, that can be considered in spatial planning instruments, we started from the list of key pressures and threats from Natura 2000 reporting.

3.1 The Natura 2000 list of key pressures and threats

The “list pressures and threats” from the reference portal for reporting under article 17 of the Habitats Directive collects standardized key pressures for reporting in Natura 2000 sites (EEA, 2023). Ecological linkages are not protected areas and therefore, legally binding land use restrictions in protected areas may be more severe than on ecological linkages.
However, regulations of the Habitat Directive are also referring to areas outside Natura 2000 sites because it concerns the protection of the ‘overall coherence’ of the Natura 2000 network (Art. 3 of the Habitat Directive).

The Habitat Directive (Commission of the European Communities, 2013) defines two typologies of elements for the Natura 2000 network and defines provisions for environmental assessments:

- **Natura 2000 sites:** Referring to Art. 3, the sites are special areas of conservation and special protection areas. The identification of such sites is mandatory.

- **Corridors and stepping stones:** Referring to Art. 3 and Art. 10, they have functions to improve the ecological coherence of Natura 2000 network, but it is not mandatory to identify them in land use planning.

- **Obligation of assessments**: Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, […], shall be subject to appropriate assessment of its implications (Art. 6, §3).

The conductions of assessments are then further clarified by specific guidelines.

The guidelines on “*Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC*” (European Commission, 2019) refer to Art. 10 and the protection of the overall coherence of the Natura 2000 network.

- “*the role of the site in ensuring the adequate geographical distribution in relation to the range”* of the species should be considered (p.43).

- Article 6(4) requires that the overall coherence of Natura 2000 is protected. Thus, the Directive presumes that the 'original' network has been coherent. If the exception regime is used, the situation must be corrected so that the coherence is fully restored (p.43).

Summed up, in cases of development projects or plans, environmental assessments must be conducted, and elements of the overall network should be considered. And although the directives "*require conservation actions to be established within the Natura 2000 sites, conservation measures are also applied outside the network to contribute to achieving good conservation status of habitats and species"*. Most of conservation measures are applied both, inside and outside the sites (EEA, 2020).

We asume that anthropogenic pressures and threats occuring inside Natura 2000 sites are also very likely to occur outside these designated areas.

The list provides a basis for the consideration of a broad range of pressures, defining 176 detailed pressures, which are grouped in 14 broad categories that can be described as thematic fields of anthropogenic and natural pressures. The names of the list is referring to the period 2019-2024.

3.2 Most important anthropogenic pressures on European level

The report on the "State of nature in the EU" from the EEA (2020) shows the results from reporting under the nature directives in the period 2013-2018. It states that *"The most frequently reported pressures for both habitats and species stem from agricultural activities and urbanisation"*. On the third rank, there are forestry practices.

3.2.1 Agricultural pressures

Changes in agricultural management are the most frequently reported type of pressure, among them, the abandonment of grassland management is most reported (14.3 %) and relevant pressures which can be managed by landscape planning, are among the most relevant: conversion from one type of agricultural land use to another, removal of small landscape features for agricultural land parcel consolidation, and conversion into agricultural land. The report states that "*Reptiles and smaller mammals are especially affected by fragmentation due to the removal of small landscape features, which reduces landscape connectivity and leads to a loss of habitat area essential for food supply, shelter and breeding sites" (ibid).* Birds are most affected by the conversion of one type of agricultural land use to another and by drainage.
The eight most relevant pressures represent 62.0% of all reported in this level 1 group.

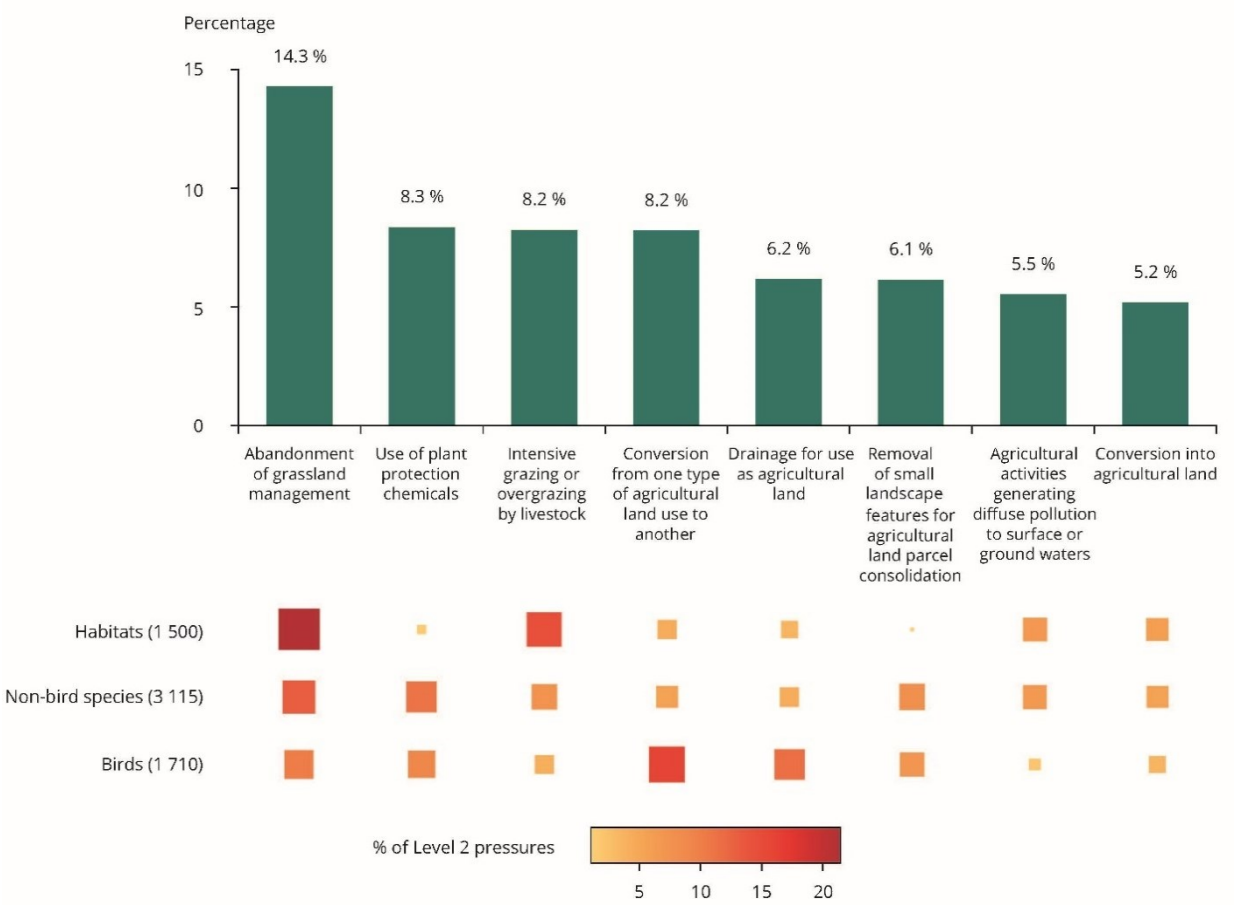


Figure 1: Distribution of the eight most relevant level 2 agricultural pressures for habitats and species, shown as the percentage of pressures within this level 1 group.

Source: EEA, 2020

3.2.2 Urbanization pressures

It is interesting, that when it comes to the group of urbanisation pressures, the most reported human-induced pressures are “Sports, tourism and leisure activities” (24.8 %), including a wide range of activities (see section 3.5 Potential incompatible anthropogenic uses). Tourism and recreational areas in general play an important role, because also the creation or development of sports, tourism and leisure infrastructure, as well as the modification of coastline, estuary and coastal conditions for urban areas are within the top five pressures. The eight most relevant pressures represent 72.2% of all reported in this level 1 group (ibid.).

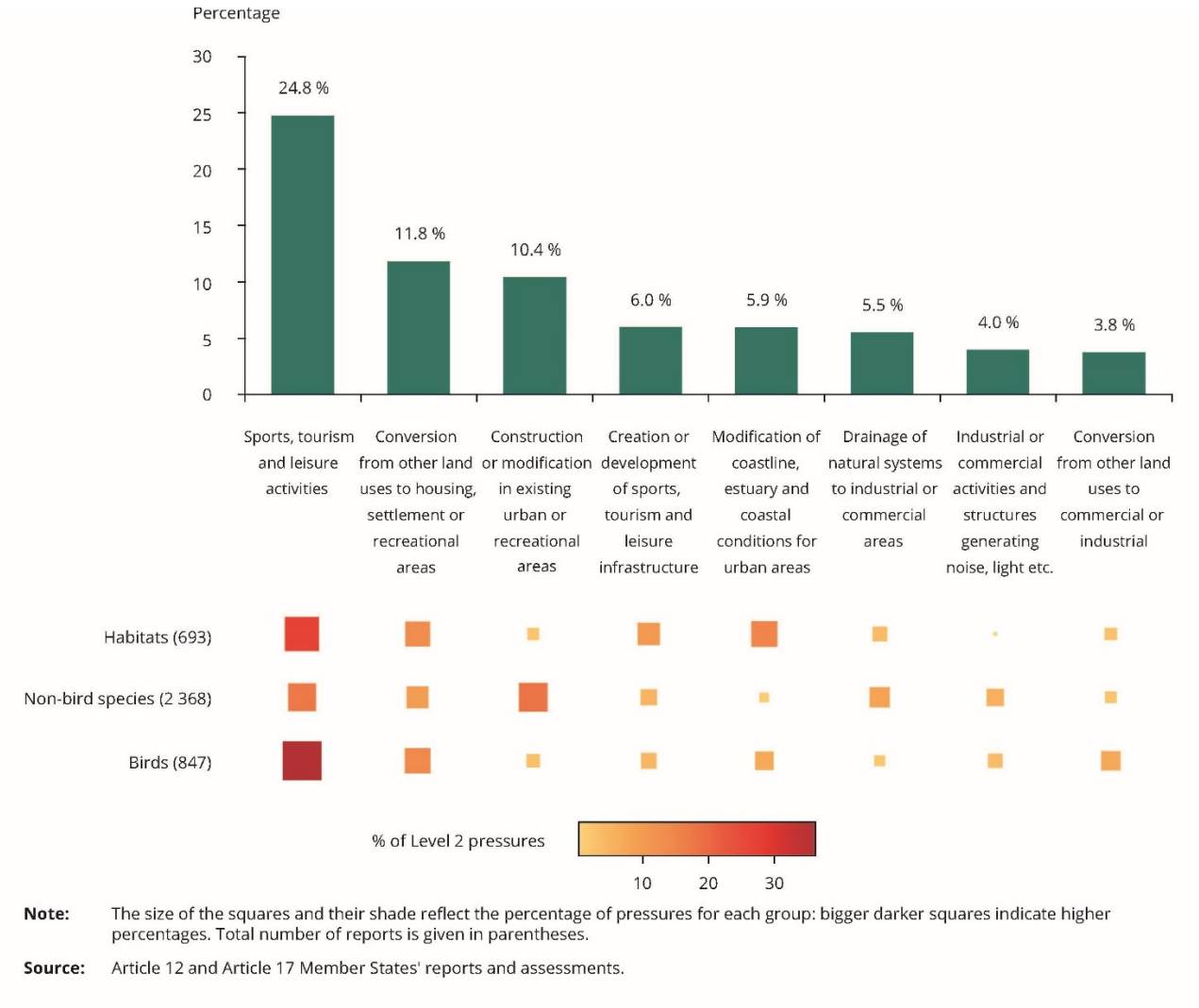


Figure 2:Distribution of the eight most relevant level 2 urban pressures for habitats and species, shown as the percentage of pressures within this level 1 group.

Source: EEA, 2020

3.2.3 Forestry pressures

In forestry, a classical land-use and landscape planning issues for connectivity can be clear-cutting and removal of all trees, which is the second highest pressure on EU level. The eight most relevant pressures represent 76.2% of all reported in this level 1 group. (ibid.)

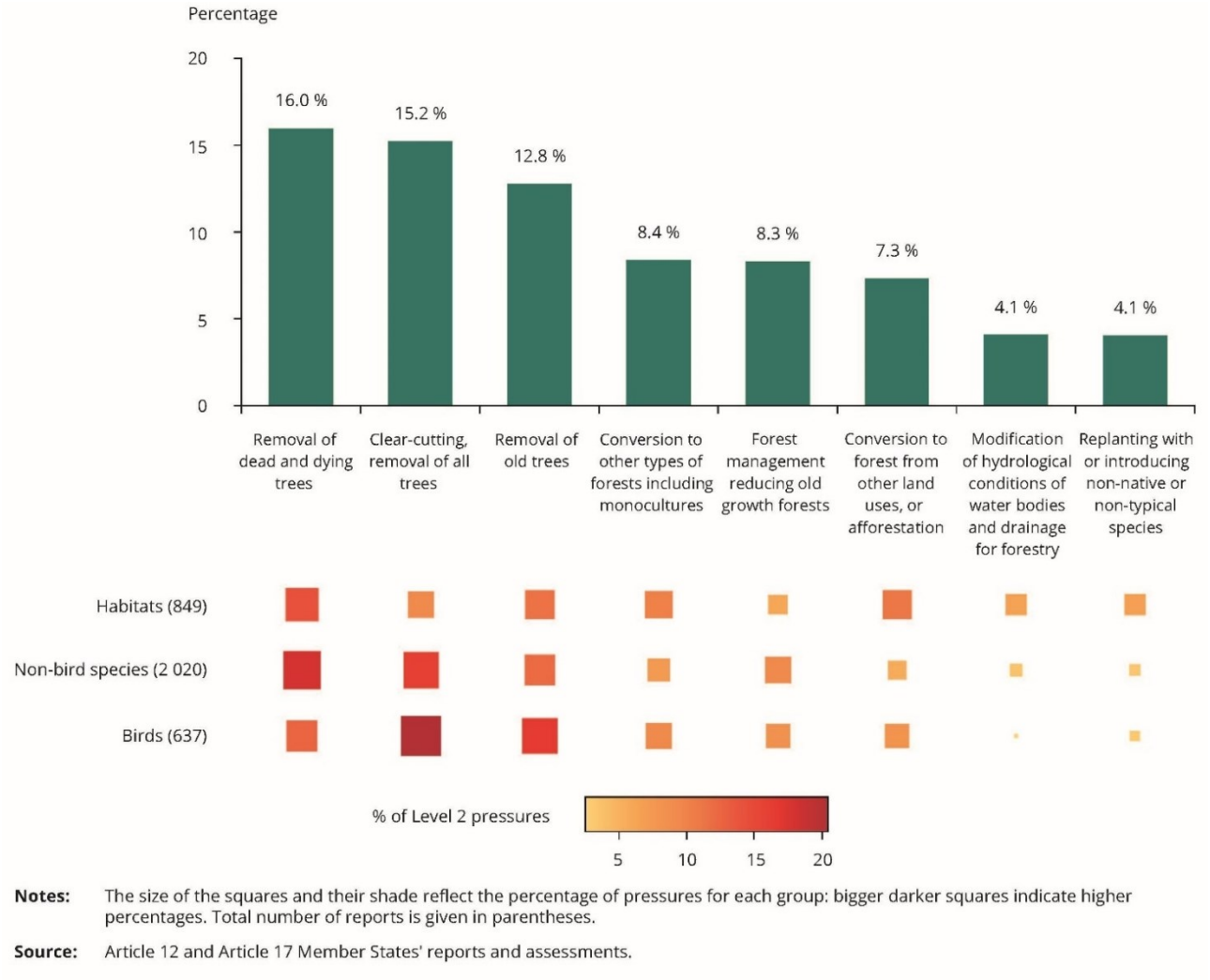


Figure 3: Distribution of the eight most relevant level 2 forestry pressures for habitats and species, shown as the percentage of pressures within this level 1 group

Source: EEA, 2020

3.2.4 Natural processes

Natural processes can be a risk to many habitats. The most relevant one among this group is natural succession, which results in changes in species composition.

In the reporting procedure, succession was in many cases a response to human intervention or management changes, accelerating the process. Among them there are the abandonment of agricultural land (e.g. abandonment of grazing, lack of hay cutting) or drainage of bogs and mires. When the ecosystem's natural balance gets distorted, they become considerable pressures, like, e.g. the elimination of disturbance regimes like natural floods, or limitation of dynamic early succession habitats to static fragments in an otherwise

unavailable agricultural and forest landscape. Bogs, mires and fens are among the habitats most vulnerable to natural succession, usually indirectly caused by human intervention, e.g. lowering water tables by drainage (ibid.).

3.2.5 Human – induced changes in water regimes

This group is unsurprisingly particularly relevant for freshwater habitats and fish. This specific pressure group only accounts for pressures that are not directly related to any other pressure group (ibid.).

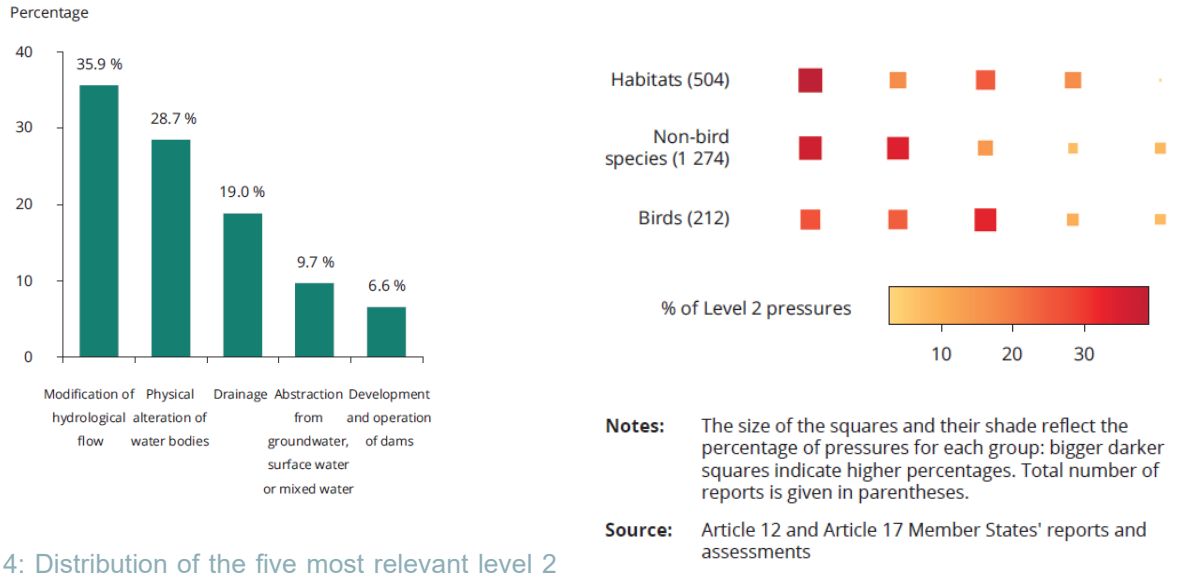


Figure 4: Distribution of the five most relevant level 2 pressures in changes in water regimes for habitats and species, shown as the percentage of pressures within this level 1 group.

Source: EEA, 2020

3.2.6 Pressures from energy production

The eight most relevant pressures from energy production represent 98.7% of all 14 pressures reported in this level 1 group. The most frequent reported are hydropower, wind, wave and tidal power installations. Spatial planning has important instruments to manage this infrastructural development, meaning that it is important to take them into account (ibid.).

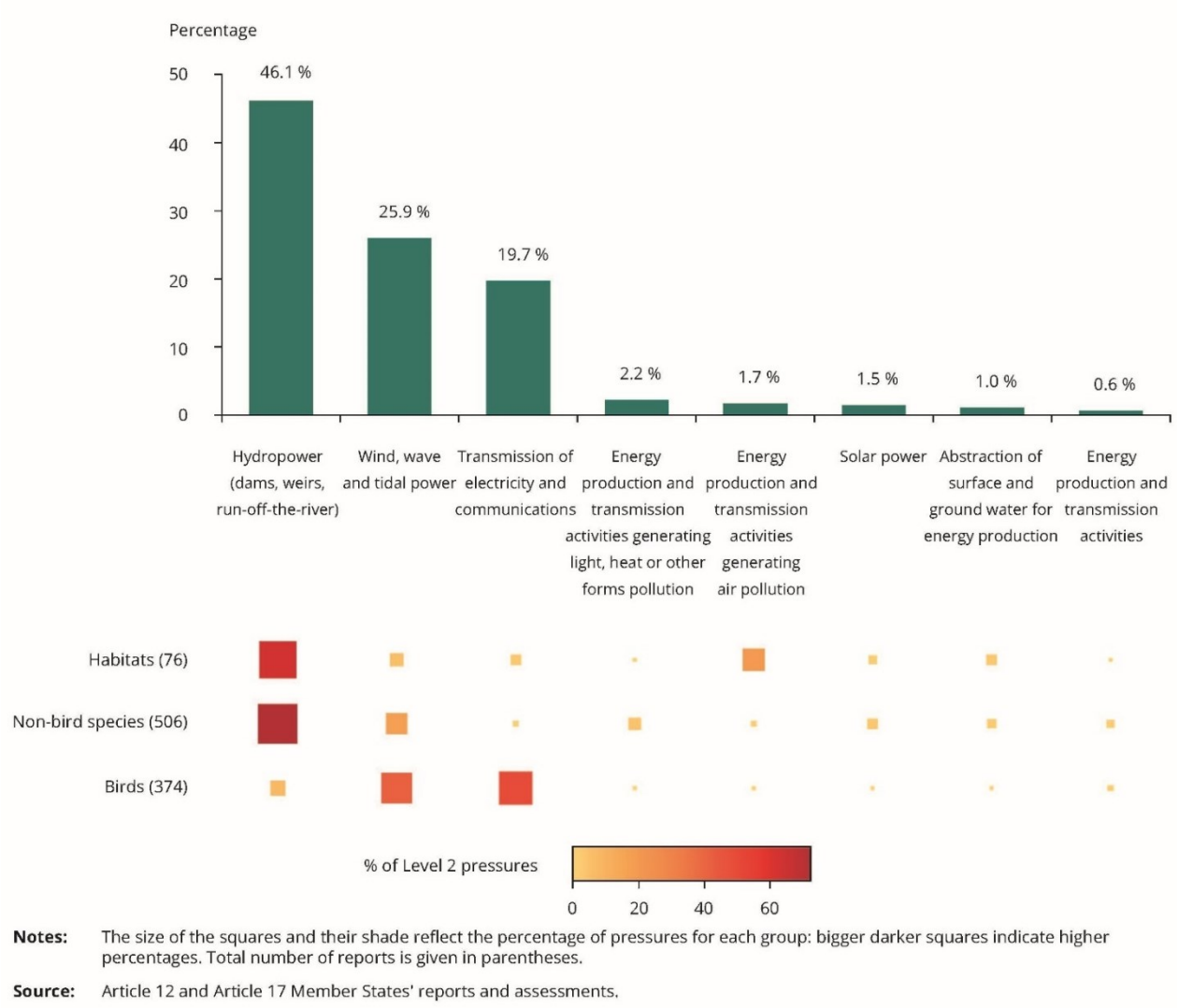


Figure 5: Distribution of the five most relevant level 2 pressures from energy production for habitats and species, shown as the percentage of pressures within this level 1 group.

Source: EEA, 2020

3.2.7 Alien and problematic species

According to the EEA (2020), invasive and alien species (IAs) *"are considered to be a growing threat in the future".* They are introduced accidentally or deliberately into a natural environment where they are not normally found. Such species can cause serious negative effects like e.g. *"decline in the quality of native vegetation owing to the spread of invasive plant species, and the overgrowth of alluvial and lowland humid habitats with invasive plants (e.g. Japanese Knotweed (Fallopia japonica) or Himalayan Balsam (Impatiens glandulifera)). (ibid.)* Spatial planning can give some indications regarding the management of connectivity areas.

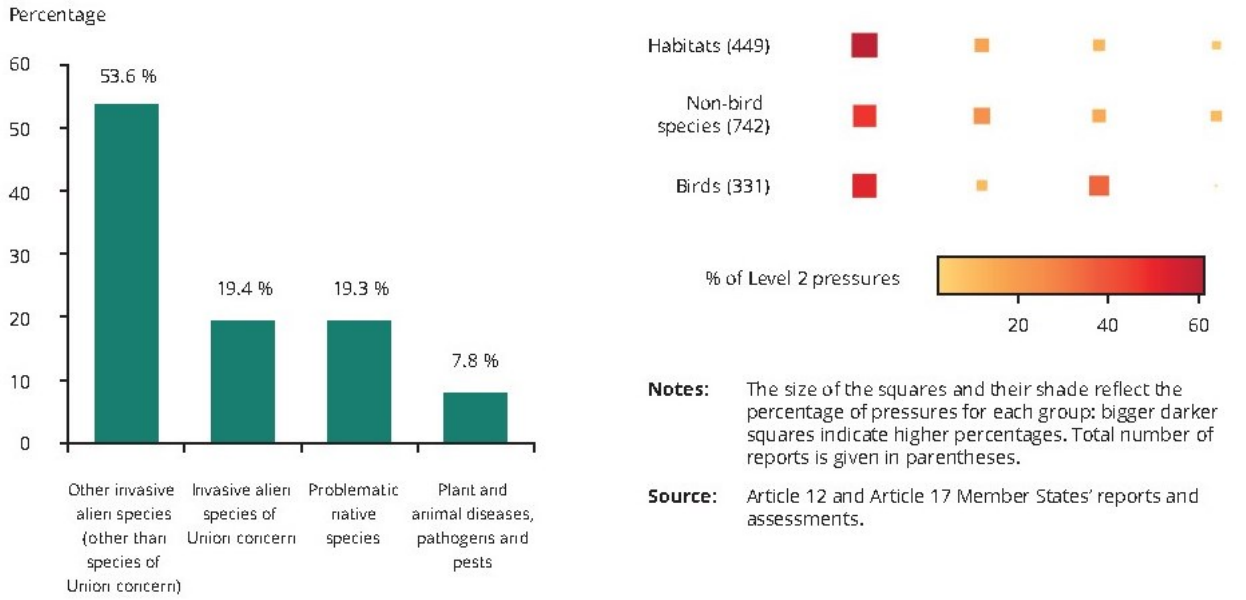


Figure 6: Distribution of the level 2 pressures caused by alien and invasive species for habitats and species, shown as the percentage of pressures within this level 1 group.

Source: EEA, 2020

3.2.8 Extraction of resources

A detailed list of pressures in the group regarding the extraction of resources is not provided in the report of the EEA (2020). Considering the Alpine available resources, we made a rough selection of not neglectable pressures based on the detailed list of key pressures and threats (EEA, 2023). The "*extraction of rocks, gravel, sand, metal ores, loam, clay and shells from quarries, inland water bodies (lakes, riverbeds) and sea*" might be one of the most important pressures in the Alps. It is to evaluate if sites of *salt extraction* are still active. Peat extraction is still a topic in the Alps, which is noticeable by a recent discussion on the peat extraction site in the lower Adige Valley (South Tyrol, IT). Considering the land needed for depositing inert materials from the alpine base tunnels (especially the Brenner Base Tunnel), another important pressure is probably "dumping/depositing of inert and dredged materials from terrestrial and marine extraction".

3.3 Most important anthropogenic pressures at Alpine level

To get an overview which are the main anthropogenic pressures and threats towards the Natura 2000 network, within the EUSALP macro-region the dashboard, “Main pressures and threats” from the EEA (2019) was consulted. The dashboard however can only give an indication at alpine level because unfortunately it cannot exactly geographically depict the EUSALP perimeter. Two main biases are to consider:

1) Switzerland is not included in this dashboard.
2) The spatial extent can only be filtered in base of member states and biogeographical regions.

To get an overview, the first query is showing reported pressures and threats on all habitats in the main alpine countries, considering only the main biogeographical regions “Alpine” and “Continental” (Query no°1). The result shows agricultural practices on the top, followed by urban development, forestry, natural processes, alien and problematic species, human-induced changes in water regimes and extraction of resources.

Query no°2 reduces the selection to high pressures only. It is visible, that the six most reported groups of pressures are basically the same, but with a different order (see Annex 1).

Query no°3 is making a focus on Austria and Slovenia only, which are the states that are completely included in the EUSALP macro-region and therefore are not biased by pressures outside EUSALP. Here, also the biogeographical region Marine Mediterranean Region was considered. The result shows almost the same result as query no°1, but changes in water regimes are more often reported than alien species, and the extraction of resources has the same importance as alien species. Query no°4 reduces the selection to high pressures only. Surprisingly, human-induced changes in water regimes are the second most reported pressures, after agricultural practices.

Query no°5 represents the Alpine biogeographical region within the EUSALP countries, which corresponds approximately to the inner Alpine Apace. The most important pressure are agricultural practices, followed by urban development, forestry, natural processes, human-induced changes in water regime, alien and problematic species, and extraction of resources.

Compared to the complete national territories (query no°1) the most important pressures are the same, but less frequently reported, despite energy production processes. Therefore, energy production is still an important pressure to consider. If we consider only high pressures in this area (query no°6) the result is highly similar to the pressures in Austria and Slovenia only.

Summed up:

- The most important groups of pressures in the Alps are
  - agricultural practices,
  - urban development,

  - forestry,
  - natural processes,
  - alien and problematic species,
  - human-induced changes in water regimes,
  - extraction of resources,
  - and energy production.

- Agricultural practices represent in each of the conducted queries the most reported anthropogenic pressures. Therefore, it constitutes an important topic to consider in landscape planning.
- Human-induced changes in water regimes are an important pressure for specific Alpine regions.
- Military actions (group H), the development and operation of transport systems (group E), as well as geological events and catastrophes (former group M) don't appear frequently among the reported pressures with a high impact. The development and operation of transport systems may have only a few cases as they are not compatible with Natura 2000 sites and therefore mainly take place outside them. Climate change is expected to be a major threat in future but is currently not among the most often reported pressures. It is at the 8th place, and it is rarely reported having a high impact.

3.4 The list of anthropogenic pressures in light of planning competences

Land-use and landscape planning as disciplines which are dealing with the development of the built environment and natural landscape have not the competence to resolve each anthropogenic or natural pressure which could be theoretically present on ecological linkages, or it is a shared competence between various sectors. Therefore, the list of broad categories of key pressures and threats was roughly evaluated. Pressures which can be managed with land-use and landscape planning instruments are basically the first six categories (PA to PF). Some of these are highly related to land-use and landscape planning, others can only be managed considering other sectors.

Table 1: Broad categories of key pressures and threats relevant for spatial planning

No.	Key Pressure/ threat	Sectors of competence		
PA	Agriculture related practices	Land-scape planning	Agriculture	Nature protection
PB	Forestry related practices		Forestry, Wildlife management	
PC	Extraction of resources (minerals, peat, non-renewable energy resources)	Land-use planning	Economic development	
PD	Energy production processes and related infrastructure development		Energy, climate protection	
PE	Development and operation of transport systems		Transport planning	
PF	Development, construction and use of residential, commercial, industrial, and recreational infrastructure and areas		Social and economic development	

For the rest of the pressures (PG to PX), other land management practices must be considered (Table 2). Guidelines for land management practices can be integrated into spatial plans, especially landscape plans and plans regarding ecological network elements. But such pressure and threats can also be steered through other land management practices.
In addition to spatial and landscape planning, some tools for managing natural resources might be important for the realization and protection of ecological corridors. Some of them derive from European directives, e.g. the water framework directive for river corridors, fundings from the Common Agricultural Policy and the Rural Development Program for agricultultural areas within corridors, forest management plans for forested areas, as well as risk management plans, hazard zone plans, and climate adaptation strategies.

Table 2: Broad categories of key pressures and threats with relevance for land management

Key Pressure/ threat	Relevance for spatial planning or land management
Extraction and cultivation of biological living resources (other than agriculture and forestry)	It is questionable if spatial planning can make prescriptions on hunting or fishing activities. However, in collaboration with hunting associations and offices for wildlife management, regulations for connectivity elements can be established. In South Tyrol the provincial offices for wildlife management and road constructions elaborated a green bridge project e.g.
Military action, public safety measures, and other human intrusions	Activities of public safety are regulated at the national level. Spatial planning with its instruments mainly at local and regional level has little influence on these topics. The collaboration with national institutions is crucial.
Alien and problematic species	Spatial planning instruments can only give recommendations. Invasive species must me managed in collaboration with sectoral offices.
Climate change	Spatial planning can have indirect effects on climate protection, and climate adaptation plans can be integrated into spatial development programs.
Mixed source pollution	This category is related to a variety of anthropogenic activities and spatial planning is a cross-cutting topic which can have a high influence on a wide range of sectors.
Human - induced changes in water regimes	This category includes mainly pressures when the key driver of the change is unclear or where these changes are related to several causes. Where a key sectoral driver(s) can be identified, the pressure/ threat should be reported under the corresponding sectoral category. The modification of flooding regimes e.g., are usually competence of regional/ provincial sectoral institutions or higher levels.
Geological events, natural processes, and catastrophes	Natural events are among the most reported key pressures. Spatial planning can have a certain effect on natural floodings. However, most of the listed key pressures in the list do not have a direct anthropogenic cause.
Unknown pressures, and from outside the Member States	The category is not referring to a specific anthropogenic activity and should be considered in one of the others.

3.5 Potential incompatible anthropogenic uses

To provide an overview of potential incompatible anthropogenic uses, we refer to the most important anthropogenic pressures in the Alps and listed the top 8 most reported pressures in the level1 groups. The codes of pressures and threats are referring to the codification of 2019 – 2024 of the EEA.

Table 3: Most important group of pressures in the Alps with top 8 most reported specific pressures

Pressure/ threat *	Pressure/threat name 2019-2024	Top 8 pressures
PA	**Agriculture related practices**	
PA01	Conversion into agricultural land (excluding drainage and burning)	5.2%
PA02	Conversion from one type of agricultural land use to another (excluding drainage and burning)	8.2%
PA04	Removal of small landscape features for agricultural land parcel consolidation (hedges, stone walls, rushes, open ditches, springs, solitary trees, etc.)	6.1%
PA05	Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)	14.3%
PA07	Intensive grazing or overgrazing by livestock	8.2%
PA14	Use of plant protection chemicals in agriculture	8.3%
PA17	Agricultural activities generating pollution to surface or ground waters (including marine)	5.5%
PA22	Drainage for use as agricultural land	6.2%
PB	**Forestry related practices**	
PB01	Conversion to forest from other land uses, or afforestation (excluding drainage)	7.3%
PB02	Conversion from one type of forestry land use to another	8.4%
PB03	Introduction and spread of new species for forestry purposes (including GMOs)	4.1%
PB07	Removal of dead and dying trees (including debris)	16.0%
PB08	Removal of old trees (excluding dead or dying trees)	12.8%
PB09	Clear-cutting, removal of all trees	15.2%
PB14	Forest management reducing old growth forests	8.3%
PB24	Drainage for forestry	4.1%
PC	**Extraction of resources (minerals, peat, non-renewable energy resources)** * Top pressures not listed in the EEA report (2020) but estimated by the project consortium.	
PC01	Extraction of minerals (e.g. rock, metal ores, gravel, sand, shell)	NO DATA*
PC02	Extraction of salt	NO DATA*
PC05	Peat extraction	NO DATA*

PC06	Dumping/depositing of inert and dredged materials from terrestrial and marine extraction	NO DATA*
PD	**Energy production processes and related infrastructure development**	
PD01	Wind, wave and tidal power (including infrastructure)	25.9%
PD02	Hydropower (dams, weirs, run-off-the-river and respective infrastructure)	46.1%
PD03	Solar power (including infrastructure)	1.5%
PD06	Transmission of electricity and communications (cables)	19.7%
PD08	Energy production and transmission activities generating pollution to surface or ground waters	0.6%
PD09	Energy production and transmission activities generating air pollution	1.7%
PD12	Energy production and transmission activities generating light, heat or other forms pollution	2.2%
PD13	Abstraction of surface and ground water for energy production (excluding hydropower)	1%
PF	**Development, construction and use of residential, commercial, industrial and recreational infrastructure and areas**	
PF01	Conversion from other land uses to built-up areas	15.6%
PF02	Construction or modification (e.g. of housing and settlements) in existing built-up areas	10.4%
PF03	Creation or development of sports, tourism and leisure infrastructure	6.0%
PF05	Sports, tourism and leisure activities	24.8%
PF12	Residential, commercial and industrial activities and structures generating noise, light, heat or other forms of pollution	4.0%
PF13	Drainage, land reclamation and conversion of wetlands, marshes, bogs, etc. for built-up areas	5.5%
PF15	Modification of coastline, estuary and coastal conditions for built-up areas	5.9%
PI	**Alien and problematic species**	
PI01	Invasive alien species of Union concern	19.4%
PI02	Other invasive alien species (other than species of Union concern)	53.6%
PI03	Problematic native species	19.3%
PI04	Plant and animal diseases, pathogens and pests	7.8%
PL	**Human-induced changes in water regimes**	
PL01	Abstraction from groundwater, surface water or mixed water (mixed or unknown drivers)	9.7%
PL02	Drainage (mixed or unknown drivers)	19.0%
PL04	Development and operation of dams (mixed or unknown drivers)	6.6%
PL05	Modification of hydrological flow (mixed or unknown drivers)	35.9%
PL06	Physical alteration of water bodies (mixed or unknown drivers)	28.7%
PM	**Geological events, natural processes and catastrophes**	
PM07	Natural processes without direct or indirect influence from human activities or climate change	NO DATA

Sources: EEA (2020) Report on the State of nature in the EU; EEA (2023). The list of pressures and threats for reporting on pressures and threats in Natura 2000 sites.

A screening of literature considering additionally the "*Strategy for improved ecological connectivity throughout the Dinaric Mountains and connecting them with the Alps"* (Premelč et al., 2022) form the Interreg ADRION DINALPCONNECT project and the "*Report on tourists' surveys results"* of the (Menzardi et al., 2023) from the Interreg Central Europe HUMANITA project confirmed the listed pressures and revealed further specific pressures regarding tourism and leisure activities. and the was considered:

- Tourism and recreational uses:
  - Summer tourism and activities: building motocross circuits, biking (including riding cross-country bikes), camping, canyoning and rafting, climbing, hiking and trekking, picking of mushrooms and other forest fruits, paragliding, cultural tours, guided tours, photography, etc. (Menzardi et al., 2023).
  - Winter tourism and activities: construction of ski lifts and cable cars, skiing and snowboarding, ski touring and free riding, heliskiing.
  - All year activities: Leisure aircraft, drones, human trampling, unregulated wildlife watching (EEA, 2020).

- Transport infrastructure:
  Although this group it is not frequently reported as anthropogenic pressure for Natura 2000 sites, it should be considered because of its severe impacts on ecological connectivity outside protected areas.

4 Potential compatible and incompatible anthropogenic uses on priority linkages

Based on the elaborated GIS model of a potential alpine ecological network, compatible and potential conflicting anthropogenic uses were identified.

4.1 Sections of potential linkages passing through intensive agriculture

For the analysis of linkages passing through areas of intensive agriculture, it turns out that land use/ land cover datasets with a lower level of detail are more appropriate.

When using the high-resolution dataset EUSALP LULC map 2020 of Marsoner et al. 2023 with a pixel size of 5 metres, it reveals that 729 of 953 linkages are passing through intensively used agricultural areas, because very small agricultural areas can cause an intersection, but don't represent the only possibility to overcome the landscape. (For details see Table 4).

Therefore, an analysis of intensive agricultural fields on potential regional linkages was made with the Corine Land Cover Dataset. Following the procedure of the DINALPCONNECT project, all types of agricultural areas were selected despite the classifications 2.4.3 - "Land principally occupied by agriculture, with significant areas of natural vegetation", 2.3.1 - "Pastures", and 2.4.4 "Agro-forestry areas" (Laner & Favilli, 2022).

To distinguish Sustainable use zones (GBI type 3) and real intensive agricultural areas, constituting a barrier, an evaluation with the High Nature Value (HNV) Farmland dataset of the EEA (2017a) was made. It is based on a selection of CORINE land cover classes and is refined based on additional expert rules (e.g. relating to altitude, soil quality) and country specific information, and based on additional European and national biodiversity data layers (ibid).

Results are showing that more than half of the potential linkages (489 of 953) are passing through widely intensively used agricultural areas. This highlights the high importance of maintaining patchy and linear woody features or other green linear elements in intensively used agricultural areas. The total length of Least-cost-paths passing through intensive agricultural areas amounts to 2,473 km, which corresponds to 11.4 % of the summarized length of all linkages in the whole network. Only 314,5 km (12%) of the linkages passing through intensive agriculture are part of HNV farmland.

LCP sections of intensive agriculture are in average approximately 470 m long and their median amounts approximately 210 m. Considering HNV farmland as passable areas, the average length is reduced to 444 m, and the median length amounts 179 m. Areas of HNV

farmland can increase the general landscape permeability and constitute important stepping stones for the ecological network. The picture below shows the HNV farmland around Lake Neusiedl (AT) which creates kind of a landscape corridor between the Lake and the nearby forest.

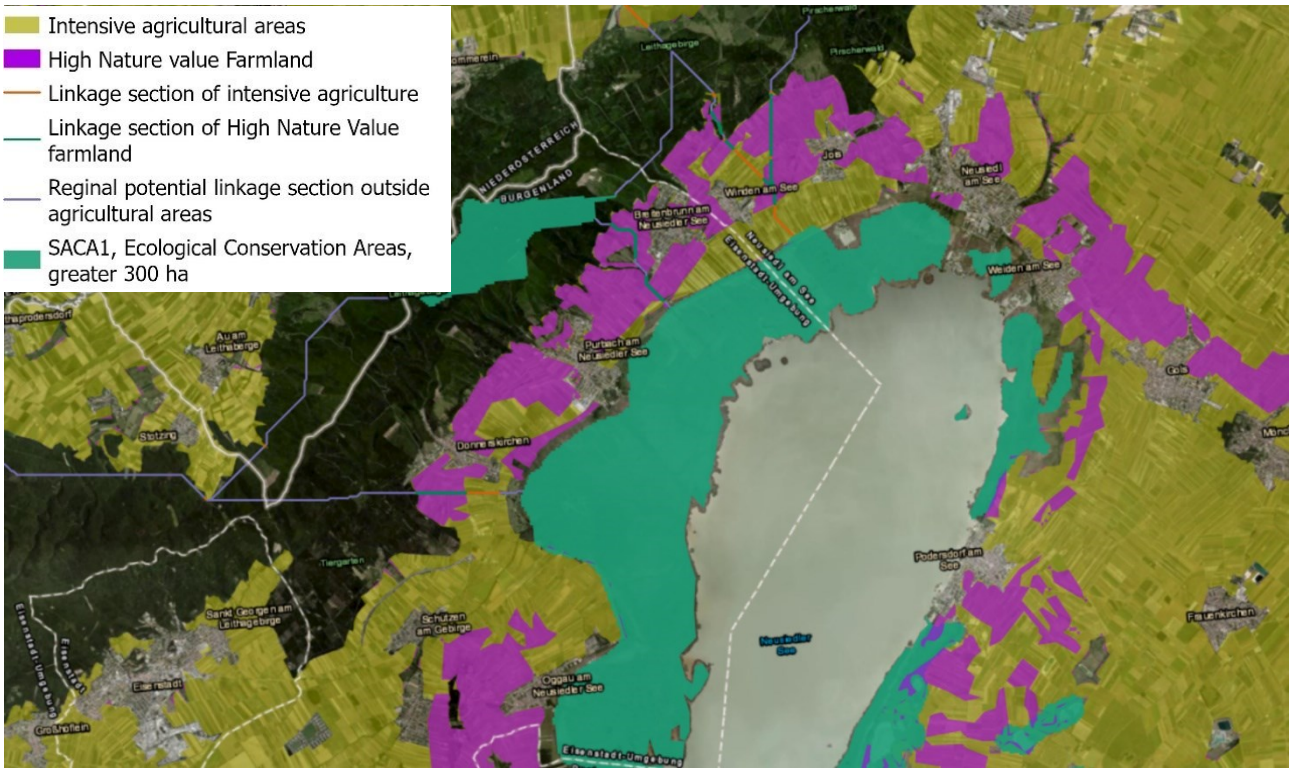


Figure 7: HNV farmland around Lake Neusiedl (AT)

The median of the total distance of sections located in intensive agriculture of these 489 linkages amounts to approximately 2 km. Theoretically this means that if a migrating species meets intensive farmland on its path, it needs to overcome approximately 2 km of such areas in total to come to another SACA1 area. Despite some outliers, this proves that the LCPs of the model are trying to avoid such areas.

Roughly speaking, most of the mentioned outliers, which are corridor distances of more than 3 km passing through intensive agricultural areas, can be found in the Po Valley (IT), and in Lower Austria. It must be verified if these potential linkages are functionally working. HNV farmland facilitates connectivity and in some cases it can be very extensive, like for example in the Po-Valley between Turin and Vercelli, at the north of the Po-River.

Screening the tracks from the longest to decreasing distances, it is notably that the smaller the distances passing through intensive agricultural areas are, the more linear green elements or smaller stepping stones are located on the paths. If this could be proven by a

statistical analysis, it would confirm that small-scale farming is more favourable to ecological connectivity elements than large-scale farming (Nature London, 2021).

The Table 4 below shows types of agricultural areas in the whole network which are assumed to be intensively cultivated and located on potential regional linkages with a patch size of more than 2 km². This corresponds to almost 14 % of the total area of regional potential linkages and includes twenty different land use/ land cover classes of intensive agricultural areas.

Table 4: Intensive agricultural land use types on potential linkages

Land use / land cover classification	Total area [km²]	Percent
21218 - Triticale	2.2	0.0%
21230 - Other non-permanent industrial crops	3.4	0.0%
21217 - Rice	4.7	0.0%
21212 - Durum wheat	13.8	0.0%
21233 - Soya	30.0	0.0%
21290 - Bare arable land	45.4	0.0%
21214 - Rye	53.7	0.1%
21221 - Potatoes	56.7	0.1%
22000 - Permanent crops	63.5	0.1%
21240 - Dry pulses	94.5	0.1%
21250 - Fodder crops (cereals and leguminous)	120.3	0.1%
21231 - Sunflower	177.4	0.2%
21222 - Sugar beet	235.5	0.2%
22200 - Orchard	294.3	0.3%
22100 - Vinyard	430.7	0.4%
21232 - Rape and turnip rape	505.3	0.5%
21213 - Barley	1045.0	1.0%
21000 - Cultivated areas - Arable land - Annual crops	3395.0	3.4%
21211 - Common wheat	3447.4	3.4%
21216 - Maize	3740.2	3.7%

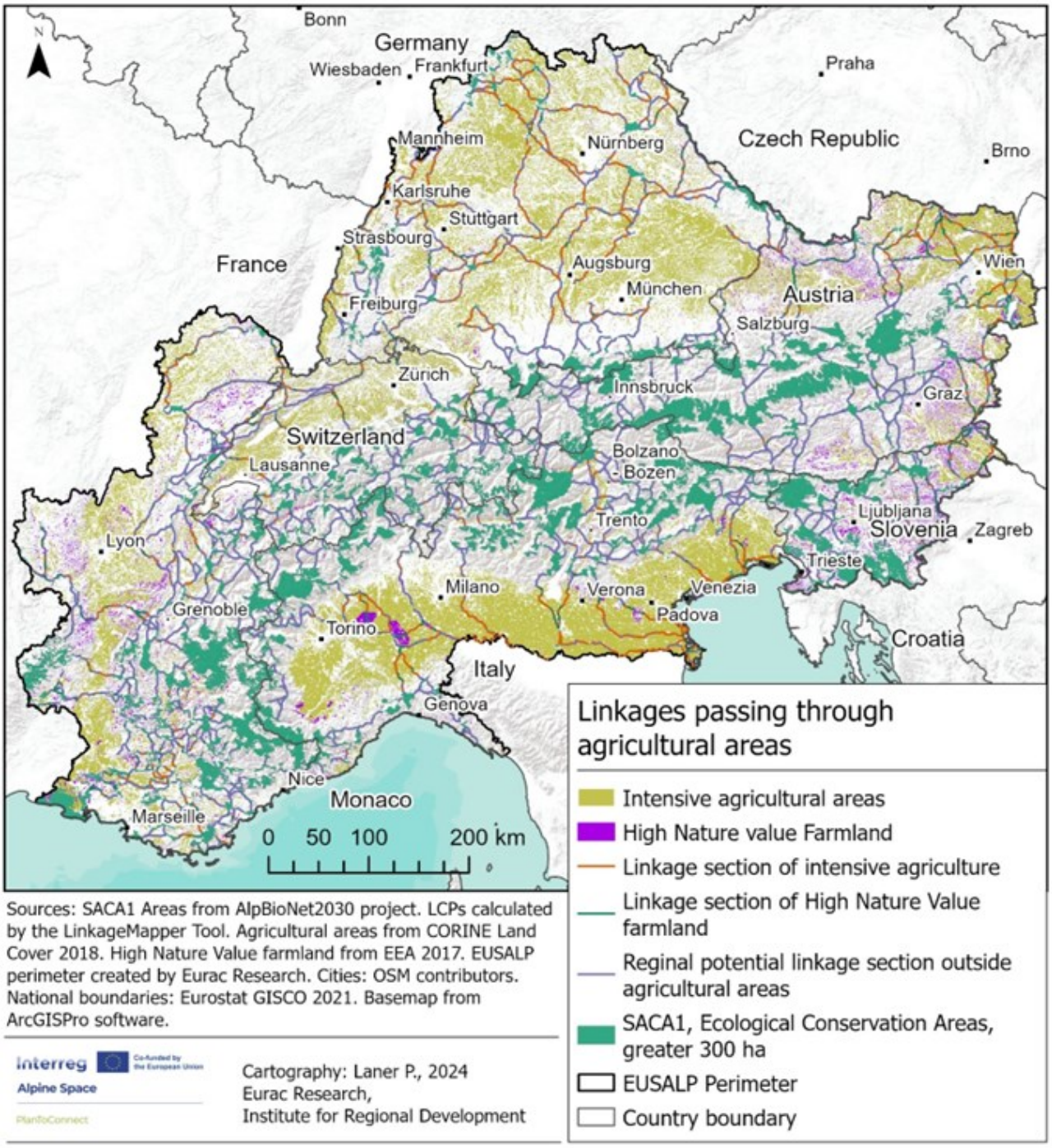


Figure 8: Potential ecological linkages passing through agricultural areas

4.2 Pressures on forest habitats

To give an overview of pressures on forest habitats, we refer to High nature Value Forests map of the EEA (2017b).

The methodology to identify the pressure on forest habitats involves the use of three data sources:

1. **Mapping of the Potential Forest Management Approach** (FMA). It includes five classes representing the intensity of management, from nature reserves with no intervention to short rotation forestry with intensive management for maximum biomass. The classes are combined into three management pressure classes: bad, ok, and good.
2. **Forest harvest and regrowth**. It is evaluated by calculating the average growth and harvest per year. Three classes have been defined: 3 – bad when harvest rate is 10% bigger than avg. growth; 2 – ok, when harvest rate is about 10% of avg. growth; 1 – good when harvest rate is 10% smaller than avg. growth.
3. **Landscape fragmentation in forest patches**. By using the JRC GUIDOS Morphological Spatial Pattern Analysis (MSPA) Tool. The outcome is a map describing the structure of forest patches and their connection to other forest patches nearby. The size of all interconnected forest patches has been calculated by classifying the size (thresholds) compared to estimated required habitat sizes for forest-based species:
   High < 50 km²; medium 50 – 500 km²; low > 500 km².

The last step combined each indicator, resulting in the degree of overall pressure by forest management, that is classified into five classes from 1- very low overall pressure to 5 - very high overall pressure. Level 1 refers to management close to nature on huge unfragmented forest patches with more regrowth than harvest. Level 5 refers to intensive management with production goals on partially highly dissected forest patches with bigger harvest than regrowth.

Figure 9 shows the results of previous methodology apply for the Alpine Space (EUSALP).

In general forest habitats in the outer Alpine Space are more affected of incompatible forest management practices than inner Alpine Space, maybe due to the mountainous topography and the more difficult conditions for forestry practices.

Forests in northern Lower Austria, as well as the forests between Freiburg and Kempten and between Nürnberg and Austria are showing a very high pressure. These forests are important stepping stones to guarantee connectivity between the inner and outer Alpine Space and should be managed in an appropriate way.
Forests in Liguria (IT) have a high overall pressure. This could be a threat for ecological connectivity between the Alps and the Apennines. Guidelines for connectivity focusing on forestry practices might be necessary.

The same for the northern Alpine space of France, areas of medium and high pressure are found around Lyon and in the Haut Jura Regional Nature Park. Within them, there are several potential regional connections crossing France and Switzerland, which are threatened by the current situation.
Instead, the southeastern part of France presents areas with low pressure that allow a connection between the different SACA1.

Lowlands have mainly a medium overall pressure, as between Nürnberg and Mannheim. The areas in the inner Alpine Space, from France through Italy and on to Austria and Slovenia have low overall pressure. There, connectivity between SACA areas needs to be maintained but especially improved in areas where the pressure is highest.

Switzerland is unfortunately excluded.

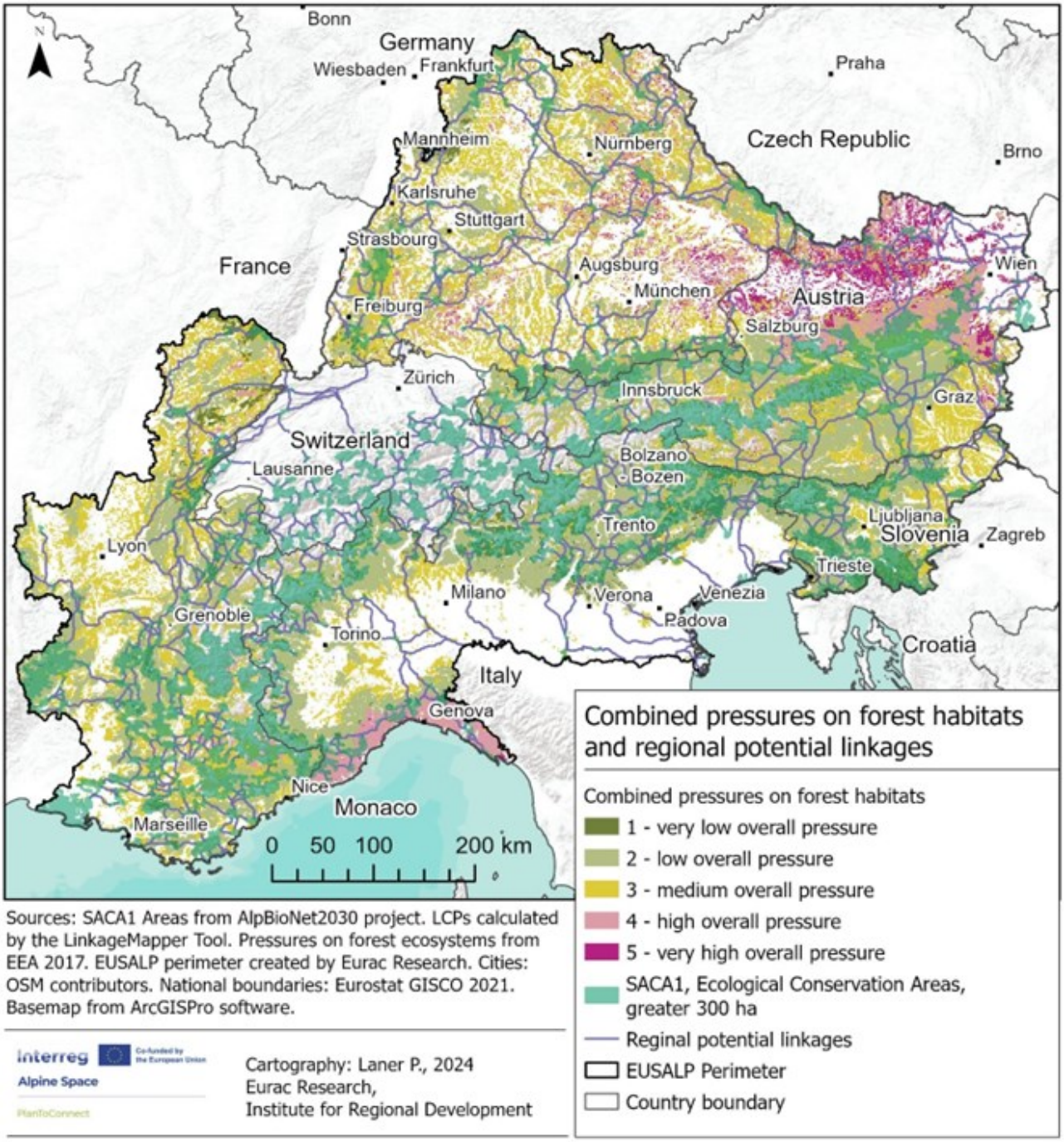


Figure 9: Pressures on forest habitats and regional potential linkages

4.3 Linkages intersecting skiing areas

A dataset for ski slopes and ski lifts, which was produced by the Interreg Alpine Space Beyond Snow project was used to verify how many ski areas might be a potential conflicting anthropogenic use on regional corridors in the Alpine Space.

When intersecting ski areas (slopes and lifts) with regional potential ecological linkages, it shows, that these tourism infrastructure elements can be mostly a barrier for inner-alpine ecological connectivity, as well as for the Jura mountains between Switzerland and France.

Around 28% of the identified linkages have a ski lift or ski slope on their path. This corresponds to 275 of 953 linkages. 167 of the 275 linkages intersecting ski areas are important for the coherency of the overall alpine potential ecological network. Linkages are intersecting skiing areas more than 500 times.

The dimension of the expansion and the amount of ski areas which are conflicting with potential corridors, shows, that winter sport infrastructure must be already considered as a severe problem for biodiversity in the inner-alpine Arc.

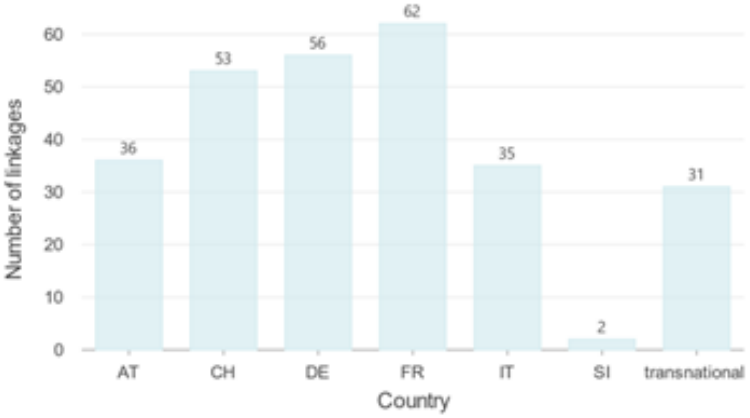


Figure 10: Number of regional potential linkages with ski area intersections, by country

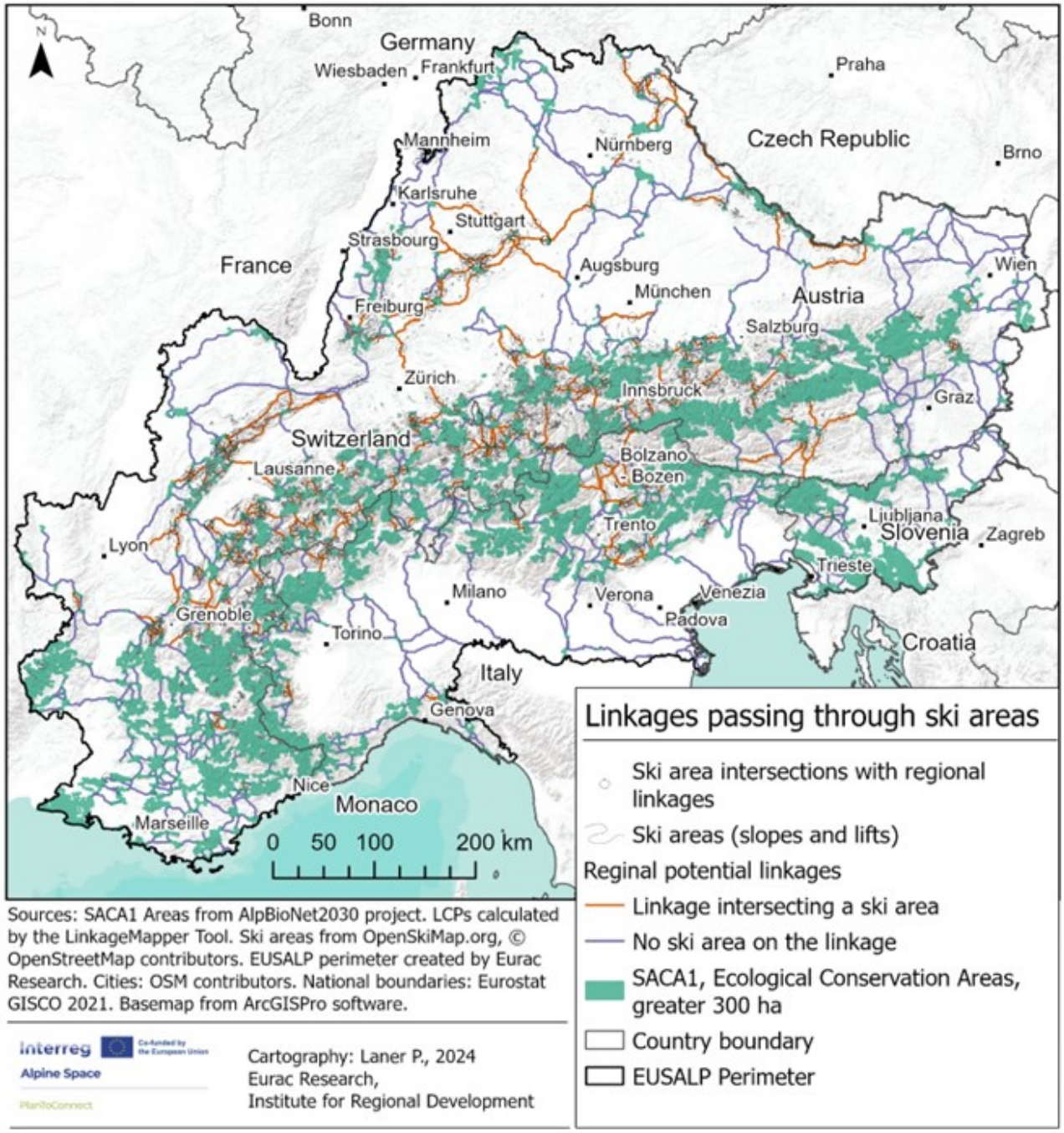


Figure 11: Potential linkages passing through ski areas

5 Inventory of typical alpine GBI network elements in PlanToConnect pilot sites and their most important conflicting land uses

To generate an inventory of GBI network elements, project partners provided standardized descriptions of typical corridor situations in their pilot site, including scale, location, form, habitat types[1] and typical connecting GBI elements.

It resulted that the pilot sites, which are spread over the Alpine arc, are covering a large range of different typologies of corridors, including:

- A variety of scales: local, intermunicipal, provincial, regional and trans-regional corridors
- Inner – alpine, pre-alpine, flatland and costal corridors
- Different forms: linear, stepping stone and landscape corridors
- Various habitats: from rocky habitats, forest habitats, grasslands, mires and fens, to freshwater habitats.

An exploratory expert opinion evaluation on the most important anthropogenic pressures and conflicting uses on these identified corridor types was conducted by an online survey, using the Survey Monkey software. The questionnaire was composed of evaluation questions by Likert scales for the overarching categories of anthropogenic pressures, and then for their subcategories. For further information on the questionnaire see “Annex 3: Questionnaire for expert evaluation of anthropogenic pressures in pilot sites”. The survey results are not representative but can be seen as exploratory evaluation of tendencies.

Overview of respondents

The expert survey on anthropogenic pressures and conflicting uses in ecological corridors gathered a total of 83 responses. This included 18 who participated in tests, 61 respondents who completed the entire questionnaire, 4 who provided incomplete responses. These findings offer insightful, albeit exploratory, tendencies regarding the impact of human activities on various corridor types.

[1] For habitat types, a filter based on the alpine countries and biogeographical regions was made from the EEA dashboard of main pressures and threats to select those which are the most important for the Alpine Space. However, all nine habitat types are appearing in the Alpine Space.

Table 5: Number of responses per pilot site

Pilot site	Number of respondents
Goriška statistical region/Intermunicipal area Tolmin, Kobarid, Bovec (SI)	6
Illertal, south of Kempten (DE)	9
Planungsregion 17 «Oberland«, Bavaria (DE)	6
Province of Sondrio, Lombardy (IT)	7
South of Lake Annecy (FR)	5
South Tyrol (IT)	12
Tennengau and Flachgau regions in Salzburg, with a particular focus on St. Gilgen (AT)	6
Trilateral transboundary pilot site (Austria-Italy-Slovenia)	6
Wetlands of the Caorle lagoon system (IT)	5
Other: • Alps, • Lombardy region, • Haute-Savoie	3
Grand Total	**65**

A total of 24 respondents are specialized in biology, wildlife management, environmental sciences, or similar fields. Meanwhile, 32 respondents are engaged in landscape planning, urban planning, regional planning, or related disciplines. An additional 9 respondents belonged to other fields:

- Protected area management
- Research on space and society, evaluation
- Tourism
- Association for the protection of the environment
- Natura 2000 network management
- Environmental assessment, ecological planning, multi-purpose ecological network design, nature -based-solutions, sustainable planning
- agriculture and forestry
- regional development, educational programmes, interpretation of heritage
- Forestry

In all pilot sites the number of respondents between planning professionals and biologists or similar fields were balanced, despite in the Goriška statistical region (SI), Oberland (Bavaria, DE) and St.Gilgen, Tennengau- Salzburg (AT) where planners dominated. Only in the pilot site of South of Lake Annecy (FR) biologists or similar fields of expertise dominated.

Overview of evaluations regarding general anthropogenic pressures

A comparison between the general categories of anthropogenic pressures shows that **transport infrastructure, urban development and agricultural practices are on the top three** most important anthropogenic pressures in the pilot sites. This was confirmed by a spatial planner, evaluating the whole Alps. The expert rated urban development and transport infrastructure as very strong pressure, and agriculture in general as strong pressure. Foresty related practices and extraction of resources are rated as the weakest anthropogenic pressures on the selected ecological corridors in the pilot sites.

Table 6: Ranking of general anthropogenic pressures in all pilot sites

General categories of anthropogenic pressures	Smallest median value in pilot sites	Average of all answers	Highest median in pilot sites
Transport infrastructure	3.5	4.37	5
Urban development	3	4.00	5
Agricultural practices	2.5	3.66	5
Human-induced changes in water regimes*	3	3.57	4
Energy production processes	1.5	2.87	4
Alien and problematic species	2	2.84	4
Forestry related practices	1.5	2.73	3.5
Extraction of resources	1.5	2.30	3

The pressures with the highest rates among the subcategories are roads – highways and related infrastructure, which just one pilot site rated below “strong” and the expert on the whole alps evaluated it as very strong pressure. Also, the conversion from other land uses to built-up areas and the use of plant protection chemicals in agricultural land were rated below “strong” by just two pilot sties. These categories are confirmed as very strong and strong pressures by the expert evaluating the whole Alps. The expert added residential, commercial and industrial activities and structures generating noise, light, heat or other forms of pollution as very strong pressure.

The expert evaluating the whole Alps evaluated also the creation or development of sports, tourism and leisure infrastructure and its effects as strong pressures. Also, hydropower dams and related effects for rivers were rated as strong pressures, i.e. development and operation of dams, modification of hydrological flow and the physical alteration of water bodies.

Shipping lanes and ferry lanes transport operations and modification of coastline, estuary and coastal conditions for built-up areas, are relevant only for the Caorle lagoon system and the South of Lake of Annecy. This has rather to do with the selection of pilot site than with the pressures itself.

A very interesting point concerns the evaluation of windmills: Despite renewable energies are seen as driver for land fragmentation and therefore as threat for ecological connectivity, existing **windmills were rated highest only as "weak" in the pilot sites**. This has less to do with the pressures itself, but rather with the selection of pilot sites.

The pressure with the lowest rates among all the other subcategories is drainage for forestry, which was rated just in one pilot site as weak to moderate. Peat extraction was rated just twice as weak and twice as moderate. Introduction and spread of new species for forestry purposes was rated also only twice as moderate.

Comparing the average values of all answers in the pilot sites, a general comparison was made to understand the tendencies for rating anthropogenic pressures in each pilot site. Anthropogenic pressures were rated highest in the Wetlands of the Caorle lagoon system (IT) and the Province of Sondrio, Lombardy (IT). They are followed by Planungsregion 17 «Oberland«, Bavaria (DE), and South of Lake Annecy (FR). The evaluations in the Autonomous Province of South Tyrol – Bolzano (IT) and Illertal - south of Kempten (DE) are rather balanced. The trilateral transboundary pilot site (Austria-Italy-Slovenia), and Tennengau and Flachgau regions in Salzburg, with a particular focus on St. Gilgen (AT), have rather low evaluations. In the Goriška statistical region (SI), anthropogenic pressures were rated as the lowest compared to other pilot sites.

When comparing roughly median and average values of all answers aggregated by categories of pressures and field of work of the respondents, i.e. biologists and similar fields, and spatial planners and similar fields, the values are mostly balanced.

In the following, nine typical alpine ecological corridors will be described more in detail and tendencies regarding the most important conflicting anthropogenic uses on them will be highlighted, based on the mentioned exploratory expert opinion evaluation.

Pilot site	South of Lake Annecy (FR)
Importance of connection (Scale)	**Local** The corridor selected has a local importance.
Location:	**Inner-alpine** Typical corridors with local or regional importance in the pilot site of the South of Lake Annecy are passages of inner-alpine valleys, crossing the valley bottoms.
Corridor type	**Linear corridors** The corridor is located in the valley bottom near the Lake of Annecy and takes sometimes the form of a linear corridor when it passes through urban areas, and sometimes the form of a landscape corridor when anthropogenic pressures decrease.
Habitat types	**Soft and hardwood forests, grasslands, meadows, cultivated areas, wetlands** The corridor goes down to the valley, starting with a majority of forested habitats covering, evolving into open grasslands and meadow until the bottom where urban areas, cultivated fields and some meadows are mostly represented.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** The corridors are connecting main natural areas, represented by biodiversity reservoirs from the SRADDET. The areas are categorized by forest habitats, open land habitats and blue infrastructures. Most important GBI elements and land uses on existing corridors crossing valley bottoms are: **GBI Type 2 - Possible restoration zones:** Managed grassland – Pastures, Permanent crops (Other possible land uses for this GBI type are Lucerne, triticale, barley) **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Tree cover in urban context, Green urban areas, Low density settlement areas **GBI Type 5 - Natural connectivity features:** Coniferous tree cover, Broadleaf tree cover, Green linear elements and tree cover in agricultural context **GBI Type 6 - Artificial connectivity features** are rare/ not existing.
Typical anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures in South of lake Annecy, appearing in the valley bottoms, are the following: • urban sprawl, transport (roads), agricultural practices, and anthropogenic obstacles (fences, road barriers, water threshold and dams, etc…)

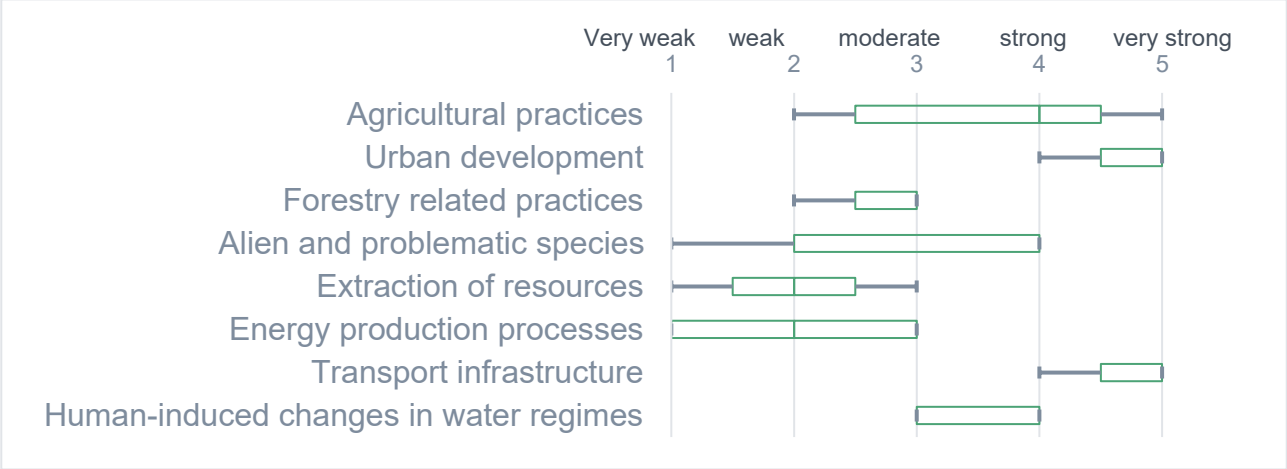


Figure 12: Expert evaluation of general anthropogenic pressures on the selected corridor type on the South of Lake Annecy (FR)

In the South of Lake Annecy (FR) the common opinion of the selected experts was that urban development and transport infrastructure are “very strong” pressures which is remarkable. Also, an expert for the whole Haute-Savoie Departement confirmed this with his evaluation for the whole region. Agricultural practices, as well as alien and problematic species were rated as strong, while the range of answers is quite large. Human-induced change in water regimes were more clearly rated as strong pressure. Pressures coming from forestry are moderate.

However, an expert evaluating the whole Haute-Savoie Département gave an evaluation of very strong pressures for almost all sub-categories regarding urban development and forestry.

The conversion from other land uses to built-up areas and construction or modification (e.g. of housing and settlements) in existing built-up areas, as well as roads – highways and related infrastructure were rated as very strong pressures. The later was confirmed by the expert evaluating the whole Haute-Savoie Département. Residential, commercial and industrial structures generating pollution were rated as strong. The effects of tourism infrastructure were rated as moderate. One expert added that tourism infrastructure is sometimes leading to destruct environments on a vast scale, mentioning ski slopes. However, this might not be the case near South Lake Annecy.

South of Lake Annecy is one of four pilot sites where drainage, land reclamation and conversion of wetlands, etc. for built-up areas is a problem and rated as moderate pressure.

Five out of seven sub-categories within the agriculture sector were rated as strong: the removal of small landscape features for agricultural parcel consolidation, the abandonment of management/use of grassland, the intensive grazing or overgrazing by livestock, the use of plant protection chemicals in agricultural land, as well as drainage for use as agricultural land. The later was confirmed by the expert evaluating the whole Haute-Savoie

Département. The expert evaluated almost all agricultural practices as strong pressures for connectivity. For South of Lake Annecy, only the conversion into agricultural land and the generated pollution by agriculture was rated as moderate.

Invasive alien species of Union concern were rated as strong, while plant and animal disease pathogens and pests were rated as moderate.

Drainage (mixed or unknown drivers) was rated as strong, while the modification of hydrological flow tends to be a moderate pressure. An expert added the effects of climate change, with periods of very hot weather and intense drought recurring frequently and therefore potentially damaging certain continuities.

Regarding energy production, hydropower – dams as well as high voltage transmission lines are rated as moderate pressure.

The introduction and spread of new species for forestry, as well as the removal of dead and dying trees (including debris) are the main problems in forested areas of ecological corridors, rated as moderate.

Flight paths of planes, helicopters and other non-leisure aircrafts were rated as moderate pressure.

Pilot site	District Oberallgaeu – "Illertal"
Importance of connection (Scale)	**Local.** The pilot site study investigates a corridor with a local importance.
Location:	**Pre-alpine** The typical corridor with local importance in the pilot site "Illertal" is a passage of pre-alpine, undulating valley, crossing the valley bottom
Corridor type	**Stepping Stone / Landscape corridor** The investigated corridor has a diameter of 6 km. The aim is the conservation of the few remaining large habitat areas, combined with the protection and restoration of many small habitat patches within this corridor. This means that even very small habitat areas are included in the connectivity planning. It is thus more of an ecological network than a corridor.
Habitat types*	**Forests, scrub, Grasslands, Freshwater habitats, Bogs, mires and fens** The corridor runs through an undulating valley and therefore covers different habitats, from forest and grassland (natural and seminatural) areas to water effected areas like bogs, mires and fens.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** The corridor under investigation is connecting two SACA1 areas, which are Natura 2000 areas. Most important GBI elements and land uses on existing corridors crossing valley bottoms are: **GBI Type 2 - Possible restoration zones:** Managed grassland – Pastures, Orchards, Cultivated areas - Arable land. (Other possible land uses for this GBI type are potatoes, common wheat, as well as maize and other cereals) **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Open settlement area, Low density settlement areas, Tree cover in urban context **GBI Type 5 - Natural connectivity features:** Moors and heathland - other scrubland, Patchy woody features, Rivernetwork, Sparsely vegetated land, Coniferous tree cover, Wetland (permanent wet areas) - inland marshes, Broadleaf tree cover, Additional woody features, Tree cover in agricultural context, Green linear elements - linear woody features, Water bodies, Coniferous tree cover, Mixed tree cover, Scrub and shrubland **GBI Type 6 - Artificial connectivity features** are rare to not existing.
Typical anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures in the pilot region "Illertal" are: agricultural practices, urban development, and transport

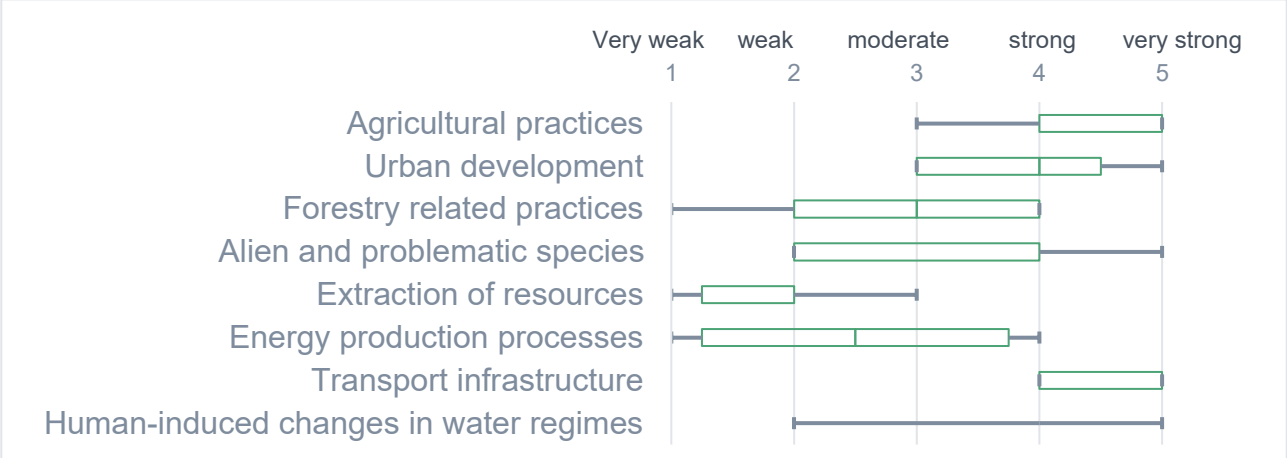


Figure 13:Expert evaluation of general anthropogenic pressures on the selected corridor type in the "Illertal" Valley, District of Oberallgaeu, Bavaria, (DE)

Agricultural practices were rated as very strong, followed by urban development, transport infrastructure and human-induced changes in water regimes, evaluated as strong pressure. Forestry related practices were evaluated as moderate.

The use of plant protection chemicals in agricultural land and drainage, were rated as the most severe pressure in the pilot site, evaluated with "very strong". Removal of small landscape features for agricultural parcel consolidation and intensive grazing or overgrazing by livestock were rated as strong. The abandonment of management/use of grassland and pollution generated by agriculture was rated as moderate. An expert added the spreading of liquid manure.

Regarding human – induced change in water regimes, drainage, modification of hydrological flow and the physical alteration of water bodies were rated between moderate and strong.

Conversion from other land uses to built-up areas, construction or modification in existing built-up areas, as well as existing tourism infrastructure and industrial structures generating pollutions were rated as strong anthropogenic pressures.

For transport infrastructure, roads, highways and related infrastructure was evaluated as strong pressure. An expert stated that road infrastructure was difficult to evaluate, and it is difficult to say whether solar plants are to be expected along the roads. Railways are secondary, but also problematic.

Regarding forestry, the removal of old trees and the reduction of old growth forests are rated as moderate. Regarding energy production high voltage transmission line were rated as moderate.

Experts stated, that in some cases, it was difficult to determine what was in the corridor and what was just outside.

Pilot site	St. Gilgen (Salzburg, Austria)
Importance of connection (Scale)	**regional**
Location:	**Inner-alpine**
Corridor type	**Linear corridors**
Habitat types*	**Grassland, Forests, Rocky habitats,**
Typical connecting GBI elements	**GBI Type 1 – Core areas:** Core habitats (based on red deer species according to the study of Leitner et al. 2014). This category includes large, unfragmented forest areas, as well as smaller, isolated forest patches (island habitats). These forests play a crucial role in biodiversity conservation and ecological connectivity. Key examples in the corridor: Schafberg, Zwölferhorn, and forested areas near Wolfgangsee and Fuschlsee. Corresponding CORINE classes are: 311 – Broad-leaved forests, 312 – Coniferous forests, 313 – Mixed forests Most important GBI elements and land uses on existing corridors crossing valley bottoms are: **GBI Type 2 - Possible restoration zones:** Managed grassland **GBI Type 4 - Green urban and peri-urban areas:** Low density settlement areas **GBI Type 5 - Natural connectivity features:** Coniferous tree cover, Green linear elements and tree cover in agricultural context, alpine and sub-alpine natural grasslands. **GBI Type 6 - Artificial connectivity features** are rare/ not existing.
Typical anthropogenic pressures	According to project partners, the most important existing anthropogenic pressures in the pilot region “Illertal” are: • urban development • agricultural practices

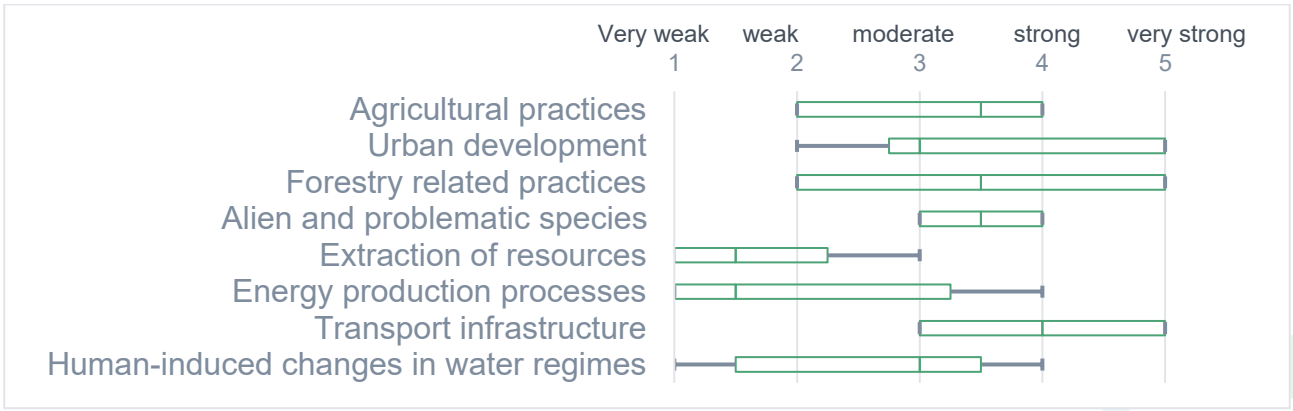


Figure 14: Expert evaluation of general anthropogenic pressures on the selected corridor type in St Gilgen (Salzburg, Austria)

In the pilot site St. Gilgen, transport infrastructure was rated as the most severe anthropogenic pressure, followed by agricultural and forestry related practices, as well as alien and problematic species. Urban development and human- induced changes in water regimes were rated as moderate.

In agricultural practices, “Agricultural activities generating pollution to surface or ground waters (incl. marine)” was rated as “very strong” pressure, the “Use of plant protection chemicals in agricultural land” was rated as strong to very strong, the “Removal of small landscape features for agricultural parcel consolidation” was rated as strong.

Regarding transport infrastructure, roads – and highways- related infrastructure was rated as strong to very strong.

Regarding Energy production, the development of “Solar power – photovoltaics” was rated as strong to very strong.

Regarding urban development, constructions on undeveloped land was rated as highest pressure. The development of tourism infrastructure, constructions in existing built-up areas, as well as the pollution coming from built-up areas was rated from moderate to strong.

The reduction of old growth forests due to management practices was rated as strong to very strong. All other forestry practices were rated as moderate, despite drainage for forestry, which was rated as weak.

Invasive alien species of Union concern and the modification of hydrological flow are moderate pressures.

Pilot site	Goriška Statistical Region
Importance of connection (Scale)	**Regional** The corridor is of regional importance.
Location:	**Pre-alpine** The corridor is located in the pre-alpine area. Its least-cost path runs along the Idrijca river with its tributaries. There are pre-alpine hills on both sides of the valley (parts of the Banjšice Hills and Idrija Hills). Together with 5 corridors running to Porezen, Škofja Loka Hills, and Polhov Gradec Hills to the east, it forms a larger connectivity area.
Corridor type	**Landscape corridor** The corridor has a landscape character. There is minimal anthropogenic pressure (rail and road network, built areas etc.) even in the valleys. The corridor links important landscape areas, notably connecting the South Trnovo Forest and Zgornja Idrijca Landscape Parks (both in the southern SACA 1 area) with the Triglav National Park (in the northern SACA 1 area).
Habitat types*	**Mixed forests, grasslands, freshwater habitats, rocky habitats (in limited quantity)** The corridor is situated at various altitudes and encompasses different land uses and habitats. Primarily, however, it covers a matrix of forest and pastures or other extensive agricultural areas.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** The focus lies on connecting the Natura 2000 area Trnovski forest – Nanos with Natura 2000 area The Julian Alps. Most important GBI elements and land uses in the corridor, are: **GBI Type 2 - Possible restoration zones:** Managed grassland – pastures **GBI Type 3 - Sustainable use zones:** Seminatural grassland – meadows **GBI Type 4 - Green urban and peri-urban areas:** Low-density settlement areas **GBI Type 5 - Natural connectivity features:** Coniferous tree cover, broadleaf tree cover, mixed tree cover, alpine and sub-alpine natural grasslands. **GBI Type 6 - Artificial connectivity features:** 3 regional roads, one railway (although the traffic is reasonable).

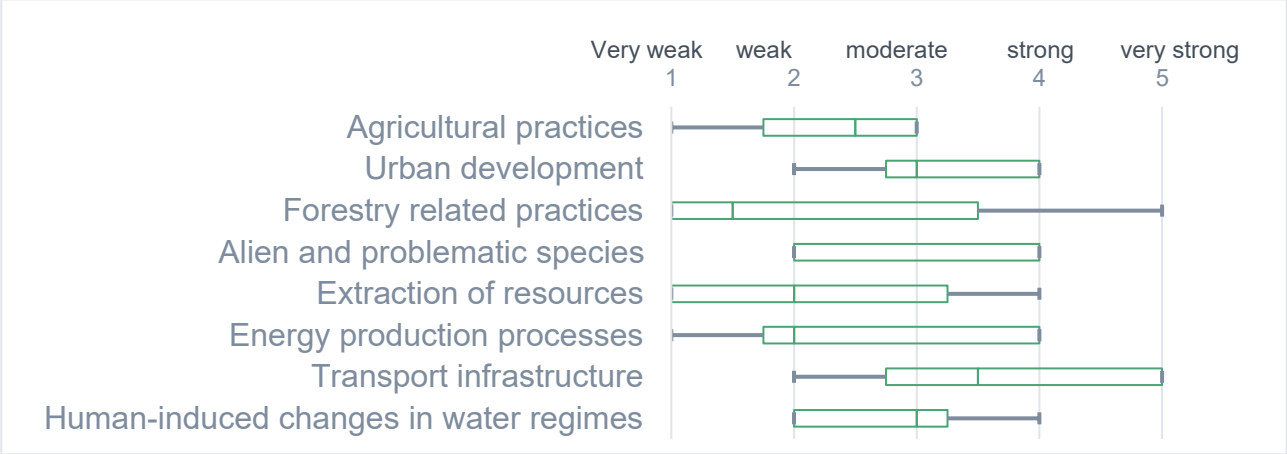


Figure 15: Expert evaluation of general anthropogenic pressures on the selected corridor type in Goriška Statistical Region (SI)

In the Goriška Statistical Region, alien and problematic species were rated as strong pressure, followed by transport infrastructure, which was evaluated as moderate to strong. However, flight paths of planes, helicopters and other non-leisure aircrafts, as well as “Roads – highways and related infrastructure” were rated very differently and in middle got a weak to moderate evaluation. Urban development and human induced changes in water regime were rated as moderate pressures.

For alien and problematic species, a moderate pressure identified was invasive alien species of Union concern.

Considering urbanisation processes, anthropogenic pressures coming from sports, tourism and leisure activities were evaluated as having the highest pressure. Other urbanisation pressures were the conversion from other land uses to built-up areas, the construction or modification of housing and settlements in existing built-up areas, and the creation or development of new sports, tourism and leisure infrastructure.

In the category of agriculture, moderate pressures included the removal of small landscape features for agricultural parcel consolidation, the abandonment of management or use of grassland, and agricultural activities generating pollution to surface or ground waters.

An expert added specifically infrastructure lines and pipelines as additional infrastructural pressure.

An expert added that potential poaching, especially regarding wolf and lynx are relevant in the region. However, spatial or landscape planning has not the most suitable instruments to intervene with this problem, therefore it is difficult to address it in the PlanToConnect project.

Pilot site	Planungsregion 17 «Oberland«, Bavaria (DE)
Importance of connection (Scale)	**Regional** The pilot site study investigates corridors with a regional importance, but also trans-regional importance is considered due to the macro-regional corridors presented by the PlanToConnect Analysis.
Location:	**pre-alpine, flatland** Typical corridors with regional importance in the pilot site Oberland are passages of pre-alpine environment, typically characterized by extensive agricultural land and valley bottoms.
Corridor type	**Landscape corridor** The corridors mainly have a landscape corridor as the approach is structural and does not focus on a specific species.
Habitat types	**Forests, Grasslands, Bogs, mires and fens** The corridors can be situated in various (near) natural environments and therefore cover multiple habitats, form mostly with agriculturally used grassland and forest cover.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** The core habitats are primarily SACA1 areas, used in the Alpine-wide analysis of corridors. In the pilot site, these are congruent with the Natura2000 bird protection areas and, in places, the nature conservation areas, which include Natura 2000 areas. Therefore, they are under strict protection status. Most important GBI elements and land uses on existing corridors are: **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Low density settlement areas, Open settlement areas
Typical anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures in Oberland, are the following: • agricultural practices, • urban development, • transport

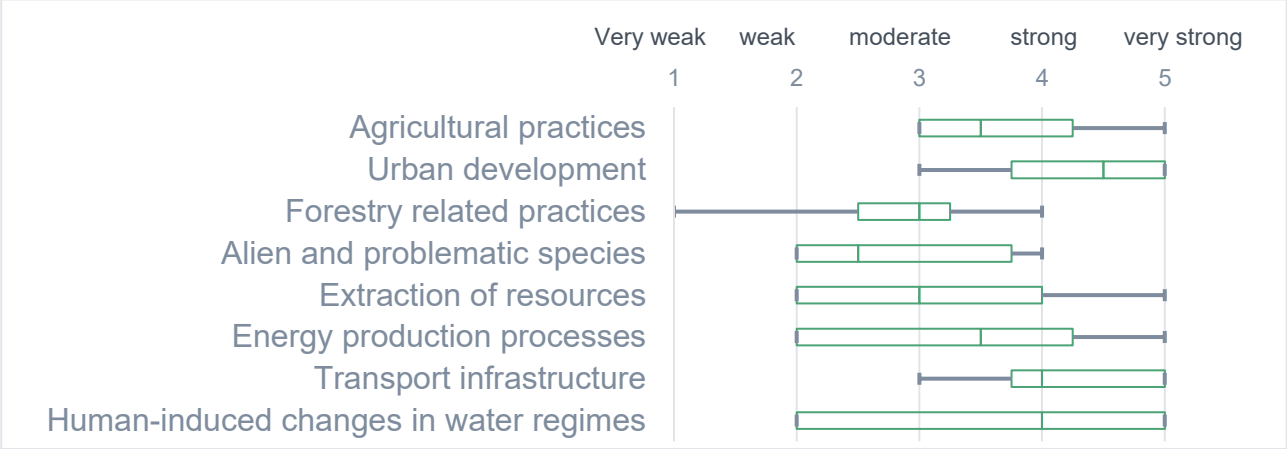


Figure 16:Expert evaluation of general anthropogenic pressures on the selected corridor type in the Planning region 17 «Oberland«, Bavaria (DE)

With just one evaluation of “very weak” in the general categories, the anthropogenic pressures in Oberland were rated relatively high. The most important general pressures are urban development, transport infrastructure and human-induced changes in water regimes, rated as strong or higher. Energy production processes and agricultural practices are rated as moderate to strong.

Regarding agriculture, the removal of small landscape features for agricultural parcel consolidation was rated as strong to very strong, followed by use of plant protection chemicals in agricultural land, practices generating pollution to surface or ground water, and drainage for use as agricultural land, rated as strong pressures. Also, the abandonment of grassland was rated between moderate and strong.

Railway and related infrastructure were rated as strong.

Conversion from other land uses to built-up areas was rated strong to very strong, followed by the effects of sports, tourism and leisure activities. The creation of new tourism infrastructure and settlement areas creating pollution were rated moderate to strong.

The development and operation of dams, specifically hydropower dams and the modification of hydrological flow were rated as strong. A water management expert was referring to water-bound networks and added that, any impairment of the flow continuum represents a burden, depending on its intensity. An increased burden for alpine rivers can be the disturbance of natural bed load operation.

Regarding problematic species, plant and animal disease pathogens and pests were rated as strong pressure, while in forestry, the removal of old trees was rated moderate to strong.

Pilot site	Sondrio Province (IT)
Importance of connection (Scale)	**Provincial (between local and regional)** The pilot project is concerned with restoring, strengthening or maintaining corridors and related ecological connectivity at the provincial level.
Location:	**Inner-alpine, pre-alpine** The primary areas of interest for the project are located in the valley floor, with the aim of restoring ecological and multifunctional connectivity between the two slopes. The areas are located inside the Alpine Convention border.
Corridor type	**Linear and landscape corridors** The corridors exhibit a dispersed linear character, contributing to the overall landscape design of ecological green and blue infrastructure.
Habitat types	**Grasslands, Freshwater habitats, Forests, Heath and scrub, Rocky habitats** The vast extent of the project area, along with its rich landscape and natural diversity, creates a wide variety of habitats. These range from more urban environments linked to agriculture and pasturelands to high mountain areas with a rocky character.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** The corridors are connecting protected areas and Biodiversity Priority Areas. Most important GBI elements and land uses on these existing corridors are: **GBI Type 2 - Possible restoration zones:** Managed grassland – Pastures; Strategic agricultural areas in the lowland (Orchards, Vineyards, Cultivated areas, Arable land); Permanent crops **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Green urban areas; Open settlement areas; Low density settlement areas **GBI Type 5 - Natural connectivity features:** Riverbeds; Moors and heathland; Sparsely vegetated land; Coniferous tree cover; River network; Broadleaf tree cover; Green linear elements and tree cover in agricultural context; Alpine and sub-alpine natural grasslands. **GBI Type 6 - Artificial connectivity features:** Dense settlements area; Roads, motorways and trunks; Industrial and commercial zones
Typical Anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures appearing in the Sondrio province are the following: agricultural practices, urban development, transport, energy production, human-induced changes in water regimes

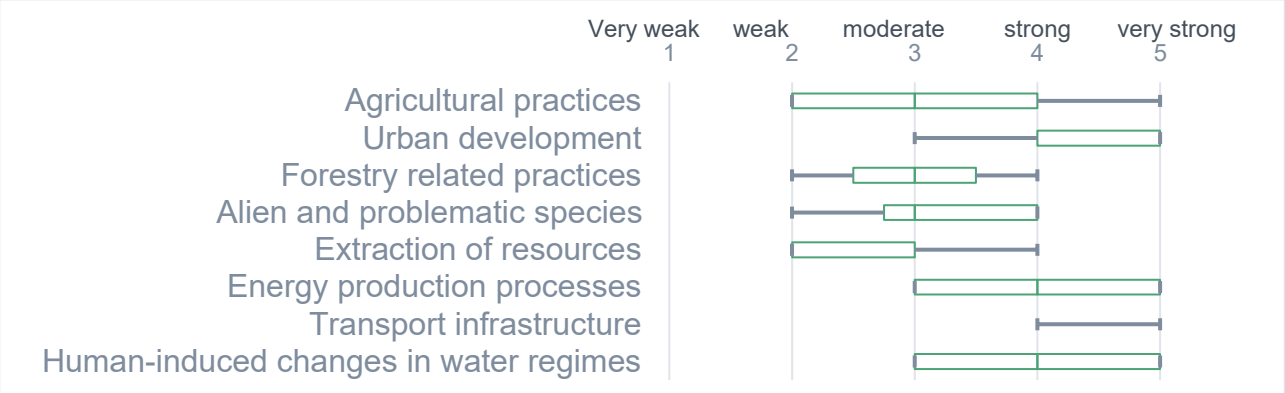


Figure 17:Expert evaluation of general anthropogenic pressures on the selected corridor type in the Sondrio Province (IT)

Without an evaluation of “very weak” in any of the general categories, the anthropogenic pressures in the Province of Sondrio were rated relatively high. In the corridors crossing the valley bottoms of the Sondrio province, urban development and transport infrastructure were evaluated as very strong pressures. The same evaluation came from an expert for the whole Lombardy region. Energy production processes and human-induced changes in water regimes were rated as strong.

Although agriculture is only rated as moderate pressure in the general category, it is astonishing that the abandonment of grassland was rated as very strong problem in the province, even higher than the strong – rated use of plant protection chemicals.

Regarding transport infrastructure, both, railways and roads/ highways were rated as very strong pressure. The same evaluation gave an expert for the whole Lombardy region. Conversion from other land uses to built-up areas, and mainly the creation or development of sports, tourism and leisure infrastructure was rated as very strong pressure. The same applied to modifications in existing built-up areas and the effects of tourism. An expert added logistics and data centre constructions. Another expert evaluating the whole Lombard region gave the evaluation of “very strong” for almost each of the sub-categories under urban development.

Lots of pressures which are related to energy production with hydropower dams are rated as strong pressure: Abstraction from ground- or surface-water, development and operation of dams, modification of hydrological flow, and the physical alteration of water bodies, including high voltage transmission lines. An expert specified the artificial river banks and beds with high transversal weirs and waterproofing, that have a low possibility for natural flooding.

Foresty did not appear among the strong pressures, while invasive species, other than species of Union concern, were rated as strong.

Pilot site	Autonomous Province of Bolzano - South Tyrol (IT)
Importance of connection (Scale)	**regional** The pilot site study investigates corridors with a regional importance.
Location:	**Inner-alpine** Typical corridors with regional importance in the pilot site South Tyrol are passages of inner-alpine valleys, crossing the valley bottoms.
Corridor type	**Linear corridors** The corridors mainly have a linear character. If anthropogenic pressures in the valley bottoms are low, it can have the form of a landscape corridor.
Habitat types	**Rocky habitats, Heath and scrub, Forests, Sclerophyllous scrubs, Grasslands** The corridors can be situated in various altitudes and therefore cover multiple habitats, form rocky high mountain areas to valley bottoms with grassland areas or orchards.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** Typical corridors are connecting highly suitable areas for red deer, greater than 2.000 ha. These areas are mainly forested areas, between 0 and 1.500 m.a.s.l., with a slope 0-30°, in 100 m distance to settlements, 200 m to roads and 300m to motorways. Most important GBI elements and land uses on the existing corridors crossing valley bottoms are: **GBI Type 2 - Possible restoration zones:** Managed grassland – Pastures, Orchards, Vineyards, Cultivated areas - Arable land. (Other possible land uses for this GBI type are potato fields, as well as maize and other cereals) **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Low density settlement areas **GBI Type 5 - Natural connectivity features:** Coniferous tree cover, Broadleaf tree cover, Green linear elements and tree cover in agricultural context, alpine and sub-alpine natural grasslands. **GBI Type 6 - Artificial connectivity features** are rare/ not existing.
Typical anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures in South Tyrol, appearing in the valley bottoms, are the following: • agricultural practices, • urban development, • extraction of resources • transport

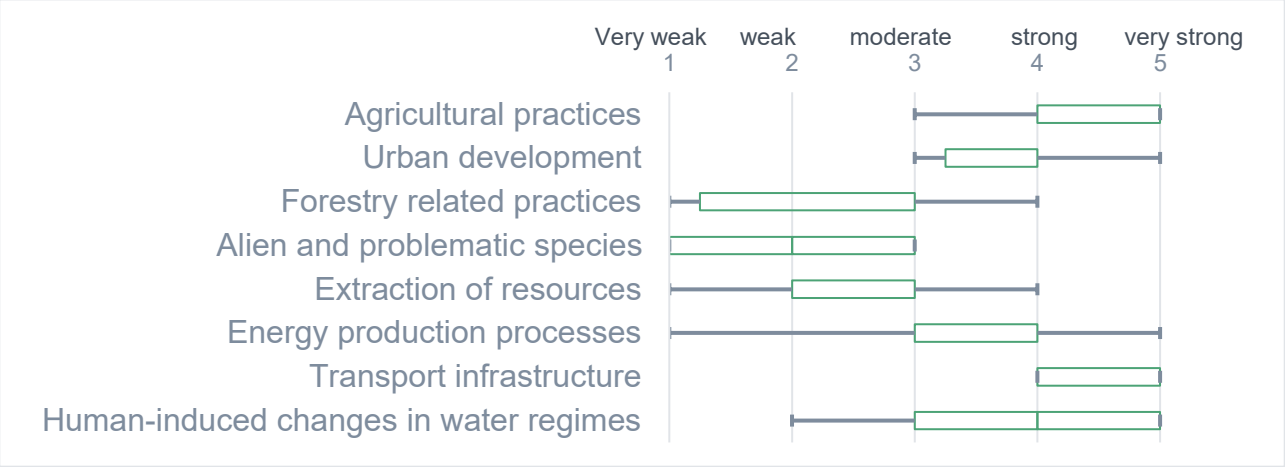


Figure 18: Expert evaluation of general anthropogenic pressures on the selected corridor type in the Autonomous Province of Bolzano - South Tyrol (IT)

In the valley bottoms of South Tyrol, transport infrastructure and intensive agriculture was rated as very strong anthropogenic pressure and therefore it is a problem for connectivity. Those pressures in the ranking are followed by urban development and human-induced changes in water regimes, which were rated as strong pressure. Forestry, extraction of resources, and energy production processes were rated as moderate pressures in the valley bottoms. Alien and problematic species still tend to play a minor role.

The removal of small landscape features for agricultural parcel consolidation was rated as very strong anthropogenic pressure for ecological connectivity. The second highest pressure is the use of plant protection chemicals in agricultural land, rated as strong to very strong. Agricultural activities generating pollution to surface or ground waters was rated as strong. Drainage for use as agricultural land was rated moderate to strong, which might be because of the numerous artificial canals in the Adige Valley to drain the fields for apple monocultures.

Roads – highways and related infrastructure was rated as very strong, while railway and related infrastructure was evaluated as strong. Flight paths of aircrafts are a moderate pressure. An expert specified that noise protection walls along roads and fences along infrastructure are additional severe barriers.

The effects of sports, tourism and leisure activities were rated as very strong pressure. The conversion from other land uses to built-up areas, including sports, tourism and leisure infrastructure, as well as modifications in built-up areas and the generation of pollution coming from settlements were rated as strong pressures.

An expert stated that "*urban sprawl, the strong transport infrastructure, intensive apple cultivation with hail nets and the increasingly cleared landscape (removal of hedges, lack of riparian vegetation in ditches, etc.) are certainly the main causes of limited (missing) natural corridors on land.*"

Hydropower dams were rated as very strong. Related to this are the development and operation of dams, modification of hydrological flows, as well as the physical alteration of

water bodies, which were rated as strong pressures. Whereas the abstraction of ground – or surface waters, as well as drainage coming from mixed or unknown drivers are moderate pressures. Also, high voltage transmission lines that are part of energy production infrastructure got a moderate evaluation. An expert specified that *"the heavily used water bodies (hydropeaking at dams, snowmaking for winter sports, canalized river courses and agricultural irrigation in summer) will certainly have a major impact on aquatic corridors and the water bodies itself."*

The extraction of resources, invasive species, and forestry tends to play a minor role: Peat extraction and extraction of minerals were rated as moderate, as well as the removal of dead and dying trees (including debris) and invasive alien species of Union concern. The rest of the categories are weak pressures.

Pilot site	The wetland area of the Caorle Lagoon system
Importance of connection (Scale)	**Regional and Trans-regional** The pilot site study investigates corridors with a regional and trans-regional importance.
Location:	**Flatland and coastal** Corridors linking the N2000 sites of the Caorle lagoon system to other protected wetlands and ecosystems along the coast and towards the pre-alpine valleys (N2000 sites as well).
Corridor type	**Linear corridors** The corridors branch off from the Caorle wetlands and are mainly linear in character (waterways, canals, rivers). A diffuse connectivity area buffers the Caorle N2000 sites that may qualify as a local landscape corridor.
Habitat types*	**Forests small patches, Grasslands, Freshwater habitats, Dunes habitats, Coastal habitats, mires and fens,** The corridors are located in different heterogenous landscapes, mainly anthropogenic. They varies from the coastal humid area, to the pre-alpine valleys, including intensive agricultural areas.
Typical connecting GBI elements	**GBI Type 1 – Core areas:** Core areas which should be connected are the Caorle lagoon system to other Natura 2000 sites northward up to the Alpine region and eastward to neighbouring wetland areas, through agricultural plains and coastal zones. Most important GBI elements and land uses on existing corridors crossing agricultural landscapes are: **GBI Type 2 - Possible restoration zones:** Managed grassland – Cultivated areas - Permanent crops - rice – **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Low density settlement areas **GBI Type 5 - Natural connectivity features:**Broadleaf tree cover, Green linear elements and tree cover in agricultural context, sub-alpine natural grasslands. **GBI Type 6 - Artificial connectivity features** are rare/ not existing.
Typical anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures around the Caorle wetlands, are the following: agricultural practices, urban development, transport, alien and problematic species, human-induced changes in water regimes

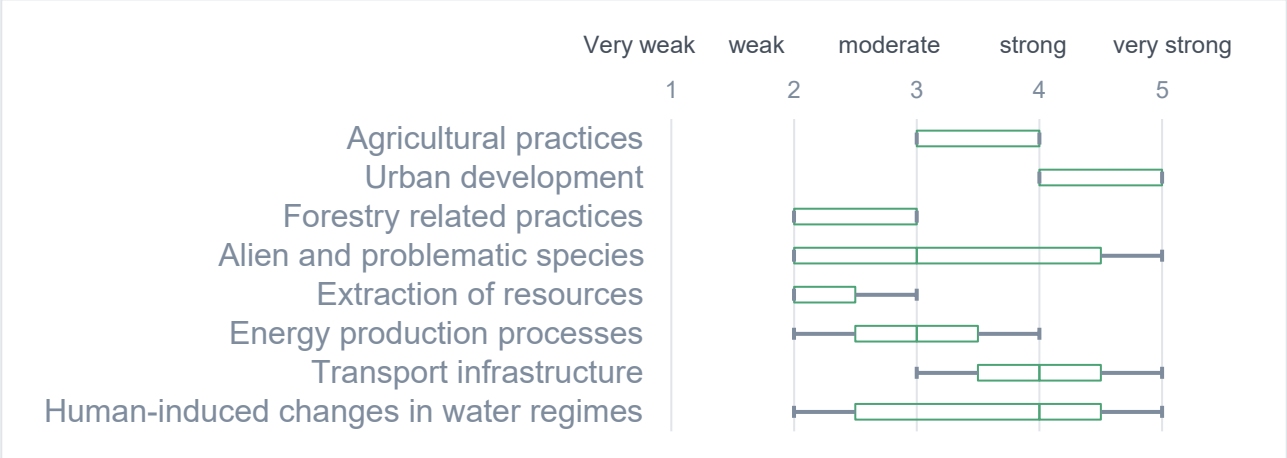


Figure 19: Expert evaluation of general anthropogenic pressures on the selected corridor type in the Caorle lagoon system (IT)

Without an evaluation of “very weak” in any of the general categories, the anthropogenic pressures in the Caorle lagoon system were rated relatively high.
The most important general pressures are agricultural practices, urban development, transport infrastructure and human-induced changes in water regimes, which were evaluated as strong. None of the sub-categories in these fields were rated as “weak” or “very weak”. Energy production processes were evaluated as moderate. Alien and problematic species as well, but the range of evaluation among the responses is very broad.

Removal of small landscape features for agricultural parcel consolidation, the use of plant protection chemicals in agricultural land, drainage for use as agricultural land, and agricultural activities generating pollution to surface or ground waters (incl. marine) were rated as strong.

Conversion from other land uses to built-up areas, including development of sports, tourism and leisure infrastructure, as well as the construction or modification in existing built-up areas are critical for the lagoon system. The generation of pollution from settlement structures and the effects of sports, tourism and leisure activities are rated as strong as well.

Regarding changes in water regimes, the abstraction from ground- or surface-water and the modification of hydrological flow were rated as strong. Both have mixed or unknown drivers.

Regarding energy production, bioenergy – biomass and the transmission of energy (high voltage transmission lines) were rated as strong.

Both, invasive alien species of Union concern and alien species which are not of Union concern are rated as strong pressures.

Pilot site	Transboundary Biosphere Reserve Julian Alps (Si, I) and Nature Park Dobratsch (A)
Importance of connection (Scale)	**Trans-regional** The pilot site study investigates the possible connection between the "Transboundary Biosphere Reserve Julian Alps (Si, I) and Nature Park Dobratsch (A)"in form of corridors with a trans-regional importance.
Location:	**Inner-alpine** Typical corridors with trans-regional importance in the pilot site in the border area of Transboundary Biosphere Reserve Julian Alps (Si, I) and Nature Park Dobratsch (A)" are passages of inner-alpine valleys, crossing the mountain ridges of the border area and valley bottoms.
Corridor type	**Landscape corridors** The corridors mainly have landscape character, because the anthropogenic pressures are low. However, there are bottlenecks in the valley bottoms, where intensified anthropogenic use allows linear corridors.
Habitat types	**Forests, Rocky habitats, Heath and scrub, Grasslands, Freshwater habitats, Bogs, mires and fens** The corridors are situated in an altituted between 550 and 2000 m and therefore cover multiple habitats. The major habitat on the mountain tidges is forest (beech and mixed forest, besides of rocky high mountain areas with heth and scrub. On the valley bottoms there are mainly grassland areas and partly wetlands (fens).
Typical connecting GBI elements	**GBI Type 1 – Core areas:** Protected areas: Nature Park (Core and outline) and Natura 2000 areas in Austria and Italy, and the Triglav National Park in Slovenia, as well as the transnational UNESCO Biosphere reserve (core, transition and development zone). Most important GBI elements and land uses on existing corridors are: **GBI Type 2 - Possible restoration zones:** Managed grassland – Pastures, cultivated areas - Arable land is rare in the selected corridor **GBI Type 3 - Sustainable use zones:** Seminatural grassland – Meadows **GBI Type 4 - Green urban and peri-urban areas:** Low density settlement areas **GBI Type 5 - Natural connectivity features:** Coniferous tree cover, Broadleaf tree cover, Green linear elements and tree cover in agricultural context, alpine and sub-alpine natural grasslands. **GBI Type 6 - Artificial connectivity features (existing bear bridge)**
Typical anthropo-genic pressures	According to project partners, the most important existing anthropogenic pressures in the border area of "Transboundary Biosphere Reserve Julian Alps (Si, I) and Nature Park Dobratsch (A)" appearing in the valley bottoms, are the following: Transport, urban development, (skiing resorts as potential development area)

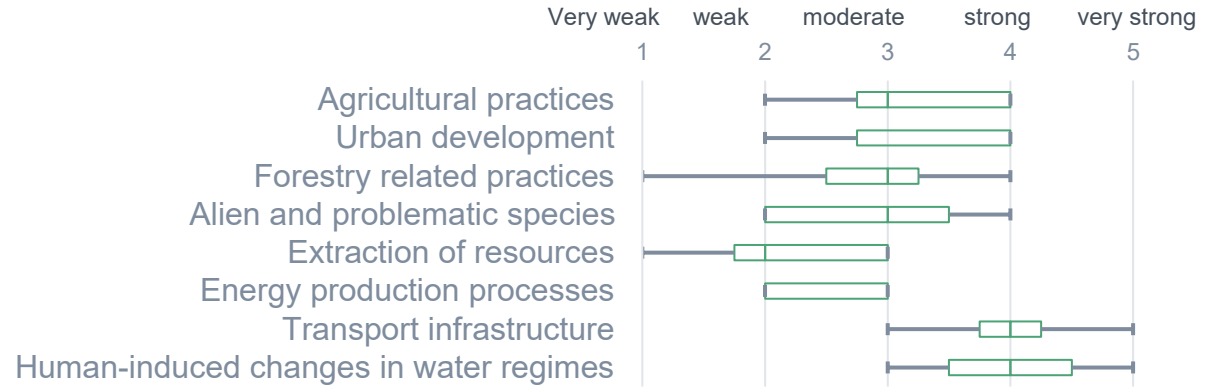


Figure 20: Expert evaluation of general anthropogenic pressures on the selected corridor type in transboundary pilot site between Italy, Austria and Slovenia.

The most severe rated anthropogenic pressures on corridors in the pilot site of the transboundary Biosphere Reserve between Austria, Italy and Slovenia are agricultural related practices, urban development, transport infrastructure and human- induced changes in water regimes.

Most important sub-categories:

Pressures that were rated with a strong impact were “Roads – highways and related infrastructure”, “Removal of dead and dying trees (including debris)”, “Removal of old trees”, and “Hydropower – dams”.
The “Development and operation of dams”, as well as “Transmission of energy – high voltage transmission line” were rated as moderate to strong.
Almost all agricultural practices were rates as moderate, while in forestry, only the “Forest management reducing old growth forests” was rated that high. Regarding urban developments, the creation of new infrastructure for tourism and housing and settlements were rated as moderate to strong. Experts specified that all the pressures do not affect the whole region, but just some parts of it. There is disturbance due to leisure activities in sensitive areas and the noise from traffic in some areas was highlighted.
All sub-categories in the group “human- induced changes in water regimes” were rated at least as moderate, only the above mentioned was rated slightly higher. “Invasive alien species of Union concern” were evaluated as moderate pressure too.

6 Mitigation and Compensation measures

For collecting mitigation and compensation measures, we are focusing on the identified groups of most important anthropogenic pressures in the Alps:

1) Agriculture related practices
2) Forestry related practices
3) Extraction of resources
4) Development, construction and use of residential, commercial, industrial and recreational infrastructure and areas, with focus on recreational infrastructures and areas for tourism
5) Alien and problematic species

Mitigation and compensation measures of following anthropogenic pressures are part of the threat report D.1.3.1:

- Development, construction and use of residential, commercial, industrial (excluding tourism)
- human-induced changes in water regimes
- energy production

Natural processes were not treated as a separate point, because the main reported pressure was "*succession*", which in many cases was a response to human intervention or management changes and therefore it is covered by the other sections.

For each category of pressures, possible mitigation or minimisation and compensation or restoration measures were identified. We refer to the mitigation hierarchy that "*is a systematic approach used in environmental impact assessment and management to address and minimise the negative impacts of development projects on the environment. It consists of steps to achieve the best possible environmental outcome."* (Dodd et al., 2024). The mitigation measure aims to moderate, reduce, or eliminate unavoidable impacts over time. For example, the following figure (approach 3) refers to the construction of a green bridge or underpass to connect two green areas. Instead, the second measure compensates (or offset) impacts outside the project footprint through maintaining, enhancing, or restoring equivalent habitats elsewhere. The figure below (approach 5) refers to the construction of a new green area at a new location.
For a more complete overview, the effects expected after the implementation of the measures were included.

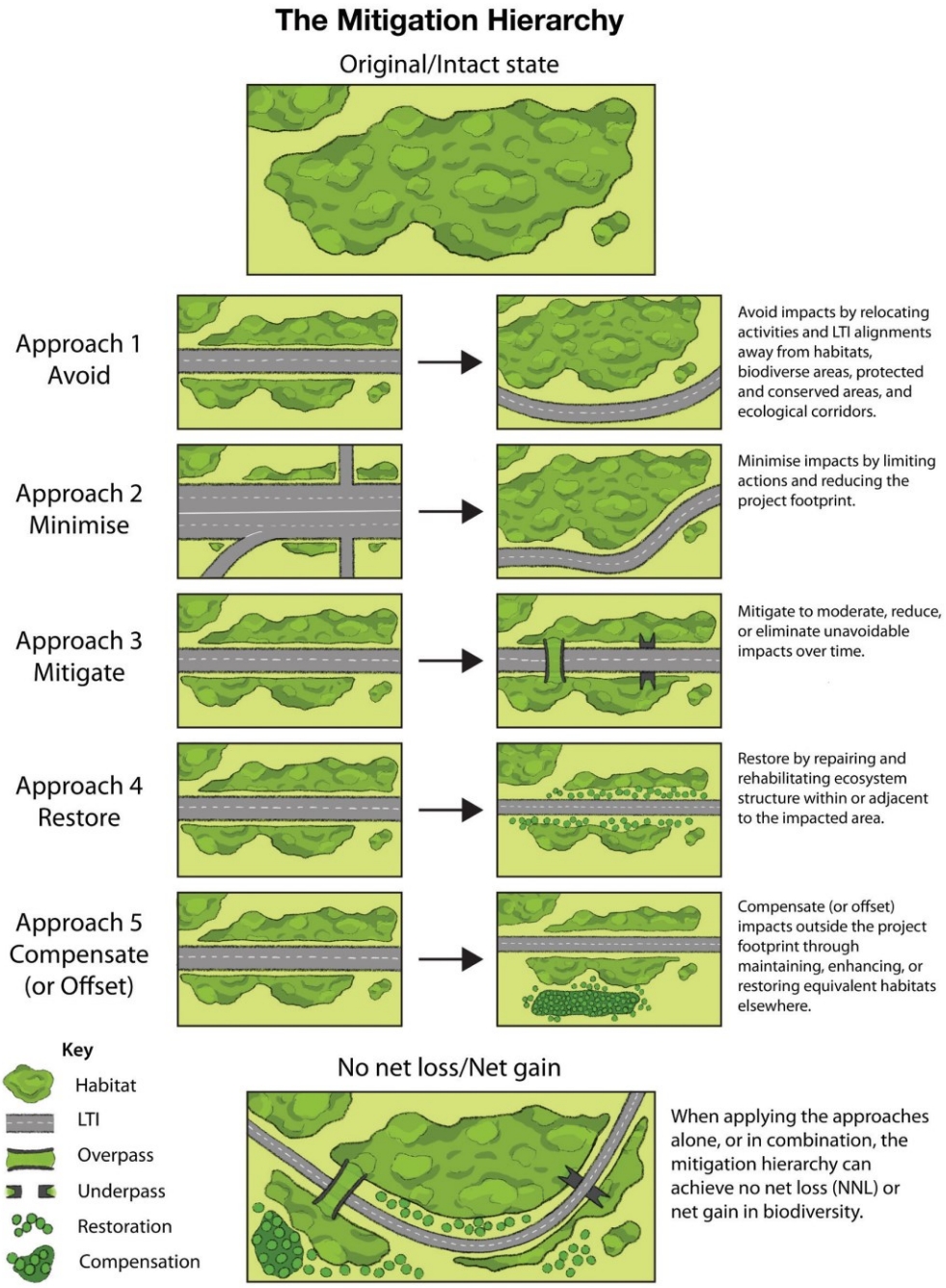


Figure 21: The mitigation Hierarchy

Source: Julie Johnson and Madison Mayfield / Center for Large Landscape Conservation in Dodd et al. (2024).

6.1 Agriculture related practices

Code and Name:

PA01: Conversion into agricultural land (excluding drainage and burning)
PA02: Conversion from one type of agricultural land use to another (excluding drainage and burning)

Mitigation and minimisation

- Buffer strips of natural vegetation between agricultural fields and wildlife-sensitive areas
- No-till farming practices (farming without turning the soil)
- Tree maintenance and preservation of pollarded trees.
- Land set-aside (leave a proportion of their land out of intensive production)
- Maintenance of traditional irrigation systems
- The measures can be combined with compensations to farmers.

Compensation or restoration

- Restoration or creation of other natural habitats outside the affected area
- Restoration of traditional irrigation systems
- Encourage unpaved paths

Expected effect

- Maintain landscape permeability of agricultural areas
- Prevent or reduce agricultural herbicides and fertilizers from reaching sensitive wildlife
- Reduce or eliminate farmers' need to apply fertilizers and pesticides
- Set-aside areas create high quality habitats for wild fauna and flora and thus contribute on a sustainable basis to the conservation of characteristic communities in open farmland
- Buffer strips contain a higher density of predators of agricultural pests (reducing the need for pesticides) and pollinators (reducing the need for fertilizers)
- Creation of a long-term natural network in agricultural areas

References

Gregory et al. (2021); Favilli in Plassmann (eds.). (2016)

Code and Name:

PA04: Removal of small landscape features for agricultural land parcel consolidation (hedges, stone walls, rushes, open ditches, springs, solitary trees, etc.)

Mitigation (and minimisation)

- Creation of ecological corridor: buffer zones, green corridors, green margins, structural linear element like hedges and dry-stone walls, hedgerows, field margins, verges, or remnants of semi-margins
- Identifying new ways of including hedges into the agricultural mesh, making their presence compatible with an efficient use of machinery

Compensation (or restoration)

- Restoration or replacement of removed landscape elements on another (or nearby) plot of land
- Creation of protected areas: if it is unavoidable to remove small landscape features, it may be useful to compensate for this loss by protecting other areas of ecological value within or near the same farm
- More urban or peri-urban greening: promote the planting of trees or the creation of green areas near agricultural areas
- Creation of an effective and permeating participative approach: co-planning processes and participative design
- Case study: call for rehabilitation of terraces agricultural systems. Trentino has promoted the restoration of landscape features through the Rural Development Plan and other regional programs. These include incentives for restoring springs water and ditches and planting trees and hedges along field margins.

Expected effect

Creating a shared vision of territorial governance and development: identifying new ways of including hedges (and other natural elements) into the agricultural mesh, making their presence compatible with an efficient use of machinery.

References

Favilli in: Plassmann (eds.). (2016), Vannucci et al., (2022), Autonome Provinz Bozen - Südtirol. (n.d.)

Code and Name:

PA05: Abandonment of management/use of grasslands and other agricultural and agroforestry systems (e.g. cessation of grazing, mowing or traditional farming)

Mitigation and minimisation

- Agriculture subsidy to maintain the management of grasslands
- Initiatives to revalorize shepherds' profession
- Control negative environmental impacts and monitoring by afforestation plan

Compensation or restoration

- Compensation for environmental services or landscape tourism taxes
- Passive management: Allow the natural process to continue without intervening. "Rewilding" or landscape naturalization vs ecological restoration strategy
- Expansion of agri-forest systems (to promote pasturing)
- Use of extensive livestock and scrubland clearing in selected areas with abandoned fields
- Opportunity for management, to set up new land uses

Expected effects

- Construction of a more complex and heterogeneous landscape, recovering parts of the cultural landscape, reduction of the probability of wildfires, and enhancement of the survival of extensive stockbreeding systems that also contribute to biodiversity.
- Transformation from a landscape of scrub to a mosaic of land use comprising forest, pasture, shrub and meadowland. This landscape can incorporate a high production value (pasture, timber, firewood, etc.), an important ecological and cultural value (soils, pollination, bio-chemical cycles, education, leisure, etc.), the regulation of geo-system (soil conservation, water regulation, water quality, flood control, etc.) and the support of a wide variety of habitats.
- Shepherds can play a new key role in the preservation of high nature value areas. (The first initiatives to revalorize shepherds' profession have been launched in some parts of the Alps, but there is still a considerable need for improvement of working conditions, such as appropriate housing, regulation of working hours and payment.)
- Reforestation and afforestation with evaluation of positive and negative effects

References

Stauder et al., (2023b); Nadal-Romero et al., (2023); Lasanta et al., (2015b); García-Ruizet al., (2020).

Code and Name

PA07: Intensive grazing or overgrazing by livestock

Mitigation and minimisation

- Rotation stocking system control

Considering Mountain Communities with low or no erosions, some possible management measures in these specific cases to change from intensive to extensive grazing could be:

- continuous monitoring of early-stage erosions or sensitive areas;
- grazing rotation, in order to decrease the grazing pressure over these areas;
- adjustment of grazing intensity and change of grazing species over eroded areas.
- Changes in the grazing calendar, changes in the number of animals - annual, marginal exchanges of pastures between neighbouring summer mountains pastures, movements of animals to other areas (Grazing plans)
- Provision of management tools - such as pasture management plans
- Encourage collective approaches (pastoral groups, land improvement consortia, collective ownership, associations, etc.) with a wider impact on the territory
- Creation of a regulatory body for summer mountain pastures and regulatory tools to prevent and face the distorting effects on the market for summer mountain pasture leases.
- Promote the use of buffer zones and the recovery of pastoral areas covered by shrubs and trees
- Support, in terms of training (of farmers and experts)

Compensation or restoration

In the case of Mountain Communities with widespread erosions and high eroded volume more severe interventions must be planned in addition to mitigation measures:

- grazing exclusion until recovery dynamics take place;
- earth moving works and grassing over heavily degraded erosions

After the recovery of the area the introduction of sustainable management is recommended, possibly by subsidies for implementation of remediation practices from local or regional administration.

Expected effects

- Control of the time and intensity of grazing so that pastures have time to regrowth: clear benefits in terms of soil protection and climate change mitigation ad adaptation.
- Near-natural grazing systems could make a considerable contribution to the protection of species diversity (more plant species), water (reduce contamination of waterbodies), soil and climate.
- Creation of networks and support for the owners in the mountain summer pastures management.

EU project examples:

- Eu project Grazing4AgroEcology: A “Self-assessment tool to estimate integrated farm performance” was developed. The main pillar is the creation of a collaborative network.
- Eu project PASTORAL: Combined biophysical and socio-economic approaches to address the vulnerability of Alpine pastures and provides a better capacity to reduce them.

References

Baronti et al., (2022b); Grazing4AgroEcology (2023); Jedicke et al, (2012); Pastoralp., (2023b); Torresani et al., (2019); USDA Climate Hubs, (n.d)

Code and Name

PA14: Use of plant protection chemicals in agriculture

Mitigation and minimisation

- Combination of VBS (vegetated buffer strips) and plant community (mix of grasses, shrubs, fast-growing trees), including a management plan.
- Eco-compensation to farmer

Practices established in EU policy instruments:

Organic farming practices, as defined in Regulation (EU) 2018/848:

- Integrated Pest Management practices, as defined in Sustainable Use Directive including:
  - Buffer strips with management practices and without pesticide,
  - Mechanical weed control,
  - Increased use of resilient, pest-resistant crop varieties and species.
  - Land lying fallow with species composition for biodiversity purpose.
- Conversion to, or maintenance of organic farming

Precision farming:

- Nutrients management plan, use of innovative approaches to minimise nutrient release, optimal pH for nutrient uptake, circular agriculture;
- Precision crop farming to reduce inputs (fertilisers, water, plant protection products)
- Improving irrigation efficiency. (Take in consideration: buffer width, slope, runoff intensity, soil composition, plant community)

Expected effect

The general expected effect is to minimise the amount of artificial and organic fertilisers farmers use, and to increase crop yield and quality. In detail:

- VBS can enhance agroecosystems due to their ability to protect streams and other wetland habitat, act as terrestrial habitat, and generally improve water quality. VBS retain or reduce a certain portion of runoff, sediment, and the associated nutrient and pesticides moving across them before flowing into surface water.
- Whether eco-compensation can reduce the use of chemicals depends on whether the compensation amount exceeds the losses caused by the reduction.

References : Prosser et al., (2020), Liu et al., (2020), European Commission (n.d)

Code and Name

PA17: Agricultural activities generating pollution to surface or ground waters (including marine)

Mitigation and minimisation

- Phytodepuration system.
- Optimisation of the fertilisation
- Riverside vegetation (riparian vegetation)
- Buffer strips
- Fencerows
- Filter strips
- Water protection plan (Gewässerschutzplan)

Expected effect

- Filter water and preserve the banks
- VBS can enhance agroecosystems due to their ability to protect streams and other wetland habitat, act as terrestrial habitat, and generally improve water quality.
- VBS retain or reduce a certain portion of runoff, sediment, and the associated nutrient and pesticides moving across them before flowing into surface water

References

Gewässerschutzplan (n.d); Favilli in Plassmann (eds.). (2016); Borin et al., (2020).

Code and Name

PA22: Drainage for use as agricultural land

Mitigation and minimisation

Controlled drainage (Drainage water management) comprises five types of mitigation measures treating drainage water before it enters streams. These were the commonly applied free water surface flow constructed wetlands (FWS), denitrifying bioreactors (DBR) and controlled drainage (CD) and the two emergent technologies saturated buffer zones (SBZ) and integrated buffer zones (IBZ)

Compensation or restoration
Restoration of other wetlands, create artificial canals

Expected effect
To reduce the load of nitrate in the water is the overall expected effect.
A check for individual applicability to the landscape must be evaluated carefully. Each measure varies in size and capacity to intercept water, where the size relative to the catchment area decreases in the order of FWS > SBZ > IBZ > DBR.

References
Carstensencet al., (2020)

6.2 Forestry related practices

For pressures PB01 - *Conversion to forest from other land uses, or afforestation (excluding drainage)* and PB02 - *Conversion from one type of forestry land use to another,* we refer to pressure PA01 - *Conversion into agricultural land*, as the mitigation and compensation measures are similar.

Code and Name

PB03: Introduction and spread of new species for forestry purposes (including GMOs)

Mitigation and minimisation

- Prevent future arrivals by identifying and managing pathways. Implementation of a strong plant quarantine program (combine with a greater international cooperation in plant quarantine)
- Coupling surveillance with eradication (second level of prevention)
- Containment to spread of invasive species (slow the spread of a species to delay impacts)

Once species are established, there are several approaches:

- Biological control (that is particularly beneficial practice in forest ecosystems), e.g. Introduction of insect predators to control insects' pets of "woody plants"
- Use of inundative releases of biological control agents
- Resistance breeding: Tree breeding to develop resistant hosts
- Forest activities: mixed plantings to promote biotic resistance to invasions and damage, use of fire to limit plant invasions and silvicultural practices (thinning)
- Risk assessment (a process to forecast the likelihood and consequence of an invasion) and pathway analysis (a process to evaluate how invasive species might be brought into an area of concern)
- Find a balance between the regeneration and growth dynamics of non-native trees (NNT) and ecological properties of native species.
- A particularly promising silvicultural measure to prevent further spreading, especially of light demanding species such as black locust and tree of heaven, is to refrain from full canopy opening.
- cvoid spreading from plantations into sensitive habitats, monitored buffer zones are an appropriate measure, particularly in well managed forest landscapes and for NNT that can be easily removed (species that are not resprouting and do not form root suckers)

Expected effect

- Forest affected by several NNT: control and reduce factors that favour their diffusion.
- Moderately invaded: local eradication and preventions actions. Localized eradication. Early detection and prevention.
- Early detection and accurate spatial delimitation

References : Liebhold et al., (2017) ; Campagnaro et al., (2022); Brundu et al., (2020) ; Venette et al., (2021); Pötzelsberger et al., (2020)

Code and Name

PB07: Removal of dead and dying trees (including debris)
PB08: Removal of old trees

Mitigation and minimisation

- (Planned) Retention forestry: important structures and organisms are intentionally retained on site for long term
- Selective logging: forest operations should be of low intensity, limited removal is recommended for maintaining the current structure, establish the right rotation age
- Certification programs: FSC and/or PEFC

Compensation or restoration

/

Expected effect

- Maintaining key biological and physical elements of the stand (e.g., patches of live trees, the scattered distribution of old trees, and dead trees such as stumps, logs, and snags) during harvesting to ameliorate the post-logging structure over forest generations.
- Maintaining and enhancing the supply of ecosystem services and the provisioning of biodiversity, increasing public acceptance of forest harvesting and the options for future forest use, achieving temporal and spatial continuity of key habitat elements and processes, including those needed by both early- and late-successional specialist species, maintaining connectivity in the managed forest landscape, minimizing the off-site impacts of harvesting, such as on aquatic systems, improving the aesthetics of harvested forests.
- Provision of credible evidence of sustainable forest management

References

Latterini et al., (2023); Mori et al., (2014); Gustafsson et al., (2012)

Code and Name

PB09: Clear-cutting, removal of all trees

Mitigation and minimisation

- Retaining trees for conservation at final harvest:
- Leave single living and dead trees, tree patches and buffer strips. Single living trees are retained, and tree patches may be left as 'islands' in felled areas or adjacent to non-felled stands, often as buffer strips along lakes, rivers, wetlands and near settlements. Standing and lying dead trees are also retained, and they should not be harmed during logging operations.

Compensation or restoration

Use of compensation forest funds:

a) Creation of an ecological corridor
b) Creation of ad hoc local forest conservation plan based on specific area

Organize and pay for the actual offsetting, i.e. establishing a new and equivalent habitat at a different place that is compensating the ecological loss caused by any (residual) development impacts.

- Example of a process:
  - Firstly, quantify the taxa that would have been affected by the expansion of the industrial site in part of the forest. Secondly, prepare a specific plan which provides for interventions that would benefit several taxa. Finally, use the available forest compensation funding to apply a multi-taxa approach. Host plants and larvae were translocated to new clearings.

Expected effect

- Restoration and improvement of habitats to favour and maintain local biodiversity and to enhance ecosystem functioning.
- Maintain the forest connectivity for forest species
  -

References

Piccini et al., (2022) ; Schulz et al., (2024); Kruys et al., (2013) ; Gustafsson et al., (2020)

Code and Name

PB14: Forest management reducing old growth forests

Mitigation and minimisation

Long logging rotations:

1) Limitation of operations during wet periods, carefully place skid trails to minimize repeated traffic and utilizing equipment with low ground pressures
2) Alternative forest treatments, such as partial cuts or stem-selection harvests, would be favoured in old-growth stands.

Compensation or restoration

/

Expected effect

- Enhancing alternative forest management strategies should help maintain sufficient areas of old-growth forest in managed landscapes and mitigate the incoming effects of climate change

References

Griffiths et al., (2018) ; Martin et al., (2020).

Code and Name

PB24: Drainage for forestry

Mitigation and minimisation

Regulating drainage is part of sustainable forest management (SFM), i.e. the creation of a smooth, long-term planning procedure for drained landscapes.

Existing techniques for rehabilitation of drained sites:

a) Constructing water-level control mechanisms and depressions or buffers at ditch outlets to mitigate the hydrological reorganization impacts on runoff and water quality, including dissolved nutrients and toxins and suspended solids.
b) Drained wetlands under intensive use should be considered for more balanced production approaches, such as the transformation from agricultural monocultures to agroforestry systems or from conventional silviculture to retention forestry.

Continuous cover forest management (CCF)* could reduce nutrient and carbon export (water management). Prioritise CCF to encourage natural regeneration and reduce clear felling over phased felling techniques to reduce the loss of soil.

For optimized buffer areas:

- Limiting the loggings further away from the water bodies to diminish their overall negative impacts for aquatic ecosystems. To maintain ecosystem functions, fixed-width, optimized riparian forests should be retained, at least in the groundwater discharge hot spots.
- Improved catchment planning to ensure that large proportions of the catchment area exceeding the thresholds for negative water quality impacts are not to be treated.
- Developing regional and local planning to promote drainage channel maintenance and overhauls. (Use of competences, data and tools of the authorities)

Compensation or restoration

- Wetland restoration and promotion of activities for the recovery of wetland forests (in other locations):

Expected effect

Enabling better targeting and implementation of watercourse maintenance and overhauls from the perspective of drainage needs, cost-effectiveness and environmental protection alike. (Project LIFE+TEN)

References: Lõhmus et al., (2015); Häggblom et al., (2020); Härkönen et al., (2023); Provincia Autonoma di Trento (2024b)

6.3 Extraction of resources (minerals, peat, non-renewable energy resources)

Code and Name

PC01: Extraction of minerals (e.g. rock, metal ores, gravel, sand, shell)

Mitigation and minimisation

Use of new and innovative technologies, having less environmental impacts:

a. The **passive seismic technique** deploys up to thousands of nodes (receivers) on the land surface to record body and surface seismic waves.
b. The **multi-array passive seismic technique** uses two types of arrays – one at the surface and another deployed vertically in drill holes – to obtain a better resolution at depth

Compensation or restoration

- Environmental compensation measures in cases of landscape restoration or mine closures.
- Strictly controls on the specifications and requirements, as well as on compliance with deadlines regarding the start of activities and their completion dates.

Expected effect

Reduce the impacts of mineral extraction

References:
European commission, (2022b); Provincia Autonoma di Bolzano – Alto Adige, (2023); PACIFIC project

Code and Name

PC05: Peat extraction

Mitigation and minimisation

- Legislation for lower extraction sites, regulated and rigorous access.
- Mining concession should be allowed only to cover proven needs. Speculation and land grabs should be avoided.
- Introduction of a monitoring system for quarries and wells

Compensation or restoration

When peat extraction is ceased, multiple after-use options exist, including abandonment, restoration, and replacement (consists of afforestation, cultivation and creation of water bodies). Active restoration measures including soil amendment, nutrient addition, hydrological manipulation, and revegetation can be conducted to assist and boost the recovery:

- The moss layer transfer technique (MLTT) can be used to improve hydrology by filling in the drainage ditches and shaping the peat surface. Afterwards, Sphagnum moss material is spread to the surface and protected with mulch layer.
- Rewet sites with spontaneous revegetation
- Replace the extracted ecosystem with alternative land-use, such as commercial forestry, cultivation of crop plants, or creation of water bodies which can create habitats for different wetland species.

The former extraction sites may be abandoned by relying on spontaneous successional processes, without actively intervening (This option is depending on national legislation, because not all countries allow this procedure.)

Expected effects

- Responsible and transparent production of peat resources (e.g.: an non-profit organization Foundation Responsibly Produced Peat)
- Long-term monitoring of the site

References

Räsänen et al., (2023); Responsiblyproducedpeat (n.d).; Provincia Autonoma di Bolzano – Alto Adige. (2023b)

Code and Name

PC06: Dumping/ depositing of inert and dredged materials from terrestrial and marine extraction

Mitigation and minimisation

The measures for safe management of mineral wastes include:

- monitoring of hazardous chemical substances in mineral waste and application of technologies that reduce their concentration;
- reduction and prevention of waste storage drains from entering ground water;
- processing of mineral waste that reduces the chemical activity of hazardous components, which makes it possible to reduce the danger from waste storage;
- storage with application of environmental protection measures;
- management of industrial wastes;
- isolation/conservation of industrial wastes

A general measure is the prevention and reduction of extractive waste generation. of extractive waste by-products can be recovered and used in the production cycle. It is possible to apply industrial wastes (crushed waste rock) in significant infrastructural programs such as construction of embankments for railroads, construction of highways, and construction of dams or flood control systems

Compensation or restoration

Site remediation and the recovery of an environmentally degraded area

Expected effects

- Safe management of mineral wastes
- Rethinking of waste product: new waste-free production

References

Rybak et al., (2021); Blengini et al., (2019)

6.4 Recreational infrastructure and areas for tourism

Code and Name

PF05: Sport, tourism and leisure activities

Mitigation and minimisation

Access and infrastructure management:

Quantitative restrictions:

- Limitation of the quantity of new accommodation/ new beds or food service facilities

Seasonal restrictions in number of participants concerning habitat and wildlife protection:

- Shift touristic demand from peak seasons to low seasons
- Reduce touristic demand in peak seasons

Geographical restrictions:

- Redistribute touristic demand geographically (from destinations with high tourism exposure to those with low or average exposure)
- Limit the construction of tourist facilities outside city centres
- Limit the touristic traffic in sensitive areas during peak seasons

Education and awareness, regulation of recreational activities:

- Promoting awareness of existing nature reserves

Incentives for sustainable tourism projects and promotion of low-impact activities

- Concerted action of stakeholders in tourism towards sustainability, also through bottom-up initiatives.
- Strengthen the public transport infrastructure and incentivise its usage by guests
- Increase the number of charging stations for e-mobility both in accommodation facilities and in public area

Compensation or restoration

- Restoration of landscape/area damaged by tourist activities
- Landscape tourism taxes

Expected effect

Lower impact of tourism activities

References: Windegger et al., (2022)

6.5 Alien and problematic species

Code and Name

PI01: Invasive alien species of Union concern
PI02: Other invasive alien species (other than species of Union concern)
PI03: Problematic native species

Mitigation and minimisation

The management of the existing populations of these pest species (animals and plants) is the main objective for minimising their impacts. Mitigation measures are highly species-specific, which can be summarized in three ways of control:

- Mechanical/ manual: Use of machines and other designated equipment for removal of the weed from water. Mechanical mowers, destroyer boats, mechanized dredgers, weed harvester tractors, and crusher boats are some of the machines used,
- Chemical application of herbicides to get rid of the weed and biological control,
- Biological control: Alternatives include the exploitation of a host as a distinct natural adversary to decrease the population size of the weed.

Alternative and new uses are medicinal uses, food for animals, compost production, or biofuel production.

Monitoring:

Existing strategies to monitor non-native species may include the utilization of cutting-edge technologies, such as satellite imaging, environmental DNA analysis, and predictive modelling such as species distribution models. Proactive surveillance measures, such as the establishment of early warning systems and rapid response teams, contribute to the effectiveness of these programs. Government agencies and ministries should take the lead in battling the scourge of the invasiveness of the weed. Efforts from nature conservation associations, citizen science initiatives, biological field stations, and national focal points for monitoring biodiversity can be an important support. Public awareness campaigns can support the prevention and early detection.

Expected effect

- More effective management and monitoring of non-native species
- Prevention of the introduction of non-native species

Example of South Tyrol:

Elodea nuttallii:
Early detection is best to ensure that the public is informed of the species and can identify new infestations through well-coordinated public awareness campaigns. On one hand, the eradication of small infestations is possible with hand weeding, benthic barriers, suction dredging, or by a combination of control measures. On the other hand, the eradication of large infestations is difficult to achieve. Once fully established in larger systems, maintenance and prevention of spread can be achieved by mechanical mowers, rake boats or hydro-jet equipment and the installation of physical barriers.
The example of Lake Rablà shows a combination of measures: In order to quickly remove the weedy masses of the invasive plant, the first measure was to lower the lake level, mow the plants, deposit them on an embankment, and transport the entire plant mass to the Bolzano incineration plant for disposal. The plant is able to adapt very well to environmental conditions and grow rapidly, so water must be removed to prevent the plant from reproducing, spreading, colonizing, and damaging pre-existing ecosystems.

References

Brundu et al., (2020); Ayanda et al., (2020); Provincia Autonoma di Bolzano - Alto Adige. (2022)

Code and Name

PI04: Plant and animal diseases, pathogens and pests

Mitigation and minimisation

The options for managing forest pest and pathogen invasions can be categorized into opportunities of pre-border and post-border mitigation.

- Before a non-native species is introduced to a new area (pre-border), preventative measures can be informed by horizon scanning, pathway action planning and risk assessments, coupled with implementation of surveillance and monitoring, including the establishment of sentinel plantings for early warning and rapid detection.
- Once the non-native species has been introduced (post-border), options to minimize the impact include implementing measures for detection, and assessing the feasibility to eradicate founding populations, contain the spread, and ultimately restoration.

Zoning:
Zones are delimited according to the presence of the pest in the area and are meant to isolate or separate populations of infested plants from populations of non-infested plants.

Expected effect

- Effective management and monitoring of pathogen and pest
- Prevention of the introduction of pests and pathogens

References

Hulbert et al., (2023); Sun et al., (2023)

7 Incentives

7.1 EU-Level

With regards funding sources for GI implementation, the analysis of Marot et al. (2024) "*shows that implementation of GI mostly relies on EU funds due to there being few financial instruments for this topic available at a national level"* (ibid.). GI projects can be financed by the LIFE programme, which have a primarily focus on conservation measures. In the analysis, they mention the LEADER programme, which should motivate Local Action Groups to declare GI as a priority for the rural development of their given area. A disadvantage of LEADER is apparently the focus on specific bottom-up designated areas, that is seen as a limitation to apply GI projects at a macro level (Marot et al., 2024).

- Common Agricultural Policy (CAP):
  In the DINALPCONNECT project, the Agricultural University of Athens (2021) analysed how ecological connectivity is integrated in European policies and came to the conclusion that in EU countries*, "ecological connectivity is implemented in agricultural sector, mostly through the Common Agricultural Policy (CAP)." (ibid.)*

  The European Agricultural Fund for Rural Development (EAFRD), part of the CAP, funds several measures that can enhance ecological connectivity, especially in rural landscapes. Key opportunities are:

  - Agri-Environment-Climate Measures (AECM):
    Supports farmers in maintaining or restoring wildlife corridors, hedgerows, and traditional land uses that benefit connectivity.
  - Eco-Schemes (since 2023 CAP reform):
    Direct payments to farmers who implement biodiversity-friendly practices, such as maintaining buffer strips, forest corridors, or reducing fencing barriers.
  - Natura 2000 & Water Framework Directive Payments:
    Supports conservation efforts within protected areas, including habitat restoration and corridors for species movement.
  - Forest and Land Management Support:
    Funds afforestation, rewilding, and habitat improvement projects that help species move across fragmented landscapes.

  The most important commitments and measures that favour ecological connectivity are made by direct payments provisions but also by the Rural Development program (Pillar II) which might be even more important. With this regard, especially the Natura 2000

schemes and the agri-environmental-climate schemes but also the agroforestry measures are important:

- *"Through Natura 2000 schemes farmers with holdings in Natura 2000 network areas, are compensated for the loss of income caused on mandatory commitments imposed by the conservation status of the area. The prerequisite for a country to implement the Natura 2000 payments measure is to enact mandatory commitments for holdings located in specific Natura 2000 areas or zones which cause a loss of income or an additional cost to the farmers."* These payments are representing a compensation measure (Agricultural University of Athens, 2021).

- *Rural Development Programs:* Under the Common Agricultural Policy, the European Agricultural Fund for Rural Development (EAFRD) supports Rural Development Programs, including agri-environmental measures. One of its six priorities is "restoring, preserving and enhancing ecosystems related to agriculture and forestry". *The EAFRD priorities are in turn broken down into 18 specific focus areas. In their programmes, countries set out targets relating to their chosen priorities and focus areas, as well as a strategy for meeting their targets* (European Commission, 2025). Under Priority 4: Restoring, Preserving and Enhancing Ecosystems, the focus area "Restoring, preserving and enhancing biodiversity" is mentioned. (European Network for Rural Development, 2016).

- LIFE programmes:
  The European LIFE Programme is financed by the European Union (EU) budget under the Multiannual Financial Framework (MFF). LIFE – projects are often co-funded with structural funds.
  "*Two of the four LIFE sub-programmes are the most relevant "Nature and Biodiversity" and "Climate Change Mitigation and Adaptation" that directly supports the realization of EU environmental policies and legislation, including those that enhance ecological connectivity. This includes habitat restoration, species conservation, and the development of green infrastructure.*" (Chiapparini et al., 2024).

7.2 Pilot site - level

At pilot site – level, many additional funding mechanisms and funding possibilities at national or regional level were gathered that can support the realization of ecological corridors.

Austria:

- **Agri-environmental programme ÖPUL**: Austrian Programme for Environmentally Friendly Agriculture
- **Contract-based nature conservation**: Integration of nature conservation measures, compensatory measures.

France:

- **Targeted programs** on:
  - Species: Reco-crapaud (Agence de l'Eau), National Action Plan (Lynx)
  - Area: Natural site management plan (National reserve, Natural Parks, Sensitive areas, etc…)
  - Natural infrastructures, e.g. hedges plantation (Adabio, Marathon de la Biodiversité), or pond restorations (Marathon)
- **State requirements:** Environmental impact assessment/ mitigation measures, updating of SCoT or PLU(i)
- **Regional funds for targeted projects** (Contrat Vert et Bleu, Contrat de territoire)
- **Research programs** (MNHN, CRNS, etc…)
- **Private sponsorship** (Banks, Foundations, Clubs, etc…)

Germany – Bavaria:

- **Compensation funds**
- **Federal and state funds**: chance.natur, Bavarian Nature Protection Fund
- **Direct marketing and labelling of products** produced on HNVF (using existing retail marketing schemes „VonHier")

Italy - South Tyrol:

- **Landscape fund:** The Nature, Landscape and Spatial Development Department is responsible for the landscape fund. It is used to improve landscape elements.
- **Environmental compensation payments from power plants**: Environmental compensation payments are made periodically because concessions are awarded.

Italy – Veneto Region:

Innovative funding sources relevant to biodiversity and connectivity include primarily financial incentives, sustainable land management practices, green bonds and crowdfunding:

- **Payments for Ecosystem Services (PES)**, which are a potential method to conservation and sustainable resource management because they provide financial incentives for the supply of ecological services.
- **Crowdfunding platforms** and **environmental, social, and corporate governance (ESG) policies:** Through these innovative tools conservation and renaturation projects can mobilize resources and community support to enhance ecological connectivity, contributing to the overall health and resilience of ecosystems. As an example, through some corporate social responsibility programs it is mandatory to report a percentage of non-mandatory investments for sustainability.
  - WoW Nature platform of ETIFOR supporting reforestation projects,
  - Corporate social responsibility programs as public-private tools (Nestlé e Purina)
  - Environmental, social, and corporate governance policies (ESG policies) certification

Slovenia:

- **State sustainability bond and Eco fund:** In Slovenia, it is useful to mention the Eco fund (in Slovenian 'Eko sklad'), which provides credit for investments that could indirectly have a positive impact on structural ecological connectivity, if it were used to finance major projects.
- **Green fund and green bond of SID Bank** (private)

8 Conclusion

The functionality of an ecological linkage depends on how it is managed, once a corridor design has been implemented. The "*management documentation for an ecological corridor should list prohibited or permissible activities and describe any restoration needed to achieve connectivity*" (Hilty et al. 2020).

However, to guarantee the functionality of ecological corridors by spatial planning procedures, several problems arise:

- Management specifications for ecological corridors in spatial planning documents are often missing, remain vague or are just interfering on a single and specific anthropogenic threat.
- Guidelines, knowledge, best practices, and standards for spatial planners to elaborate plans and programs and environmental assessment procedures, to consider the land use conflict between ecological connectivity and the development of anthropogenic needs and human infrastructure, are lacking.
- Spatial planning can influence sectoral policies just to a certain degree and does not have all competences that are necessary to cover the comprehensive management of ecological corridors.

To fill these gaps, an inventory of typical ecological corridors with a collection of compatible and conflicting anthropogenic uses and a catalogue of mitigation and compensation measures was elaborated in this activity.

Resulted anthropogenic pressures on typical ecological corridors in the Alps

According to the queries from the list of the list of key pressures and threats of the European Environmental Agency, the most important groups of anthropogenic pressures on Natura 2000 networks in the Alps are: agricultural practices, urban development, forestry, natural processes, alien and problematic species, human-induced changes in water regimes, extraction of resources, and energy production. Tourism and recreational uses, as well as transport infrastructure were added due to their highly touristic attractiveness of the Alpine Space and general importance for territories outside protected areas. In total, 49 specific anthropogenic pressures were selected as important for the Alpine Space.

The results of the GIS analysis showed that more than half of the potential linkages are affected of intensively used agricultural areas, while the parts of passings through intensively used agricultural land are rather short. The median length amounts 179 m. Only 314,5 km (12%) of the linkages passing through intensive agriculture are part of High Nature Value farmland. Corridor distances of more than 3 km passing through intensive agricultural areas, can be found in the Po Valley (IT), and in Lower Austria. This highlights the high importance of maintaining patchy and linear woody features or other green linear elements in intensively

used agricultural areas, which is mentioned in the description of mitigation and compensation measures (section 5).

Regarding forestry-related pressures, the GIS analysis revealed that forest habitats of the outer Alpine Space are more affected of incompatible forest management practices than the inner Alpine Space. Especially Lower - and Upper Austria, as well as Liguria (IT) are affected of high to very high overall pressures coming from forestry.

Regarding tourism it was revealed that 275 out of 953 linkages are passing through ski areas, and mostly inner-alpine linkages are affected.

Typical corridors in the PlanToConnect pilot sites, spread over the Alpine arc, are covering a large range of different typologies of corridors, including:

- A variety of scales: local, intermunicipal, provincial, regional and trans-regional corridors
- Inner – alpine, pre-alpine, flatland and costal corridors
- Different forms: linear, stepping stone and landscape corridors
- Various habitats: from rocky habitats, forest habitats, grasslands, mires and fens, to freshwater habitats.

The results of the expert survey, that referred to these typical Alpine ecological corridors, showed that transport infrastructure, urban development, agricultural practices, and human-induced changes in water regimes were evaluated as the most important general anthropogenic pressures in the PlanToConnect pilot sites, while forestry related practices (despite in Austria) and extraction of resources were rated as the less important ones. Roads – highway and relate infrastructure, conversion from other land uses to built-up areas, as well as the use of plant protection chemicals in agriculture are the most severe rated sub-categories of anthropogenic pressures in the pilot sites.

Despite renewable energies are seen as driver for land fragmentation and therefore as threat for ecological connectivity, existing windmills were rated highest only as “weak” in the pilot sites. This result might be highly biased by the selection of pilot sites.

References

Agricultural University of Athens (2021) D.T1.1.2 Report on questionnaire results and interviews to national experts in sectoral policies in agriculture and forestry. Interreg ADRION DINALPCONNECT project.

Autonome Provinz Bozen - Südtirol (n.d), Gewässerschutzplan | Landesagentur für Umwelt und Klimaschutz. https://umwelt.provinz.bz.it/wasser/gewaesserschutzplan.asp

Autonome Provinz Bozen - Südtirol. (n.d.). *Natur, Landschaft und Raumentwicklung*. https://natura-territorio.provincia.bz.it/it/premi-incentivanti-per-la-cura-ed-il-mantenimento-del-paesaggio

Ayanda, O. I., Ajayi, T., & Asuwaju, F. P. (2020). Eichhornia crassipes (Mart.) Solms: Uses, Challenges, Threats, and Prospects. TheScientificWorldJournal, 2020, 3452172. https://doi.org/10.1155/2020/3452172

Baronti, S., Ungaro, F., Maienza, A., Ugolini, F., Lagomarsino, A., Agnelli, A. E., Calzolari, C., Pisseri, F., Robbiati, G., & Vaccari, F. P. (2022b). Rotational pasture management to increase the sustainability of mountain livestock farms in the Alpine region. Regional Environmental Change, 22(2). https://doi.org/10.1007/s10113-022-01896-1

Bennett G., Mazza L., de Nocker L., Gantioler S., Losarcos L., Margerison C., Kaphengst T., McConville A.J., Rayment M., Brink P.T., et al. (2011). Green Infrastructure Implementation and Efficiency; Institute for European Environmental Policy: London, UK, 2011. https://ec.europa.eu/environment/nature/ecosystems/docs/implementation_efficiency.pdf

Blengini, G.A.; Mathieux, F., Mancini, L.; Nyberg, M.; Viegas, H.M. (Editors); Salminen, J.; Garbarino, E.; Orveillon, G.; Saveyn, H.; Mateos Aquilino, V.; Llorens González, T.; García Polonio, F.; Horckmans, L.; D'Hugues, P.; Balomenos, E.; Dino, G.; de la Feld, M.; Mádai, F.; Földessy, J.; Mucsi, G.; Gombkötő, I.; Calleja,I. Recovery of critical and other raw materials from mining waste and landfills: State of play on existing practices, EUR 29744 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-03391-2, doi:10.2760/494020, JRC116131.

Borin, M., Pappalardo, E., (2020). Drenaggio controllato e fitodepurazione per la riduzione delle perdite di nutrienti in agricoltura. Veneto Agricoltura. DOI:10.13140/2.1.2001.7601

Brundu, G., E Costello, K., Maggs, G. Montagnani, C., Nunes, A. L., Pergl, J., Peyton, J., Robertson, P., Roy, H., Scalera, R., Smith, K., Solarz, W., Tricarico, E., van Valkenburg, J. (2020). An introduction to the invasive alien species of Union concern, Doi: 10.2779/046410

Brundu, G., Pauchard, A., Pyšek, P., Pergl, J., Bindewald, A. M., Brunori, A., Canavan, S., Campagnaro, T., Celesti-Grapow, L., De, M., Dechoum, S., Dufour-Dror, J., Essl, F., Flory, S. L., Genovesi, P., Guarino, F., Guangzhe, L., Hulme, P. E., Jäger, H., . Richardson, D. M. (2020). Global guidelines for the sustainable use of non-native trees to prevent tree invasions and mitigate their negative impacts. *NeoBiota*, *61*, 65–116. https://doi.org/10.3897/neobiota.61.58380

Campagnaro, T., Brundu, G., Burrascano, S., Celesti-Grapow, L., La Mantia, T., Sitzia, T., & Badalamenti, E. (2022b). Tree invasions in Italian forests. *Forest Ecology and Management*, *521*, 120382. https://doi.org/10.1016/j.foreco.2022.120382

Carstensen, M.V., Hashemi, F., Hoffmann, C.C. et al. Efficiency of mitigation measures targeting nutrient losses from agricultural drainage systems: A review. (2020). Ambio 49, 1820–1837. https://doi.org/10.1007/s13280-020-01345-5

Chiapparini C., Laner P., Vitangeli V., Favilli F., Gibelli G., Pandolfi M. A. (2024). Planning instruments and processes for GBI network planning and implementation in the Alps. Analysis of planning practices on establishing GBI networks for connectivity in the Alpine Space. Deliverable 2.1.1. Interreg Alpine Space PlanToConnect project. https://www.alpine-space.eu/project/plantoconnect/

Commission of the European Communities (2013). Council Directive 92 /43 / EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Communities. Document 31992L0043. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31992L0043

Concepción E.D., Aneva I., Jay M., Lukanov S.,Marsden K., Moreno G., Oppermann R., Pardo A., Piskol S., Rolo V., Schraml A., Díaz M, (2020). Optimizing biodiversity gain of European agriculture through regional targeting and adaptive management of conservation tools, Biological Conservation, Volume 241, 2020, 108384, ISSN 0006-3207. https://doi.org/10.1016/j.biocon.2019.108384.

CORDIS Project: European Commission. (2022, April 26). Finding new minerals in Europe using environment-friendly, low-cost technologies. CORDIS. https://cordis.europa.eu/article/id/436268-finding-new-minerals-in-europe-using-environment-friendly-low-cost-technologies

DINALPCONNECT project (2023). Ecological connectivity: a bridge to conserving biodiversity and reducing fragmentation of the Adriatic-Ionian region. Information List. Interreg ADRION DINALPCONNECT project. https://dinalpconnect.adrioninterreg.eu/wp-content/uploads/2023/02/Information-List-Document-FINAL.pdf

Dodd, N., Butynski, M., Ament, R., Chen, S., Jayasinghe, N., Lim, J.C., Saaban, S., Tiwari, S. K., van der Ree, R., Wang, Y., & Wong, E. P. (2024). Handbook to Mitigate the Impacts of Roads and Railways on Asian Elephants. AsETWG (Asian Elephant Transport Working Group); IUCN WCPA Connectivity Conservation Specialist Group/IUCN SSC Asian Elephant Specialist Group. https://doi.org/10.53847/PZNC3560

EEA, European Environment Agency (2019). Home. Topics and subtopics. Biodiversity — Ecosystems. State of Nature in the EU. National summary dashboards - Habitats ... Main pressures and threats. https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards-archived/main-pressures-and-threats

EEA, European Environment Agency (2020). State of nature in the EU. Results from reporting under the nature directives 2013-2018. EEA Report No 10/2020. Luxembourg: Publications Office of the European Union. https://doi.org/10.2800/088178

EEA, European Environment Agency (2023). Eionet. Central Data Repository. Reference portal for reporting under Article 17 of the Habitats Directive. List of pressures and threats for the

period 2019-2024 (last updated 24/05/2023). https://cdr.eionet.europa.eu/help/habitats_art17

EEA, European Environmental Agency, (2017a). High Nature Value (HNV) farmland. High Nature Value (HNV) farmland 2012 (100 m) accounting version, Nov. 2017. Temporal coverage: 2012. eea_hnv-farmland_s. https://www.eea.europa.eu/en/datahub/datahubitem-view/1bd26e8f-8ea0-45e0-b6bf-9ed2baff5d28

EEA, European Environmental Agency, (2017a). High Nature Value (HNV) farmland. High Nature Value (HNV) farmland 2012 (100 m) accounting version, Nov. 2017. Temporal coverage: 2012. eea_hnv-farmland_s. https://www.eea.europa.eu/en/datahub/datahubitem-view/1bd26e8f-8ea0-45e0-b6bf-9ed2baff5d28

EEA, European Environmental Agency, (2017b). Pressures on forest ecosystems. Management related pressures on forest ecosystems, Dec. 2017. eea_r_3035_1_km_combined-forest-pressure_p_2012-2017_v01_r00. https://www.eea.europa.eu/en/datahub/datahubitem-view/f56fe6f0-f29f-49d5-8e00-e7730f0fd105

EEA, European Environmental Agency, (2017b). Pressures on forest ecosystems. Management related pressures on forest ecosystems, Dec. 2017. eea_r_3035_1_km_combined-forest-pressure_p_2012-2017_v01_r00. https://www.eea.europa.eu/en/datahub/datahubitem-view/f56fe6f0-f29f-49d5-8e00-e7730f0fd105

European Commission (2019). Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC. Notices from European Union institutions, bodies, offices and agencies. Official Journal of the European Union (2019/C 33/01). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019XC0125(07).

European Commission (2025). Rural development. https://agriculture.ec.europa.eu/common-agricultural-policy/rural-development_en

European Commission (n.d), Pratiche e metodi sostenibili per l'agricoltura. Agriculture and Rural Development. https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/sustainable-agricultural-practices-and-methods_it

European Commission, (2013). EC: Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Green Infrastructure (GI) — Enhancing Europe's Natural Capital, The European Commission, Brussel., 2013. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249, 03.04.2023

European Commission, (2017). Calculating the potential impacts of Ecological Focus Areas on biodiversity and ecosystem services. https://joint-research-centre.ec.europa.eu/jrc-news/calculating-potential-impacts-ecological-focus-areas-biodiversity-and-ecosystem-services-2017-03-30_en, 15.03.2023

European Commission, (2021). European Commission. Knowledge for Policy. Green and Blue Infrastructures. https://knowledge4policy.ec.europa.eu/glossary-item/green-blue-infrastructures_en, 06.02.2023.

European Commission: Directorate-General for Environment. (2023). Guidelines on closer-to-nature forest management. Publications Office of the European Union. https://data.europa.eu/doi/10.2779/731018.

European Network for Rural Development (2016). RDPs 2014-2020: Key facts & figures. Rural Development Priority 4: Restoring, preserving and enhancing ecosystems related to agriculture and forestry. https://ec.europa.eu/enrd/sites/default/files/priority-4-summary.pdf

Favilli, F. (2016). Agriculture and Ecological Connectivity. In: Plassmann, G. Badura, M. Kohler, Y., Walzer, PK and Walzer, C (eds.) Alpine Nature 2030 - Creating [ecological] connectivity for generations to come. Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Berlin, Germany Pp. 115-12.

Finka, M., Ondrejička, V., Husár, M., Huba, M., Li, J. et al. (2021). Guidelines on how to Use Spatial Planning Tools in Integrative Management of Ecological Corridors. Danube Transnational Programme ConnectGREEN Project. "Restoring and managing ecological corridors in mountains as the green infrastructure in the Danube basin". State Nature Conservancy of the Slovak Republic, Banská Bystrica, 76 pp. https://www.interreg-danube.eu/uploads/media/approved_project_output/0001/46/4bf6e34e0cc88332516e33e95333685adf014665.pdf

García-Ruiz, J., Lasanta, T., Nadal-Romero, E., Lana-Renault, N., & Álvarez-Farizo, B. (2020). Rewilding and restoring cultural landscapes in Mediterranean mountains: Opportunities and challenges. Land Use Policy, 99, 104850. https://doi.org/10.1016/j.landusepol.2020.104850

Grazing4AgroEcologu project: Grazing4AgroEcology (2023, February 17) Expected results of the project. Grazing4AgroEcology. https://grazing4agroecology.eu/project-description/expected-results/

Gregory, A., Spence, E., Beier, P., & Garding, E. (2021). Toward best management practices for ecological corridors. Land, 10(2), 140. https://doi.org/10.3390/land10020140

Griffiths, N. A., Rau, B. M., Vaché, K. B., Starr, G., Bitew, M. M., Aubrey, D. P., Martin, J. A., Benton, E., & Jackson, C. R. (2018). Environmental effects of short-rotation woody crops for bioenergy: What is and isn't known. GCB Bioenergy, 11(4), 554–572. https://doi.org/10.1111/gcbb.12536

Grillmayer R., Danzinger F., Borgwardt F., Moser D. (2023a). Absicherung und Etablierung der Lebensraumvernetzung in Österreich. Planungsgrundlagen. Wien: Umweltbundesamt. https://www.zobodat.at/pdf/UBA_REP_864_0001-0102.pdf

Grillmayer R., Leissing D., Leitner H., (2023b). Leitfaden zur Beurteilung der Durchlässigkeit von Lebensraumkorridoren. Konzipiert für wildlebende Säugetiere ab Hasengröße. Vienna: Federal Ministry of the Republic of Austria for Climate Action, Environment, energy, Mobility, Innovation and technology. https://geonetwork.lebensraumvernetzung.at/geonetwork/srv/api/records/3d4beb5e-c9b0-4769-b76b-6a148038d3fb?language=all

Gustafsson, L., Baker, S. C., Bauhus, J., Beese, W. J., Brodie, A., Kouki, J., Lindenmayer, D. B., Lõhmus, A., Pastur, G. M., Messier, C., Neyland, M., Palik, B., Sverdrup-Thygeson, A., Volney, W. J. A., Wayne, A., & Franklin, J. F. (2012). Retention Forestry to maintain

Multifunctional Forests: A World perspective. *BioScience*, *62*(7), 633–645. https://doi.org/10.1525/bio.2012.62.7.6

Gustafsson, L., Hannerz, M., Koivula, M., Shorohova, E., Vanha-Majamaa, I., & Weslien, J. (2020). Research on retention forestry in Northern Europe. *Ecological Processes*, *9*(1). https://doi.org/10.1186/s13717-019-0208-2

Häggblom, O., Härkönen, L., Joensuu, S., Keskisarja, V., & Äijö, H. (2020). Water management guidelines for agriculture and forestry.

Härkönen, L. H., Lepistö, A., Sarkkola, S., Kortelainen, P., & Räike, A. (2023b). Reviewing peatland forestry: Implications and mitigation measures for freshwater ecosystem browning. Forest Ecology and Management, 531, 120776. https://doi.org/10.1016/j.foreco.2023.120776

Hilty, J., Worboys, G.L., Keeley, A., Woodley, S., Lausche, B., Locke, H., Carr, M., Pulsford I., Pittock, J., White, J.W., Theobald, D.M., Levine, J., Reuling, M., Watson, J.E.M., Ament, R., and Tabor, G.M., (2020). Guidelines for conserving connectivity through ecological networks and corridors. Best Practice Protected Area Guidelines Series No. 30. Gland, Switzerland: IUCN. *Corresponding authors: Hilty, Keeley, Woodley, Tabor.

Hulbert, J. M., Hallett, R. A., Roy, H. E., & Cleary, M. (2023). Citizen science can enhance strategies to detect and manage invasive forest pests and pathogens. Frontiers in Ecology and Evolution, 11. https://doi.org/10.3389/fevo.2023.1113978

Jedicke, E., Metzner, J., Unseld, L., (2012). Extensive grazing - Sustainable nature conservation on pastures in the EU, the German federation and its federal states.

Kruys, N., Fridman, J., Götmark, F., Simonsson, P., & Gustafsson, L. (2013). Retaining trees for conservation at clearcutting has increased structural diversity in young Swedish production forests. Forest Ecology and Management, 3*04*, 312–321. https://doi.org/10.1016/j.foreco.2013.05.018

Kurtul, I., & Haubrock, P. J. (2024). The need of centralized coordination to counter biological invasions in the European Union. Environmental Sciences Europe, 36(1). https://doi.org/10.1186/s12302-024-00955-0

Laner P., Favilli F., (2022). Report on ecological connectivity assessment. Evaluations for the project area and transboundary pilot region. Eurac Research Deliverable T.1.3.1. Draft version. EU Interreg Adrion; DINALPCONNECT project.

Laner P., Vitangeli V., Favilli F., Plassmann G., Coronado O. (2024). Mapping report of priority connectivity areas for spatial planning and GBI typology catalogue. An in-depth analysis of a potential ecological network and of human barriers in the EUSALP area. Deliverable D1.1.1. PlanToConnect project. https://www.alpine-space.eu/wp-content/uploads/2024/06/D1.1.1_Mapping-report-of-priority-connectivity-areas-for-spatial-planning.pdf

Lasanta, T., Nadal-Romero, E., & Arnáez, J. (2015). Managing abandoned farmland to control the impact of re-vegetation on the environment. The state of the art in Europe. Environmental Science & Policy, 52, 99–109. https://doi.org/10.1016/j.envsci.2015.05.012

Latterini, F., Mederski, P. S., Jaeger, D., Venanzi, R., Tavankar, F., & Picchio, R. (2023). The influence of various silvicultural treatments and forest operations on tree species biodiversity. Current Forestry Reports, 9(2), 59–71. https://doi.org/10.1007/s40725-023-00179-0

Leitner H., Leissing D., Signer J. (2014). Lebensraumvernetzung Salzburg. Im Auftrag von Land Salzburg und der Salzburger Jägerschaft. 59 S. Klagenfurt, am 22.12.2014.

Liebhold, A. M., Brockerhoff, E. G., Kalisz, S., Nuñez, M. A., Wardle, D. A., & Wingfield, M. J. (2017). Biological invasions in forest ecosystems. Biological Invasions, 19(11), 3437–3458. https://doi.org/10.1007/s10530-017-1458-5

LIFE+TEN Project: Provincia Autonoma di Trento (2024b, September 5). *LIFE+TEN*. Provincia Autonoma Di Trento. https://www.provincia.tn.it/Documenti-e-dati/Progetti/LIFE-TEN

Liu, M., Chen, C., Yang, L., Min, Q., & Xiong, Y. (2020). Agricultural eco-compensation may not necessarily reduce chemical inputs. The Science of the total environment, 741, 139847. https://doi.org/10.1016/j.scitotenv.2020.139847

Lõhmus, A., Remm, L., & Rannap, R. (2015b). Just a ditch in forest? Reconsidering draining in the context of sustainable forest management. BioScience, 65(11), 1066–1076. https://doi.org/10.1093/biosci/biv136

Martin, M., Boucher, Y., Fenton, N. J., Marchand, P., & Morin, H. (2020b). Forest management has reduced the structural diversity of residual boreal old-growth forest landscapes in Eastern Canada. Forest Ecology and Management, 458, 117765. https://doi.org/10.1016/j.foreco.2019.117765

Menzardi P., de Bortoli I., Favilli F. (2023). Report on tourists' surveys results. Eurac research, Italy. https://www.interreg-central.eu/wp-content/uploads/2024/05/HUMANITA_Report_tourists_survey_D_3_1_1_final-.pdf

Mori, A. S., & Kitagawa, R. (2014). Retention forestry as a major paradigm for safeguarding forest biodiversity in productive landscapes: A global meta-analysis. Biological Conservation, 175, 65–73. https://doi.org/10.1016/j.biocon.2014.04.016

Nadal-Romero, E., Llena, M., Cortijos-López, M., & Lasanta, T. (2023). Afforestation after land abandonment as a nature-based solution in Mediterranean mid-mountain areas: Implications and research gaps. Current Opinion in Environmental Science & Health, 34, 100481. https://doi.org/10.1016/j.coesh.2023.100481

Nature (London), (2021). Small farms outdo big ones on biodiversity - and crop yields. Vol.592 (7853), p.168-168.

Pastoralp. (2023b, November 24). Pastoralp tools. Pastoralp. https://www.pastoralp.eu/homepage/

Patterson C., Torres A., Coroi M., Cumming K., Hanson M., Noble B., … Jaeger J. A. G. (2022). Treatment of ecological connectivity in environmental assessment: A global survey of current practices and common issues. Impact Assessment and Project Appraisal, 40(6), 460–474. https://doi.org/10.1080/14615517.2022.2099728

Patterson C., Torres A., Coroi M., Cumming K., Hanson M., Noble B. F., … Jaeger J. A. G. (2023). Pathways for improving the consideration of ecological connectivity in environmental

assessment: lessons from five case studies. Impact Assessment and Project Appraisal, 41(5), 374–390. https://doi.org/10.1080/14615517.2023.2246727

Piccini, I., Pittarello, M., Gili, F., Dotta, A., Lorizzo, R., Magnani, C., Grieco, P., Lonati, M., Bertolino, S., & Bonelli, S. (2022). Using forest compensation funds to reverse biodiversity loss: A case study of Turin–Lyon High-Speed Railway Line. *Sustainability*, *14*(8), 4411. https://doi.org/10.3390/su14084411

Pötzelsberger, E., Spiecker, H., Neophytou, C., Mohren, F., Gazda, A., & Hasenauer, H. (2020). Growing non-native trees in European forests brings benefits and opportunities but also has its risks and limits. Current Forestry Reports, 6(4), 339–353. https://doi.org/10.1007/s40725-020-00129-0

Premelč M., Drouet Q., Bertoncelj I., Slana d. (2022). Strategy for improved ecological connectivity throughout the Dinaric Mountains and connecting them with the Alps. EU Interreg ADRION DINALPCONNECT project. https://dinalpconnect.adrioninterreg.eu/wp-content/uploads/2022/09/D.T1.4-Strategy-for-improved-EC-throughout-the-Dinaric-Mountains-and-connecting-them-with-the-Alps.pdf

Prosser, RS., Hoekstra, PF., Gene, S., Truman, C, White M., Hanson, ML. (2020) A review of the effectiveness of vegetated buffers to mitigate pesticide and nutrient transport into surface waters from agricultural areas. Journal Environmental Management. Volume 261, 1 May 2020, 110210. doi: https://doi.org/10.1016/j.jenvman.2020.110210.

Provincia Autonoma di Bolzano - Alto Adige. (2022, August 12). Rablà: continua il lavoro di eradicazione della pianta aliena. News Provincia di Bolzano. https://news.provincia.bz.it/it/news/rabla-continua-il-lavoro-di-eradicazione-della-pianta-aliena

Provincia Autonoma di Bolzano – Alto Adige. (2023, July 24). Migliorata la procedura per l'estrazione di materie prime minerali. News Provincia di Bolzano. https://news.provincia.bz.it/it/news/migliorata-la-procedura-per-l-estrazione-di-materie-prime-minerali

Provincia Autonoma di Bolzano – Alto Adige. (2023b, March 14). Cave e torbiere: approvato il disegno di legge. News Provincia di Bolzano. https://news.provincia.bz.it/it/news/cave-e-torbiere-approvato-il-disegno-di-legge

Provincia Autonoma di Bolzano – Alto Adige. (n.d.). Settore foreste - Selvicoltura naturalistica. Sostenibilità in Alto Adige. https://nachhaltigkeit.provinz.bz.it/it/projekte/settore-foreste-selvicoltura-naturalistica

Provincia Autonoma di Trento – Urbanistica (n.d) - Fondo per la riqualificazione degli insediamenti storici e del paesaggio. http://www.urbanistica.provincia.tn.it/fondo_paesaggio/

Provincia Autonoma di Trento, (2024, September 3). AZIONE C.7 Tutela di habitat: recupero di boschi umidi in zone umide lentiche e lotiche. Provincia Autonoma Di Trento. https://www.provincia.tn.it/News/Approfondimenti/AZIONE-C.7-Tutela-di-habitat-recupero-di-boschi-umidi-in-zone-umide-lentiche-e-lotiche#

Puettmann, K. J., Wilson, S. M., Baker, S. C., Donoso, P. J., Drössler, L., Amente, G., Harvey, B. D., Knoke, T., Lu, Y., Nocentini, S., Putz, F. E., Yoshida, T., & Bauhus, J. (2015b).

Silvicultural alternatives to conventional even-aged forest management - what limits global adoption? Forest Ecosystems, 2(1). https://doi.org/10.1186/s40663-015-0031-x

Räsänen, A., Albrecht, E., Annala, M., Aro, L., Laine, A. M., Maanavilja, L., Mustajoki, J., Ronkanen, A. K., Silvan, N., Tarvainen, O., & Tolvanen, A. (2023). After-use of peat extraction sites - A systematic review of biodiversity, climate, hydrological and social impacts. The Science of the total environment, 882, 163583. https://doi.org/10.1016/j.scitotenv.2023.163583

Responsiblyproducedpeat (n.d). What we do. Responsiblyproducedpeat. https://www.responsiblyproducedpeat.org/en/what-we-do

Rixen C., Rolando A., (2013). The Impacts of Skiing and Related Winter Recreational Activities on Mountain Environments. Bentham Science Publishers.

Rybak, J., Gorbatyuk, S. M., Bujanovna-Syuryun, K. C., Khairutdinov, A. M., Tyulyaeva, Y. S., & Makarov, P. S. (2021). Utilization of mineral waste: A method for expanding the mineral resource base of a mining and smelting company. *Metallurgist*, *64*(9–10), 851–861. https://doi.org/10.1007/s11015-021-01065-5

Schulz, T., Ohmura, T., Troxler, D., & Lieberherr, E. (2024). Forest clearances, compensatory afforestation and biodiversity offsetting in forests: Balancing flexibility and equivalency in Switzerland. Forest Policy and Economics, 163, 103219. https://doi.org/10.1016/j.forpol.2024.103219

Stauder, J., Meimberg, H., & Kriechbaum, M. (2023). An exploration of drivers for abandonment or continuation of summer pasture grazing in South Tyrol, Italy. Sustainability, 15(9), 7355. https://doi.org/10.3390/su15097355

Sun, H., Douma, J.C., Schenk, M.F. et al. (2023) Zoning strategies for managing outbreaks of alien plant pests in the European Union: a review. J Pest Sci 96, 903–919. https://doi.org/10.1007/s10340-023-01591-y

Torres A., Patterson C., & Jaeger J. A. G. (2022). Advancing the consideration of ecological connectivity in environmental assessment: Synthesis and next steps forward. Impact Assessment and Project Appraisal, 40(6), 451–459. https://doi.org/10.1080/14615517.2022.2134619

Torresani, L., Wu, J., Masin, R., Penasa, M., & Tarolli, P. (2019). Estimating soil degradation in montane grasslands of North-eastern Italian Alps (Italy). *Heliyon*, *5*(6), e01825. https://doi.org/10.1016/j.heliyon.2019.e01825

University of Ljubljana, Biotechnical Faculty, Acer Novo mesto d.o.o., & Fisheries Research Institute of Slovenia. (2021). The identification of ecological corridors at the national level to support spatial development planning and the management of nature and other resources. Final report of the CRP V5-1937 project, funded by ARRS and MOP. https://www.bf.uni-lj.si/mma/CRP_V5-1937_PORO__ILO_2021_12_09_urejeno_julij_2022.pdf/20221027094623 11/?m=1666856783

USDA Climate Hubs (n.d), Managing grazing to improve climate resilience. https://www.climatehubs.usda.gov/hubs/northeast/topic/managing-grazing-improve-climate-resilience

Vannucci, A., Andreoli, M., & Rovai, M. (2022). Land use change and disappearance of hedgerows in a Tuscan rural landscape: A discussion on policy tools to revert this trend. Sustainability, 14(20), 1334*1. https://doi.org/10.3390/su142013341*

Venette, R. C., Gordon, D. R., Juzwik, J., Koch, F. H., Liebhold, A. M., Peterson, R. K. D., Sing, S. E., & Yemshanov, D. (2021b). Early intervention strategies for invasive species management: connections between risk assessment, prevention efforts, eradication, and other rapid responses. In Springer eBooks (pp. 111–131). https://doi.org/10.1007/978-3-030-45367-1_6

Windegger, F., Scuttari, A., Walder, M., Erschbamer, G., de Rachewiltz, M., Corradini, P., Weisel, Z. K., Habicher, D., Ghirardello, L., Wallnöfer, V., Garzon, G., Moroder, P. (2022). The Sustainable Tourism Observatory of South Tyrol (STOST). Annual Progress Report – 2022 edition, Bolzano, Eurac Research.

Annexes

Annex 1: Main pressures and threats from Natura 2000 reporting

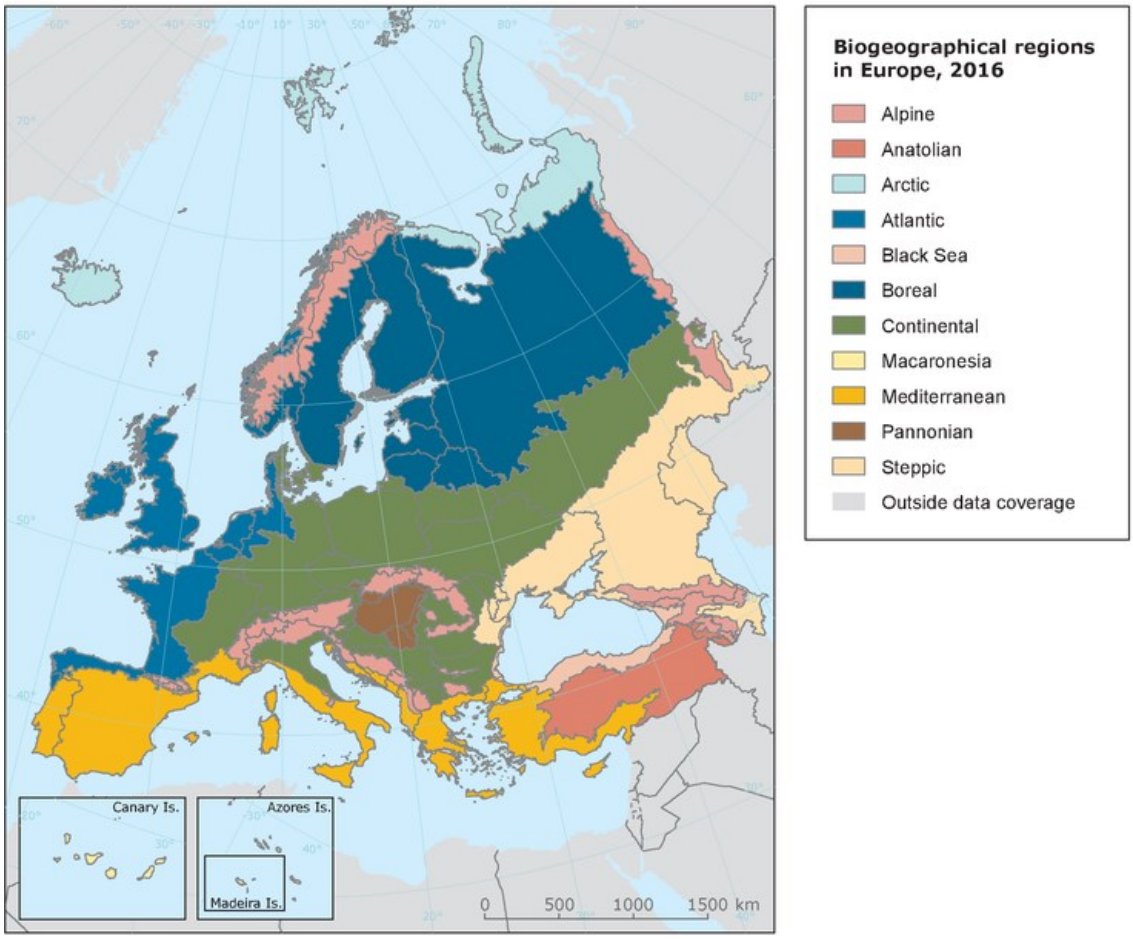


Figure 22: Biogeographical regions in Europe

Source: EEA (2017). https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2

Following figures are showing proportions of habitats or species assessments reported as being affected by one or more pressures/threats from broad pressure categories. This information illustrates the relative importance of pressures (currently acting) and threats (expected in near future).

Query 1:

Habitats, Member State(s): AT, DE, FR, IT, SI; Type: Pressures and threats; Biogeographical regions: Alpine (ALP), Continental (CON); Impact: All; Habitat group: All

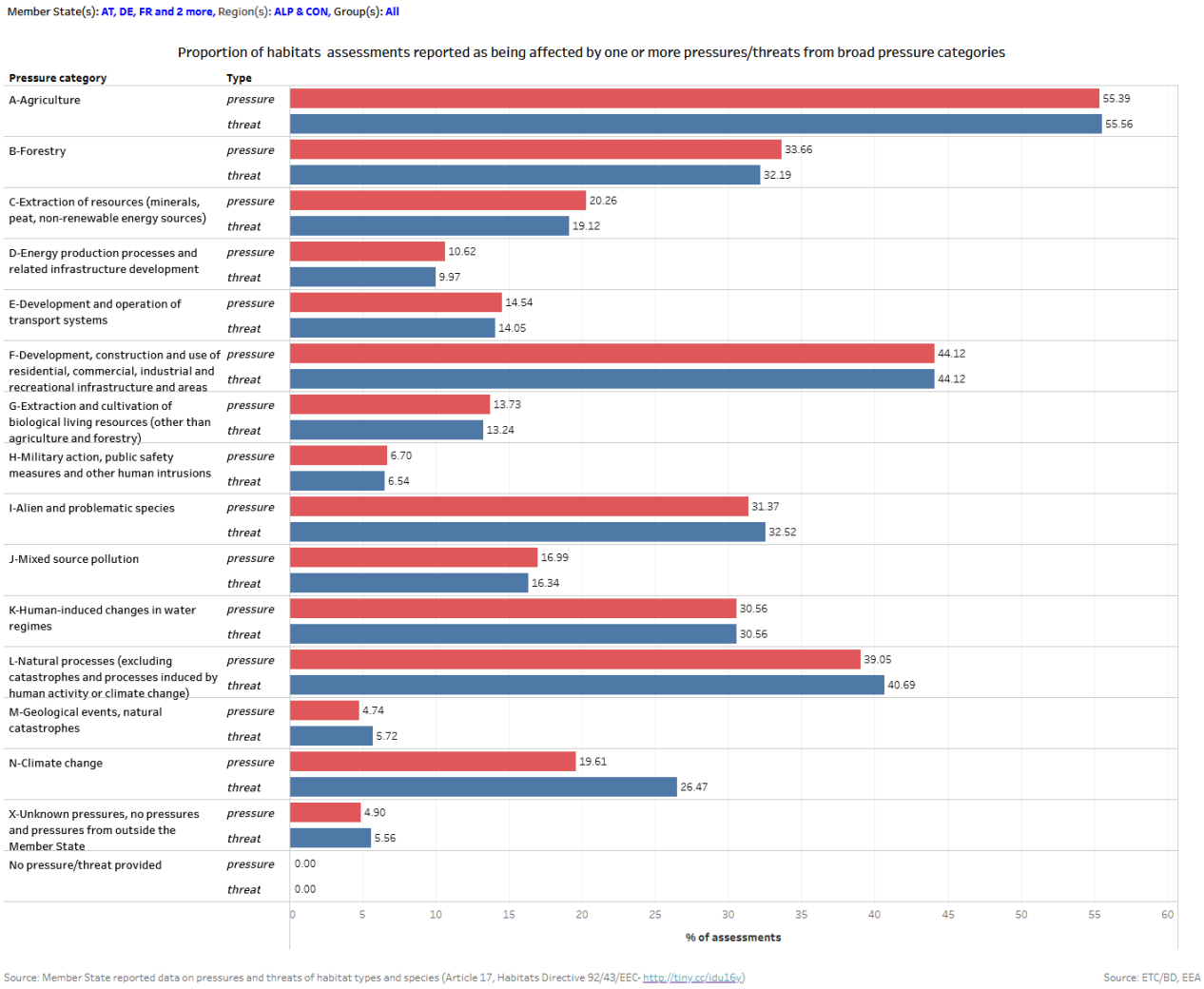


Figure 23: Query 1. Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

Query 2:

Habitats, Member State(s): AT, DE, FR, IT, SI; Type: Pressures and threats; Biogeographical regions: Alpine (ALP), Continental (CON); Impact: **High only**; Habitat group: All

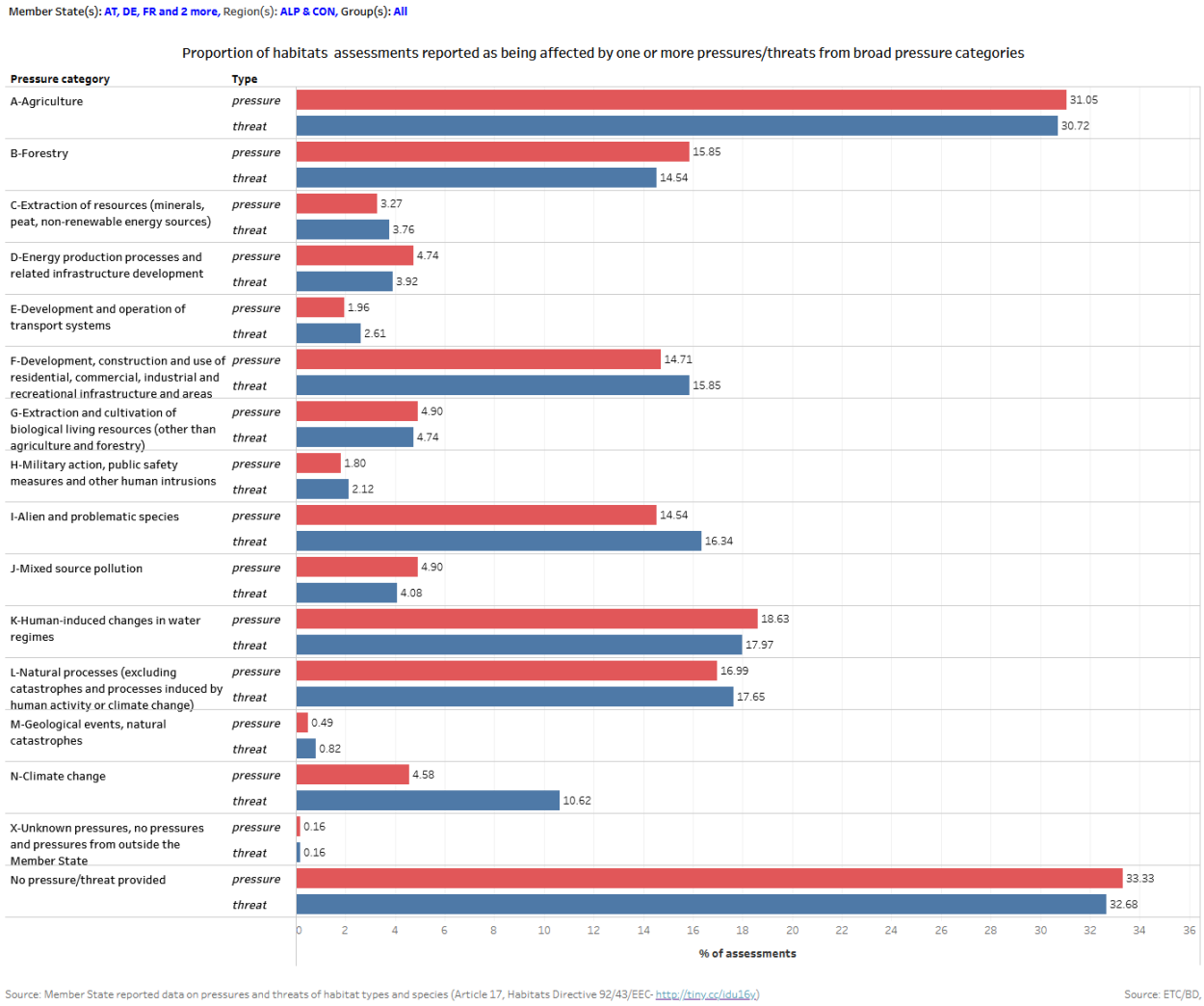


Figure 24: Query 2. Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

Query 3:

Habitats, Member State(s): **AT, SI**; Type: Pressures and threats; Biogeographical regions: Alpine (ALP), Continental (CON); Marine Mediterranean Region (MMED); Impact: All; Habitat group: All

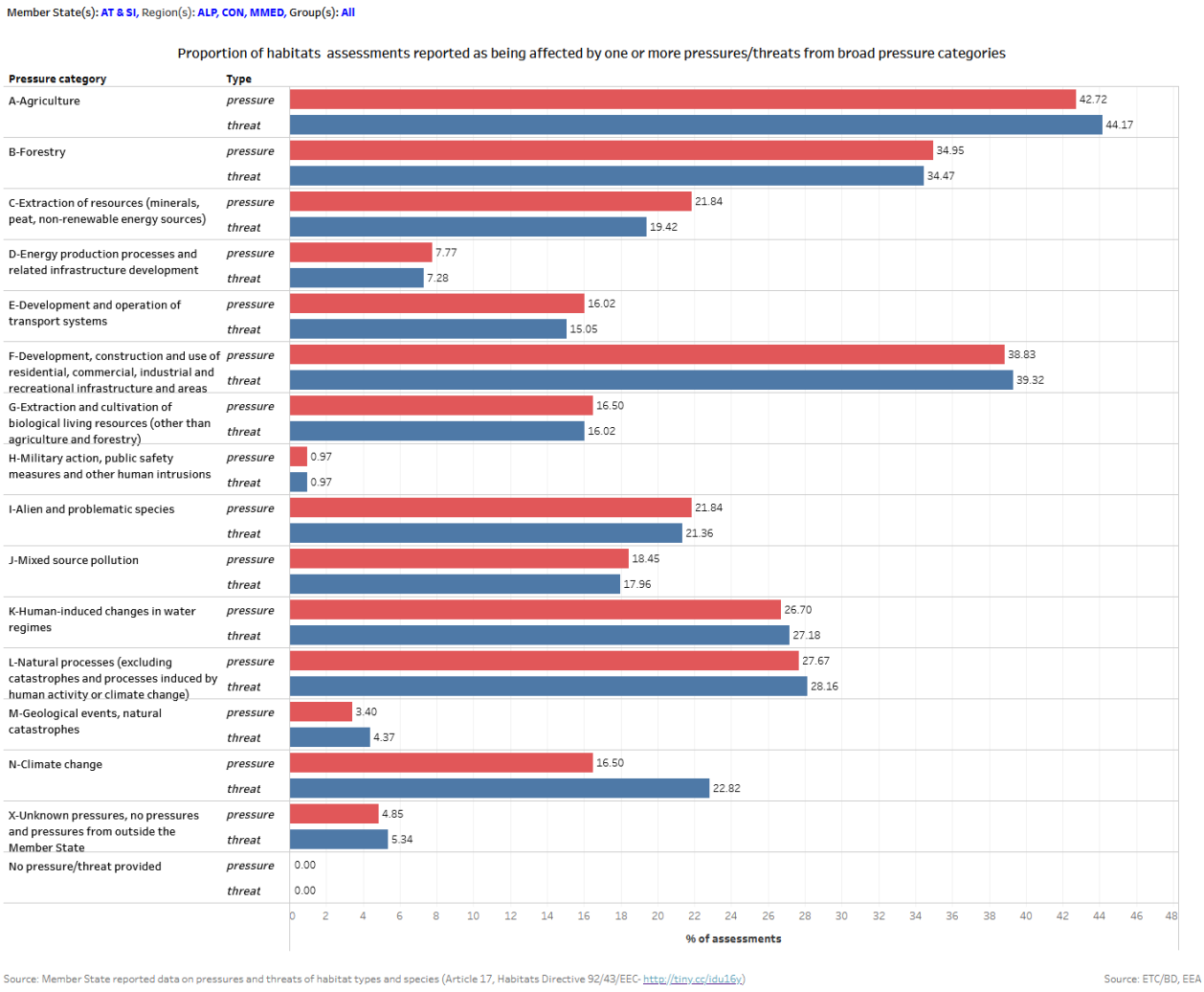


Figure 25:Query 3. Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

Query 4:

Habitats, Member State(s): **AT, SI**; Type: Pressures and threats; Biogeographical regions: Alpine (ALP), Continental (CON); Marine Mediterranean Region (MMED); Impact: **High only**; Habitat group: All

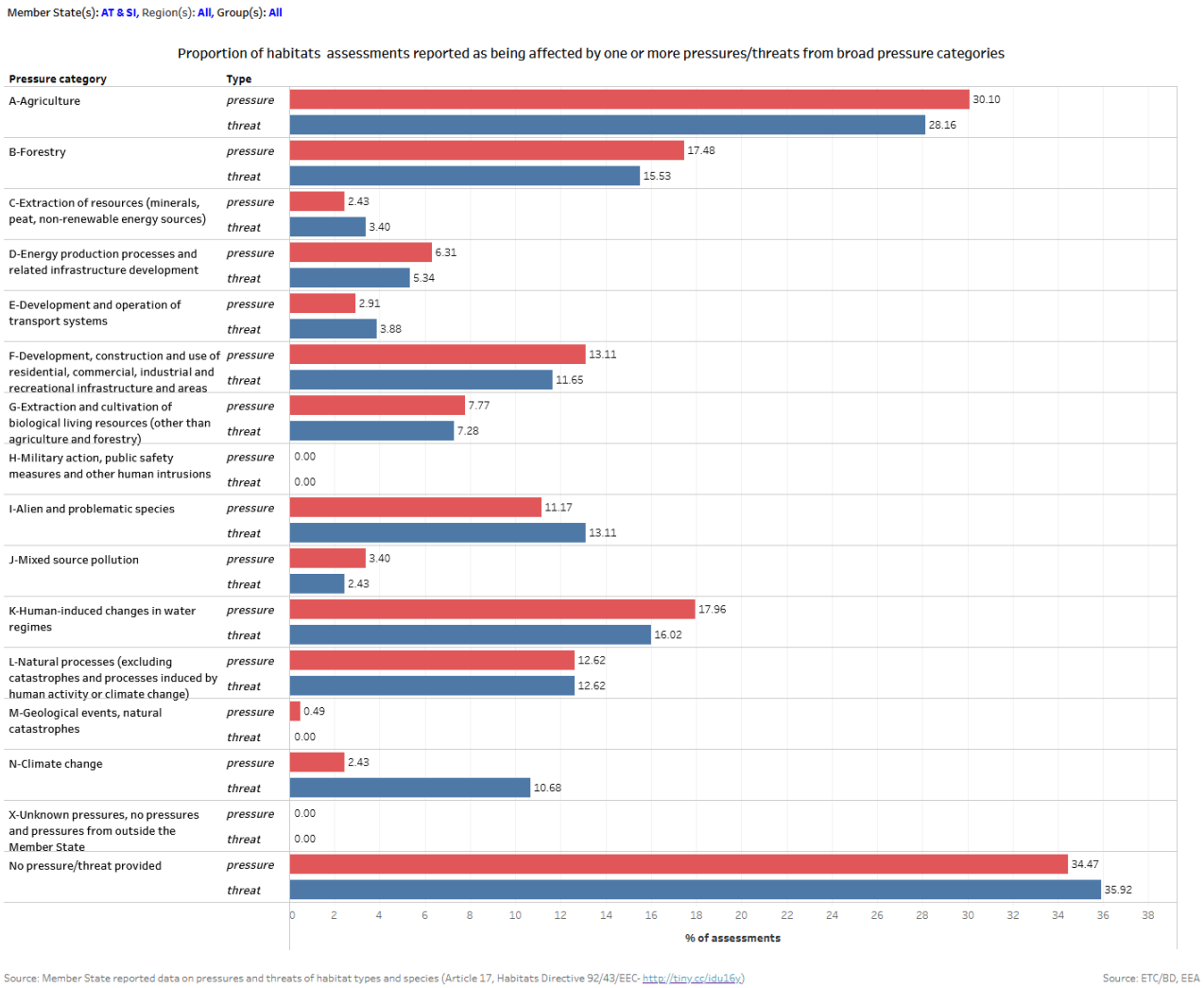


Figure 26: Query 4. Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

Query 5:

Habitats, Member State(s): AT, DE, FR, IT, SI; Type: Pressures and threats; Biogeographical regions: **Alpine (ALP)**; Impact: All; Habitat group: All

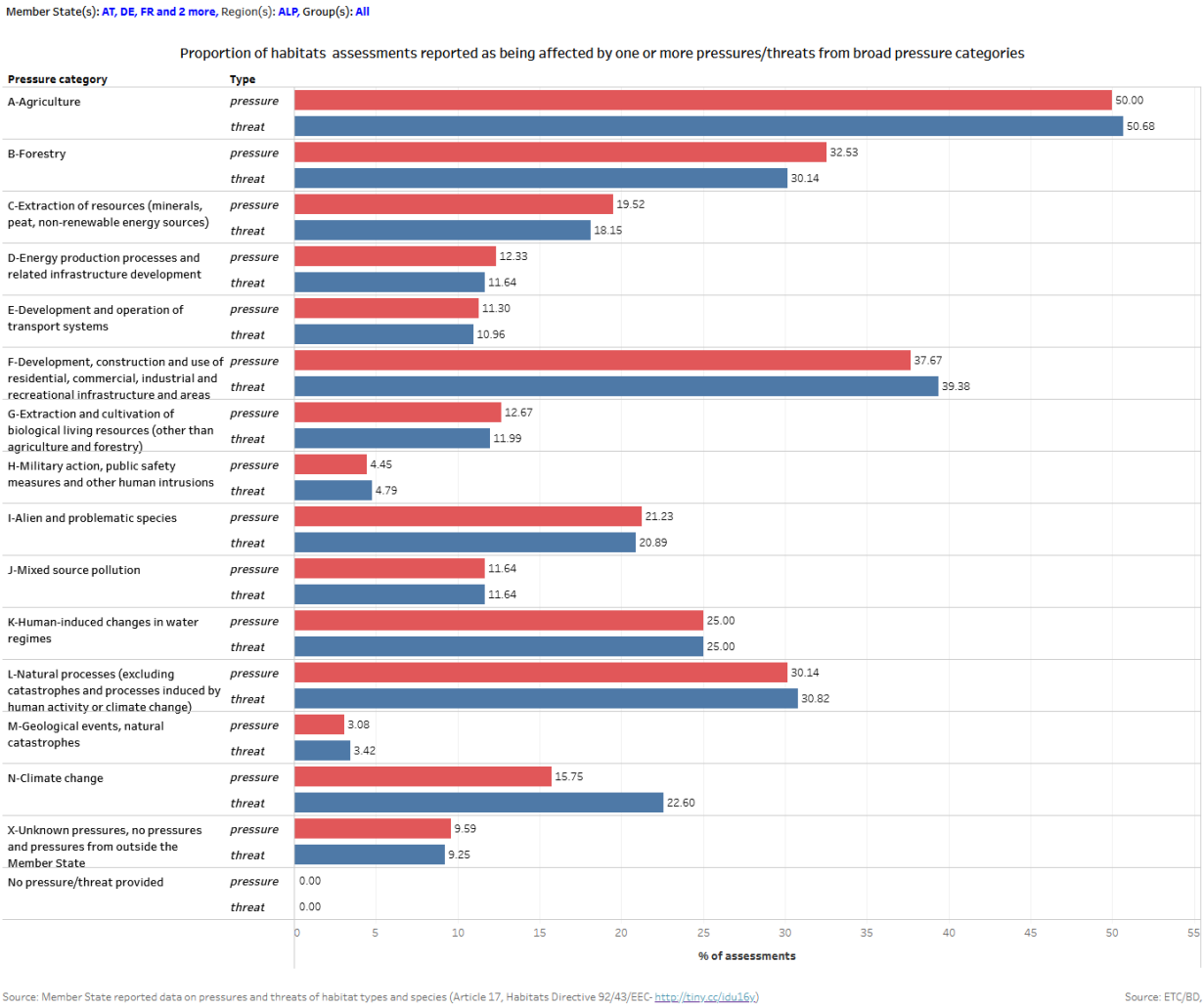


Figure 27: Query 5. Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

Query 6:

Habitats, Member State(s): AT, DE, FR, IT, SI; Type: Pressures and threats; Biogeographical regions: **Alpine (ALP)**; Impact: **High only**; Habitat group: All

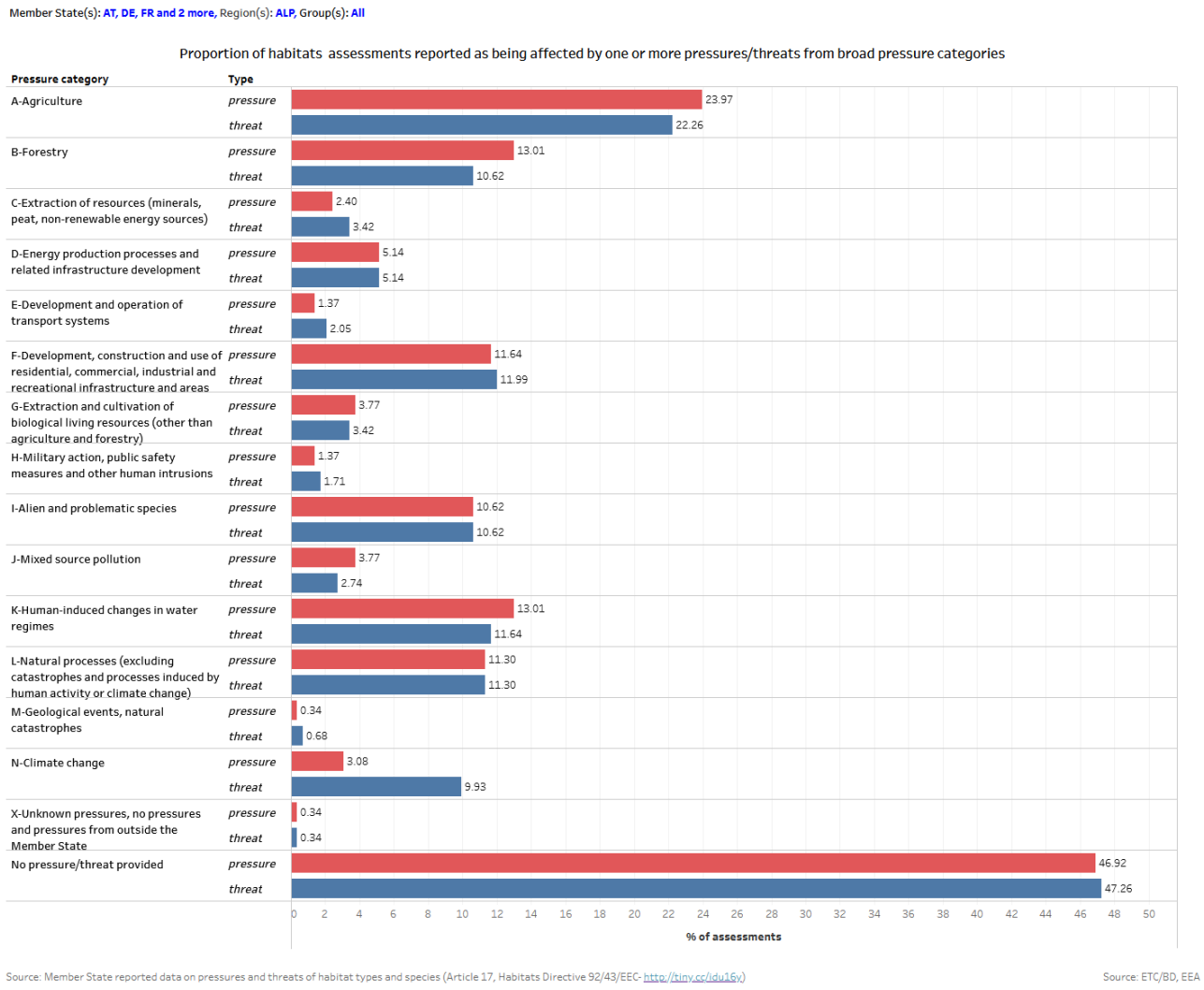


Figure 28: Query 6. Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

Annex 2 Proportion of habitats assessments reported as being affected by one or more pressures/threats from broad pressure categories.

		All countries				AT, SI				Inner Alpine Space			
		Query 1 - all pressures		Query 2 - high only		Query 3 - all pressures		Query 4 - high only		Query 5 - all pressures		Query 6 - high only	
		pressures	threats	pressures	threats	pressures	threats	pressures	threats	pressures	threats	pressures	threats
PA	Agriculture related practices	55,39	55,56	31,05	30,72	42,72	44,17	30,10	28,16	50,00	50,68	23,97	22,26
PB	Forestry related practices	33,66	32,19	15,85	14,54	34,95	34,47	17,48	15,53	32,53	30,14	13,01	10,62
PC	Extraction of resources (minerals, peat, non-renewable energy resources)	20,26	19,12	3,27	3,76	21,84	19,42	2,43	3,40	19,52	18,15	2,40	3,42
PD	Energy production processes and related infrastructure development	10,62	9,97	4,74	3,92	7,77	7,28	6,31	5,34	12,33	11,64	5,14	5,14
PE	Development and operation of transport systems	14,54	14,05	1,96	2,61	16,02	15,05	2,91	3,88	11,30	10,96	1,37	2,05
PF	Development, construction and use of residential, commercial, industrial and recreational infrastructure and areas	44,12	44,12	14,71	15,85	38,83	39,32	13,11	11,65	37,67	39,38	11,64	11,99
PG	Extraction and cultivation of biological living resources (other than agriculture and forestry)	13,72	13,24	4,9	4,74	16,50	16,02	7,77	7,28	12,67	11,99	3,77	3,42
PH	Military action, public safety measures, and other human intrusions	6,7	6,54	1,8	2,12	0,97	0,97	0,00	0,00	4,45	4,79	1,37	1,71
PI	Alien and problematic species	31,37	32,52	14,54	16,34	21,84	21,36	11,17	13,11	21,33	20,89	10,62	10,62
PJ	Climate change	19,61	26,47	4,58	10,62	16,50	22,82	2,43	10,68	15,75	22,60	3,08	9,93
PK	Mixed source pollution	16,99	16,34	4,94	4,08	18,45	17,96	3,40	2,43	11,64	11,64	3,77	2,74
PL	Human-induced changes in water regimes	30,56	30,56	18,63	17,97	26,70	27,18	17,96	16,02	25,00	25,00	13,01	11,64
PM	Geological events, natural processes and catastrophes (values taken from natural processes).	39,05	40,69	16,99	17,65	27,67	28,16	12,62	12,62	30,14	30,82	11,30	11,30
PX	Unknown pressures, no pressures and pressures from outside the Member State	4,9	5,56	33,33	32,68	4,85	5,35	34,47	35,92	9,59	9,25	46,92	47,26

Figure 13: Main pressures and threats. The color scale, from red to green, visualizes the distribution of pressures and threats from greatest to least.

Annex 3: Questionnaire for expert evaluation of anthropogenic pressures in pilot sites

Eurac Research – a private, not-for-profit research center in Bolzano, Italy – is conducting a research study on how to mainstream ecological connectivity in spatial planning processes. The study is funded by the Interreg Alpine Space Programme, in collaboration with project partners from five alpine countries.

The aim of the Interreg Alpine Space project "PlanToConnect" is to **promote the consideration of ecological networks in spatial planning instruments** of the Alpine regions.
Among the actions of the project, one activity specifically focuses on creating an inventory of possible mitigation and compensation measures, as well as incentives to minimise anthropogenic pressure on a set of typical ecological corridors in the Alpine Space.

The Institute for Regional Development at Eurac Research has prepared, as a first step, a list of anthropogenic pressures mainly affecting protected areas, based on desk research. However, ecological linkages mostly depend on landscape elements outside protected areas. Therefore, we kindly **request your professional validation** of this list of anthropogenic pressures on green and blue infrastructure outside protected areas, regarding its relevance to the geographical area where you work, and which is of your local knowledge.

This survey will take approximately ten minutes to complete.
May we **kindly ask you to complete it by February 14.**

The staff of the project thanks you for your collaboration and your valuable contribution.
The Staff of the Institute for Regional Development (Eurac Research) is at your disposal for further information:
· Peter Laner (peter.laner@eurac.edu; +39 0471 055 438)
· Andrea Omizzolo (andrea.omizzolo@eurac.edu;+39 0471 055 324).

* 1. Privacy Policy

☐ All data collected through this questionnaire will be processed only in anonymous form or rather in such a manner that it is impossible identify the individuals. Participation in the survey is voluntary and may be terminated at any time without giving reasons.

* 2. Declaration

☐ I CONFIRM that I have understood the content and objectives of the questionnaire and that I agree to complete the survey voluntarily.

The project is working on various pilot sites in the Alpine Space (see https://www.alpine-space.eu/project/plantoconnect/ - "Pilots"). The description of the corridor typology of your pilot site was sent via email.

* 3. Please, select the region you are referring to:

* 4. What is your field of work? Choose one of the following options and specify the field of work

◯ Biology, wildlife management, environmental sciences, or similar fields
◯ Landscape planning, urban planning, regional planning, or similar fields
◯ Other (please specify)

The European Environmental Agency (EEA) provides a list of standardized anthropogenic pressures (https://cdr.eionet.europa.eu/help/habitats_art17), which is used for reporting of the conservation status regarding natural habitat types in designated areas. It is structured into two hierarchical levels, of which the first comprises several overarching categories.

* 5. Considering these overarching categories, how strong are the effects of the following anthropogenic pressures regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Agricultural practices	○	○	○	○	○	○
Urban development	○	○	○	○	○	○
Forestry related practices	○	○	○	○	○	○
Alien and problematic species	○	○	○	○	○	○
Extraction of resources	○	○	○	○	○	○
Energy production processes	○	○	○	○	○	○
Transport infrastructure	○	○	○	○	○	○
Human-induced changes in water regimes*	○	○	○	○	○	○

*This category is used when the key driver of the changes is unclear or where these changes are related to several causes

Each overarching category of pressure is composed of several subcategories. You will now be asked to evaluate the subcategories of each main anthropogenic pressures

* 6. How strong are the effects of the following subcategories of the pressure "**agricultural practices**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Conversion into agricultural land (excluding drainage and burning)	○	○	○	○	○	○
Removal of small landscape features for agricultural parcel consolidation	○	○	○	○	○	○
Abandonment of management/use of grassland and other agricultural and agroforestry system	○	○	○	○	○	○
Intensive grazing or overgrazing by livestock	○	○	○	○	○	○
Use of plant protection chemicals in agricultural land	○	○	○	○	○	○
Drainage for use as agricultural land	○	○	○	○	○	○
Agricultural activities generating pollution to surface or ground waters (including marine)	○	○	○	○	○	○

* 7. How strong are the effects of the following subcategories of the pressure "**transport infrastructure**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Roads – highways and related infrastructure	○	○	○	○	○	○
Railway and related infrastructure	○	○	○	○	○	○
Shipping lanes and ferry lanes transport operations	○	○	○	○	○	○
Flight paths of planes, helicopters and other non-leisure aircrafts	○	○	○	○	○	○

* 8. How strong are the effects of following subcategories of the pressure "**extraction of resources**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Extraction of minerals (e.g. rock, metal ores, gravel, sand, shell)	○	○	○	○	○	○
Peat extraction	○	○	○	○	○	○
Dumping/depositing of inert and dredged materials from terrestrial and marine extraction	○	○	○	○	○	○

* 9. How strong/severe are the effects of following subcategory of the pressure "**urban/industrial development**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Conversion from other land uses to built-up areas	○	○	○	○	○	○
Construction or modification (e.g. of housing and settlements) in existing built-up areas	○	○	○	○	○	○
Creation or development of sports, tourism and leisure infrastructure	○	○	○	○	○	○
Sports, tourism and leisure activities	○	○	○	○	○	○
Residential, commercial and industrial activities and structures generating noise, light, heat or other forms of pollution	○	○	○	○	○	○
Drainage, land reclamation and conversion of wetlands, marshes, bogs, etc. for built-up areas	○	○	○	○	○	○
Modification of coastline, estuary and coastal conditions for built-up areas	○	○	○	○	○	○

* 10. How strong are the effects of the following subcategories of the pressure "**forestry related practices**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Clear-cutting, removal of all trees	○	○	○	○	○	○
Forest management reducing old growth forests	○	○	○	○	○	○
Introduction and spread of new species for forestry purposes (including GMO's)	○	○	○	○	○	○
Removal of dead and dying trees (including debris)	○	○	○	○	○	○
Removal of old trees	○	○	○	○	○	○
Drainage for forestry	○	○	○	○	○	○

* 11. How strong are the effects of the following subcategories of the pressure "**alien and problematic species**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Invasive alien species of Union concern	○	○	○	○	○	○
Other invasive alien species (other than species of Union concern)	○	○	○	○	○	○
Problematic native species	○	○	○	○	○	○
Plant and animal disease pathogens and pests	○	○	○	○	○	○

* 12. How strong are the effects of the following subcategories of the pressure "**energy production - renewable energy**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Windpower - windmills	○	○	○	○	○	○
Solar power – photovoltaics	○	○	○	○	○	○
Bioenergy – biomass	○	○	○	○	○	○
Transmission of energy – high voltage transmission line	○	○	○	○	○	○
Hydropower - dams	○	○	○	○	○	○

* 13. How strong are the effects of the following subcategories of the pressure "**human-induced changes in water regimes**" regarding ecological linkages in your region?

	Very weak	Weak	Moderate	Strong	Very strong	I don't know
Abstraction from groundwater, surface water or mixed water (mixed or unknown drivers)	○	○	○	○	○	○
Drainage (mixed or unknown drivers)	○	○	○	○	○	○
Development and operation of dams (mixed or unknown drivers)	○	○	○	○	○	○
Modification of hydrological flow (mixed or unknown drivers)	○	○	○	○	○	○
Physical alteration of water bodies (mixed or unknown drivers)	○	○	○	○	○	○

4. From your work experience, are there any other severe pressures that occur in your region? If so, please briefly descrive them.

Thank you for taking the time to complete this survey, we appreciate your contribution. We will get back to you to share the survey results and next steps. For more information about the project, please visit the PlanToConnect website.

D1.2.1 Transnational inventory of alpine GBI network elements with compatible and conflicting uses

Main authors:
Laner Peter (peter.laner@eurac.edu), Vittoria Vettorazzo (vittoria.vettorazzo@eurac.edu), – Eurac Research

Layout
Laner Peter, Vittoria Vettorazzo - Institute for Regional Development, Eurac Research

April 2025

With contributions from the PlanToConnect project partners:

Urban Planning Institute of the Republic of Slovenia (SI)

Veneto Region (IT)

ALPARC – the Network of Alpine Protected Areas (FR)

Asters, organisation for the conservation of natural areas in Upper Savoy (FR)

Eurac Research (IT)

ifuplan - Institute for Environmental Planning and Spatial Development (DE)

University of Würzburg (DE)

Salzburg Institute for Regional Planning and Housing (AT)

E.C.O. Institute of Ecology Ltd. (AT)

Fondazione Politecnico di Milano (IT)