Interreg Alpine Space

Co-funded by the European Union

PlanToConnect

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 Ecological connectivity, green and blue infrastructure networks and spatial planning in the Alpine Space

ANNEXES

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Annex 1: Ecological Networks in the Alpine Space Regions

The section includes descriptions and analysis of each single network that belongs to the mosaic of national and regional concepts in the Alpine space defined by EURAC Research and discussed in Section 2 of the report.

Partners analyzed and described the following ecological network plans/concepts:

NUTS 0
- *Austria (Lebensraumvernatzung.at (2022). Geodatenkatalog Lebensraumvernetzung. LRVA-2022: Aktuelle Version der Lebensraumkorridore Österreich (Version 2022-10-16): SIR, ECO,*
- *Germany (German National Biotope network): Ifuplan, JMU,*
- *Slovenia (Definition of ecological corridors at SI level as a support for spatial development planning and management of nature and other resources): UIRS*
- *Switzerland (Wildtierkorridore Überregional): RV,*
- *France (La Trame verte et bleue): ALPARC, ASTERS-CEN74*

NUTS 2:
- *Veneto, Friuli V.G., Liguria: RV,*
- *Lombardia, Piemonte: FPM,*
- *P.A. Bolzano, P.A. Trento: EURAC Research.*

As the European Union remarks, the Nomenclature of territorial units for statistics, abbreviated NUTS (from the French version Nomenclature des Unités territoriales statistiques) is a geographical nomenclature subdividing the economic territory of the European Union (EU) into regions at three different levels (NUTS 1, 2 and 3 respectively, moving from larger to smaller territorial units). Above NUTS 1, there is the 'national' level of the Member States. The NUTS is based on Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS), which is regularly updated.

The current NUTS 2021 classification is valid from 1 January 2021 and lists 92 regions at NUTS 1, 242 regions at NUTS 2 and 1 166 regions at NUTS 3 level. The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK for the purpose of:

- the collection, development, and harmonization of European regional statistics
- socio-economic analyses of the regions,
- NUTS 1: major socio-economic regions,
- NUTS 2: basic regions for the application of regional policies,
- NUTS 3: small regions for specific diagnoses,
- framing of EU regional policies,
- regions eligible for support from cohesion policy have been defined at NUTS 2 level,
- the cohesion report has so far mainly been prepared at NUTS 2 level.

For each area listed above, a text has been drafted by responsible PPs (in brackets) including the following paragraphs:

1. Network typology

- Protected area network: network that recognizes only what is already in the territory: e.g includes N2000 and other national or regional protected areas according to IUCN classification. Contain measures to maintain habitat. Does not contain measures for ecological connectivity (e.g., no corridors).
- Ecological network plan adds other biodiversity-relevant areas identified, by studies, analyses, models, etc., to the 'Analytical Network'. Defines measures for conservation and protection. Contains prescription to improving connectivity (e.g., corridor schemes with prescription or addresses for their implementation).
- Other (e.g. GBI network concepts)

2. The ecological network and its legal framework of reference

The paragraph provides a synthetic description of the network. PPs included the following information:

- If the network plan/concept is at national (NUTS 0) or sub-national (NUTS 2) level.
- If it is a legally binding tool (e.g., a formal plan defined by the statutory framework and feature regulated procedures, such as spatial plans, landscape plans, etc.), or if it is an informal plan/study (e.g. commissioned by the government to research institutes, universities or professionals). Should the network be a part of a legal planning system, PPs had to specify the reference law (e.g., spatial planning law, nature protection law, etc.) from the responsible authority.
- If the ecological network described is part of a top-down interconnected planning system. Spatial plans may come in integrated systems, with higher level plans (e.g., national and regional) prevailing over local level spatial policies and plans (e.g., regional and/or local). Lower-level spatial policies and plans should always adopt the specific determinations of higher-level spatial plans (e.g., from national, regional, provincial to municipal). PPs had to provide a scheme and describe what is the difference among the levels, with a focus on connectivity planning.

3. Network objectives

In this paragraph, PPs were called to specify the ecological network objectives, as stated in the planning document. Plus, they had to define if the network plan is targeting biodiversity and the movement of species/genes only. PPs had to explicitly state if it ensures the preservation of ecological processes/functions/services as well (e.g., nutrient cycle, primary production, water purification, climate risk protection, etc.).

4. Network structure and elements

In this paragraph, PPs had to list the hierarchy of the elements that are included in the network and provide a brief description of each of them. They specified the connectivity elements (e.g., steppingstones, corridors, linkages, etc.) and, possibly, which spatial category is addressed by the EC or GBI network (e.g., the German National Biotope network

proposes connectivity for three spatial categories: forest, wet/aquatic habitats, dry habitats). Plus, PPs had to determine if connections to neighboring administrative units are considered (countries and/or regions) and the definition of any prioritization about biodiversity area or corridor.

5. Methodology used in network and corridor design

In this paragraph, PPs were called to describe the methodology applied to draft the network scheme (e.g., core areas, buffers, corridors, etc.), with a focus on connectivity conservation and restoration areas outside of protected areas. They had to specify if the methodology to identify them is based on a structural approach (habitats and landscape matrix) or a functional approach (the socalled species-specific connectivity). The specification refers to the behavior of each single investigated species, or of umbrella species, to environmental conditions, or to both species- and landscape-specific approaches, combining different methods.

6. Tools and guidance for planners and practitioners

In this paragraph, PPs described the tools provided by the institution that outlined the network. The tools may include maps (as pdf or GIS datasets), regulations, projects, guidelines, recommendations, legally binding frameworks, action programs, economic resources (providing links to the tools). E.g., in Veneto the regional spatial planning department provides GIS maps (downloadable Shapefiles/Layers) and technical standards.

7. Specific regulations for connectivity conservation and restoration areas

PPs had to clarify if there is any specific legislative requirement that applies to connectivity areas, describing if there are any specific regulations about developments and uses in the connectivity areas. Plus, they were called to describe if there are plans, projects, transformative actions, human activities, which take place in connectivity areas that should be assessed through environmental impact assessments. In accordance with paragraphs 3 and 4 of Article 6 of Council Directive 92/43/EEC, national laws apply “Assessment” to alterations or projects in or near Natura 2000 Sites. In implementation of Article 10 of the same directive, Member States can optionally apply this procedure also in the case of alterations or projects that, although outside Natura 2000 Sites, may disturb protected habitats and species.

8. Implementation of the connectivity conservation and restoration areas

In this paragraph, PPs had to explain how the ecological network is implemented, thus whether there are plans or projects for concrete implementation. Some examples:

- in a multi-level planning system, they should explain how the higher-level network is included and developed in the urban/territorial plans of the lower administrative levels,
- they should describe whether there are projects with interventions for the realization of the ecological network such as Wildlife crossings structures (overpasses, green bridges, tunnels, and so on), or management interventions of existing habitats, or restoration interventions of existing habitats, such as the development of new habitats,
- They had to provide here a brief description and reference to relevant good practices.

9. Implementation difficulties/opportunities

In this part, PPs had to describe difficulties and/or opportunities in implementing and building the ecological network, focusing on connectivity conservation and restoration areas outside the main protected areas. For example:

- if obstacles, gaps or inconsistencies emerged in corridor planning across planning levels and/or administrative borders,
- implementation challenges,
- perspective to improve the ecological network,
- upgrade of existing or development of new tools to implement the network,
- suggestions to improve the planning instruments,
- implementing environmental assessment to project or land transformation that could be disturb corridors,
- example or best practices of connectivity implementation in the country.

10. Monitoring system

This paragraph describes whether (and how) the implementation of the network and of the connectivity conservation and restoration areas is monitored or not. If any, PPs had to describe the monitoring system, the tools used and their features (indicators, maps), reporting periodicity and the institution or authority responsible for monitoring. In a multilevel planning system monitoring could also include an assessment of consistency in network development at different administrative levels (providing references and link to any relevant assessments and monitoring report).

Information for country overviews has been elaborated from: European Environment Agency (EEA): Member States profiles[1] and summary dashbord under article 17 (habitat)[2] and under art 12 (birds)[3] State of Nature report 2013-2018; Environment Statistics from the United Nations[4] Environment at a Glance Indicators - OECD Library[5], Transition Performance Index 2021, European Union[6].

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[1] https://www.eea.europa.eu/en/countries/eea-member-countries

[2] https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards-archived/main-pressures-and-threats

[3] https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-12-national-summary-dashboards-archived/main-pressures-and-threats

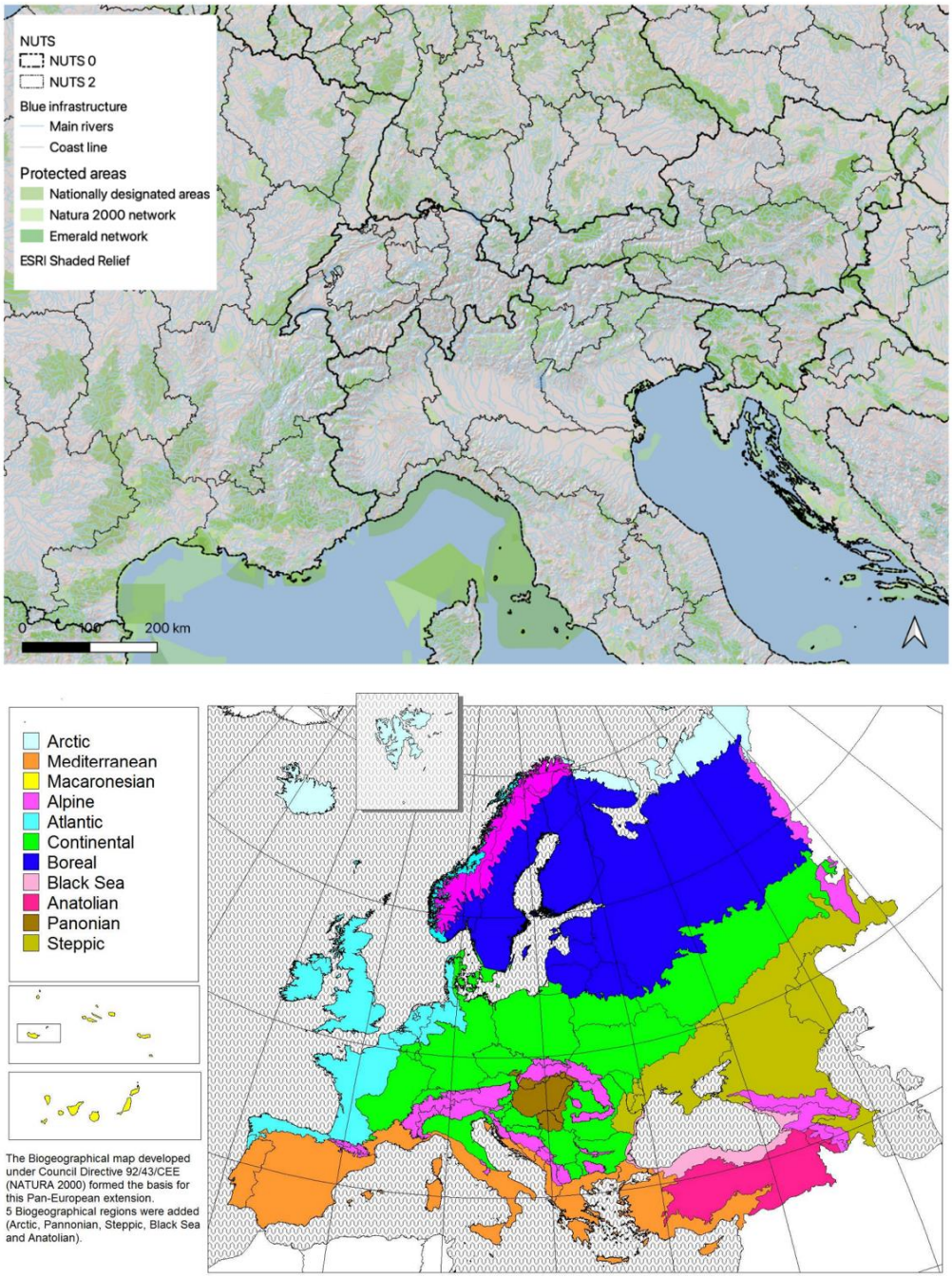
[4] *https://unstats.un.org/unsd/envstats/snapshots/*,

[5] *https://www.oecd-ilibrary.org*

[6] *https://projects.research-and-innovation.ec.europa.eu/en/knowledge-publications-tools-and-data/interactive-reports/transition-performance-index-2021*

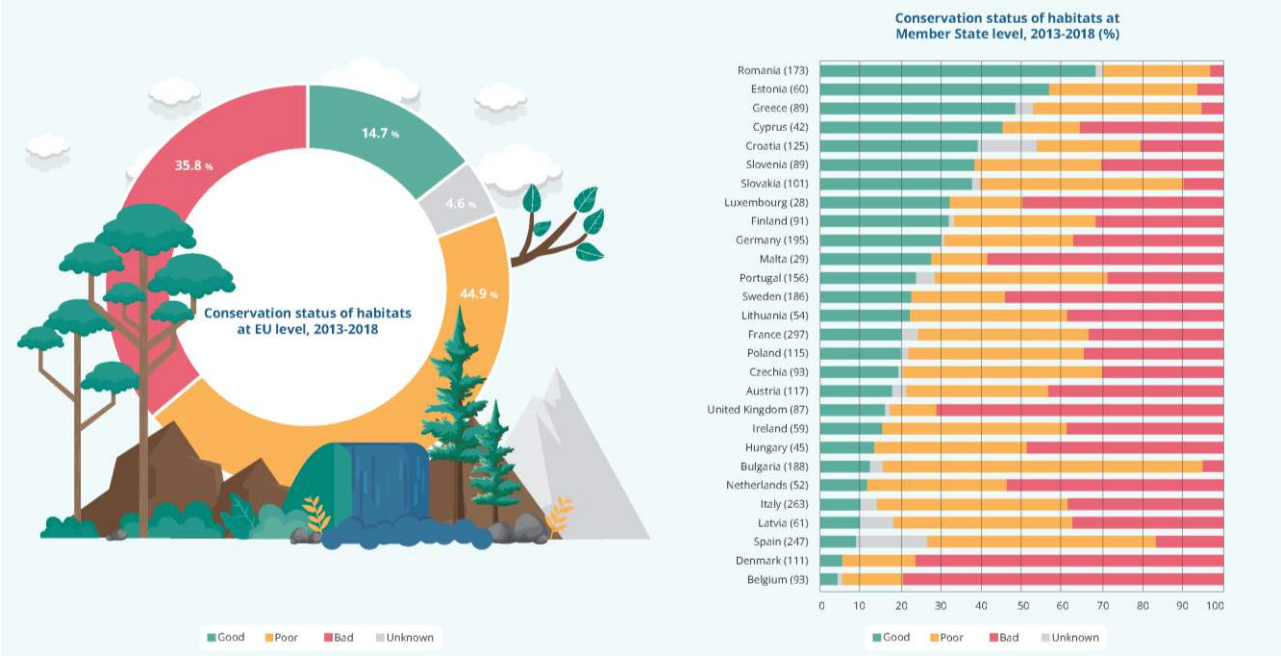
1.1 Key facts on Natura 2000

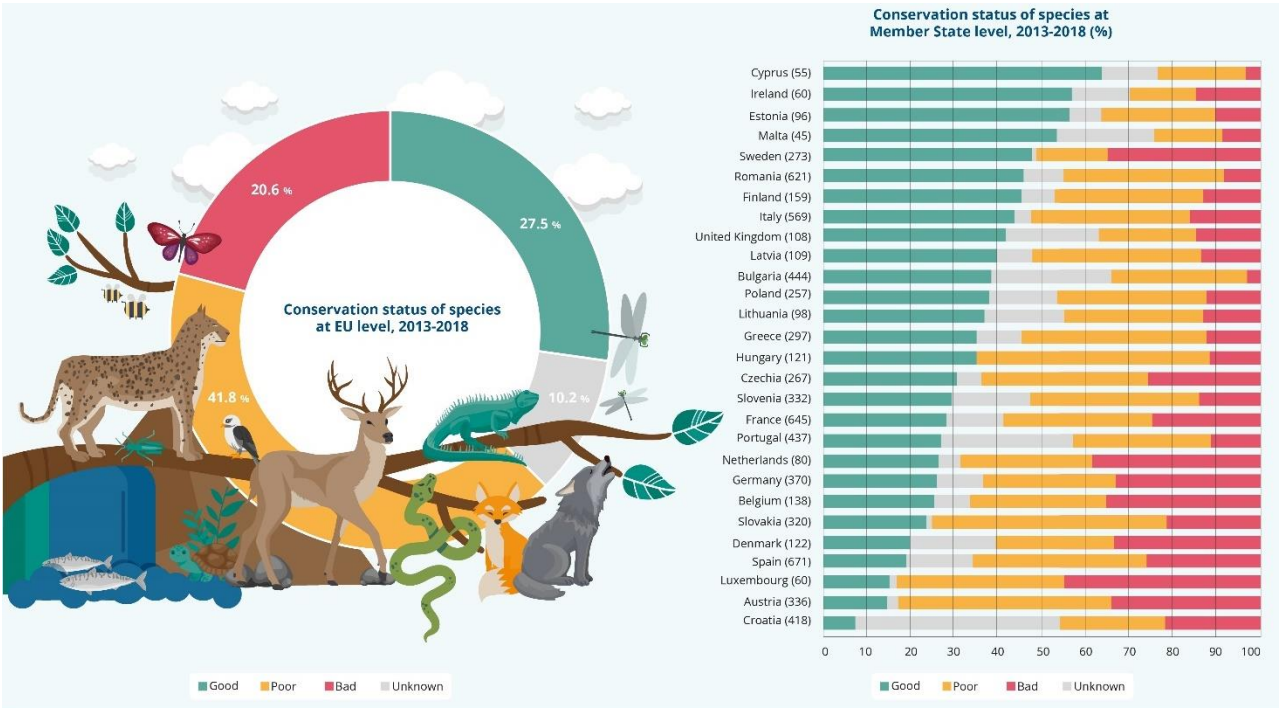
1.1.1 Protected areas in the Alpine Space and Bioregions



Protected areas in the Alpine Space and Bioregions (source: Emerald Network, 2010)

1.1.2 Conservation status of habitats and species at Member State level

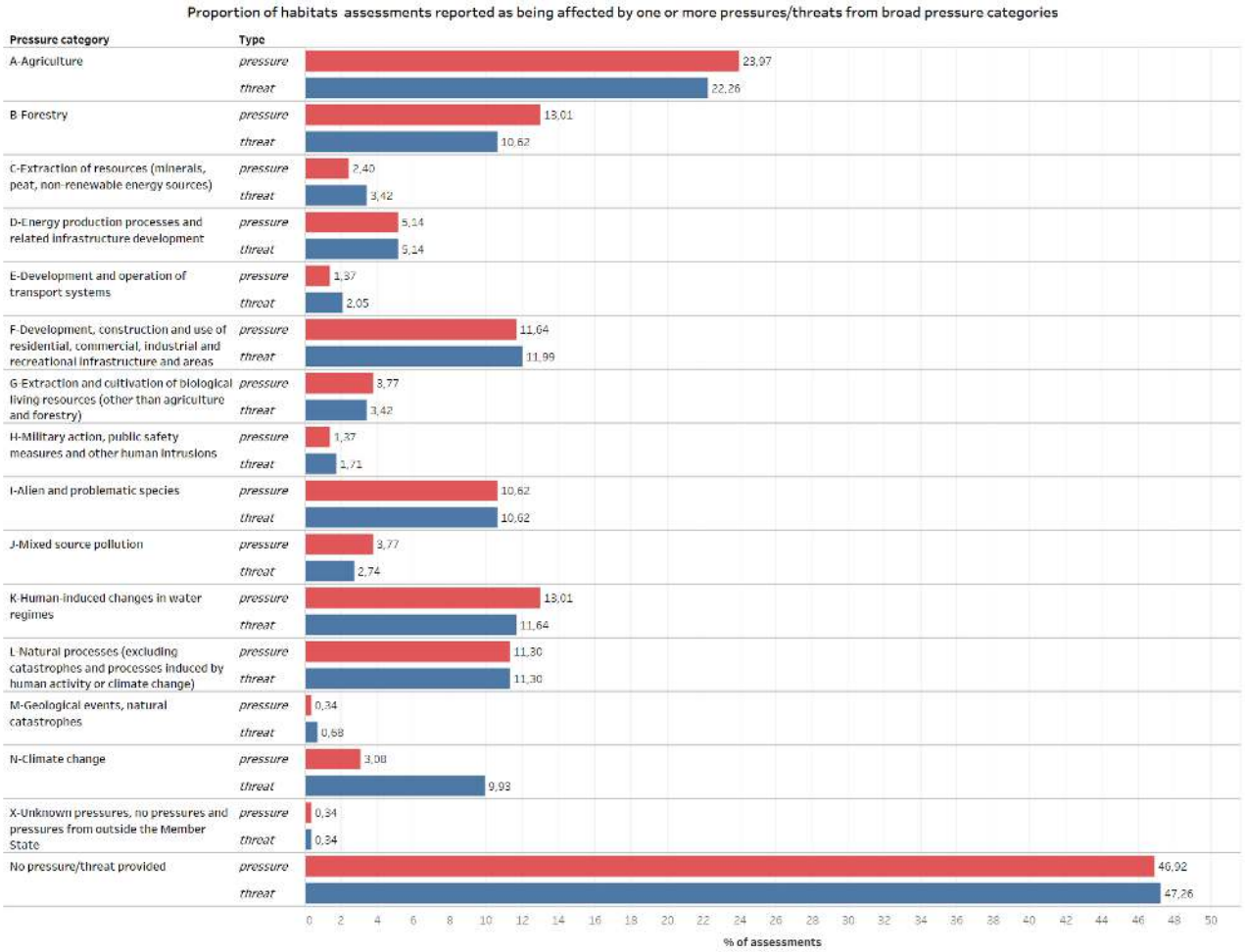




1.1.3 Main pressures and threats to N2000 in the Alpine Space

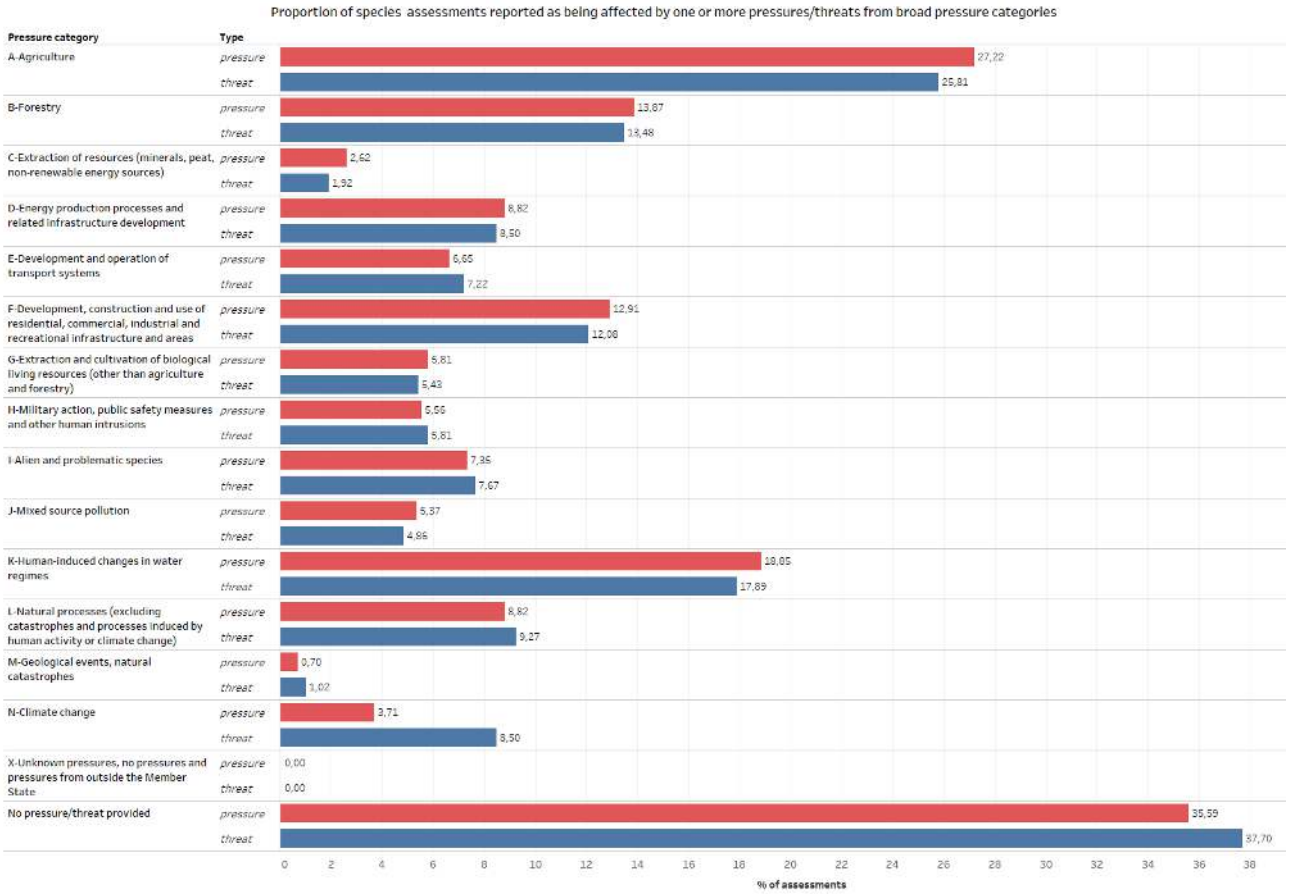
The figures below show the percentage of the habitats and species reported as being affected by one or more pressures/threats **(high only**) under the pressure categories A-N. This information illustrates the relative importance of pressures (currently acting) and threats (expected in near future). (EEA, State of Nature report 2013-2018, summary dashbord under article 17 of the habitat directive)[7]

Frequency of main pressure and threats on habitats of the Alpine and Continental Biogegraphical Regions (AT, DE, IT, FR, SL)



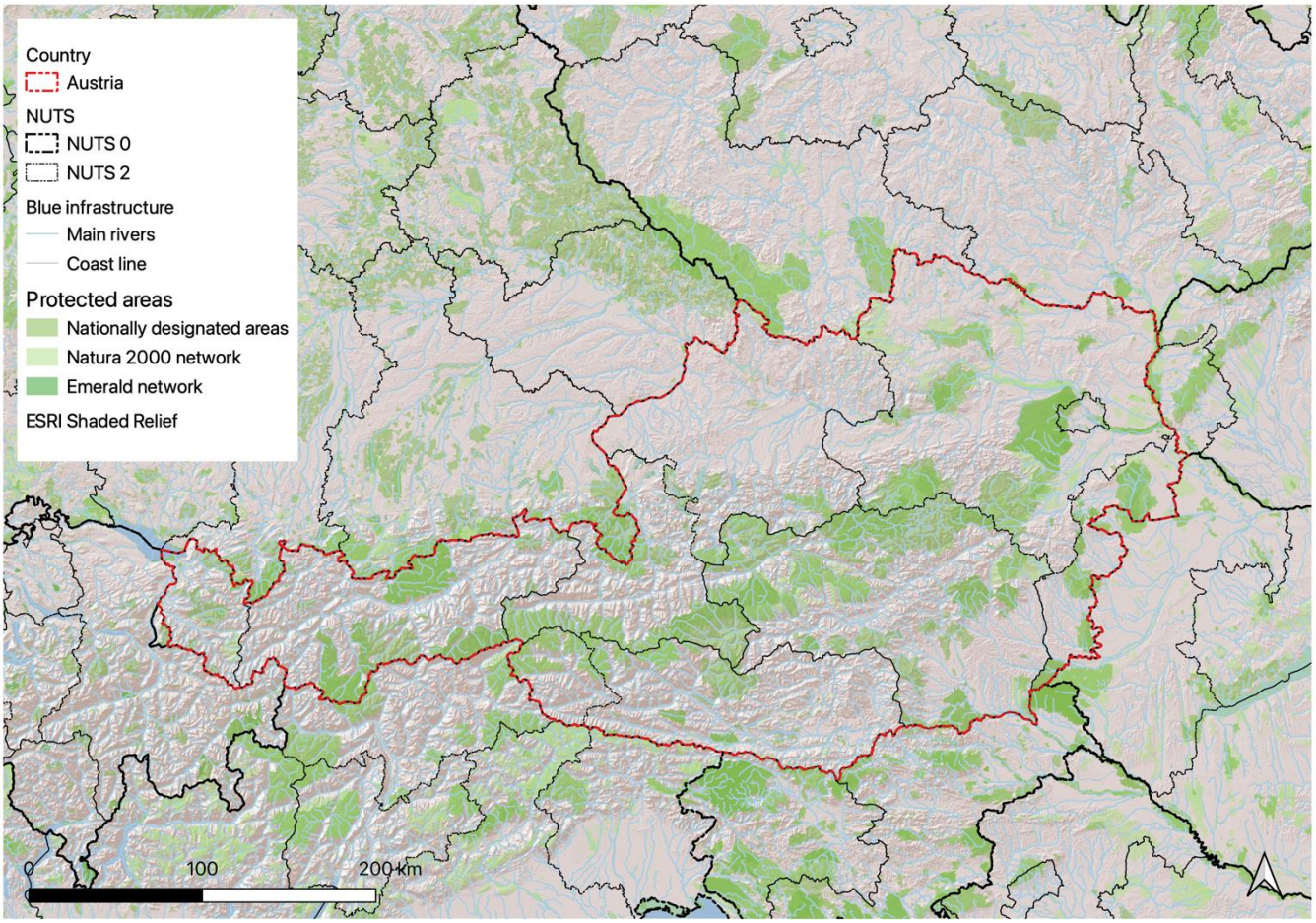
7 https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards-archived/main-pressures-and-threats

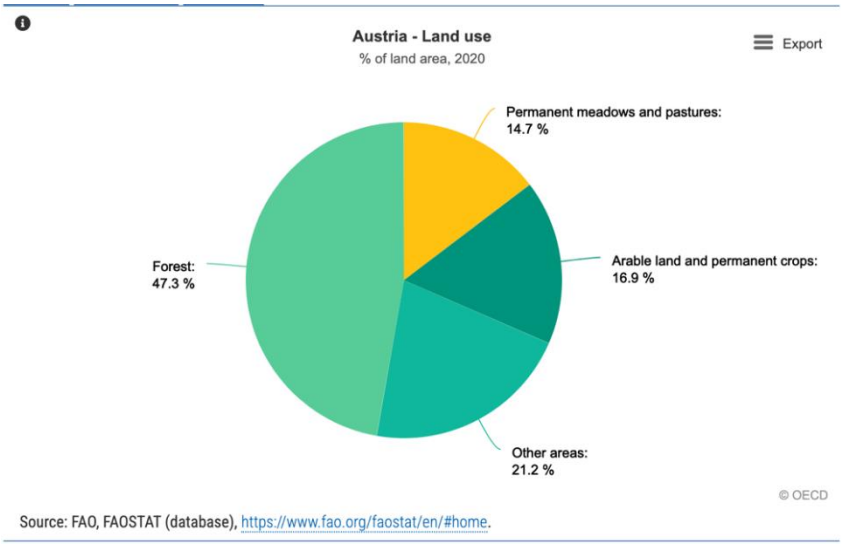
Frequency of main pressure and threats on species of the Alpine and Continental Biogegraphical Regions (AT, DE, IT, FR, SL)



1.2 Austria

Lebensraumvernatzung.at (2022) by SIR and ECO





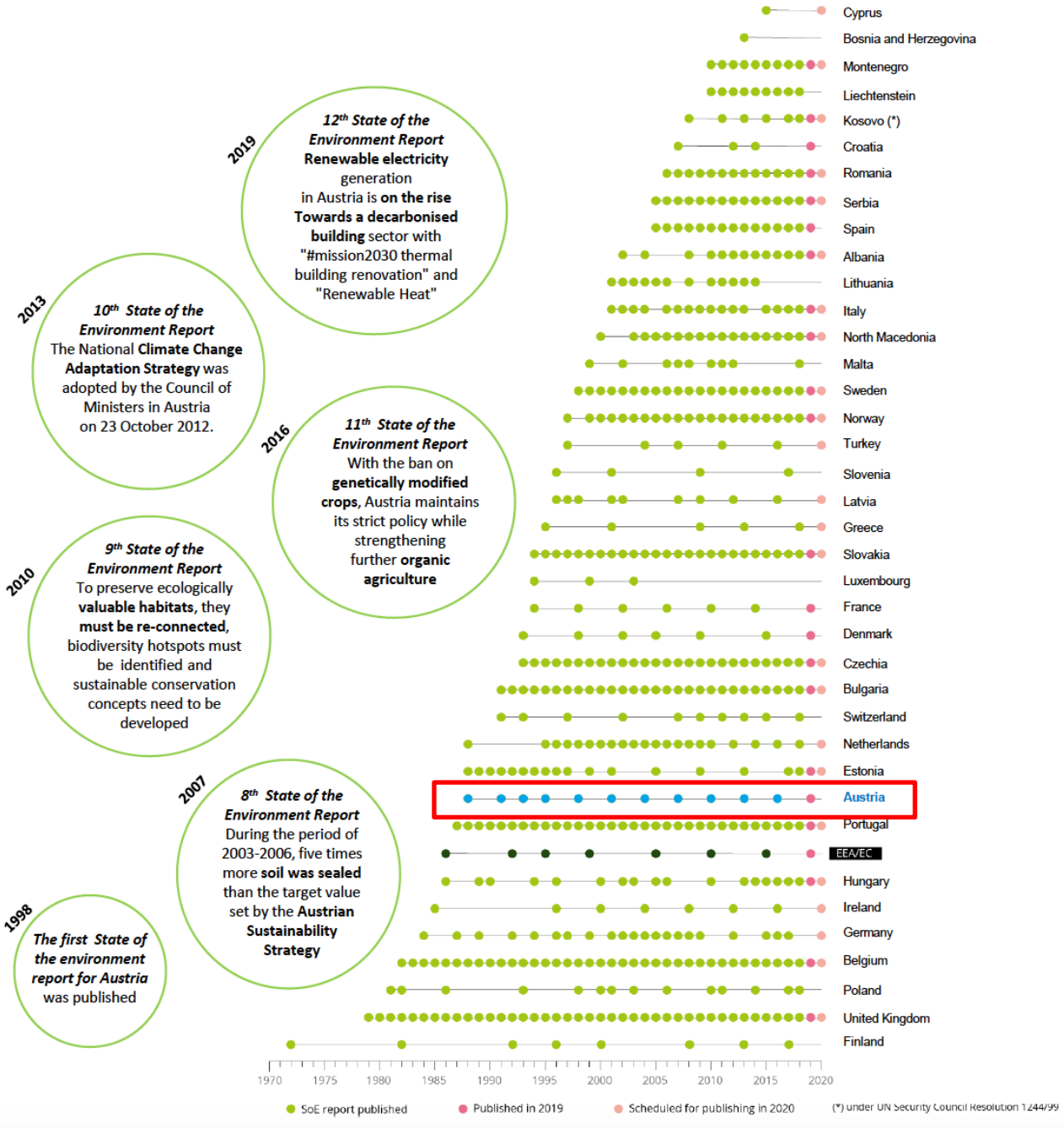
Country overview

Air and climate		
Emissions of		*Year*
SO2 (1000t)	10	2020
SO2 per capita (kg)	1	2020
NOx (1000t)	123	2020
NOx per capita (kg)	123	2020
CO2 (million tonnes)	62	2020
CO2 per capita (tonnes)	7	2020
GHG (million tonnes CO2 eq.)	74	2020
GHG per capita (tonnes CO2 eq.)	8	2020
Consumption of ozone depleting CFCs (ODP t)	-	Year
Biodiversity		
Proportion of terrestrial and marine areas protected (%)	28	2014
Number of threatened species	122	2016
Fish catch (tonnes)	350	2015
Change in fish catch from previous year (%)	0	2015
Economy		
GDP growth rate from previous year (%)	1	2016
GDP per capita (at current prices - $US)	44.857	2016
% Value added: agriculture, hunting, forestry, fishing	1	2016
% Value added: mining, manufacturing, utilities	22	2015
Population		
Population (1000)	8.955	2019
Population growth rate from previous year (%)	1	2020

Energy		
Total energy supply (PJ)	1.396	2019
Energy supply per capita (GJ)	156	2019
Energy use intensity (MJ per USD constant 2011 PPP GDP))	3	2019
Renewable electricity production (%)	71	2019
Land and agriculture		
Total area (sq km)	82.520	2020
Agricultural land (sq km)	82.520	2020
Arable land (% of agric. land)	50	2020
Permanent crops (% of agric. land)	3	2020
Permanent meadows and pastures (% of agric. land)	48	2020
Change in agricultural land area since 1990 (%)	0	2020
Forest area (sq km)	38.992	2020
Change in forest area since 1990 (%)	-97	2020
Waste		
Total population served by municipal waste collection (%)	-	
Municipal waste collected (1000t)	5.220	2019
Hazardous waste generated per capita (kg)	1	2018
Proportion of hazardous waste treated or disposed (%)	35	2018
Proportion of municipal waste recycled (%)	26	2019
Water and sanitation		
Renewable freshwater resources per capita (m3)		
Proportion of wastewater treated (%)	46	2019
Proportion of freshwater abstracted (%)	-	

AUSTRIA

STATE OF THE ENVIRONMENT REPORTING

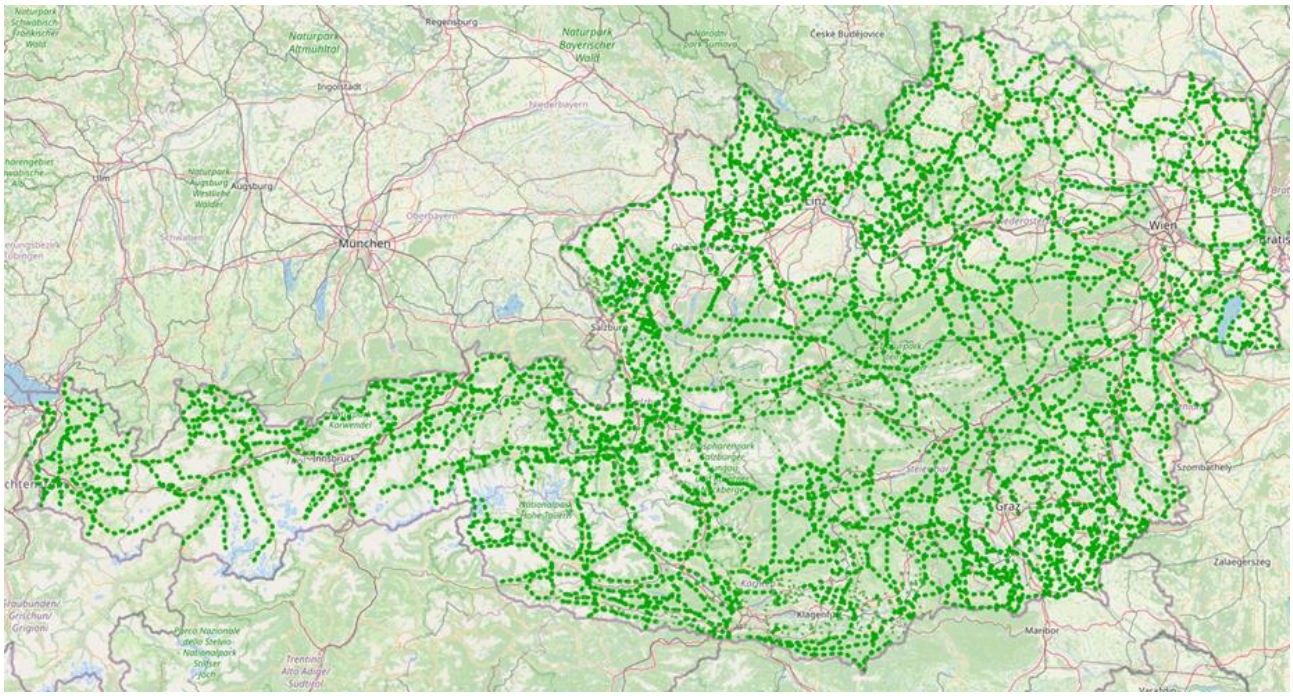



Federal Ministry
Republic of Austria
Sustainability and Tourism
umweltbundesamt
ZWÖLFTER UMWELTKONTROLLBERICHT
Umweltsituation in Österreich
The latest State of the Environment report for Austria published
Austrian Bioeconomy Strategy adopted
National Air Pollution Control Programme in force
2019
Austrian Climate and Energy Strategy adopted
2030 Agenda Implementation in Austria adopted
2030 Agenda for Sustainable Development
Paris Agreement on Climate Change
EU Invasive Alien Species Regulation in force
Austrian Energy Efficiency Act issued
National Biodiversity Strategy 2020+ in force
2018
2015
2014
Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters ratified
Austria starts issuing bans by ordinances for the import/cultivation of some genetically modified products into Austria
Austrian Climate Change Act enacted
Green Energy law in force
The National Climate Change Adaptation Strategy was adopted by the Council of Ministers
Austrian resource efficiency action plan into force
2005
2006
2011
2012
Working Programmes "Decentralised sustainability strategies - Local Agenda 21" start
Federal Constitutional Law for a nuclear free Austria issued
Foundation of the Danube National Park which includes the former planning area of the hydroelectric power plant of 1984
Austria joins the EU and transposes the Environmental Acquis into national legislation
First National Environmental Plan (NUP) for sustainable development in Austria
Introduction of Comprehensive Environmental Protection as a state objective in the Austrian Federal Constitution
2003
1999
1996
1995
1994
Stockholm conference on the Human Environment
Referendum in Austria with the result not to commission the Zwentendorf nuclear power plant
Citizens protest against hydroelectric power plant in Hainburg alluvial plain
The Environment Agency Austria established as a federal agency by the Federal Act on Environmental Control.
The first State of the environment report for Austria published
1972
1978
1984
1988
United Nations milestones
European Union milestones
EEA milestones
Milestones Austria

1. Network typology

Other (e.g. GBI network concepts)

Since 2018, a nationwide Austrian concept for supra-regional ecological networks has been determined. Within the project 'Habitat-Network as a contribution to securing biodiversity in Austria', the most important regional and national habitat corridors in Austria were mapped. They are the essential basis for the conservation of networked habitats. The corridors were updated the last time in 2022.



Map of the most important habitat corridors in Austria, available at the website lebensraumvernetzung.at

2. The ecological network and its legal framework of reference

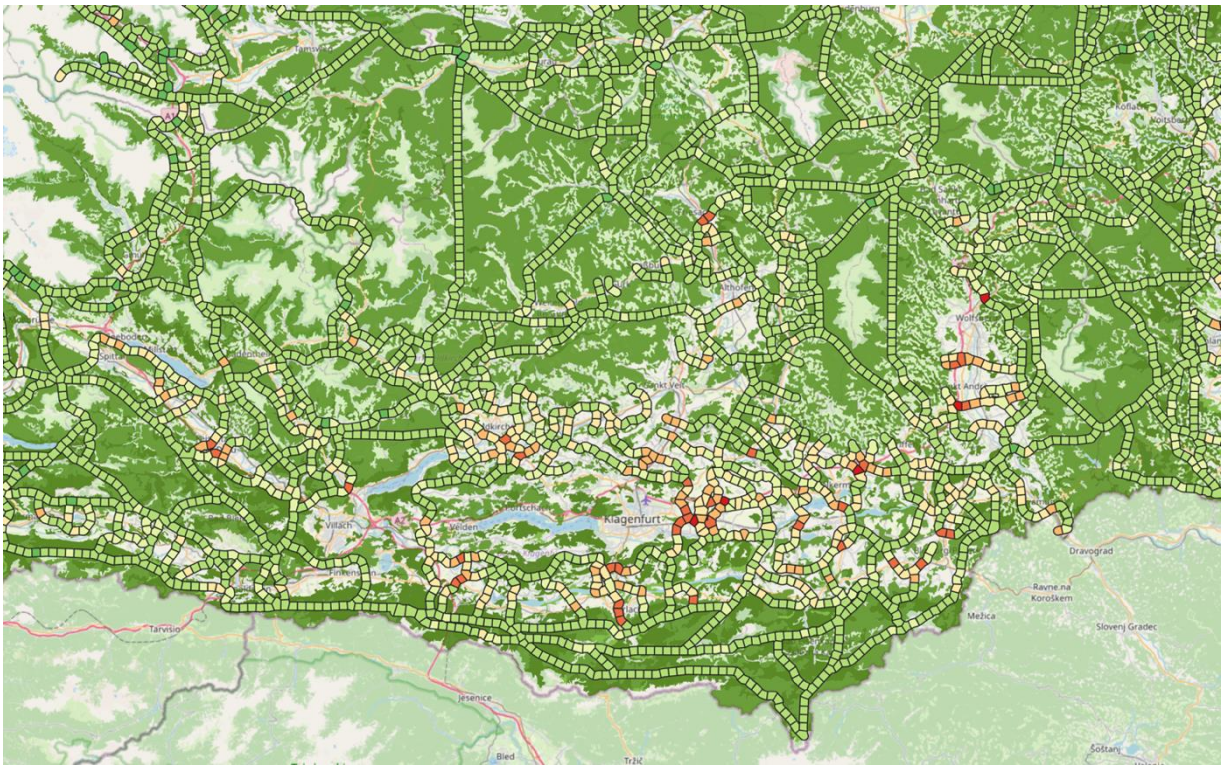
The Austrian Habitat network is a national concept (NUTS 0), which was elaborated by experts who support goals of the platform with their expertise. It was commissioned by the Ministry of climate, environment, energy, mobility, innovation, and technology, and it is available on the webpage www.lebensraumvernetzung.at. It is organized as a coordination platform for ecological networks with many stakeholders. It has following goals:

- Legal anchoring of the examination of habitat networking,
- Knowledge exchange and transfer (research, implementation projects, applications, etc.),
- Coordination of criteria for habitat connectivity,
- Contact point for questions regarding habitat networking,
- Provide current planning bases.

The network concept is an informal study. In Austria, nature conservation related topics are organized at federal level. The network is not legally binding, neither in the federal nature conservation laws, nor in the federal spatial planning laws. However, there are ongoing attempts to bring the contents into the respective federal laws, nature conservation and spatial planning.

The network is harmonized on the federal boundaries, on the national boundaries and (partly) integrated into the federal GIS systems of the administrations. Therefore, it is available as a nationwide data set for spatial planning and for sectoral planning in various contexts. Due to this fact, it can be and it is considered already in spatial planning on regional and local level.

The study on habitat connectivity has been done at national level. For some of the regions in Austria also regional corridor models has been developed in specific projects.



Map of the Networking Indices (2022), available at the website lebensraumvernetzung.at

3. Network objectives

The network is an implementation measure of the Austrian Biodiversity Strategy 2020+ and contributes to the successful realization of 2 of its goals:

a) Preserving species and habitats (establishing a quantitatively sufficient, functioning biotope network - barrier-free landscape, migration corridors), and

b) Considering biodiversity and ecosystem services in the sectors of spatial planning and transport/mobility (reduce land use, green infrastructure in spatial planning, significantly increase the permeability of higher-level transport routes).

Ecosystem services such as clean air, clean water, food timber and other natural products, recreational space, water retention, climate regulation and genetic resources are cited in the concept.

4. Network structure and elements

The network consists of modelled corridors, that connect large and just slightly fragmented core habitats and Natura 2000 sites. The corridors are categorized as supra-regional, regional, and local corridors. The corridors run primarily in forests, but also in grasslands or farmlands and cross rivers and lakes, as well as unfenced transport infrastructure. The habitat corridors primarily serve forest-preferring animal and plant species, but also species of semi-open landscapes.

The networks consider thematic aspects of terrestrial green habitat connectivity, but not those of wet or dry habitats. The connectivity of wetlands and aquatic habitats was analyzed by the project “Auenland - The floodplain inventory as the basis for an Austria-wide floodplain strategy” (LAZOWSKI & SCHWARZ 2014: Auenland - Das Aueninventar als Grundlage einer österreichweiten Auenstrategie naturschutzbund, Salzburg).

At the Austrian boarder, supra-regional corridors of the neighboring countries were considered.

5. Methodology used in network and corridor design

The methodology used following GIS working steps:

- Creation of a landscape model,
- Creation of a permeability/resistance model,
- Calculation of optimal habitat corridors (least cost path),
- Analysis of corridor sections.

For the modelling of the corridors, large core habitats and Natura 2000 sites were integrated, as well as existing and planned green bridges. The approach used was a combination of structural and functional elements. In principle, the habitat corridors are low-barrier, undeveloped and unsealed spaces. In a validation step, the corridors were verified in a participatory project with different stakeholders.

6. Tools and guidance for planners and practitioners

The corridors are available for free as interactive map and as GIS-data (download) on the website www.lebensraumvernetzung.at, an online information portal provided by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK). Guidelines to assess the wild ecological permeability of habitat corridors, fact sheets and a report on planning basics were published in 2023 and are available in the download section of the website.

7. Specific provisions for connectivity conservation and restoration areas

There is no specific legislative provision that applies to connectivity areas in Austria yet.

8. Implementation of the connectivity conservation and restoration areas

In terms of implementation of the connectivity conservation and restoration areas, the network developed a process that allows a widely automated production of specific maps on the topic of habitat connectivity, embedded in the Austrian forest development plan. Most of the federal states mentioned their willingness to implement this. By integrating the special maps on habitat connectivity, the habitat corridors are (partly) available for the first time in an official, Austria-wide planning tool.

Within the network projects, first steps towards a joint approach between road and railway and the ministry of infrastructure have been initiated and will be intensified in the coming years with the aim to coordinate existing crossing structures across infrastructures, but also to build new green bridges and subways in a targeted manner.

9. Implementation difficulties/opportunities

In Austria, nature conservation as well as spatial planning, are organized at the federal level. This makes the implementation of the habitat corridors within the legislation of the nine federal states more difficult. But there are ongoing attempts to bring the contents into the respective federal laws.

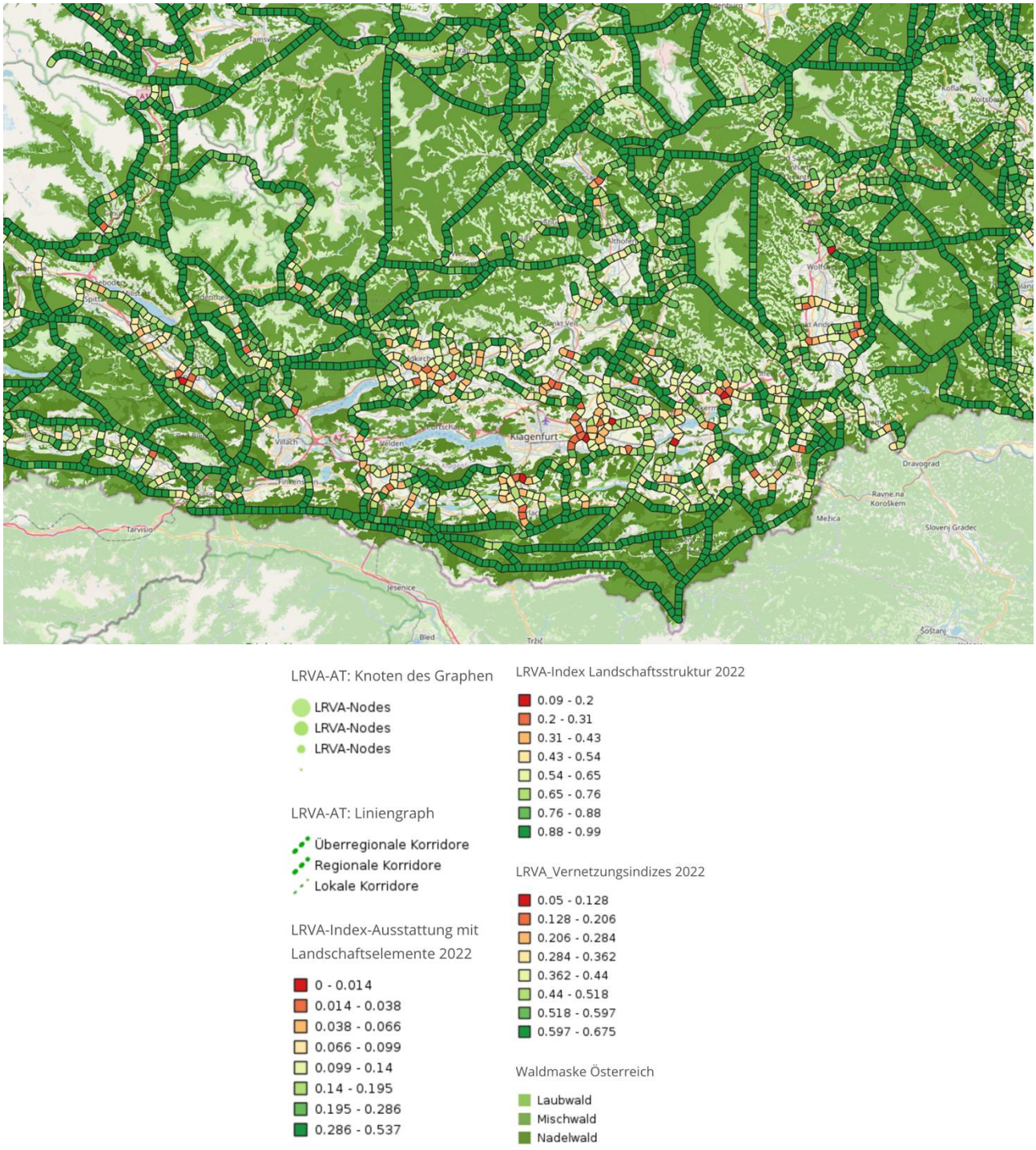
10. Monitoring system

The technical report on habitat connectivity (Leitner et al., 2018) points out that a monitoring system that evaluates the status of existing corridors would be desirable. However, this has not yet been implemented.

Bibliography

Basic study/technical report: Leitner, H., Grillmayer, R., Leissing, D., Lackner, S., Banko, G., Stejskal-Tiefenbach, M., 2018. Lebensraumvernetzung zur Sicherung der Biodiversität in Österreich. Technischer Bericht.

Guideline for assessment: Leitner, H., Leissing, D., Grillmayer, R. (2023): Leitfaden zur Beurteilung der wildökologischen Durchlässigkeit von Lebensraumkorridoren: Konzipiert für wildlebende Säugetiere ab Hasengröße. Herausgeber: Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie. Wien.

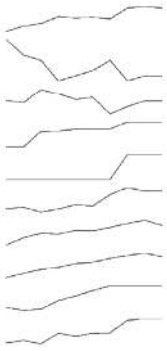


Map of the Landscape structure (2022), available at the website lebensraumvernetzung.at

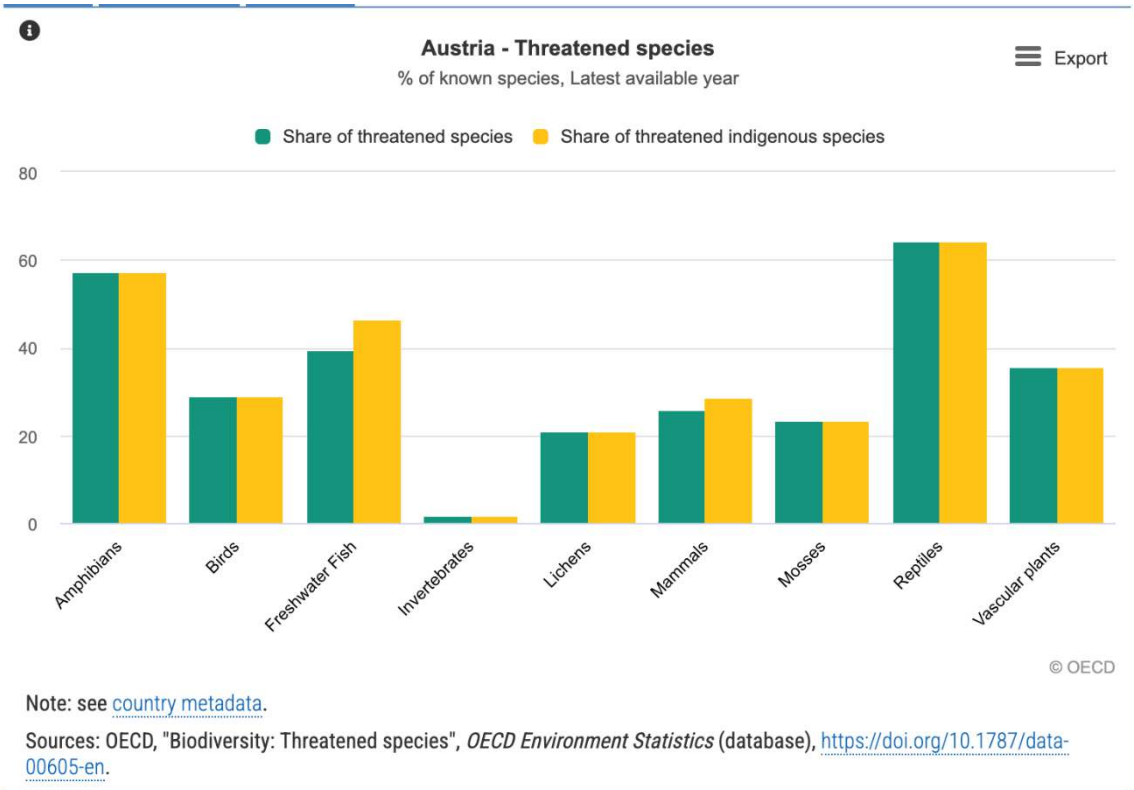
Country projections for the future

TRANSITIONS PERFORMANCE INDEX 2021

3.	**Environmental transition**		**34**	**59.1**	–
3.1	EMISSIONS REDUCTION: Gross greenhouse gas emissions (tonnes per capita)	9.3	47	**61.3**	–
3.2	BIODIVERSITY	70.3	26	**70.3**	↘
3.2.1	Terrestrial key biodiversity areas (KBAs) protected (%)	67.4	28	**67.4**	–
3.2.2	Freshwater key biodiversity areas (KBAs) protected (%)	71.2	26	**71.2**	–
3.2.3	Pesticide use per area of cropland (kg/ha)	3.6	42	**74.6**	↘
3.3	MATERIAL USE	33.8	57	**33.8**	↑
3.3.1	Resource productivity (PPP$ per kg)	2.9	18	**49.1**	↑
3.3.2	Material footprint (tonnes per capita)	32.6	62	**18.5**	↓
3.4	ENERGY PRODUCTIVITY: Energy productivity (PPP$ per koe)	14.2	19	**70.9**	↗



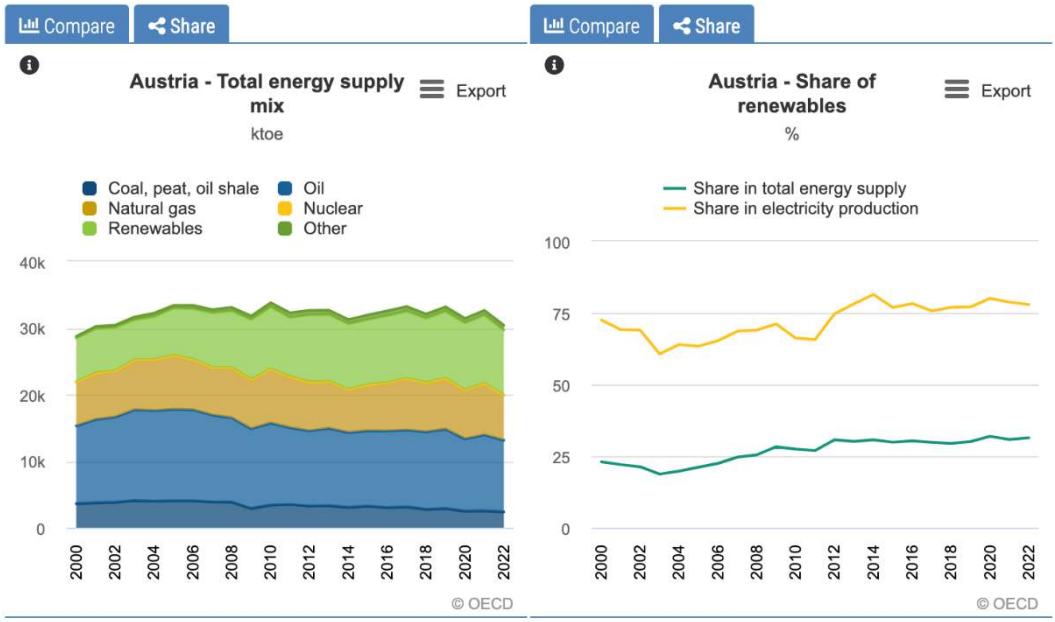
ENVIRONMENT AT A GLANCE INDICATORS, OECD 2023



Note: see country metadata.

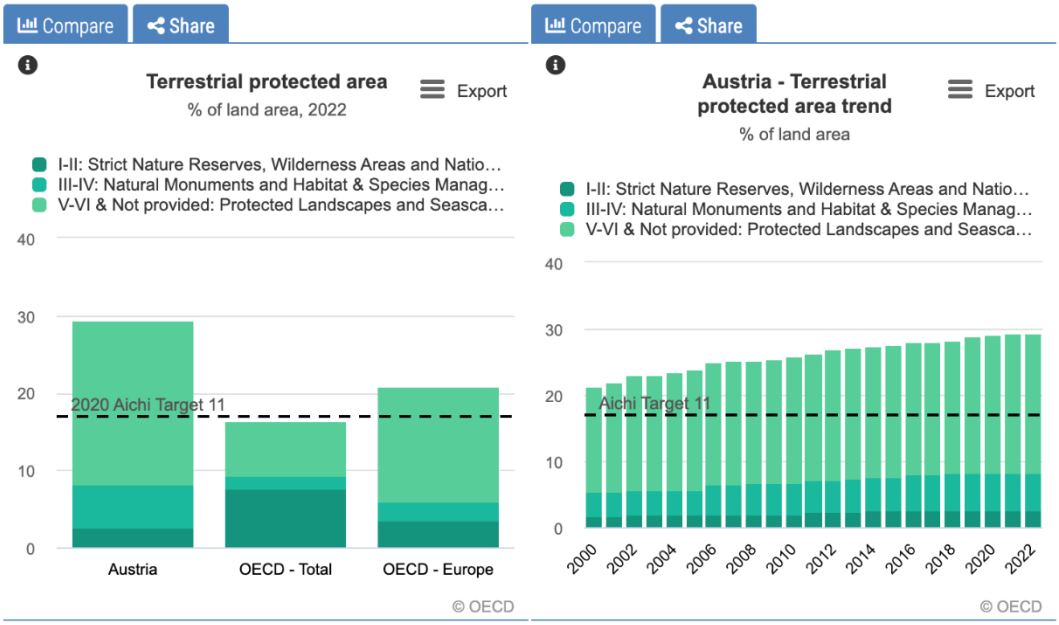
Sources: OECD, "Biodiversity: Threatened species", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00605-en.

Energy mix



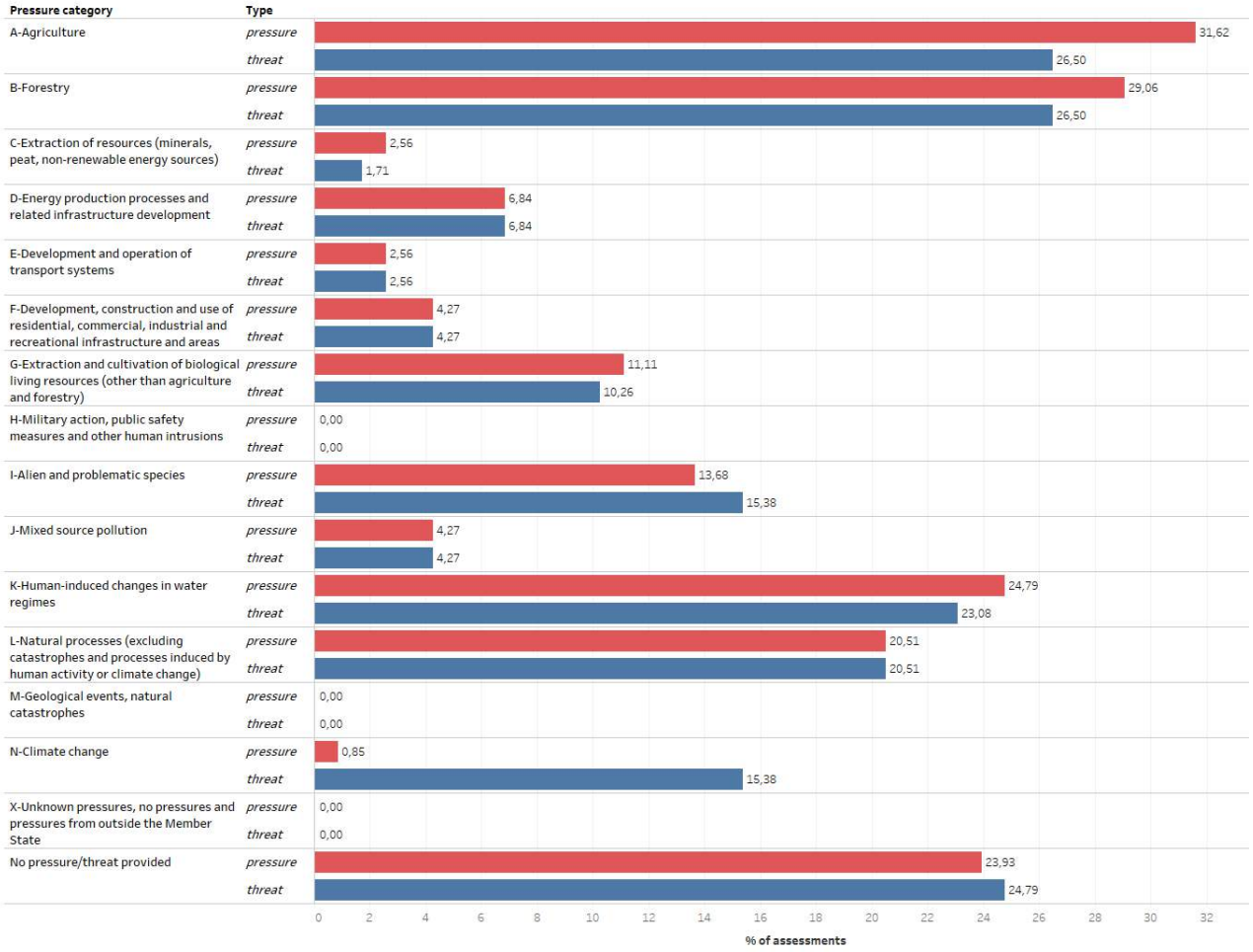
Source: IEA, "World energy statistics", *IEA World Energy Statistics and Balances* (database), https://doi.org/10.1787/data-00510-en.

Protected areas

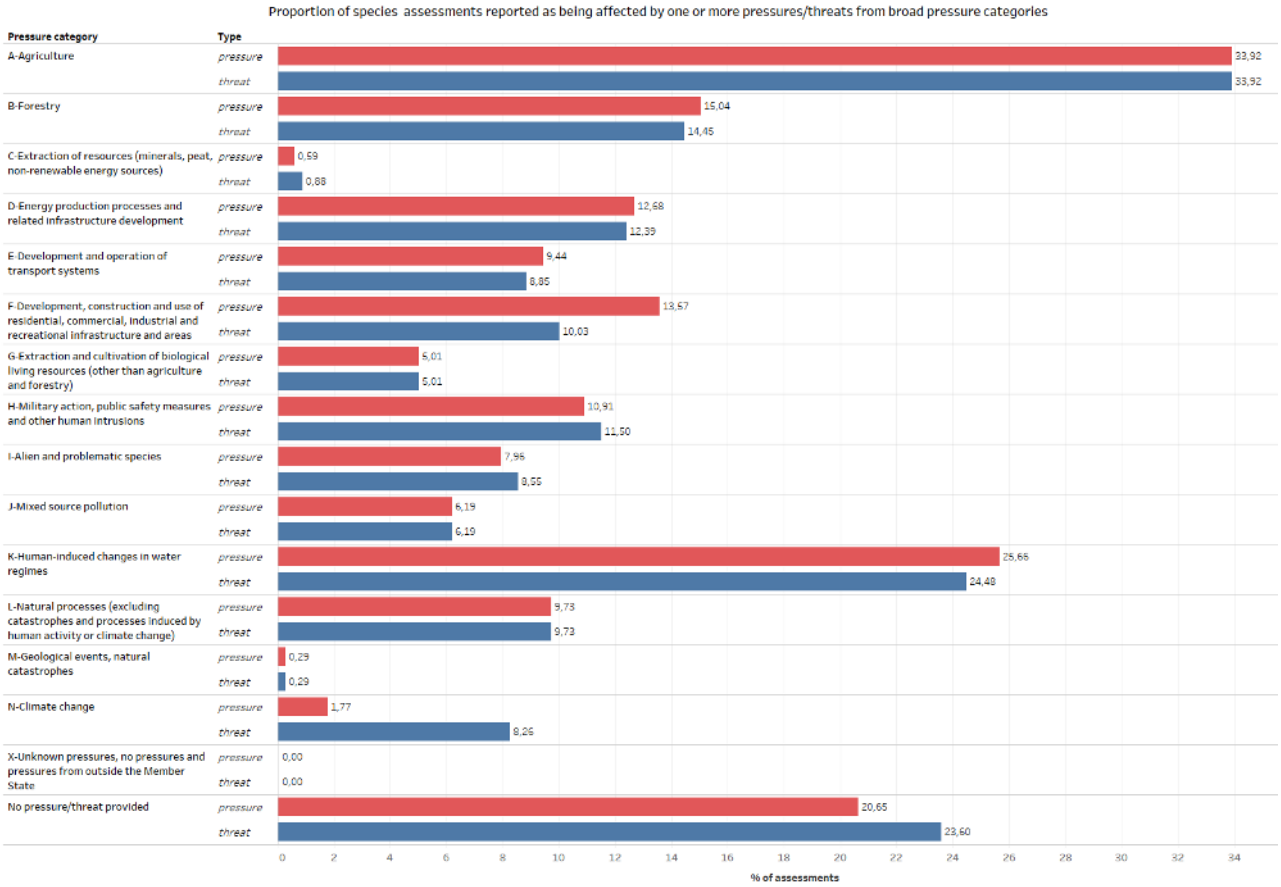


Source: OECD, "Biodiversity: Protected areas", *OECD Environment Statistics* (database), https://doi.org/10.1787/5fa661ce-en.

Frequency of main pressure and threats on habitats of the Alpine and Continental Biogegraphical Regions (AT)

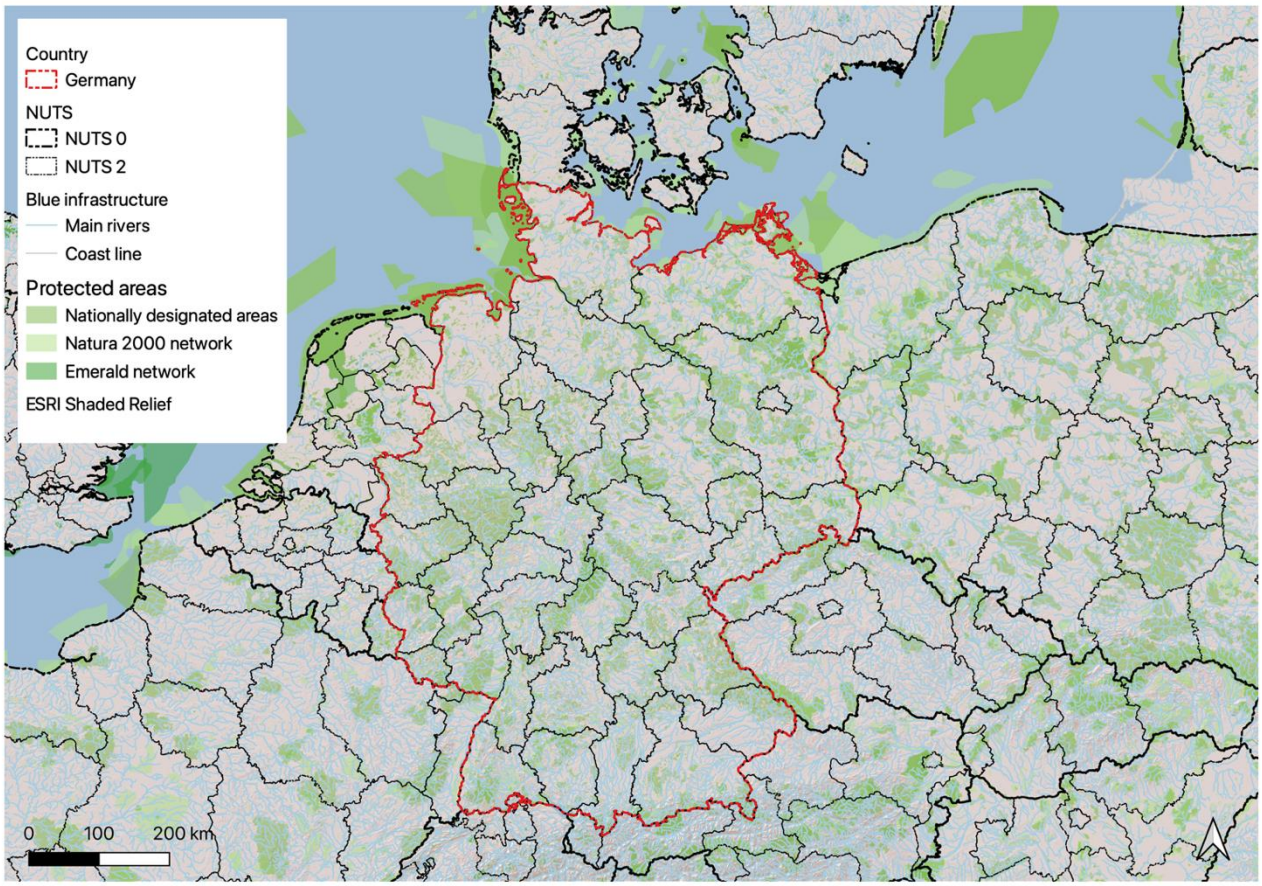


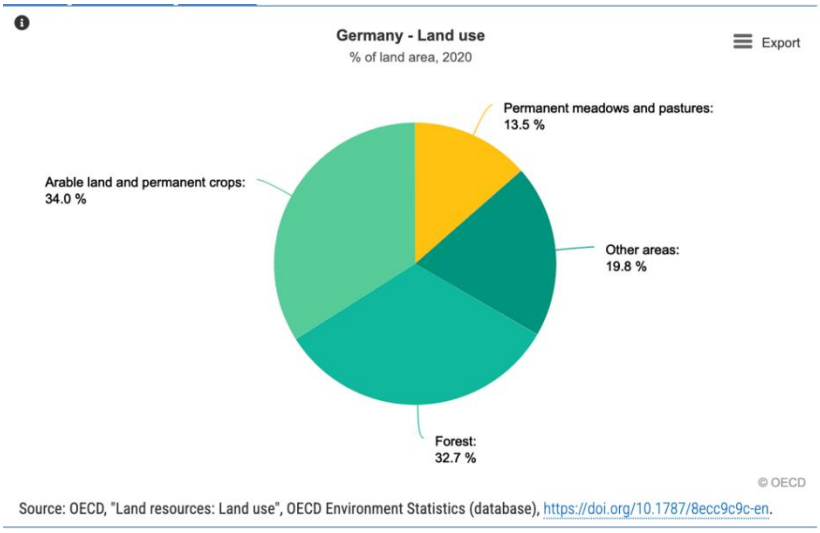
Frequency of main pressure and threats on species of the Alpine and Continental Biogegraphical Regions (AT)



1.3 Germany

German National Biotope network by Ifuplan and JMU





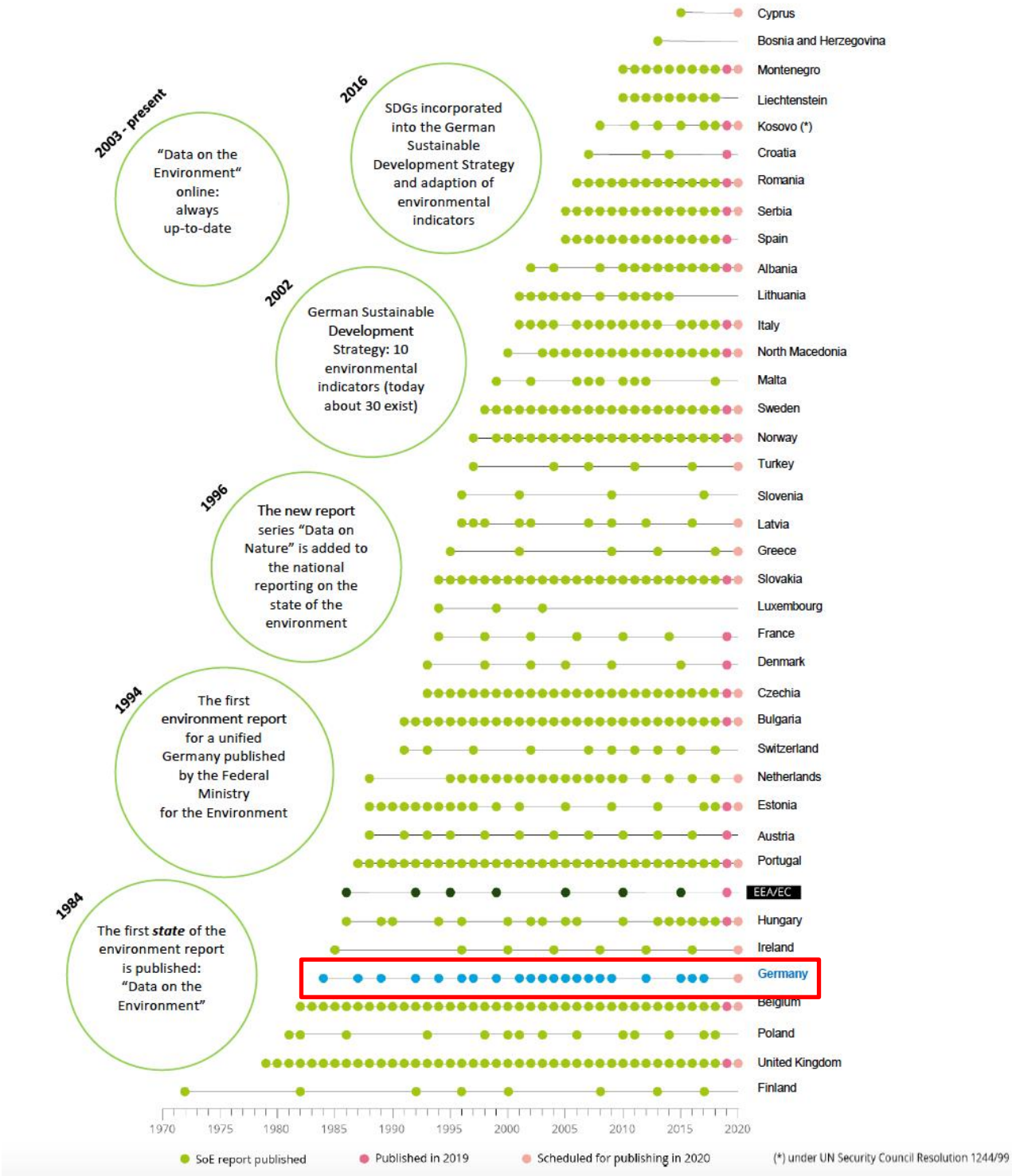
Country overview

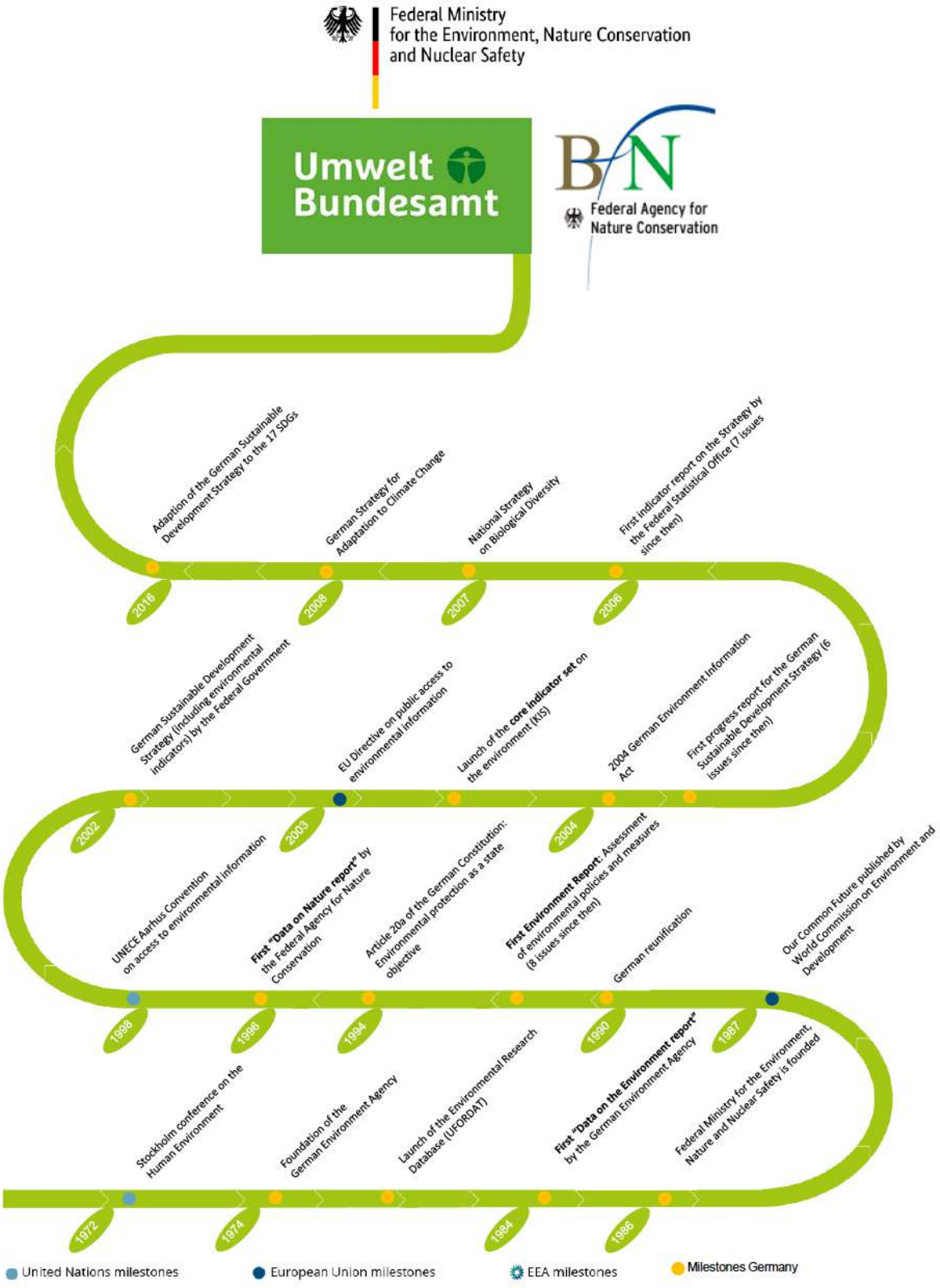
Air and climate		
Emissions of		*Year*
SO2 (1000t)	233	2020
SO2 per capita (kg)	3	2020
NOx (1000t)	978	2020
NOx per capita (kg)	978	2020
CO2 (million tonnes)	639	2020
CO2 per capita (tonnes)	8	2020
GHG (million tonnes CO2 eq.)	729	2020
GHG per capita (tonnes CO2 eq.)	9	2020
Consumption of ozone depleting CFCs (ODP t)	-	Year
Biodiversity		
Proportion of terrestrial and marine areas protected (%)	38	2014
Number of threatened species	140	2016
Fish catch (tonnes)	261.744	2015
Change in fish catch from previous year (%)	7	2015
Economy		
GDP growth rate from previous year (%)	2	2016
GDP per capita (at current prices - $US)	42.456	2016
% Value added: agriculture, hunting, forestry, fishing	1	2016
% Value added: mining, manufacturing, utilities	26	2015
Population		
Population (1000)	83.517	2019
Population growth rate from previous year (%)	0	2020

Energy		
Total energy supply (PJ)	12.314	2019
Energy supply per capita (GJ)	147	2019
Energy use intensity (MJ per USD constant 2011 PPP GDP)	3	2019
Renewable electricity production (%)	33	2019
Land and agriculture		
Total area (sq km)	349.390	2020
Agricultural land (sq km)	349.390	2020
Arable land (% of agric. land)	70	2020
Permanent crops (% of agric. land)	1	2020
Permanent meadows and pastures (% of agric. land)	29	2020
Change in agricultural land area since 1990 (%)		2020
Forest area (sq km)	114.190	2020
Change in forest area since 1990 (%)	305	2020
Waste		
Total population served by municipal waste collection (%)	-	
Municipal waste collected (1000t)	50.612	2019
Hazardous waste generated per capita (kg)	3	2018
Proportion of hazardous waste treated or disposed (%)	93	2018
Proportion of municipal waste recycled (%)	48	2019
Water and sanitation		
Renewable freshwater resources per capita (m3)	1.393	2018
Proportion of wastewater treated (%)	-	
Proportion of freshwater abstracted (%)	-	

GERMANY

STATE OF THE ENVIRONMENT REPORTING




Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Umwelt Bundesamt
BfN Federal Agency for Nature Conservation
Adaption of the German Sustainable Development Strategy to the 17 SDGs
2016
German Strategy for Adaptation to Climate Change
2008
National Strategy on Biological Diversity
2007
First indicator report on the Strategy by the Federal Statistical Office (7 issues since then)
2006
German Sustainable Development Strategy (including environmental indicators) by the Federal Government
2002
EU Directive on public access to environmental information
2003
Launch of the core indicator set on the environment (KIS)
2004
2004 German Environment Information Act
First progress report for the German Sustainable Development Strategy (6 issues since then)
UNECE Aarhus Convention on access to environmental information
1998
First "Data on Nature report" by the Federal Agency for Nature Conservation
1996
Article 20a of the German Constitution: Environmental protection as a state objective
1994
First Environment Report: Assessment of environmental policies and measures (8 issues since then)
1990
German reunification
Our Common Future published by World Commission on Environment and Development
1987
Stockholm conference on the Human Environment
1972
Foundation of the German Environment Agency
1974
Launch of the Environmental Research Database (UFORDAT)
1984
First "Data on the Environment report" by the German Environment Agency
1986
Federal Ministry for the Environment, Nature and Nuclear Safety is founded
United Nations milestones
European Union milestones
EEA milestones
Milestones Germany

1. Network typology (check corresponding answer)

Other (e.g. GBI network concepts)

The German Federal Green Infrastructure Concept (Bundeskonzept Grüne Infrastruktur - BKGI) serves to implement the EU Biodiversity Strategy; the aim is to conserve and restore ecosystem services and thus protect natural capital. It is an integrative and spatially applicable concept of nature conservation that identifies areas and spaces of nationwide importance for the conservation of biodiversity, as well as individual ecosystem services. The BKGI is an informal and not legally binding concept that integrates legal and nature conservation concepts regulated by national conservation law and targets. Used as a ground laying input for national decision-making as well as data and evaluation framework for an ecologically sustainable design of other spatial planning sectors. The BKGI aims to connect the different levels of decision-making on a landscape scale as well as on supra-administrative level in accordance with EU strategy for green infrastructure. In addition, the development of green infrastructure and the diverse ecosystem services it supports will need to be monitored and further assessed in the future and linked to the nationwide recording and assessment of ecosystem services as part of the implementation of Goal 2 and Measure 5 of the EU Biodiversity Strategy for 2020. It refers to the concept of ecosystem services as well as nationally implemented target dimensions for nature conservation: Conservation and protection of natural and cultural diversity, protection of materialistic functions as well as protection of immaterialist functions of nature and landscape. The BKGI is the first concept to ever deal with green infrastructure on a national, supra-regional and regional scale.

2. The ecological network and its legal framework of reference

The BKGI is a national concept (NUTS 0). Refers to the German national law of nature conservation (Bundesna-turschutzgesetz, BNatSchG) and tries to integrate the nationally mentioned conservation targets with the main national targets of spatial planning mentioned in Ministerial Conference on Spatial Planning (“Minister-konferenz der Raumordnung” - MKRO 2016) such as:

- minimize conflicts of spatial usage,
- establish large scale open space networks,
- create and design cultural landscapes,
- reduce land take, sustainable use of coastlines and ocean spaces,
- adapt spatial structures to climate change,
- regulate the development of renewable energy and their transmission lines/networks.

The goal is to harmonize different planning sectors regarding the EU Biodiversity strategy.

The BKGI is an integrative, informal concept/study. In Germany, nature conservation is regulated by national law but implemented by federal and regional governments. The same goes for spatial planning, so the network/concept rather functions as an approach delivering suggestions on how to integrate green infrastructure into the regional planning structures. It can be rather classified as a guiding structure that at this point does not serve as main prioritization matter for planners. It combines all existing spatial plans regarding ecosystem protection. So far it is only available as a national concept/data set, but its main components

already exist on federal and regional level (e.g. protected areas or N2K network). Therefore, it can instrumentally partly already be considered on a regional and local level, but its existence does not play a pivotal role in planning decisions.

The concept of the BKGI has been done at national level, harmonizing nationally relating targets and regulations so it can be applied to all federal states following the cascading system of planning from national to communal level. On Lower levels (communal level in particular), analysis regarding the Habitat Network ("Biotopverbund") have been conducted (e.g. Baden-Württemberg). In Bavaria this is still at an early stage and lacks implementation to fully present a network structure as planning outside of communal levels rather present guiding recommendations and communal levels have the final power in implementing those recommendations, aiming for multifunctionality in land use planning.

3. Network objectives

The BKGI displays the existing spaces and instruments already existing for nature conservation and ecosystem service protection. It focuses on the protection of ecosystems and their services. As well as the following objectives taken from the BNatSchG (national law):

- Preserving diversity of natural and cultural landscape heritage (incl. biological diversity),
- Preserving material services and functionalities of natural threshold,
- Preserving immaterial functions in connection to subjective experiences regarding nature and landscape.

Hereby it focuses rather generally on air/climate, water, soil and geotopes, plants and animal species, biotopes, and landscapes in a balanced distribution. It is hereby reaction on EU regulations regarding N2K and the German national conservation law. The main objectives are:

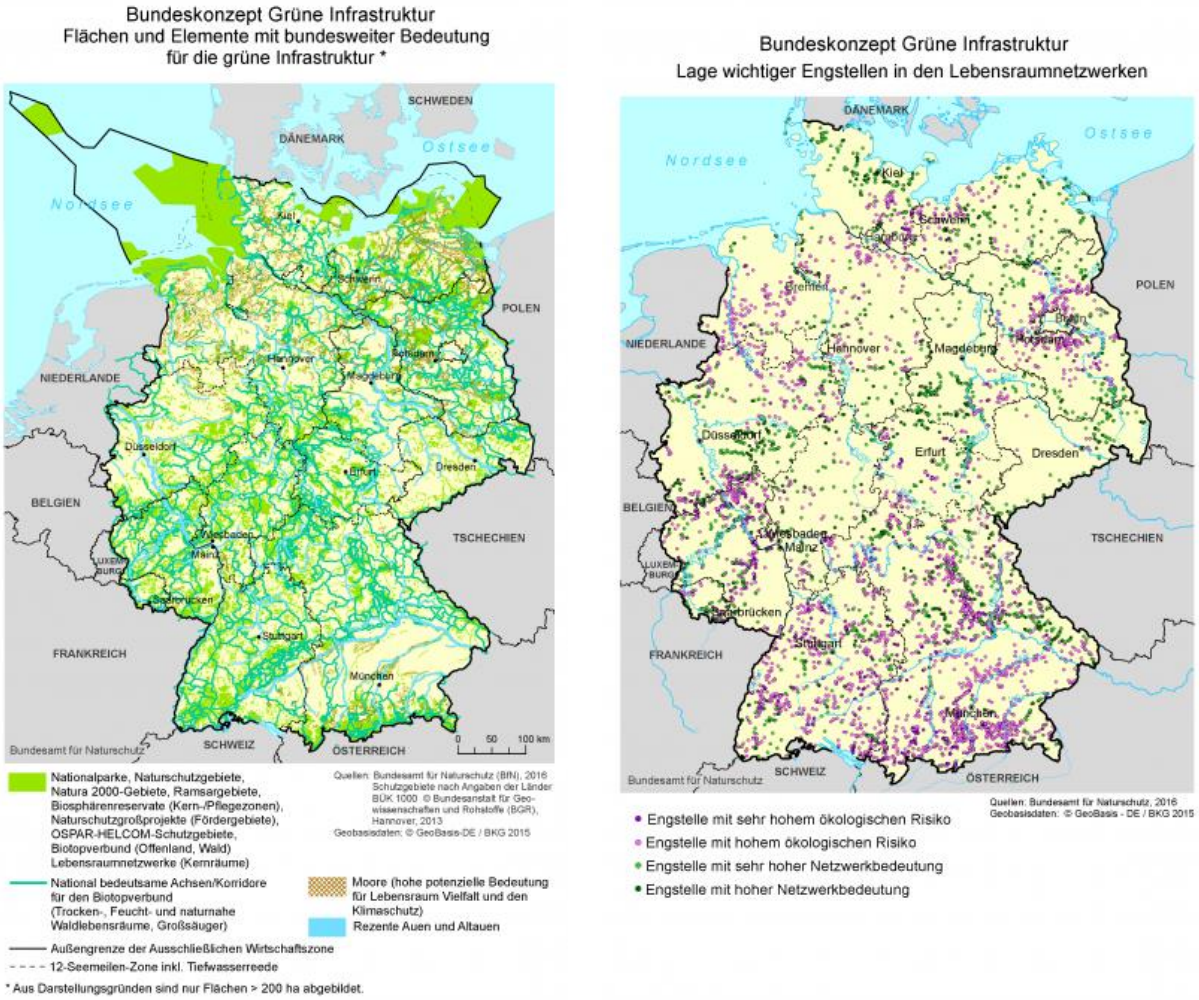
- implement concepts on EU scale regarding GI on national level,
- simplify coordination with neighboring states,
- offer a possible framework to integrate all existing nature conservation concepts on national scale,
- concretize all spatially relevant targets of the NBS (National Strategy on biological diversity),
- support the regional administrative authorities through information and evaluation data,
- help using synergies and prevent delays as well as ecologically quantify planning through information service and distribution in federal states.

4. Network structure and elements

Element of the BKGI concept are spaces and elements in nature and landscape that are remarkable in their qualitatively seldom or extraordinary characteristics and therefore not replaceable.

The network consists of three main categories as habitat ("Lebensraum"), species ("Arten") and territorial systems ("Gebietssysteme") each categorized into further categories. The

latter comprising the general protection statuses for landscapes (e.g. biosphere reserves, N2K, RAMSAR-, HELCOM- and OSPAR-protection areas, nature parks, nature conservation areas, etc…), corridors for connectivity, wetlands, meadows.



BKGI scheme available at https://www.bfn.de/daten-und-fakten/

The first thematic focus on “Lebensraum” as habitats consider the biotope and habitat networks as well as modelled corridors of the “green band” (“Grünes Band”) and spaces for biotope connection as well as international connection points. According to the BNatSchG, 10 % of each federal state should be part of a connected biotope network to ensure a cross-state biotope network. On a regional scale additionally to the above-mentioned aspects the BKGI should also focus on sectoral planning regarding spatial planning on national, federal, and regional scale, landscape planning incl. biotope network planning and the national traffic plan (Bundesverkehrswegeplan). Part of the network are next to the habitat (Trockenlebensräume, Waldlebensräume, Feuchtlebensräume und Fließgewässer,

Großsäuger), open space biotopes, forest. It comprises its content from the national law, nature conservation initiative 2020, National program of reconnection, Natura 2000 Network, EU Water Framework directive, Pan-European Ecological Network, EU Biodiversity Strategy to 2020, Berner and Bonner convention.

5. Methodology used in network and corridor design

The approach of the BKGI tries to create a comprehensive analysis of the three main objectives (protection of the diversity of the natural and cultural landscape heritage, protection of materialist functions and protection of immaterialist functions of nature and landscape). Each objection should, if useful, be related to objects of acting (Handlungsgegenstand) of nature protection: air, climate, water, soil/geotope, species, plants, habitats, landscapes. The methodology focused on different protection areas, habitats, species and tried to identify specific corridors as well as spaces for biotope connection (also on an international level). Maps display these topics in a first step, following up with an analysis of specific bottlenecks, meaning spaces that are at risk due to settlement and traffic infrastructure.

6. Tools and guidance for planners and practitioners

The BKGI geodata is not accessible for the broad public. A special userrequest must be directly posed to the National Authority for Nature conservation to get access to the GIS-shapefiles that build the BKGI. A special and detailed PDF-document of expert evaluations on the concept is freely available and can be downloaded (https://www.bfn.de/bundeskonzept-gruene-infrastruktur#anchor-7001). This document can be viewed as a detailed and qualitative description of the concept. The concept itself is distributed via map-data, that can be downloaded by individual thematic sector as .pdf-Maps.

7. Specific provisions for connectivity conservation and restoration areas

There are no specific legislative provisions or norm regulating transformations and uses that apply to connectivity areas. Plans, projects, and human activities are subject to environmental impact assessment, in all areas of the landscape. Therefore there is no environmental impact assessments through BKGI given.

8. Implementation of the connectivity conservation and restoration areas

So far, the BKGI only serves as a framework that is not legally binding but rather tries to support decision-making for nature protection measures. As a result, the incorporation of the concept and further development in urban/territorial plans of the lower levels is highly lacking. Additionally higher-administrative levels are not referring in detail to the concept. Regional plans and federal state plans rather combine their take on green infrastructure with mentioning specific elements from the BKGI (e.g. biotope connectivity, protection areas, “Regionale Grünzüge”, etc.). This is due to the historic and development characteristic of the BKGI that does not invent any new instruments but combines existing instruments that are partially already implemented in federal plans. E.g. in this context, in Bavaria and especially in Baden-Württemberg, detailed analyses of the biotope network on a

local/regional level are either existing or being analyzed at the moment. In Bavaria especially communal biotope networks are being detected by the Bayerisches Artenschutzzentrum (BayAZ).

The BKGI tries to contribute to the "Bundesprogramm Wiedervernetzung", aiming to reconnect ecosystems. To be integrated into the BKGI are the following concepts that are currently established:

- nationally relevant ("bedeutsam") landscapes,
- national proramm "blue string "Band" Germany",
- National action plan for protected areas,
- Marine environment.

9. Implementation difficulties/opportunities

In Germany the national law for nature protection does not go into detail as the main power for implementing conservation (and connectivity) measures lays within the federal governments, or rather the local governments (Lower state nature conservation authorities). Only construction management are legally and conclusively binding (exception on regional planning level: Reserved Areas ("Vorbehaltsgebiete") / Priority Areas ("Vorranggebiete") - defined in the regional plan). The BKGI and its evaluation document states that they are in constant need to be further developed. A efficient protection of the national green Infrastructure network can only achieved by executing activities at the same time to support planning sectors. Therefore research, implementation and integration of future conservation concepts are necessary.

In a further note specific mentionable aspects are not part of the Green Infrastructure, e.g. "Hotspots for biological diversity", due to their large-scale presentation and their lack of data. The BKGI offers a great opportunity for connectivity as it also portrays "Unzerschnittene Verkehrsarme Räume" (non-fragmented, low-traffic-impact spaces), that are not conflicted >100 km2 with traffic infrastructure, or canals. It enables planners and practitioners to get full access to relevant data in one "document" regarding traffic planning, energy transmission line planning, spatial planning, settlement and infrastructure planning, implementation of the white book "Grün in der Stadt" / Green in the city (obligatory measures to be taken to improve green spaces in urban areas), Nature conservation offensive 2020 and trans-European networks.

10. Monitoring system

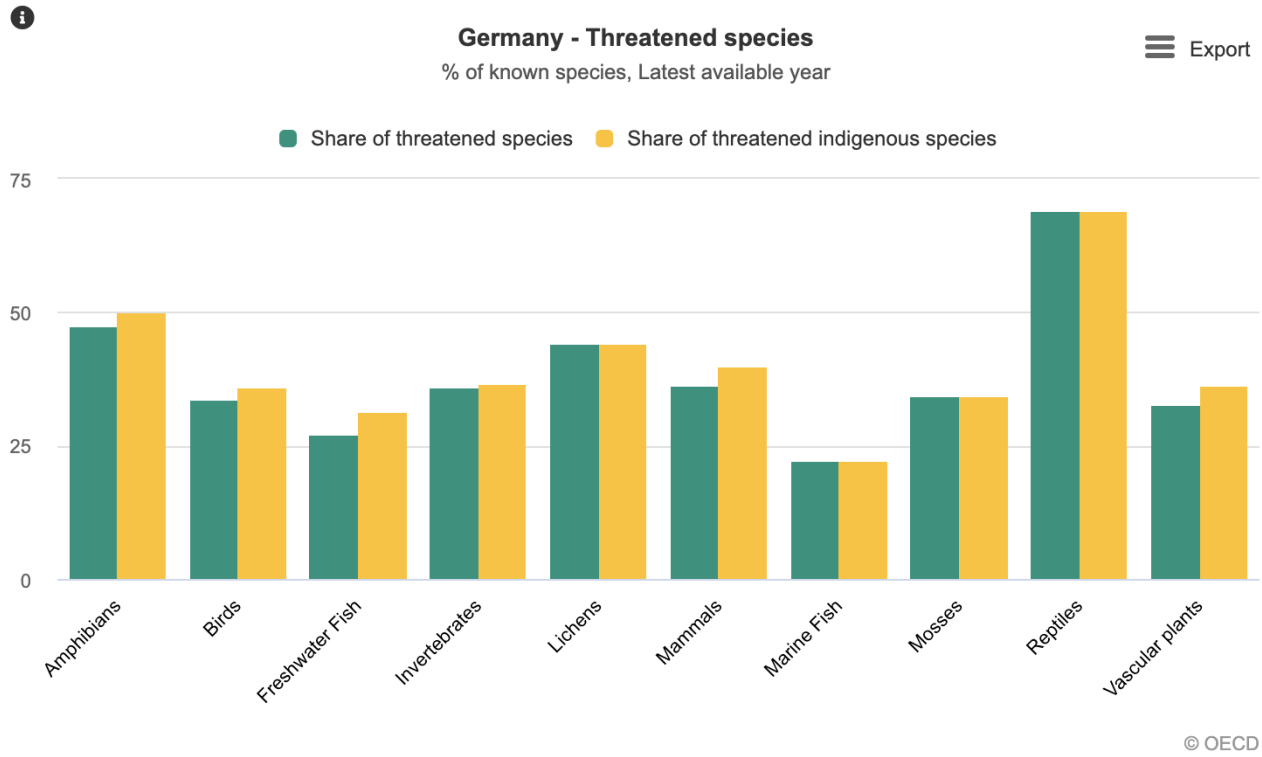
The BKGI needs to be concurrently developed. A sort of monitoring system can be framed by the lower-level nature conservation areas that are the last resort for binding nature conservation measurements. Besides nature conservation, remaining traffic planning, energy infrastructure planning, agriculture, forestry, and fishery economies need to accept and implement the concept. For a further integration into practitioners doings, it would be useful to have a further distribution of geodatabase. The BKGI mentions that for further development a target-oriented monitoring should be established.

Country projections for the future

TRANSITIONS PERFORMANCE INDEX 2021

3.	**Environmental transition**		**20**	**65.0**	↗
3.1	EMISSIONS REDUCTION: Gross greenhouse gas emissions (tonnes per capita)	10.1	51	**57.9**	↑
3.2	BIODIVERSITY	77.6	15	**77.6**	–
3.2.1	Terrestrial key biodiversity areas (KBAs) protected (%)	78.7	18	**78.7**	–
3.2.2	Freshwater key biodiversity areas (KBAs) protected (%)	78.8	21	**78.8**	–
3.2.3	Pesticide use per area of cropland (kg/ha)	3.8	44	**72.9**	↘
3.3	MATERIAL USE	55.3	15	**55.3**	↑
3.3.1	Resource productivity (PPP$ per kg)	4.1	11	**67.7**	↑
3.3.2	Material footprint (tonnes per capita)	22.8	40	**42.9**	↘
3.4	ENERGY PRODUCTIVITY: Energy productivity (PPP$ per koe)	13.8	22	**69.2**	↑

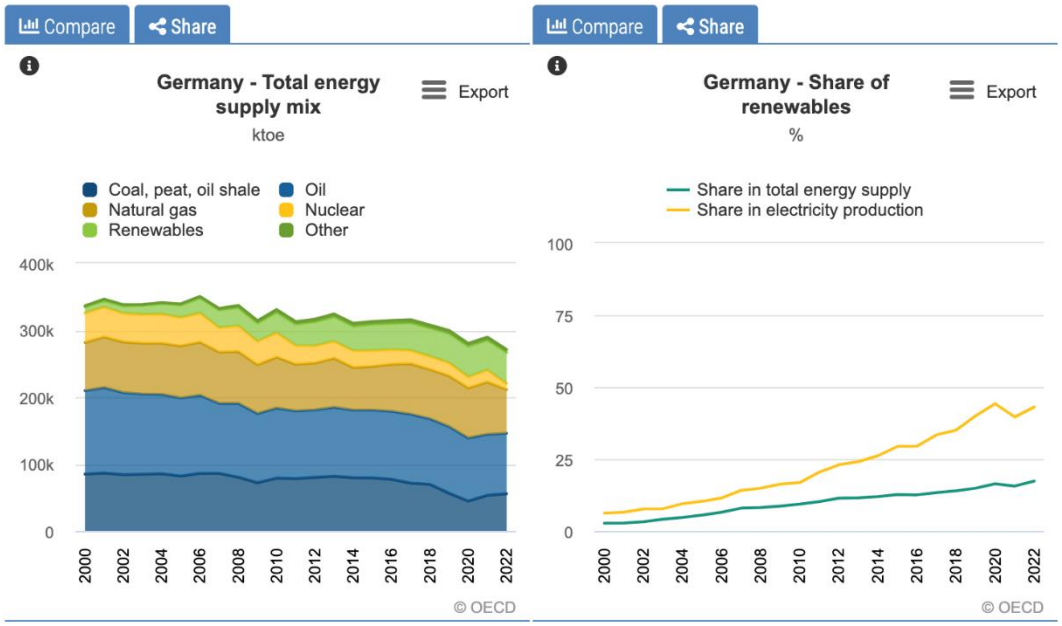
ENVIRONMENT AT A GLANCE INDICATORS, OECD 2023



Note: see country metadata.

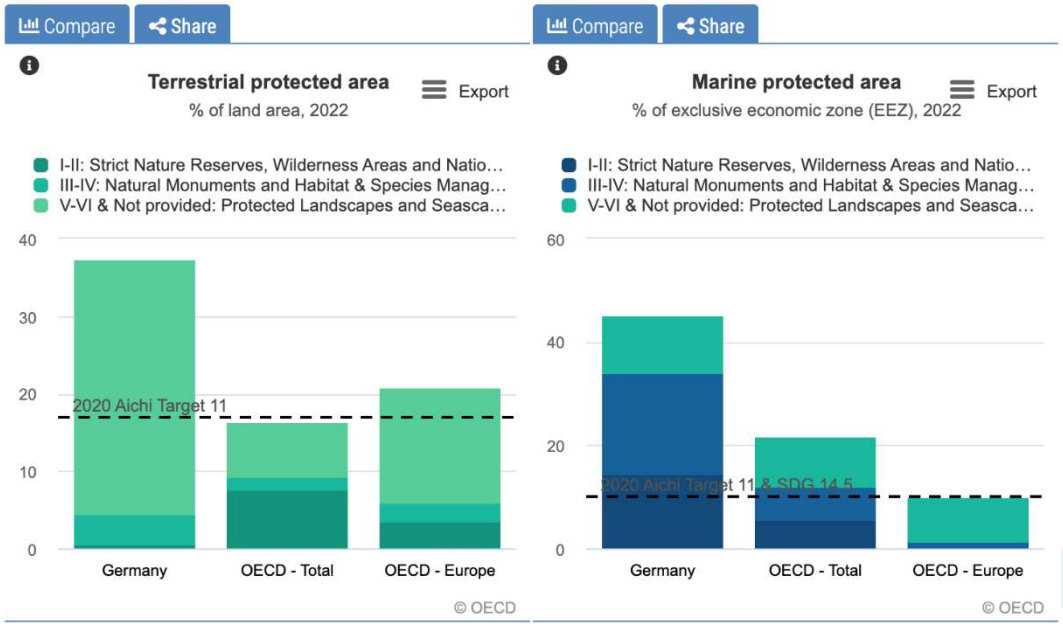
Sources: OECD, "Biodiversity: Threatened species", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00605-en.

Energy mix



Source: IEA, "World energy statistics", *IEA World Energy Statistics and Balances* (database), https://doi.org/10.1787/data-00510-en.

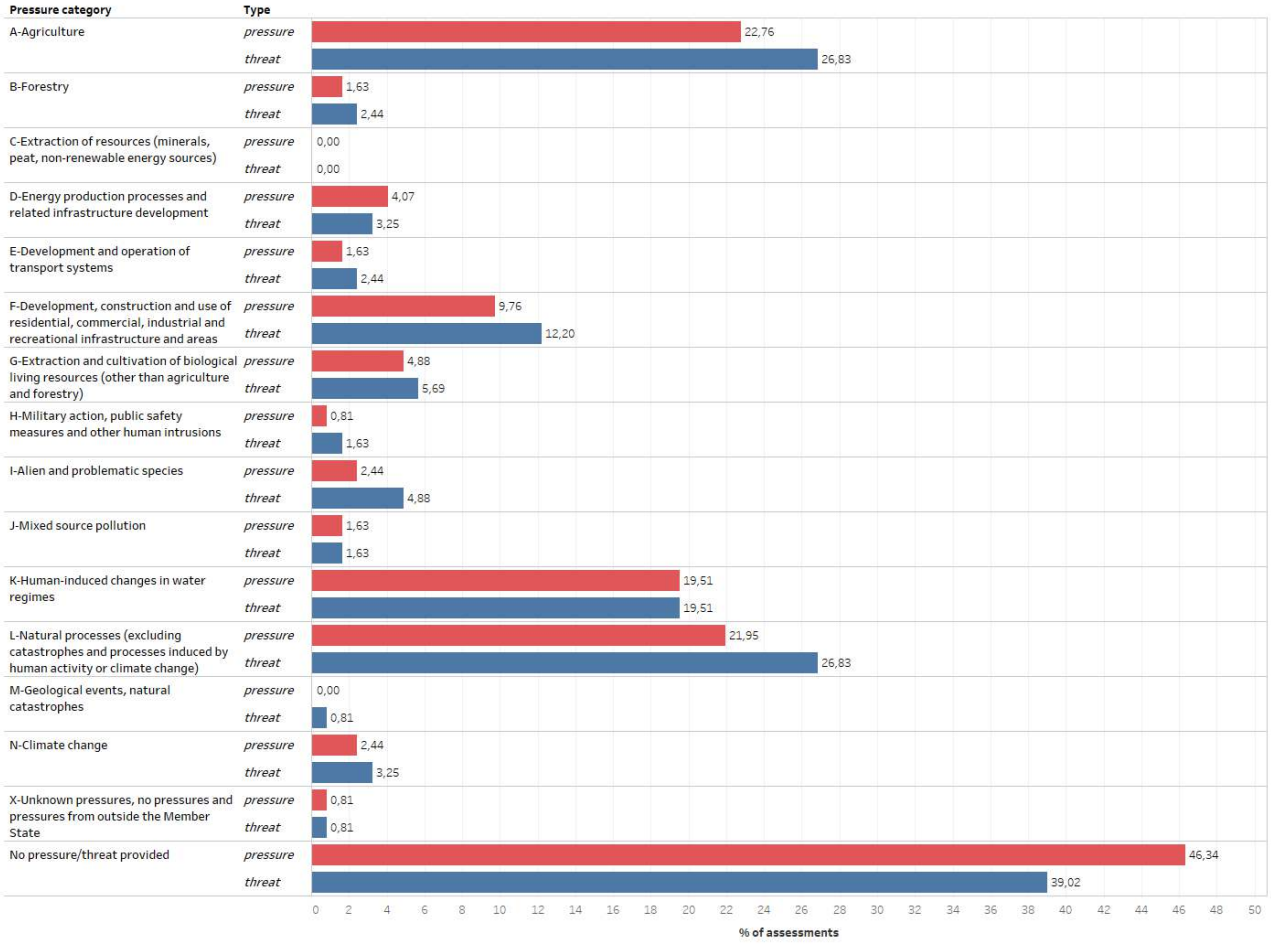
Protected areas



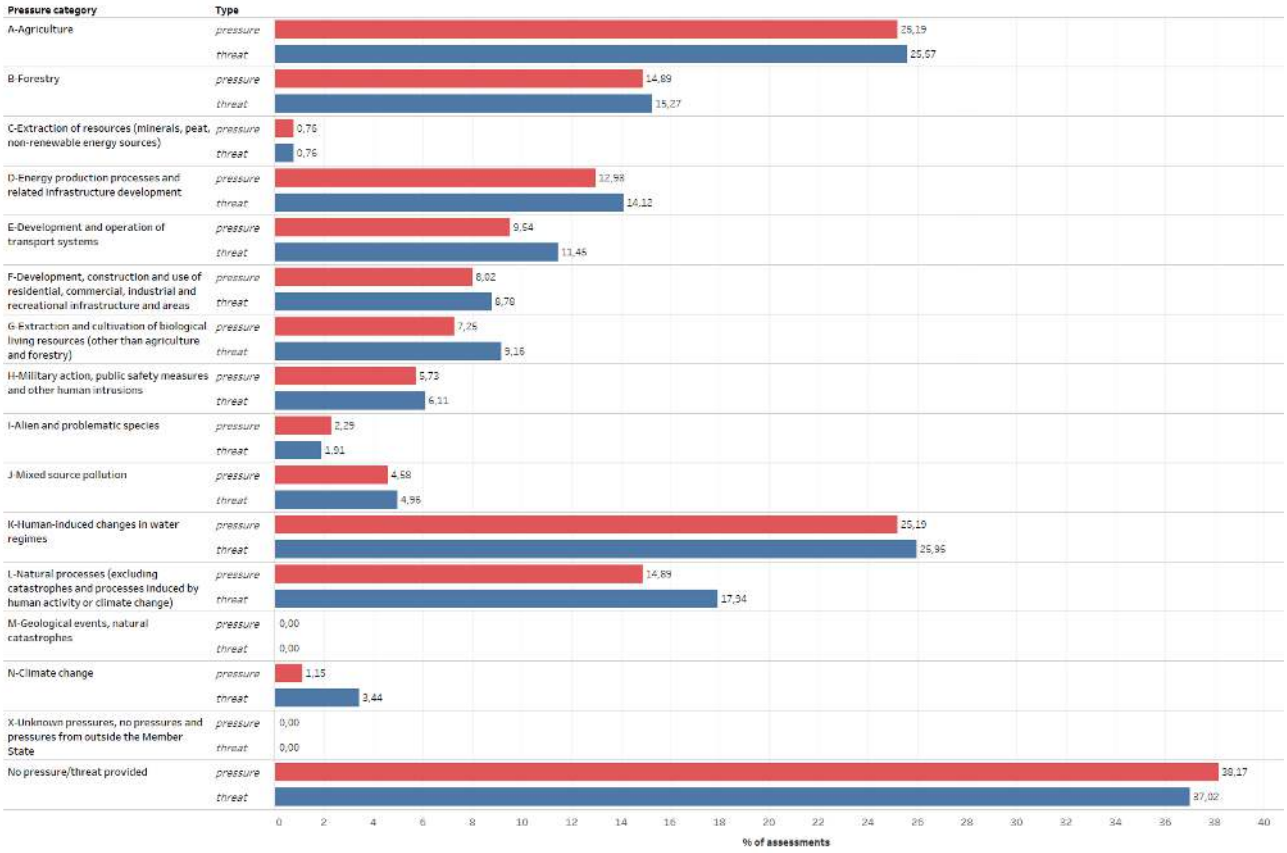
Source: OECD, "Biodiversity: Protected areas", *OECD Environment Statistics* (database), https://doi.org/10.1787/5fa661ce-en.

STATE OF THE NATURE REPORT 2013-2018

Frequency of main pressure and threats on habitats of the Alpine and Continental Biogegraphical Regions (DE)

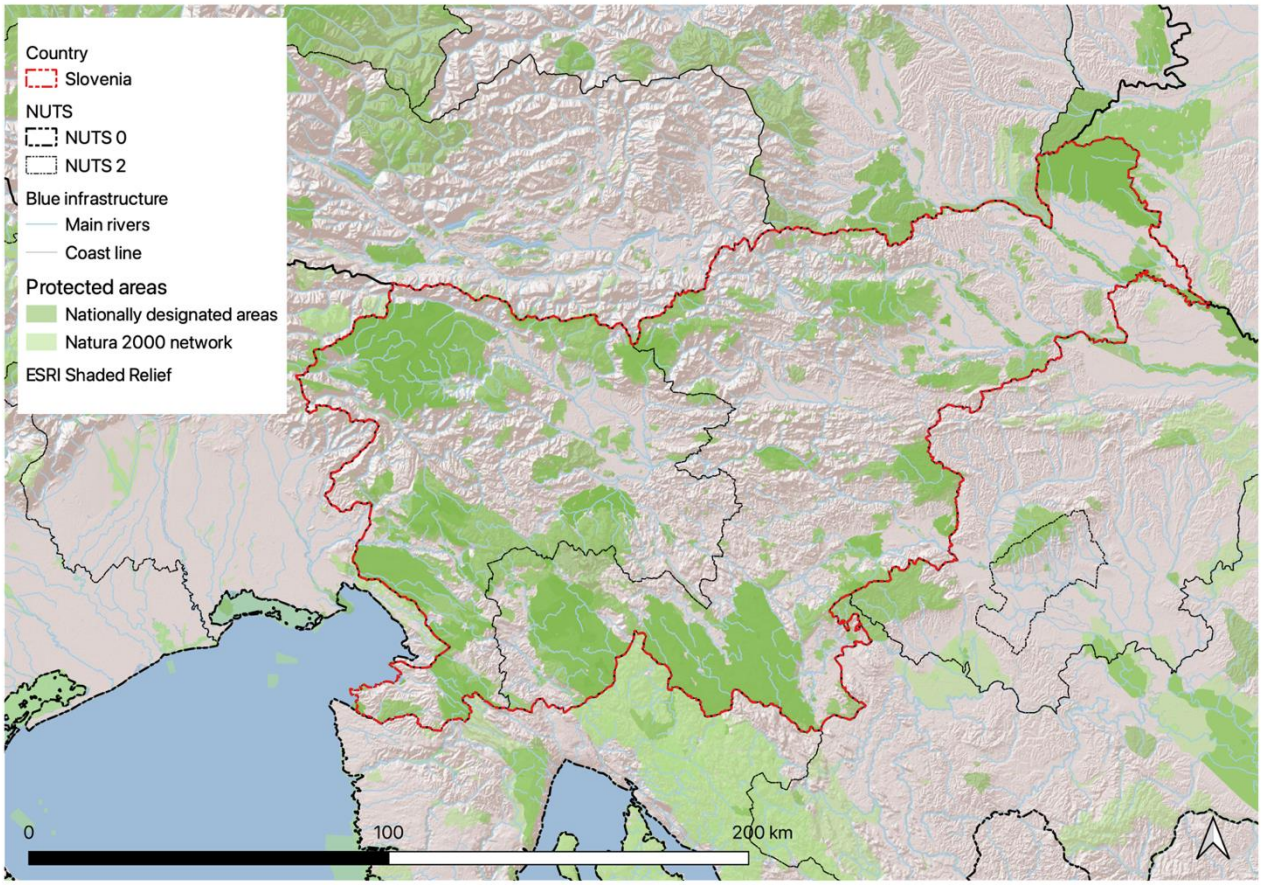


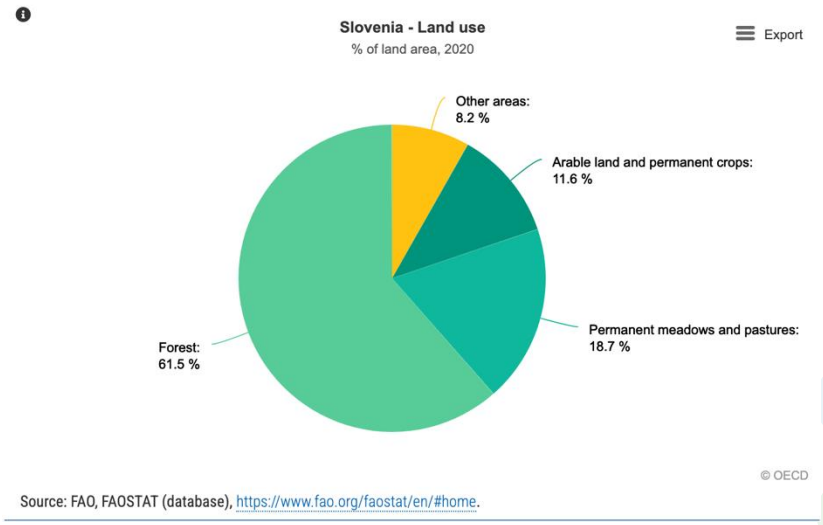
Frequency of main pressure and threats on species of the Alpine and Continental Biogegraphical Regions (DE)



1.4 Slovenia

Definition of ecological corridors at SI level as a support for spatial development planning and management of nature and other resources by UIRS





Country overview

Air and climate		
Emissions of		*Year*
SO2 (1000t)	3	2020
SO2 per capita (kg)	2	2020
NOx (1000t)	25	2020
NOx per capita (kg)	25	2020
CO2 (million tonnes)	13	2020
CO2 per capita (tonnes)	6	2020
GHG (million tonnes CO2 eq.)	16	2020
GHG per capita (tonnes CO2 eq.)	8	2020
Consumption of ozone depleting CFCs (ODP t)	-	Year

Biodiversity		
Proportion of terrestrial and marine areas protected (%)	54	2014
Number of threatened species	143	2016
Fish catch (tonnes)	343	2015
Change in fish catch from previous year (%)	-20	2015

Economy		
GDP growth rate from previous year (%)	3	2016
GDP per capita (at current prices - $US)	21.517	2016
% Value added: agriculture, hunting, forestry, fishing	2	2016
% Value added: mining, manufacturing, utilities	27	2015

Population		
Population (1000)	2.079	2019
Population growth rate from previous year (%)	0	2020

Energy		
Total energy supply (PJ)	285	2019
Energy supply per capita (GJ)	137	2019
Energy use intensity (MJ per USD constant 2011 PPP GDP))	4	2019
Renewable electricity production (%)	31	2019

Land and agriculture		
Total area (sq km)	20.136	2020
Agricultural land (sq km)	20.136	2020
Arable land (% of agric. land)	30	2020
Permanent crops (% of agric. land)	9	2020
Permanent meadows and pastures (% of agric. land)	62	2020
Change in agricultural land area since 1990 (%)	-	2020
Forest area (sq km)	12.378	2020
Change in forest area since 1990 (%)	-	2020

Waste		
Total population served by municipal waste collection (%)	-	
Municipal waste collected (1000t)	0	2019
Hazardous waste generated per capita (kg)	1	2018
Proportion of hazardous waste treated or disposed (%)	59	2018
Proportion of municipal waste recycled (%)	43	2019

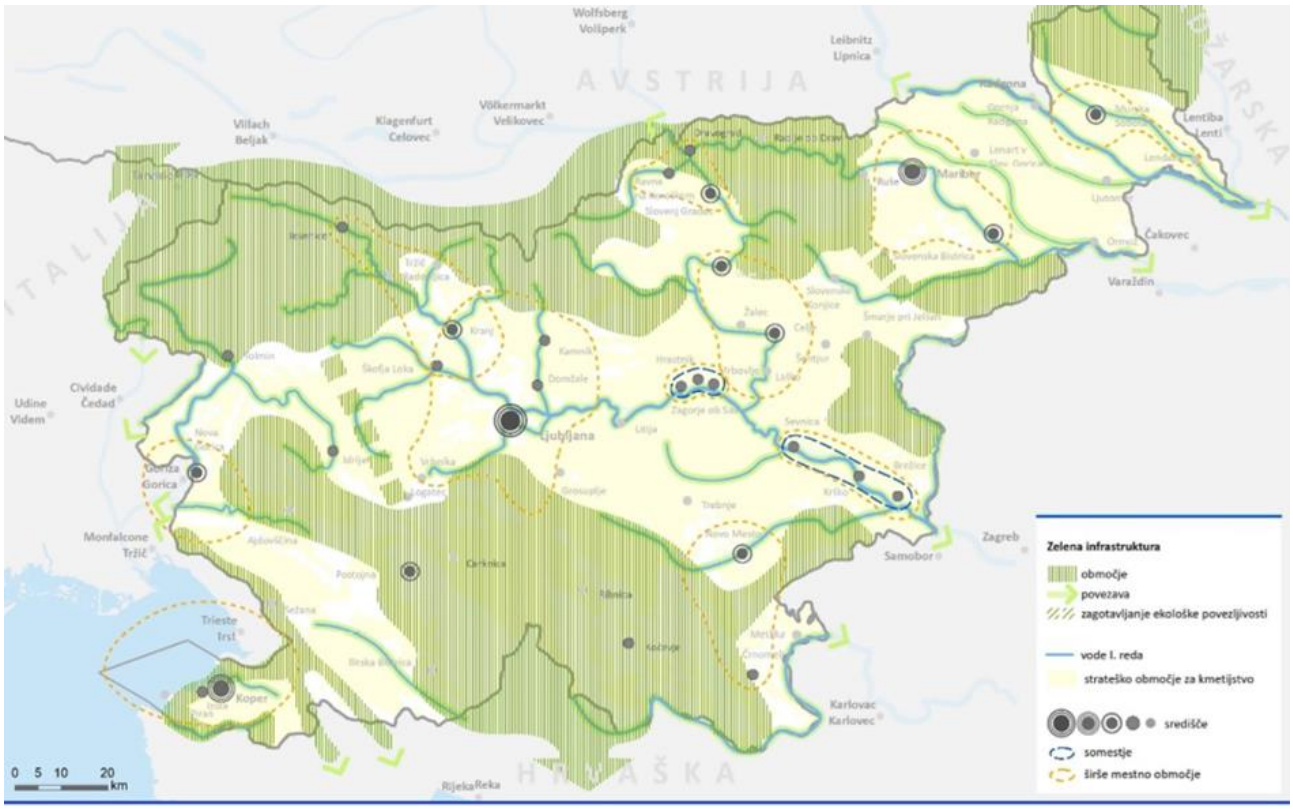
Water and sanitation		
Renewable freshwater resources per capita (m3)	14.572	2018
Proportion of wastewater treated (%)		
Proportion of freshwater abstracted (%)		

SLOVENIA

STATE OF THE ENVIRONMENT REPORTING

Slovenian Environment Agency

Green infrastructure network - strategic outline at national level (Spatial Planning Strategy of Slovenia 2050, 2023)



Green infrastructure available at https://www.uradni-list.si/glasilo-uradni-list-rs

1. Network typology (check corresponding answer)

Other (e.g. GBI network concepts)

The proposed network is outlined on a very strategic level and only schematically presented on a map. It includes large geographical units such as Alpine and Dinaric Mountain ranges, and hills (e.g. Pohorje massif), larger forest complexes, karst fields, karst area etc. The areas include protected areas, nature parks (e.g. Notranjski regionalni park, Triglav national park), and Natura2000 areas within these geographic units, first-order waters (rivers) and associated permanent or intermittent lakes, tidal areas, the sea, and the naturally preserved coastline. The linkages between these units are not defined and are only illustrated by dashed lines.

2. The ecological network and its legal framework of reference

According to the Spatial Planning Strategy of Slovenia 2050 (2023) green infrastructure is a strategically designed and managed network of natural and semi-natural areas and the links between them. It includes green and waterscape features and green spaces in settlements.

In the coastal zone, it includes the sea and parts of the coast. Green infrastructure ensures the conservation of biodiversity and the achievement of nature conservation objectives, increasing the resilience of territory to climate change, improving the functioning of ecosystems, providing benefits to the population, especially in terms of health, safety, quality of life, and strengthening spatial identity.

Green infrastructure also provides benefits for the economy, particularly in the conservation and restoration of natural resources. Green infrastructure links urban and rural areas, the sea and the coast to the hinterland. Green infrastructure is planned at regional level through regional green systems and at local level through green systems for settlements.

The concept is prepared on NUTS 0 (national) level.

It is legally binding as a strategic content, which is the mandatory basis for subordinate spatial planning acts. However, due to its very schematic/strategic outline it should be defined in more detail.

It could be said that the network is a part of a cascading planning system; it should be further detailed on the regional level and finally on the local level; especially the linkages between “core areas” are not defined; also ‘core areas’ include whole geographic units encompassing the valuable and tricky parts such as settlements and infrastructure networks.

3. Network objectives

The ecological network objective is to maintain the connectivity of wildlife habitats; forest habitats especially (connectivity between larger forest complexes). The methodology used is not species-specific but supports the general connectivity that is needed to maintain wildlife species that use such corridors to move between habitats/sub-populations. Species include brown bear (forests), red deer (grassland/forest), vultures (gliding birds), aquatic birds (wetlands), and migratory fish species. By maintaining forest corridors in fragmented landscapes, connectivity is also maintained for other smaller species for which such forests may also provide habitat (deer and small game).

4. Network structure and elements

Main (or core) areas are: larger forest complexes (13 complexes; serving as habitats of deer and large carnivores).

Corridors: defined based on identifying actual movements of species and using the “Least-cost path” analysis.

Neighboring administrative units are considered: on international level (countries) - to focus on the ecological function of green infrastructure, which is achieved by linking ecologically important landscape features across national borders, removing barriers to ecological connectivity and improving the condition of natural ecosystems.

5. Methodology used in network and corridor design

Green infrastructure network scheme (see figure) is based on structural approach (habitats and landscape matrix).

6. Tools and guidance for planners and practitioners

The document only provides a very general map/schematic illustration on the network which includes the core areas but only illustrative linkages among them.

7. Specific provisions for connectivity conservation and restoration areas

No specific provisions regarding connectivity areas are detailed in the Strategy (2023).

8. Implementation of the connectivity conservation and restoration areas

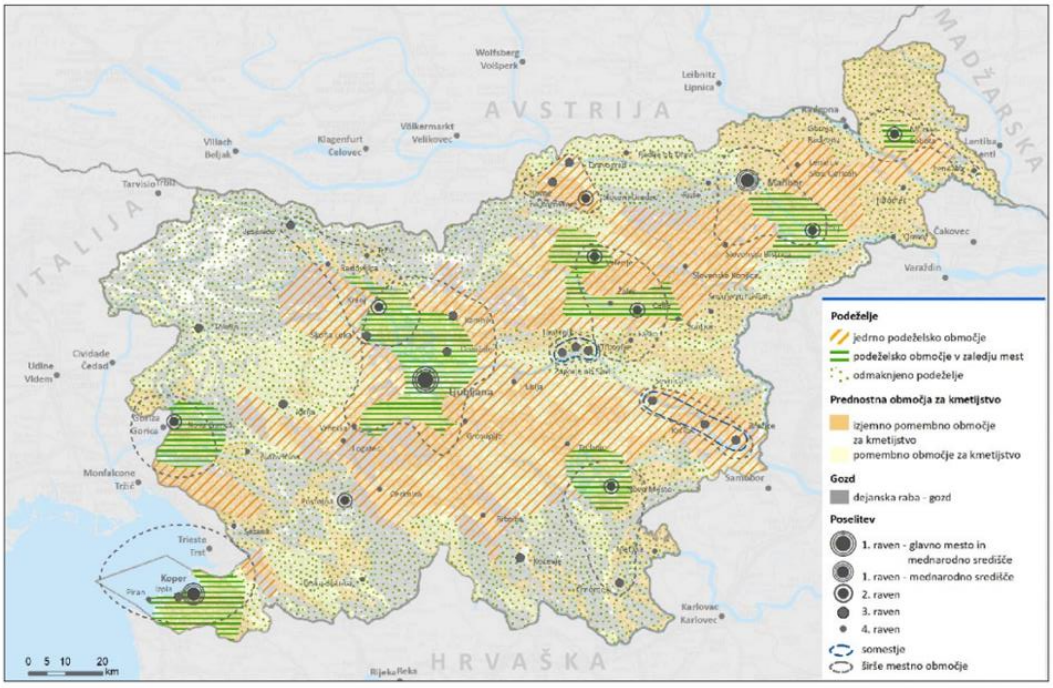
As the Strategy was only adopted in 2023 there is currently no information on concrete implementation. It is expected that the strategic outline of the network will be used in preparation of the regional spatial plans following in 2025 and subsequent years.

9. Implementation difficulties/opportunities

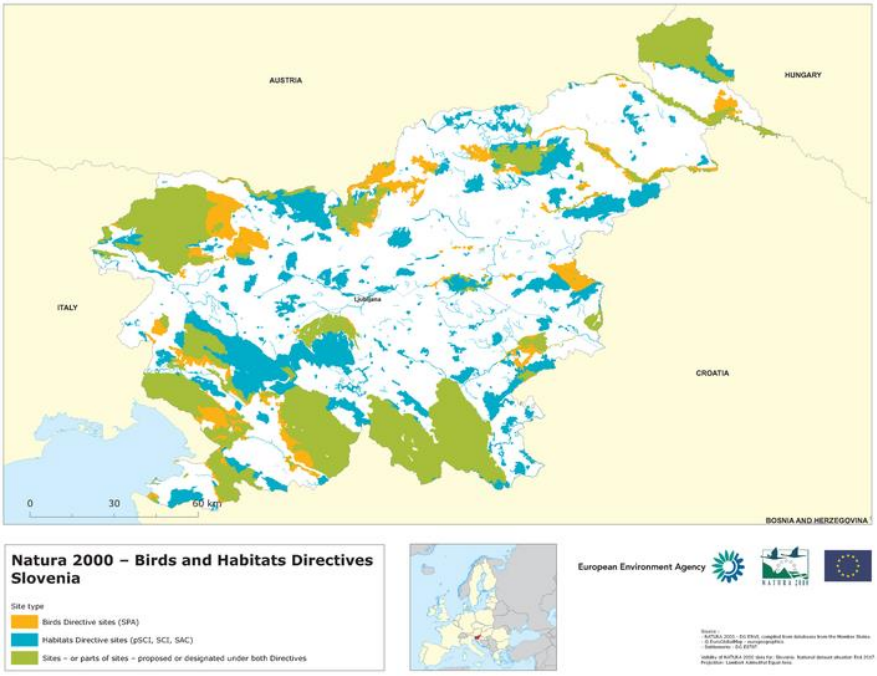
There is a need for further definition of linkages (as well as obstacles, gaps, inconsistencies) in subsequent spatial planning documents. The intersectoral cooperation is crucial in detailed planning and implementation of the network.

10. Monitoring system

Due to the novelty of the Strategy (2023) there has been no monitoring yet. The Spatial Management Act (2022) foresees a “Report on spatial development” every four years which includes also the report on implementation of the Strategy and other spatial planning acts and proposals for the further spatial development of the country, including proposals for updating the Strategy and other state regulations relating to spatial planning.

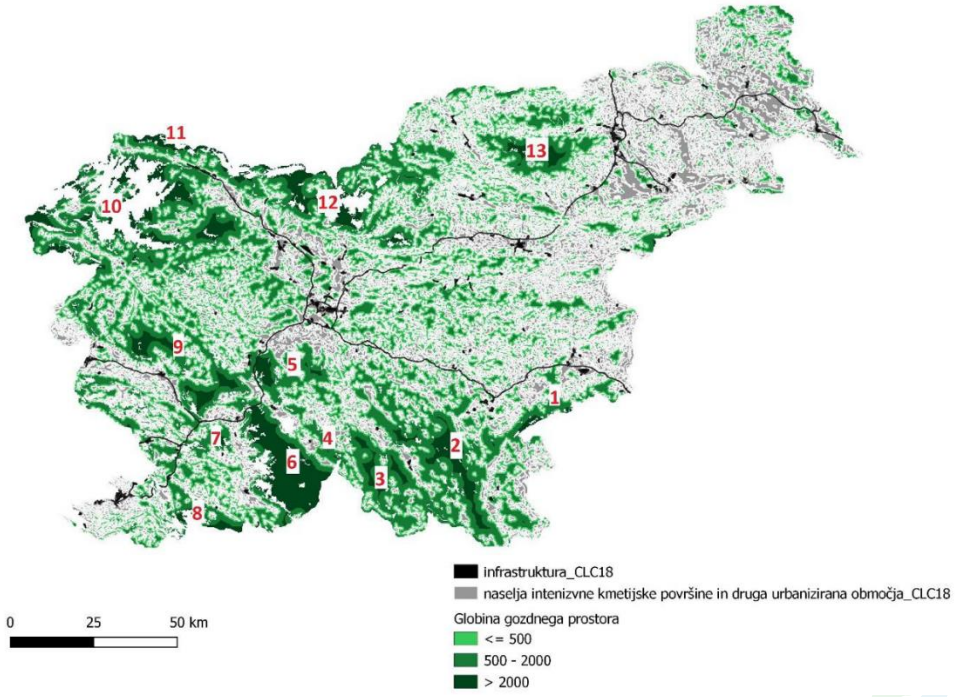


Agricultural areas available at https://www.uradni-list.si/glasilo-uradni-list-rs



Natura 2000 areas available at https://www.eea.europa.eu/data-and-maps/figures/natura-2000-birds-and-habitat-directives-9/slovenia

"Corridors to maintain wildlife habitat connectivity" by Slovenia Forest Service (Zavod za gozdove Slovenije)



Corridors mapping (Source: Slovenia Forest Service, 2023)

1. Network typology (check corresponding answer)

Ecological network plan

2. The ecological network and its legal framework of reference

Slovenia Forest Service developed the Methodology to protect corridors at national level: the currently proposed corridors should be checked and respected (from 2023 on) in any spatial plan adoption or changes procedure (municipal, regional or national), where the opinion (or terms) on the compatibility of interventions is requested (by the Spatial Management Act). The document is now legally binding (statutory framework). It should be used on any level of spatial planning (not cascading).

3. Network objectives

The ecological network objective is to maintain the connectivity of wildlife habitats; forest habitats especially (connectivity between larger forest complexes). The methodology used is not species-specific but supports the general connectivity that is needed to maintain wildlife species that use such corridors to move between habitats/sub-populations. Species include deer, wild boar, and large carnivores. By maintaining forest corridors in fragmented landscapes, connectivity is also maintained for other smaller species for which such forests may also provide habitat (deer and small game).

4. Network structure and elements

Main (or core) areas are: larger forest complexes (13 complexes; serving as habitats of deer, wild boar and large carnivores).

Corridors: defined based on identifying actual movements of species and using the “Least-cost path” analysis.

5. Methodology used in network and corridor design

The corridors to maintain wildlife habitat connectivity (see figure) are based on structural approach (13 selected important forest habitants), the linkages are based on the “Least-cost path” analysis and validated by exact data from monitoring the transitions of species (species-specific connectivity; hunters associated; reports on road accidents including wildlife etc.). The network and corridor design combines the structural and species approaches.

6. Tools and guidance for planners and practitioners

The document provides a map; the data is also available in .shp form on request.

7. Specific provisions for connectivity conservation and restoration areas

Based on defined corridors, there is a data layer provided on “importance (1st level) of biological (and diversity) function of forests”, for these areas, restrictions apply against changing the forests to other spatial use (in spatial plans). Any changes of forest areas to other uses are verified during the adoption process of spatial plans by the responsible ministry.

8. Implementation of the connectivity conservation and restoration areas

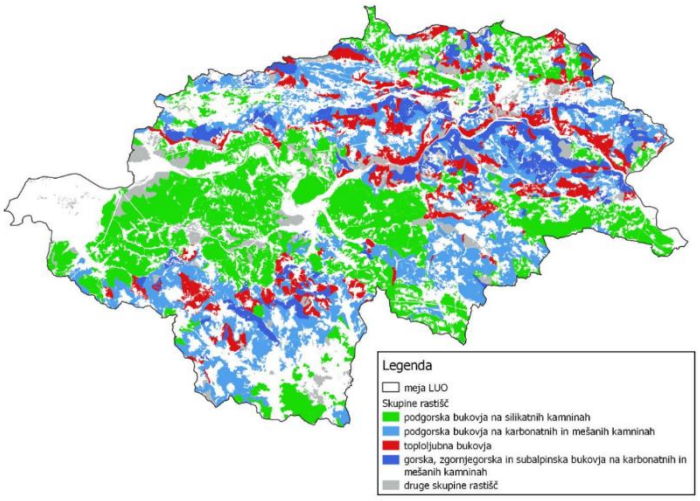
As the corridors were only adopted in 2023, there is currently no information on concrete implementation.

9. Implementation difficulties/opportunities

There is a need of open dialogue and sharing information especially with spatial planning practitioners, municipalities etc. The intersectoral cooperation is crucial in detailed planning and implementation of the network.

10. Monitoring system

Due to the novelty, there has been no monitoring yet. The Spatial Management Act (2022) foresees a"Report on spatial development" every four years which includes also the report on implementation of the Strategy and other spatial planning acts and proposals for the further spatial development of the country, including proposals for updating the Strategy and other state regulations relating to spatial planning.



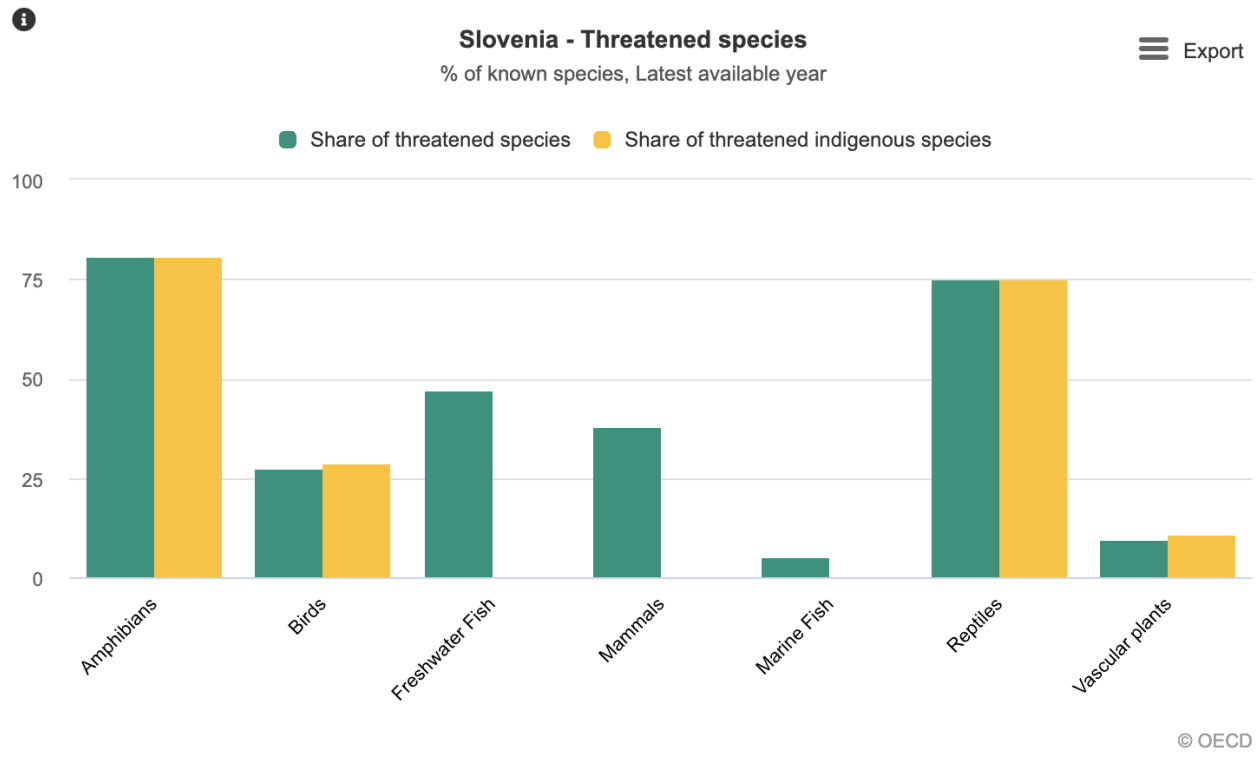
Forest site types available and Demonstration of key corridors to maintain ecological connectivity, available at http://www.zgs.si/

Country projections for the future

TRANSITIONS PERFORMANCE INDEX 2021

3.	**Environmental transition**		**30**	**60.9**	↗
3.1	EMISSIONS REDUCTION: Gross greenhouse gas emissions (tonnes per capita)	8.2	42	**65.8**	↗
3.2	BIODIVERSITY	77.1	18	**77.1**	–
3.2.1	Terrestrial key biodiversity areas (KBAs) protected (%)	73.5	24	**73.5**	–
3.2.2	Freshwater key biodiversity areas (KBAs) protected (%)	84.0	20	**84.0**	–
3.2.3	Pesticide use per area of cropland (kg/ha)	4.2	46	**70.4**	–
3.3	MATERIAL USE	45.0	38	**45.0**	↑
3.3.1	Resource productivity (PPP$ per kg)	3.0	16	**49.4**	↑
3.3.2	Material footprint (tonnes per capita)	23.8	43	**40.6**	–
3.4	ENERGY PRODUCTIVITY: Energy productivity (PPP$ per koe)	11.1	37	**55.5**	↑

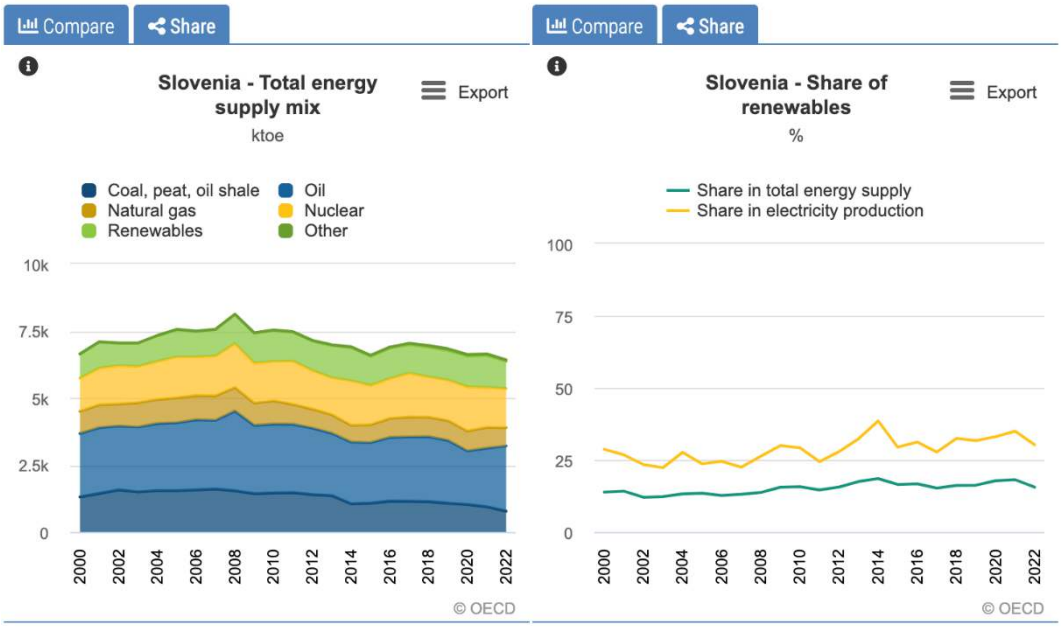
ENVIRONMENT AT A GLANCE INDICATORS, OECD 2023



Note: see country metadata.

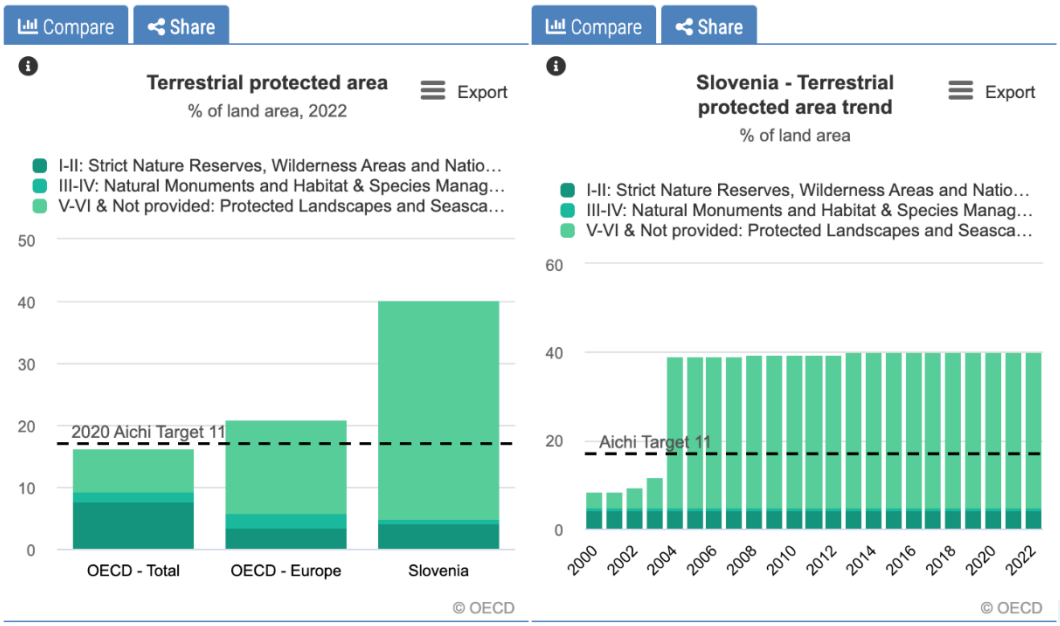
Sources: OECD, "Biodiversity: Threatened species", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00605-en; IUCN, "The IUCN Red List of Threatened Species", https://www.iucnredlist.org/assessment/red-list-index.

Energy mix



Source: IEA, "World energy statistics", *IEA World Energy Statistics and Balances* (database), https://doi.org/10.1787/data-00510-en.

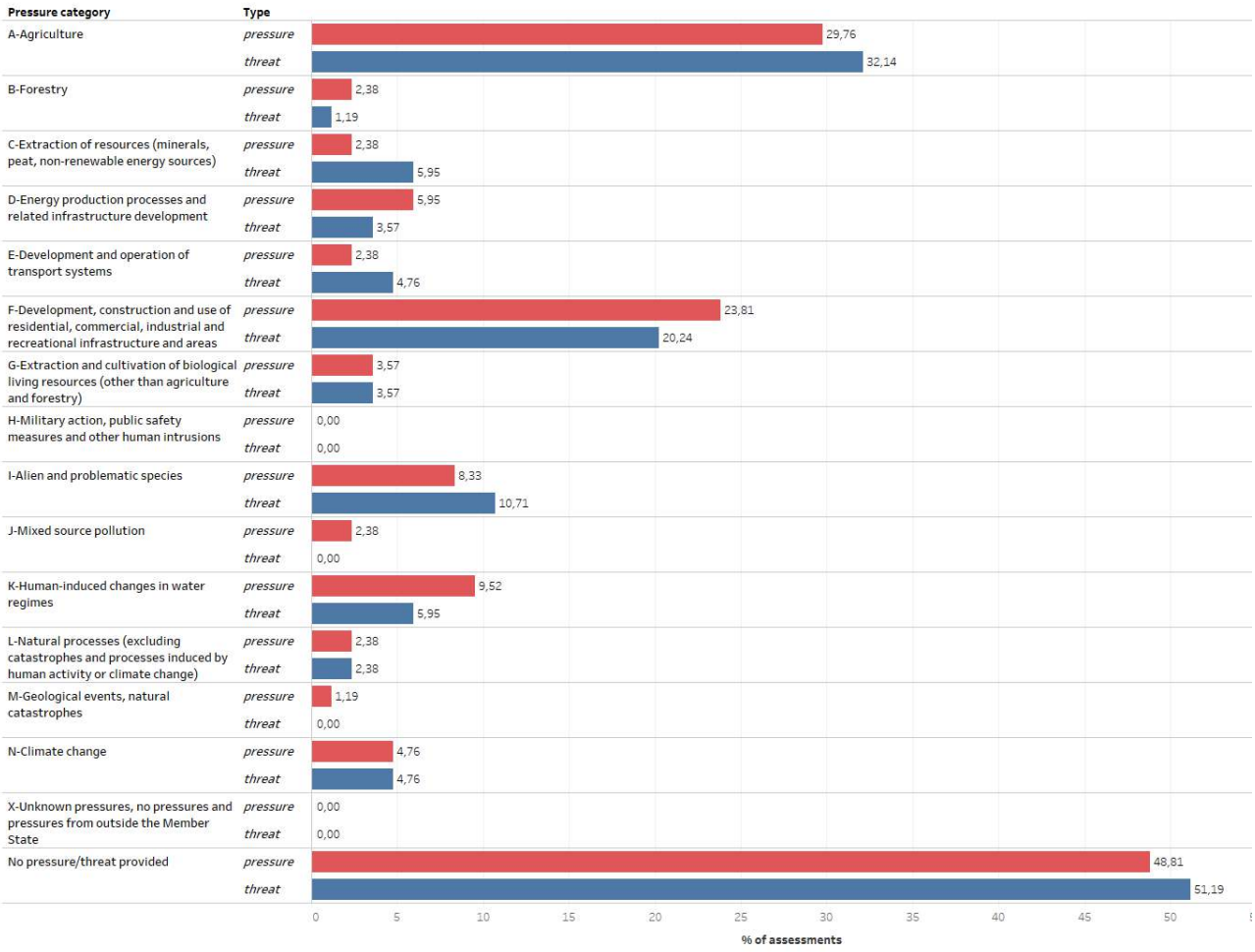
Protected areas



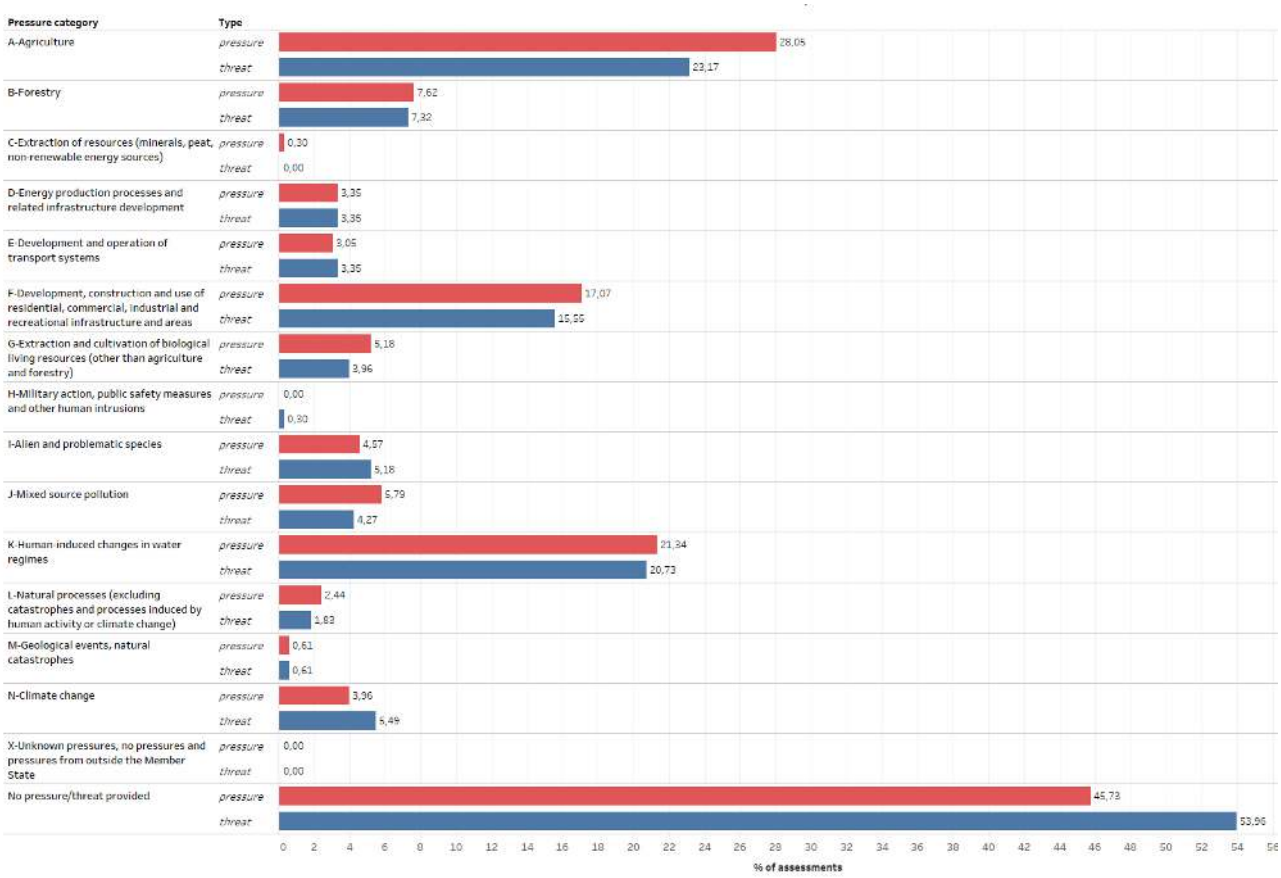
Source: OECD, "Biodiversity: Protected areas", *OECD Environment Statistics* (database), https://doi.org/10.1787/5fa661ce-en.

STATE OF NATURE REPORT 2013-2018 (EEA)

Frequency of main pressure and threats on habitats of the Alpine and Continental Biogegraphical Regions (SI)

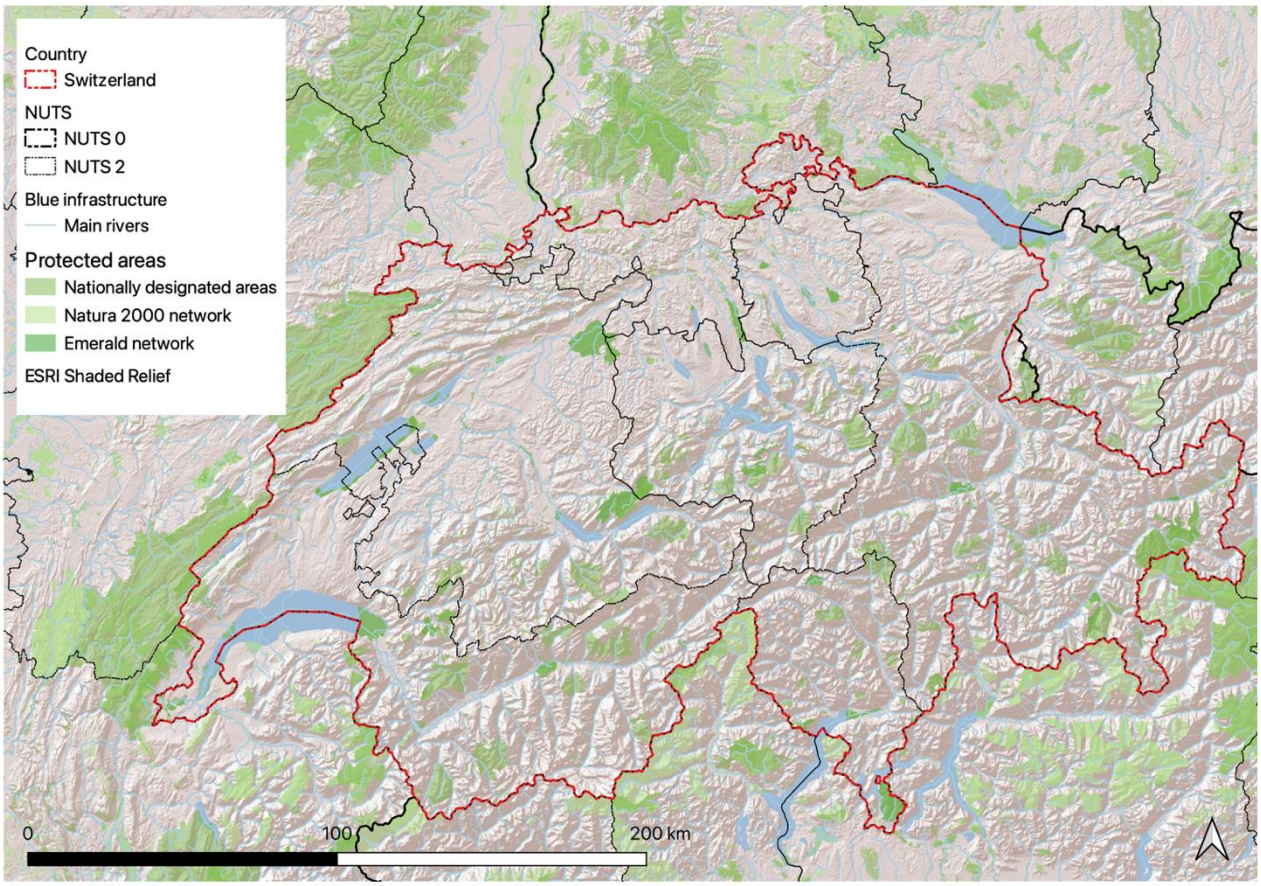


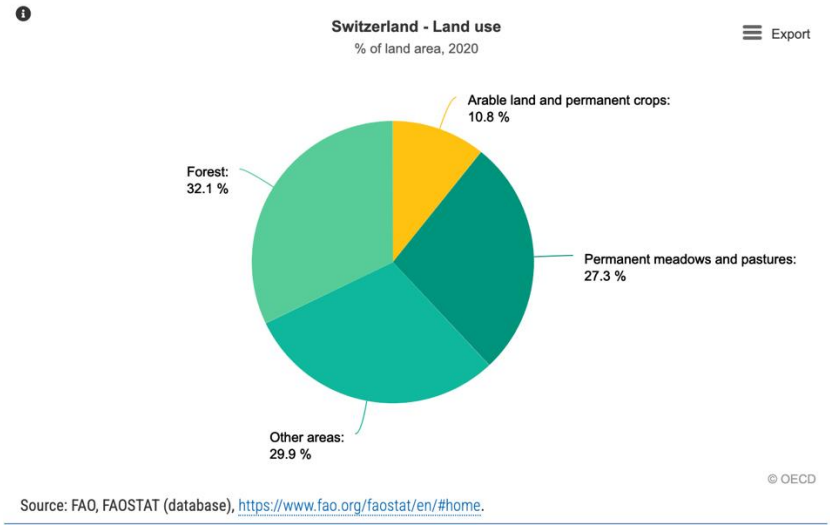
Frequency of main pressure and threats on species of the Alpine and Continental Biogegraphical Regions (SI)



1.5 Switzerland

Wildtierkorridore Überregional by EURAC Research





Country overview

Air and climate		
Emissions of		*Year*
SO2 (1000t)	4	2020
SO2 per capita (kg)	0	2020
NOx (1000t)	53	2020
NOx per capita (kg)	53	2020
CO2 (million tonnes)	34	2020
CO2 per capita (tonnes)	4	2020
GHG (million tonnes CO2 eq.)	43	2020
GHG per capita (tonnes CO2 eq.)	5	2020
Consumption of ozone depleting CFCs (ODP t)	0	Year
Biodiversity		
Proportion of terrestrial and marine areas protected (%)	10	2014
Number of threatened species	74	2016
Fish catch (tonnes)	2.023	2015
Change in fish catch from previous year (%)	2	2015
Economy		
GDP growth rate from previous year (%)	1	2016
GDP per capita (at current prices - $US)	79.609	2016
% Value added: agriculture, hunting, forestry, fishing	1	2016
% Value added: mining, manufacturing, utilities	20	2015
Population		
Population (1000)	8.591	2019
Population growth rate from previous year (%)	1	2020

Energy		
Total energy supply (PJ)	1.023	2019
Energy supply per capita (GJ)	119	2019
Energy use intensity (MJ per USD constant 2011 PPP GDP))	2	2019
Renewable electricity production (%)	59	2019
Land and agriculture		
Total area (sq km)	39.516	2020
Agricultural land (sq km)	39.516	2020
Arable land (% of agric. land)	27	2020
Permanent crops (% of agric. land)	2	2020
Permanent meadows and pastures (% of agric. land)	72	2020
Change in agricultural land area since 1990 (%)	-6	2020
Forest area (sq km)	12.691	2020
Change in forest area since 1990 (%)	10	2020
Waste		
Total population served by municipal waste collection (%)	-	
Municipal waste collected (1000t)	6.079	2019
Hazardous waste generated per capita (kg)	-	
Proportion of hazardous waste treated or disposed (%)	-	
Proportion of municipal waste recycled (%)	30	2019
Water and sanitation		
Renewable freshwater resources per capita (m3)	5.389	2019
Proportion of wastewater treated (%)	-	
Proportion of freshwater abstracted (%)	-	

SWITZERLAND

STATE OF THE ENVIRONMENT REPORTING


Environment Switzerland 2018
Latest State of the Environment Report published
2018
OECD Environmental Performance Reviews Switzerland (3rd cycle)
Paris Agreement came into force in Switzerland
SBS Action Plan launched
2017
Green Economy Measures
2016
2030 Agenda for Sustainable Development
Paris Agreement on Climate Change
2015
Adoption of the "Environmental Indicators System"
2014
Switzerland ratifies Aarhus Convention
2013
Green Economy Action Plan
Rio+20 Conference on Sustainable Development
2012
Swiss Biodiversity Strategy (SBS)
Nagoya Strategic Plan for Biodiversity, including the Aichi Biodiversity targets
2010
Millennium Declaration and Millennium Development Goals
2000
EU Directive on Public Access to Environmental Information
2003
Adoption of the "General concept for environmental reporting in Switzerland"
2004
Swiss membership to EEA/Eionet
2006
OECD Environmental Performance Reviews Switzerland (2nd cycle)
2007
First Swiss SoE indicators-based report
Online platform for environmental reporting (FOEN website)
Act on the Reduction of CO_2 Emissions
1999
UNECE Aarhus Convention on Access to Environmental Information
1998
OECD Environmental Performance Reviews Switzerland (1st cycle)
1997
First Global Environmental Outlook published
First European Environment State and Outlook report published
1995
EEA/Eionet Establishment
1994
Convention on Biological Diversity (CBD)
1992
Forest Act
1991
First Swiss SoE report published
Environmental Protection Act
1983
Act on the Protection of Nature and Cultural Heritage
1966
Stockholm conference on the Human Environment
1972
SAEFL (Swiss Agency for the Environment, Forests and Landscape) established (FOEN since 2006)
Waters Protection Act
United Nations milestones
European Union milestones
EEA milestones
OECD Milestones
Milestones Switzerland

1. Network typology (check corresponding answer)

Ecological network plan

The Swiss federal government set the foundations for the development of an ecological infrastructure in its 'Biodiversity Strategy' (2012), which outlines the main commitments to protecting species variety, ecosystems, and genetic diversity through ten strategic objectives. The 'Swiss Biodiversity Strategy' (SBS) originated after the Earth Summit in Rio de Janeiro, when Switzerland joined the Convention on Biological Diversity (CBD) in 1992 and committed to create a national strategy. The SBS goals will be met thanks to the linked action plan (2017) and its immediate initiatives and pilot projects.

2. The ecological network and its legal framework of reference

The Protection of nature and landscape is ruled by art. 78 of the Swiss Constitution (1999), which declares that cantons are responsible for protecting nature and landscape, as federal goals. The Confederation protects landscapes, historical sites, and cultural monuments, plus it supports relevant protection efforts, and acquires or safeguards national importance sites. Federal regulations can be issued for fauna and flora, endangered species, and special beauty wetlands protection. The Ecological Infrastructure (EI) is a national binding project.

The first Federal Act on the Protection of Nature and Cultural Heritage (FAPNCH) dates to 1966, and it has been integrated by the Ordinance on the protection of nature and landscape (1991), under which natural forest reserves are promoted, after which specific laws about fishing, hunting, and protected areas of different kinds have been promulgated, including the Ordinance on the Federal Inventory of Landscapes, Sites and Natural Monuments (2017). According to programmatic agreements, cantons are responsible for planning the ecological infrastructure in their territory. To support them in this task, the Federal Office for the Environment (FOEN) has developed a specific guide (Arbeitshilfe für die kantonale Planung im Rahmen der Programmvereinbarung-speriode, 2020-24), with the aim of defining the 17% of the Confederation as priority areas.

3. Network objectives

The 'Swiss Biodiversity Strategy Action Plan' translated the goals into actions through actual initiatives by also supplementing the environmental legislation. Its first implementation phase, 2017-2023, revolved around several activities (urgent measures, synergy measures) and pilot projects, that are carried out in collaboration with Federal Administration partners, as well as cantons, communes, and third parties. Its measures:

- directly promote biodiversity (further development of ecological infrastructure, promotion of species),
- create links between the Confederation biodiversity policy and other policy areas (e.g. agriculture, spatial planning, transport, economic development),
- raise awareness among decision-makers and citizens of the importance of biodiversity as a basis for life.

The FOEN assessed the measures and pilot projects from the first phase of implementation in terms of ecological and economic efficacy in protecting and enhancing biodiversity. Based on these studies, on June 21, 2023, the Federal Council resolved to extend the first phase of the Plan for one year, until the end of 2024. At the same time, the Federal Council has directed the FOEN to develop an Action Plan for the second phase of implementation, which will run from 2025 until the end of 2030.

4. Network structure and elements

The Swiss Landscape Concept (SLC) defines the preservation and networking of valuable habitats as a quality objective. It requires that the sectoral policies of the Confederation and the cantons contribute to the creation of its ecological infrastructure.

As of 2020, Switzerland has 304 wildlife corridors of supra-regional importance. They link fragmented ecosystems or suitable habitats and are essential for species. This is because roads and railways present insur-mountable obstacles for many wild creatures. Large wild creatures like deer and stags, medium-sized ones like foxes and hares, and little ones like frogs or bats all require the ability to travel for food and reproduction.

The main structure of the Ecological Infrastructure (EI) is related to protected areas and other priority areas, which include biotopes of national, regional and local importance, such as floodplains, amphibian breeding sites, marshes, dry meadows and pastures (protected under the FAPNCH), the Swiss National Park, the core areas of periurban nature parks (protected under the FAPNCH), reserves of international and national importance for waterfowl and migratory birds, federal hunting restricted areas (banned under the Federal Act on Hunting, FAH) and forest reserves (Federal Act on Forests, FAF).

Priority areas also include international protected areas, such as Ramsar sites and the Emerald Network, or areas protected by third parties, such as Pro Natura, provided that the protection is binding, as well as areas for the promotion of biodiversity that are particularly valuable (Federal Act on Agriculture, FAA).

The EI also involves interconnection zones, which are essential for long-term biodiversity protection, ensuring connectivity to priority areas beyond cantonal and national borders. Interconnection zones include water and floodable areas (protected under the Federal Act on Water Protection, FAWP, or the Ordinance on Water Protection, OWP), national wetlands (FAPNCH), supra-regional wildlife corridors, wildlife passages, and forest edges, ensuring biodiversity is not solely protected. Similarly to water bodies, woodland edges have significant potential to connect biological systems, such as forests and open lands. They are integrated in the EI when cantons include them within the framework of ecological planning and are ecologically upgraded.

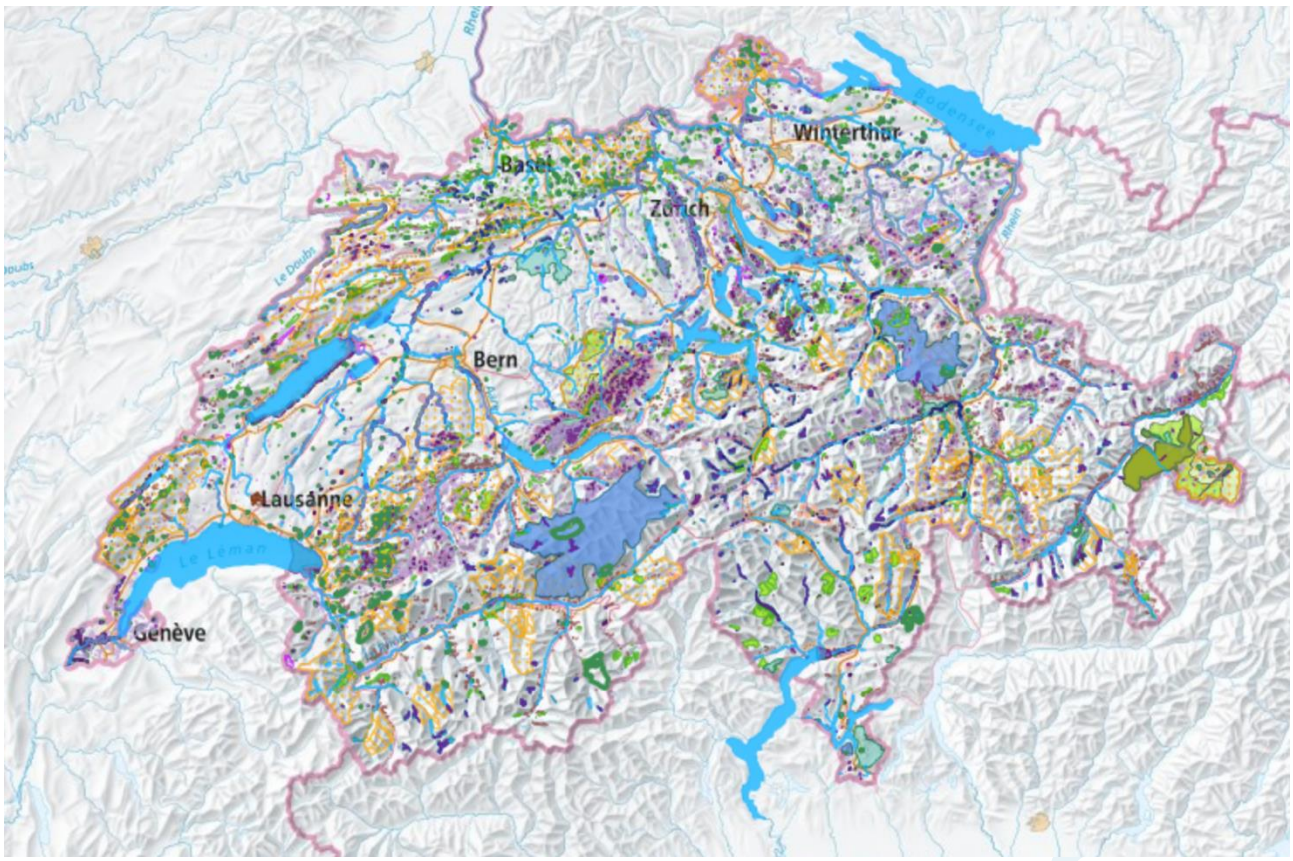
5. Methodology used in network and corridor design

As mentioned by the FOEN Guidelines on EI design, the Three Directions for the Development of a Functional Ecological Infrastructure basically pursue three goals: Ensuring the quality of existing areas (EI operations), the targeted use of existing processes

for the quantitative expansion of the areas from the point of view of the EI, and the further supplementation of the areas to close the remaining gaps.

The EI operations aim at improving the quality of existing core and networking areas through renovation and targeted development. Examples include safeguarding inventory objects, upgrading water and migratory bird reserves, buffering areas, restoring impaired areas, preparing management plans, and optimizing uses in moorland landscapes. The EI is expanded through quantitative extensions, using existing processes and programs coordinated with specialist planning.

This includes renaturation planning, water area definition, forest reserve designation, wildlife corridor safeguarding, and planned wildlife passages, aiming to create additional high-quality areas within ongoing planning. The Supplementing of EI will be completed by including additional cantonal protected areas under national planning principles. Gaps include species occurrences outside protected areas and significant deficits. Action should be taken on areas with restoration potential, deficits, and barriers.



Ecological Infrastructure mapping available at https://www.bafu.admin.ch/bafu/it/home/temi/biodiversita

National goals, territorial priorities, and substantive priorities are identified and ranked by cantons for development and implementation of the EI, complementing regional characteristics. The EI is crucial for enhancing the quality and functionality of landscape, promoting sustainable use and biodiversity conservation. It involves protecting animals and plants, allowing uses to natural site conditions and ecosystem carrying capacity, plus near-natural silviculture, and site-adapted agriculture. It also includes settlement areas, upgraded habitats, and small structures. The EI enhances sustainable land use by creating high-quality, well-connected areas. Its integration in landscape entails cooperation with sectoral policies and spatial planning. Cantons are developing landscape concepts to implement the SLC and align landscape and nature conservation interests in structural plans.

6. Tools and guidance for planners and practitioners

The federal government is implementing a national strategy to preserve and promote biodiversity, financially supporting cantons and participating in international conventions, aiming to address the current state of biodiversity. By signing the Convention on Biological Diversity (CBD), Switzerland has been committed to the long-term preservation and promotion of biodiversity since 1992. At the national level, the Swiss Biodiversity Strategy (2012) sets out the Federal Council goals in this regard. The SBS Action Plan is the main reference for the implementation of the related goals.

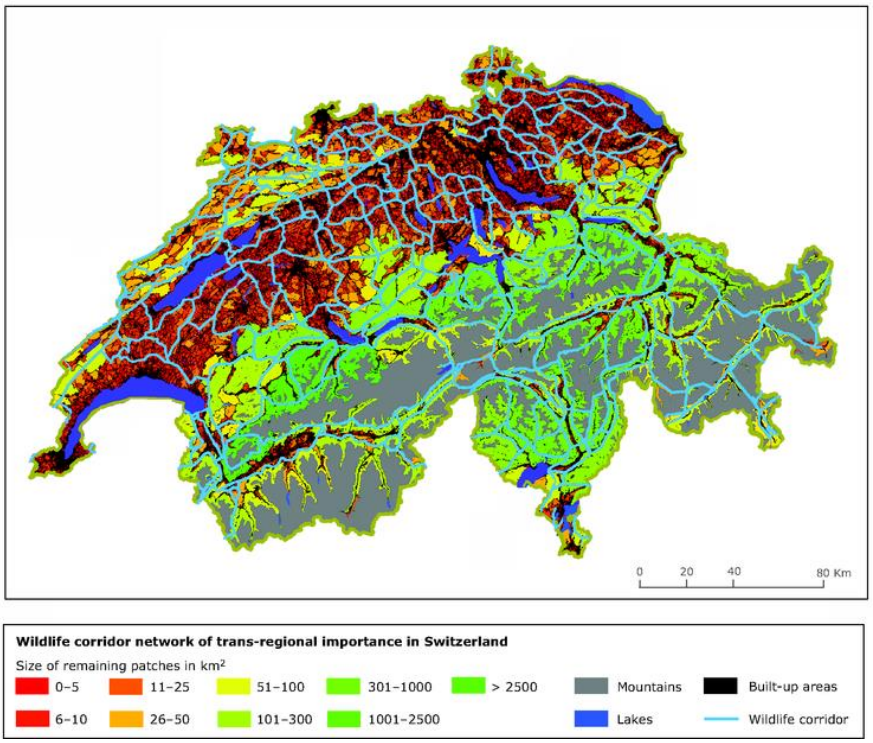
The FOEN, as authority that is outlining the network, provides several tools to Cantons, Municipalities, planners, and practitioners. The tools include maps (as pdf or GIS datasets), regulations, projects, guidelines, recommendations, programmatic agreements, action programs, economic resources, and a climate change pilot program from the National Center for Climate Services (NCCS).

As the Nature and Cultural Heritage Protection Act determined, the Confederation has to ensure that aspects of nature and landscape are sufficiently taken into account in every initiative planned, implemented, and financed by the Confederation. The production and consumption patterns of our country economy and society, however, are regularly the cause of exceeding the limits of the planet capacity. Switzerland therefore also has an international commitment to fulfil and is therefore a party to various global and regional conventions.

7. Specific provisions for connectivity conservation and restoration areas

Biodiversity needs space. To this end, the Confederation may designate biotopes of national importance. It has also committed itself to continuing to develop an Ecological Infrastructure that can provide nature with a network of central areas (ecological value areas), that are functionally connected to each other through inter-connected areas. The EI is necessary for the survival of species: it considers the development and mobility needs of species within their ranges even in the event of changes in general conditions, for example due to climate change.

Forest areas (excluding forest reserves) can be designated by cantons as specific priority function elements in the forest development plan (Waldentwicklungsplan, WEP) and are considered as connectivity areas.



Overlay of the wildlife corridor network of trans-regional importance in Switzerland available at https://www.eea.europa.eu/data-and-maps/figures/overlay-of-the-wildlife-corridor

8. Implementation of the connectivity conservation and restoration areas

The Swiss Biodiversity Strategy Action Plan, implemented by FOEN, consists of over 30 measures and pilot projects. These measures aim to preserve and promote species diversity, as nearly half of 230 habitat types in Switzerland are under threat. The plan aims to enhance these habitats and develop ecological infrastructure, while preserving and promoting 35% of the 56,000 endangered species. The measures are expected to be implemented in close cooperation with other agencies and stakeholders. The implemented measures can be divided into 4 groups:

- Measures for habitats/EI,
- Measures for the species management,
- Measures for the sustainable use,
- Immediate measures for the protection of nature and forest biodiversity.

Measures are implemented in the following four areas of the programmatic agreements:
4.1.1 Maintenance and rehabilitation of existing protected areas,
4.1.2 Creation and maintenance of forest reserves,
4.1.3 Quantitative and qualitative protection of old stands and deadwood,
4.1.4 Specific promotion of priority species at national level.

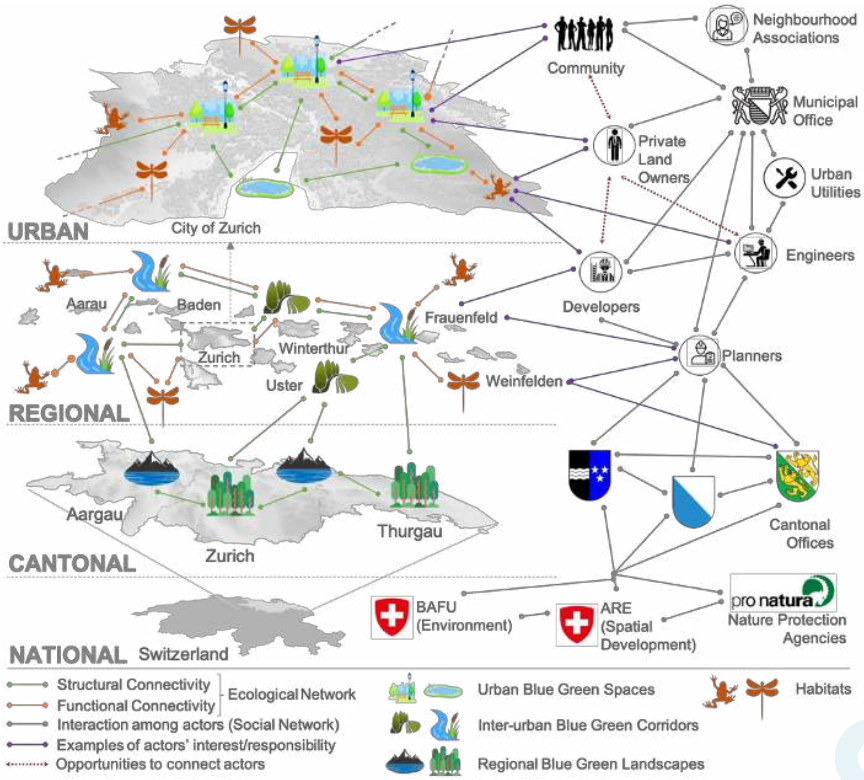
9. Implementation difficulties/opportunities

In 2016, the Federal Council allocated funds for immediate measures in nature protection and forest biodiversity to reduce implementation gaps in national biotopes. These resources are incorporated into program agreements between the Confederation and cantons, used efficiently. cantons supplement contributions. Investing in biodiversity is worthwhile as it generates added value for agriculture and forestry in peripheral regions, secures jobs, and enhances product value.

The network is still to be finalized and the new program (2025-2030) will have to consider the first assessment cycle, that determined the efficacy of measures in terms of environmental and economical sustainability.

10. Monitoring system

As the FOEN asserts, the state of biodiversity in Switzerland is unsatisfactory: half of the habitats and a third of the species are threatened. The reduced variety of species also leads to a loss of genetic diversity, which persists at all levels of biodiversity. The state of biodiversity is monitored through dedicated national programs, the data of which make well-founded statements to politicians and society and serve to take targeted action.

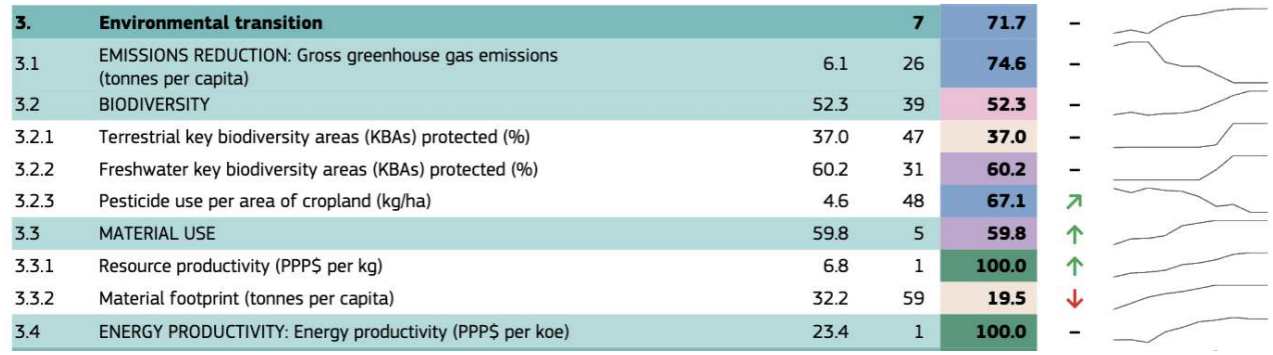


Social-ecological network structure in Switzerland available at https://www.eawag.ch/en/department/ess/projects/bluegreennet/

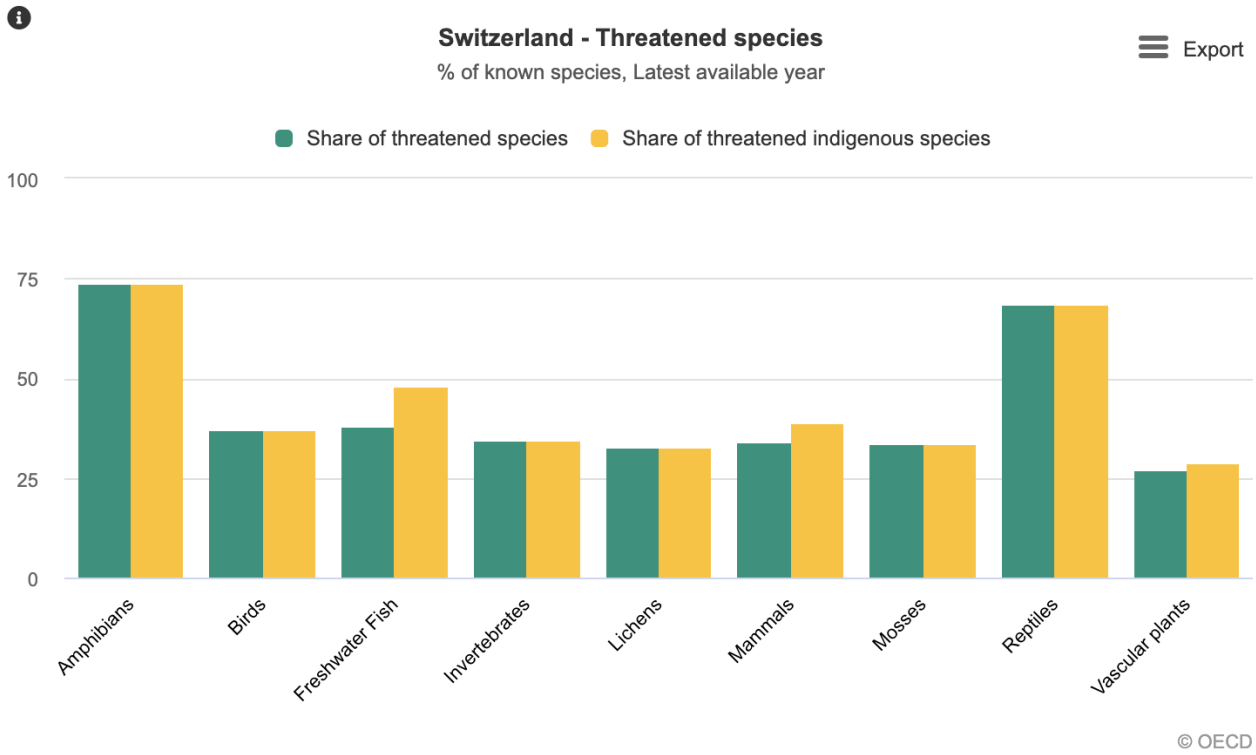
Country projections for the future

TRANSITIONS PERFORMANCE INDEX 2021

3.	**Environmental transition**		**7**	**71.7**	–
3.1	EMISSIONS REDUCTION: Gross greenhouse gas emissions (tonnes per capita)	6.1	26	**74.6**	–
3.2	BIODIVERSITY	52.3	39	**52.3**	–
3.2.1	Terrestrial key biodiversity areas (KBAs) protected (%)	37.0	47	**37.0**	–
3.2.2	Freshwater key biodiversity areas (KBAs) protected (%)	60.2	31	**60.2**	–
3.2.3	Pesticide use per area of cropland (kg/ha)	4.6	48	**67.1**	↗
3.3	MATERIAL USE	59.8	5	**59.8**	↑
3.3.1	Resource productivity (PPP$ per kg)	6.8	1	**100.0**	↑
3.3.2	Material footprint (tonnes per capita)	32.2	59	**19.5**	↓
3.4	ENERGY PRODUCTIVITY: Energy productivity (PPP$ per koe)	23.4	1	**100.0**	–



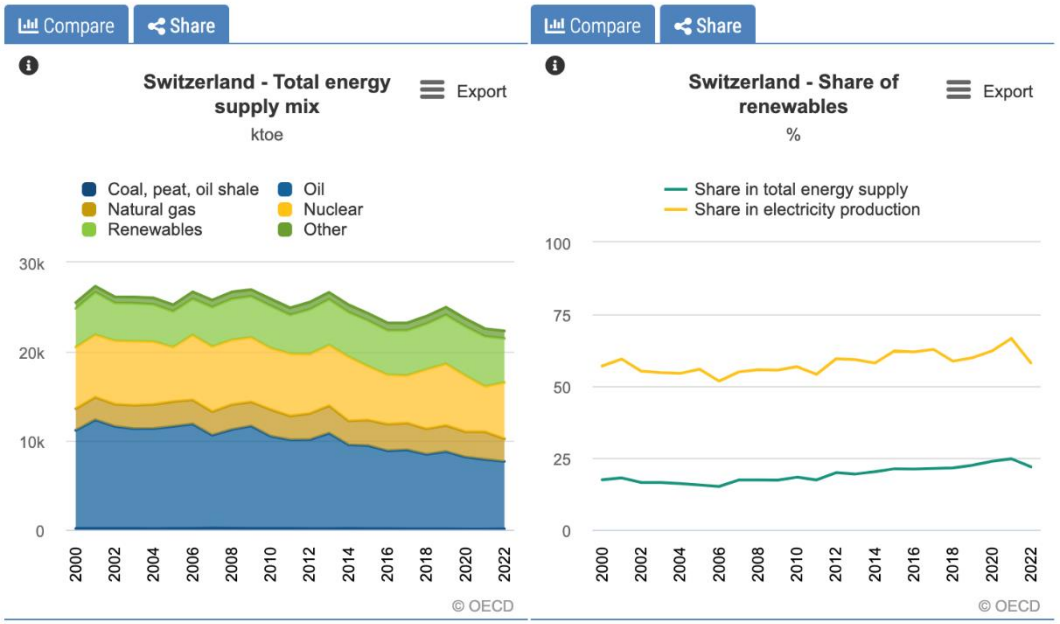
ENVIRONMENT AT A GLANCE INDICATORS, OECD 2023



Note: see country metadata.

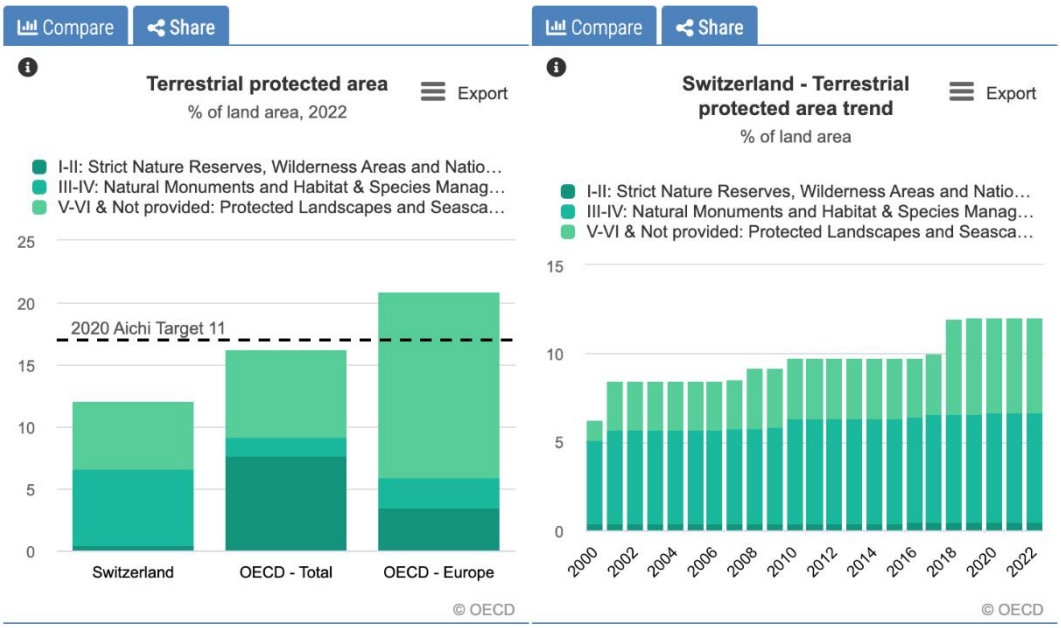
Sources: OECD, "Biodiversity: Threatened species", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00605-en.

Energy mix



Source: IEA, "World energy statistics", *IEA World Energy Statistics and Balances* (database), https://doi.org/10.1787/data-00510-en.

Protected areas

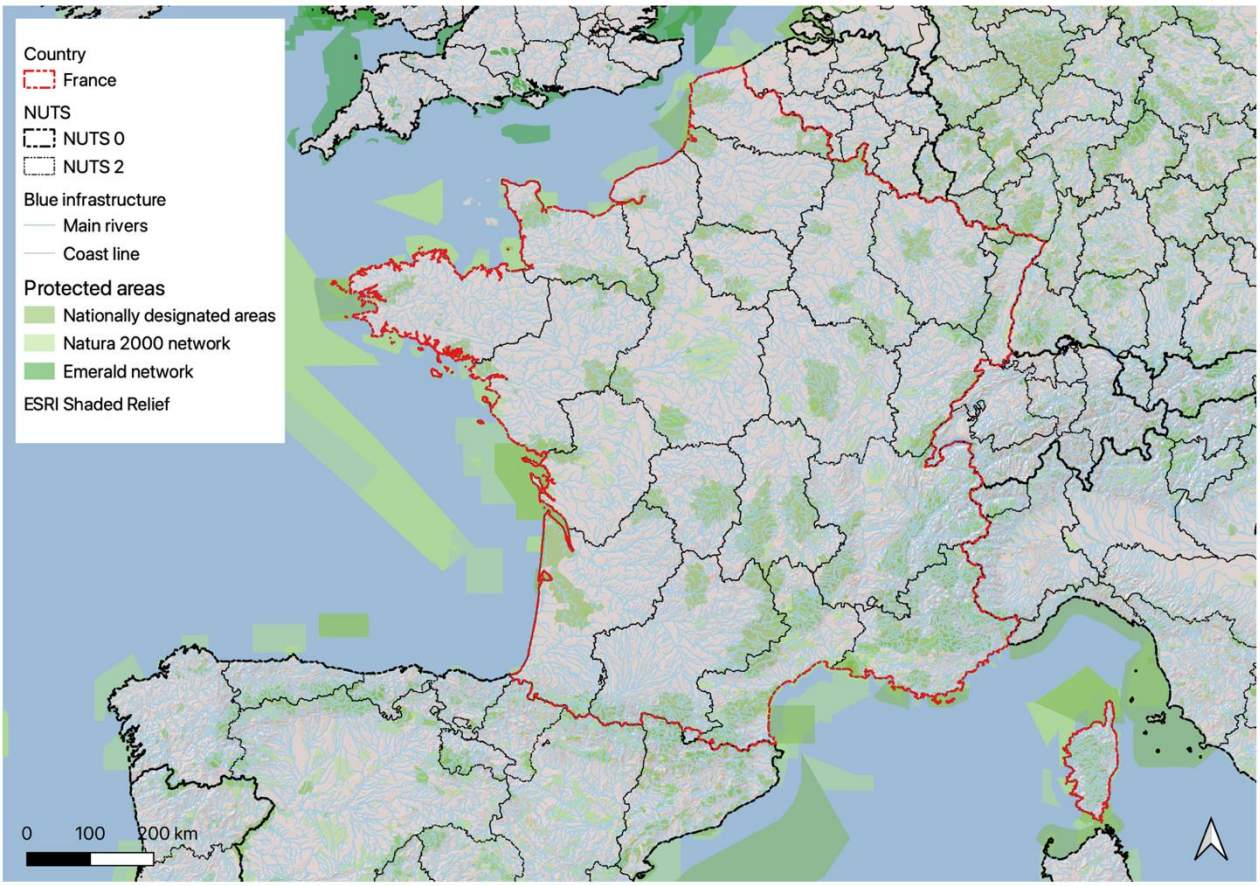


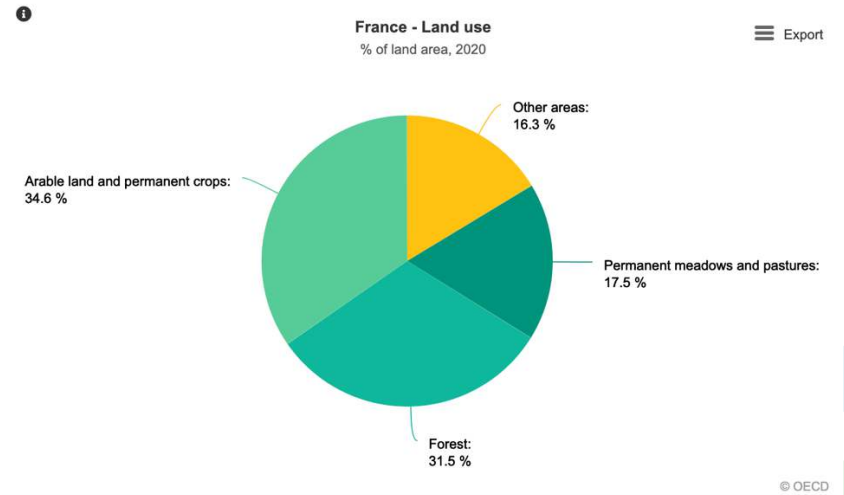
Note: Only biodiversity-relevant areas (excluding other protected landscapes) are included in the categories V-VI for Switzerland.

Source: OECD, "Biodiversity: Protected areas", *OECD Environment Statistics* (database), https://doi.org/10.1787/5fa661ce-en.

1.6 France

La Trame verte et bleue by ALPARC, ASTERS-CEN74





Country overview

Air and climate		
Emissions of		*Year*
SO2 (1000t)	129	2020
SO2 per capita (kg)	2	2020
NOx (1000t)	705	2020
NOx per capita (kg)	705	2020
CO2 (million tonnes)	295	2020
CO2 per capita (tonnes)	5	2020
GHG (million tonnes CO2 eq.)	399	2020
GHG per capita (tonnes CO2 eq.)	6	2020
Consumption of ozone depleting CFCs (ODP t)	-	Year
Biodiversity		
Proportion of terrestrial and marine areas protected (%)	26	2014
Number of threatened species	286	2016
Fish catch (tonnes)	505.214	2015
Change in fish catch from previous year (%)	-10	2015
Economy		
GDP growth rate from previous year (%)	1	2016
GDP per capita (at current prices - $US)	36.826	2016
% Value added: agriculture, hunting, forestry, fishing	2	2016
% Value added: mining, manufacturing, utilities	14	2015
Population		
Population (1000)	65.130	2019
Population growth rate from previous year (%)	0	2020

Energy		
Total energy supply (PJ)	10.114	2019
Energy supply per capita (GJ)	150	2019
Energy use intensity (MJ per USD constant 2011 PPP GDP))	3	2019
Renewable electricity production (%)	19	2019
Land and agriculture		
Total area (sq km)	547.557	2020
Agricultural land (sq km)	547.557	2020
Arable land (% of agric. land)	63	2020
Permanent crops (% of agric. land)	4	2020
Permanent meadows and pastures (% of agric. land)	34	2020
Change in agricultural land area since 1990 (%)	-7	2020
Forest area (sq km)	172.530	2020
Change in forest area since 1990 (%)	20	2020
Waste		
Total population served by municipal waste collection (%)	-	
Municipal waste collected (1000t)		2019
Hazardous waste generated per capita (kg)	2	2018
Proportion of hazardous waste treated or disposed (%)	79	2018
Proportion of municipal waste recycled (%)	23	2019
Water and sanitation		
Renewable freshwater resources per capita (m3)	3.676	2019
Proportion of wastewater treated (%)	-	
Proportion of freshwater abstracted (%)	-	

FRANCE

STATE OF THE ENVIRONMENT REPORTING

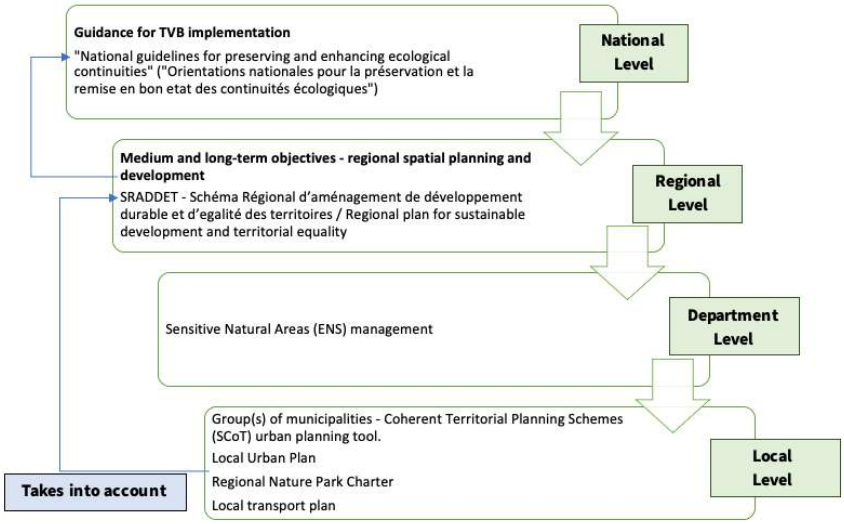

L'environnement en France
Rapport sur l'état de l'environnement
RAPPORT DE SYNTHÈSE
FOCUS ENVIRONNEMENT & SANTÉ
Latest French SoE report published, including a new website about environmental information
2019
IPBES Global Assessment Report on Biodiversity and Ecosystem services published
UNEP 6th Global environmental Outlook published
Global Resources Outlook 2019 published
2018
Biodiversity Action Plan
Circular Economy roadmap
2017
Climate Action Plan
2016
Law for the reconquest of biodiversity
2030 Agenda for Sustainable Development
Sendai Framework for Disaster Risk Reduction
2015
Paris Agreement on Climate Change
Law on Energy Transition to Green Growth
2014
Sixth French SoE Report published
2013
7th Environment Action Program
Biodiversity Strategy to 2020
Fifth French SoE Report published
2011
2010
2009 – 2010
General Directorate of sustainable development, including IFEN, established
Laws of "Grenelle de l'environnement"
2008
"Grenelle de l'environnement" "Grenelle de la mer"
Fourth French SoE Report published
2007 – 2012
2006
Charter of the environment launched
2005
Directive on Public Access to Environmental Information
Third French SoE Report published
2003
2002
UNECE Aarhus Convention on Access to Environmental information
Second French SoE Report published
1998
First French SoE Report: an encyclopedia of the environment published
1994
French institute of environment (IFEN) established
1992
Stockholm conference on the Human Environment
1972
United Nations milestones
European Union milestones
EEA milestones
Milestones France

1. Network typology (check corresponding answer)

Ecological network plan

2. The ecological network and its legal framework of reference

The Trame verte et bleue - TVB (green and blue infrastructure) is the ecological network framework in France, it was introduced by the Grenelle I (2009) and II (2010) laws to reduce the fragmentation of natural and semi-natural habitats and to take better account of biodiversity in spatial planning. This legal framework which also includes decrees and other legal provisions, define the main lines of action of the ecological network, objectives, concepts, the role, and orientations of three territorial levels in the implementation (national, regional and local).



Trame verte et bleue network structure

The implementation of these orientations is regulated by the Environment Code (Code de l'environnement) and the Urban Planning Code (Code de l'urbanisme, which provides that "In accordance with the Sustainable Development Goals, the action of public authorities in the field of urban planning aims to achieve the following objectives: […] The protection of natural environments and landscapes, the preservation of air quality, water, soil and subsoil, natural resources, biodiversity, ecosystems, green spaces and creation, the preservation and restoration of ecological connectivity"). These tools allow to define de governance scheme, the synergies and coordination between different spatial planning documents for the implementation of the ecological network on the territory.

The Trame verte et bleue is a concept that is deployed at three territorial scales (see following diagram) linked by an opposability relation («Takes into account»): the urban planning documents established at the local level must take into account the SRADDET

established at the regional level and the SRADDET must take into account the national guidelines:

- at the national level, a framework document entitled “National Guidelines for the Preservation and Restoration of Ecological Continuities” (ON TVB) was approved by Decree No. 2014-45 of 20 January 2014,
- at the regional level, the Regional Ecological Coherence Scheme (included in the SRADDET) identifies the green and blue infrastructures for ecological connectivity (TVB) and proposes a strategic action plan to preserve or restore ecological continuity,
- at the local level, urban planning documents (Local Urban Plans, Territorial Coherence Schemes, etc.) integrate the issues of ecological continuity specific to their territory.

The regional-scale ecological networks (SRADDET) were compiled in the form of geographical data to create the national TVB. The national map is therefore a restitution of regional ecological continuities at the national level (see 6. Tools and guidance for planners and practitioners). Read more about the national legal and implementation framework of the TVB in: Presentation of the TVB - legal framework.

3. Network objectives

The TVB objectives are enunciated on the National guidelines (Décret 2019-1400). It aims to contribute to the preservation and restoration of ecological continuity to stop the loss of biodiversity. The planning documents developed into the different territorial levels must follow the national guidelines.

Additionally, according to the Environment code (art. L. 371-1 I), the TVB pursuits the following objectives:

1. To reduce fragmentation and the vulnerability of natural habitats and species’ habitats, and take their movements into account in the context of climate change,
2. To identify, conserve and connect areas important to biodiversity conservation through ecological corridors,
3. To implement the water quality and quantity objectives set by the river basin management plans (RBMP),
4. To take wildlife biology into account,
5. To facilitate the genetic exchanges necessary to the survival of wildlife species,
6. To improve the quality and diversity of the landscape.

4. Network structure and elements

The TVB is composed of two main elements:

- Core areas: areas with a rich and well represented biodiversity, where species can complete all or part of their life cycle (feeding, reproduction, resting) and where natural habitats can function properly. These reservoirs of biodiversity include some protected areas categories and other areas enunciated in the Environment Code:
  - natural areas that are important for preserving biodiversity
  - protected areas

  - watercourses and canals (mentioned of the Environment Code which constitute both reservoirs of biodiversity and ecological corridors);
  - wetlands (mentioned in the Environment Code, which may act as either biodiversity reservoirs or ecological corridors, or both).
- Ecological corridors provide connections between reservoirs of biodiversity, offering species favourable conditions for moving around and completing their life cycle.
  - the permanent plant cover along watercourses (mentioned in the Environment Code);
  - watercourses and canals (mentioned in the Environment Code, which constitute both reservoirs of biodiversity and ecological corridors);
  - wetlands (mentioned in the Environment Code, which may act as either biodiversity reservoirs or ecological corridors, or both).

5. Methodology used in network and corridor design

In application of the «Guide méthodologique identifiant les enjeux nationaux et transfrontaliers relatifs à la préservation et à la remise en bon état des continuités écologiques» and based on the available knowledge for each region, the 'Trame bleue' (ecological continuity network relating to aquatic environments) is defined by the hydrographic network and does not differentiate between biodiversity reservoirs and ecological corridors. The 'Trame verte' consists of biodiversity reservoirs, permeable spaces, and ecological corridors.

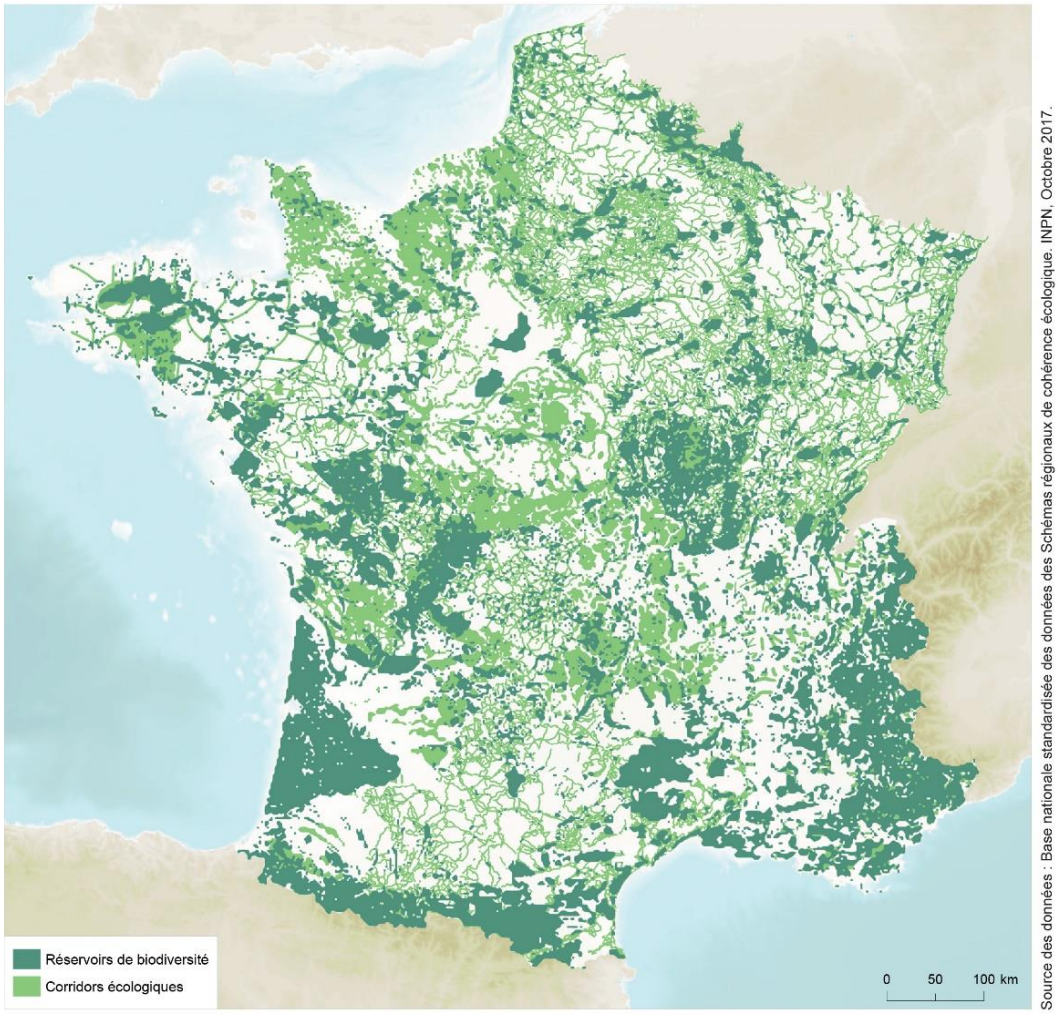
The method used to distinguish biodiversity reservoirs and corridors varies between regions. In general, it relies on the identification of protected areas, the range of threatened species at national level, and natural habitats.

As an example, for the Rhône-Alpes, it was chosen not to identify biodiversity reservoirs using a «species» approach because the specificities of each species could not be considered at the regional level. The methodological chosen for the identification of biodiversity reservoirs was to integrate several existing perimeters, already identified, recognized for their value from the point of view of biodiversity:

- Protected areas (Prefectural orders for the protection of biotopes, national parks, national and regional nature reserves, forest biological reserves, Natura 2000 sites, ENS sites),
- Sites managed by the Conservatoire du littoral, the CEN Rhône-Alpes, and the Office national de la chasse et de la faune sauvage,
- Areas corresponding to the breeding habitats and/or ranges of emblematic species targeted by the MNHN as 'TVB coherence species'.

With regard to permeable spaces, this component of the regional TVB was built from land cover data (Corine Land Cover 2012) to create continuums (sub-networks) attached to different types of naturals environments (forest, grassland, wetland, ...) based on the modeling of the displacement of groups of species across the landscape (using a cost-distance algorithm to qualify the attractiveness of certain spaces) to define a permeability gradient.

SYNTHÈSE NATIONALE DES ENJEUX DE CONTINUITÉS ÉCOLOGIQUES RÉGIONALES



Cette carte restitue les continuités écologiques identifiées dans le cadre des travaux relatifs aux schémas régionaux de cohérence écologique (SRCE) en France métropolitaine (Corse exclue et à l'exception de la sous-trame des cours d'eau qui fera l'objet d'un travail spécifique). Elle est indicative et ne tient pas compte de la validité des SRCE. Seuls les SRCE en vigueur ont une valeur réglementaire.
Éditée pour une impression au format A4, cette carte est le résultat d'un traitement des données régionales (issues de méthodes différentes) effectué pour permettre une restitution à l'échelle nationale.
Pour plus d'informations sur la méthode utilisée : **BILLON L., GREGOIRE A., DUCHENE C., MUSTIERE S., LOMBARD A., SORDELLO R. (2017).** ***Réalisation d'une carte de synthèse nationale des continuités écologiques régionales.*** **Rapport méthodologique. UMS Parimoine Naturel AFB-CNRS-MNHN, COGIT-IGN, Centre de ressources Trame verte et bleue. 33 pages.**

Ecological Continuity mapping available at https://www.trameverteetbleue.fr/

The identification and drawing of ecological corridors (connection between reservoirs) for the Rhone-Alpes region considers artificialized spaces (as not permeable), fragmenting elements (roads, dams, etc...) and points of punctual or linear conflicts, drawn at the regional level (example of collision zones with roads). Some corridors resulting from local studies have also been integrated into the regional ecological connectivity network.

6. Tools and guidance for planners and practitioners

The different elements integrating the TVB are mapped, a national overview of the network illustrating corridors and reservoirs of biodiversity is available under different formats:

- Static (https://inpn.mnhn.fr/docs/TVB/Carte_nationale_TVB_C&R_%20FAQ.pdf),
- Vector layers (https://inpn.mnhn.fr/programme/trame-verte-et-bleue/donnees-srce).

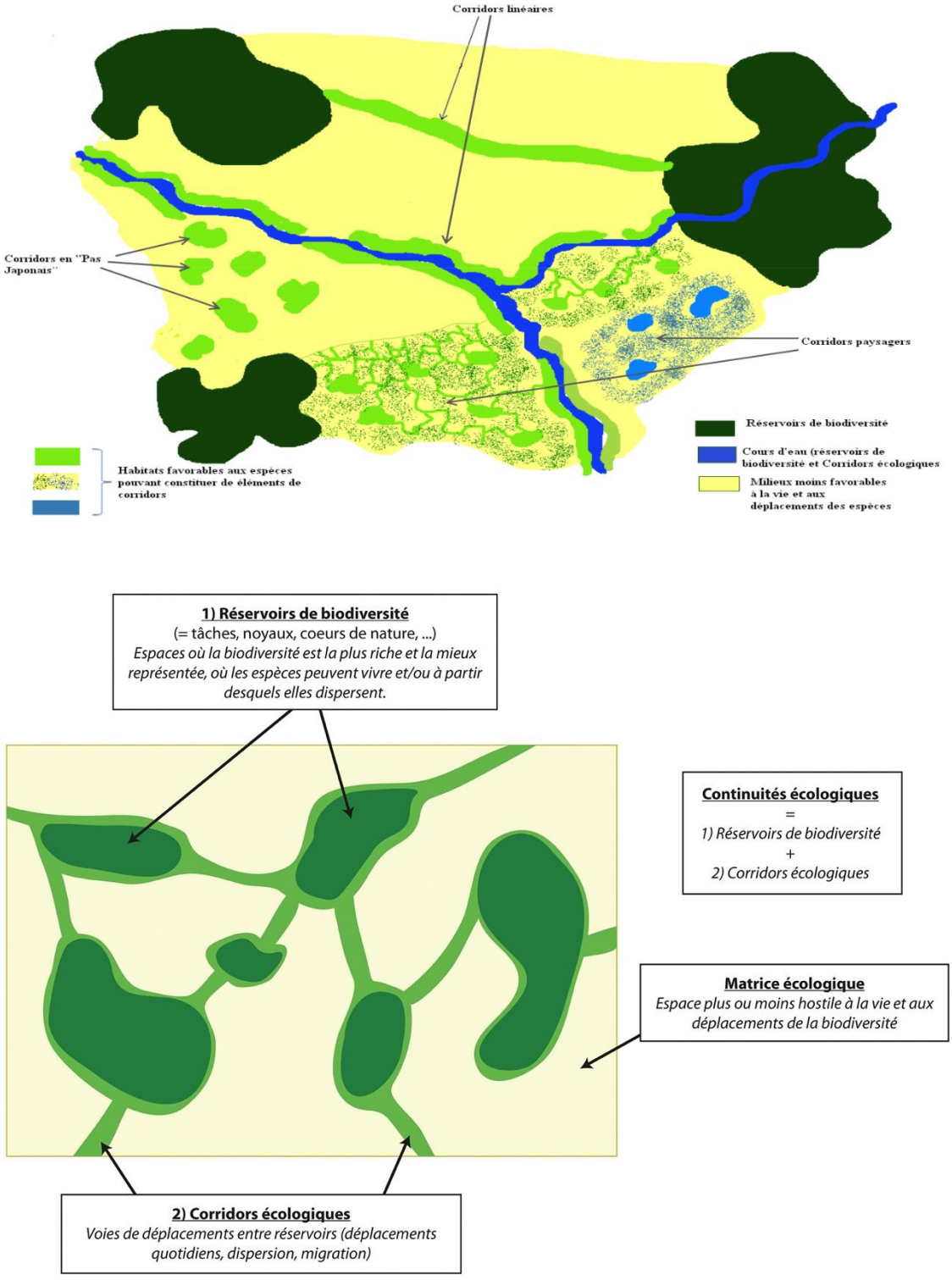
The national map is a combination of some features of the regional mapping process of ecological continuities. In the regional level with the SRADDET - Regional plan for sustainable development and territorial equality, there are different documents including a report with an overview of the current situation, the major challenges and the objectives pursued by the plan, a document of general rules and an extensive cartographic overview of the territory indicating the orientations and objectives on different themes including the ecological network (protection and conservation). The TVB includes different methodological guidelines addressed to the different territorial levels as a support for the elaboration of their planning documents (e.g. Implementation guidelines from the SRADDET - Provence Alpes Côte d'Azur). The mapping of each ecological network component becomes more precise as the territorial scale gets closer to the municipality level which allows to verify the consistency between the TVB, the current land uses and urban planning maps.

The Environment code indicates that urban planning documents such as SCoT or the Local urban plans have as objective, among others, preserving and creating ecological continuity which implies the elaboration of specifical orientations to be translated into local urban plans for the preservation and restoration. Recommendations regarding for instance:

- Urban development control,
- Light pollution,
- Delimitation of remarkable natural areas,
- Strict nature protection implementation.

7. Specific provisions for connectivity conservation and restoration areas

The Environment code includes the general concepts regarding the connectivity components, some of these areas are recognized under one or several official protection status (Natura 2000, nature reserves, natural area of ecological, faunal and floristic interest - ZNIEFF, among others) which allows to regulate and limit the land transformations accordingly with the objectives pursued by the protection designation, the areas that are not covered by these protection measures are included on the planning documents in order to have a complete inventory of areas with an important biodiversity value and at the same time to monitor the evolution and disturbances of the ecological network.



Scheme of the Trame Verte et Bleu (Source: Matthieu Fajon, Irstea; INPN)

8. Implementation of the connectivity conservation and restoration areas

The implementation is based on a scheme that runs from the national to the local level, as described in section 2. of this chapter.

9. Implementation difficulties/opportunities

Difficulties: the level of precision of the ecological network cartography on the local level varies from one SCoT to another, affecting the process of identifying and elaborating measures to address territorial challenges.

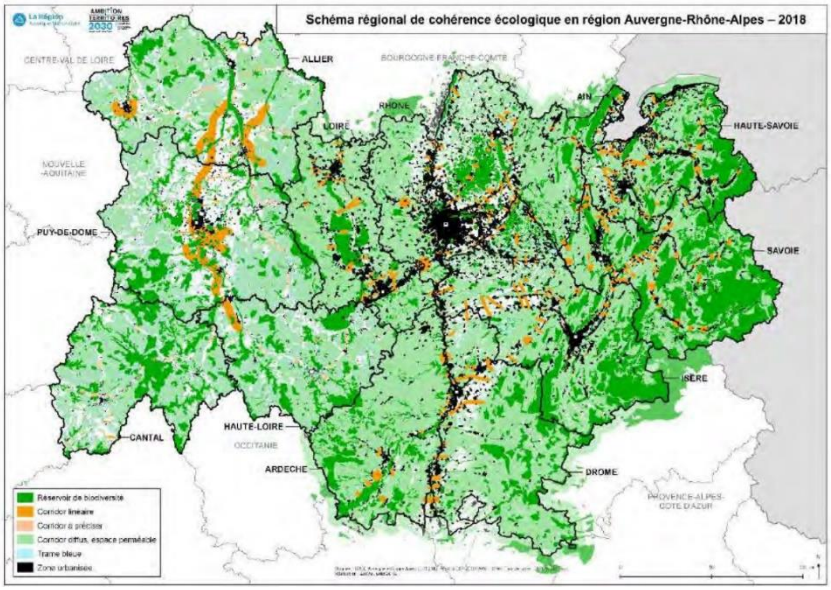
Opportunities:

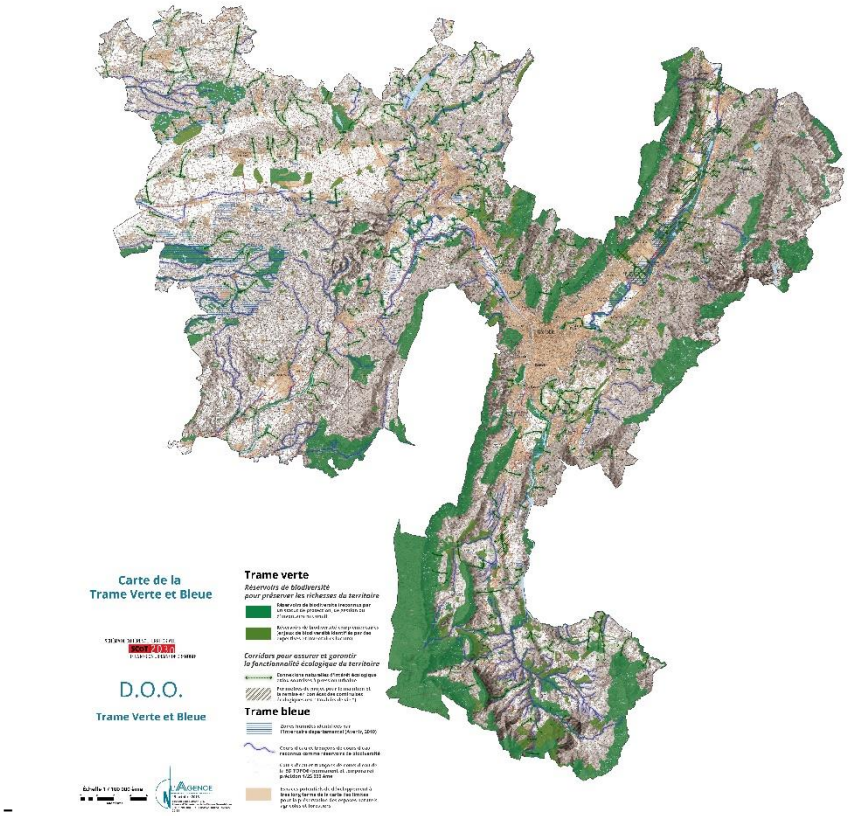
- The articulation between the different planning documents strengthens the implementation of the TVB and allow to incorporate additional ecological network challenges e.g. dark infrastructure;
- The governance model let different territorial levels, sectors, and key stakeholders dialogue;
- Develop actions to enable the reinforcement of the TVB as mentioned on the National biodiversity strategy 2030 in accordance with the objectives set through the Kunming-Montreal Global Biodiversity Framework adopted in 2022, the strategy addresses ecological connectivity specifically through the measure number 20 “Strengthening actions in favor of ecological networks and removing their main obstacles” with four concrete actions to implement by 2027:
  - Reduce the main discontinuities in the region,
  - Set quantitative targets for the fragmentation indicator,
  - Continuing to restore the ecological continuity of watercourses,
  - Speeding up the introduction of dark infrastructure in regional strategies (Trame Verte et Bleue, 2023).

10. Monitoring system

Monitoring and evaluation of the TVB is carried out on the regional and local levels:

- The SRADDET integrates three main documents: a report, a booklet of general rules and the annexes. The report, contains a summary of the current situation, the challenges in the areas covered by the plan and the objectives that are described and also illustrated into a synthetic map (Ministère de la transition écologique et de la cohésion des territoires, 2021). The plan also includes an environmental evaluation, this tool contributes to the monitoring and continuous improvement of the plan and its revision. The monitoring indicators cover the key challenges identified in the initial assessment. Some of these challenges are related to specific theme, others are transversal. (Région Auvergne-Rhône-Alpes, 2019).
- Spatial planning in the local level is defined by different planning documents, the intermunicipal level SCoT also includes an environmental evaluation and the implementation of indicators for monitoring the advancements on the objectives defined on the plan.





Ecological Coherence mapping and TVB map (Source: Auvergne-Rhône-Alpes SRADDET - Etat des lieux volet territoire; SCoT de la région grenobloise)

Bibliography

ALPARC. (2023). Alpine Parks 2030. Chambéry. Retrieved from https://alparc.org/images/alpineparks/AlpineParks2030_LD.pdf

Convention on Biological Biodiversity. (2011). Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets. Retrieved from https://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf

Convention on Biological Biodiversity. (2022). Nations Adopt Four Goals, 23 Targets for 2030 In Landmark UN Biodiversity Agreement. Montreal. Retrieved from https://prod.drupal.www.infra.cbd.int/sites/default/files/2022-12/221219-CBD-PressRelease-COP15-Final_0.pdf

European Commission. (2020). Biodiversity strategy for 2030. Retrieved from https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB); ALPARC. (2016). Alpine Nature 2030. Retrieved from https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/alpine_nature_2030_broschuere_en_bf.pdf

Ministère de la transition écologique et de la cohésion des territoires. (2021). SRADDET : un schéma stratégique, prescriptif et intégrateur pour les régions. Retrieved from https://www.ecologie.gouv.fr/sraddet-schema-strategique-prescriptif-et-integrateur-regions

Ministère de la transition écologique et de la cohésion des territoires. (2023). Stratégie nationale biodiversité 2030. Retrieved from https://www.ecologie.gouv.fr/sites/default/files/Dossier-de-presse_SNB2030.pdf

Perrin, M., Berthrand, N., & Kohler, Y. (2019). PLACE Report: Spatial Planning & Ecological Connectivity - an analytical overview across the Alpine Convention area. Grenoble.

Région Auvergne-Rhône-Alpes. (2019). SRADDET - Evaluation environnementale. Retrieved from https://www.auvergnerhonealpes.fr/media/2209/download?inline

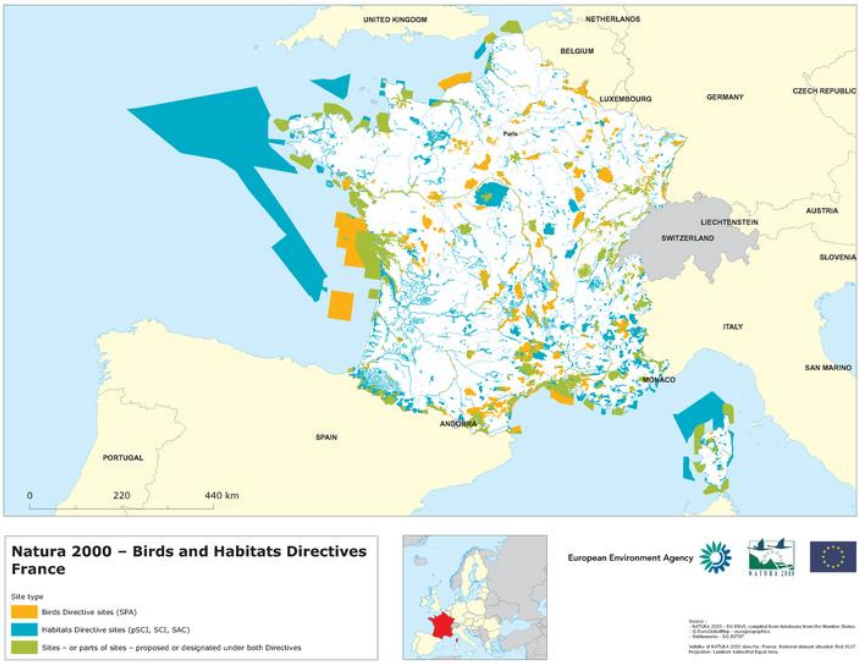
Territorial Agenda 2007. (2007). Territorial Agenda of the European Union 2007. Retrieved from https://ec.europa.eu/regional_policy/sources/policy/what/territorial-cohesion/territorial_agenda_leipzig2007.pdf

Territorial Agenda 2020. (2011). Territorial Agenda of the European Union 2020 - Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions. Agreed at the Informal Ministerial Meeting of Ministers Responsible for Spatial Planning and Territorial Development. Retrieved from https://ec.europa.eu/regional_policy/en/information/publications/communications/2011/territorial-agenda-of-the-european-union-2020

Territorial Agenda 2030. (2020). Territorial Agenda 2030 - A future for all places. Retrieved from https://territorialagenda.eu/wp-content/uploads/TA2030_jun2021_en.pdf

Trame Verte et Bleue. (2023). Les Trames écologiques dans la Stratégie nationale biodiversité 2030. Retrieved from https://www.trameverteetbleue.fr/vie-tvb/actualites/trames-ecologiques-dans-strategie-nationale-biodiversite-2030

Evolution of nature conservation policies in France available at https://www.encyclopedie-environnement.org/en/life/ecological-networks-biodiversity-conservation-land-use-planning/



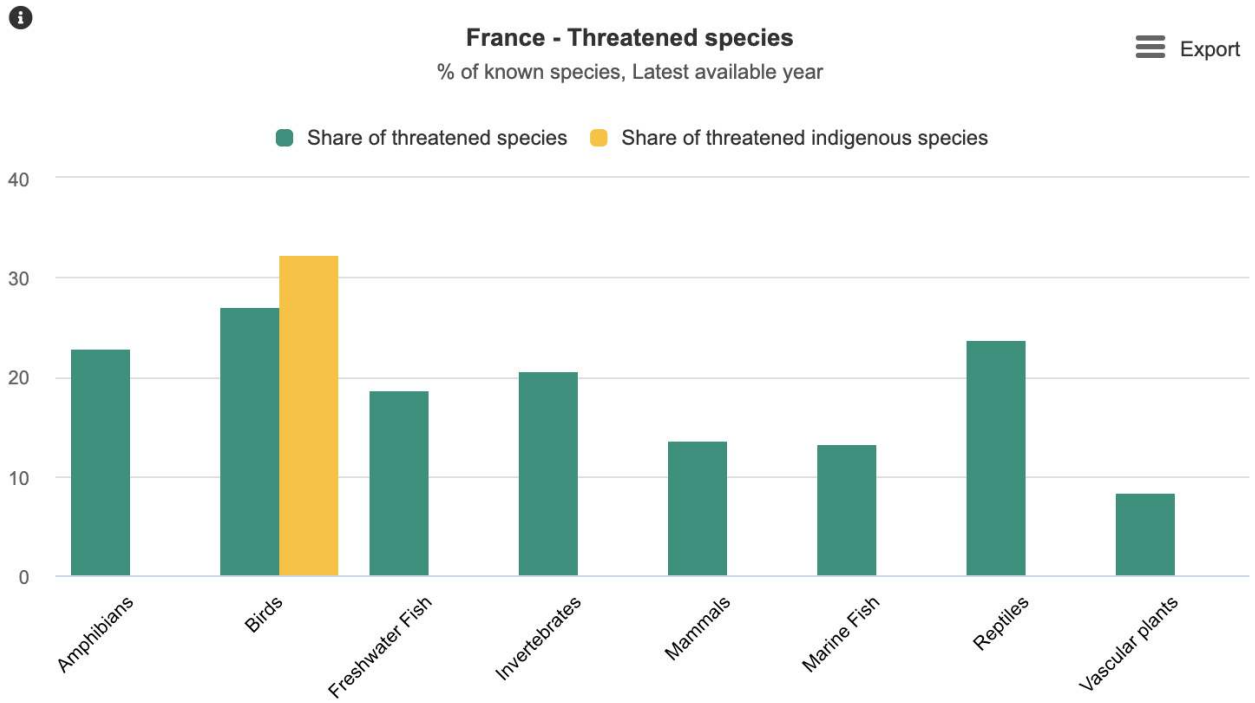
Natura 2000 areas available at https://www.eea.europa.eu/data-and-maps/figures/natura-2000-birds-and-habitat-directives-9/france

Country projections for the future

TRANSITIONS PERFORMANCE INDEX 2021

3.	**Environmental transition**		**13**	**66.8**	↑
3.1	EMISSIONS REDUCTION: Gross greenhouse gas emissions (tonnes per capita)	6.8	32	**71.7**	–
3.2	BIODIVERSITY	77.2	17	**77.2**	↑
3.2.1	Terrestrial key biodiversity areas (KBAs) protected (%)	80.9	13	**80.9**	↑
3.2.2	Freshwater key biodiversity areas (KBAs) protected (%)	78.0	22	**78.0**	↑
3.2.3	Pesticide use per area of cropland (kg/ha)	4.5	47	**68.1**	↓
3.3	MATERIAL USE	58.0	9	**58.0**	↑
3.3.1	Resource productivity (PPP$ per kg)	4.3	8	**72.3**	↑
3.3.2	Material footprint (tonnes per capita)	22.5	38	**43.7**	↘
3.4	ENERGY PRODUCTIVITY: Energy productivity (PPP$ per koe)	12.0	31	**60.2**	↑

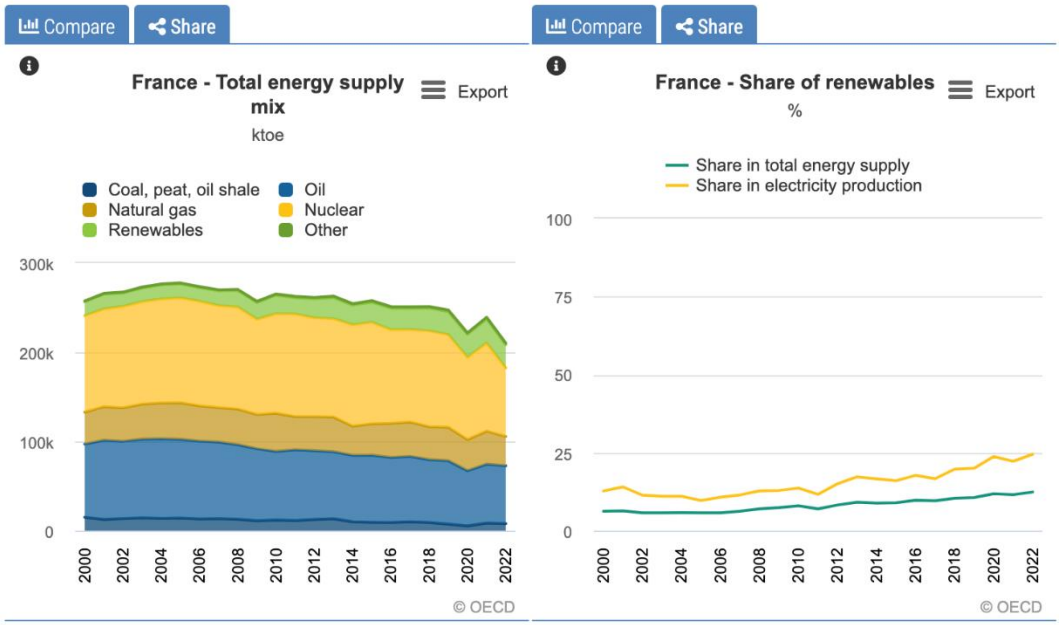
ENVIRONMENT AT A GLANCE INDICATORS, OECD 2023



Note: Threatened species: see country metadata.

Sources: OECD, "Biodiversity: Threatened species", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00605-en.

Energy mix



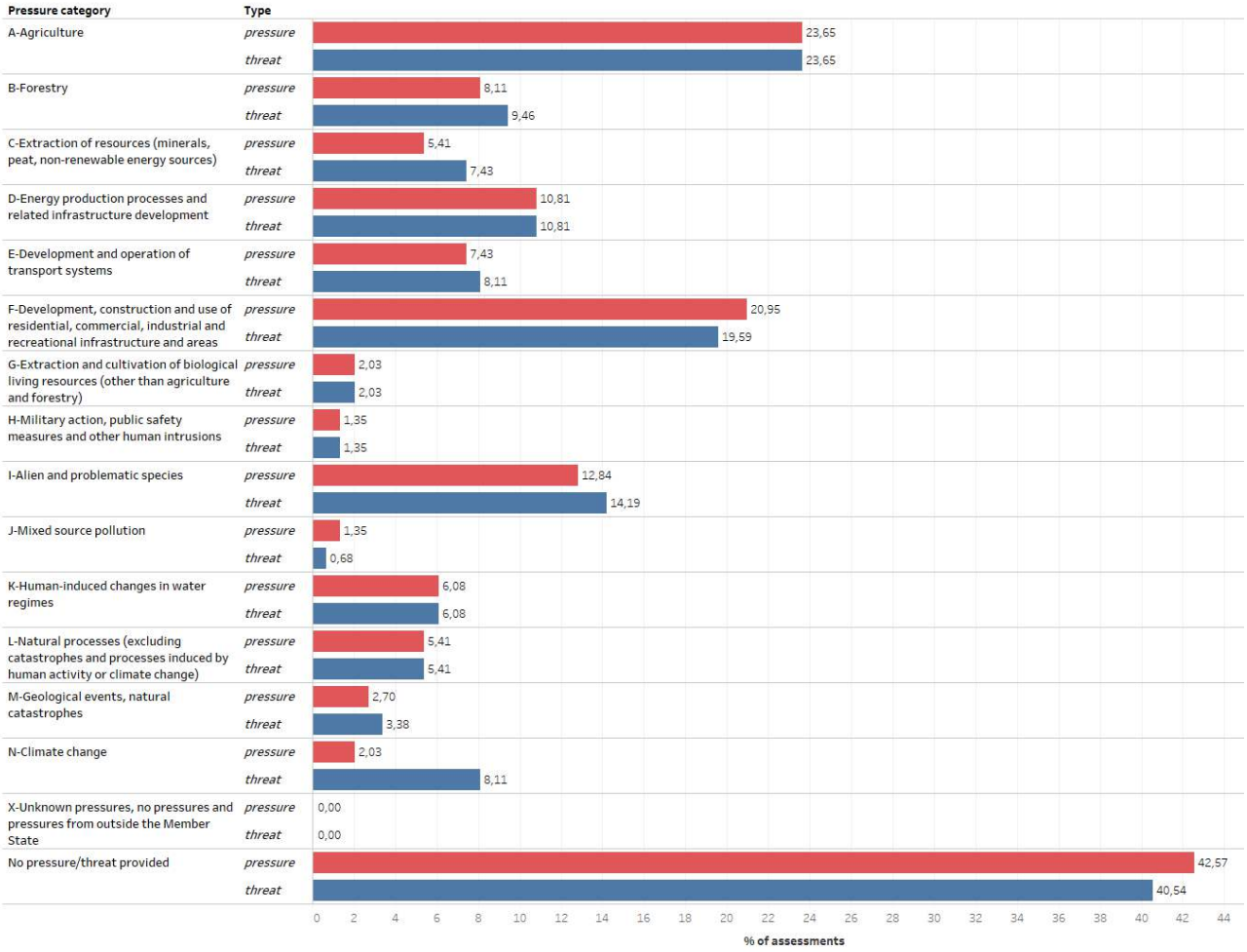
Source: IEA, "World energy statistics", IEA World Energy Statistics and Balances (database), https://doi.org/10.1787/data-00510-en.

Protected areas

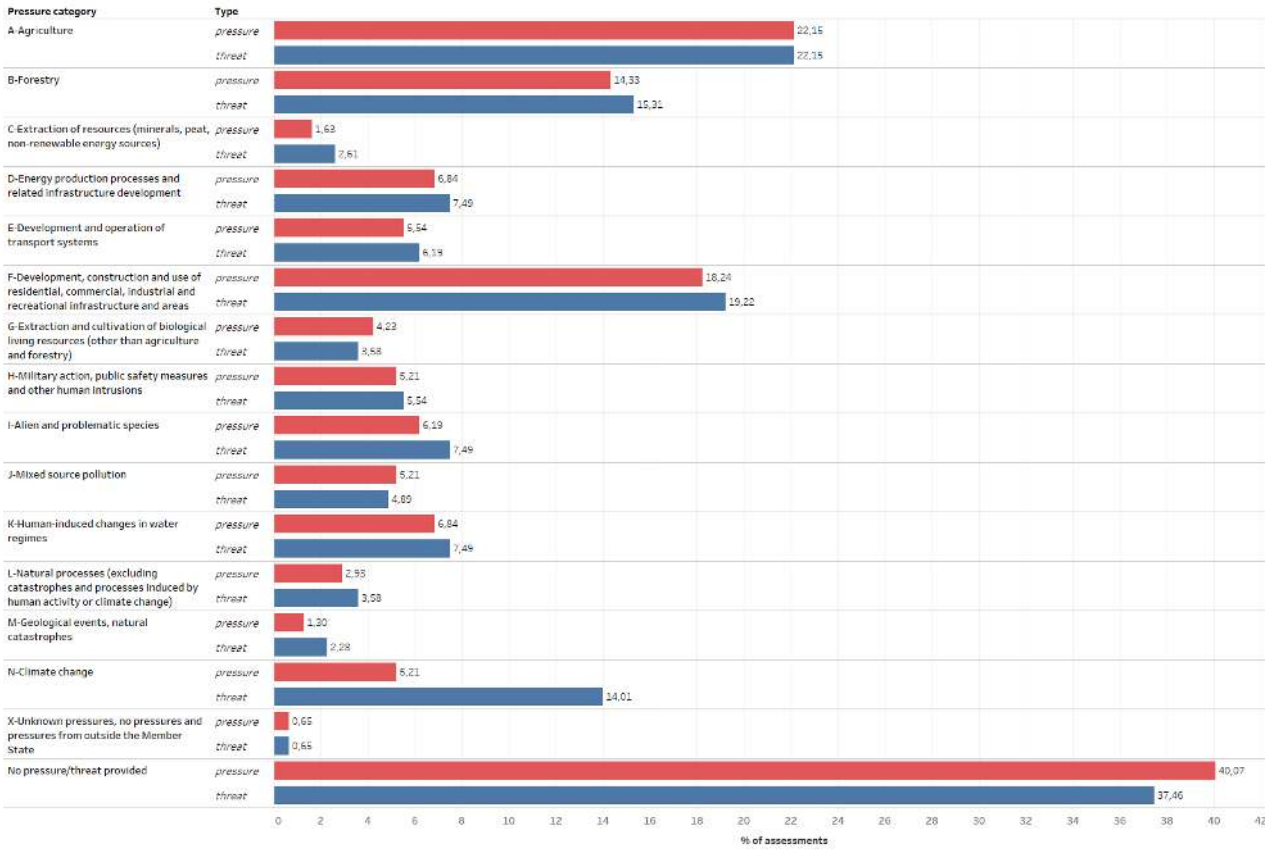
Source: OECD, "Biodiversity: Protected areas", OECD Environment Statistics (database), https://doi.org/10.1787/5fa661ce-en.

STATE OF NATURE REPORT 2013-2018 (EEA)

Frequency of main pressure and threats on habitats of the Alpine and Mediterranean Biogegraphical Regions (FR)

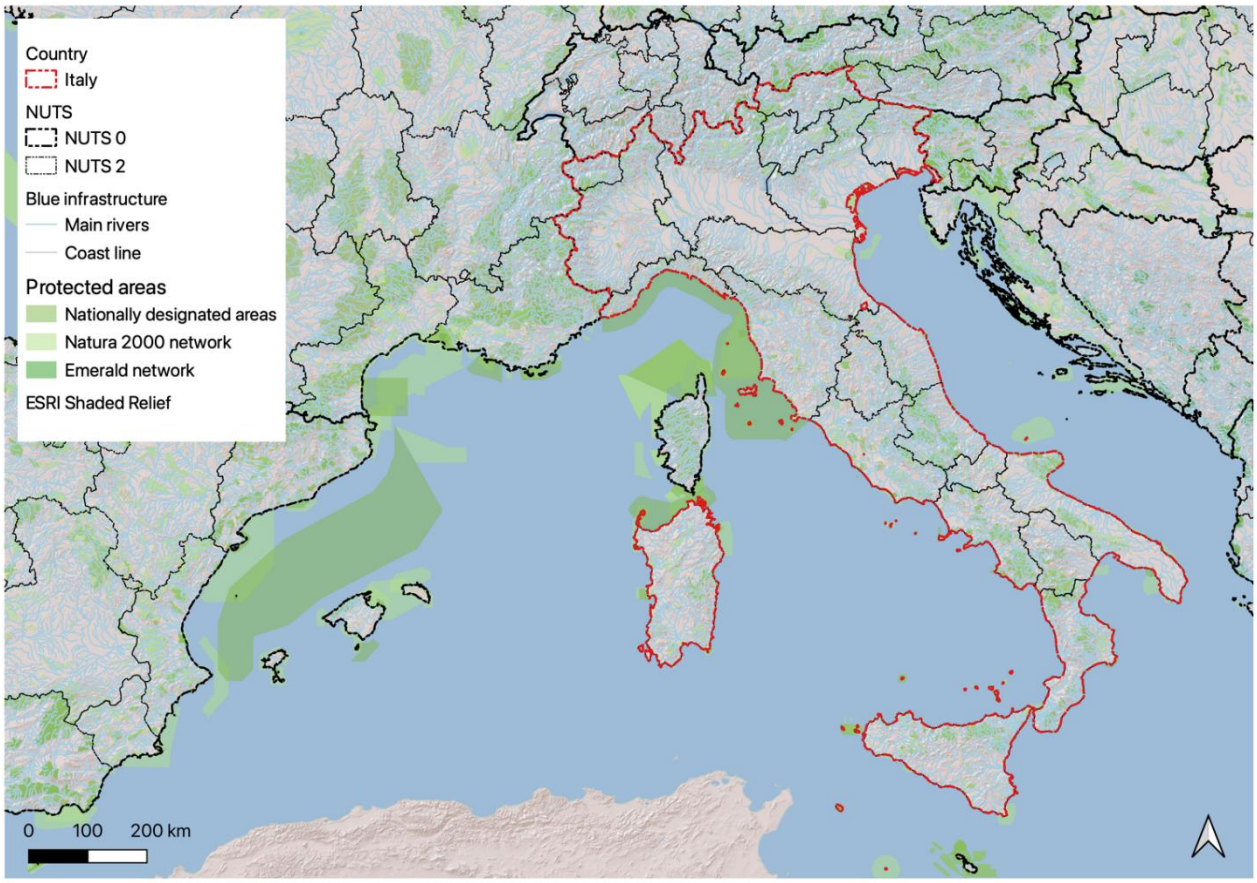


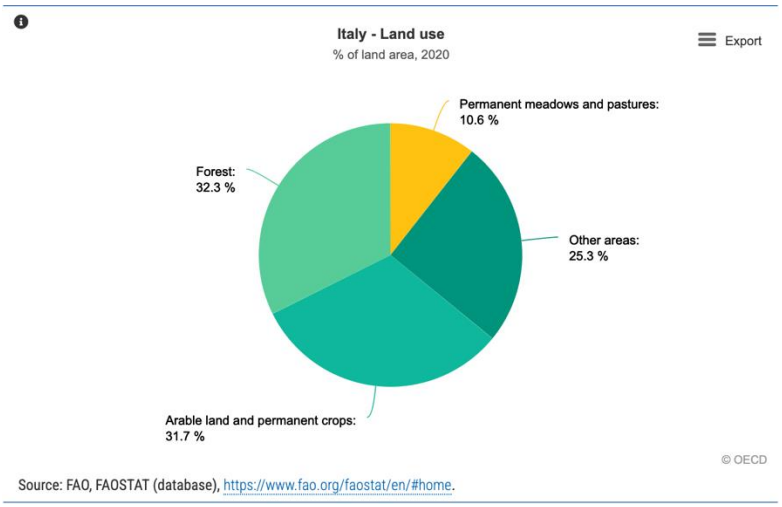
Frequency of main pressure and threats on species of the Alpine and Mediterranean Biogegraphical Regions (FR)



1.7 Italy

by Regione Veneto





Country overview

Air and climate		
Emissions of		*Year*
SO2 (1000t)	82	2020
SO2 per capita (kg)	1	2020
NOx (1000t)	573	2020
NOx per capita (kg)	573	2020
CO2 (million tonnes)	302	2020
CO2 per capita (tonnes)	5	2020
GHG (million tonnes CO2 eq.)	381	2020
GHG per capita (tonnes CO2 eq.)	6	2020
Consumption of ozone depleting CFCs (ODP t)	-	Year

Biodiversity		
Proportion of terrestrial and marine areas protected (%)	13	2014
Number of threatened species	372	2016
Fish catch (tonnes)	198.198	2015
Change in fish catch from previous year (%)	8	2015

Economy			
GDP growth rate from previous year (%)	1	2016	2
GDP per capita (at current prices - $US)	31.279	2016	45
% Value added: agriculture, hunting, forestry, fishing	2	2016	30
% Value added: mining, manufacturing, utilities	19	2015	

Population		
Population (1000)	60.550	2019
Population growth rate from previous year (%)	0	2020

Energy		
Total energy supply (PJ)	6.221	2019
Energy supply per capita (GJ)	103	2019
Energy use intensity (MJ per USD constant 2011 PPP GDP))	2	2019
Renewable electricity production (%)	31	2019

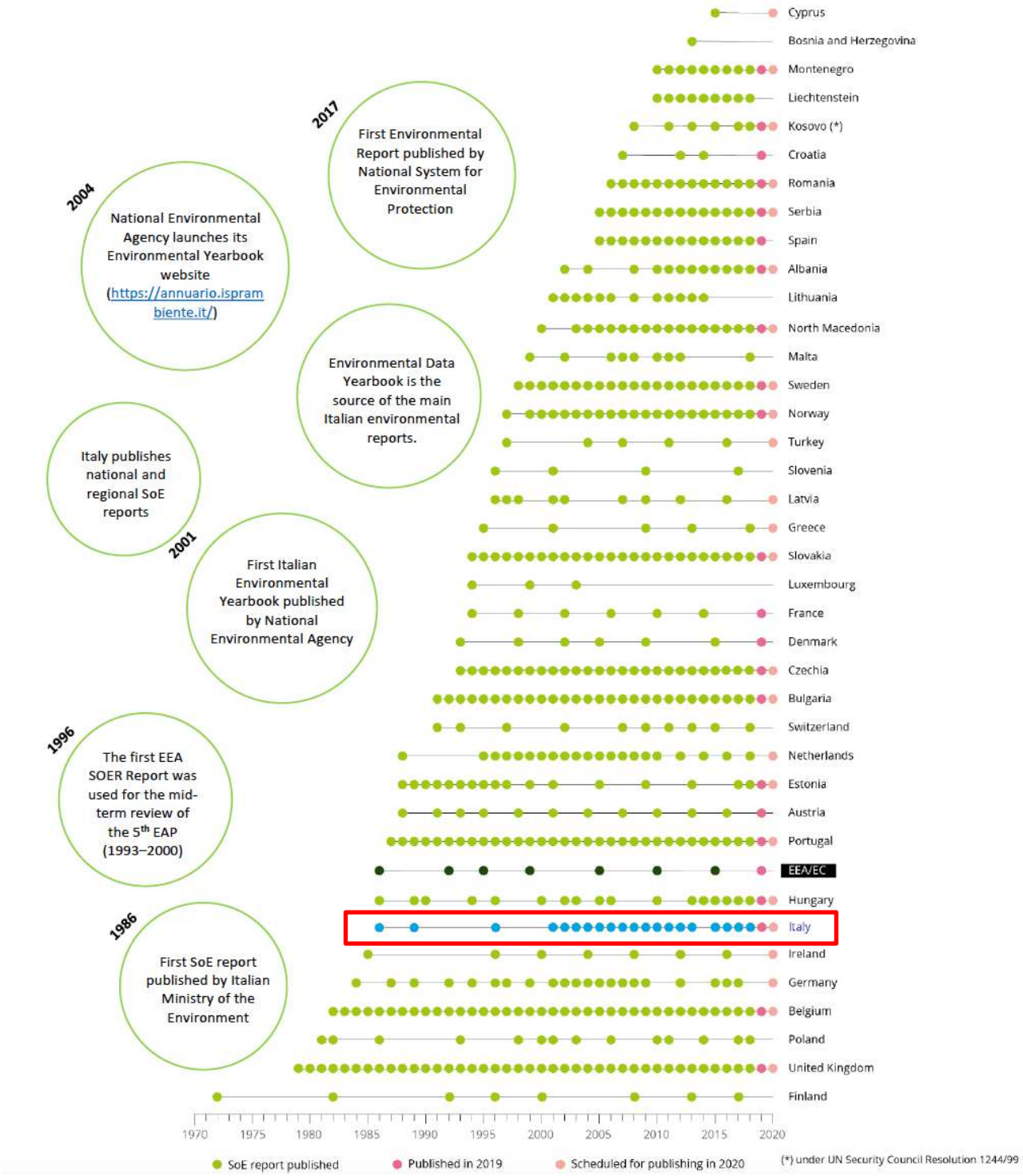
Land and agriculture		
Total area (sq km)	295.717	2020
Agricultural land (sq km)	295.717	2020
Arable land (% of agric. land)	53	2020
Permanent crops (% of agric. land)	19	2020
Permanent meadows and pastures (% of agric. land)	29	2020
Change in agricultural land area since 1990 (%)	-23	2020
Forest area (sq km)	95.661	2020
Change in forest area since 1990 (%)	26	2020

Waste		
Total population served by municipal waste collection (%)	-	
Municipal waste collected (1000t)	30.023	2019
Hazardous waste generated per capita (kg)	2	2018
Proportion of hazardous waste treated or disposed (%)	45	2018
Proportion of municipal waste recycled (%)	30	2019

Water and sanitation		
Renewable freshwater resources per capita (m3)		
Proportion of wastewater treated (%)		
Proportion of freshwater abstracted (%)		

ITALY

STATE OF THE ENVIRONMENT REPORTING




Last SoE Report by MoE and Environmental Yearbook by ISPRA Published in 2020
Next Environmental Yearbook by ISPRA Scheduled for 2021
2020
Start-up phase: Environmental forecasting
2030 Agenda for Sustainable Development
Paris Agreement on Climate Chance
Action Plan for the Circular Economy
Environmental criminal offence law
Green Economy law
National Climate Change Adaptation Strategy
2015
The National Network for Environmental Protection (SNPA) established
First National Report published by National System for Environmental Protection
National Strategy for Sustainable Development
Towards a Model of Circular Economy for Italy published
Waste Package
2016
2017
2018
2019
Copernicus Programme Established
7 th Environment Action Programme
National Energy Strategy
National Waste Prevention Program
Rio+20 Conference on Sustainable Development
Biodiversity Strategy to 2020
National Marine Strategy
National Biodiversity Strategy
Transposition of the EU INSPIRE Directive
Transposition of the EU Ambient Air Quality Directives
2020 Climate & Energy package
Marine Strategy Framework Directive
2014
2013
2012
2011
2010
2009
2008
First Italian Yearbook by National Environmental Agency published
National framework law on protection against electric, magnetic and electromagnetic exposure
Ratified the Aarhus Convention
National Action Plan for GHG emissions reduction
EU Directive Public Access to Environmental Information
Transposition of the EU directive on public access to environmental information
Legislative Decree n. 152/2006 and subsequent amendments, Environmental Code
REACH (Registration, Evaluation, Authorisation and Restriction of chemicals)
EU INSPIRE Directive
2001
2002
2003
2005
2006
2007
Water Framework Directive
UNECE Arhus convention on Access to Environmental Information
Kyoto Protocol
Transposition of the Habitat Directive
Framework Law on noise pollution
National Environment Agency / Regional Environment Agencies Established
EEA / Eionet established
2000
1998
1997
1995
1994
Italian Ministry of the Environment Established
First SoE report published by Italian Ministry of the Environment
Transposition of the Seveso I Directive (and subsequent directives Seveso II & III)
Directive on the Conservation of natural Habitats, Fauna and Flora (Natura 2000)
Transposition of the Birds Directive
1986
1988
1992
United Nations milestones
European Union milestones
EEA milestones
Milestones Italy

In Italy, Ecological Networks are planned and developed at regional level, as planning is a sector that can be managed both at national and regional levels, according to the Italian legislation (Article 117 of the Constitution, as in the formulation of the Constitutional Law of Reform no. 1 of 2001). The Environment has only recently been added to the Constitutional values mentioned at Article 9, thanks to the Constitutional law no. 11 (11 February 2022), as in its original formulation, the Italian Constitution was only mentioning landscape and cultural heritage as elements to be preserved, even though the natural heritage was systematically preserved through special acts since the promulgation of laws no. 778 of 1922 and 1497 of 1939. Cultural heritage was, instead, preserved at national level at least since 1902 (laws no 185 of 1902 and 364 of 1909).

The first Italian law which was mentioning the environment as a diffuse value in a modern conception was law no. 349 of 1986, which created the Ministry of Environment and introduced in the Italian national legislation the concept of environmental damages. With law no. 394 of 1991, Italy introduced a general framework for natural parks, even though some national parks were created and recognized decades before, such as Gran Paradiso (1922), Abruzzo (1923), Circeo (1934), and Stelvio (1935). Italy was the fourth country in Europe creating two natural parks, after Sweden, Switzerland, and Spain.

The new environmental sensitivity lead, first, to the identification of new national parks in the 1980s (e.g. Arcipelago Toscano, Aspromonte, and Monti Sibillini) and then to the definition of a legislative framework for parks in 1994 (only the sea was preserved under law no. 979 of 1982), which followed in most instances the related regional laws. In 2010, the preserved areas in Italy (covering 10.50% of the national territory divided into 871 areas, for a total of about 3,163,590.71 hectares on land and about 2,853,033.93 hectares at sea, plus 658.02 kilometers of coastline) were divided into:

- 24 national parks,
- 147 national natural reserves,
- 27 marine protected areas (and two underwater parks and the International Marine Mammal Sanctuary),
- 134 regional natural parks,
- 365 regional natural reserves,
- 171 other protected areas with different classifications and designations,

In Italy, Regions were introduced formally in the 1948 Constitution, but were practically enforced only after 1972, with the transfer of administrative duties to the related authorities, and the Environmental protection became a regional duty only with law no. 382 of 1975 and the Decree of the President of the Republic no. 616 of 1977. The first regional park in Italy was created in Lombardy with the regional law no. 1 of 1974, creating the river park protecting the Ticino River, thanks to the regional law no. 58 of 1973 (replaced by law no. 82 of 1986), which was entitling the Regional Authority of the power of creating protected areas in its territory. Piedmont, Lazio, Liguria, Veneto and Sicily followed right after, forestalling the national legislation.

In the actual framework, most Italian Regions have a regional law defining the framework for regional parks and protected areas at different levels, contributing to the definition of a

national Ecological Network, which has only been promoted as a future project by now. The National Ecological Network project is an operational tool for territorial planning, programming, and natural resource utilization at the national level. Within this framework, many 'networks' models have been developed: a global network that includes all vertebrate species in Italy, a specialized network for each taxonomic category (= group of species), and ultimately a network for all 149 animals at risk of extinction in Italy.

In the northern part of Italy, in the geographical space which covers the Po Valley, enclosed between the Alps and the Apennines, touching the Adriatic and Tyrrhenian seas, several Ecological Networks models have been created by the 6 Ordinary Regions included in this geographical entity (Piedmont, Liguria, Lombardy, Emilia- Romagna, Veneto, Friuli), plus two Special System Authorities, i.e. Valle d'Aosta and Trentino-Alto Adige, this last consisting of two Autonomous Provinces (Trento and Bolzano) with specific duties in the Environment protection. In most of the Italian Region, the general design of Ecological Networks is determined at Regional level and can be integrated by Provincial and Municipal plans, that should follow the regional guidelines in the design of their local networks. The specific Ecological Network descriptions will be presented in the following pages, excluding Valle d'Aosta and Emilia-Romagna that are here briefly summarized.

Valle d'Aosta determined the definition of a Regional Ecological Network under Article 3 of Regional Law no. 8 of 2007. The Regional Authority has recently started the activities for the identification of the Regional Ecological Network and the creation of the related cartography, thanks to the Biodiv'Connect project, as part of the PITEM Biodivalp, funded by the European Territorial Cooperation Program Alcotra Italy-France 2014-20 (ERDF). The harbinger of the following Ecological Network project was mentioned at Article 19 of the Regional Territorial Plan of 1998 (that is actually under revision since 2022), which identified specific subsystems of ecological, landscape, and functional relationships, which constitute several 'units of relations' referred to as 'local units'. Each of them is described in an overview profile defining:

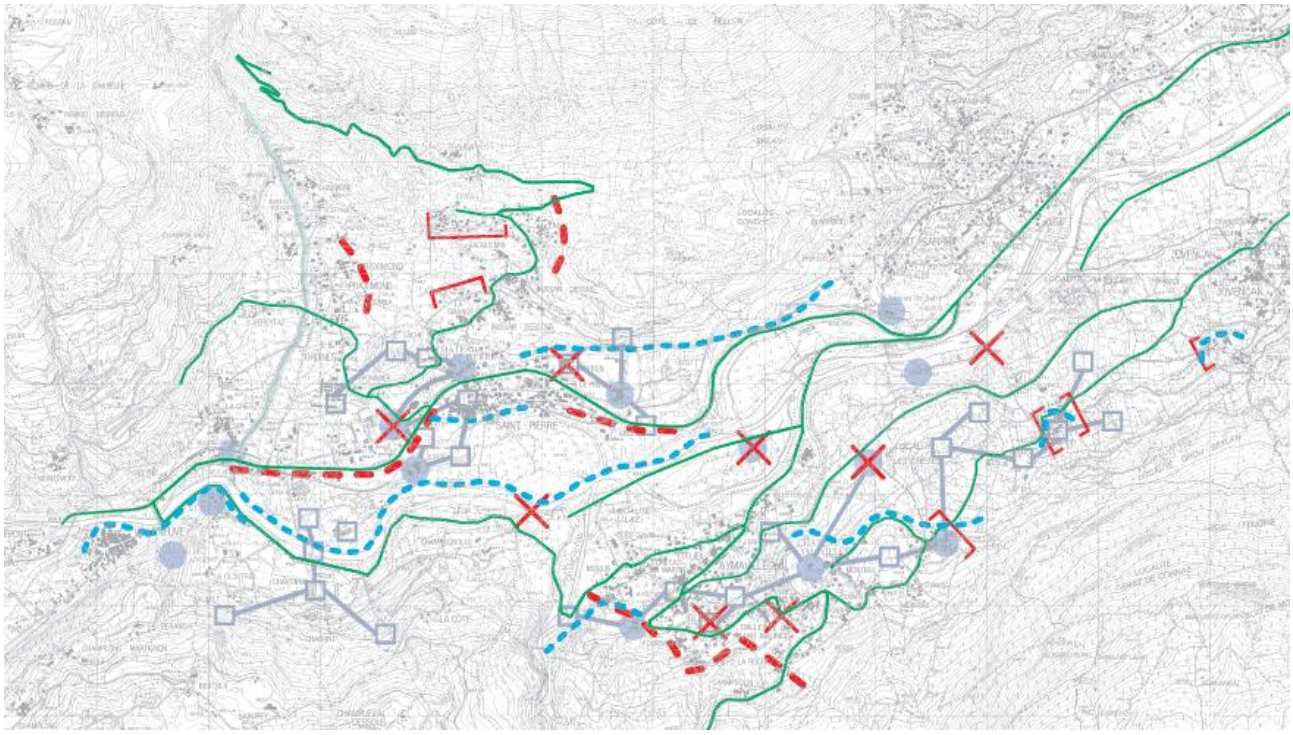
a) the landscape interactions between its main components;
b) ecological and landscape connection lines, consisting of continuous bands of natural and semi-natural components and the corridors that connect them;
c) ecological corridors, consisting of linear elements, such as rivers and hedgerows, to connect areas and resources of natural interest;
d) free gaps, which separate built-up areas, ensuring ecological continuity and landscaping of green areas;
e) the boundaries of urbanization expansions in relation to the agricultural context;
f) the main panoramic views;
g) the main viewpoints;
h) landscape integration sites, consisting of particularly intense landscape interactions between neighboring elements;
i) the natural margins and edges of built-up areas, having particular landscape importance;
j) elements of visual degradation or deduction that alter or damage landscape and ecological interactions.

UNITÀ LOCALI ~ UNITÉS LOCALES

schemi grafici in scala 1:20.000 (Riproduzione ridotta in scala 1:28.000) – cartes à l'échelle 1/20 000 (Reproduction réduite au 1/28.000)

RIFERIMENTO ALLE SCHEDE DELLE UNITÀ LOCALI "SITUAZIONI PROBLEMATICHE E ORIENTAMENTI" / RÉFÉRENCE AUX FICHES DES UNITÉS LOCALES : "PROBLÈMES ET ORIENTATIONS"	SIMBOLI DEGLI SCHEMI GRAFICI DELLE UNITÀ LOCALI / SYMBOLES UTILISÉS SUR LES CARTES DES UNITÉS LOCALES	RIFERIMENTO ALLE NORME DI ATTUAZIONE ARTICOLO 19, COMMA 3 / RÉFÉRENCE AUX DISPOSITIONS D'APPLICATION, TROISIÈME ALINÉA DE L'ARTICLE 19
Interazioni paesistiche tra principali componenti Interactions des principales caractéristiques du paysage		a) le interazioni paesistiche tra le principali componenti che caratterizzano il paesaggio a) interactions, du point de vue paysager, des principaux caractères du paysage
Fasce di connessione ecologica e paesistica Liaisons écologiques et paysagères		b) le linee di connessione ecologica e paesistica, costituite da fasce continue di componenti naturali e semi-naturali e dai corridoi che le collegano b) liaisons écologiques et paysagères, constituées par des bandes continues d'éléments naturels et semi-naturels et par les couloirs qui les relient
Corridoi ecologici Couloirs écologiques		c) i corridoi ecologici, costituiti da elementi lineari, quali corsi d'acqua e sistemi spondali, alberate e siepi, ecc., atti a collegare le aree e le risorse d'interesse c) couloirs écologiques constitués par des éléments linéaires, tels que des cours d'eau, rivages, rideaux végétaux, haies, etc., de nature à lier les aires et les ressources d'intérêt écologique
Varchi liberi Coupures d'urbanisation	] [	d) i varchi liberi da costruzioni, che separano le areee edificate, assicuarando la continuità ecologica e paesistica delle aree verdi d) coupures d'urbanisation qui assurent la continuité écologique et paysagère des aires naturelles
Confini dell'edificato Limites des constructions		e) i confini delle espansioni urbanizzate nei confronti del contesto agricolo e) limites de l'extension des urbanisations par rapport au contexte agricole
Mete visive Eléments visibles	mete visive éléments visibles	f) le principali mete visive f) principaux éléments visibles
Canali di fruizione e punti panoramici Accès et points panoramiques	canali di fuizione da percosi pedonali parcours piétonnier canali di fuizione da strade route punti panoramici point panoramique	g) i canali principali di fruizione visiva e i punti panoarmici g) principaux itinéraires de jouissance et points panoramiques
Siti di particolare integrazione paesistica Sites d'intégration paysagère	componenti di sito particolare non emergenti e loro relazioni composantes de site particulières, non apparentes, et leurs relations componenti emergenti e loro relazioni composantes apparentes, et leurs relations	h) i siti di integrazione paesistica, costituiti da interazioni paesistiche particolarmente intense tra elementi limitrofi h) sites d'intégration, considérés du point de vue paysager et caractérisés par une interaction particulièrement intense des éléments paysagers limitrophes
Margini e bordi Limites et bords naturels		i) i margini naturali e i bordi dell'edificato, di particolare rilievo paesistico i) bords naturels et limites de l'habitat revêtant un intérêt particulier du point de vue paysager
Detrazioni o degrado Dégradation et altération visuelle		l) gli elementi di degrado o di detrazione visiva, che alterano o mutilano le interazioni paesistiche ed ecologiche l) facteurs de dégradation et d'altération visuelle qui modifient ou limitent les interactions paysagères et écologiques
Connessioni viabilistiche Liaisons	nuove connessioni viabilistiche nouvelles liaisons	m1) le connessioni per la mobilità, significative per l'unità locale: viabilistiche m1) liaisons significatives pour l'unité locale : voirie
Sistemi di trasporti pubblici Systèmes de transports en commun		m2) le connessioni per la mobilità, significative per l'unità locale: con trasporti pubblici m2) liaisons significatives pour l'unité locale : transports en commun
Centri di servizio complementari Centres de services complémentaires		n1) le relazioni funzionali, significative per l'unità locale: tra centri di sevizi complementari n1) relations fonctionnelles significatives pour l'unité locale: entre les centres de services complémentaires
Integrazione servizi e risorse turistiche Intégration services et ressources touristiques		n2) le relazioni funzionali, significative per l'unità locale: tra servizi o risorse turistiche complementari o integrabili n2) relations fonctionnelles significatives pour l'unité locale: entre les services ou ressources touristiques complémentaires ou susceptibles d'être intégrés
	nuovi percorsi pedonali turistici nouveaux parcours touristiques piétonniers	

Local Units elements in Valle d'Aosta available at
https://www.regione.vda.it/territorio/territorio/pianificazione_territoriale/ptr/pdf/schede_unita_locali.pdf



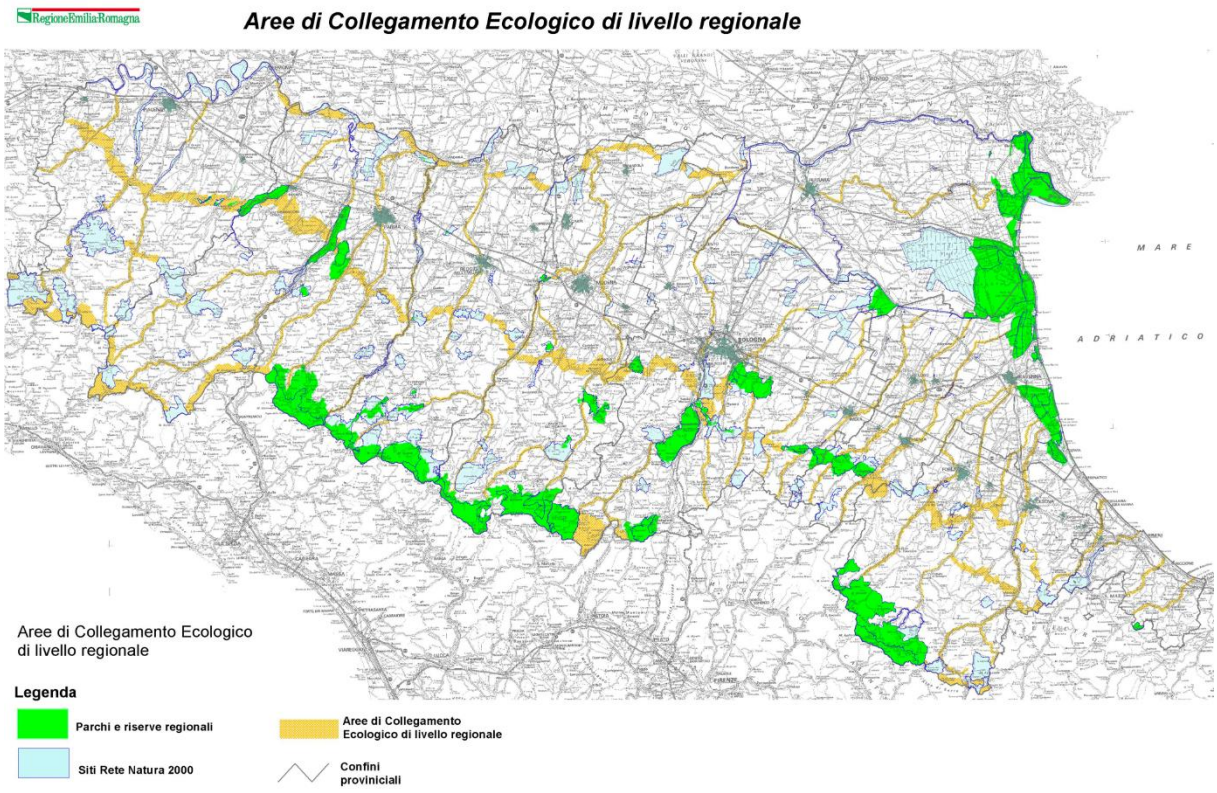
Local Unit of the base of Doire Baltée, from Villeneuve to Sarre, in Valle d'Aosta available at https://www.regione.vda.it/territorio/territorio/pianificazione_territoriale/ptr/pdf/schede_unita_locali.pdf

The Ecological Network in Emilia-Romagna connects the Protected Areas and the sites of the Natura 2000 Network in the region. The Regional Ecological Network was defined by Article 2 letter f of Regional Law no. 6 of 2005. It includes Ecological connection areas, important from a geographical and naturalistic point of view and should be protected as they promote the conservation and exchange of flora and fauna species. As a result, 33 regional ecological connection areas have been identified and represented on a map on a scale of 1:250,000. They can be grouped by ecological functionality and by different problems and management methods into the following three categories: Supra-regional ecological connection areas, Transversal ecological connection areas, Rivers ecological connection areas.

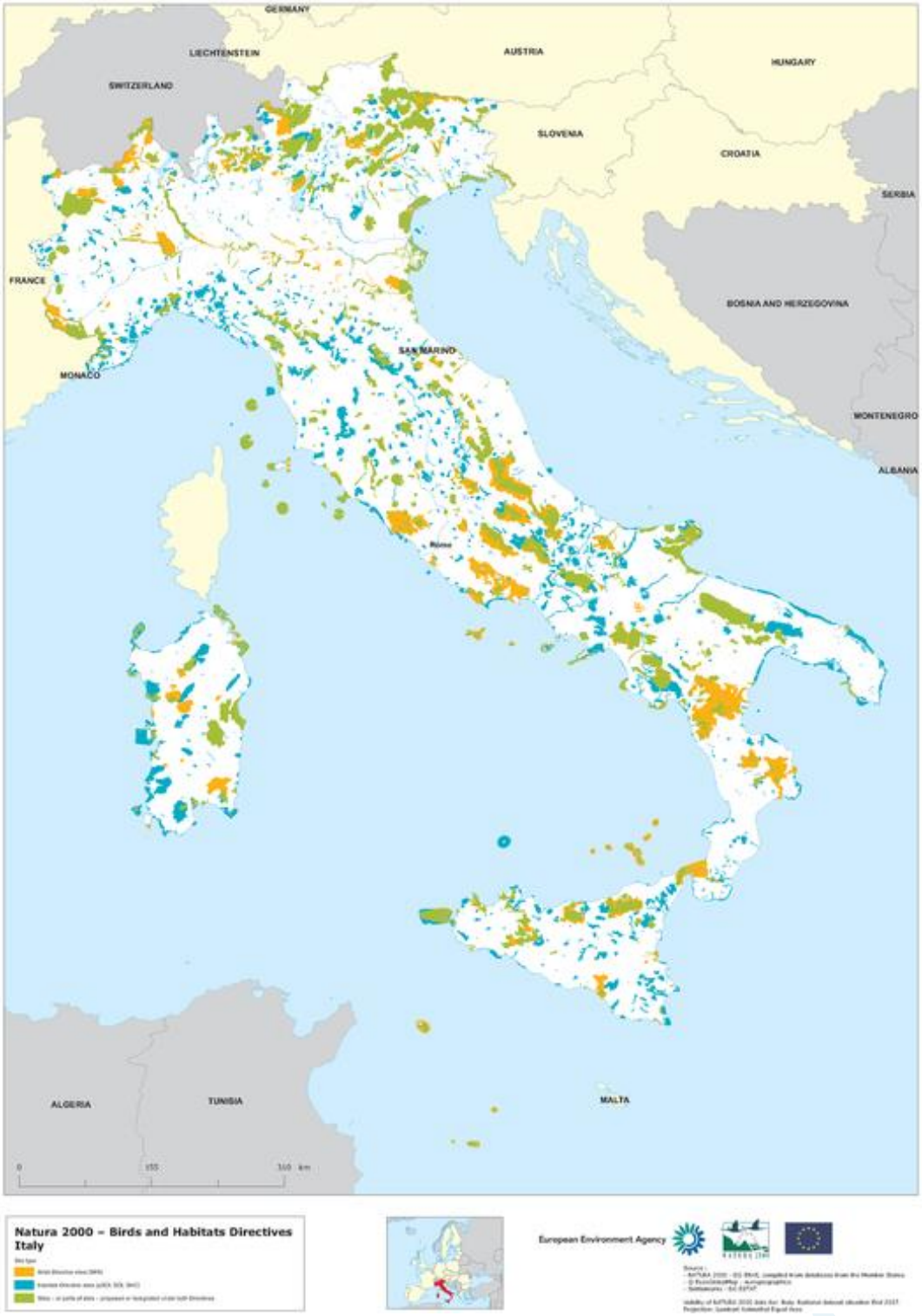
Based on the Regional Program for the Regional System of Protected Areas and Natura 2000 Network Sites, Emilia-Romagna:

- coordinates the management of protected areas and Natura 2000 sites,
- identifies and describes the Ecological Connection Areas.

In addition, the Region promotes connected environmental actions with the Regional Forest Plan, the Regional Rural Development Program (RDP) and funds for the creation of new forests.



Ecological connection areas and Natura 2000 areas in Emilia-Romagna available at https://ambiente.regione.emilia-romagna.it/it/parchi-natura2000/sistema-regionale/rete-ecologica

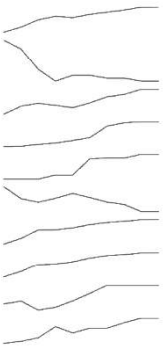


Natura 2000 areas available at https://www.eea.europa.eu/data-and-maps/figures/natura-2000-birds-and-habitat-directives-9/italy

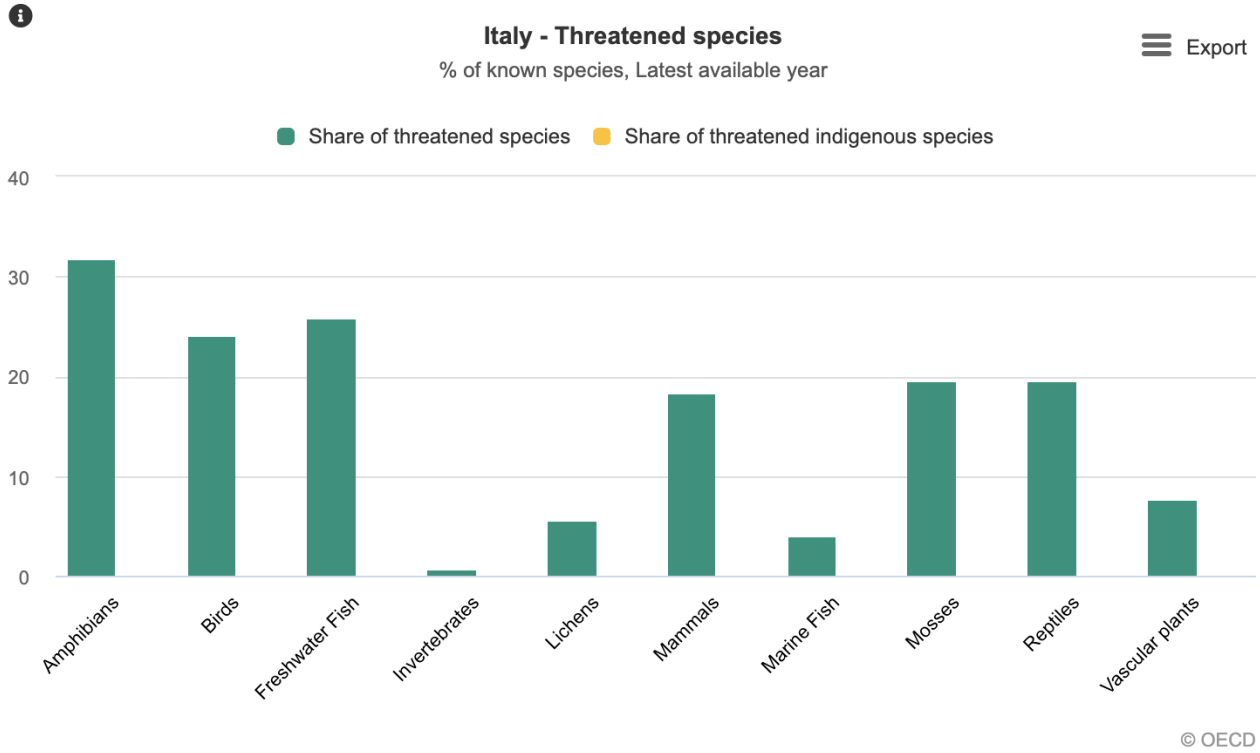
Country projections for the future

TRANSITIONS PERFORMANCE INDEX 2021

3.	**Environmental transition**		**3**	**73.8**	↑
3.1	EMISSIONS REDUCTION: Gross greenhouse gas emissions (tonnes per capita)	7.2	35	**70.0**	↗
3.2	BIODIVERSITY	76.9	20	**76.9**	↗
3.2.1	Terrestrial key biodiversity areas (KBAs) protected (%)	75.7	21	**75.7**	–
3.2.2	Freshwater key biodiversity areas (KBAs) protected (%)	85.2	17	**85.2**	–
3.2.3	Pesticide use per area of cropland (kg/ha)	5.2	50	**62.8**	↑
3.3	MATERIAL USE	69.4	2	**69.4**	↑
3.3.1	Resource productivity (PPP$ per kg)	5.5	5	**92.4**	↑
3.3.2	Material footprint (tonnes per capita)	21.4	36	**46.5**	↘
3.4	ENERGY PRODUCTIVITY: Energy productivity (PPP$ per koe)	15.8	9	**79.1**	↑



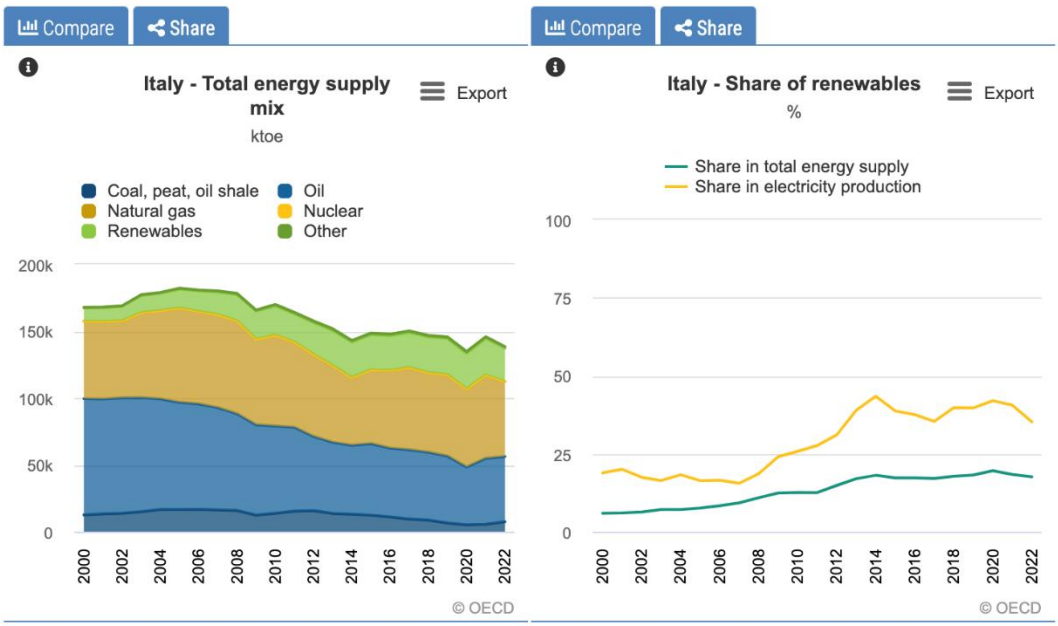
ENVIRONMENT AT A GLANCE INDICATORS, OECD 2023



Note: see country metadata.

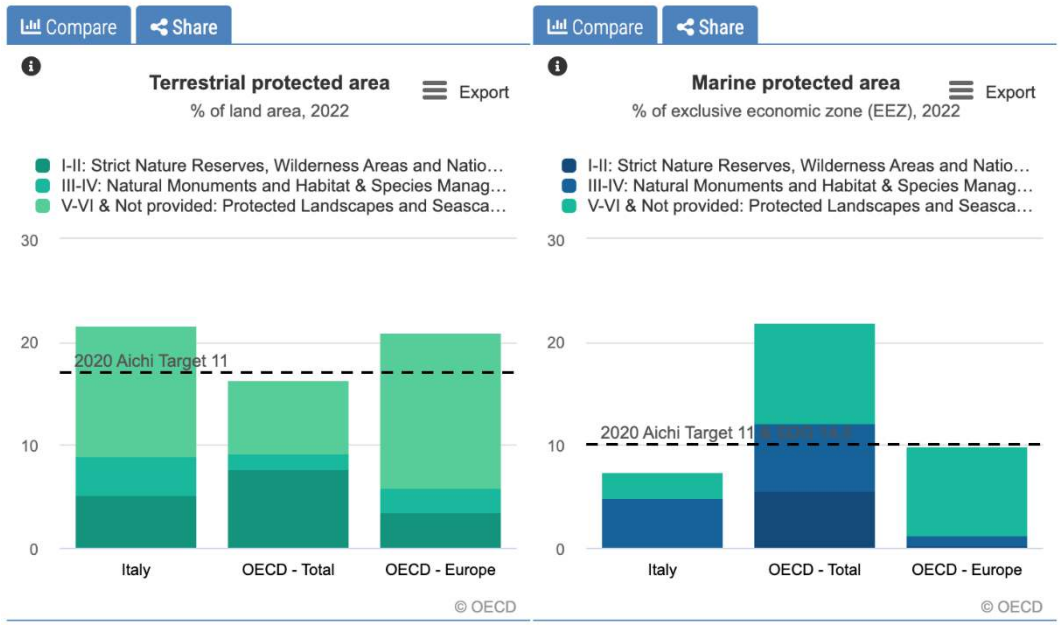
Sources: OECD, "Biodiversity: Threatened species", *OECD Environment Statistics* (database), https://doi.org/10.1787/data-00605-en.

Energy mix



Source: IEA, "World energy statistics", IEA World Energy Statistics and Balances (database), https://doi.org/10.1787/data-00510-en.

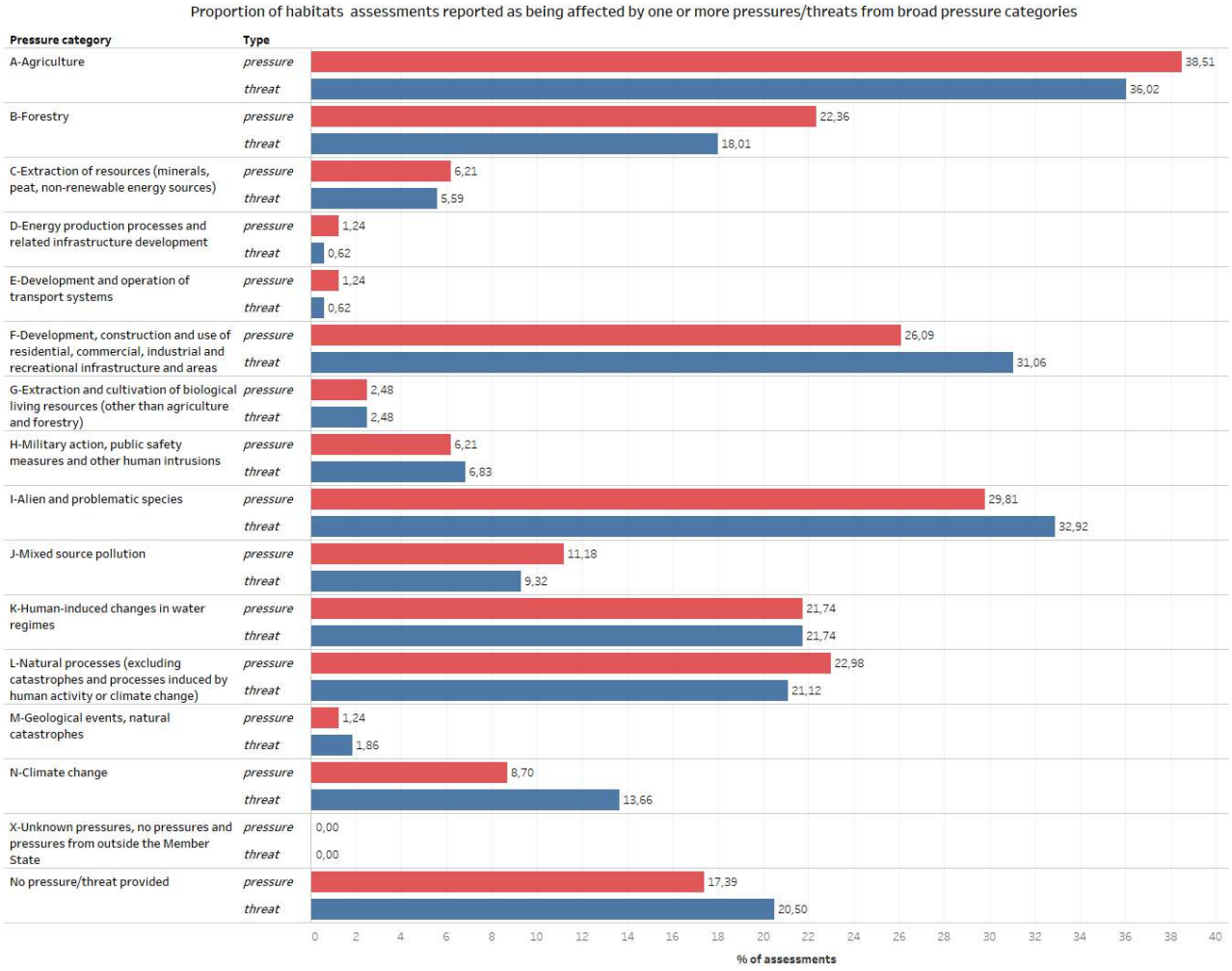
Protected areas



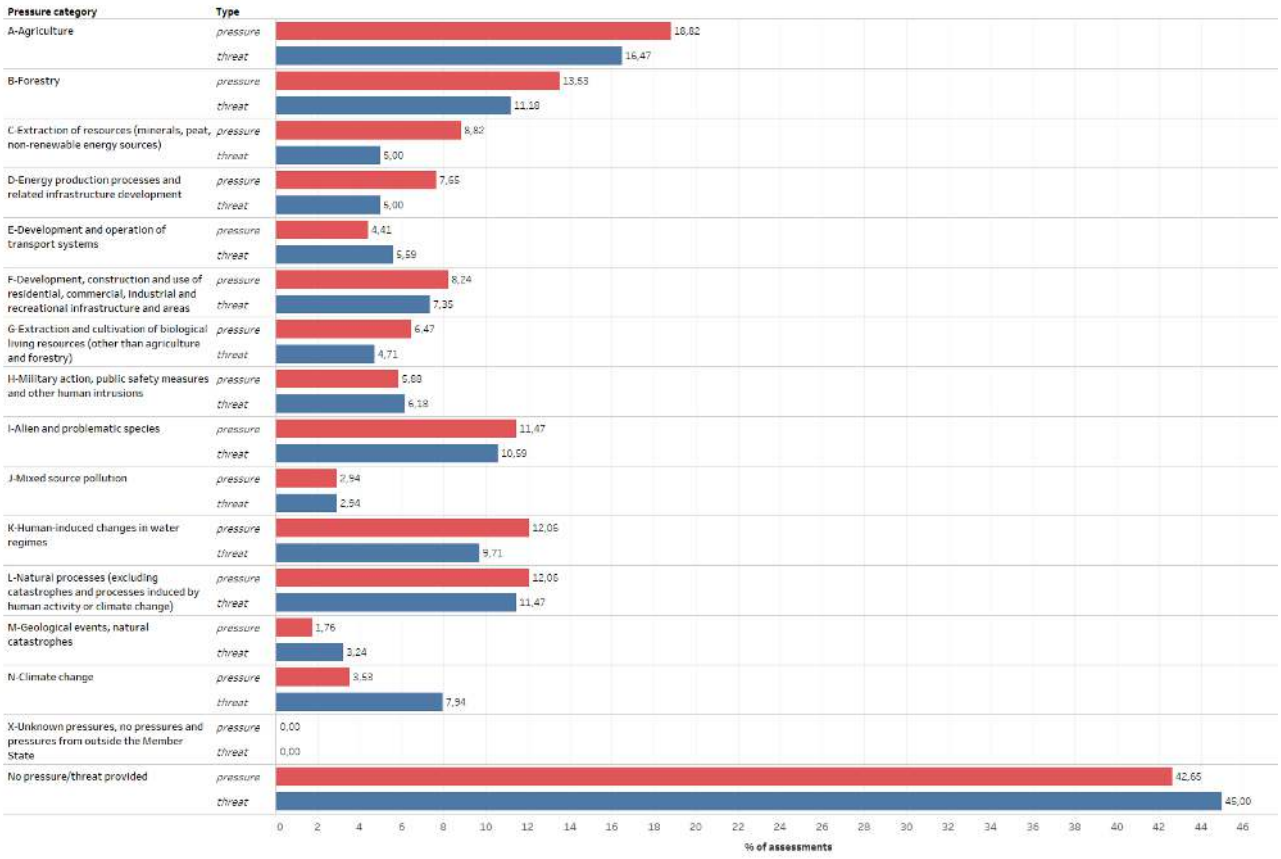
Source: OECD, "Biodiversity: Protected areas", *OECD Environment Statistics* (database), https://doi.org/10.1787/5fa661ce-en.

STATE OF NATURE REPORT 2013-2018 (EEA)

Frequency of main pressure and threats on habitats of the Alpine and Continental Biogegraphical Regions (IT)

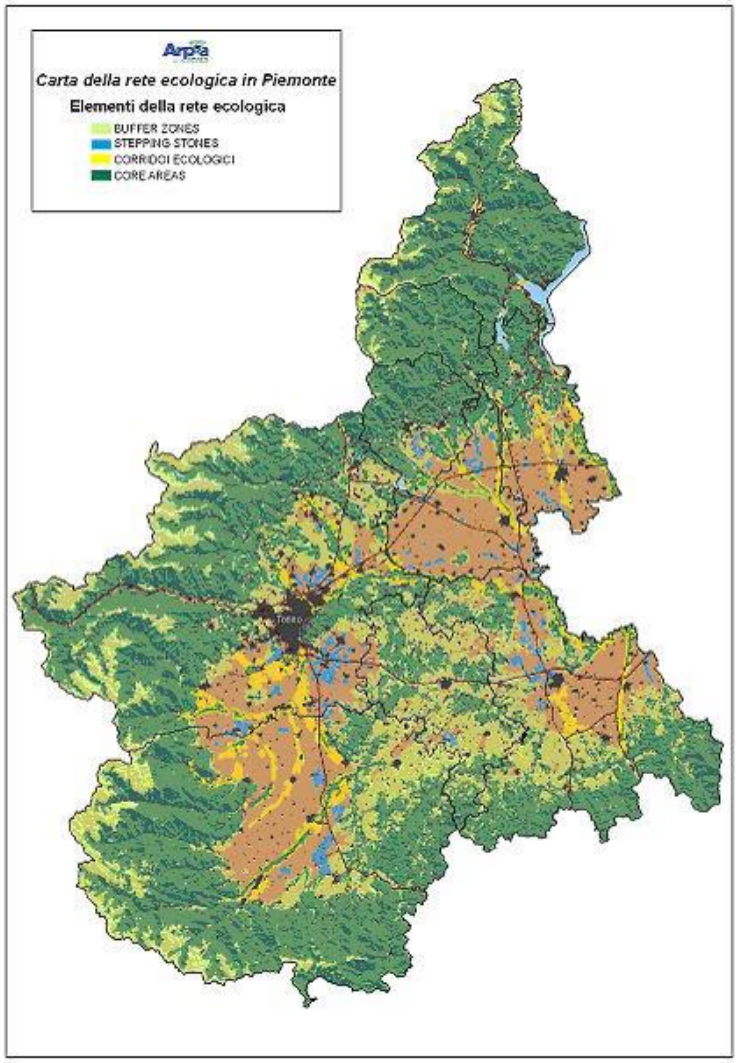


Frequency of main pressure and threats on species of the Alpine and Continental Biogegraphical Regions (IT)



1.8 Piedmont

by Fondazione Politecnico di Milano



Ecological Network map in Piedmont available at https://www.regione.piemonte.it/

1. Network typology (check corresponding answer)

Protected area network and Ecological network plan

2. The ecological network and its legal framework of reference

Piedmont Region developed the Regional Ecological Network through the Regional Law no. 19 of 2009 - Consolidation Act on the Protection of Natural Areas and Biodiversity - identifying within it the Regional System of Protected Areas as a fundamental network component. It consists of national parks, state nature reserves (for the part falling within the

regional territory), and protected areas under regional, provincial, and local management (NUTS 2). The network is part of a cascading planning system implemented by the PPR (Regional Landscape Plan) and declined at the metropolitan level through a specific ecological sub-network (Rete Ecologica della Città Metropolitana di Torino).

3. Network objectives

The regional law defines procedures for biodiversity conservation and management of protected areas. The territorial public authorities and other entities, to which the management of areas included in the Natura 2000 network is delegated, coordinate to create an integrated and interconnected system of elements that ensures the active conservation of biodiversity and the environmental sustainability of territorial transformation processes.

4. Network structure and elements

The regional ecological network consists of the following areas:

- Piedmont system of protected areas,
- Contiguous areas,
- Special Areas of Conservation (SAC), Sites of Community Importance (SCI) and Special Protection Areas (SPA) forming part of the Natura 2000 network,
- Natural protection zones,
- Ecological corridors,
- Other areas and land features important for biodiversity.

5. Methodology used in network and corridor design

The network definition followed a structural approach based on the following elements:

- the primary and secondary nodes, formed by the system of Protected Areas, Natura 2000 Network sites, natural safeguard areas, contiguous areas, and additional sites of natural interest; the nodes are the areas with the most significant wealth of natural habitats;
- the connections, formed by the hydrographic network corridors, ecological corridors, support points, areas of natural continuity and suitable connection belts, and the main supra-regional connection belts; the connections maintain and favor the dynamics of dispersion of biological populations between the various nodes of the network;
- the project areas, formed by the buffer areas, node contexts, river contexts and environmental crossings;
- the environmental regeneration areas, which include peri-urban contexts of regional and local importance, urbanized areas, as well as agricultural areas in which to recreate diffuse connectivity and discontinuity stretches to be recovered and mitigated.

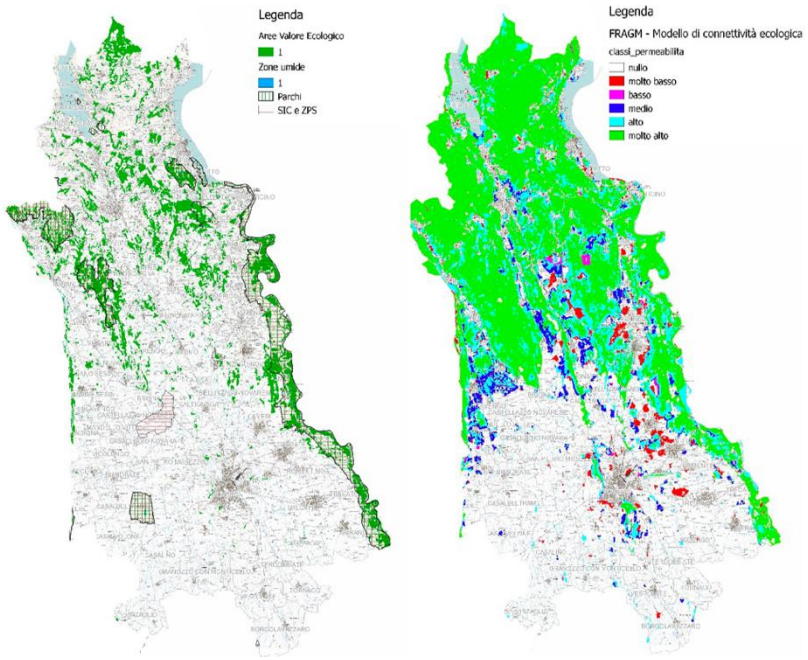
A technical-scientific methodology is used to identify the main elements of the regional ecological network and its implementation (Regional Committee Resolution no. 52-1979 of 2015). This methodology is based on the regional cartographic database (regional GIS, regional geoportal), to which fauna and vegetation indicators and modelling tools are applied to identify areas of ecological value and ecologically permeable areas.

6. Tools and guidance for planners and practitioners

Guidelines for Strategically Planned Green and Blue Infrastructure (Regione Piemonte), available at https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2023-01/Linee%20Guida_completa.pdf

Recommendations for Policy Instrument - PR ERDF 2021-2027 regarding the financing of Green and Blue Infra-structure (Regione Piemonte), available at https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2023-01/Raccomandazioni.pdf

Datasets from Geoportale Piemonte



Core Areas and Ecological Connectivity maps in the Province of Novara available at https://www.regione.piemonte.it/

7. Specific provisions for connectivity conservation and restoration areas

According to Regional Law no. 19 of 2009 (Consolidation Act on the Protection of Natural Areas and Biodiversity), areas included in the regional natural areas map and intended to be established as protected areas are subject to the protection and preservation rules established by the Region in relation to their different classification within the prohibitions and limitations of the law.

The law defines the environmental impact assessment (VIA) in which the direct and indirect effects of interventions and projects on habitats and species for which the Natura 2000 network areas and proposed sites of community importance have been identified and considered.

As in the Lombardy region, in Piedmont the elements that make up the ecological network are subject to protection by the competent authorities. For ecological corridors included in urban and territorial instruments at any level, the authority responsible for plans or interventions' approvals affecting ecological corridors defines the interventions necessary to compensate for any negative effects. Compensation, conservation, and reconstitution interventions are the responsibility of the individual proposing the interventions subject to environmental assessment. The Region, in agreement with the local authorities concerned, prepares special programs of activities and interventions concerning ecological corridors for their conservation and reconstitution which are approved by a resolution of the Regional Council.

8. Implementation of the connectivity conservation and restoration areas

The Regional Law no. 19 of 2009 defines the implementation of the regional ecological network and is included in the regional landscape plan (PPR) and Regional Territorial Plan (PTR). Consequently, at the provincial level, the ecological network proposed by the Provincial Territorial Coordination Plan (PTC2), in accordance with the indications of the Regional Landscape Plan and the Regional Territorial Plan has a multifunctional objective. It intends to associate the priority objective of maintaining and increasing biodiversity with other objectives such as safeguarding and improving the environmental and landscape quality of the territory and its use, in a compatible tourism-recreational way. It contains within it: protected areas and Natura 2000 network sites; perifluvial strips and ecological connection corridors; areas of specific environmental and landscape value; wetlands and wooded areas.

Regarding the municipal level, the municipal ecological network (REC) is intended as a completion and extension of the provincial ecological network design with the priority objective of safeguarding and increasing the level of naturalness and biodiversity present in the municipal territory. The specific objectives for the municipal network are the provision within the urban plan of areas intended for ecological compensation; encouragement of environmental improvement measures aimed at increasing reticularity; improvement of existing natural areas and areas undergoing renaturalisation; promotion of fruition activities such as sports and openair recreation; provision of new works and related compensation measures.

As good practice, the Corona Verde strategic project started in 2001 with DOCUP 2000-2006 European funding (ROP 2000-2006), aiming to create a Corona Verde (Green Belt) around Turin, combining the 'corona di delitie' (a constellation of Savoy residences around Turin) with the concept of the 'green belt', widely used in 20th-century European town planning. The project aimed to define a path to shape a significant ecological and environmental infrastructure that is complementary and subsidiary to the regional protected areas and compensatory to the intense urbanization in Turin hinterland. In 2009, the project was supported by funding from the POR-FESR 2007-2013, through which it was possible to implement a concept of a multifunctional and integrated ecological network by jointly targeting: ecological rebalancing through active conservation of natural spaces and connection networks, protection of the hydrographic network and safeguarding countryside; the enhancement of the historical and cultural heritage, in its expressions of exceptional

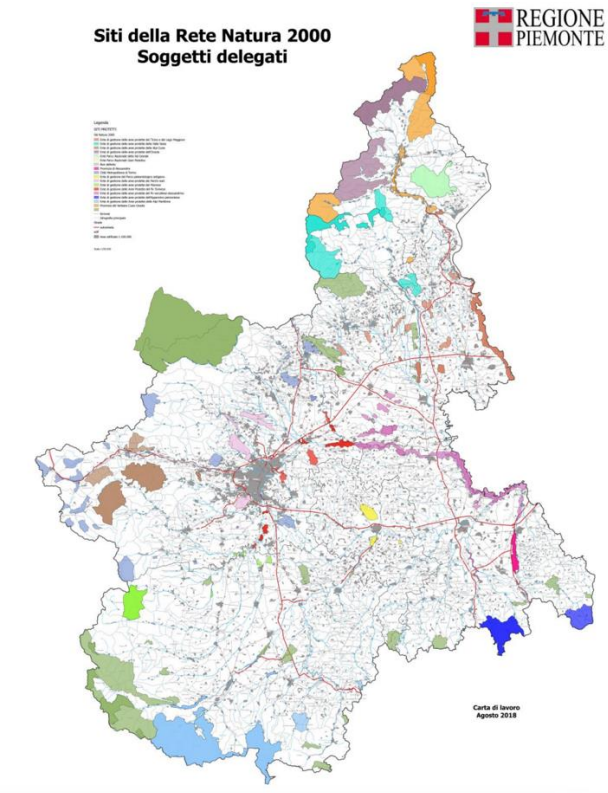
value (the remarkable architectures of Savoy power) and the widespread systems of cultural landscapes. Through the project, several interventions and management programs on a supra-municipal and local scale, a system for enhancing open spaces that passes through the control of land taking and the recovery of a balance between the city and rural and natural settings.

9. Implementation difficulties/opportunities

In Piedmont region, the integration of ecological networks has been increasingly addressed by supra-local planning tools (e.g. regional and provincial territorial plans, natural parks plans). By contrast, at the local level, there is still a weak operational perspective, required for an urban development oriented towards the conservation of natural spaces, ecological connectivity, and landscape protection. Indeed, the programmatic guidelines defined for the ecological networks are hardly translated into a local project accompanied by specific actions and rules for the implementation and management of the network.

10. Monitoring system

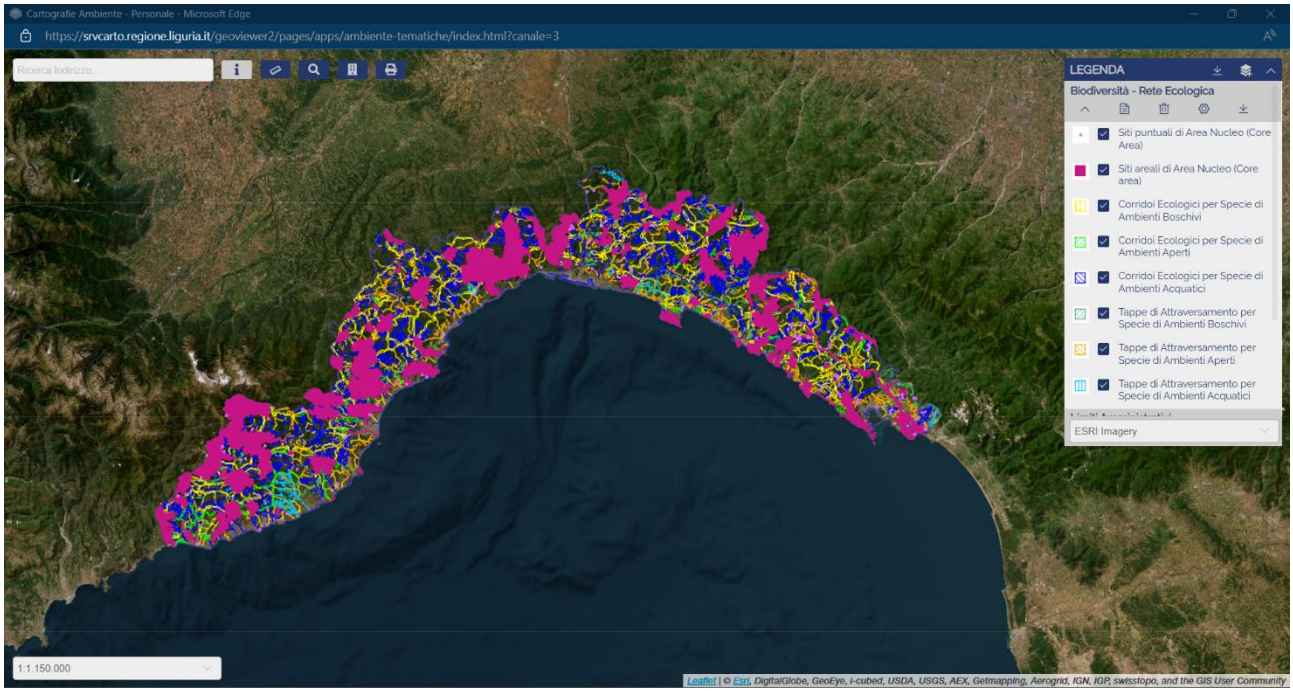
To acquire a better knowledge of the environment and its evolutionary trends, the Region monitors species and habitats of Community interest, in accordance with Article 17 of Directive 92/43/EEC and Article 12 of Directive 2009/147/EEC and manages the systematic collection and processing of information on the state of the environment, also by setting up naturalistic databases.



Natura 2000 sites map in Piedmont available at https://www.regione.piemonte.it/

1.9 Liguria

Regional Ecological Network by Studio Gibelli (Regione del Veneto)



Ecological Network shapefiles available at Geoportale Liguria

1. Network typology (check corresponding answer)

The variety of the environmental mosaic in Liguria is remarkable. In fact, despite the limited land area, it is possible to find several habitats.

In the environmental mosaic the types belonging to the forest category prevail. The most represented environment in Liguria is chestnut groves, which cover about 22 percent of the territory. Other types of forest environments widely represented are hop hornbeam forests and oak wood, which, together with chestnut groves, cover about 37 percent of the regional territory. On minor surfaces, but equally significant areas, rural environments develop, particularly olive groves, extensive crops, and complex agricultural systems, which undoubtedly provide a clear characterization of the Ligurian landscape (about 11 percent).

Liguria, with an area of about 5,410 km2 and 330 km of coastline, is a region that runs parallel to the Ligurian Sea, forming an extended arc in the overall East-West direction, in a peculiar geographic position, in between all three regions present in Italy: Continental, Alpine and Middle Eastern. The Ligurian territory presents an articulated and complex geological arrangement, in which two mountainous systems (the Alps and the Apennines), profoundly different from a lithological and structural point of view, come into contact.

According to this orographic setup, the river courses also have strongly sloped longitudinal profiles. The hydrological system is variable, but extreme flooding can occur during heavy weather events. The combination of several factors including orography and the presence of erodible lithologies with a climate characterized by dry periods alternating with very heavy rainfall. The Ligurian context is rich in biodiversity with unique ecosystems in terms of resources and environmental assets. It represents a valuable element of Europe common heritage, as the Alpine chain constitutes a strategic ecological link between northern Europe and the Apennine system, as well as the Adriatic Sea through the hydrographic system that departs from the Ligurian Alps and flows into the Po River.

The Liguria region has developed a Regional Ecological Network Project based on the Natura 2000 Network extended by functional ecological linkage areas. It has not introduced the Green and Blue Infrastructures concept.

The Liguria Region appears to be characterized by high ecological value over much of its surface area. The presence of inaccessible environments, with low population density and lacking major industrial activities, has in many cases enabled the preservation of places of high naturalness. Anthropogenic pressure, in fact, is mainly concentrated on the coast and around the main population centers. For this reason, some of the areas with the highest ecological value do not possess an equally high index of environmental fragility. This is especially the case for the inland areas of the province of Imperia where, before an important naturalness corresponds a very low territorial fragility. The most critical areas are the Genoese valleys, along which the main routes of connection with the northern regions have developed.

2. The ecological network and its legal framework of reference

Regional Law no. 28 of 2009 “Provisions on the protection and enhancement of biodiversity” established the Regional Ecological Network (Article 1 paragraph 2 letter d, Article 3 paragraph 1), and with Resolution no. 1793 of 2009, section 2, the Region formally approved “the cartographic representation, in digital format of the Map of the ecological - functional terrestrial connection areas in scale 1:10,000 [...]”

Liguria Region contributes significantly to the implementation of the Natura 2000 Network by enhancing biodiversity through the establishment of an extensive network of sites of communitarian interest (Sic) and Special Protection Areas (Zps) and through other actions aimed at the protection and enhancement of the region naturalistic emergencies.

In Italy there is no National Ecological Network framework, but several protection models of specific elements and areas scattered throughout the country:

- National Parks (IUCN Category II),
- Natura 2000 sites,
- Integral and Oriented Nature Reserves (IUCN category Ia and Ib),
- Wetlands (Ramsar Convention and Important Bird and Biodiversity Area (IBA),
- Parks and Regional Protected Areas (IUCN Category V),
- Natural World Heritage Sites UNESCO,
- Biosphere UNESCO Reserves (Man and the Biosphere Program (MAB) | UNESCO).

Thus, there is no uniform prescriptive legislation. A useful reference is the handbook published by APAT (now ISPRA, Higher Institute for Environmental Protection and Research) on “Management of Functional Ecological Linkage Areas. Guidelines and operational methods for the adjustment of spatial planning tools to the construction of ecological networks at the local scale”. The document is focusing on the integration of the concepts of biodiversity, fragmentation, ecological network for the purpose of its integration into local planning and providing guidelines and criteria for the construction of the Municipal Ecological Network.

At a national level, there is also the 2030 National Biodiversity Strategy, which pursues two goals:

1. Build a coherent network of terrestrial and marine Protected Areas with the goal to establish 30% of protected areas on land and sea, and 10% strictly protected areas;
2. Restore terrestrial and marine ecosystems, reaching a restoration of the 30% of the conservation status of habitats and species, particularly through the activity conducted at the regional scale about the objectives and conservation measures of Network Natura 2000 sites.

18 actions are formulated to achieve these targets. Read more on this topic in 2030 National Biodiversity Strategy, Ministry of Environment and Energy Security (mase.gov.it).

The Ecological Network analyzed is a Regional Level Network: the design and its regulations are limited to the territory of the Liguria Region. The Regional Ecological Network (RER) is the framework for the construction of Ecological Networks of local administrations: Metropolitan City of Genoa, Provinces, Municipalities and for other institutions involved in land planning and management.

The Regional Law no. 36 of 1997 as amended defines levels of land planning in the regional territory, assigning to each of them roles, contents and tools. In the municipal level of planning exercised by single and associated municipalities, focused on the regulation of the topsoil and subsoil in competence, Regional Law no. 36/1997 as amended, indicates among the mandatory contents of PUC (Municipal Urban Plans) the cartography showing the elements of the Regional Ecological Network in the municipal territory.

3. Network objectives

The main purpose of the regional ecological network is to preserve the natural resources found that prove to be of particular importance for the conservation, migration, geographic distribution, and genetic exchange of wild species. A network, therefore, built specifically for the conservation of biodiversity.

In Article 3 paragraph 2 of Regional Law no. 28 of 2009, the objectives of the Regional Ecological Network are outlined:

“2. The Region, through the Regional Ecological Network, pursues in particular, the following objectives:

(a) to maintain or recover the functionality of ecosystems on the regional territory;

(b) to ensure the ecological coherence of the Natura 2000 network in application of Directive 92/43/EEC and later amendments and additions, avoiding environmental fragmentation with respect to the peculiar habitats to the species under conservation of each Natura 2000 network site;

(c) foster ecological connectivity among populations of species of community interest within Natura 2000 network sites."

4. Network structure and elements

The following elements and connection types were identified for the construction of the Regional Ecological Network:

- Areal core sites, correspond to Natura 2000 network sites and protected areas and represent the areas to relate to the network. In current terminology they can be identified with core areas.
- Punctual core sites, correspond to areas of proven ecological value for the functionality of the network, but of small size or even punctual, for which connections to the network are not possible. Some ecotonal areas, caves, cliffs, puddles, wetlands, and some areas of minor fauna are occasionally found in this typology due to special situations of isolation.
- Ecological corridors that represent a connection of great importance for all ecological groups.

Natura 2000 Network in Liguria is represented by 126 SAC/SIC of which 27 are marine and 7 SPA, representing 29.1% of the Ligurian territory with about 158,000 [ha] for the terrestrial Natura 2000 Network (of which about 20,000 [ha] for SPA) and 9,000 [ha] for the marine Natura 2000 Network.

Ligurian Natura 2000 Network sites vary in size, with ranges from 8 to 15,834 [ha] and have heterogeneous characteristics. Each site consists of a territorial unit that ensures the conservation of a complex of habitats, biotopes and naturalistic values and allows the maintenance of a high degree of biodiversity.

All three bio-geographical regions present in Italy are represented in the Ligurian Natura 2000 Network:

1. Alpine,
2. Continental,
3. Mediterranean.

There are 14 sites included in the Alpine bio-geographical region, 11 sites belonging to the Continental bio-geographical region, 101 sites belonging to the Mediterranean bio-geographical region, and 7 Special Protection Zones, in which Beigua SPA protects a very important "bottleneck area" for raptor migration and the 6 SPA in the Ligurian Alps, which protect a variety of alpine species at the limits of their area.

The regional territory of Liguria also has a very high level of environments belonging to all three bio-geographic regions found in Italy: Mediterranean, Continental, and Alpine.

To preserve the ecosystem wealth of Ligurian resources and the region natural assets, specific areas have been established and their combination has led to the setup of a system of protected areas on a regional scale.

The Regional System of Protected Areas of Liguria.

The Land System of Protected Areas, the heart of this Ligurian reality, is integrated by 3 state Marine Protected Areas (Bergeggi, Cinque Terre and Portofino), one in the process of being established (Gallinara) and the Marine Protection Areas of two regional protected areas (Hanbury Botanical Gardens and Portovenere), as well as the International Cetacean Sanctuary of the Ligurian Sea. The land area protected as a nature park or nature reserve or botanical garden is 33,414 ha (6.17 percent of the regional territory), to which is added 1,206 ha of contiguous special regime areas (Montemarcello-Magra Park). The Alta Via of Ligurian mountains represents, together with the Excursion Network of Liguria (REL), a model of sustainable accessibility to protected areas.

5. Methodology used in network and corridor design

The geometries providing the main base for the habitats perimeter of the Ligurian territory result from the Liguria Region Land Use Map (scale 1:10,000), published by Liguria Region in August 2011.

The use of these geometries, as a cartographic base, turned out to be a suitable procedure for the purposes set, during the surveys it was possible to verify the correspondence between the environments surveyed on the territory and the polygons present on the Map to which the Corine Biotopes/EUNIS categories were then associated.

For the province of Savona alone, indepth studies were carried out and reported in the Regional Map.

Therefore, it should be specified that the Ligurian Ecological Network was not constructed homogeneously throughout the Region.

In a preliminary phase, some categories of the Land Use Map were directly converted, especially those referring to anthropized settings, also by combining typologies in which the thematic detail was too important. Other categories, mainly referred to the agricultural settings catalogued in a non-unique way, were verified through orthophotos, and attributed to the relevant Corine Biotopes codes.

In a second stage, a series of surveys were carried out to determine the environments found in areas, especially natural areas, except from the assignments made earlier.

6. Tools and guidance for planners and practitioners

The cartography of the Ecological Network is available in two versions:

1. static version (webgis available at the Region geoportal: https://www.banchedati.ambienteinliguria.it/index.php/cartografia, https://srvcarto.regione.liguria.it/geoviewer2/pages/apps/ambiente-tematiche/index.html?canale=3),

2. numerical version vector shapefiles (core areas shapefiles polygonal/punctual; Ecological Corridors for Species of Aquatic/Open/Wooded Environments polygonal shapefiles; Crossing Stages for Species of Aquatic/Open/Bosque Environments polygonal shapefiles) (vector files can be downloaded from the Region geoportal at the same address above).

The elaboration has indicative and non-design value.

The rules for the regional ecological network can be found in the already mentioned LR 28/2009, Article 4 refers to conservation measures to prevent the degradation of natural habitats and species habitats, as well as the disturbance of species for which the areas have been designated, to the extent that such disturbance could have significant consequences on the objectives of these regulations. The measures concern Natura 2000 Sites and their ecological-functional linkage areas.

Conservation measures generally prevail over existing or adopted land-use and urban planning instruments of any level.

The management plans for Natura 2000 Sites decline the conservation measures for each site as stipulated in Article 5 of the previously mentioned law.

The Art. 16 reports the directions for the protection of fauna, specifically it defines the animal species considered as protected and the prohibitions referred to all phases of the biological cycle of these species.

Other:

- Guidelines for articulating the regulations of the Regional Ecological Network
- Guidelines for municipal planning.

7. Specific provisions for connectivity conservation and restoration areas

The reference legislation for environmental assessments is national, resulting from the various EU Directives that have followed one another over time and introduced VIA, Vinca e VAS.

In Liguria, VIncA is regulated by Law no. 28 of 2009, and Regional Committee Resolution no. 30 of 2013, as amended.

Art. 6 of the mentioned law states that: “The approval of plans, projects and interventions affecting Natura 2000 network sites is conditioned by the positive result of the Impact Assessment, except in the mentioned Article 5, paragraphs 9 and 10, of Presidential Decree 357/1997 and further amendments and integrations. The Impact Assessment, if required according to the criteria in paragraph 2, is an essential part of the ordinary procedure of authorization or approval. [...]”. Art. 9 reports that the Impact Assessment is carried out by the Region, according to the terms identified by the Regional Council, in plans, projects and interventions involving more than one Natura 2000 site and in regional plans, projects and interventions with different management authority.

There are further details in the same law.

In Liguria, in addition to the mentioned Law no. 28 of 2009, “Provisions on the protection and enhancement of biodiversity,” the reference for impact assessment procedures is the more recent Deliberation of the Regional Council no. 30 of 2013, “Approval of criteria and procedural guidelines for the impact assessment of plans, projects and interventions,” Annex A, which contains the minimum contents of the impact study, replacing the previous Deliberation no. 328 of 2006.

The ecological network is generally a planning element that is also used as a tool to assess:

- in SEA, ecological network is used to evaluate the sustainability and compatibility of urban plan effect to biodiversity and ecosystem.
- in EIA, ecological network is used to evaluate the impacts, both positive and negative, that projects and interventions may generate on habitats and species.

Ecological networks can also be used as a reference for the location of mitigation and compensation works for urban plan or impacts generated by projects.

8. Implementation of the connectivity conservation and restoration areas

In the planning system provided for by the Urban Planning LR 36/1997 as amended, the Ecological Network is a mandatory content for PUC (Municipal Urban Plans). Since 2009, when the Ecological Network came into effect, most of PUC have been approved out of a total of 234 municipalities.

9. Implementation difficulties/opportunities

The lack of methodological homogeneity in the construction of the Ecological Network does not allow to compare the territories of the different provinces with each other and then to apply the same evaluative or analytical criteria to the whole regional territory that can consistently describe the region habitat conservation and thus the effectiveness of the Ecological Network.

In 2021 a further study, aimed at harmonizing the databases of municipal land use plans, revealed the conceptual difference in approach by individual provinces to the definition on the territory of ecological corridors, buffer strips, renaturation areas, high naturalness areas, this difference is most evident at many provincial boundaries.

10. Monitoring system

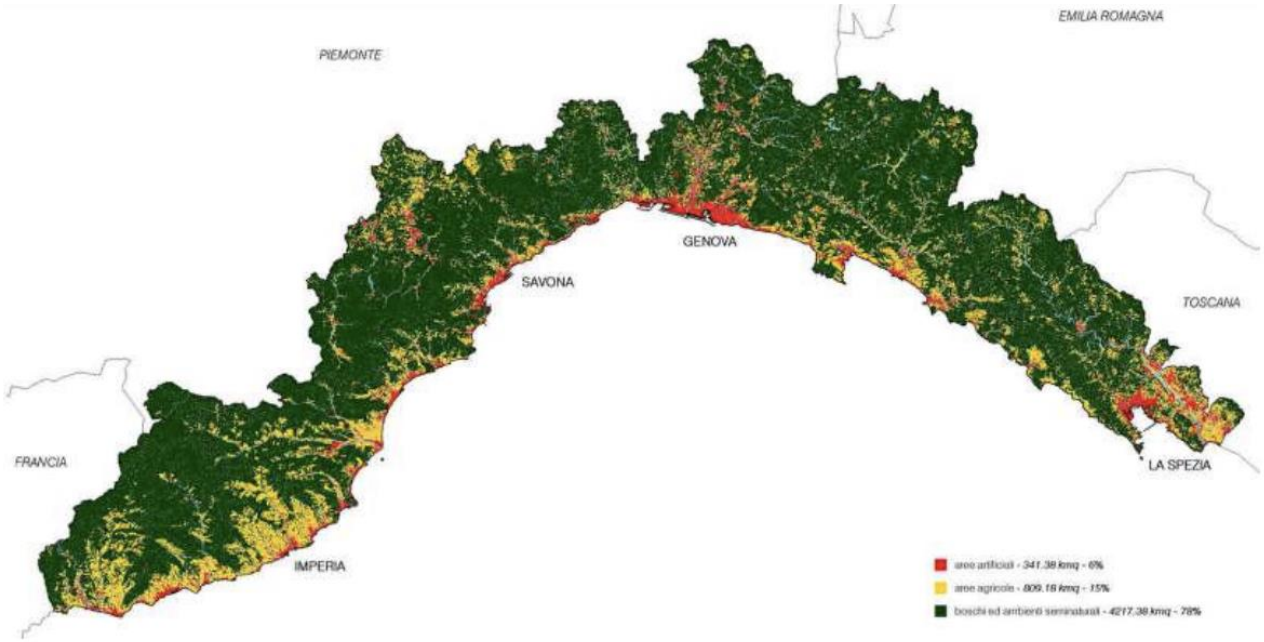
Law 28/2009, Art. 13 introduces Monitoring and Art. 14 the Regional Biodiversity Observatory.

To collect and organize data concerning the conservation status of habitats and species of community, national and regional interest, the Ligurian Observatory of Biodiversity managed by ARPAL, Libioss, deals alerts about species of interest. Nearly 3,500 animal and plant species and subspecies have been classified, with validated and georeferenced data collected by the various organizations operating in the Ligurian territory.

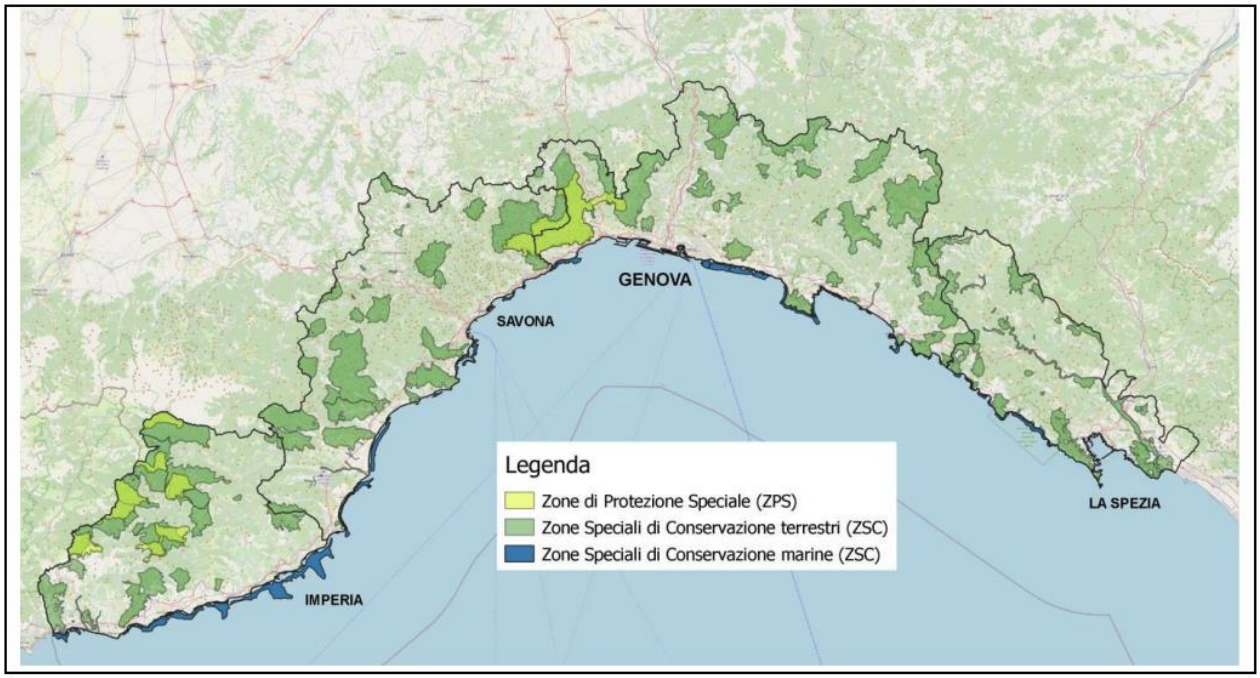
Environmental monitoring must be ensured in the environmental impact assessment process, with adequate operational methods to verify the effective environmental compatibility of the planned actions, also in relation to naturalistic aspects.

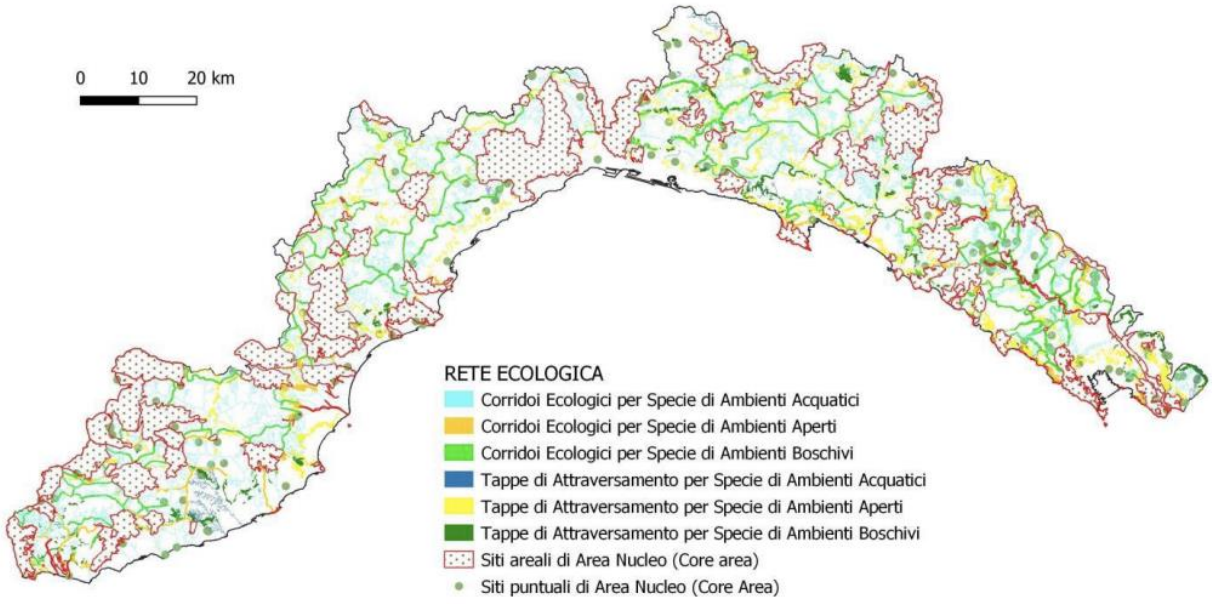
Monitoring, as provided for in Regional Committee Resolution no. 30 of 2013, must also verify the actual effectiveness of the mitigation measures to be able to correct their failure.

During the implementation phase of the interventions can be defined the more specific procedures of the monitoring of the implemented measures (directing the managers and other subjects involved in the monitoring activities of naturalistic character if necessary); in this forum can also be defined the feedback modalities that can be activated for any critical issues and any improvements of the interventions on naturalistic aspects.



Land use and forestry map in Liguria available at https://www.regione.liguria.it/components/com_publiccompetitions/includes/download.php?id=49814:rapporto-ambientale-ptr.pdf

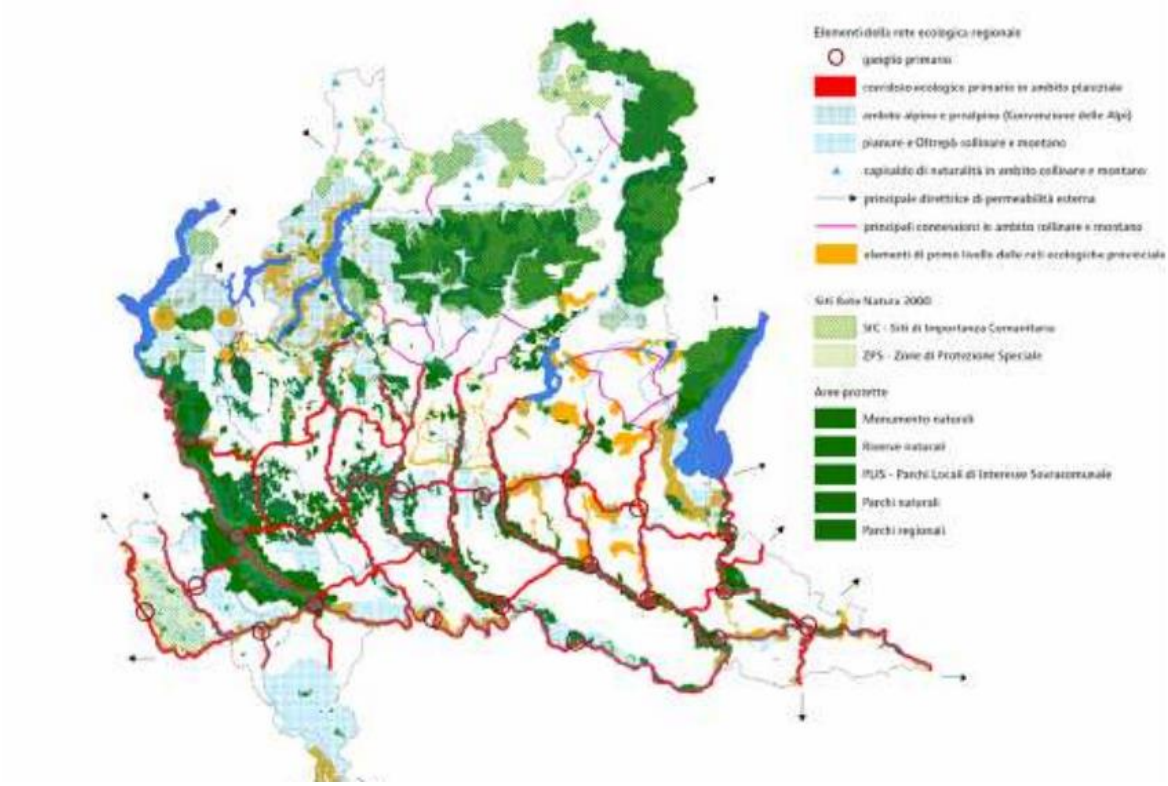




Natura 2000 sites and Ecological network maps in Liguria available at https://download.mase.gov.it/Natura2000/PAF/Liguria/PAF_Liguria_2021-2027.pdf

1.10 Lombardy

Regional Ecological Network by Fondazione Politecnico di Milano



Map of the Protected areas and the Regional ecological network as a main infrastructure of the Regional Territorial Plan

1. Network typology (check corresponding answer)

Protected area network and Ecological network plan

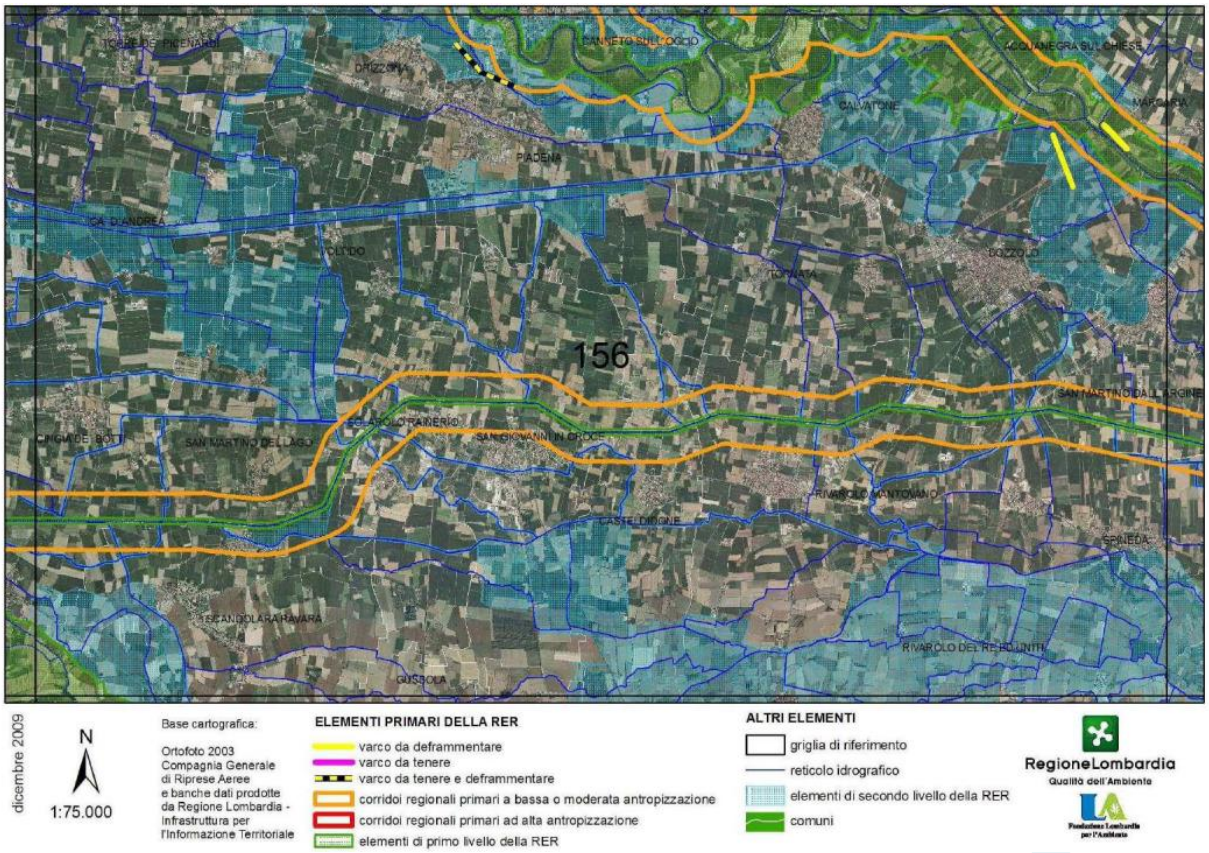
2. The ecological network and its legal framework of reference

The Lombardy region Protected Areas Network (Sistema delle Aree Protette Lombarde) was established through the Regional Law no. 86 of 1983, it has a subnational (NUTS 2) governance level. It provides binding regulations for the establishment and management of natural reserves, parks, and natural monuments, as well as areas of special natural and environmental importance. The system of protected areas is governed by the Regional Protected Areas Plan (Piano Regionale Aree Protette - PRAP), which includes one national park, 24 regional parks, 101 parks of supra-municipal interest, three national nature reserves and 67 regional nature reserves, 33 natural monuments and 246 Natura 2000 Network sites, 147 CIS, 67 SPZ and the Regional Ecological Network (RER). The network is part of a cascading planning system. It includes national parks and Rete Natura 2000 sites (defined at the European level). At the municipal level, more specific plans are implemented. The

PTR (Regional Territorial Plan, 2010) assumes the RER as a main GI infrastructure to be developed at the Provincial level by the Provincial territorial Plan (n. 11 Provinces and the Metropolitan area of Milan) and further exploited at the local level in the Land Use Plans (1506 municipalities). The PTR/PPR (Regional Territorial Plan/Regional Landscape Plan) foresee that the RER will be integrated with other components of the green system and open spaces, whether agricultural or of landscape value, natural or semi-natural, anticipating the EU GI concept (2013) also in terms of multifunctionality. The aim was to promote the integration between plans for the protection of areas of environmental importance and the spatial and landscape planning tools through a transcalar and comprehensive approach.

3. Network objectives

The main network purposes are the conservation, recovery, and valorization of the natural and environmental assets of the Lombardy territory, considering the local interests in economic and social development. In collaboration with the local authorities, the region implements the constitutional and statutory principles and coordinates their interventions, defining within the regional law the general plan of the protected areas of natural and environmental interest.



Example of Lombardy Region RER Primary level

4. Network structure and elements

The system of protected areas is governed by the Regional Protected Areas Plan (Piano Regionale Aree Protette - PRAP), which includes one national park, 24 regional parks, 101 parks of supra-municipal interest, three national nature reserves and 67 regional nature reserves, 33 natural monuments and 246 Natura 2000 Network sites, 147 CIS, 67 SPZ and the Regional Ecological Network. The protected areas identified by the plan are subject to the following protection regimes:

- natural parks, understood as areas with the characteristics outlined in Article 2, paragraph 2, of Law no. 394 of 1991 (framework law on protected areas), characterized by a high degree of naturalness and in any case intended for functions prevalently of conservation and restoration of natural features; the regulations outlined in Title III of Law no. 394/91 and Chapter II of this law apply to these areas
- regional parks, understood as areas that constitute a general reference point for the Lombardy community, are organized in a unitary manner, with preeminent regard for the needs of nature and environmental protection, cultural and recreational use, the development of agricultural, forestry and pastoral activities and other traditional activities that favor the economic, social and cultural growth of resident communities;
- nature reserves, understood as areas specifically designated for the conservation of nature in all its manifestations that contribute to the maintenance of the relevant ecosystems;
- natural monuments are individual elements or small areas of the natural environment of particular natural and scientific value, which must be preserved in their entirety;
- other areas of special natural and environmental importance that must, in any case, be subject to a protection regime.
- The RER scheme was approved with the Regional Act n. 8/10962/2009 composed by the following elements:
- Regional priority corridors with low or moderate anthropisation: directive provides for avoiding land transformations. In cases of strategic transformations for spatial needs, the maintenance of at least 50% of the section provided by the RER (500 m) is required;
- Regional priority corridors with high anthropisation: directive provides for avoiding soil transformations. In cases of transformations needed for strategic territorial needs, the Impact Assessment (Valutazione di Incidenza VIC) must be carried out to guarantee the maintenance of the global functionality of the Natura 2000 Network with the conservation of protected habitats and species and to identify the defragmentation interventions on the areas affected by compensatory renaturation interventions;
- First level elements and primary ganglions: directive provides for avoiding the reduction of regional relevant crossing points; the elimination of existing nature elements, the inclusion in “transformation areas” provided by Land Use Plans.

5. Methodology used in network and corridor design

A structural approach is followed to define the network elements. The entire process of determining the PRAP (Regional Protected Areas Plan), supported by the technical working group and the technical-scientific support of the Lombardy Environment Foundation, was

therefore based on a continuous comparison between the various parties involved (the Lombardy Region Green Systems and Landscape DG, the technical working group, the Protected Area management bodies), according to a method that provided for technical-scientific analysis and assessment phases alternating with participatory approach.

6. Tools and guidance for planners and practitioners

Handbook: Teniche e metodi per la realizzazione della RER available at https://www.regione.lombardia.it/wps/wcm/connect/325e1e9a-0cf2-4189-8f36-da30ccdb4295/Tecniche+e+Metodi+per+la+realizzazione+della+Rete+Ecologica+Regionale.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-325e1e9a-0cf2-4189-8f36-da30ccdb4295-lAHbXAG

Handbook: Buone pratiche per la rete ecologica. Un'opportunità per l'agricoltura lombarda available at https://www.regione.lombardia.it/wps/wcm/connect/7547a064-ac30-4f2e-a7b6-86a097c61a89/Buone+Pratiche+per+la+Rete+Ecologica+Regionale.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-7547a064-ac30-4f2e-a7b6-86a097c61a89-lAHbXA1

Project LIFE22-IPN-IT-LIFE NatConnect2030 - (January 2024 on) Integrated LIFE. Natural connections for Natu-ra2000 in Northern Italy to 2030. Regions involved: Lombardia 60%, Emilia-Romagna 52%, Piedmont 75%, Veneto 53%, Trento 70%. Available at https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE22-IPN-IT-LIFE-NatConnect2030-101104366/natural-connections-for-natura2000-in-northern-italy-to-2030

LIFE GESTIRE2020 is an experimental, innovative and integrated project for the conservation of biodiversity in Lombardy, available at https://naturachevale.it/il-progetto/life-gestire-2020/

Datasets from Geoportale Lombardia.

7. Specific provisions for connectivity conservation and restoration areas

Law No. 394 of 1991, the framework law on protected areas, sets fundamental principles for establishing and managing protected natural areas to guarantee and promote the conservation and enhancement of the country natural heritage.

The other elements that compose the regional ecological network in the same way are governed by a specific law, which is summarized together with the system of protected areas and Natura 2000 sites in the "Regional Ecological Network Master plan" (approved by Regional Committee Resolution no. 6447/2008). The core areas of the primary ecological network described by the decree are the areas of priority interest for biodiversity; the primary ecological corridors of regional level; the primary ganglions of regional level in the lowland area; the settlement crossings to be considered at risk for the purposes of ecological connectivity. The regional and sub-regional authorities responsible for planning and design take these elements and their protection into account when drafting the various planning and design instruments, as well as within the planned technical-administrative assessment processes.

In particular, the decree indicates precise rules to be provided for in planning instruments.

- For primary regional corridors with low or moderate anthropisation, it requires avoiding new transformations as an ordinary criterion. In cases of strategic transformations for spatial needs, at least 50 per cent of the section provided for by the RER (500m) must be maintained in each case.
- For primary regional corridors with high anthropisation it prescribes the avoidance of new land transformations as a general rule. In cases of transformations deemed strategic for territorial needs, these will be adequately justified through the implementation of the Impact Assessment procedure.
- For first level elements (and Primary Ganglia) the following should be avoided as a general criterion

• the reduction of the regional relevance gaps,
• the elimination of existing elements of naturalness,
• inclusion in 'transformation areas' provided for by the local planning tools.

According to the type of connective areas, protection regimes are arranged for compatible human activities within them, as stated in article 3, comma 12 of the Regional Law no. 30/1986. Violations of the prohibitions and mandatory requirements shall be prosecuted under administrative penalties. Specifics for Natura 2000 sites: local authorities carry out the impact assessment of all the interventions of the territorial government plan and its variants. A specific inspection prior to the plan adoption takes place, and subsequently, if necessary, updates occur according to the result of the strategic environmental assessment (VAS).

8. Implementation of the connectivity conservation and restoration areas

The territorial plan of the Lombardy Region (PTR) defines the implementation of the regional ecological network in its territory, specifically the implementation is made possible through the Provincial and Local Ecological Network projects that, based on a specific Document of Addresses, detail the regional network.

The perspective of the Lombardy ecological networks is a multifunctional one; in this sense they must be considered as an opportunity to rebalance the overall ecosystem, both for the government of the territory at various levels, and for multiple sector policies that also set themselves environmental requalification and reconstruction objectives. The legislative document (D.G.R. of 27 December 2007 no. 8/6415) provides for the interconnection of the Regional Ecological Network with the territorial planning tools. The opportunities for synergy and coherence could be implemented as a priority through the planning tools for the coordinated government of the territory defined by the regional law no. 12 of 11 March 2005, on the three scale levels:

- at a regional level with the Regional Territorial Plan and the Area Plans,
- at provincial level with the Provincial Coordination Territorial Plans,
- at municipal level with the Territorial Government Plans/General Regulatory Plans.

The Provincial Ecological Network (REP) is made up of the elements of a strictly ecological nature, in accordance with Article 24 of the Regional Landscape Plan, and in particular the

primary naturalistic structure; provincial nodes; provincial green corridors; and provincial level crossings.

The municipal ecological network (REC), in coherence with the overordinated levels of government of the territory, undertakes to provide an integrated framework of the existing naturalistic sensitivities, and an ecosystem reference scenario for the evaluation of strengths and weaknesses, opportunities and threats present in the governed territory. The constitutive elements of the REC are those reported above of the REP plus supplementary details such as additional protected areas; network nodes; ecological corridors and connections; ecological redevelopment areas; support areas; critical elements for the network.

9. Implementation difficulties/opportunities

In a multilevel planning system like the Lombard one, the main challenge regards the declination of the regional and provincial ecological network at the local level. In general, in land use plans, the design of the ecological network emerges more as the result of a regulatory compliance than as a local project that structures settlement principles and regenerate the environmental and landscape assets. Indeed, plans often struggle in designing an interconnected system composed of urban and extraurban open spaces and green infrastructures for the economic and touristic valorization of the territory. Specifically, another common challenge regards the effective realization of the local ecological network: (i) the presence of economic and individual interests may conflict with environmental conservation goals, preventing the necessary political and social support to effectively implement ecological networks, making participatory processes, and awareness-raising measures fundamental steps in the planning process; (ii) the land availability for the network realization poses the challenge of identifying in the plan complex mechanisms for the acquisition of the land (e.g. equalization measures). Especially in mountain areas a relevant constraint to the implementation of ecological networks regards the high fragmentation of private property (e.g. forests, wooded areas, lands used for alpine agriculture practices) that are crucial in the network design; (iii) the availability of financial resources to implement the network project represents another common challenge that require the preliminary identification, both at the supra-local and municipal level, of the possible measures to finance interventions (e.g., preventive ecological compensation, municipal funds dedicated to network project interventions, access to European and national funds dedicated to environmental conservation and biodiversity).

10. Monitoring system

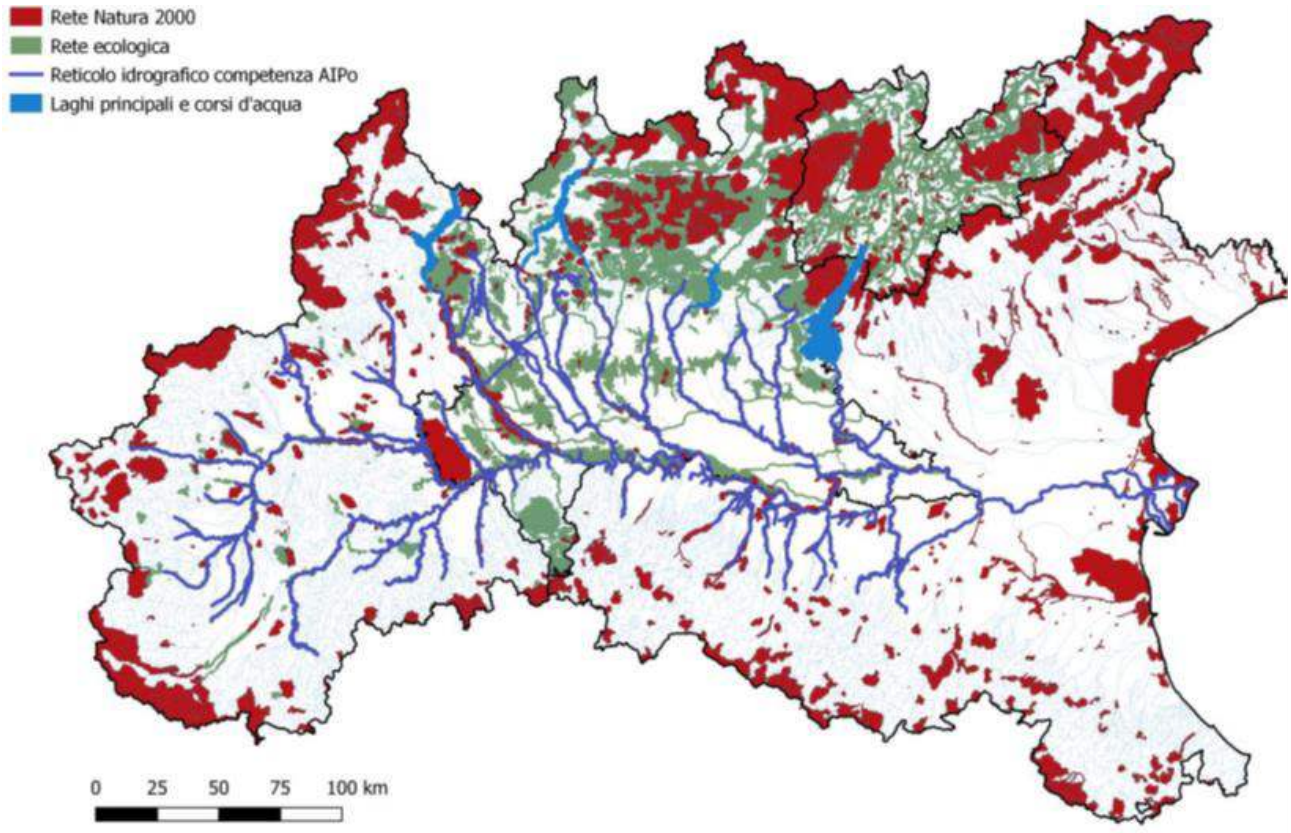
Concerning protected areas, every year, parks transmit monitoring data on technical-administrative activities and the conservation and enhancement of the natural and infrastructural heritage, as well as data on the parameters used to determine the annual operating contribution of the managing bodies. For technical-administrative activities, data are collected on the authorizations and opinions that the park authority issues in carrying out its institutional activities. Conservation and enhancement activities, on the other hand, are measured through data on collaborations with associations, farmers, the number of

students and citizens involved in environmental education activities, and through the number of assignments and supply, work or service contracts awarded.

Regarding the ecological network, the implementation of ecological networks at the different administrative levels could be measured and evaluated by a system of assessment indicators (see the following materials:

Regione Lombardia, Rete Ecologica Regionale. Programmazione territoriale degli enti locali at https://www.regione.lombardia.it/wps/wcm/connect/970c54d7-7ac2-4212-b6d2-7c8c1986e8df/Rete+Ecologica+Regionale+e+prog+terr+enti+locali.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-970c54d7-7ac2-4212-b6d2-7c8c1986e8df-n6HhYP5

Handbook: Tecniche e metodi per la realizzazione della RER https://www.regione.lombardia.it/wps/wcm/connect/325e1e9a-0cf2-4189-8f36-da30ccdb4295/Tecniche+e+Metodi+per+la+realizzazione+della+Rete+Ecologica+Regionale.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-325e1e9a-0cf2-4189-8f36-da30ccdb4295-lAHbXAG)

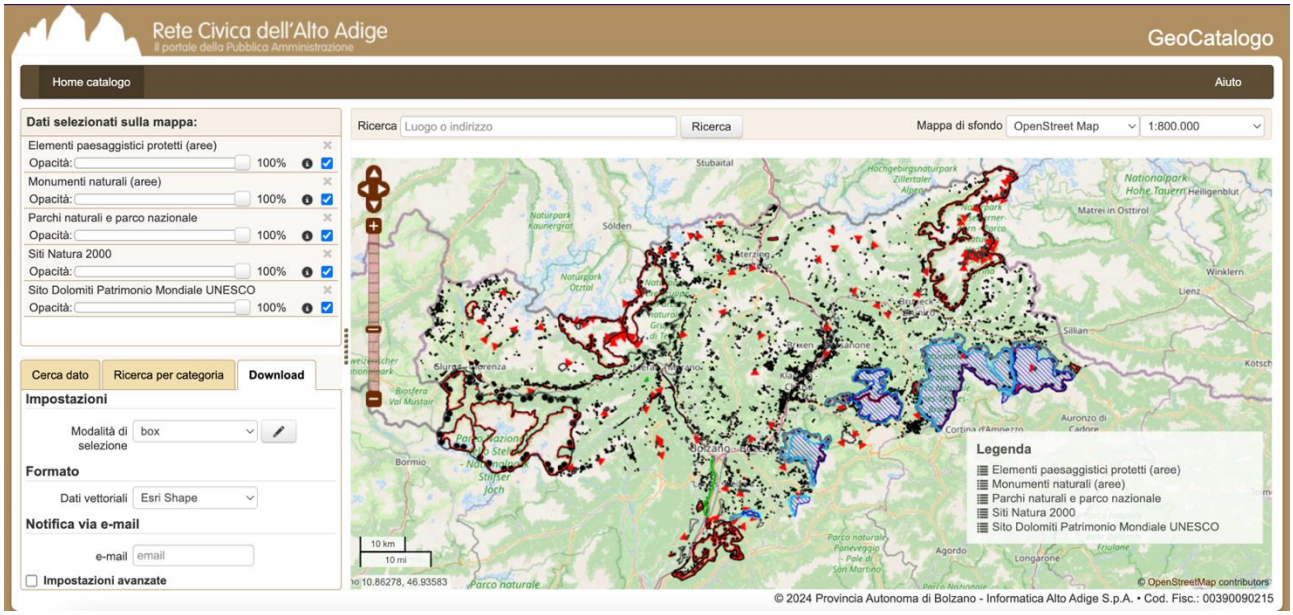


Lombardy Region ecological connectivity outline

Lombardy Region RER main scheme

1.11 Authonomous province of Bolzano – South Tyrol

Protected area network by EURAC Research



Ecological Network shapefiles available at Geoportale Provincia Bolzano

1. Network typology (check corresponding answer)

Protected area network

2. The ecological network and its legal framework of reference

The Autonomous Province of Bolzano - South Tyrol, (hereinafter referred to as "South Tyrol") is a NUTS 2 and NUTS 3 region at the same time, due to its Autonomy status.

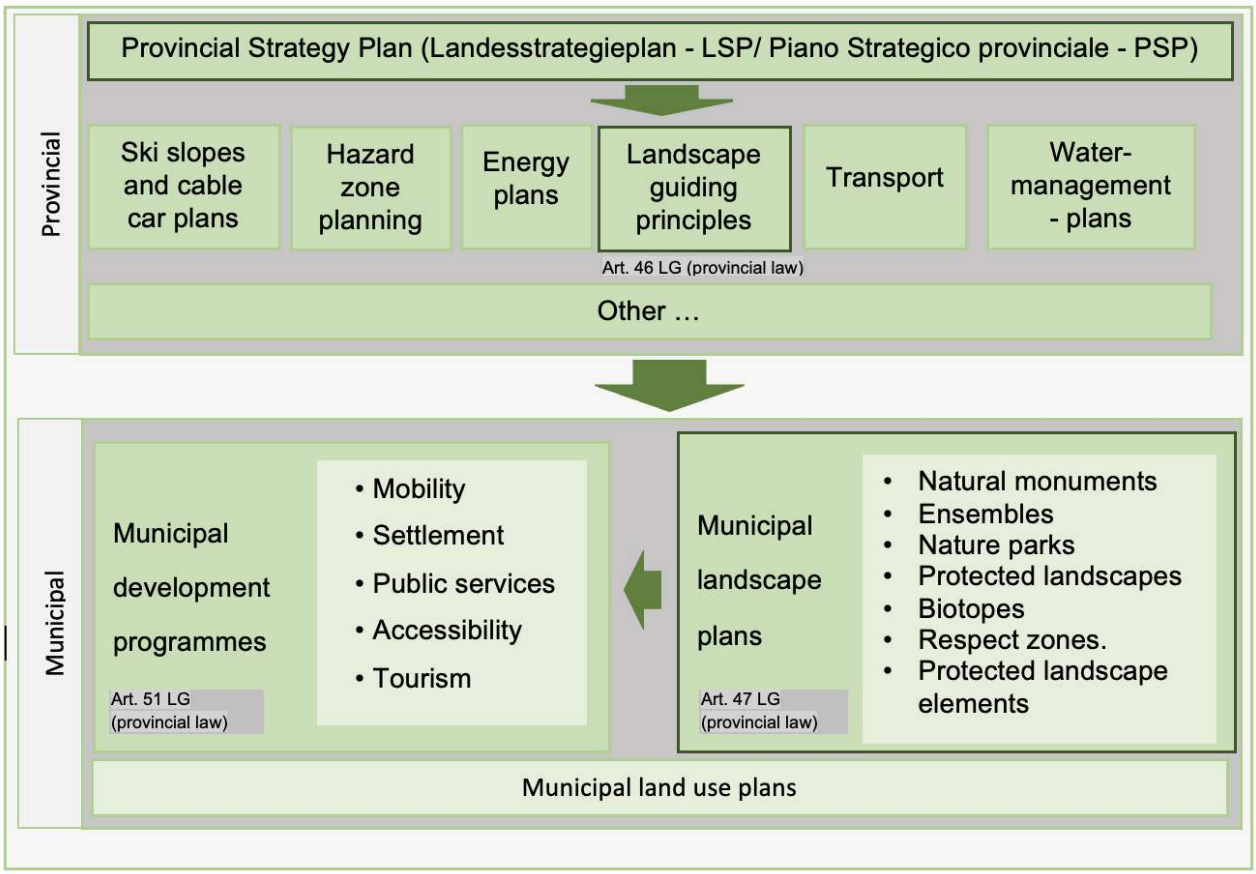
The relatively new provincial spatial planning law of South Tyrol (provincial law 9/2018 "territory and Landscape") recognizes existing GBI elements, which are already present in the landscape and gives them a legally binding character. A study about the current state of structural ecological connectivity was conducted in 2022 in course of the Interreg Alpine Space LUIGI project by the Institute for Alpine Environment of Eurac Research and another one about local wildlife passages in 2015 by the Provincial Office for Landscape Planning, but without legal binding.

South Tyrol is one of the last areas in the Alpine Space which have no ecological network concept at regional or provincial level that is provided by a public authority. The specification of an ecological network at regional level is missing in spatial planning instruments. There is no spatial planning document by now (March 2024), which takes over existing analysis on the ecological network at regional level, to give them a legally binding and a programmatic character.

The new “Provincial Strategy Plan” (PSP), elaborated under coordination of the Provincial Planning Office, is currently in phase of review and approval, and it will probably mention the establishment of ecological connectivity as one of the main objectives under the macro-topic of “Biodiversity”. This could lead to a more binding character for all municipalities. The PSP is defining sectoral plans, of which one will be the Landscape Guiding Principles, that could define more detailed specifications regarding ecological connectivity at provincial level.

However, by now, most of the legally binding ecological network elements are included in the municipal landscape plans and have protective function but they are not following a provincial concept and there is no projected potential network.

By now (March 2024), the informal studies regarding ecological connectivity at provincial level are considered by spatial planning offices for the elaboration of municipal development programs or their evaluations within the Strategic Environmental Assessments. Ecological connectivity is increasingly considered by planning practitioners within the elaboration of development programs because the informal guideline for their elaboration is mentioning this topic (Autonomous Province of Bolzano - South Tyrol, 2024).



Scheme for the planning system in South Tyrol:

Some municipalities are elaborating an in-depth landscape analysis on voluntary basis because planning costs are funded by the province to 80%. The pre-condition is that the program will be elaborated through a collaboration of municipalities (more than 1) and that a specific topic is chosen. The topic of an in-depth landscape analysis is chosen by 38 (out of 116) municipalities, therefore they obliged themselves to perform detailed analysis on “Natural environment and ecology”, “Landscapes characterized by agriculture and forestry, and traditional cultural landscape”, “Landscape and nature experience - Recreation close to nature”, and “settlements”. (Autonomous Province of Bolzano - South Tyrol, 2023). Within the topic “natural environment and ecology”, an analysis on ecological networks and its barriers, as well as the identification of opportunities for large-scale nature corridors in the scenario-part is required. These requirements are mentioned in technical guidelines.

3. Network objectives

The main objectives of the spatial planning law are only mentioning the protection and enhancement of the landscape and natural resources, (Provincial Law 9/2018, Art.2, Abs. 1, lit. c.). The future Provincial Strategy Plan will probably mention the general objective to “make the protection and conservation of biodiversity and ecosystems effective”. The specific objectives will be in line with the European Biodiversity Strategy 2030 and define two objectives:

- Increase the amount of the provincial protected area to at least 30% by including strategic areas for ecological connectivity by 2030.
- “To protect and to expand provincial ecological corridors and to connect them to the European ecological network”.

Ecological functions to counteract climate change will be probably mentioned, but not directly referring to ecological connectivity.

4. Network structure and elements

Following elements are protected in any case by the spatial planning law (Article 12):

Lakes and a surrounding buffer area of 300 m, Rivers, streams, and watercourses with a buffer of 150 m, mountain areas above 1.600 m, glaciers, the Stelvio National Park, nature parks and nature protection areas (nature conservation areas), forests, wetlands, archeological sites.

The municipal landscape plans define areas at local level that are covered by “landscape protection” (Article 11). The current legally defined network recognizes existing GBI elements:

- “Natural monuments”, “Nature parks”, “Biotopes” and “Protected landscape elements” are the most important elements for the ecological network. Especially the protected landscape elements are corresponding to areas outside protected parks or biotopes which should serve for ecological connectivity. It is defined that protected landscape elements “are parts of the landscape that contribute to biodiversity and landscape diversity as well as to the ecological stability or permeability in the biotope network”.

- "Protected landscapes", and "Landscape respect zones" contribute indirectly to ecological connectivity. Landscape respect zones are foreseen for the protection of agricultural areas, to avoid fragmentation. However, they are mainly used to protect agricultural areas in the valley bottoms and have mostly inappropriate land use characteristics. Just in one case, a landscape respect zone is contributing to forest connectivity. Protected landscapes can have a natural value, but in most cases, they protect the beauty of the landscape.
- Protected areas that can be defined in landscape plans, which are less important for ecological connectivity at large scale are ensembles, gardens and parks, and landscape viewpoints.
- Natura 2000 sites outside protected areas, according to the provincial nature protection law (Provincial Law no. 6 of 2010).

The national park has a transregional characteristic and nature parks have an intermunicipal characteristic. Although protected landscape elements are not following a provincial concept, interlinkages across municipalities are mostly considered, because they are mapped by a structural approach of existing GBI elements. A provincial dataset exists where all landscape elements are mapped, but there is no explicit prioritization regarding the protection of GBI elements.

5. Methodology used in network and corridor design

Landscape plans on municipal level are primarily drawn up by the Landscape Planning Office. Landscape elements within these plans are first identified by analyzing aerial images. In a second step, these analyses are checked, confirmed, and evaluated with site visits. A structural approach is primarily pursued here. Protected landscape elements can consist of hedge rows, water courses, groups of trees, riparian forests, chestnut orchards, dry grassland, and wetlands. However, only wetlands and dry grasslands are protected by the provincial nature protection law. Other GBI elements are not defined by law and have rather a historical tradition to consider them in the landscape plans. A functional approach is not followed.

6. Tools and guidance for planners and practitioners

The province of South Tyrol is providing a WebGIS service called GeoBrowser Maps, where data for protected areas and protected landscape elements are provided on a provincial level for viewing the data. The data are findable under "Planning", "Landscape planning".

The additional service of the GeoCatalogue makes it possible to download geodata available in the Autonomous Province of Bolzano - South Tyrol. All types of protected areas, as well as Protected Landscape Elements are downloadable under the category "Basemaps and planning", "Spatial planning and cadastre". However, the reference to the provincial law is hardly findable, which can be considered as a current information gap.

At local scale it exists a landscape inventory. It provides basic information on nature and landscape for further planning, project assessment and restoration projects. Landscape inventories record all near-natural landscape elements within the intensively cultivated landscape, e.g. hedges, or woody features, etc. The survey team commissioned by the

municipality enters the landscape elements on a map, assesses the ecological and landscape characterizing value, the floristic composition and the condition on site and proposes concrete measures for preservation, maintenance, and enhancement. However, this tool only has a recommendatory effect for project evaluation, it is almost outdated, and the elaboration of the inventory was not carried out by each municipality, so it is incomplete.

7. Specific provisions for connectivity conservation and restoration areas

The identification of an existing forest area, also in valley bottoms which can serve as stepping stones, e.g., is always a reason to assign a protection category to the area. However, there is no explicit legislative provision that apply to connectivity areas. Environmental impact assessments are not foreseen for protected landscape elements and landscape respect zones.

8. Implementation of the connectivity conservation and restoration areas

Currently, there is no multi-level planning system for ecological connectivity existing in South Tyrol. Planning and implementation are mainly happening at local level, without a superordinate provincial concept. The new Provincial Strategy Plan will probably define objectives regarding ecological connectivity at provincial level, which will be superordinated, however, it is not yet clear, if they will be defined cartographically.

Recently, the first green bridge was planned as a compensation measure for the extension of the state road in Pusteria Valley. It is planned at a road section where most of the animal-vehicle- collisions in South Tyrol take place. However, these are single implementation measures not following a provincial concept.

Reflectors were installed at dangerous road sections in the whole province, where the most wildlife accidents occur. However, these measures are implemented to prevent car accidents and to keep wildlife away from roads, instead of improving connectivity for them.

Restoration projects are single cases and not targeted in the sense of a regional network. Such opportunities can occur for rivers, or when areas in the valley bottom are available for purchase that could be interesting for establishing stepping stones. However, these opportunities are rare.

9. Implementation difficulties/opportunities

Obstacles, gaps and inconsistencies in corridor planning:

- Landscape plans are drawn up for individual municipalities. Protected landscape elements are recorded according to their actual existence and entered in the landscape plan. If they exist across borders, they are entered in this way, but there is no coordination.
- The planning of protected landscape elements is not coordinated among municipalities, however existing landscape elements.
- Environmental compensation measures are not coordinated and are not following any priorities at provincial level, which makes it difficult to follow a general concept.

- As there is no official ecological network plan at regional level, municipalities are starting to plan their own network, with the risk of losing the chance to create a coherent regional ecological network.
- Implementation challenges:
- Regarding the impact of the analysis carried out for the landscape inventory on planning depends very much on the municipality and the political will.
- There are examples where political pressure has led to the prevention of nature conservation measures. Farmers' organizations, for example, have prevented the creation of a biotope, even though suitable land would have been made available by the landowner.
- For the implementation of the Nature Park Alps of Sarentino e.g., which is in the center of South Tyrol, there is a missing political will from the side of the municipalities.
- The Office for Landscape Planning in charge of protecting areas outside nature parks and biotopes has little resources. It has no monetary resources to buy land and little personal resources.
- Perspective to improve the ecological network:
- The provincial strategy plan could be a chance to define the most important objectives.
- Upgrade of existing or development of new tools to implement the network:
- The landscape planning office sees as an important step to provide data and information and to identify ecological corridors on a scientific basis.
- The Regional Connectivity Working Group sees the GeoBrowser as an important instrument for providing information regarding a potential ecological network in South Tyrol. An improvement of the GeoBrowser would be a direct link of the provided data to the respective law or planning instrument.

Suggestions to improve the planning instruments:

- Guidelines for new spatial planning instruments were elaborated in the last years, which recommend for the first time to consider ecological connectivity in spatial plans at local level.
- It is highly recommended to elaborate a provincial potential ecological network and to make it legally binding for municipalities. The Landscape Guiding Principles, which are a sectoral plan at provincial level, defined by the Provincial Strategy Plan, could contain such a provincial ecological network. Such a provincial network would be useful to coordinate e.g. compensation measures.

10. Monitoring system

A monitoring system is not yet available in any form. Employees of the Landscape Planning Office are monitoring the landscape in their daily work, but there is a lack of time for a real monitoring.

Bibliography

Autonomous Province of Bolzano - South Tyrol, (2023). Collaborazione intercomunale nel settore del paesaggio nell'ambito dell'elaborazione del programma di sviluppo comunale per il territorio e il paesaggio. Catalogo dei criteri per l'elaborazione di un programma di sviluppo

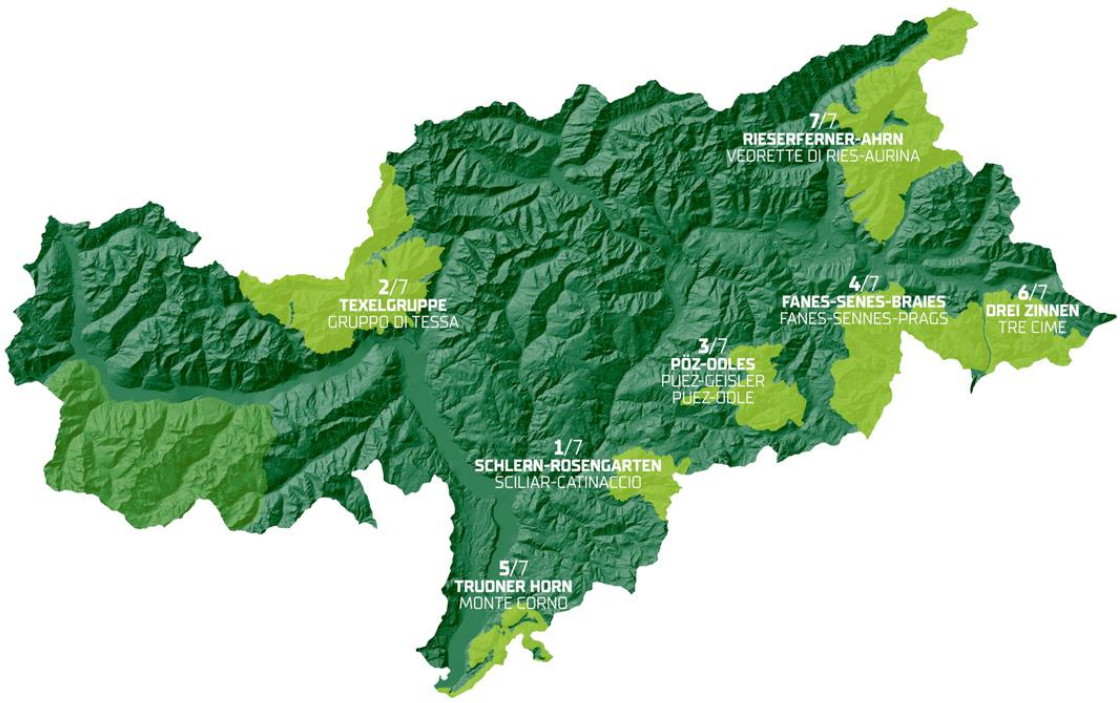
del paesaggio approfondito. https://assets-eu-01.kc-usercontent.com/e90ea1ed-9101-0155-579f-5243d49e1f43/5becc07e-53ed-4b62-96d0-9a05899bb010/GProRL_Kriterienkatalog%20Landschaft.pdf, 06.03.2024

Autonomous Province of Bolzano - South Tyrol. (2024) [1]. Linee guida tecniche per l'elaborazione del pro-gramma di sviluppo comunale per il territorio e il paesaggio (PSCTP). https://assets-eu-01.kc-usercontent.com/e90ea1ed-9101-0155-579f-5243d49e1f43/30da92c1-4a1f-4788-8b2c-ba201d24b44d/Leitfaden%20GProRL%20-%20Linee%20guida%20PSCTP.pdf, 06.03.2024

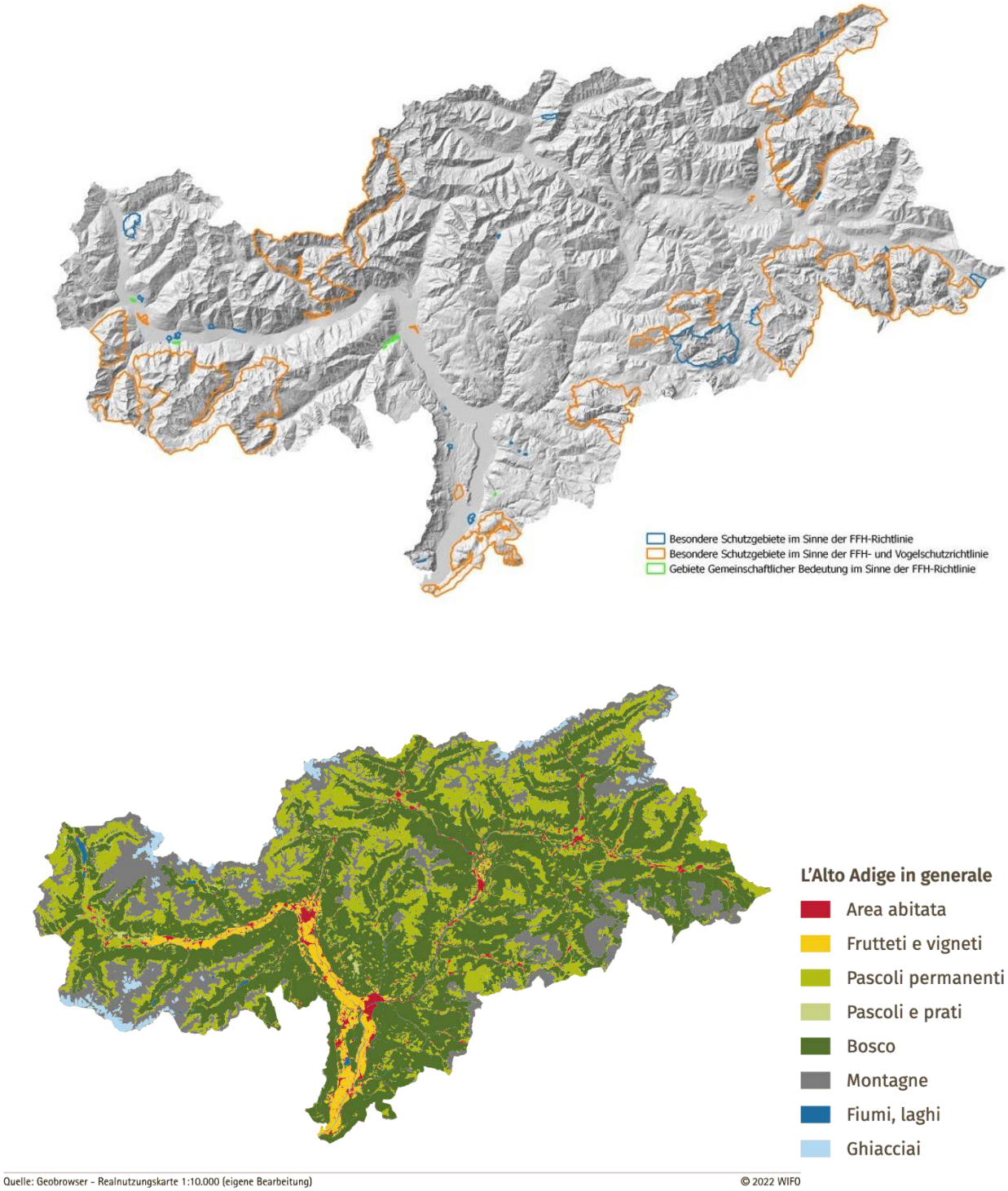
Autonomous Province of Bolzano - South Tyrol. (2024) [2]. Natura, paesaggio e sviluppo del territorio. Cartografia provinciale. https://natura-territorio.provincia.bz.it/it/geodati-e-webgis

Provincial law 9/2018. Testo coordinato con le modifiche introdotte. situazione al 9 giugno 2023. https://assets-eu-01.kc-usercontent.com/e90ea1ed-9101-0155-579f-5243d49e1f43/eea1a7ae-4d6f-4fe2-b0ef-ae1926bc6330/Koordinierter%20Text%20Landesgesetz%20vom%2010.%20Juli%202018%2C%20Nr.%209.pdf

Provincial law 6/2010: Legge di tutela della natura e altre disposizioni. http://lexbrowser.provincia.bz.it/doc/it/lp-2010-6/legge_provinciale12_maggio_2010_n_6.aspx?view=1



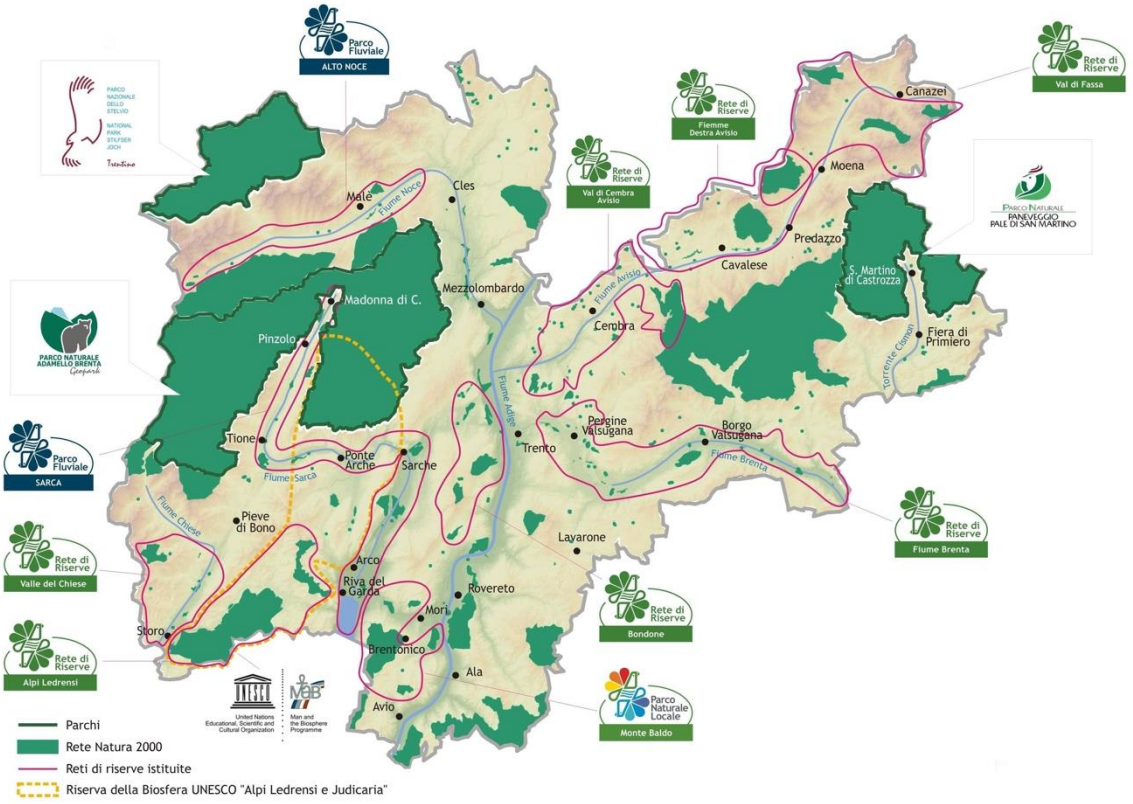
Natural parks in South Tyrol



Natura 2000 sites and land use in South Tyrol

1.12 Authonomous province of Trento

Protected area network and Ecological network by EURAC Research



Reserves and Parks Network in Provincia di Trento

1. Network typology (check corresponding answer)

Protected areas network and Ecological network plan

2. The ecological network and its legal framework of reference

The Autonomous Province of Trento, (hereinafter referred to as “Trentino” - PAT) is a NUTS 2 and NUTS 3 region at the same time, due to its Autonomy status.

It has an extension of over 620,000 hectares, of which more than 30% are protected: a national park, two provincial nature parks, 135 sites belonging to the Natura 2000 Network and 46 provincial nature reserves (PAT, 2021).

The concept of ecological network finds a specific reference in the legislation on protected areas, and a generic reference in the legislation concerning territorial governance (ISPRA, 2010).

Ecological corridors are not included in the provincial legal framework but are only an indicative analysis, nevertheless widely used by provincial offices.

Provincial Law n. 11/2007, introduced the “Networks of Reserves” with the aim of designing the Local Ecological Network system, through which Trentino biodiversity is enhanced through decentralized management involving local communities according to the principle of ‘responsible subsidiarity’. This officially designed “Trentino Multipurpose Ecological Network” includes all parks, all sites of the ‘Natura 2000 Network’ and the ‘Territorial Areas of Ecological Integration’ (AIE).

To implement the contents of the Provincial Law, and to develop the European vision of the Natura 2000 Network, in 2012 the Life+ T.E.N. (= Trentino Ecological Network) project was launched, which aimed to arrive at the definition of a Provincial Ecological Network, included in the broader mosaic of the Alpine ecological network. The Life+ T.E.N. designed unofficially the first Trentino Networks of Reserves scheme and governance system (the core of the Provincial Ecological Network), recently amended through Provincial Law 6/2021, and the promulgation of the Deliberation of the Provincial Council 26 August 2022, n.1512. The project final main results are now officially used for the renewal of the provincial spatial instruments (March 2024).

The Ecological Network is also considered in the Provincial Urban Plan (PUP) (currently under updating, March 2024) as Ecological and Environmental Networks System, included as an invariant element (PAT, 2024).

Consequently, it is also part of the 16 Community Territorial Plans, introduced by Provincial Law No. 1/2008, configured as the instrument to define, from an urban and landscape point of view, the strategies for a sustainable development of the different Trentino valleys territorial areas. One of the main tasks for these plans is the deepening of the indications of the PUP for ecological and environmental networks.

3. Network objectives

The main objectives of the Provincial Urban Plan, in accordance with the provisions of Provincial Law no. 1 of 4 March 2008 (Urban Planning and Government of the Territory) mentioning directly or indirectly the ecological connectivity are:

- guaranteeing the valorization and reproducibility of the system of territorial resources of the province, with respect for the environment and in order to pursue the realization of sustainable and durable development consistent with the principle of responsible subsidiarity;
- to define the reference framework for the approval of community territorial plans, the general regulatory plans of municipalities and other territorial planning instruments of a sectorial nature, as well as the territorial and environmental framework for socio-economic planning.

The map of the ecological and environmental networks of the PUP contains the specific regulation for the provincial territory; it identifies the areas within the Networks of Reserves suitable for interconnecting spaces and natural resources both within the provincial territory and in relations with surrounding territories, to ensure ecosystem functionality and in particular the migration and dispersion movements necessary for the conservation of biodiversity and habitats.

The specific objectives are in line with the European Biodiversity Strategy 2030, but do not explicitly include for the ecological network the guarantee of the maintenance of ecological processes/functions/services.

4. Network structure and elements

Ecological and environmental networks of the Trentino PUP consist of:

- Water resources, for the protection of water resources, the general plan for public water use and the provincial water protection plan, as well as other sectoral regulations, apply.
  - Protection of selected wells and springs,
  - Lake protection areas,
  - River Protection Areas,
- High naturalness areas
  - High nature areas are the sites and areas of the 'Natura 2000' network, nature parks, provincial nature reserves and local reserves identified in accordance with the regulations on protected areas.
  - High integrity areas consist of glaciers, rocks and wooded cliffs.
  - Subject to the provisions of this section, for the protection of high-nature and high-integrity areas, sector regulations apply.
- Natura 2000 sites and areas,
- Nature Protected Areas,
- Reserves,
- Areas of high integrity
  - Areas of high integrity are characterized by the presence of glaciers and wooded rocks and cliffs that, as areas of low or absent anthropisation, for altimetric, topographical and geomorphological reasons, soil nature and accessibility, cannot normally be affected by activities involving permanent settlements.

For the exact perimeter and specific regulations concerning the protection and use of the aforementioned areas, the specific provincial provisions on the subject, identified by specific provincial laws, apply.

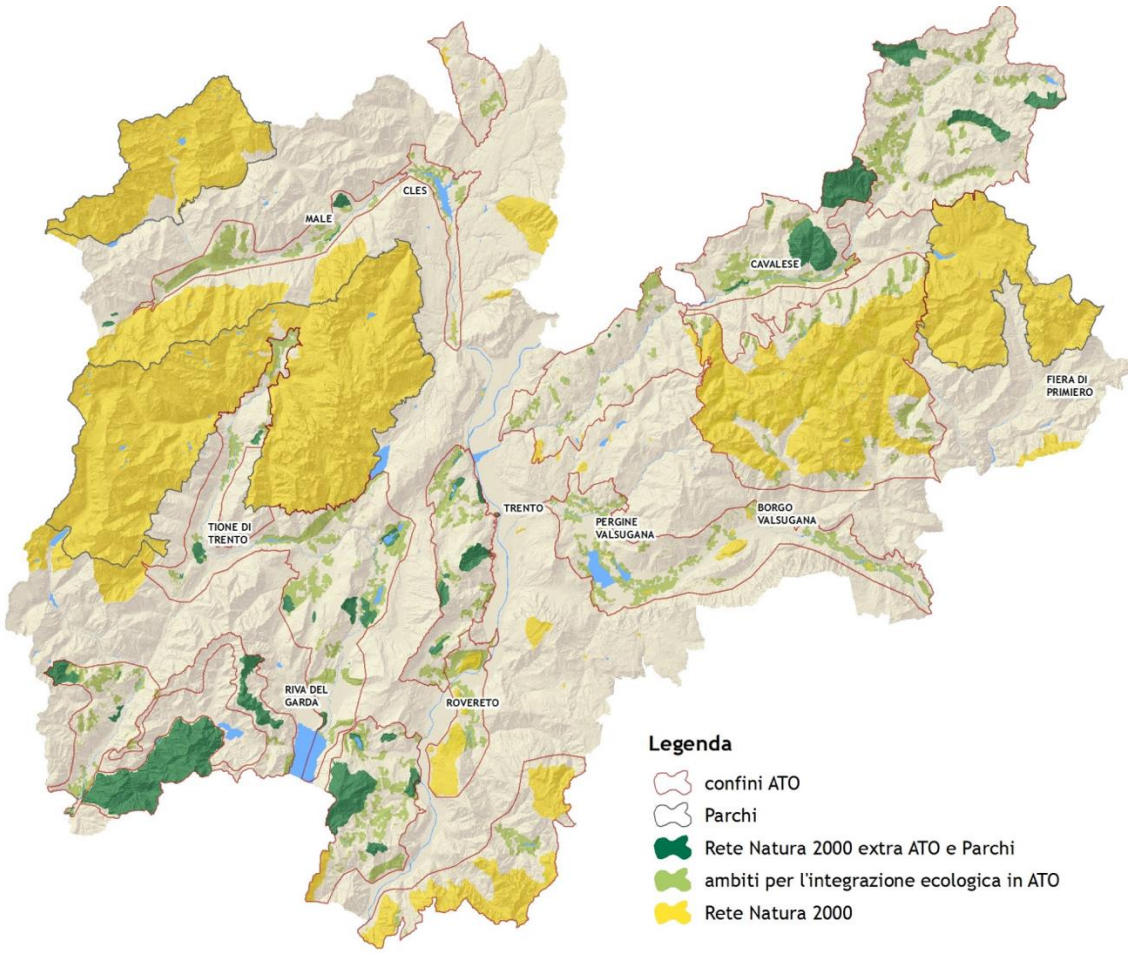
5. Methodology used in network and corridor design

The Life+ T.E.N. project was dedicated to the design of the ecological network. In 2012, this project developed an extensive ecological and structural database.

Thanks to this knowledge, and in accordance with criteria of naturalistic, administrative, and geographical uniformity, a territorial system of 14 'Homogeneous Territorial Ambits' (ATOs) was defined. In this system most of the sites of the Natura 2000 Network and other protected

areas present in the provincial territory were made to fall, seeking to favor their connectivity, forming the backbone of the actual provincial Multipurpose Ecological Network.

Each of these 14 areas, which involve the territory of different municipalities, constitutes a sort of “hatchery” for the establishment of new Networks of Reserves (art. 47 L.P. 11/2007), which may take place on the basis of a voluntary choice by the institutions involved.



Connectivity map (LIFE project, 2017) for the planning system of Provincia di Trento

Then, the project, thanks also to the development of specific spatial planning tools in the fields of agriculture, tourism, landscape protection, infrastructure management and forest management, developed a provincial-specific inventory of active protection and connectivity reconstruction actions.

Thus, specific guidelines for the definition of active conservation inventories, i.e. those forms of active conservation, defined for each homogeneous territorial area identified during the project, were drawn up.

As main result, a provincial General Inventory, which defines an overall framework at the provincial level of the active protection and restoration of ecological connectivity actions, with the quantification of implementation costs, the definition of a financial timetable over 12 years, and the identification of possible funding sources, was elaborated. This general inventory, an essential tool for the medium-long term management of the Multipurpose Ecological Network and specifically of the Trentino Natura 2000 Network, summarizes the data of: 14 active protection inventories for as many Homogeneous Territorial Areas; 3 inventories for the areas falling within the three Trentino Parks (Trentino Stelvio National Park, Adamello Brenta Nature Park, Paneveggio - Pale di San Martino Nature Park); 1 inventory for the Special Areas of Conservation bordering the Adamello Brenta Nature Park; the individual inventories of management actions drawn up for the remaining Natura 2000 Network sites.

Subsequently, the first unofficial ecological network was identified following an in-depth analysis of the provincial territory carried out by provincial research centers with the support of the provincial offices, to high-light both the main connections between the sites of the Natura 2000 Network and the presence of ecological fragmentation barriers. Distribution and abundance models were developed for the most valuable species (of community interest, threatened on a continental and local scale, and/or biological indicators) and the distribution (source) areas with the greatest environmental and potential suitability for them and their associated biological communities were identified.

6. Tools and guidance for planners and practitioners

The technical documents and guidelines of the Life+ T.E.N. project can be downloaded from the website www.lifeten.tn.it , a site from which it is possible to access also the documents and the database of flora and fauna species of Community interest and threatened in Trentino (WebGIS Life+ T.E.N.).

Updated information on Networks of Reserves with documents and guidelines are uploaded at the dedicated provincial webpage: https://www.provincia.tn.it/News/Approfondimenti/Sistema-delle-Reti-di-Riserve-la-situazione-attuale#

The actual ecological network map is present in the Trentino Geocartographic Portal, under the theme ‘Urbanism’ and the specific layer ‘Ecological and environmental networks’. https://webgis.provincia.tn.it/wgt/mobile.html?lang=it&topic=5&bgLayer=sfondo_urb&layers=ammcom,sic,zps,habitat,reti_eco_ambientali&X=5108537.10&Y=652507.20&zoom=3&layers_opacity=1,0.7,0.8,0.5,1&catalogNodes=21; Official legend: http://www.urbanistica-dati.provincia.tn.it/pupnew/legende/reti_ecologiche.pdf

The specific references in the Provincial Urban Plan, are located in the Annex B, “IMPLEMENTATION RULES” http://www.urbanistica.provincia.tn.it/ binary/pat_urbanistica/normativa_pup2008/allegato_B_norme_di_attuazione.pdf , specifically in the Article 19 “Contents of ecological and environmental networks” and Article 27 “Reserves”.

7. Specific provisions for connectivity conservation and restoration areas

The Province of Trento has an office for Biodiversity and Natura 2000 Areas, whose tasks include taking care of the promotion and impulse actions of the provincial ecological network, ensuring, in particular, the necessary technical support to the structure it belongs to, as well as to the local authorities for the activation, planning and management of the reserve networks.

There is no explicit legislative provision that apply to connectivity areas. However, general references can be found in the Provincial Law n. 11/2007. Moreover, specific provisions for connectivity conservation and restoration areas are part of the main results of the Life+ T.E.N. project.

8. Implementation of the connectivity conservation and restoration areas

Ecological and environmental networks are part of the Trentino PUP, identified by provincial law and following the results of the LIFE TEN project. They are therefore considered in Community Territorial Plans - subordinate instrument of the PUP - and mandatory transposed by the municipal urban and territorial plans.

In 2016, the Trentino Network of Reserves system was nominated for the European Sustainable Tourism Charter.

Following the adoption of the Reserve Network, some nature restoration measures, one of the types of active management and renaturation of provincial nature reserves, are implemented. They may consist of:

- Removal of elements of environmental disturbance, such as landfills and roads - In some Reserves, at the time of establishment, considerable damage had already been inflicted due to the construction of infrastructure such as roads or landfills. Whenever possible, these sources of disturbance (also aesthetic) were removed, recovering the lost environments. E.g. Lake Ampola, Roncegno, Taio di Nomi, Lake Pudro, Palù di Tuenno.
- Renaturation of lake shores - The lakeshores have been extensively modified for tourist-bathing use, through the removal of vegetation, consolidation with stones and gravel and the creation of paths. In these situations, the Reserves have intervened by reshaping the profile of the shoreline, removing discharged materials and encouraging the development of typical vegetation. Examples: Lake Ampola, Lases, Prà dell'Albi-Cei.
- Renaturation of watercourses - some stretches of watercourses in the Reserves suffered heavily from canalisation and "cementing" operations carried out in the past. In order to restore these environments to their ecological functions, including their role as habitats for flora and fauna and their function as water purifiers, the banks were remodelled and the watercourses were given new spaces by reconstructing a more natural environment. Examples: Inghiaie, La Rupe, La Rocchetta.
- Restoration of the water table level in peat bogs subject to drainage - In peat bogs that had been subjected to drainage works in the past, the original water table level was restored by plugging the artificially created "holes" with peat fill. This prevented the rapid desiccation of the peat bog, which would have irreversibly upset its delicate balance. Examples: Palù Longa and Palù Tremole.

- Reconstitution of hygrophilous woods - The hygrophilous woods of black alder, white alder and willows, typical of the wetlands on the banks of lakes and watercourses, are valuable but unfortunately increasingly rare environments. In biotopes, when suitable environmental conditions are in place, attempts are made to reconstitute these important habitats by planting nursery stock and cuttings, which, due to their particularly rapid development, are able to form new woodland formations in just a few years. Examples: La Rupe, La Rocchetta, Roncegno, Borghetto.

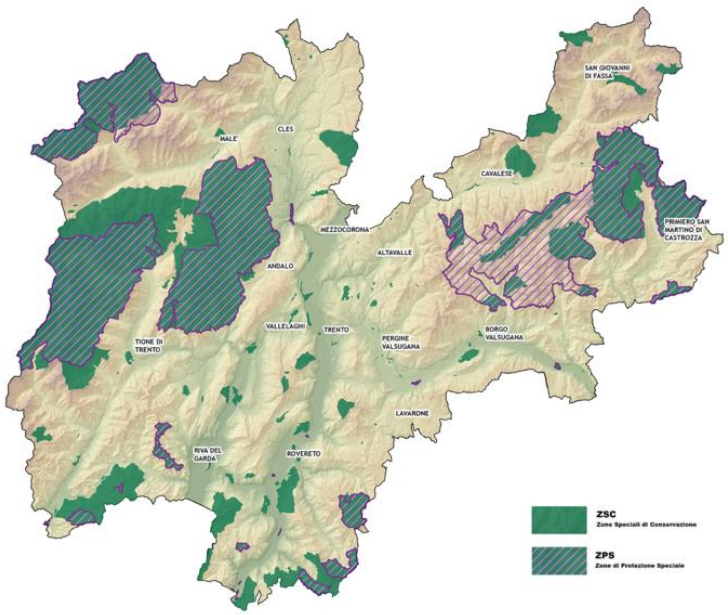
9. Implementation difficulties/opportunities

The main problems to the implementation of the provincial ecological network in Trentino are due to the large human infrastructural barriers such as the railway network, the motorway and main road network and the main agricultural landscape with high added value for the local and national economy.

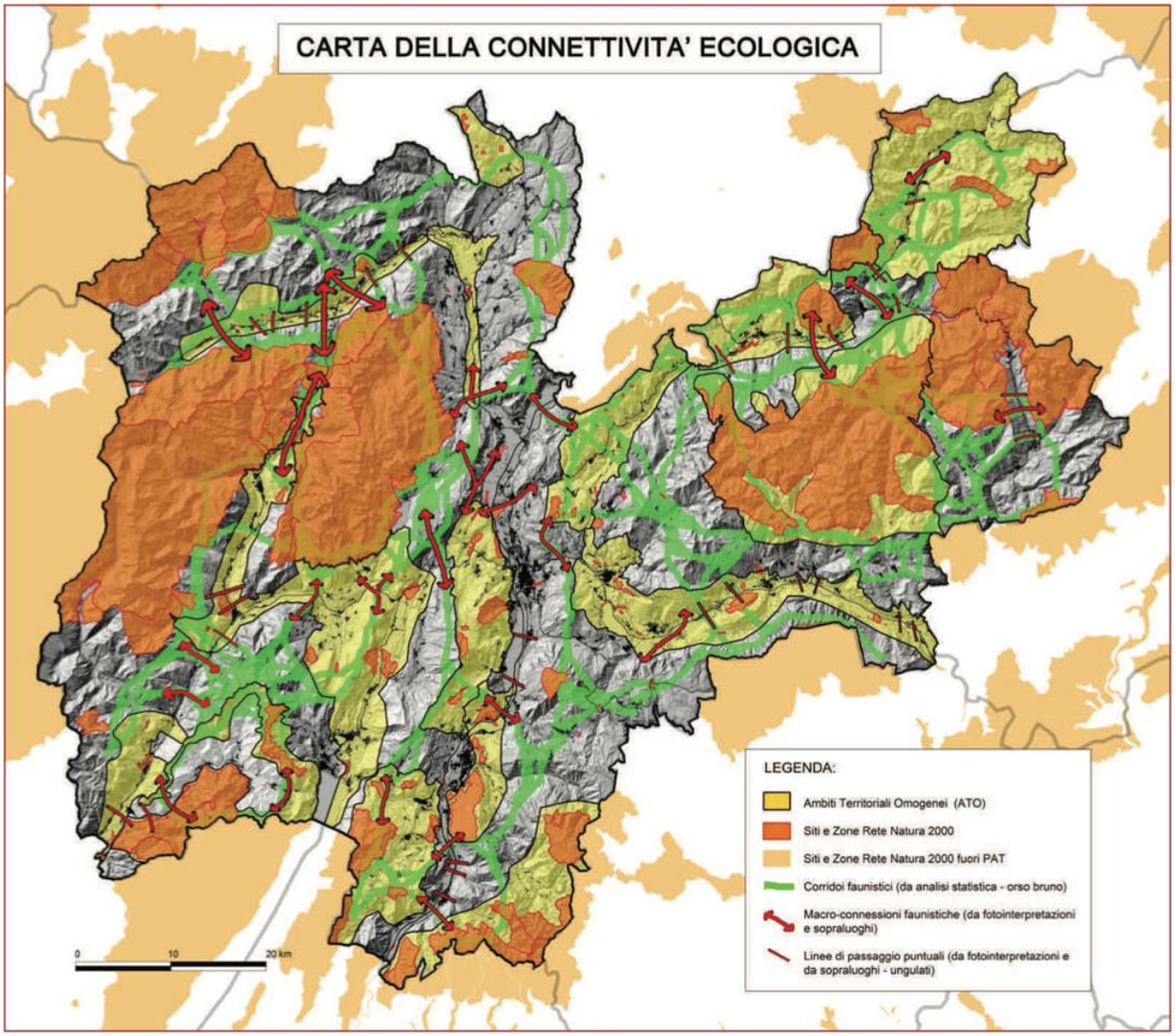
These barriers objectively prevent the implementation of activities to improve the permeability of specific territories, to better connect certain areas of the network, and to plan wide-ranging projects involving several local economic actors. In addition, the ecological corridors are not included in a law or a provincial plan but are only an indicative analysis, nevertheless widely used by provincial offices.

10. Monitoring system

A dedicated monitoring system is not yet available. Therefore, a monitoring system was elaborated by the Life+ T.E.N. project for the Reserves Networks, and now it is implemented by the Biodiversity and Nature 2000 provincial office and by the scientific provincial bides such as the MUSE.



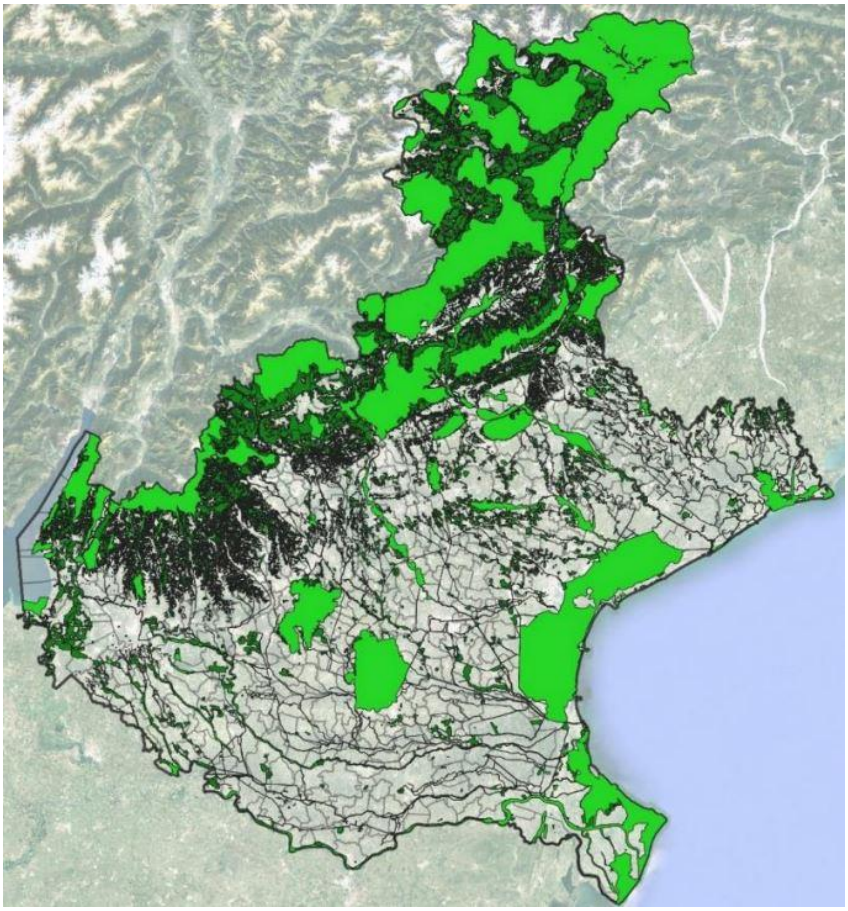
Natura 2000 areas map (LIFE project, 2012) for the planning system of Provincia di Trento



Connectivity map (LIFE project, 2012) for the planning system of Provincia di Trento

1.13 Veneto

Regional Ecological Network by Studio Gibelli (Regione Veneto)



Ecological network in Veneto (source: Regione Veneto)

1. Network typology (check corresponding answer)

Ecological network plan

2. The ecological network and its legal framework of reference

The Veneto Region is equipped with a Regional Ecological Network scheme (RER). RER is one of the contents of the Regional Territorial Coordination Plan (PTRC) , which is an instrument provided by the Regional Legislation . The Regional Ecological Network is aimed at the preservation, protection, and enhancement of biodiversity, including through the improvement of ecological connectivity in the territory. The Region Ecological Network integrates nature conservation in Protected Areas (parks and nature reserves) and in Natura 2000 sites, and the enhancement of biodiversity and widespread naturalness in the man-made territory (cities and agricultural areas) with the aim of forming a spatial matrix that

supports ecological connectivity. The integration between the approaches designed for the conservation and the diffuse naturalness, evolves the traditional Ecological Network concept toward the paradigm of Green and Blue Infrastructures.

In Italy there is no National Ecological Network framework, but several protection models of specific elements and areas scattered throughout the country:

- National Parks (IUCN Category II),
- Natura 2000 sites,
- Integral and Oriented Nature Reserves (IUCN category Ia and Ib),
- Wetlands (Ramsar Convention and Important Bird and Biodiversity Area (IBA),
- Parks and Regional Protected Areas (IUCN Category V),
- Natural World Heritage Sites UNESCO,
- Biosphere UNESCO Reserves (Man and the Biosphere Programme (MAB) | UNESCO).

At a national level, there is the 2030 National Biodiversity Strategy, which pursues two goals:

1. Build a coherent network of terrestrial and marine Protected Areas with the goal to establish 30% of protected areas on land and sea, and 10% strictly protected areas.
2. Restore terrestrial and marine ecosystems, reaching a restoration of the 30% of the conservation status of habitats and species, particularly through the activity conducted at the regional scale about the objectives and conservation measures of Network Natura 2000 sites.

18 actions are formulated to achieve these targets. Read more on this topic in:2030 National Biodiversity Strategy | Ministry of Environment and Energy Security (mase.gov.it).

The Ecological Network analyzed is at a Regional Level: the design and its regulations are limited to the Veneto Region Territory. The Regional Ecological Network (ERN) is the framework for the construction of Ecological local governments Networks: Metropolitan City of Venice, Provinces, Municipalities and for other corporations involved in the territory planning and management.

Thus, RER is part of a cascade system in which each administrative level is coordinated:

- the regional level defines the overall scheme, the nodal points on which the network is based, and the main connectivity routes (corridors). It also defines the tasks for the lower administrative levels;
- the provincial level, which is the most important level for the construction and implementation of ecological networks in the Veneto Region system, builds a more detailed design consistent with the regional scheme and articulates directions and actions for the implementation of the ecological network at the municipal level;
- the municipal level incorporates the directions of the higher administrative levels and is responsible for developing the local design, actions, and measures to protect/build/restore ecological connectivity.

3. Network objectives

The Regional Ecological Network was developed in the Regional Territorial Coordination Plan in order to respond to the anthropogenic transformations that have occurred over time, and which have heavily affected the environment and natural structures, interfering with animal and plant wildlife species and, in general, with ecological processes. The industrialization of agriculture, the changes in land use, the construction of the road network and large metropolitan areas have led to the fragmentation of natural areas, the degradation of ecosystems, the loss of natural habitats and their destructuring, and, ultimately, to the extinction of species. Therefore, the Regional Ecological Network, in accordance with the contents of Directive 79/409/EEC and Directive 92/43/EEC, pursues the following objectives:

(a) ensure adequate habitat areas to support the survival of species;

(b) to ensure sufficient connectivity to allow the species movement between the core areas;

(c) ensure adequate protection of core areas from edge effect;

(d) ensure the maintenance of primary ecological processes and functions.

(e) ensure a balance between environmental ecosystems and human activities;

(f) safeguard ecosystem continuity;

(g) pursue greater sustainability of settlements.

4. Network structure and elements

The network covers a total of 40% of the entire Veneto region, with a distribution ranging from 81% in the province of Belluno to 19% in the province of Padua.

The Regional Ecological Network consists of the following elements:

Core areas: are the backbone of the network and include Natura 2000 sites and Protected Natural Areas, IUCN categories Ia and Ib, II, V.;

- are mainly concentrated in mountain, hill and coastal areas, as well as including all major waterways in the region;
- specific regulations are defined;
- the province with the highest percentage of mountain core areas is Belluno;

Continuous or widespread linear ecological corridors:

- are areas of sufficient extent and naturalness, having a continuous, diffuse, or discontinuous linear structure, essential for migration, geographic distribution and genetic exchange of plant and animal species. These areas have a ecological protection function implemented by filtering the effects of anthropization;
- perform linkage functions for some species or groups of species moving over long distances;

- are unevenly distributed throughout the region. They include different areas and the network of minor water-courses (including those of anthropogenic origin);
- there is a specific legislation.

Caves, natural cavities characterized by the presence of endemism or fragile balances, hardly accessible or isolated. Alongside the network elements, 46 Biodiversity Priority Areas are also identified. Three priority areas are recognized in mountainous areas. The peculiarities and ecological values of these areas are to be found in valuable wetlands (peat bogs, ponds, swamps), vegetational contexts among which various endemic floras and species of high phytogeographic value are found, protected fauna (especially invertebrates, birds, and mammals). Geographic, faunal botanical and vegetational characters have an interregional value in continuity with territories in Trentino Alto-Adige and Lombardy. The other 43 priority areas are found in hilly and low-land areas. These areas include species (endemisms, species of community interest, species included in thered lists) important for ecological processes (connectivity, migration, etc.) related to homogeneous taxonomic groups of species (Reptiles and Amphibians, Fish, Birds, Mammals, and Invertebrates) and macro-types of vegetation. These areas are fundamental because they are in spots where the conflict between nature conservation and anthropogenic development of the land is higher. The priority areas of the Plain include the pilot area of “Caorle Lagoon and the Estuary of the Tagliamento River.”

5. Methodology used in network and corridor design

Each territorial context has its own characteristics in terms of species, communities, ecosystems, and conservation issues, so the basic knowledge of the physical and biological characters of the territory and their dynamic processes, allows to understand the actual and potential situation, on which the Ecological Network can be designed. The Ecological Network of the Veneto Region was therefore constructed by successive steps.

1) the environment condition was analyzed by identifying ecologically homogeneous areas, defined as environmental units, characterized by common climatic, lithological, geomorphological, soil, ecosystem and anthropization features;

2) the Ecological Network framework has been defined by identifying areas of naturalistic character, according to their floristic and faunal value, the vegetation value. The goal is to identify natural and seminatural habitats of regional interest aimed at the nature conservation. The backbone areas of the Network are Natura 2000 Sites, Protected Areas, Nature Reserves and Biodiversity Priority Areas. In the Regional Ecological Network these areas are called core areas;

3) real needs for connectivity between core areas and corridors have been identified to define a new ecosystem arrangement and restore their primary functions. The goal is to conserve the residual nature through the maintenance of ecological connections and relationships, but also through the reconstruction of ecosystem units capable of performing multipurpose functions. Corridors are also identified by considering the characteristics and status of environmental units.

6. Tools and guidance for planners and practitioners

The Ecological Network is represented in a specific cartographic elaboration of the PTRC. The cartography is available in two versions:

- static version (Table 09, available on the Region website: https://www.regione.veneto.it/web/ptrc/ptrc)
- numerical version vector shapefiles (core areas, polygonal shapefile; Corridors, polygonal shapefile; Caves, point shapefile) (vector files can be downloaded from the Regional Geoportal https://idt2.regione.veneto.it/).

The elaboration has indicative and non-design value. The Regional Ecological Network plan is accompanied by norms that specify its definition at each administrative level (regional, provincial, municipal levels). Norms are also specifically addressing Ecological Corridors to support the connectivity of the network. In the Ecological Corridors the interventions that interrupt the ecosystem functions guaranteed by the corridors are prohibited, except for interventions for hydrogeological safety.

According to the cascade planning system, the Region lists the tasks of other administrative levels:

- the Provinces and the Metropolitan City of Venice, in their territorial plan, define the actions necessary to improve the ecological capabilities of habitats and species in ecological corridors
- they may also propose new elements to ensure the continuity of the ecosystem, inspired by the principle of balance between the naturalistic-environmental purpose and socio-economic development.
- municipalities, in their urban plan, identify measures to minimize the effects caused by the processes of anthropization or transformation on ecological corridors, also providing structures designed to overcome natural or artificial barriers, to allow the functional continuity of the corridors. For the definition of such measures, municipalities shall promote activities study of the Ecological Network.

Standards are traced by different guidelines for the Mountain Area and the Plain Area to improve biodiversity, ecological functionality and resolve fragmentation:

- in the Mountain Scope, conservation actions should be prioritized.
- in the Plain Scope, actions aimed at restoring ecological connectivity are prioritized.

7. Specific provisions for connectivity conservation and restoration areas

The reference laws for environmental assessments is national, derived from the various EU Directives that have followed one another over time and have introduced EIAs, VinCAs and SEAs. In application of paragraphs 3 and 4 of Article 6 of the Habitats Directive, any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment (VinCAs) of its implications for the site in view of the site conservation objectives. A large part of the core areas of the Regional

Ecological Network are Natura 2000 Sites. For the Ecological Network elements outside Natura 2000 Sites, generally there is no impact assessment. In corridors the impact assessment (VinCA) is required only if the project or land transformation has effect on populations of species of Community interest that are significant for the overall coherence of the N2000 sites and based on fitting monitoring that allows their identification in accordance with Article 10 of the Habitats Directive.

The ecological network is generally a planning element that is also used as a tool to assess:

- in SEA, ecological network is used to evaluate the sustainability and compatibility of urban plan effect to biodiversity and ecosystem.
- in EIA, ecological network is used to evaluate the impacts, both positive and negative, that projects and interventions may generate on habitats and species;

Ecological networks can also be used as a reference for the location of mitigation and compensation works for urban plan or impacts generated by projects.

8. Implementation of the connectivity conservation and restoration areas

In the cascade planning system, the first step of implementing the Regional Ecological Network is given to the provinces and then to the municipalities. The Regional Ecological Network had a long period of conception starting from the year 2000 and ending in 2020. During this period, all Provinces and the Metropolitan City of Venice planned their ecological networks consistently with the work developed by the Region.

Regarding the implementation at the municipal scale, municipalities have developed ecological networks in their urban planning tools, consistent with the higher levels. In many cases, municipalities have introduced ecological corridors with the aim of discouraging certain land transformations that would have increased fragmentation.

9. Implementation difficulties/opportunities

- The description of the Network terminology is not always consistent between maps, report and regulations. The regulations, which are the prevailing content for the implementation of the network, are clear and precisely identify the elements that constitute it. However, the graphic tables and the report there have similar but not the exact same terminology, and this generates some difficulty in the understanding. Other elements on which the ecological network is based are mentioned in the report (e.g., Priority Areas for Biodiversity), but it is not clear how they are then incorporated into the network itself.
- The drawing of the network that does not clarify the main directions of connectivity, particularly in the hill area (core areas of the second level)
- Provincial plans have developed their ecological network consistently with regional directions. However, the use of different methods in different territories has resulted in different structures and elements: in some cases, with detail and variety of elements, in other cases the regional ecological network is resumed. Such different patterns may generate problems of continuity or inconsistency between the elements of different networks at the boundaries of the provinces.

- The paradigm shift from the Ecological Network to the Green and Blue Infrastructure paradigm will lead to a broader approach that considers the whole territory and the different ecosystem functions that characterize the different parts of the Veneto territorial system, including anthropogenic ecosystems (e.g., agricultural areas, cities). The GBI encompasses the Ecological Network, which becomes the fundamental backbone for the maintenance of natural capital and ecological connectivity necessary to sustain biodiversity and the Ecosystem Services (designed for the health of the territory and populations present).
- The future drafting of the Landscape Plan may include among its contents, the new outline of the regional GBI, accompanied by the guidelines for its implementation in the different administrative levels and for the investigations related to the environmental assessments (SEA, EIA, VINCA). The landscape plan may also provide a reference legend and structure for the implementation of the GBI in the other administrative levels.
- The development of the regional GBI may also focus on the relationships and opportunities arising from other tools normally used for land management (e.g., FEASR-PSR measures, ROP- FEASR measures
- European projects of various types, forest management and water governance tools, river contracts and program agreements
- Collect and develop goals, actions and tools defined by the National Biodiversity Strategy in the regional GBI

10. Monitoring system

Monitoring of ecological network implementation is planned but not carried out. The Regional Plan (PTRC) among the indicators provided for the monitoring of biodiversity, geodiversity and landscape objectives includes the following 2 indicators:

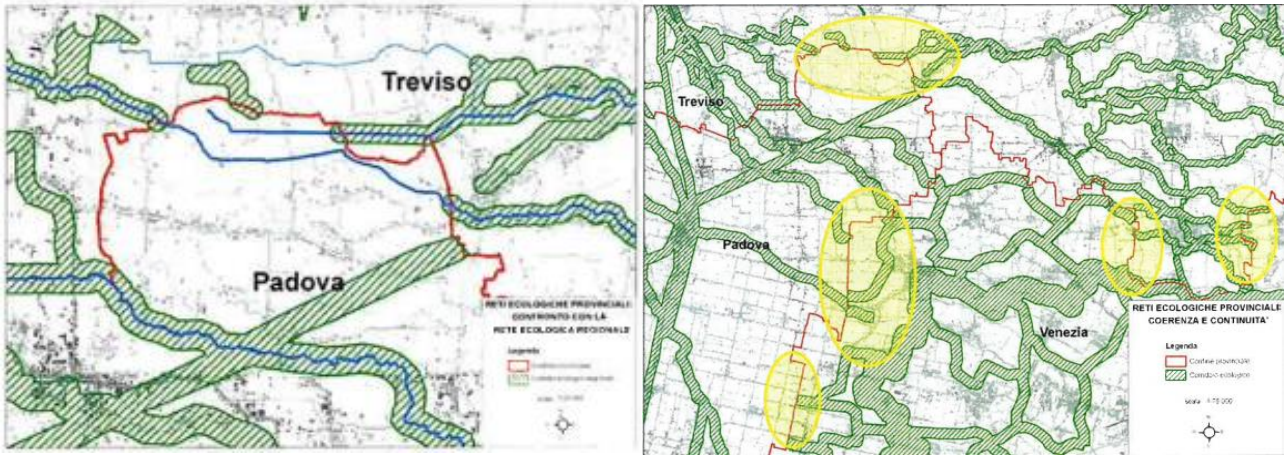
- Conservation status of concerned N2000 sites.
- Increase and functionality of the regional ecological network (regional, provincial and municipal objectives).

However, the data sources, calculation method and benchmarks to be used for their evaluation are not defined. In 2020 as part of a study to develop a monitoring protocol for the PTRC objectives, an attempt was made to operationally translate these indicators, taking into consideration the availability of up-to-date data and ease of calculation, the following indicators were proposed:

- % of regional ecological network area/total regional area (source Veneto Region databases);
- % land consumption in regional ecological network/total land consumption (source ISPRA, ARPAV annual reports);
- % area of protected areas N2000 / total area (source Veneto Region);
- Conservation status N2000 sites - % in satisfactory conservation status (FV) (source N2000 network).

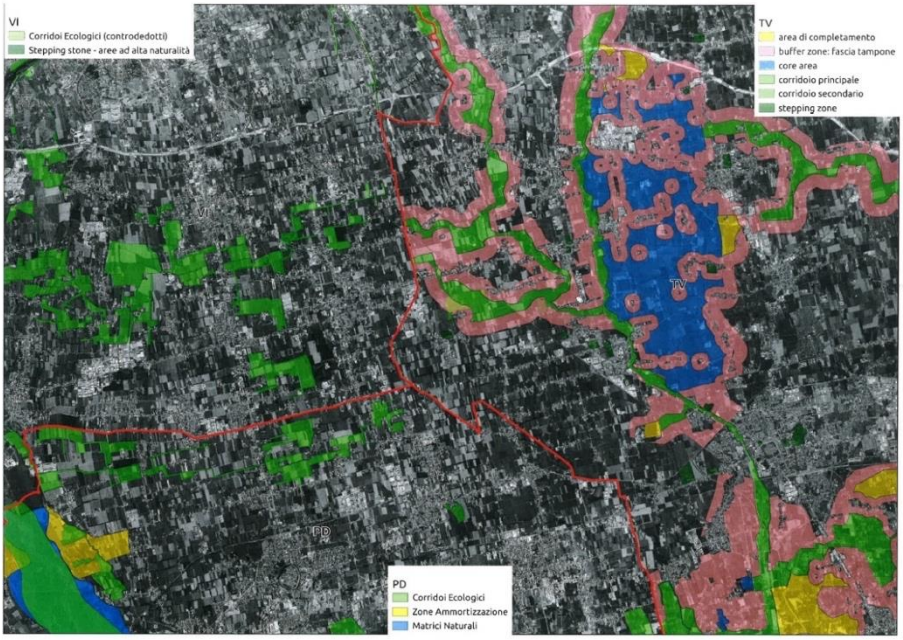
Regarding the consistency and continuity of provincial and municipal networks, two analyses were conducted. In 2015 an initial analysis of the coherence and continuity between the

ecological networks of the provincial plans of Padova, Treviso and Venezia have showed a fair continuity in the design of ecological corridors however there several inconsistencies were found at the boundaries including the interruption of some corridors.



Ecologica network in Padova (source: Provincia di Padova)

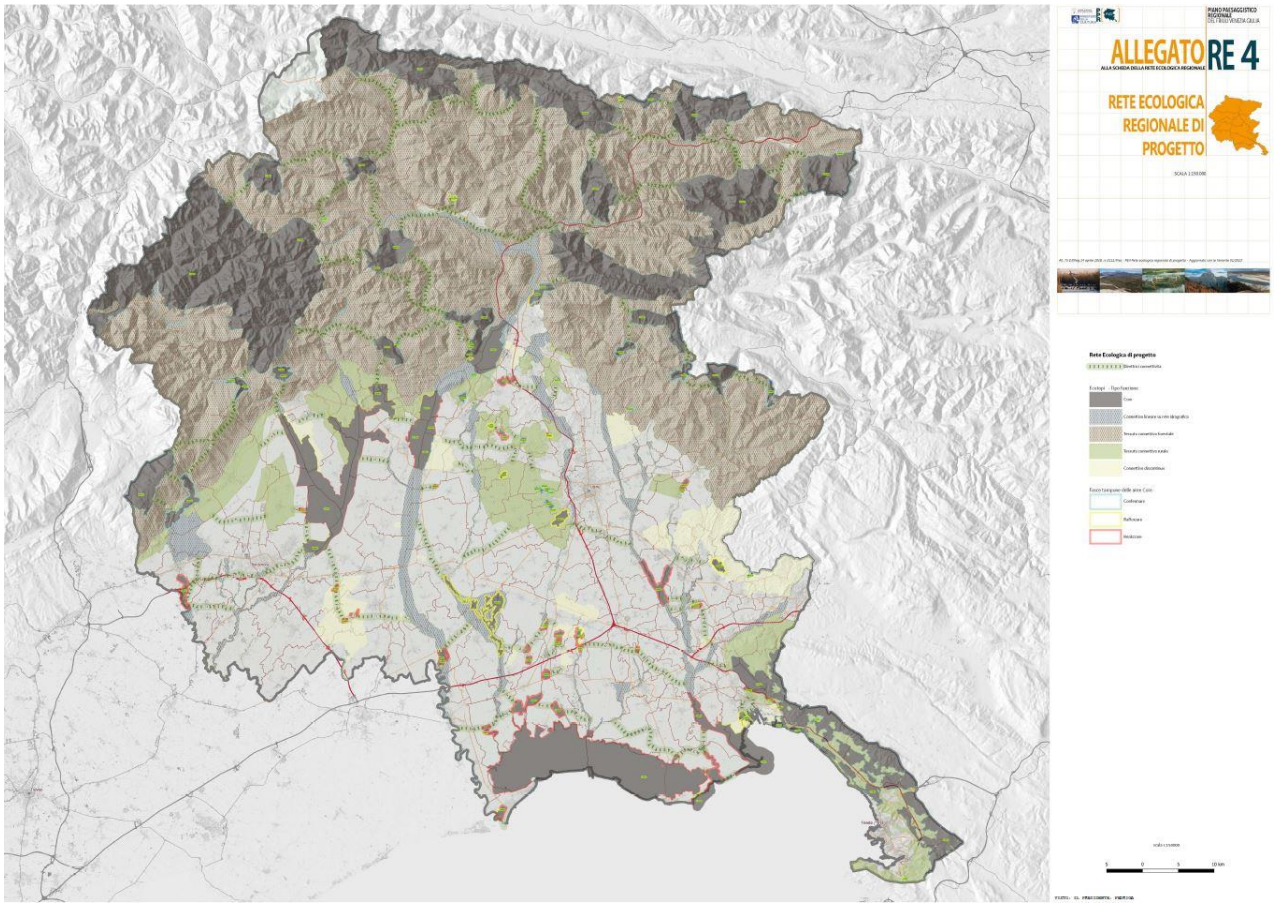
In 2021 a further study, aimed at harmonizing the databases of municipal land use plans, revealed the conceptual difference in approach by individual provinces to the identification on the territory of ecological corridors, buffer strips, renaturation areas, areas of high naturalness, this difference is most evident at many provincial boundaries.



Ecological network at local level (source: Regione Veneto)

1.14 Friuli

Regional Ecological Network by Studio Gibelli (Veneto Region)



All. 75 D.P.Reg 24 aprile 2018, n. 0111/Pres - Ecological network concept

1. Network typology (check corresponding answer)

Ecological network plan

2. The ecological network and its legal framework of reference

The Regional Ecological Network is aimed at ensuring connectivity to natural and semi-natural ecosystems, based on the assumption that not isolated ecosystems ensure landscape quality and the functioning of ecosystem services. The Regional Ecological Network identifies natural, semi-natural, rural, and urban landscapes for the purpose of conservation, improvement and increase of landscape quality and ecological connectivity of the regional territory. The ERN relates to the entire regional territory, which is divided, classified, and described according to ecological functionality. The Regional Ecological Network is one of the contents of the Regional Landscape Plan of Friuli Venezia Giulia, defined in Art. 4 of the Technical Implementation Rules: The PPR is drawn up in accordance

with the provisions contained in the European Landscape Convention approved by the Committee of Ministers of the European Council in Strasbourg on July 19, 2000, and ratified by the Italian State with the Law no. 14 of January 9, 2006. (Ratification and execution of the European Landscape Convention, held in Florence on October 20, 2000), to the Legislative Decree No. 42 of January 22, 2004 (Code of cultural heritage and landscape, pursuant to Article 10 of Law No. 137 of July 6, 2002)[...]

The Ecological Network is specified in Art.43 of the Technical Implementation Rules as:

The Ecological Network of the PPR is conceived as an interconnected system of landscapes whose biodiversity is to be safeguarded and is structured in the Regional Ecological Network (RER) and Local Ecological Networks (REL). The Local Ecological Network analyzes the territory at a more detailed scale and identifies specific portions of natural and semi-natural habitats on the territory (nodes of the network), which are connected to each other by ecological corridors.

The Ecological Network has a multiscale and species-specific meaning. Its elements take on different structural and functional characteristics when interpreted at different spatial scales or for different species; this sometimes results in changing the functional role played by the same element in the network system. In this context, the ecological network developed at the local scale (REL) is defined as an interconnected system of natural habitats that permeate the landscape and make it possible to maintain the conditions essential for safeguarding potentially threatened animal and plant species. In fact, the elements of REL are represented by single habitats, sets of natural habitats, or extensive landscape mosaics where urbanized areas, cultivated areas, and natural elements (hedges, tree rows, meadows, residual forests) follow one another with varying density. It is therefore a matter of identifying the areas, the strips of land where the conditions of potential ecological and environmental connection are greatest.

3. Network objectives

Within the framework of the Regional Landscape Plan (RPP), the Ecological Network has nature conservation and biodiversity preservation as its primary goals. Within this framework, a study was conducted to define an operational model aimed at identifying ecological connection routes. The model was based on the potential distribution of target habitats and species applicable to the regional territory. The specific case is addressed to intensely urbanized landscapes and landscapes of mountain and lowland areas of the Friuli Venezia Giulia region.

The Regional Ecological Network defines specific goals related to different areas of the regional territory based on the characteristic threats.

Because of the varied regional environmental situation, it was useful to identify different conservation objectives within different geographical areas:

- Alpine and prealpine area: the main connectivity goal for the mountain area is the conservation and restoration of areas and connections between natural and seminatural open environments.

- Hill systems: the goal is the conservation of wet forests, natural and seminatural open environments and those not necessarily community interest habitats but relevant as wet habitats of species.
- High Plains: the elements of greatest conservation value are isolated in a deeply transformed environment. The matrix of these elements is an inhomogeneous agroecosystem, in which coexist both large land rearrangements and traditional rural area.
- Lower Plain: the lower plain hosted a wide system of freshwater wetlands generated by surface outcrop, the objectives are the conservation of lowland forests, open environments and wetland habitats and the maintenance and restoration of connections between these elements.
- Sedimentary coastal system: the objectives are to preserve the natural character of dune systems and hydrological dynamics of the lagoon, and to maintain and restore connections with the environments of the lowlands (lowland forests, stable meadows, wetlands).
- Karst: the main goals are the preservation and restoration of open environments and the conservation of the network of karst ponds.

4. Network structure and elements

The functional categories that distinguish the Friuli Venezia Giulia Region are taken from the categories identified and described in the APAT Manual 26/2003 “Management of ecological and functional connection areas”.

From a structural point of view, each landscape area is expected to be divided into ecotopes. To each ecotope is attributed only one prevalent function.

The functional categories are as follows:

- Core area and buffer strips: these are predominantly natural areas of large size and of high functional and qualitative value to maintain the target populations of habitats and species of flora and fauna. The buffer strips are the territorial sectors adjacent to the core areas and have, or should have, a protective function towards the latter on the negative effects of the anthropic matrix on the most sensitive habitats and species.
- Connective categories: linear connectives on hydrographic networks. They are the linear connections between core areas along the waterways. Their essential requirement is continuity, rather than extension. Their function is to maintain and encourage the dynamics of dispersion of biological populations between natural areas, preventing the negative consequences of isolation.
- Discontinuous connectives (stepping stones). These are smaller natural or seminatural areas placed along ideal lines of passage that function as a support and shelter for mobile organisms, as long as that the matrix placed between one area and another does not constitute an impassable barrier.
- Areas of poor connectivity: these ecotopes are characterized by the presence of vast anthropized areas that significantly reduce the possibility of movement and relationship among metapopulations of terrestrial wildlife, especially of the smaller and less mobile species.

5. Methodology used in network and corridor design

The Regional Ecological Network is defined by three different levels of territory:

- Structural level: describes and hierarchizes significant elements from an ecological point of view of each area (natural areas, rural fabric, anthropized areas).
- Functional level: identifies elementary spatial units of the landscape with homogeneous functional ecological characteristics, defined as ecotopes, and specifies their role within the Regional Ecological Network Regional Ecological Network.
- Project level: for each ecotope a specific project is defined (areas to be conserved, areas to be strengthened, areas to be restored); restoration areas of regional interest are also highlighted.

6. Tools and guidance for planners and practitioners

In order to build the Regional Ecological Network it is essential to take into consideration all the elements that constitute it in relation to the land transformation forecasts. The planning is addressed at improving the ecological connectivity of the network, therefore, it provides different degrees of intervention depending on the degree of connectivity between ecotopes and the need to connect them. There are three types of degrees of intervention for connectivity:

1. interventions to confirm if it is fully efficient and effective;
2. interventions to strengthen where functionality is partially impaired or threatened by land use transformations;
3. interventions to implement where connectivity is disrupted or severely compromised, it is necessary to identify areas of environmental restoration and a priority scale of interventions needed to fill structural gaps in the network.

A tool called Minimum spanning tree obtained with Graphab was used to evaluate project intervention priorities in the Friuli Region Network, which allows the identification of major functional connectivity guidelines at the regional level. When a connectivity guideline crosses an ecotope with low connectivity, a restoration area with the highest priority for implementation must be identified.

7. Specific provisions for connectivity conservation and restoration areas

The Ecological Network established under the PPRFVG has a multiscalar and species-specific character, as its constituent elements take on different structural characteristics when read at different spatial scales, or for different species. The PPR-FVG has defined the Regional Ecological Network (RER), which identifies the system of protected and unprotected natural areas of high interest for environmental balance and represents the interface tool between the ecological system of the regional territory and the Landscape Plan.

In addition, criteria and guidelines have been identified for the identification of Local Ecological Networks (REL) at the planning scale of large areas. The Network thus understood is the most certain connecting element, precisely because of its ecosystem and environmental characters, to connect different territories and to form the framework on which

to base a landscape vision not constrained either by rigid boundaries of landscape areas or by punctual and territorially pulverized landscape and environmental assets. The connectivity directories do not represent areas in which to necessarily realize the connecting elements, but the routes that meet the criterion of minimum travel cost between two core areas. They are thus the optimal routes that rely on the presence of natural elements at a distance that minimizes the cost of travel. The identified directories, considering the scale of analysis of the RER, thus represent a rough indication of the territory connection needs, which can be more precisely defined by the REL. The local ecological network, considering the actual physical layout of the territory and using more detailed analysis tools (cartographies), will be able to identify alternative routes that nevertheless maintain the function of connecting the core areas of the RER, highlighted in the draft regional network. The RER, with reference to the entire regional territory, identifies natural, semi-natural, rural and urban landscapes for the purpose of conserving, improving and increasing the landscape and ecological quality of the regional territory, and defines strategies for enhancing ecological connections. The RER recognizes for each landscape area of the PPR-FVG functional units called “ecotopes,” for which the Landscape Area Sheets define guidelines and directives to be implemented by planning, programming, and regulatory instruments.

8. Implementation of the connectivity conservation and restoration areas

In the case the intervention is planned on the vegetation in the area, firstly it will be necessary to consider the phytosociological survey carried out to determine the methods of intervention that can be compatible with the type of habitat present. The following guidelines will have to be followed:

- Avoid reduction, fragmentation, alteration of habitats of community interest and habitats of species;
- Promotion and maintenance of a “separation” vegetation strip including suitable tree, shrub and herbaceous species;
- Prohibition or otherwise restraint the use of herbicides and the practice of pyro-diserbos for vegetation control;
- Carry out bank renaturalization works in order to (re)build the potential habitat of the site

In case the interventions involve work that will directly affect the riverbed of small streams, consider the following directions:

- The (limited) morphological transformations must be inspired by criteria of enhancement of naturalness, structural and bionatural, or renaturalization processes; in particular, the maintenance and recovery of open runoff of all watercourses must be pursued
- Preserve the ecological continuity of the watercourse;
- Maintain as far as possible the ecological continuity, natural sinuosity and succession of scrapes and pools of the water body;
- Hydraulic works should be aimed at the rehabilitation and renaturalization of watercourses, with the employ of naturalistic engineering techniques and low environmental impact.

- Ensure the renewal of the most sensitive and important species with reference to the type of habitat in which interventions are carried out.
- Use of fuels with low environmental impact - use of biogas produced as a replacement for other fuels.
- Prioritize, where possible, the techniques of naturalistic engineering.

9. Implementation difficulties/opportunities

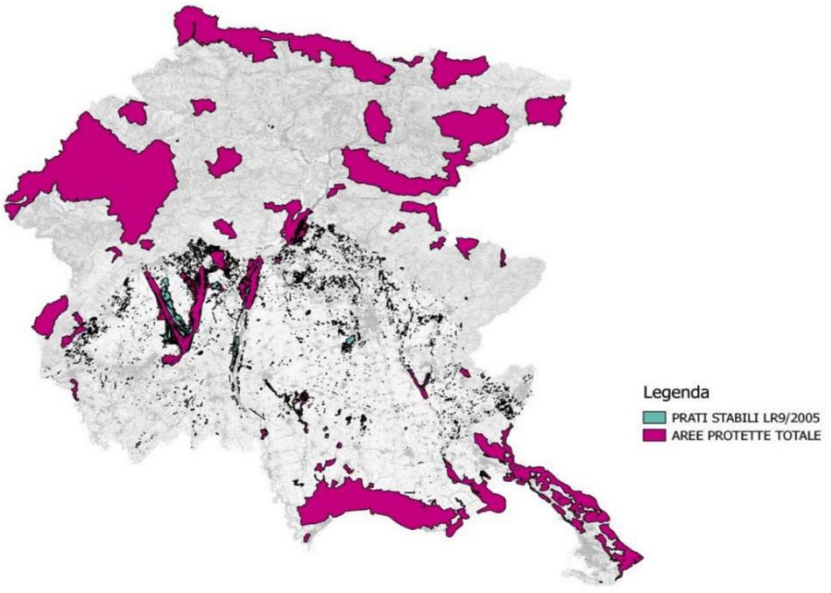
The process of fragmentation of natural environments by anthropogenic causes is a primary cause of biodiversity loss. Fragmentation can be defined as “the process that generates a progressive reduction in the area of natural environments and an increase in their isolation: natural surfaces come, thus, to constitute spatially segregated and progressively isolated fragments embedded in a spatial matrix of anthropogenic origin.”

10. Monitoring system

Environmental monitoring must be ensured in the environmental impact assessment process, with sufficient operational methods to verify the effective environmental compatibility of the planned actions, also in relation to naturalistic aspects.

Monitoring, as provided for in DGR No. 30 of 18.01.2013, must also verify the actual effectiveness of the mitigation measures in order to be able in case to repair their failure.

During the implementation phase of the interventions more specific monitoring of the implemented measures can be defined, the feedback modalities that can be activated for possible criticalities and improvements of the interventions on naturalistic aspects can also be defined.



Protected areas and grasslands in Friuli available at regione.fvg.it

Annex 2: Definitions of technical terms

The comparison of each ecological network is useful to identify what works or not in every regional/national model. To determine common and harmonized outcomes, a glossary is the most important starting point.

Scientific definitions and EU policy definitions

Ecological Connectivity

The term ecological connectivity was developed from the definition of "degree to which landscape facilitates or impedes movement" (Taylor et al., 1993), to a more specific definition of Crooks and Sanjayan, 2006: "Ecological connectivity describes the movement of organisms as gene flow, migration and dispersal of species or processes in a landscape; the more movement there is, the better the connectivity." For spatial planning purposes, a structural approach for the definition of ecological connectivity, including the spatial dimension is most appropriate. Defining ecological connectivity as "the unimpeded movement of species and the flow of natural processes that sustain life on Earth" (UNEP - CMS, 2020), without consideration of the spatial dimension or the landscape is too broad for the PlanToConnect project. Recent literature regarding ecological connectivity for spatial conservation planning defines connectivity as "the flow of materials, energy, and/or organisms, genes, etc." across space, which means among habitat patches or regions of interests. "Specifically, ecological connectivity can include propagule dispersal, adult movement, species migrations, species interactions, and ontogenetic linkages, with the associated flows of energy and matter" (Beger et al. 2022).

Table 1. Connectivity as a value-laden concept. Selected contexts of connectivity and potential audiences applying these concepts for spatial conservation area network planning

Type of connectivity	Definition/examples	Reference for definition	Example user group
Land–sea connectivity	Flows of sediment and pollutants from rivers into the sea, and movement of animals between land, rivers, and the sea	[70]	Ecologist, environmental scientist, engineer
Ontogenetic connectivity	Movement of individuals occurring as part of life cycles (metres to thousands of km), e.g., amphibians	[15,48]	Ecologist, park manager
Corridors	Distinct habitant patches are linked such that movement of animals can be facilitated. Disruption of corridors often occurs due to fragmentation	[36]	Environmental scientist, wildlife biologist, park manager, tourism operator
Pathogen dispersal	Airborne dispersal of fungal spores (regional and continental scale, 50–5000 km)	[46]	Epidemiologist
Pollutant advection and diffusion	Transport of pollutants in a medium (e.g., oil spill, sewage transport in water)	[54]	Engineer, geophysicist
Dispersal connectivity	The movement of propagules or juveniles among spatially distinct habitat patches. Scale highly variable, dependent on medium and species	[55,57,58,79]	Modeller, hydrodynamics engineer, oceanographer, ecologist
Migration	The scheduled movement of individuals	[47,83]	Wildlife biologist, ornithologist, park manager, tourism operator
Genetic connectivity	The movement of genetic material between nearby or distant habitat regions over multiple generations	[16]	Geneticist, evolutionary ecologist
Temporal connectivity	Linkages among sites as species shift their ranges over time	[51,84]	Climate scientist, global change ecologist
Energy flow	Transport of nutrients as part of animal movement	[39]	Ecologist, chemist

Source: (Beger et al. 2022)

Reviewing these definitions of the last decades, the most appropriate for the PlanToConnect project is to see ecological connectivity as “the unimpeded movement of species and the flow of natural processes that sustain life on Earth” (UNEP - CMS, 2020).

Structural and functional connectivity

According to Godron & Forman (1983), Taylor et al. (1993) and Pierik et al. (2016) (in Favilli, Hoffmann, Ravazzoli, 2017) the structural and functional connectivity can be defined and distinguished in such a way:

Structural connectivity, also called landscape connectivity, is purely referring to physical conditions of the territory (space/landscape), and is solely influenced by factors like land use, topography, level of fragmentation, the presence of infrastructure.

Functional connectivity, so-called species- specific connectivity, refers to the behaviour of the investigated species to environmental conditions. This is solely influenced by ecological necessities of the species and their behaviour. This is a concept which firstly came up in the 80ies and which is developed by a high number of scientific studies.

For functional connectivity a lot of information as well as monitoring is required about the selected target species (specific habitat requirements, dispersal behaviour, population dynamics, etc.). Analysing a high number of target species can be time consuming. Another disadvantage is the focus on one or a few species, which do not represent the whole biodiversity. Apart from the consideration of umbrella species, measures that support connectivity for a single species are not necessarily beneficial for others. “As only some 20% of the global extant species richness has been identified, an understanding of species richness is mostly limited to the most common taxa (Kim and Byrne, 2006)” (Luethi 2019, not published).

The basis of spatial planning are natural, semi-natural and artificial physical structures. Therefore, the PlanToConnect project proposes to focus on structural connectivity rather than functional connectivity. This means looking at physical structures (various habitats) rather than individual species and their spatial distribution.

The IUCN Guidelines for Ecological Connectivity describes structural connectivity more in detail as “a measure of habitat permeability based on the physical features and arrangements of habitat patches, disturbances, and other land, freshwater or seascape elements presumed to be important for organisms to move through their environment (Hilty et al., 2019). Structural connectivity modelling aims to identify areas through which a variety of species may be able to move. Models often prioritise ecological corridors characterised by a low degree of human modification – areas which are assumed to be permeable to species sensitive to human disturbance (Dickson et al., 2017). In addition, linear areas that provide connectivity, such as river corridors, ocean currents or linear forest fragments, can be identified and prioritised for conservation (e.g., Rouget et al., 2006).” (Hilty et al., 2020).

“Various connectivity concepts were proposed and tested, including the ecological network concept (Hilty et al., 2006), consisting of core areas, corridors and buffer areas. The green

infrastructure concept of the European Union is based on these concepts and does also include additional elements such as steppingstones (e.g. Kramer-Schadt et al., 2011; Saura et al., 2014, in Luethi 2019). The green and blue infrastructure concept is used as a tool to achieve ecological connectivity (see definition on Green and Blue Infrastructures).

Ecological corridors

"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).

Green and Blue Infrastructures

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." (EC: Communication, 2013).

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)

In an urban context, GI has been understood as a strategic approach to open space or landscape planning to fulfil a wide range of ecological, social, and economic objectives as well as a narrowly focused spatial solution to local storm water management (Fletcher et al. 2015, p. 533). While the general approach can be used for the PlanToConnect project, the focus of the project will be extra-urban areas.

Similar approaches such as ecological networks and green space planning had been implemented before and alongside (the development of GI concept) in many countries (Nordh and Olafsson 2020; Grădinaru and Hersperger 2018).

Typology of GBI infrastructure

"According to sources such as the European Commission (2013), Beery et al. (2017), and Ghofrani et al. (2017), GBI includes natural, semi-natural, and artificially created multi-functional elements. Although considerable attention is paid to GBI, there is no uniform typology for it (Young et al., 2014). GBI can be categorised according to function, position, and scale (Ghofrani et al., 2017). Besides large-scale elements such as public parks, urban forests, rivers, and streams – which are considered the basis of urban GBI – there are also small-scale elements such as street greenery, front gardens, allotments, and community gardens." (Macháč et al.2022)

The following main typologies of green infrastructure elements can be distinguished at various scales:

- core areas of high biodiversity value;

- restoration zones such as reforestation areas;
- ecosystem service zones oriented to provide a range of ecosystem service benefits;
- green urban and peri-urban areas such as urban parks and green roofs;
- and natural and artificial connectivity features to assist species movement.

(Bennett et al. 2011 in Campagna et al. 2020,)

In the GREEN INFRASTRUCTURE IMPLEMENTATION AND EFFICIENCY Report (Bennett et al. 2011), the terms “GBI typology” and “GBI elements” are used synonymously.

Table 2.1 Typology of green infrastructure elements

Green Infrastructure element	Includes:
Core areas	Areas of high biodiversity importance, including large areas of healthy and functioning ecosystems with minimal intervention required, and smaller areas that require management; such as Natura 2000 areas and other protected areas (eg IUCN categories I, II and IV).
Restoration zones	Reforestation zones, new areas of habitat for specific species or restored ecosystems for service provision.
Sustainable use/Ecosystem Service Zones	Areas that are managed sustainably for economic purposes, whilst maintaining healthy ecosystems and proving a range of ecosystem service benefits (eg multi-use forests and High Nature Value farming systems). Such areas help maintain the permeability of the landscape (ie enable species to exist in the wider landscape and move between core areas)
Green urban and peri-urban areas	Parks, gardens, grassy verges, green walls, green roofs.
Natural connectivity features	Ecological corridors (hedgerows, wildlife strips, stone walls) stepping stones (ie patches of habitat that enable species to move between core areas), riparian river vegetation, etc.
Artificial connectivity features	Features that are designed specifically to assist species movement, such as green bridges (ie bridges that are covered by an appropriate habitat to encourage the movement of animals across them), tunnels and fish passes.

(Bennett et al. 2011)

The PlanToConnect project is mainly focusing on core areas of high biodiversity value, restoration zones and natural and artificial connectivity features to assist species movement (typology 1,2 and 5).

GBI elements

Despite some scientific articles referring to the term “GBI elements”, there was no dedicated scientific definition found so far.

In recent scientific literature, the term “GBI elements” is used to describe areal, linear or punctual parts of the landscape matrix. Staccione et al. 2022 describes core areas and corridors as green network elements. Concepción et al. 2020 describes semi-natural GBI elements in agricultural landscapes. That can be e.g., field margins, hedgerows, fallow land, pastures, woodlands. A table of habitat indicators linked to distinct GBI elements and options supported by greening of agriculture was elaborated by Concepción et al. 2020 in an international study.

For the term “GBI elements”, a specific definition for this project is needed. See chapter “project definitions”.

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).

Connectivity conservation area[8]

Connectivity conservation area is a generic term introduced in recent scientific literature for land/sea areas actively managed for connectivity conservation (Worboys et al., 2010, p. 4). The intention is to use ‘connectivity conservation area’ (or simply connectivity area) to avoid confusion with other related terms, such as ‘protected area’, and also to distinguish the field and its broader scope from the original uses of the term corridor which were more linear and focussed on wildlife, principally animal populations. Today, the term corridor continues to be an important spatial tool, among a suite of tools being developed, to support connectivity conservation.

Large scale connectivity – On a large spatial scale, connectivity areas facilitate the migrations of animals between breeding and wintering areas, or over daily, seasonal, and annual time-frames, even if no protected areas are specifically established for their habitat (Marra et al., in Crooks and Sanjayan, 2006, ch. 7). Hydrologic connectivity transfers matter, energy and organisms through the medium of water within or between elements of the hydrologic cycle. These functions are critical for maintaining the biological integrity of ecosystems and providing water and other ecosystem services for peoples see environmental flows in Part II, section 3.1.9, below).

Small scale connectivity - On a smaller scale, connectivity conservation provides important biodiversity benefits for local areas. Hedgerows, forest belts around agricultural fields, and patches of natural vegetation interspersed in semi-developed areas are examples of connectivity conservation measures which provide habitat for locally important species (birds, butterflies, amphibians) and local ecosystem services. For example, the dominant crop pollinators worldwide are bees, which rely on natural connectivity among different

[8] IUCN - the legal aspects of connectivity conservation (2013) https://portals.iucn.org/library/efiles/documents/eplp-085-001.pdf

habitat types particularly floral habitats (Ricketts et al., in Crooks and Sanjayan, 2006, ch. 11).

Whether on a small or large scale, connectivity conservation areas may also provide recreational, tourism, educational, spiritual, and scientific benefits so long as consistent with the primary conservation purpose, and by doing in some cases may generate monies through fees and services to invest back into the area.

(Lausche et al., 2013)

Protected area

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

Technical terms from the AlpBioNet2030 project

Ecological conservation areas (SACA1)

SACA1 areas will be the basis for ecological connectivity modelling in the PlanToConnect project. The term was developed in the AlpBioNet2030 project and is defined by “Areas, that still have considerable space for connectivity with non-fragmented surfaces and where connectivity should be conserved”. According to Plassmann et al. 2019, currently 61% of the Ecological Conservation Areas within the Alpine Convention Perimeter are located in protected areas, which means there is a big potential for protection of these areas.

Ecological intervention areas (SACA2)

The main focus in the PlanToConnect project lies on areas for possible interventions to improve ecological connectivity. The AlpBioNet 2030 project simulated such areas with very large extension and developed the term “Ecological Intervention Areas”. These are areas “with a high potential for connectivity in which larger, more or less natural non-fragmented zones could be created, especially by connecting protected areas, Natura2000 sites or other precious biotopes. Ecological connectivity is currently working to some extent in these areas but would benefit from enhancements” (Plassmann et al. 2019).

(Large-scale) Connectivity Areas

The PlanToConenct project will focus also on so-called “Connectivity areas”, which were defined in AlpBioNEt2030 at large-scale. These areas are “strategic regions, where protection, planning and specific ad-hoc measures are necessary to avoid isolation of Alpine biodiversity at the Alpine periphery and to allow the conservation of large-scale wildlife corridors reaching neighbouring mountain massifs”. (Plassmann et al. 2019).

Project definitions for the PlanToConnect project

The following definitions were elaborated for the PlanToConnect project to reach the same understanding of technical terms and to and retain them over the duration of the project.

Potential ecological linkages

'Potential ecological linkages' are geographically identified landscape elements, resulting from a connectivity model, which are connecting important ecological areas. These can be protected areas, Natura 2000 sites, or Ecological Conservation Areas (defined by AlpBioNet2030).

Potential corridors are mostly a result of modelling approaches, calculated by the least cost paths, circuit theory (like SACA2), randomized shortest paths, or other methods. The term is commonly used in ecological network modelling, also in scientific literature (cf. Zhang & Song 2020).

Priority connectivity areas for spatial planning

"Priority connectivity areas" for spatial planning are areas at the Alpine or Regional level where specific provisions aimed at preserving or re-establishing ecological connectivity should be included in national and regional spatial plans to avoid the isolation of Alpine biodiversity and enable ecosystem adaptation to climate change.

It is possible to define different types of Priority connectivity areas from large-scale level to small-scale level:

Macro regional	-Large scale "Connectivity areas" (for the definition see AlpBioNet), where measures are still needed.
Regional	SACA1 areas not protected and outside the Natura2000 Network.
	Potential Ecological Corridors, prioritised by an opportunity for protection or a risk by an existing, growing or possible upcoming anthropogenic pressure, such as infrastructure developments.
Local	"Potential corridors" <5km of the Alpine Parks 2030 project*, which are currently not protected or managed. *The Alpine Parks 2030 project defined potential corridors through intersecting buffer zones of 2,5km around SACA1 areas, if they are within an SACA2 area (Ecological Intervention Area) defined by the AlpBioNet2030 project. Within SACA2 areas there is a high potential for connectivity.

Alpine priority planning “hot spots”

“Hot spots of ecological connectivity” are near natural areas on a local level, rich in biodiversity or with a high landscape permeability characteristic, important for ecological connectivity. The project defines “hot spots” as concrete areas on a local level, which mostly are limited in extension.

GBI elements

Considering scientific literature, “GBI elements” can be defined as parts of the GBI network in the landscape matrix, with a natural or semi-natural characteristic. Therefore, the PlanToConnect project considers GBI elements on regional or macro-regional level as homogenous areas of land cover classifications within natural and semi-natural connectivity features (e.g., ecological corridors or other high permeable parts of the landscape).

In terms of structural connectivity, IfuPlan propose the following categories as GBI elements. They are based on the categories of CORINE Land Cover 5 ha CLC5 (2018)1. CORINE Land Cover data are available alpine wide.

“Artificial areas” and “Agricultural land” are categories that usually do not accommodate a great diversity of species and rather represent barriers. The other categories are natural or semi-natural biotope types that often host a large number of endangered species. These categories can be further complemented.

References

Beger M., Metaxas a., Balbar A.C., McGowan J.A., Daigle R., Kuempel C.D., Treml E.A., Possingham H.P., (2022). Demystifying ecological connectivity for actionable spatial conservation planning. Trends in Ecology & Evolution. Volume 37, Issue 12, 2022, 1079-1091, ISSN 0169-5347, https://doi.org/10.1016/j.tree.2022.09.002.

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, 2011. https://ec.europa.eu/environment/nature/ecosystems/docs/implementation_efficiency.pdf

Campagna, M., Di Cesare, E.A., Cocco, C. Integrating Green-Infrastructures Design in Strategic Spatial Planning with Geodesign. Sustainability 2020, 12, 1820. https://doi.org/10.3390/su12051820

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.

Crooks, K.R. and Sanjayan, M.A. (2006). Connectivity Conservation: Maintaining Connections for Nature. In: Crooks, K.R. and Sanjayan, M., Eds.: Connectivity Conservation, Cambridge University Press, Cambridge, 1-20. http://dx.doi.org/10.1017/cbo9780511754821.001

EC: Communication, 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 Natural Capital, The European Commission, Brussel., 2013. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249, 03.04.2023

EC, 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

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

Favilli F., Hoffmann C., Ravazzoli E., (2017). Connettività ecologica in ambiente montano: metodologia GIS, barriere fisiche, socioeconomiche e legali. In Pechlaner H., Streifeneder T. (Eds.) Lo sviluppo di regioni, luoghi e destinazioni. Prospettive sulle relazioni tra uomo e territorio. Athesia: Bolzano.

Fletcher T. D., Shuster W., Hunt W. F., Ashley R., Butler D., Arthur S., et al(2015) SUDS, LID, BMPs, WSUD and more—the evolution andapplication of terminology surrounding urban drainage. UrbanWater 12(7): 525–542. https://doi.org/10.1080/1573062X.2014.916314

Grădinaru S. R., Hersperger A. M. (2018) Green infrastructure in strategic spatial plans: evidence from European urban regions. Urban For Urban Green. https://doi.org/10.1016/j.ufug.2018.04.018

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 (jodi@y2y.net), Keeley (annika.keeley@yahoo.com), Woodley (woodleysj@gmail.com), Tabor (gary@largelandscapes.org).

IUCN, (2008). Effective protected areas. https://www.iucn.org/our-work/topic/effective-protected-areas

Lausche, Barbara, David Farrier, Jonathan Verschuuren, Antonio G. M. La Viña, Arie Trouwborst, Charles-Hubert Born, Lawrence Aug (2013). The Legal Aspects of Connectivity Conservation. A Concept Paper, IUCN, Gland, Switzerland. xxiv + 190 pp

Luethi, R. (2019). Draft paper on the continuum suitability index. Not published.

Macháč J., Brabec J., Arnberger A (2022). Exploring public preferences and preference heterogeneity for green and blue infrastructure in urban green spaces. Urban Forestry & Urban Greening, Volume 75, 2022, 127695, ISSN 1618-8667, https://doi.org/10.1016/j.ufug.2022.127695.

Nordh H, Olafsson A. S. (2020) Plans for urban green infrastructure in Scandinavia. J Environ Plan Manag. https://doi.org/10.1080/09640568.2020.1787960

Staccione A., Candiago S., Mysiak J. (2022) Mapping a Green Infrastructure Network: a framework for spatial connectivity applied in Northern Italy, Environmental Science & Policy, Volume 131, 2022, Pages 57-67, ISSN 1462-9011, https://doi.org/10.1016/j.envsci.2022.01.017.

Taylor P.D., Fahrig L., Henein K., Merriam G. (1993). Connectivity is a Vital Element of Landscape Strukture. Oikos, 68, No.3 (Dec. 1993), pp. 571-573.

UNEP - CMS (2020). Improving Ways of Addressing Connectivity in the Conservation of Migratory Species, Resolution 12.26 (REV.COP13), Gandhinagar, India (17-22 February 2020). United Nations environmental programme, convention on migratory species. UNEP/CMS/COP13/CRP 26.4.4. https://www.cms.int/sites/default/files/document/cms_cop13_res.12.26_rev.cop13_e.pdf

Zhang Y, Song W. (2020). Identify Ecological Corridors and Build Potential Ecological Networks in Response to Recent Land Cover Changes in Xinjiang, China. Sustainability. 2020; 12(21):8960. https://doi.org/10.3390/su12218960

Planning instruments and processes for GBI network planning and implementation in the Alps

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