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Guidance on a strategic framework for further supporting the deployment of EU-level green and blue infrastructure

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Executive summary

Green infrastructure (GI) is a strategically planned network 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.

In addition to providing a key tool to halt and reverse the loss of biodiversity, this network of biodiversity-rich green (land) and blue (water) spaces, provides simultaneously a multiplicity of benefits in a cost-efficient way. The delivery of those benefits is maximised if planned at a strategic level.

The Action Plan for Nature, People and the Economy aims to improve the practical implementation of the EU nature legislation and accelerate progress towards the EU 2020 goal of halting and reversing the loss of biodiversity and ecosystem services. Acknowledging the positive contribution that green and blue infrastructure can bring to the implementation of the EU Nature legislation and to the achievement of the EU biodiversity strategy to 2020, Action 12 of this Action Plan foresees the development of a guidance providing a strategic framework for further supporting the deployment of EU-level green infrastructure so as to enhance the delivery of essential ecosystem services throughout the EU territory.

This guidance implements this action, and seeks to encourage the scaling-up of investments in EU-level GI projects, avoiding that there are only a few independent initiatives that do not deliver the full potential. It aims to stimulate a more strategic and integrated approach to GI, so as to maximise the delivery of ecosystem services and the EU added value, using the Natura 2000 network as its backbone. It also aims at providing information on the relevant existing funding sources and supporting tools.

This guidance contributes to establishing a strategic framework to support EU-level green and blue infrastructure projects to maximise the benefits provided. It should contribute to restoring and better connecting functional ecosystems and to improving the connectivity of the Natura 2000 network and other areas of high value for biodiversity that are fragmented or isolated. It should also contribute to fostering the integration of ecosystem services in EU policies and supporting funding instruments, and it complements the dedicated guidance on integrating ecosystems and their services in planning and decision-making also foreseen under the Action Plan.

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I. CONTEXT AND INTRODUCTION

1. GREEN AND BLUE INFRASTRUCTURE AS A TOOL TO CONSERVE AND ENHANCE THE MULTIPLE BENEFITS THAT NATURE PROVIDES

In the EU as in other parts of the world, biodiversity is in continuous decline. The regional assessment report on biodiversity and ecosystem services for Europe and Central Asia produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[1] has highlighted that the extent of natural ecosystems such as wetlands has declined by 50 per cent since 1970 while natural and semi-natural grasslands, peatlands and coastal marine habitats have been degraded[2]. Over the last decade, the continuing decline in biodiversity has had negative consequences for the delivery of many ecosystem services[3], such as habitat maintenance, pollination, the regulation of freshwater quantity and quality, soil formation and the regulation of floods.

The Commission adopted an EU strategy on green infrastructure (GI strategy[4]) in 2013 to enhance economic benefits by attracting greater investment in Europe's natural capital. The strategy included four priority work streams: promoting GI in the main policy areas; improving information, strengthening the knowledge base and promoting innovation; improving access to finance; and contributing to the development of GI projects at EU level.

According to the EU strategy, green infrastructure[5] (GI) is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services[6]. It incorporates biodiversity-rich terrestrial and aquatic ecosystems on land and at sea. On land, GI is present in rural and urban settings.

In addition to providing a key tool to halt and reverse the loss of biodiversity, green and blue infrastructure[7] provides a multiplicity of benefits in a simultaneous and cost-efficient way. The delivery of those benefits is maximised when the network of green and blue spaces is planned at a strategic level.

The Natura 2000 network constitutes the backbone of the EU green and blue infrastructure. The Nature Fitness Check[8] confirmed that to harness the full benefits of EU nature legislation, improvements in implementation are required. It highlighted that habitat and landscape

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1 IPBES, 2018 https://www.ipbes.net/assessment-reports/eca

2 IPBES, 2018 https://www.ipbes.net/assessment-reports/eca; https://www.ipbes.net/assessment-reports/ldr

3 Ecosystem services designate the benefits that people obtain from ecosystems (MA, 2005); or the direct and indirect contributions of ecosystems to human wellbeing (TEEB, 2010).

4 COM(2013) 249 final.

5 Pursuant to the EU Strategy on Green Infrastructure (COM (2013)249.

6 Ecosystem services designate the benefits that people obtain from ecosystems (MA, 2005); or the direct and indirect contributions of ecosystems to human wellbeing (TEEB, 2010).

7 The EU definition of green infrastructure includes aquatic ecosystems in its meaning; to highlight more explicitly the aquatic dimension of the concept, alongside tis terrestrial one, this document uses also the expression 'green and blue infrastructure'.

8 http://ec.europa.eu/environment/nature/legislation/fitness_check/index_en.htm

management and restoration measures through GI are needed with a view to contributing to the favourable conservation status of habitats and species of Community interest and ensuring the coherence of the Natura 2000 network. Other nationally and locally protected areas also contribute to EU green and blue infrastructure.

In light of its multi-functionality, GI supports implementation of and compliance with EU environmental legislation and policies, such as on nature protection, air quality, water and the marine environment; as well as with climate change adaptation and mitigation policies. The ecological connectivity provided by green and blue infrastructure contributes to easing species' adaptation to climate change, allowing them to extend their habitat range and accommodate their migration needs through ecological corridors. Green and blue infrastructure enhances as well the carbon sequestration properties of environmental features in both rural and urban environments, thus mitigating climate change. Biodiversity-rich parks, green spaces and waterways can also help mitigate the negative effects of summer heat waves and air pollution[9] in cities; and contribute to disaster risk reduction. Green and blue infrastructure also contributes to connecting urban and rural ecosystems.

Green and blue infrastructure can also positively contribute to the sustainability of broader EU policies, such as regional development, social cohesion, agriculture, transport, energy production and transmission, disaster risk management, fisheries and maritime policies.

Green and blue infrastructure offers approaches that are more sustainable than or complementary to those provided through conventional civil engineering ('grey infrastructure')[10][11][12], for instance through artificial connectivity features such as fish passes or tunnels for amphibians and small- and moderate-sized mammals.

In addition to its positive impacts on human health and the environment, GI also brings multiple other social and economic benefits: it provides for recreation areas, enhances social cohesion, supports job creation and makes cities, rural and coastal areas more attractive places to live and work in. Healthy, resilient and productive ecosystems are a necessary pre-requisite for a smart, sustainable and inclusive economy. It has been estimated that the economic value of nature's services amounts to EUR 1,696 per hectare per year for the regulation of freshwater and coastal water quality; EUR 964 for non-material contributions such as physical and psychological experiences linked to tourism and recreation; and EUR 400 for the regulation of climate[13].

Green and blue infrastructure should also be seen as a bridging concept to facilitate communication and understanding across disciplines, coordinate groups of stakeholders, and

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9 http://www.fao.org/resources/infographics/infographics-details/en/c/411348/

10 Nellemann, C., Corcoran, E. (eds) 2010. Dead Planet, Living Planet — Biodiversity and ecosystem restoration for sustainable development. A rapid response Assessment. UNEP, GRID-Arendal.

11 http://ec.europa.eu/environment/nature/ecosystems/studies.htm#design.

12 http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructures/GI%20Final%20Report.pdf

13 https://www.ipbes.net/event/ipbes-6-plenary

build consensus around particular policy issues, with a view to serve a variety of societal goals. To this aim, it should be developed with the active involvement of all stakeholders.

A review of the EU green infrastructure strategy was carried out throughout 2017 and its outcome provides useful background for this guidance (COM(2019) 236 final; and SWD(2019) 184 final). Whilst the EU GI strategy has highlighted the multiple benefits of GI and built some momentum for the deployment of GI in the EU, the review has shown that a strategic approach for GI at EU level has not been implemented yet, and a more robust enabling framework for GI should be considered. GI deployment is often only implemented at a small scale, not giving due recognition to the potential economic and social benefits of using green and blue instead of or in complement to grey infrastructure at a wider scale. The review has also shown that whilst integration of GI into appropriate EU funding mechanisms has provided new opportunities, uptake is still too limited. Efforts should be stepped up to achieve effective mainstreaming of GI in relevant EU policies and legislation.

2. A GUIDANCE DOCUMENT TO FOSTER INVESTMENT IN AND PROMOTE GOOD PRACTICES ON EU-LEVEL GREEN AND BLUE INFRASTRUCTURE PROJECTS

The Action Plan for Nature, People, and the Economy[14] aims to improve the practical implementation of the Birds and Habitats Directives and accelerate progress towards the EU 2020 goal of halting and reversing the loss of biodiversity and ecosystem services. This guidance implements Action 12 of the Action Plan, which foresees that: "*the Commission, in close cooperation with Member States and stakeholders, will develop a guidance providing a strategic framework for further supporting the deployment of EU-level Green Infrastructure, containing a series of guidelines on objectives, priorities and selection criteria for Green Infrastructure projects of European interest that contribute to the goals of the Nature Directives, including through improving connectivity of Natura 2000 sites in a cross border context, with a view to identify projects to be prioritised with appropriate funding, at a scale which transcends administrative boundaries, so as to enhance the delivery of essential ecosystem services throughout the EU territory*".

This Action acknowledges the positive contribution that green and blue infrastructure can bring to the implementation of EU Nature legislation and to the achievement of the EU biodiversity strategy to 2020, and aims at contributing to further action at EU level to avoid that there will be only a few independent initiatives that do not deliver the full potential.

The **objective** of the guidance is to encourage the scaling-up of investments in EU-level GI projects, by setting out criteria to identify those projects, by providing examples of such projects and of the benefits ensued and by providing information on the relevant existing EU funding sources and supporting tools. Whereas the EU GI strategy covers green and blue infrastructure at all levels, this guidance document aims at stimulating a more strategic and

[14] http://ec.europa.eu/environment/nature/legislation/fitness_check/action_plan/index_en.htm

integrated approach at the EU level to maximise the delivery of ecosystem services and the EU added value of green and blue infrastructure, using the Natura 2000 network as its backbone.

This guidance document contributes to establishing a strategic framework for supporting EU level green and blue infrastructure projects, in order to maximise benefits provided. It should contribute to enhancing the delivery of ecosystem services, to restoring and better connecting functional ecosystems and to improving the connectivity of the Natura 2000 network and other areas of high value for biodiversity that are fragmented or isolated.

Whilst this guidance and the suggested criteria for the development of EU-level green and blue infrastructure projects are not legally binding, they aim at providing stakeholders, managing authorities and evaluators with information and inspiration which can be taken in to account in relevant assessment and decision-making processes.

This guidance also contributes to fostering the integration of ecosystem services in EU policies and supporting funding instruments, and complements the dedicated guidance on integrating ecosystems and their services in planning and decision-making.

The **target audience** includes potential promoters of projects supporting EU level GI, e.g. national and sub-national authorities; municipalities; public entities; spatial planners; NGOs; landowners; land users; businesses; as well as the managing authorities of the relevant financing instruments.

Key elements: after an introductory chapter I, chapter II puts forward a set of key criteria to help identify and stimulate projects that would transcend administrative boundaries, enhance the delivery of essential ecosystem services and contribute to the goals of the EU Nature Directives, including through ecosystem restoration and improving the functional connectivity of Natura 2000 sites.

Chapter III contains information on EU financing instruments available to support such projects, as well as scientific and technical tools and instruments to support the design of projects.

To help implement the guidance to specific contexts: Annex I provides more details on relevant case studies; Annex II presents some benefits of green and blue infrastructure to other policies; and Annex III introduces relevant EU financing instruments.

II. EU-LEVEL GREEN AND BLUE INFRASTRUCTURE PROJECTS: DEFINITION, CRITERIA AND ILLUSTRATIONS

1. FURTHER CLARIFYING THE NOTION OF GREEN INFRASTRUCTURE

The review of progress in implementation of the EU GI strategy revealed that the multiple aspects and scales covered by the definition of green infrastructure are sometimes challenging to capture. This guidance document offers an opportunity to clarify that definition.

The three components of green and blue infrastructure (i.e. a strategically planned network; biodiversity-rich natural and semi-natural areas with other environmental features; managed to deliver a wide range of ecosystem services) are cumulative.

- **a strategically planned network**: With a view to deliver their full benefits, green and/or blue areas need to be spatially and functionally connected to each other through a strategic and integrated planning process. Often, establishing the network will also require active restoration activities.

- **of natural and semi-natural areas with other environmental features**: biodiversity is at the core of the GI strategy, given that it takes place within the broader EU biodiversity strategy to 2020 and aims to help achieve its objectives. Therefore, to qualify as GI, green and/or blue areas must include healthy ecosystems with a rich diversity of species that provide multiple ecosystem services and benefits. They should also include elements of the landscape that are important for biodiversity conservation: on the local scale, biodiversity-rich parks, gardens, green roofs, ponds, streams, woods, hedgerows, meadows, restored brownfield sites and coastal sand-dunes can all contribute to GI if they deliver multiple ecosystem services. Connecting elements are green bridges and fish ladders. On the regional or national scale, large protected natural areas, large lakes, river basins, high-nature value forests, extensive pasture, low-intensity agricultural areas, extensive dune systems and coastal lagoons are just a few of many examples. On the EU scale, trans-boundary features such as international river basins, forests and mountain ranges are examples of the EU's supranational GI.

- **designed and managed to deliver a wide range of ecosystem services**: The EU green infrastructure concept is a services-oriented one; its objective is to lead to an enhanced delivery of ecosystem services. The green and blue areas that are part of the network must therefore be managed in a way that actively maintains or even enhances the ecosystems services they provide.

2. CRITERIA FOR IDENTIFYING EU-LEVEL GREEN AND BLUE INFRASTRUCTURE PROJECTS

EU-level GI projects should comply with all the elements of the above-mentioned definition of GI. In addition, they should fulfil the following cumulative criteria:

a) Conservation and/or enhancement of multiple ecosystems services at a significant scale

Any EU-level GI project should clearly contribute towards the conservation and/or enhancement of multiple ecosystem services at a significant scale (see criterion c for the meaning of 'significant scale'). Tools for measuring these ecosystem services – in particular using the EU methodology on Mapping and Assessment of Ecosystems and their Services (MAES) – are described in chapter 3.

b) Contribution to the goals of the Nature Directives[15]

Projects should contribute to improving the conservation status of species or habitats types covered by EU nature legislation and the condition of the corresponding ecosystems. This can be achieved by managing Natura 2000 sites so that they reach their conservation objectives. It can also include measures aimed at ensuring the ecological coherence of the Natura 2000 network (cf. implementation of Article 10 of the Habitats Directive) or connecting existing Natura 2000 sites with buffer zones to defragment the landscape. Projects aimed at restoring degraded habitats or populations of species covered by EU Nature legislation wherever necessary to achieve a good conservation status can also provide substantial added value to reaching the objectives of the Birds and Habitats Directives.

c) Strategic approach with an EU-level impact

With a view to upscale the necessary measures needed to halt biodiversity loss, a **strategic approach** should be fostered through projects that either are deployed at a scale that is significant and transcends administrative boundaries; *or* involve a minimum of two Member States (or a Member State and a neighbouring country); *or* implement a national GI strategy or a national restoration prioritisation framework[16].

Being deployed at a '**significant scale**' means that projects **provide benefits** beyond the local scale. It also means avoiding disparate scattered GI measures but undertaking instead a consolidated approach at a relevant scale for ecosystems, e.g. projects aiming at restoring whole river basins or flood plains.

The transcendence of administrative boundaries includes cooperation between administrative entities such as districts, departments, regions, states and countries.

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[15] Directive 2009/147/EC and Directive 92/43/EEC.

[16] http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/RPF.pdf

Cooperation between at least two Member States can include several types of action, such as cooperation on a cross-border / transboundary habitat area (including marine) or cooperation to improve a flyway or aquatic migratory route. Cooperation can also take place in areas situated within the territory of one Member State, and which would deliver EU-level benefits, such as restoring EU priority natural habitats.

Island countries can participate in all of those kinds of cooperation.

A strategically planned network of green or blue infrastructure is deemed to exist when a national GI strategy or a national restoration prioritization framework is already in place, to which a given EU-level GI project would aim at contributing.

The following case studies illustrate how these three criteria can be implemented in a synergistic manner, for the benefit of nature, people and the economy. **A full and comprehensive presentation of those as well as several other relevant case studies is included in Annex I.**

***Box 1 - DANUBEPARKS*: the Danube River Network of Protected Areas – Development and Implementation of Transnational Strategies for the Conservation of the Natural Heritage at the Danube River & DANUBEPARKS STEP 2.0**

Project duration: 2009 – 2012 & 2012 – 2014; **Budget**: EUR 2.7 million & EUR 2.2 million

Funds used: ERDF (INTERREG – South-East Europe Transnational Cooperation Programme)

Project description

The first DANUBEPARKS project (2009-2012) established a transnational network of 12 protected areas (later extended to 15) from eight Danube countries – Austria, Bulgaria, Croatia, Germany, Hungary, Serbia, Slovakia, and Romania – in order to systematically tackle common ecological challenges on a Danube-wide scale, recognising that the Danube is one interrelated and interdependent ecosystem. The network's objectives, set out in the 'Declaration of Vienna', were to establish a platform for continuous transnational cooperation, develop and implement joint conservation strategies, coherent management practice, and a common corporate identity. The network also implemented pilot transnational conservation projects. The project focused on five core implementation areas, namely: *River Morphology and River Restoration; Floodplain Management and Habitat Network*; *Conservation of Flagship Species*, which included Sturgeons and White-tailed Eagles; *Monitoring and NATURA 2000*; and *Nature Tourism*.

A follow-up project, DANUBEPARKS STEP 2.0 (2012-2014) aimed to build upon the achievements of the first project, secure its results, and further expand the network. This second step involved 20 partners in nine countries – the aforementioned eight plus Moldova. The project focused on the preservation and restoration of natural river dynamics, maintenance of an international network of floodplain forest habitat, further

support of the White-tailed Eagle population, monitoring of indicator species for river dynamics, and further promoting nature tourism and environmental education.

DANUBEPARKS has been a flagship project of the EU Strategy for the Danube Region, contributing to the Strategy's implementation.

Impacts of the projects (including environmental, social, and economic benefits)

Protected areas play an important role in the long-term conservation of Danube ecosystems and their services. The DANUBEPARKS project and its follow-up resulted in increased collaboration among protected area managing organisations, the exchange of knowledge and experience, and the elaboration of transnational thematic strategies.

The projects contributed to reconciling the sometimes conflicting interests of nature conservation and economic sectors. For example, following an integrative approach and in cooperation with water management authorities, DANUBEPARKS developed a *'Strategy on Conservation and Navigation'* that identifies potential conflicts as well as possible synergies between conservation and water transport, with a view to helping Danube protected areas managers to engage in negotiations with the navigation sector and water management authorities to find win-win solutions that improve both navigability and ecology. The *'Strategic position on Tourism, Environmental Education and Regional Development'* aims to help foster sustainable tourism along the Danube and in protected areas, while minimising the negative pressures tourism may place on biodiversity.

The project activities aimed at enhancing nature tourism and recreation opportunities are also likely to have generated additional income and local jobs, although the project reports do not provide estimates of these benefits.

<u>How the project meets the three EU-level GI criteria</u>

i) Enhance the delivery of multiple ecosystem services at a significant scale

The project contributed to maintaining and/or enhancing several ecosystem services. The project's actions related to the protection and management of floodplain forests benefit services such as carbon sequestration and sustainable flood protection. Another relevant project activity was the analysis of the genetic variability of Black Poplar in several Danube protected areas, which provides a basis for the definition of long-term strategies for protection and conservation of the gene pool of European Black Poplar. The project also enhanced nature-based recreation and tourism opportunities, as well as environmental education, through actions related to product development (e.g. boat and bike excursions), joint capacity-building activities (e.g. training for rangers to guide international groups) and international marketing efforts.

ii) Contribute to the goals of EU Nature legislation

The projects were explicitly aimed at safeguarding the rich biodiversity of the Danube Basin. Under the umbrella of DANUBEPARKS, the participating protected areas, which altogether comprise over 30 Natura 2000 sites, have comprehensively addressed common challenges on a Danube-wide scale, by implementing actions on habitat management, species monitoring and conservation, and river restoration. Some of the

actions undertaken by the project benefit species protected under the Nature Directives, including the White-tailed Eagle and the Danube Sturgeon. Moreover, DANUBEPARKS actively promoted and communicated the crucial role of protected areas in order to raise public awareness. For its work across 9 countries the project won the Natura 2000 Award – 2015 in the category "Networking and cross-border cooperation[17].

iii) EU-level green and blue infrastructure projects should have a strategic approach with an EU-level impact

The two projects reflect a strategic, transnational approach to protecting and managing green infrastructure in the Danube River Basin. The two projects involved cooperation between protected area representatives from eight and nine countries respectively.

[17] http://ec.europa.eu/environment/nature/natura2000/awards/previous-editions/2015-edition/winners/networking-and-cross-border-cooperation/index_en.htm

Box 3 – The European Green Belt

Project duration: 2003 - ongoing

Funds used: ERDF, Interreg, BfN, BUND, BMUB, EuroNatur

Project description

The European Green Belt stretches over 12,500 kilometres along what was once the Iron Curtain, forming a corridor of habitats hosting a great variety of species: it reaches from the north of Europe to the Black and the Adriatic Sea in the south. Since the project's start in 2003, the inspiring idea of transforming the Iron Curtain into a 'European Green Belt' has at least partially become a reality: today it connects more than 4,000 protected areas in 16 EU countries, as well as 8 non-EU countries (Albania, Kosovo*, FYR Macedonia, Montenegro, Norway, Russia, Serbia, and Turkey). Almost 150 governmental and non-governmental organisations from these countries have come together in the initiative. The focus of the initiative is to conserve and restore the natural heritage along the former Iron Curtain to function as an ecological network whilst respecting the economic, social and cultural needs of local communities.

The initiative comprises four sections – the Fennoscandian, Baltic, Central European and Balkan Green Belts. To coordinate and facilitate the further development and protection of the Green Belt, a European Green Belt Association was established in 2015.

Impacts of the project (including environmental, social, and economic benefits)

Examples of economic and social benefits provided by the European Green Belt include recreation and tourism, health benefits (derived from the multiple ecosystem services provided by the protected areas and corridors covered by the European Green Belt), beneficial effects on the local economy (including local employment) and preservation of cultural heritage.

Research in Finland has shown that EUR 1 of public investment in nature conservation along the Green Belt of Fennoscandia has a return of EUR 10 to local private income, for example via tourism and tourism-related businesses. The total income of the national parks and hiking areas on the Finnish side of the Green Belt totalled around EUR 100 million in 2016.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

The European Green Belt delivers multiple ecosystem services. It is mainly aimed at (transboundary) connectivity of natural habitats and providing habitat for species of concern (see ii), as well as migratory routes (especially important with climate change). The European Green Belt delivers multifunctional benefits through its high potential of providing regulating, but also provisioning and cultural ecosystem services. A study undertaken by the University of Munich has demonstrated that given the wide variety of habitat types covered by the European Green Belt, the initiative contributes to maintaining or enhancing a wealth of ecosystem services, from climate change mitigation and air quality regulation, to the provision of opportunities for nature-based tourism and

recreation.

ii) Contribute to the goals of EU Nature legislation

The European Green Belt connects a string of important habitats, from grassland fallow and wetlands, to dry grasslands and mature woodlands. The European Green Belt's ecological network consists of core areas, sustainable use areas, and green infrastructure/landscape corridors or buffer zones. This network crosses nearly all of the continent's biogeographic regions from old-growth boreal forests and taiga in the north, to coastal and marine habitats in the Baltic region, to steppes in the south. This is important for migrating species such as wolves, bears and lynxes, as well as amphibians and birds. For example, the present distribution of the Balkan lynx (*Lynx lynx balcanicus*) largely matches the course of the Balkan Green Belt between Albania and Macedonia, Montenegro and Kosovo*. Such well-connected networks of protected areas play an important role in supporting populations in adapting to habitat fragmentation and climate change.

In addition, the European Green Belt serves as a refuge for a range of threatened species, such as black vultures and griffon vultures. On the 1,400 km stretch in Germany alone, a survey by German conservation NGOs found more than 600 animal and plant species on the IUCN's Red List.

The European Green Belt's protected areas include Natura 2000 and Emerald sites, national parks, biosphere reserves, as well as other areas with varying levels of protection. Studies have demonstrated that the coverage of protected areas is much higher in the core zone of the Green Belt than outside.

iii) EU-level green and blue infrastructure projects should have a strategic approach with an EU-level impact

Crossing 24 countries, both within and outside the EU, the European Green Belt serves as a good practice example of cross-border cooperation on green infrastructure. The 9th European Green Belt Conference in 2016 highlighted, for example, that "combining biodiversity, economic and social benefits, the Green Belt Initiative is a symbol of transboundary cooperation to promote Europe's shared natural and cultural heritage". The initiative is a living example of structured and prolonged transboundary cooperation for preserving and developing green infrastructure.

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

The following case study also illustrates how certain **urban GI projects** can be relevant in the context of this guidance, when they constitute a coherent part of wider-scale green and blue infrastructure projects.

Box 4 – Emscher Landscape Park and Emscher River Restoration

Project duration: Ongoing projects since 1989 and 1992

Budget: Emscher Landscape Park: EUR 500 million; Emscher River Restoration: EUR 5,3 billion

Fund used: several EU funds since the mid-1990s; co-financed by the German federal government, the Federal state of North Rhine-Westphalia , the 20 municipalities involved, the Ruhr Regional Association , the water management association Emschergenossenschaft & Lippeverband and their members.

Project description

Two strategic and long-term regional projects,including hundreds of single actions and local projects, support the transformation of the Ruhr region in North Rhine-Westphalia, Germany since the early 1990s.

The Emscher river and its tributaries are located in the northern part of the centre of the Ruhr agglomeration, an area heavily affected by the decline of the coal and steel industries since the 1960s. The Emscher Landscape Park is a 457 km² regional park system between 20 cities. Almost half of the 5.1 million inhabitants of the Ruhr region live in this core of the agglomeration. To create the Emscher Landscape Park, vacant land of the former coal and steel industries and their transport infrastructures was converted into a connected system of urban landscapes, new parks, industrial and natural heritage and a network of bike paths. The park system includes more than 100 single projects and represents a complete transformation of the area from a forgotten place to an attractive and connecting green infrastructure.

The restoration of the Emscher river system is a parallel large-scale project. The Emscher and its tributaries are reconverted from highly modified open wastewater channels with concrete beds into natural stream systems. For this, a new 423 km underground sewer network is constructed to separate waste and river water. Subsequently, the concrete shells are removed, the channelization is reversed, and stream profiles widened. A system of floodplains and near-natural retention reservoirs will provide additional flood protection. The morphology and connectivity of the Emscher and its tributaries are restored aboveground.

Impacts of the project (including environmental, social, and economic benefits)

This complete conversion of the Emscher system enhances the quality of life and the ecological situation along the rivers, as well as in the urban neighbourhoods. The large Emscher renewal investments have helped transform the region from decline to smart growth. Ruhr is back with a new and diversified economic structure with new and sustainable urban qualities, based on green infrastructure.

The Emscher revitalisation is estimated to create about 1,400 direct jobs per year from its inception to 2020 (Barabas et al., 2013). Beyond these direct impacts on employment, the project contributes to improving quality of life in the area and increasing the area's overall attractiveness. Millions of people use the new parks and bikeways. The quality of life has been raised in all neighbourhoods. Five million visitors travel on the *Route of Industrial Heritage Ruhr* yearly.

A recent valuation study on the Emscher restoration project estimates that the ecosystem services resulting from the initiative have an annual market value/direct

economic impact of over EUR 21 million, while the area's 'non-market value' (based on estimates of 'willingness to pay in appreciation that restored river sections exist') is estimated at EUR 107 million per year (Gerner et al., 2018).

How the projects meet the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

The projects contribute to enhancing a suite of ecosystem services, including flood control, microclimate regulation, as well as cultural ecosystem services such as opportunities for recreation and aesthetic quality of the landscape.

ii) Contribute to the goals of EU Nature legislation

The projects included research and investments in and implementation of actions aimed at improving biodiversity, connecting biotopes, benefitting rare species, enriching the aquatic biotopes and enabling the 'rebirth' of the banks of the restored rivers. The initiatives also fostered a new understanding of industrial nature and urban wilderness and their ecosystem services, and promoted accessibility to urban nature including protected wildlife areas.

iii) EU-level green and blue infrastructure projects should have a strategic approach with an EU-level impact

Both projects are large-scale, strategic green infrastructure projects transcending administrative boundaries. They demonstrate how the development of green and blue infrastructure can serve as a strategic factor for the transformation of an entire region.

III. EU SUPPORTING TOOLS AND INSTRUMENTS

1. EU CURRENT FINANCING INSTRUMENTS TO SUPPORT STRATEGIC INVESTMENTS IN EU-LEVEL GREEN INFRASTRUCTURE PROJECTS

In the 2014-2020 period, the European Structural and Investment Funds (ESIF) – in particular, the **European Agricultural Fund for Rural Development** (EAFRD), the **European Maritime and Fisheries Fund** (EMFF), the **European Regional Development Fund** (ERDF) including Interreg, and the **Cohesion Fund** – present several opportunities to finance EU-level GI projects. These funds are governed by a set of common rules and principles as laid down in the Common Provisions Regulation (CPR) (Regulation (EU) No 1303/2013). The CPR outlines, amongst others, requirements with regard to strategic planning and programming, including thematic objectives (TOs) that ESIF-funded projects and measures must support. Table 1 below presents the thematic objectives for the 2014-2020 period and identifies links with EU-level GI.

Table 1 – Links between ESIF thematic objectives and EU-level GI

Thematic Objective	Links to EU-level GI
TO1: Strengthening research, technological development and innovation	Research and innovation can support the design and implementation of EU-level GI projects (e.g. through the development of methods/tools for identifying areas for prioritisation, assessing ecosystem service delivery, etc.). EU-level GI projects may also entail research and innovation (R&I) elements (alongside other activities), e.g. demonstration of innovative approaches to GI implementation.
TO2: Enhancing access to, and use and quality of, Information and Communication Technologies	The Digital Europe programme can contribute to enable the considerable data monitoring, interconnection and modelling that is necessary to operate green and blue infrastructure.
TO3: Enhancing the competitiveness of SMEs, of the agricultural sector (for the EAFRD) and of the fishery and aquaculture sector (for the EMFF)	EU-level GI projects may result in the creation of business opportunities related to nature and ecosystem services, such as nature-based recreation and tourism. EU-level GI projects related to agricultural or aquatic ecosystems may enhance competitiveness of the agriculture, fishery, or aquaculture sectors by enhancing the ecosystem services on which these sectors depend.
TO4: Supporting the shift towards a low-carbon economy in all sectors	EU-level GI projects can contribute to carbon sequestration
TO5: Promoting climate change adaptation, risk	EU-level GI projects can deliver benefits related to climate change adaptation, risk prevention and management,

prevention and management	including through storm water retention, and mitigation of natural hazards such as floods, storm surges, landslides and avalanches.
TO6: Preserving and protecting the environment and promoting resource efficiency	EU-level GI projects directly contribute to the objective of protecting the environment since they are intended to enhance the delivery of ecosystem services and to contribute to achieving the goals of the Nature Directives. Such projects may also promote resource efficiency; e.g. natural water retention measures may reduce the need for wastewater treatment.
TO7: Promoting sustainable transport and removing bottlenecks in key network infrastructures	EU-level GI projects can contribute to the 'greening' of transport infrastructure, e.g. by mitigating habitat fragmentation effects, creating habitat for species alongside roads and rail networks, improving navigability of water courses while benefitting species and ecosystems, etc.
TO8: Promoting sustainable and quality employment and supporting labour mobility	Although promoting employment is not a core objective of EU-level GI projects, such projects can generate direct and indirect employment opportunities, e.g. in the area of nature-based tourism, or in professions related to implementation of GI (e.g. landscape architecture, restoration, ecological engineering).
TO9: Promoting social inclusion, combating poverty and any discrimination	EU-level GI projects can contribute to reducing poverty in rural areas by protecting / enhancing the ecosystem services on which rural communities depend. Creation of quality green space and/or improved accessibility to nature areas can help improve social cohesion, deliver recreation opportunities, and have positive impacts on health and well-being.
TO10: Investing in education, training and vocational training for skills and lifelong learning	Potential indirect linkages exist, e.g. if GI-related education and skills are included in curricula, or if EU-level GI sites are used for environmental education and training (e.g. educational visits to protected areas). In addition, research is accumulating on how a better environment improves cognitive abilities and health; and having access to nature and quality environment has a direct positive impact on education.
TO11: Enhancing institutional capacity of public authorities/stakeholders and efficient public administration	Not directly linked

Among ESIF, the **European Agricultural Fund for Rural Development**[18] (EAFRD) is the funding instrument for the EU's rural development policy, also known as the 'second pillar' of the CAP. Measures relevant to EU-level GI include those under: Article 17.1(d): non-productive investments linked to the achievement of agri-environment-climate objectives; Article 18.1(a): investments in preventive actions aimed at reducing the consequences of natural disasters, adverse climatic events and catastrophic events; Article 21: afforestation and creation of woodland; establishment of agroforestry systems; prevention and restoration of damage to forests from forest fires, natural disasters and catastrophic events, and investments improving the resilience and environmental value as well as the mitigation potential of forest ecosystems; Article 28: Agri-environment-climate payments, which support agricultural practices that make a positive contribution to the environment and climate; Article 34: Forest-environmental and climate services and forest conservation; Article 35 : Co-operation; Article 44: LEADER co-operation activities. Although most of the relevant measures are unlikely to support an EU-level GI project entirely, they could finance certain activities therein.

The **European Maritime and Fisheries Fund**[19] (EMFF) supports the implementation of the Common Fisheries Policy (CFP) and the EU Integrated Maritime Policy (IMP). The protection and restoration of aquatic biodiversity and ecosystems are mentioned among the EMFF's priorities. Several measures provided by the EMFF Regulation are compatible with the objectives of EU-level GI projects, such as e.g. Article 40: 'Protection and restoration of marine biodiversity and ecosystems and compensation regimes in the framework of sustainable fishing activities'; or Article 44, related to inland fishing and inland aquatic fauna and flora, which supports the management, restoration and monitoring of NATURA 2000 sites affected by fishing activities, and the rehabilitation of inland waters in accordance with the Water Framework Directive, including spawning grounds and migration routes for migratory species.

The **European Regional Development Fund** (ERDF) and the **Cohesion Fund** (CF) are two of the three financial instruments for implementing the EU's Cohesion Policy (together with the European Social Fund). Under the Investments for Growth and Jobs Goal, EU-level GI projects or part of them can be supported within several of the ERDF and CF thematic objectives related, for example, to environmental protection, climate adaptation and risk prevention. Moreover, under the European Territorial Cooperation goal, ERDF has more than 100 **Interreg** programmes (cross-border, transnational, maritime and interregional) that can fund GI projects in several countries.

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[18] Regulation (EU) No 1303/2013 (CPR) govern implementation of the EAFRD. The specific objectives and provisions for EAFRD support are set out in Council Regulation (EU) No 1305/2013 of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development.

[19] Council Regulation (EU) No 508/2014 of 15 May 2014 on the EMFF and the Common Provisions Regulation (EU) No 1303/2013.

In addition to the ESIF (which are presented in more details in Annex III), EU-level GI projects can be financed through the **Programme for Environment and Climate Action**[20] (LIFE)[21]. The general objective of LIFE is to contribute to the development, implementation and enforcement of EU environmental and climate policy and legislation by co-financing projects with European added value. In 2014-2020, the LIFE Programme includes support for so-called Integrated Projects (see annex III Box 3) which implement on a large territorial scale environmental and climate plans or strategies required by environmental or climate legislation.

The **EU Framework Programme for Research and Innovation** (**Horizon 2020**[22]) can support research activities underpinning the deployment of EU-level GI projects (such as e.g. scientific research on ecological processes, development of tools for GI mapping and assessment) and innovation actions, which could, for example, consist of the development of new, innovative nature-based solutions or innovative approaches to GI implementation. The transnational character of Horizon 2020 projects makes the fund particularly interesting for EU-level GI projects.

Innovative biodiversity financing for EU-level GI can also be provided by the **Natural Capital Financing Facility** (NCFF)[23], a financing mechanism managed by the European Investment Bank that supports projects focusing on nature and biodiversity and ecosystem-based adaptation to climate change, through loans and equity. The objectives of the NCFF are i) to address market gaps and barriers for revenue generating or cost saving projects that are aimed at preserving natural capital, including climate change adaptation projects, and ii) to demonstrate that investment into biodiversity (and climate change adaptation) can be financially attractive and that biodiversity conservation activities can be bankable projects that can generate revenues or deliver cost savings. It explicitly includes Green Infrastructure projects amongst eligible projects.

The **Connecting Europe Facility**[24] (CEF) is a key EU funding instrument to support the development of high performing, sustainable and efficiently interconnected trans-European networks in energy. Several measures provided by the CEF and the TEN-E Regulation[25] are compatible with the objectives of EU-level GI projects. Green and blue infrastructure could support the implementation of Projects of Common Interest[26] in preparatory phases as part of their design, permitting or environmental studies or during works in the form of purchase, supply, deployment, development, construction and installation activities of different GI components, systems and services.

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[20] Council Regulation (EU) No 1293/2013 of 11 December 2013; http://ec.europa.eu/environment/life/about/index.htm#life2014

[21] Nature or water integrated projects. See e.g. LIFE IP 4Natura - Integrated actions for the conservation and management of Natura 2000 sites, species, habitats and ecosystems in Greece

[22] e.g. through Nature Based Solution projects - https://ec.europa.eu/research/environment/index.cfm?pg=nbs

[23] http://www.eib.org/en/products/blending/ncff/index.htm

[24] https://ec.europa.eu/inea/en/connecting-europe-facility

[25] Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009

[26] https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest

Annex III contains a targeted presentation of those relevant opportunities provided by existing EU financing instruments as well as innovative financing to support EU-level green and blue infrastructure projects.

2. THE REVISED PRIORITISED ACTION FRAMEWORKS FOR NATURE

Prioritised action frameworks (PAF) are strategic multiannual planning tools, aimed at providing a comprehensive overview of the measures that are needed to implement the EU-wide Natura 2000 network and its associated GI, specifying the financing needs for these measures and linking them to the corresponding EU funding programmes.

The revised format [27] for Prioritised Action Frameworks (PAFs) for the post-2020 multiannual financial framework provides new opportunities for enhancing the contribution of GI to reaching EU nature and biodiversity objectives in the context of EU funds.

Where the ecological requirements of species and habitats of EU interest cannot be met by measures within the Natura 2000 network, Member States are now invited to also present in their PAF additional GI measures that contribute to the ecological coherence of the network. Such an approach offers multiple benefits:

i. it contributes to implementation of EU nature legislation, including Article 10 of the Habitats Directives which calls for the Member States to consider in the land–use planning and development policies the management of features of the landscape which are of major importance for wild fauna and flora;

ii. it helps the Member States to evaluate the needs related to GI and possibilities for its deployment

iii. it helps to identify win-win scenarios and synergies between different policies in view of delivering multiple benefits to citizens.

Following several rounds of consultations, the updated format of the PAF[28] was approved at the meeting of the Expert Group on the Birds and Habitats Directives on 22 May 2018.

3. SUPPORTING SCIENTIFIC AND TECHNICAL TOOLS

Green and blue infrastructure is both a spatial and a functional concept aimed at maximising the delivery of nature benefits. In the context of the 7th EU Environment Action Programme[29] and the EU Biodiversity Strategy to 2020, the EU has developed a number of supporting tools to map, assess and support the spatial and functional dimensions of green and blue infrastructure. These tools include e.g. the EU initiative on mapping and assessment of ecosystems and their services (MAES); and geographical information system (GIS) tools.

[27] http://ec.europa.eu/environment/nature/natura2000/financing/docs/PAF%20format%20EN.docx
[28] http://ec.europa.eu/environment/nature/natura2000/financing/docs/PAF%20format%20EN.docx
[29] http://ec.europa.eu/environment/action-programme/

a) Mapping and Assessment of Ecosystems and their Services (MAES)

The European MAES initiative[30] has developed a coherent analytical framework to ensure that consistent approaches linking biodiversity, ecosystem condition and ecosystem services, are used across Member States and at EU level (1st MAES Report, 2013). The MAES framework includes a typology for ecosystems in EU (based on EUNIS and Corine Land Cover) and promotes a classification of ecosystem services that allows for integration in accounting systems[31] (based on CICES[32]). The common assessment framework was further developed with a selection of indicators and a European map of ecosystems (2nd MAES Report, 2014). The 3rd MAES Report (2016) synthesises the European Environment Agency's work on ecosystem mapping and provides short assessments of pressures, condition and biodiversity for main ecosystem types mainly based on datasets derived from reporting under EU environmental policies. A fourth report addressed urban ecosystems and green infrastructure (4th MAES Report, 2016). The 5th MAES report further consolidates and enhances the operational guidance on mapping and assessment of ecosystem condition and provides a selection of key indicators across different ecosystems according to a joint framework; it provides the basis for an integrated ecosystem assessment to evaluate the achievements of the EU Biodiversity Strategy. These indicators are presented in Annex III.

The European relevance and value added of EU-level green and blue infrastructure projects can be explained and demonstrated using the MAES methodology, together with the EU approach to restoration prioritization frameworks[33].

Figure 1: A common assessment framework for ecosystems

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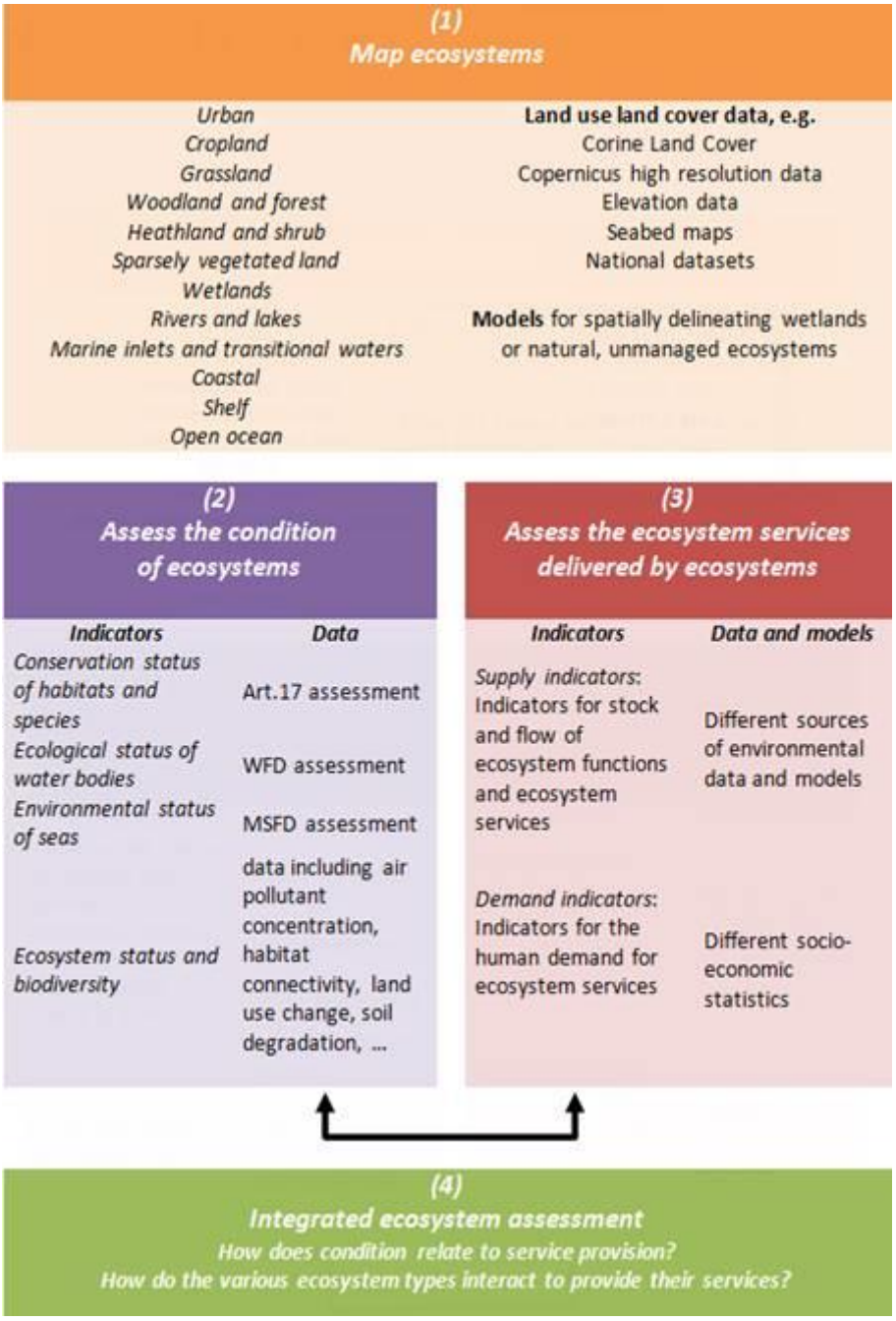
30 https://biodiversity.europa.eu/maes

31 http://ec.europa.eu/environment/nature/capital_accounting/index_en.htm

32 Common International Classification of Ecosystem Services; https://cices.eu/

33 http://ec.europa.eu/environment/nature/biodiversity/strategy/pdf/RPF%20letter%20to%20MS%20from%20PB%20April%202014%20Annexe.pdf



b) Geospatial methodological guidelines, data and tools

The EU GI strategy called to 'review the extent and quality of the technical and spatial data available for decision-makers in relation to GI deployment'.

Spatially explicit datasets and methods are available to support the assessment and mapping of GI and its components. To further develop GI, datasets and methods are also available to identify priority areas for conservation and restoration actions. Some decision support tools also exist to develop scenarios using different land use policy drivers to test their impact on GI in the future.

Models for GI development and assessment require the input of spatial datasets at multiple scales, i.e. from the local to pan-European scale. The European CORINE Land Cover (CLC) data set is one of the only harmonised and regularly updated available information that can be used for mapping land use and land cover in the EU, with a spatial resolution of 25 ha. The LUCAS survey as it provides another harmonised data set for land use and land cover at the European scale [34]. The more recent European Copernicus Programme provides new opportunities such as, amongst other data, the local component product Urban Atlas, with a spatial resolution of 0.25 ha for the urban areas and 1 ha for the non-urban classes, and the Copernicus High Resolution layers on forests, grasslands or water.

These tools are presented and analysed in more details in a technical report published alongside this guidance document titled 'Strategic green infrastructure and ecosystem restoration: geospatial methods, data and tools'[35]. This report focuses on data, tools and their application in case studies selected in both rural and urban contexts. Europe-wide data are in certain cases combined with regional data for demonstration purposes ; all data and tools are listed (with a web link to download) specifying the GI element in question. The report provides technical methodological guidance to support strategic policy and decision-making to deploy a well-connected, multi-functional and cross-border GI. It also identifies knowledge gaps. GI mapping is particularly demonstrated to enhance nature protection and biodiversity beyond protected areas, to deliver multiple ecosystem services, to prioritise measures for defragmentation and restoration and find trade-offs of land allocation involving all sectors

c) The Natura 2000 biogeographical process

The purpose of the Natura 2000 Biogeographical Process, launched in 2012 by the European Commission, is to assist Member States in managing Natura 2000 as a coherent ecological network, whilst exchanging experience and best practices, addressing objectives and priorities and enhancing cooperation and synergies.

In the context of the viability of the Natura 2000 network, it is also important to know how to ensure that habitats also achieve a level of favourable conservation status in the wider landscape, and how to address the major threats and opportunities that occur there.

The cooperation initiated under the Natura 2000 Biogeographical Process particularly focuses on issues that are common to several Member States. In this perspective, Annex I habitats have been selected for priority discussion among Member States sharing a same biogeographical region. For many of these habitats, an improvement of e.g. their structure and functions would entail ensuring a certain connectivity of targeted Natura 2000 sites and therefore restoration activities also outside the network. These priority habitats should be considered in the context of this guidance.

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[34] https://ec.europa.eu/eurostat/statistics-explained/index.php/LUCAS_-_Land_use_and_land_cover_survey

[35] Estreguil, C., Dige, G., Kleeschulte, S., Carrao, H., Raynal, J. and Teller, A., Strategic Green Infrastructure and Ecosystem Restoration: geospatial methods, data and tools, EUR 29449 EN,Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-97295-9, doi:10.2760/36800, JRC113815.

d) A sustainable bioeconomy for Europe

The bioeconomy[36] covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. For the bioeconomy to deliver on sustainability, we must be able to better understand and measure its effects and impacts on the ecological boundaries of our planet. This is necessary to develop the bioeconomy in a way that attenuates pressures on the environment, values and protects biodiversity and enhances the full range of ecosystem services.

The European Commission's Knowledge Centre for Bioeconomy [37] (KCB) aims at eenhancing and making accessible the knowledge on the bioeconomy, including on biodiversity and ecosystems, to deploy it within safe ecological limits; and this knowledge can also support the deployment of green infrastructure in the EU.

[36] COM(2018) 673 final.
[37] https://ec.europa.eu/knowledge4policy/bioeconomy

IV. NEXT STEPS

The European Commission proposals for the EU Multi-annual Financial Framework 2021-2027 provide new opportunities for supporting GI, including through

- The new LIFE programme, which includes new 'strategic nature projects', which aim at strengthening the integration of nature and biodiversity in other policies through a more coordinated and strategic approach. This should provide major opportunities for supporting EU level GI projects. 'Strategic integrated projects' for other policies, e.g. water, will also provide further funding opportunities;
- Cohesion policy, including the proposed Regulation on the European territorial cooperation goal (Interreg), which aims at fostering cross-border, transnational, maritime and inter-regional cooperation;
- The new EU Common Agricultural Policy, putting greater emphasis on environment and climate, and the role given to Member States to design CAP strategic plans, which will be an opportunity to foster EU-level green and blue infrastructure projects;
- The new European Maritime and Fisheries Fund, relevant as regards costal and marine green and blue infrastructure;
- The new Framework Programme for Research and Innovation, Horizon Europe, investing on enhancing knowledge and demonstrating solutions to preserve and restore biodiversity and ecosystems.

With a view to contributing to establishing a strategic framework for EU level green and blue infrastructure, the Commission services intend to revisit and update this guidance within three years in the light of the experience gained and of the new EU Multiannual Financial Framework 2021-2027.

Annex I. Full case studies

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TRANSGREEN – Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature

Project duration: 2017 – 2019; **Budget:** EUR 2,481,321

EU funds used: ERDF – Interreg Danube Transnational Programme (85% of project costs)

Project description

The network of highways and railways that connect key areas of Central and Eastern Europe to the rest of the continent is currently being planned for development, as part of the Trans-European Network for Transport (TEN-T). The network is being extended across the Carpathian Mountains and will cross through green infrastructure comprising natural and protected areas, including Natura 2000 sites, threatening wildlife connectivity. More than a quarter of Europe's large carnivores populations live in the Carpathians. The planned road and rail developments threaten to cut through the movement corridors of these and numerous other species, thus leading to habitat fragmentation that seriously menaces their long-term wellbeing and survival. On the other hand, preserving nature at all costs could mean slowing down regional development and people's movement across the mountains. At the same time, the intersection between roads and ecological corridors can lead to collisions and roadkill, threatening not only wildlife but also people's lives.

While negative effects of transport and the relative fragility of mountainous ecosystems call for the identification of innovative solutions to reduce harmful impacts, transport planners widely lack experience and expertise for mitigating ecological impacts of transport infrastructure and safety issues related to wildlife crossing. Moreover, in some countries of the project area, there is a lack of biodiversity baseline data and planning processes do not take into consideration sufficient time for data collection and monitoring. This situation has caused conflicts with nature conservation stakeholders and consequently lengthy delays of infrastructure project implementation. Guidance and planning security are needed from project developers and the conservation community alike.

The apparent conflict between nature and infrastructure can be overcome by properly integrating people's and nature's perspectives into transport planning for the Carpathian region and actively involving a variety of stakeholders in the process. The TRANSGREEN project, which started in January 2017, aims at enhancing the safety and environmental-friendliness of road and rail networks under development in the Carpathian region in the Czech Republic, Hungary, Romania, Slovakia, and Ukraine.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

By maintaining ecological corridors along transport infrastructure, the project will also contribute to maintaining or enhancing regulating services. In particular, GI along transport infrastructure is expected to contribute to air quality regulation (reducing pollution from transport by capturing pollutants), as well as climate and water regulation.

ii) Contribute to the goals of EU Nature legislation

The project is specifically aimed at maintaining habitats and preserving and enhancing connectivity for wildlife, in order to protect the rich biodiversity of the Carpathian region. Several of the species that will benefit from the project's actions are protected under the Habitats Directive, including the brown bear (*Ursus arctos*), the wolf (*Canis lupus*) and the lynx (*Lynx lynx*).

iii) EU-level green and blue infrastructure projects should have a strategic approach

The project covers five countries and includes two pilot areas involving cross-border transport infrastructure.

GI actions undertaken

The project entails three broad categories of activities:

- **Developing adapted and specific technical solutions**: Field studies focusing on Trans-European Network for Transport (TEN-T) infrastructure projects in different stages of development are conducted in four pilot areas: Tîrgu Mureș - Iași (Romania), Arad - Deva (Romania), Miskolc (Hungary) - Košice (Slovakia) - Uzhgorod (Ukraine), Beskydy (Czech Republic-Slovakia). Relevant stakeholders are involved in discussions, data gathering and sharing. Field work is being conducted to identify critical areas for wildlife and safety, and ecological corridors and to collect data on biodiversity along the planned and existing infrastructure routes. For each of the pilot areas, a '*Catalogue of measures'* is being elaborated together with decision makers, local stakeholders, nature conservation organisations and road and rail administrations/authorities to avoid/overcome conflicts between transport planning objectives and green infrastructure objectives (Natura 2000 sites, wildlife corridors, road-less/low traffic areas etc.).
- **Consultations and knowledge sharing across pilot areas** that are in different stages of linear infrastructure development (planning, construction, operation, and monitoring) including a survey of costs and benefits of ecosystem services/green infrastructure in relation to transport infrastructure.
- **Consultations for interdisciplinary approaches:** Meetings and partnerships with ministries, planners, developers, administrations, relevant local authorities, protected areas, consultants and NGOs for the development of the publication '*Guidelines for improving infrastructure development'*. The results of the scientific work and activities in the pilot areas will be reflected in the publication addressed to road/rail infrastructure planners, developers, and involved authorities from the field of nature conservation and transport. On the political level, the project will develop a *'Strategic Action Plan for Sustainable Transport Development in the Carpathians'* and foster cross-sectoral meetings at the national and Carpathian Convention level.

Impacts of the project (including environmental, social, and economic benefits)

TRANSGREEN will contribute to preserving ecological corridors and to ensuring a safer road and rail network in the Carpathians by integrating green infrastructure elements into TEN-T related transport infrastructure development. This will benefit both wildlife and regional development.

The project helps to minimise conflicts between transport planning and GI objectives by fostering dialogue between stakeholders from different sectors. To date, 247 different stakeholders across the project area have been involved in project events and activities at the local, national and international level; most of these stakeholders had never worked with each other before. This has led to raised awareness of the problem and better coordination and interoperability among relevant stakeholders from the transport, spatial planning and environmental sector.

The project activities and preliminary results are already feeding into policy and planning processes. Project partners are involved in cross-sectoral working groups at the governmental level in the Czech Republic, Slovakia, and Romania, where concrete measures for the pilot areas are being developed. Official recommendations prepared by the project partners together with experts on measures for wildlife crossings (widening of an existing overpass, speed limits) were sent to authorities of the Pardubický region, Czech Republic. The plans for infrastructure construction and improvements of existing infrastructure were changed accordingly. In Ukraine, the project partners are involved in the "greening" of the National Transport Strategy 2030.

Overall, the project will contribute not only to maintaining or improving connectivity for wildlife, but also to the improvement of the traffic situation (e.g. less traffic that runs through villages or city centres, faster connections to larger centres), and to increased transport safety by avoiding collisions with wildlife.

The project results will also be disseminated beyond the Carpathians (e.g. through the Infra Eco Network of professionals working in the field of nature conservation and road ecology - IENE), which may lead to further uptake of the solutions and approaches developed in TRANSGREEN.

TRANSGREEN results will also be further promoted through a complementary project, ConnectGREEN (ERDF-funded through the Danube Transnational Programme) which has recently been approved and deals with aspects of green infrastructure related to spatial planning.

References & further information

Project website: www.interreg-danube.eu/approved-projects/transgreen

TRANSGREEN (2016) Introduction to the project. Available at: www.carpathianconvention.org/tl_files/carpathiancon/Downloads/03%20Meetings%20and%20Events/Implementation%20Committee/CCIC_Vienna2016/Presentations/TRANSGREEN.pdf

Case study developed with inputs from Hildegard Meyer, WWF International Danube-Carpathian Programme.

The Alpine-Carpathian Corridor

Project duration: 2009-2012; **Budget:** EUR 1,852,450

EU funds used: ERDF – Interreg: Cross-Border Cooperation Programme Slovakia–Austria (77% of project costs).

Project description

The mountain ranges of the Alps and the Carpathians provide habitat to many emblematic species, such as the deer, lynx, brown bear and wolf, but are separated by a lowland area of intensive economic activity, including two capitals, Vienna and Bratislava. The development of road infrastructure, urban settlements and industrial activity in this area have been fragmenting the landscape and interrupting the traditional route taken by wildlife to cross between the two mountain ranges. The objective of the Alpine-Carpathian Corridor project was to support the re-establishment of an ecological corridor between the eastern reaches of the Alps and the Western Carpathians – i.e. in Austria and Slovakia – in order to enable wildlife migration and genetic exchange between wildlife populations, whilst improving the area's recreational value for citizens. The project also aimed to strengthen conservation management in the protected areas along the Alpine-Carpathian Corridor and in neighbouring habitats.

The project involved several partners from Austria and Slovakia, including the DAPHNE Centre for Applied Ecology, WWF, the United Nations Environment Programme (UNEP) Vienna Office, the University of Natural Resources and Life Sciences, Vienna (BOKU) and the national highway companies.

The initiative is a flagship project of the EU Strategy for the Danube Region (EUSDR).

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

In addition to its benefits to wildlife, the project aimed to enhance cultural ecosystem services, such as recreation, tourism and ecological education, for example through the establishment and promotion of a transboundary biking route allowing travellers to experience nature and learn about biodiversity along the ecological corridor.

ii) Contribute to the goals of EU Nature legislation

The project was explicitly aimed at restoring ecological connectivity, thereby benefitting numerous species, from large mammals such as the lynx and brown bear, to birds and amphibian species.

iii) EU-level green and blue infrastructure projects should have a strategic approach

The project was transboundary, involving actions in Austria and Slovakia.

GI actions undertaken

Based on scientific research on the impacts of fragmentation on wildlife, the project developed GIS-based models in order to identify the optimal location of the corridor. To support implementation of the corridor, the project developed technical documentation for building wildlife overpasses across highways and facilitated knowledge-exchange and the sharing of experience between the Austrian and Slovakian national highway companies. Specific outputs of the project included the construction of a green bridge over the A4 motorway in Austria, developing technical documentation for a green bridge across the D2 highway in Slovakia (constructed after the end of the project), and enhancing nature-based recreation opportunities through the establishment of a biking route. The project also provided assistance in integrating the Alpine-Carpathian corridor into spatial planning instruments.

In addition, the project sought to secure political commitment to further develop and maintain the Alpine-Carpathian Corridor in the long-term through the negotiation of a Memorandum of Understanding between all relevant stakeholders in both countries, including the national and regional authorities, as well as the national highway companies. The Memorandum of Understanding was accompanied by a detailed Action Plan for the corridor's implementation.

Impacts of the project (including environmental, social, and economic benefits)

The project succeeded in fostering a better understanding of the need for ecological connectivity measures and in garnering political commitment to maintain the ecological corridor in the long term. The stakeholders involved are still very much committed to the Memorandum of Understanding adopted in the framework of the project.

The project generated private investment in connectivity solutions from the highway companies in both Austria and Slovakia. The project also involved significant capacity-building, transfer of experience and technical assistance to Slovakia on planning and constructing green bridges. This transfer of expertise may also provide benefits in the long term.

Ecological networks like the Alpine Carpathian Corridor help sustain not only viable populations of wildlife species, but also a healthy and attractive environment for recreation and tourism in the vicinity of economically dynamic areas. The project helped promote the corridor as an area for recreation, and contributed to raising environmental awareness among citizens. A 316 km cross-border biking route was created in the framework of the project. The project also contributed to improving transport safety by helping to avoid wildlife accidents.

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LIFE ELIA-RTE – Development of the beddings of the electricity transportation network as means of enhancing biodiversity

Project duration: 2011-2017; **Budget:** EUR 3 million

Funds used: LIFE (38% of project costs); co-financed by the Belgian Transmission System Operator (TSO) ELIA (22%), the French TSO RTE (13%), and the Walloon regional government (27%).

Project description

The aim of the LIFE ELIA-RTE project was to develop innovative techniques for the creation and maintenance of ecological corridors under overhead electricity lines.

In wooded area, trees can become a major problem for network safety since their growth can interfere with electricity transmission infrastructure. This is usually managed by clearing the vegetation through mulching and manual cuttings. The corridors created in this way are usually devoid of vegetation and wildlife and considered to have a negative impact on the natural beauty of the landscape. At the same time, transmission system operators spend considerable sums on the maintenance of such corridors. Moreover, by clearing vegetation and enriching the soil, these management techniques in fact promote seedlings and the rapid return of the species that TSOs seek to avoid under the lines.

The LIFE ELIA-RTE project aimed to turn these areas into a network of ecological corridors and maximise their potential benefits for biodiversity, while ensuring safety of the electricity network. Specifically, the project aimed to restore 130 km of corridors in several locations across Belgium and France. The new ecological corridors will allow local biodiversity to develop and will help facilitate the movement of species across natural sites, which is particularly important in the context of climate change.

The project also sought to demonstrate that active management for biodiversity can reduce the costs of securing and maintaining corridors under overhead power lines, compared to the current management practices undertaken by TSOs. By demonstrating good practices, developing guidelines, and sharing its experience with other European TSOs, the project aims to encourage further uptake of these practices in other parts of the 300,000 km network of high-voltage power lines in the EU.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

The project was not specifically intended to address ecosystem services, but several of the project actions can be considered to contribute to maintaining or enhancing ecosystem services, compared to the traditional approaches to managing the corridors. For example, orchards and flower meadows benefit pollination, the restoration of peatland habitats contributes to carbon storage, and landscape improvements increase the areas' amenity value. More generally, the project enhances the sustainability of energy production.

ii) Contribute to the goals of EU Nature legislation

The project locations cover parts of 31 Natura 2000 sites in the Belgian Walloon region and five sites in France. It contributes to the restoration of several natural habitats of EU interest, namely peatlands, moors, chalky grasslands and lean meadows. By creating a network of ecological corridors, the project improves connectivity between natural areas. Specific actions undertaken as part of the project benefit species; for example, the creation of a network of ponds along forest corridors allows amphibians to travel easily and colonise new areas, and ensures genetic mixing of the populations. Dragonflies and a number of other aquatic insects will also benefit from improved ecological connectivity.

iii) EU-level green and blue infrastructure projects should have a strategic approach

The project covers locations in two Member States and demonstrates approaches that can be replicated and scaled up throughout the EU.

GI actions undertaken

The project implemented seven types of actions, designed to combine electricity security with biodiversity improvements:

- Planting or restoration of structured forest edges: The establishment of forest edges composed of species known to be of low height at maturity greatly reduces the growth possibilities of tree species which are problematic due to their height, since the selected species will occupy the space and reduce the amount of light reaching the ground. In addition, forest edges promote biodiversity, as they constitute a transition zone hosting species of both forest and open environments, and also provide habitat to the species dependent on these edges. They also play an important role in ecological connectivity.
- Planting conservatory orchards: Similarly to forest edges, orchards reduce the possibility of growth of problematic tree species. Conservatory orchards are orchards grown to safeguard rare species of wild fruit trees. Their flowers and fruits also attract pollinators, as well as large and small wild fauna. Orchards also improve the aesthetic quality of the landscape.
- Restoration of rare natural habitats (peatlands, moors, chalky grasslands and sparse meadows): Natural habitats restored as part of the project were selected due to the low height of the vegetation, which is compatible with ensuring electrical safety. At the same time, the restoration actions contribute to maintaining or enhancing the ecological quality of these rare habitats, and benefit the species they host.
- Creation of natural ponds: Digging ponds in the corridors facilitates the movement of species such as dragonflies, frogs, toads and water birds and allows the establishment of various plant species.
- Management through mowing and pasturing: Mowing or pasturing using grazing cattle controls the growth of young tree shoots and enables the development of typical flora.
- Sowing flower meadows: Sparse meadows are rich in flora which benefits pollen-gathering insects.

- Combating invasive species: Corridors can become vectors for the spread of invasive plant species. The project sought to reduce these negative impacts by promoting appropriate techniques for prevention and management.

The project also developed a vade-mecum of best practices for transmission system operators, as well as a vade-mecum for landowners and land managers.

Impacts of the project (including environmental, social, and economic benefits)

The project's achievements in terms of ecological improvements include the creation or restoration of 259 hectares of forest edges; plantation of 22 hectares of wild orchards; restoration of 91 hectares of natural habitats; 74 hectares under management by grazing and mowing; 29 hectares of sowed meadows; and creation of 157 ponds.

Overall, the project demonstrated that alternative methods of managing vegetation under electricity transmission lines can provide benefits for biodiversity, transmission system operators, landowners, and residents alike. An economic assessment carried out as part of the project showed that the alternative management actions implemented by the project resulted in significant cost savings compared to the traditional vegetation management methods (mulching and manual fellings) implemented by the Belgian TSO. The project actions were shown to break even in 3 to 12 years, and to become 1.4 to 3.9 times cheaper (depending on the action) than the traditional management methods after a period of 30 years.

Moreover, traditional vegetation management involves operations that are highly visible and not appreciated by locals. TSOs do not own the land under high-voltage lines. Although the TSOs have the right to manage vegetation affecting electricity lines, landowners do not feel involved in the choices and decisions made in terms of maintenance operations. The project demonstrated how TSOs can develop local partnerships – e.g. entrusting vegetation management to local rural stakeholders – that contribute to a better implementation of the actions on site and also benefit landowners. For example, farmers managing the areas through pasturing or mowing can receive agricultural subsidies under the agri-environment measures. For slviculture, the planting of forest edges and conservatory orchards contributes to diversification of the forest range, allows the production of small logs sought for particular products, and mitigate the impact of winds on forest stands. For the hunting sector, sowing lean meadows, forest borders and restoration of certain natural habitats offer game an environment for nesting and/or feeding.

In addition, the ecological corridors contribute to preserving the natural beauty of the landscape, improving the areas' attractiveness to tourists, hunters and local residents, and promotes greater acceptance of line infrastructure in the landscape by the general public.

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Lafnitz - Habitat cross-linking on an Alpine pannonical river

Project duration: 2003 - 2007; **Budget:** EUR 4,567,454

EU funds used: LIFE (44% of total project costs)

Project description

The Lafnitz is one of the last remaining semi-natural lowland rivers in Austria, having been left to meander without intervention for over three-quarters of its 112 km course. Consequently, it hosts numerous fish species listed in Annex II of the Habitats Directive, as well as bird species protected under the Birds Directive, in and around its loops, oxbow lakes, side channels and associated alluvial forests. The entire river area has been designated as a Natura 2000 site. The Lafnitz river valley is also a Ramsar site.

Most of the banks and floodplain landscape of the Lafnitz had been maintained from the 1980s onwards to promote passive flood protection, i.e. creating or securing naturally occurring water retention areas in order to slow down water flow and reduce flood risk. However, past engineering interventions continued to have negative impacts on aquatic ecosystems in the riverbed itself. In particular, dams and weirs interrupted some free-flowing sections of the river, constraining migration and causing fish populations to become isolated. Several areas of the banks and riverbed had been altered into uniform profiles, fixed by blocks of stone. Many side channels and meanders had become choked with sediments by being separated from the main river course and were slowly drying up. Groundwater levels in the surrounding area were also decreasing. In other parts of the river, the problem was increased stream velocity leading to an absence of quiet water refuges for wildlife.

The objectives of the LIFE Lafnitz project were to remove obstacles to fish migration over the whole river course, including its side channels, to reconnect the meanders, and to regenerate the dried-out alluvial forests. It also aimed to enable the floodplain area to redevelop its characteristic mosaic of flowing and standing waters, muddy banks, pioneer vegetation and forests. The project thus sought to reunite isolated fish populations and recreate natural habitats which provide spawning grounds for fish and amphibians and foraging areas for birds.

The project targeted almost the entire length of the river, from the Styrian mountains of Austria to the lowlands in Hungary. The project built on a partnership between nature conservation, water management and agricultural authorities. It received effective support from municipalities and associations.

<u>How the project meets the three EU-level GI criteria</u>

i) Enhance the delivery of multiple ecosystem services at a significant scale

The restoration and connectivity enhancement actions undertaken by the project contributed to several ecosystem services. Floodplain forest, wet meadows and side channels absorb water, slowing down the flow of floodwater and lowering its peak, thereby contributing to flood protection. This water storage in the landscape also boosts groundwater levels. The project actions therefore contributed not only to the goals of the Nature Directives, but also to meeting the objectives of the Water Framework Directive and the Floods Directive. The project also enhanced opportunities for recreation and eco-tourism.

ii) Contribute to the goals of EU Nature legislation

The Lafnitz is one of the richest rivers in Austria in terms of fish species: 36 native fish species occur between the river's source in the Joglland (Austria) and its confluence with the Raab at the Hungarian border. These species include trout and pike, but also several rare species protected under the Habitats Directive, such as the Danube streber, the white-finned gudgeon or the golden-spined loach. The project was specifically aimed at improving habitat conditions and the conservation status of these species, by tackling the key ecological problems along the river: the interruption of the river continuum and the fish migration corridors, the loss of river structure, and insufficient connections to secondary channels.

The project interventions also contributed to raising groundwater levels in dried-out pools and floodplain forest (a habitat type listed in Annex I of the Habitats Directive).

iii) EU-level green and blue infrastructure projects should have a strategic approach

The project involved interventions in both the Austrian and the Hungarian part of this cross-boundary river.

GI actions undertaken

Several project actions focused on reconnecting side channels and oxbow lakes that had been cut off from the Lafnitz by river regulation work in the past. These watercourses were slowly desiccating, while groundwater levels in the vicinity were also dropping, causing pools and wetlands in the floodplain to dry out. At five locations, the project reconnected such cut-off watercourses to the Lafnitz or to its tributary in Hungary, the Lahn-patak. Altogether, more than 7.8 km of side channels and oxbows were reconnected. These reconnections created new spawning areas and habitat for juvenile fish, as well as refuge areas where all fish species can take shelter during floods in the main river. By allowing side channels to refill with water from the Lafnitz, the reconnections also allowed groundwater levels in the vicinity to rise. Dried-out ponds and floodplain forests became wet again, benefitting amphibians such as the fire-bellied toad and yellow-bellied toad.

Water supplies were also improved in the main river. In several river sections, the water was too shallow and flow velocity was too low due to water being diverted to power small hydro-electric plants. In such sections with low water levels, algae could grow and eventually choke the stream. The project paid compensation to four electricity plants to leave more water in the main river, for the benefit of fish species.

The project also implemented structural improvements to restore river dynamics in sections where the river had been regulated. For example, steep banks fixed with stone blocks had their gradients lowered; the riverbed was widened with bays and new islets and gravel banks; bushes and trees were planted along the banks; and groynes were built into the riverbed to deflect the current. The project also involved the removal or modification of weirs and the construction of fish passes to enable fish movement.

Altogether, these interventions benefitted a range of species, including: the kingfisher (newly-eroded cliffs provide nesting cavities); fish species such as the Ukrainian brook lamprey, bullhead, weatherfish, Danube streber, spined loach, white-finned gudgeon (benefitting from the removal of barriers and creation of new habitats and spawning opportunities); ash and alder gallery woods along watercourses, as well as silt banks with Chenopodion and Bidention vegetation.

Impacts of the project (including environmental, social, and economic benefits)

The project succeeded in restoring river continuity, which allows isolated fish subpopulations to mix and exchange genes again and to colonise additional parts of the river. The river has been returned to optimal ecological condition, while maintaining sustainable flood protection.

The project succeeded in restoring habitat types such as alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* and rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation. Ecological monitoring carried out after implementation of specific project actions shows a number of concrete improvements for several species listed under the Habitats Directive - the Ukrainian brook lamprey, bullhead, Danube streber, zingel, white-finned gudgeon, gold-spined loach, asp, bitterling, striped ruffe, spined loach and weatherfish.

The project also contributed to making the area more attractive for tourism and recreation. For example, in 2005 the Association for the Promotion of the Lafnitz Valley Ramsar Site established a new recreation opportunity, the 'Lafnitz valley trekking tour'; the trekking route has been designed to also include sites of the LIFE project, such as the Mayrhofer fish pass. This allows the LIFE project to be presented to a wider public. In the Hungarian part of the project, along the Lahn-patak River, measures were taken during the LIFE project to make the restored landscape accessible for recreation and excursions. For example, a nature trail along the river was created, and panels explaining aspects of nature and water conservation were erected.

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DRAVA LIFE – Integrated River Management project, Croatia

Project duration: 2015 - 2020; **Budget:** EUR 4,592,898

Funds used: 60% of the project's costs are financed by an Action Grant from the LIFE programme under the Nature and Biodiversity strand. The remaining 40% is contributed by the project partners. WWF Austria, a project partner, is co-financed and supported by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management and by Coca Cola for this project. Green Osijek's work in this project is co-financed by the Croatian government's Office for Cooperation with NGOs.

Project description

The DRAVA LIFE project aims to restore the natural ecosystem at seven sites covering the majority of the Croatian reach of the Drava River, a transboundary river in Italy, Austria, Slovenia, Croatia and Hungary. This reach also forms a major part of the five-country Mura-Drava-Danube Transboundary UNESCO Biosphere Reserve. The project aims to restore 310 kilometres of the Drava River and 1000 m of dynamic river banks through various restoration and awareness raising activities. It is a demonstration project to showcase nature conservation of this type in Croatia and the western Balkans, and it runs from 2015 to 2020.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

The project aims for strategic restoration of key semi-natural sites, including Natura 2000 sites, along the Drava River to contribute to the integrity of the transboundary UNESCO Biosphere Reserve, which incorporates the river. It therefore constitutes a component of a larger strategic network of natural and semi-natural areas in the form of the Biosphere Reserve.

Although the project does not primarily aim to enhance ecosystem services, several of its actions will result in their increased provision. The restoration actions will provide more room for the river, which is likely to reduce flood risk. Specifically, restoration of the river's side arms will reduce water levels during periods of high water and will divert floodwaters away from settlements. The project is also expected to enhance groundwater supplies by increasing infiltration of river water. Recreational opportunities will be improved, particularly swimming and fishing in the river.

ii) Contribute to the goals of EU Nature legislation

The project is explicitly designed to contribute to implementation of the EU Nature legislation. It aims to restore the river in four Natura 2000 sites, and aims to raise awareness and recognition of those sites. The protection of dynamic steep river banks aims to ensure habitat for several protected species, and actions will be taken to reduce human disturbances of breeding birds, such as the endangered and protected little tern (*Sterna albifrons*), including visitor management and awareness raising.

iii) EU-level green and blue infrastructure projects should have a strategic approach

The project is explicitly designed to contribute to implementation of the EU Nature legislation. It aims to restore the river in four Natura 2000 sites, and aims to raise awareness and recognition of those sites. The protection of dynamic steep river banks aims to ensure habitat for several protected species, and actions will be taken to reduce human disturbances of breeding birds, such as the endangered and protected little tern (*Sterna albifrons*), including visitor management and awareness raising.

While the project sites are all in Croatia, the project involves cross-border knowledge transfer and cooperation with the other countries in the Biosphere Reserve, a strategically planned, transboundary reserve. Strategic documents for the project are prepared at workshops at which partners from both Croatia and its neighbouring countries participate. For example, an action plan for river birds was produced with input from workshop participants from Croatia, Hungary, Serbia and Slovenia, with the aim of producing an action plan coordinated across the five countries of the Biosphere Reserve. A Natura 2000 Management Strategy is being produced, which takes into account the goals for a Transboundary Management Plan developed as part of the coopMDD project, funded by the Interreg Danube Programme. In this way, cooperation structures for future cross-border work are being agreed on. The project also involves cross-border cooperation in financing – it is partly indirectly financed by the Austrian Federal Government through WWF Austria.

GI actions undertaken

The LIFE funds and partner contributions are used for technical measures that restore the hydromorphological condition of specific sites within the Natura 2000 network and Biosphere Reserve. These activities include protecting dynamic river banks, creating side arms of the river, removing bank revetments and groins, widening the river bed in some places, improving the quality of floodplain forest and several others. Some riverine plants will be reintroduced, including German tamarisk (*Myricaria germanica*) and dwarf cattail (*Typha minima*) on three large gravel bars. Through these activities, the river dynamics will be restored, which will create new steep banks, gravel banks and sand banks. These measures aim to improve the status of endangered species and habitats, particularly Annex I habitat type 3230 - Alpine rivers and their ligneous vegetation with *Myricaria germanica*, including within Natura 2000 sites. To date, various plans have been completed, including a guidance plan on nature visitors, a Natura 2000 management strategy and an action plan for river birds. Designs for the restoration measures have been agreed and will soon undergo environmental impact assessment.

Awareness raising campaigns seek to reduce human disturbance of species, as well as improve the recognition of Natura 2000. The campaigns involve establishing educational centres, exhibitions, activities with schools, workshops, videos and others. For example, information boards have been installed near gravel banks to inform visitors about how to reduce the effects of human disturbances on breeding birds. The project also seeks to enhance cooperation with other countries in the Drava River basin through, for example, joint development of strategic and action plans.

Impacts of the project (including environmental, social, and economic benefits)

The project is ongoing until 2020, and therefore the benefits discussed here are expected or preliminary results. The expected environmental benefits in terms of habitat restoration include the acquisition of 41 ha of land; the restoration of 1000 m of dynamic river banks; creation of 13 ha of new gravel, sand and mud banks; 14.5 km of river side arms either restored or created; and improvement of 300 ha of floodplain forests. These improvements to the quality and variation in habitats are expected to benefit several bird species, particularly those that nest in banks. In particular, the project is anticipated to increase the breeding population of endangered birds including the little tern (*Sterna albifrons*) through habitat restoration and efforts to reduce human disturbances during the breeding season, including information boards near breeding locations.

The project is expected to create several social benefits, primarily through enhanced provision of ecosystem services. As previously mentioned, the restoration of side arms increases the river's retention capacity, and is therefore expected to reduce flood risk. The increased infiltration may cause groundwater levels to rise, benefitting drinking water supplies for the local population that depends on groundwater. It is also thought that river restoration measures will improve fish habitat and therefore populations, benefitting local fishermen. The economic benefits of the project, in addition to those deriving from the social benefits previously described, are expected to primarily result from an improvement in the area's attractiveness for tourism and recreation based on its natural values. The benefits from the restored dynamic river environment and improved cross-border cooperation are expected to endure long beyond the completion of the project.

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DANUBEPARKS: Danube River Network of Protected Areas – Development and Implementation of Transnational Strategies for the Conservation of the Natural Heritage at the Danube River & DANUBEPARKS STEP 2.0

Project duration: 2009 – 2012 & 2012 – 2014; **Budget**: EUR 2.7 million & EUR 2.2 million

Funds used: ERDF (INTERREG – South-East Europe Transnational Cooperation Programme)

Project description

The Danube has long been recognised for its unique habitats and species and the wide range of provisioning, regulating, and cultural ecosystem services that it provides. However, in the last 150 years, structural interventions for flood protection, navigation, power generation, agriculture, forestry, and urban development have substantially altered the natural flow of the river putting this unique natural asset under significant pressure.

The first DANUBEPARKS project implemented from April 2009 to February 2012 established a network of 12 partners (later extended to 15) representing protected areas from eight Danube countries – Austria, Bulgaria, Croatia, Germany, Hungary, Serbia, Slovakia, and Romania – in order to systematically tackle common challenges on a Danube-wide scale. The network's objectives, set out in the 'Declaration of Vienna', were to promote the exchange of knowledge and experience, develop and implement Danube-wide strategies, optimise the management of the Danube natural heritage, and strengthen each protected area at the local level. The network also implemented pilot conservation projects. The project focused on five core implementation areas, namely: *River Morphology and River Restoration; Floodplain Management and Habitat Network*; *Conservation of Flagship Species*, which included Sturgeons and White-tailed Eagles; *Monitoring and NATURA 2000*; and *Nature Tourism*.

A follow-up project, DANUBEPARKS STEP 2.0, was implemented between October 2012 and September 2014 and aimed to build upon the achievements of the first project, secure its results, and further enlarge the network. In this second step, there were 20 partners in nine countries – the aforementioned eight plus Moldova. The project focused on the preservation and restoration of natural river dynamics, maintenance of an international network of floodplain forest habitat, further support of the White-tailed Eagle population, monitoring of indicator species for river dynamics, and further promoting nature tourism and environmental education.

DANUBEPARKS is a flagship project of the EU Strategy for the Danube Region (EUSDR), contributing to the Strategy's implementation.

The DANUBEPARKS network remains active and operates as the DANUBEPARKS Association since 2014, continuing the implementation of the strategies and action plans developed during these two projects.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

In addition to the positive impacts on species and habitats, the projects contributed to maintaining and/or enhancing several ecosystem services. For example, the project enhanced nature-based recreation and tourism opportunities, as well as environmental education, through actions related to product-development (e.g. boat and bike excursions), joint capacity-building activities (e.g. training for rangers to guide international groups) and international marketing efforts. A 'Strategy on Tourism, Environmental Education and Regional Development' was developed, which can underpin further efforts to develop sustainable tourism in Danube protected areas. The project's actions related to protection and management of floodplain forests benefit services such as carbon sequestration and sustainable flood protection. Another relevant project activity was the analysis of the genetic variability of Black Poplar in several Danube protected areas, which provides a basis for the definition of long-term strategies for protection and conservation of the gene pool of European Black Poplar.

ii) Contribute to the goals of EU Nature legislation

The projects were explicitly aimed at safeguarding the rich biodiversity of the Danube Basin. Under the umbrella of DANUBEPARKS, the participating Protected Areas, which altogether comprise over 30 Natura 2000 sites, have comprehensively addressed common challenges on a Danube-wide scale, by implementing actions on habitat management, species monitoring and conservation, and river restoration. Some of the actions undertaken by the project benefit species protected under the Nature Directives, including the White-tailed Eagle and the Danube Sturgeon. Moreover, DANUBEPARKS actively promoted and communicated the crucial role of Protected Areas in order to raise public awareness.

iii) EU-level green and blue infrastructure projects should have a strategic approach

The two projects reflect a strategic, transnational approach to protecting and managing green infrastructure in the Danube River Basin. The two projects involved cooperation between protected area representatives from eight, respectively nine countries.

GI actions undertaken

Both projects focused on five main thematic areas. Some of the actions carried out under each area are summarised below:

- River morphology and revitalization: Specific actions included the removal of transverse artificial structures in secondary side-arm systems in the Duna-Dráva National Park (Hungary) and the Slovakian floodplains to improve the water regime; ecological adaptation of groynes to improve the habitat status of island structures in the Hungarian Danube section; restoration of the embankment in the Dunajské luhy Protected Landscape Area (Slovakia); monitoring of indicator species of natural river dynamics, with a view to identifying river sections important for conservation or restoration. The actions were implemented in close cooperation with water management authorities. A '*DANUBEPARKS Strategy on Conservation and Navigation*' was also developed.

- Habitat management: Several pilot projects were implemented in the first project, including the purchase and management of grasslands in the cross-border area of Austria and Slovakia, the restoration of grasslands in the Duna-Dráva National Park (Hungary), and reforestation with native trees in Slovakia. The project also developed '*Perspectives for Danube Floodplain Forests*' which provide general guidance on managing floodplain forests in protected areas and help to establish common standards along the entire Danube River. The guidance also includes suggestions on how to further protect the forests along the Danube and help re-naturalise forest stands. The first project also focused on coherent management in border areas, through the development of cross-border management plans.

- Flagship species conservation: Specific actions focused on the White-tailed Eagle and the Danube Sturgeon, two species which are representative of the health of habitats in Danube ecosystems. An 'Action Plan for the Conservation of the White-tailed Eagle along the Danube' was elaborated and a database bringing together monitoring information from all Danube countries was set up. Regarding sturgeons, DANUBEPARKS brought together experts from protected areas and sturgeon research and reproduction institutions to define concrete steps for the perseveration of the endangered species.

- Monitoring and NATURA 2000: Monitoring species and habitats is one of the main tasks of NATURA 2000 management. DANUBEPARKS played an important role in identifying species to be monitored and creating transnational monitoring concepts and databases. Through this, a fish database from all protected areas was formulated, the Little Ringed Plover and Sand Martin populations (as indicators of river dynamics) were monitored, and a handbook to monitor two mammal species that inhabit floodplains (beaver and mink) was developed.

- Nature tourism: DANUBEPARKS developed a '*Strategy on Tourism, Environmental Education and Regional Development'*. It also focused on facilitating experience-exchange and capacity-building events for rangers, guides, and information staff. Moreover, the Network implemented marketing activities, planned a visitor centre in Hungary, developed maps that contain information on the regions and the Protected Areas, and installed tourist-friendly infrastructure, such as nature trails, visitor centres, boat mini-harbours, and cycle corridors.

Impacts of the projects (including environmental, social, and economic benefits)

Protected areas play an important role in the long-term conservation of Danube ecosystems and their services. The DANUBEPARKS project and its follow-up resulted in increased collaboration among protected area managing organisations, the exchange of knowledge and experience, and the elaboration of transnational thematic strategies, all of which can contribute to improving the conservation and management of protected areas along the Danube, which in turn benefits local inhabitants as well as visitors.

The projects contributed to reconciling the sometimes conflicting interests of nature conservation and economic sectors. For example, following an integrative approach and in cooperation with water management authorities, DANUBEPARKS developed a *'Strategy on Conservation and Navigation'* that identifies possible synergies for conservation and

navigation and underlines potential conflicts, which can strengthen the position of protected areas in negotiations with the navigation sector and water management authorities. The *'Strategy on Tourism, Environmental Education and Regional Development'* can help foster sustainable tourism along the Danube and in protected areas, while avoiding the negative pressures tourism may place on biodiversity.

The project activities aimed at enhancing nature tourism and recreation opportunities are also likely to have generated additional income and local jobs, although the project reports do not provide estimates of these benefits.

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LIFE FLANDRE - FLemish And North-French Dunes REstoration

Project duration: 2013 - 2020; **Budget:** EUR 4,066,454

EU funds used: LIFE (50% of total budget)

Project description

The coastal dunes between Dunkirk in France and Westende in Belgium represent one of the most famous dune systems in continental Europe. The area is characterised by broad sandy beaches, carved foredunes, megaparabolic dunes with large humid dune slacks, and low, gently undulating older 'fossil' dunes formed between 3 000 BC and 800 AD. The dunes on both sides of the border became spatially fragmented and severely degraded during the 20th century as a result urbanisation, water abstraction, recreational use, the fixation of sand drift, invasion by alien species, intensification of agriculture in the transitions between dunes and polders, and the decline of traditional agro-pastoral activities on the remaining dune area, resulting in scrub encroachment and a loss of biodiversity. Over 60% of the original dune areas have disappeared due to urban development in the coastal region. Most of the remaining dune areas in both France and Belgium have been included in the Natura 2000 network.

LIFE-FLANDRE is a cross-border conservation project implemented by Flemish and French authorities, which aims to step up co-operation across the border in order to: restore habitats that are characteristic of coastal environments; reinforce populations of remarkable and endangered species; safeguard natural heritage through the acquisition and management of coastal dunes; and raise public awareness of the natural heritage value of the fragile dune areas. The project will also establish an Advisory Committee (which will remain in place after the end of the project) as a transnational management board, and draw up a cross-border management plan and a legal basis for cross-border cooperation for the management of the dune belts. The project thus aims to be a first step in the establishment of a transnational European natural park, which is intended to serve as an example of cross-border cooperation for other Member States.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

An evaluation of ecosystem services provided by the project area at the start of the project (De Nocker et al., 2015) shows that the dunes are especially important for recreation and tourism, water provisioning from groundwater and regulation of water quality, and protection against coastal flooding. While the project foresees only a relatively small amount of restoration activities and the direct increase in regulating services is thus likely to be limited (De Nocker et al., 2015), the project can contribute to maintaining the delivery of ecosystem services through improved management and protection of the dune ecosystems. Increased public awareness and strengthened co-operation between the relevant authorities can also have indirect benefits on ecosystem services. The establishment of a cross-boundary nature area would also contribute to maintaining or enhancing tourism and recreation benefits, which are already high in the dune areas.

ii) Contribute to the goals of EU Nature legislation

The project aims to consolidate the Natura 2000 network in Belgium and France by restoring habitat types which are characteristic of the sedimentary coasts of the Atlantic biogeographical region and the populations of several species of EU interest, including the narrow mouthed whorl snail (*Vertigo angustior*), great crested newt (*Triturus cristatus*), creeping marshwort (*Apium repens*), fen orchid (*Liparis loeselii*), and natterjack toad (*Bufo calamita*).

iii) EU-level green and blue infrastructure projects should have a strategic approach

The project involves transboundary cooperation between two Member States.

GI actions undertaken

Actions foreseen in the framework of the project include the acquisition of land (to expand the publically owned and actively managed dune area), establishment of management plans for dune sites, habitat restoration at several project locations, creation of a new walking path in the Dune Dewulf in France in order to reduce the negative impacts on biodiversity of uncontrolled recreational use, and public awareness raising activities. The project also strengthens co-operation between the Belgian and French public authorities that are competent for the acquisition and management of protected sites, and is intended to pave the way for the establishment of a transnational European natural park covering the dune areas.

Impacts of the project (including environmental, social, and economic benefits)

As the project is ongoing, this section discusses the expected results and benefits of the actions. Expected results in relation to habitats and species include, in Belgium: the establishment of management plans for at least 93 ha of dunes purchased by the Agency for Nature and Forests, and their designation as a Flemish nature reserve; the acquisition of 30 ha of dunes to expand the publically owned and actively managed dune area; restoration of 2 ha of humid dune slack habitat, the creation of three ponds, and the restoration of three ponds as aquatic habitat for the great crested newt (*Triturus cristatus*) and the natterjack toad (*Epidalea calamita*, formerly *Bufo calamita*). In France, expected results include: 58.3 ha of dunes added to the managed, publically-owned sites; restoration of 65.1 ha of humid dune slacks and grey dunes; optimisation of 3.6 ha of habitat of the narrow-mouthed whorl snail (*Vertigo angustior*); the creation of ten ponds as aquatic habitat for the great crested newt and the natterjack toad; creation of a new walking path in the Dune Dewulf.

In both countries, the project will lead to the adoption of a common management plan for the cross-border dune belts between Dunkirk and Westende, and a legal basis for the cooperation between French and Belgian authorities for the management of coastal dunes as a transnational European natural park. Overall, the project is expected to improve the ecological cohesion and connectivity of the network of dune sites on both sides of the border.

In terms of societal benefits, the project is likely to maintain or increase the tourism and recreation benefits derived from the project area, which are already very high. An assessment of ecosystem services provided by the project area (De Nocker et al., 2015), estimates that

each year 2 to 4.5 million people visit the project area, spending altogether EUR 60 to 200 million which translates into employment for 900 to 3,000 people (Full Time Equivalents, FTE). This impact is particularly large in the Flemish part of the project area, which is larger and estimated to have more visits per hectare. At the same time, tourism and recreation also represent a pressure on these ecosystems, hence adequate protection of the dunes is essential to the sustainable development of coastal tourism in the area (De Nocker et al., 2015). As noted above, other ecosystem services such as coastal flood protection, water provisioning and water quality may also benefit from the project, especially in the long term.

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Case study developed with inputs from Jean-Louis Herrier, Agentschap Natuur & Bos.

Emscher Landscape Park and Emscher River Restoration

Project duration: Ongoing projects since 1989 and 1992

Budget: Emscher Landscape Park: EUR 500 million; Emscher River Restoration: EUR 5,3 billion

Fund used: several EU funds since the mid-1990s, Rechar I & II, Resider I & II, ERDF, EAFRD, SMI Programme, URBAN, URBACT, LIFE, Horizon 2020; co-financed by the German federal government, the Federal state of North Rhine-Westphalia (NRW), the 20 municipalities involved, the Ruhr Regional Association (RVR), the water management association Emschergenossenschaft & Lippeverband (EGLV) and their industrial and commercial, private and public members; scientific projects funded by several EU initiatives; European Investment Bank – Institute.

Project description

Two strategic and long-term regional projects (including hundreds of single actions and local projects) support the transformation of the Ruhr region in North Rhine-Westphalia, Germany since the early 1990s.

The Emscher river and its tributaries are located in the northern part of the centre of the agglomeration Ruhr. This area suffered the most from the decline of the coal and steel industries since the 1960s and was characterised in the public opinion in the 1980s as the poor part of the region, with contaminated air, soils and rivers, destroyed landscapes and without future. The massive green and blue investments that have been undertaken in the last 30 years and that are still ongoing are part of a new perspective of an intelligent, sustainable and integrated Metropolitan Region Ruhr.

The Emscher Landscape Park is a 457 km² regional park system between 20 cities. Almost half of the 5.1 million inhabitants of the Ruhr region live in this core of the agglomeration. The Emscher Landscape Park includes seven north-south oriented regional corridors (where the tributaries of the Emscher river system flow and the Seseke system which is part of the Lippe catchment) and a combining backbone, an east-west corridor named New Emscher Valley. For the Emscher Landscape Park, vacant land of the former coal and steel industries and their transport infrastructures was converted into a connected system of urban landscapes, new parks, industrial and natural heritage and a system of bike paths on former rail tracks and on the banks of canals and rivers. The park system includes more than 100 single projects, follows integrated goals of urban landscape development, includes green neighbourhoods, nature in the city, urban farming and urban forestry, offers new urban services, and is used by millions of people. It represents a complete transformation of the area from a forgotten place to an attractive and connecting green infrastructure.

The restoration of the Emscher river system is a parallel and also unique large-scale project of 30 years. The Emscher catchment has an area of 865 km² and the Emscher is discharging into the river Rhine. The Emscher and its tributaries are reconverted from highly modified open wastewater channels with concrete beds into natural stream systems. For this, a new underground sewer network of 423 km in length is constructed to separate waste and river water. Subsequently, the concrete shells are removed, the channelization is reversed, and stream profiles widened. A system of floodplains and near-natural retention reservoirs will provide additional flood protection. The morphology and connectivity of the Emscher and its

tributaries are restored aboveground, covering a total length of 341 km. This complete conversion of the whole Emscher system enhances the quality of life and the ecological situation along the rivers, as well as in the urban neighbourhoods. The wastewater-free Emscher system will be completed by 2021 and the last aboveground works on the river beds and banks will be finished around 2025.

The development of green and blue infrastructure along the Emscher followed the economic policy objective of raising the region's attractiveness to modern standards. Both projects were implemented as adaptive and learning systems with numerous partners and stakeholders, including the participation of the local cities and neighbourhoods. The initiatives were supported by several governments, the mayors of the municipalities and the local parliaments. The two initiatives demonstrate that green infrastructure can serve as a strategically key factor for a whole region. The mayors in the region are currently discussing the implementation of *Green Infrastructure Ruhr* as a new approach for RUHR 2030. Five fields of action are seen in a new and operative green context: Urban Landscape, Water in the City, Green Urbanism, Climate-friendly Mobility (including bikepath networks) and Climate Protection & supporting Energy Efficiency. The Emscher park and river project is regarded worldwide as an intelligent strategy and blueprint of change for industrial cities and regions.

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

The projects contribute to enhancing a suite of ecosystem services, including flood control, microclimate regulation, as well as cultural ecosystem services such as opportunities for recreation and aesthetic quality of the landscape.

ii) Contribute to the goals of EU Nature legislation

Beginning as strategic topics of the *International Building Exhibition (IBA) Emscher Park* (1989 – 1999) two master plans for the park and river development and numerous competitions and detailed plans created the solutions for repairing, re-designing and creating new green and blue infrastructure in the urban surroundings. This included research and investments in and implementation of actions aimed at improving biodiversity, connecting biotopes, benefitting rare and relevant species, enriching the aquatic biotopes and enabling the 'rebirth' of the banks of the new rivers. The initiatives also fostered a new understanding of industrial nature and urban wilderness and their ecosystem services, and promoted accessibility to urban nature including protected wildlife areas (*Nature for People*).

iii) EU-level green and blue infrastructure projects should have a strategic approach

Both projects are large-scale, strategic green infrastructure projects transcending administrative boundaries. They demonstrate how the development of green and blue infrastructure can serve as a strategic factor for the transformation of an entire region.

GI actions undertaken

The list of projects that have been completed in the Emscher Landscape Park and the Emscher river system is as long as the variety of its functions and solutions. Although the

projects were not explicitly named as GI, ecosystem services or nature-based solutions, they serve these functions.

The urban landscape and the rivers were systematically mapped and scientifically scanned. Several Ministers of Environment or of urban, social, cultural or economic affairs, as well as private stakeholders, interest groups, environmentalists, unions and NGOs were involved in the process. International architects, water management experts, biologists, ecologists, landscape planners, city planners, artists and media were invited to develop authentic solutions for the single sites in Emscher Landscape Park or the river parts along the Emscher and its tributaries. The local departments and authorities for environment, city planning, business development and local companies supported custom-made solutions for local needs.

Unique projects were generated, such as the Landscape Park Duisburg-North, Gasometer Oberhausen, World Heritage Zollverein, Phoenix Dortmund, WestPark, Hall of the Century Bochum, Richard Serra – Bramme to the Ruhr, Route of Industrial Nature, IndustrieWald Ruhr – Urban Forestry Ruhr, 20 projects of Working in the Park, Tetrahedron Bottrop, RheinPark Duisburg, Emscher Park Bikeway, Inner Harbour Duisburg, EmscherBikeway, Tiger and Turtle, EmscherKunst, Waiting for the River or Slinky Springs to Fame.

Thousands of trees were planted, hundreds of hectares of polluted soils were cleaned and given back to nature and people, new parks and gardens were designed and planted, a system of landmarks was installed on the former mining hills, and a new management of brownfields was implemented. Urban wilderness and its species became of great interest for schools. Most of the river beds have already been converted, new aquatic biotopes are in place, new fauna and flora is spreading and becomes part of an ongoing monitoring of the new ecological development of the Emscher. Unconventional multi-functional land uses were installed, such as a zoo area working as a floodplain or former industrial sites that are used for sports and leisure today.

New integrated initiatives like *"Future Convention for Stormwater"* (2005) and *"Water in the Cities of tomorrow"* (2014) support sustainable water management. The aims of water sensitive urban design have become a political priority in the region; the goal is to consider the concerns of urban drainage, urban attractiveness, demographical trends, and challenges resulting from climate change in an integrated way rather than as isolated themes.

Impacts of the project (including environmental, social, and economic benefits)

The large Emscher renewal investments have been shown to benefit the region and its economy already. The region's economy has been transformed from decline to smart growth. Ruhr is back with a new and diversified economic structure with new and sustainable urban qualities, based on green infrastructure.

The Emscher revitalisation is estimated to create about 1400 direct jobs per year from its inception to 2020 (Barabas et al., 2013). Beyond these direct impacts on employment, the project contributes to improving quality of life in the area and increasing the area's overall attractiveness. Millions of local people and from abroad use the new parks and the new bikeways, day by day. The quality of life has been raised in all neighbourhoods. Five million visitors travel on the *Route of Industrial Heritage Ruhr* yearly. Most of them are coming from the Ruhr: learning to know more about their identity, their cities and landscapes. The current plans for the *Bicycle Network Ruhr* announce 700 km new bikeways to be built – on top of

the existing 1200 km. The Ruhr area today is next to the Cologne Cathedral the most visited touristic site in Germany.

A recent valuation study on the Emscher restoration project estimates that the ecosystem services resulting from the initiative have an annual market value/direct economic impact of over EUR 21 million, while the area's 'non-market value' (based on estimates of 'willingness to pay in appreciation that restored river sections exist') is estimated at EUR 107 million per year (Gerner et al., 2018).

The general impact of the systematic upgrading of urban environmental qualities is the changed value and improved attractiveness of the Ruhr region overall. The green and blue transformation accompanies the economic, social and cultural change of the region.

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The European Green Belt

Project duration: 2003 - ongoing

Funds used: ERDF, Interreg, BfN, BUND, BMUB, EuroNatur

Project description

The European Green Belt stretches over 12,500 kilometres along what was once the Iron Curtain forming a corridor of habitats hosting a great variety of species: it reaches from the north of Europe to the Black and the Adriatic Sea in the south. Since the project's start in 2003, the inspiring idea of transforming the Iron Curtain into a 'European Green Belt' has at least partially become a reality: today it connects more than 4,000 protected areas in 16 EU countries, five candidate countries (Albania, Montenegro, FYR Macedonia, Serbia, Turkey), one potential candidate (Kosovo*) and two non-EU countries (Russia and Norway). Almost 150 governmental and non-governmental organisations from these countries have come together in the European Green Belt Initiative.

The European Green Belt was launched as an international initiative in 2003 when various existing regional initiatives merged into one. The focus of the initiative is to conserve and restore the natural heritage along the former Iron Curtain to function as an ecological network whilst respecting the economic, social and cultural needs of local communities. In the words of IUCN, the Green Belt of Europe is a "global symbol for transboundary nature conservation and sustainable development".[38]

The initiative comprises four sections – Fennoscandian, Baltic, Central European and Balkan Green Belt – which reflect the regional diversity of the European Green Belt.

A European Green Belt Association –currently composed of governmental and NGO representatives from 30 organisations from 16 countries – was established in 2015, with the mission of ensuring "that the European Green Belt is efficiently protected and that its sustainable development is promoted by facilitating an on-going, co-ordinated transboundary co-operation at all levels and across all sectors of society."[39]

How the project meets the three EU-level GI criteria

i) Enhance the delivery of multiple ecosystem services at a significant scale

The European Green Belt delivers multiple ecosystem services. It is mainly aimed at (transboundary) connectivity of natural habitats and providing habitat for species of concern (see ii), as well as migratory routes (especially important with climate change). It also serves as an example of transboundary cooperation, cultural diversity (cultural heritage) and sustainable development. The European Green Belt delivers multifunctional benefits through its high potential of providing especially regulating, but also provisioning and cultural

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

[38] EuroNatur (2014) The European Green Belt Initiative - 10 years of challenges, experiences and achievements. Available at: https://www.euronatur.org/fileadmin/docs/projekte/Gruenes_Band/European_Greenbelt_10_years_Brochure.pdf

[39] http://www.europeangreenbelt.org/association.html

ecosystem services. Given the wide variety of habitat types covered by the European Green Belt, the initiative contributes to maintaining or enhancing a wealth of ecosystem services, from climate change mitigation and air quality regulation, to the provision of opportunities for nature-based tourism and recreation. Further improvement of the European Green Belt is also increasing the capability of delivering a wide range of environmental and quality of life benefits.

ii) Contribute to the goals of EU Nature legislation

The European Green Belt should not be seen as a continuous strip of protected area, but rather as a bridging element that links grassland fallow and wetlands, dry grasslands and mature woodlands, thus forming a string of important habitats. Seen on a large scale, the European Green Belt's ecological network consists of core areas, sustainable use areas, and green infrastructure / landscape corridors or buffer zones. The European Green Belt serves as the backbone of a Pan-European ecological network crossing nearly all of the continent's biogeographic regions from old-growth boreal forests and taiga in the north to coastal and marine habitats in the Baltic region to steppes in the south, which is of significant importance for migrating species such as wolves, bears and lynxes, as well as amphibians and birds. For example, the present distribution of the Balkan lynx (*Lynx lynx balcanicus*) largely matches the course of the Balkan Green Belt between Albania and FYR Macedonia, Montenegro and Kosovo*. Such well-connected networks of protected areas play an important role in supporting populations in adapting to habitat fragmentation and climate change.

Additionally, the European Green Belt serves as a refuge for a range of threatened species, such as black vultures and griffon vultures. On the 1400 km stretch in Germany alone, a survey by German conservation NGOs found more than 600 animal and plant species on the IUCN's Red List.

The European Green Belt's protected areas include Natura 2000 and Emerald sites, national parks, biosphere reserves, as well as other areas with varying levels of protection.

iii) EU-level green and blue infrastructure projects should have a strategic approach

Crossing 24 countries, both within and outside the EU, the European Green Belt serves as a good practice example of cross-border cooperation on green infrastructure. The 9th European Green Belt Conference in 2016 highlighted, for example, that "combining biodiversity, economic and social benefits, the Green Belt Initiative is a symbol of transboundary cooperation to promote Europe's shared natural and cultural heritage"[40]. The initiative is a living example of structured and prolonged transboundary cooperation for preserving and developing green infrastructure.

GI actions undertaken

The initiative is centred on transboundary cooperation activities for the conservation of biodiversity along the former Iron Curtain. It is structured around four sections - the Fennoscandian, Baltic, Central European and Balkan Green Belt. Within each section, a wide

[40] Conclusions of the 9th Pan-European Green Belt Conference 31st October, 3 November 2016, Koli, Finland. Available at: http://www.ym.fi/download/noname/%7B8DA856AF-0801-4858-973F-9E6C5B326152%7D/124822

range of projects and specific activities have contributed to consolidating and maintaining the European Green Belt since the initiative's inception. To cite only a few examples, in the Fennoscandian part, the 'Arctic Biological, Cultural and Geological Heritage Project' included activities such as mapping and restoring sites relevant to the cultural history of the area, creation of new nature trails, and training of tourism operators in methods to achieve more sustainable tourism. In the Baltic Green Belt, a project in the Väinameri bay (Estonia) aimed to restore and manage semi-natural coastal grasslands to maintain a higher level of biodiversity of coastal flora and bird fauna. In the Central European Green Belt, specific activities range from nature conservation and restoration measures, to environmental education and eco-tourism. In the Balkan Green Belt, the 'Balkan Lynx Recovery programme' focused on enlarging the protected area system in the border area between Albania, FYR Macedonia, Montenegro, and Kosovo* in order to protect the current and potential habitats of the Balkan lynx.[41]

Projects covering the entire European Green Belt include, for example, the development of the Iron Curtain Trail, a cycling route spanning the entire length of the European Green Belt.

Impacts of the project (including environmental, social, and economic benefits)

Examples of economic and social benefits provided by the European Green Belt include recreation and tourism, health benefits (derived from the multiple ecosystem services provided by the protected areas and corridors covered by the European Green Belt), beneficial effects on the local economy (including employment of local people) and preservation of cultural heritage.

Research in Finland has shown that EUR 1 of public investment in nature conservation along the Green Belt of Fennoscandia has a return of EUR 10 to local private income, for example via tourism and tourism-related businesses. The total income of the national parks and hiking areas on the Finnish side of the Green Belt totalled around EUR 100 million in 2016.

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Case study developed with inputs from Anne Katrin Heinrichs and Gabriel Schwaderer, EuroNatur.

Rewilding in Western Iberia, Spain and Portugal

Project Duration: Rewilding project: open-ended; LIFE + Nature: Conservación de la Biodiversidad en el Oeste Ibérico, Reserva Campanarios de Azaba (2009-2012); LIFE Club de Fincas (2013 -2018);

Budget: Funded by LIFE+, MAVA Foundation, Rewilding Europe, Spanish Ministry of Environment

Project description

Western Iberia covers approximately 2.5 million ha of a transnational area between Spain and Portugal. The region has the highest land abandonment levels in Europe. The landscape is formed by a mosaic of natural and semi-natural habitats that alternate between mountain massifs covered by scrub, and deep valleys cut through by the Rivers Duero and Tajo. In between these, there is mature Mediterranean forest, extensive crops, and dehesa (also known as montado). The dehesa occupies the largest extension, and consists of open forest pastures of holm, cork and oak trees, created by human activity. Together, these habitats form one of the most important biodiversity areas in the Mediterranean basin, with 26 Natura 2000 sites, and two national/regional protected areas; emblematic fauna includes the Iberian lynx, Iberian imperial eagle, and black stork.

The vision is for the region of Western Iberia to become one of the most exciting wild areas of Western Europe, where ecological processes shape the landscape towards a much more natural state, where wildlife (including Iberian wolf, Iberian ibex, red deer and roe deer) occurs in natural densities, and where old local traditions, ways and products, create new sources of opportunities, income and pride for the region's inhabitants. Projects in the area aim to improve the conservation status of the region, and increase the value of the area together with local inhabitants, and public and private landowners.

Impacts of the project (including environmental, social and economic benefits)

Grazing fire brigades

Core rewilding areas with no-take zones have been established, where large herbivores have been reintroduced, such as Retuerta horses and traditional breeds of bovines, sayaguesa and maronesas. They have brought back natural grazing regimes, and act as ‘grazing fire brigades’ against uncontrolled fires due to the disappearance of other grazing livestock in the area. These large herbivores help with the reestablishment of the trophic and ecological structure of the dehesa, by facilitating the reappearance of other species as they create mosaic landscapes suitable for prey (rabbits, partridge) of highly endangered species such as the Iberian lynx and Bonelli’s eagle. These wilder areas then act as a source for wildlife regeneration, which connect through wildlife corridors, and are surrounded by transition and buffer zones, where people use the landscape in sustainable and wildlife friendly ways.

Supporting local enterprises

Through financial loans and expert business advice, projects are helping a number of local entrepreneurs to create rewilding-focused enterprises, helping create pioneering nature-based tourism models. The initiative is contributing to the branding of the area as a nature-oriented

region, with wildlife-watching, the commercialization of locally branded products produced with biodiversity objectives, creation of green employment and the development of eco-tourism ventures linking to the rich history of the area's cultural and environmental heritage.

The LIFE Club de Fincas del Oeste Iberico, for instance, aims to bring together areas of high natural value, part of the Natura 2000 network, by bringing the landowners – private or public – into a club where agricultural practices that benefit biodiversity are rewarded through increased income both sides of the border.

Shaping the greater Côa Valley

Rewilding Europe is working with its local partners to shape the Côa Valley through the development of a 120,000-hectare wildlife corridor – the Greater Côa Valley – that connects the Malcata mountain range in the south with the larger Douro Valley in the north. To reach this goal the project focusses on securing strategically located core areas and connecting them by signing land-use agreements with landowners and hunting associations, and on restoring natural processes and scavenging in the zones between them.

How the initiative meets the three EU-level criteria

i) **Enhance the delivery of multiple ecosystem services at a significant scale**

The initiative is contributing to the improvement of various ecosystem services, including pollination opportunities, reducing the risk of excessive forest fires at the landscape level, a trophic chain that can sustain itself including cleaning the landscape of carrion, and the opportunities that nature provides for ecotourism, and to safeguard historical and cultural heritage.

ii) **Contribute to the goals of EU Nature legislation**

The comeback of large herbivores in the area promotes the re-establishment of the trophic and ecological structure of the dehesa, an ecosystem listed in Annex I of the habitats Directive. This initiative contributes to the improvement of the conservation status of protected species, such as the Iberian lynx (listed in Annex IV of the Habitats Directive) and Bonelli's eagle (in Annex I of the Birds Directive). The development of the wildlife corridors improves the ecological and functional connectivity of the Natura 2000 sites of Western Iberia.

iii) **EU-level green and blue infrastructure projects should have a strategic approach**

The Western Iberia initiative focuses on restoring natural processes at landscape level, by restoring the corridors of the river Duero in the Central Iberian System, an area known for its priority connectors for conservation and restoration for the network of Natura 2000 woodland sites in the Iberian Peninsula.

National and regional governments, municipalities, associations, landowners and agro-producers are all working together to make environmental conservation a viable option in terms of regional development and employment.

Annex II. The multiple benefits of green and blue infrastructure

EU-Ievel GI projects contribute to improving the implementation and achieving objectives of several EU relevant policies and legislation, including but also beyond nature and environment, such as:

- **Contribution to halting the loss of biodiversity and the degradation of ecosystem services in the EU, and restoring them**

  Biodiversity – the essential variety of life forms on Earth – continues to decline in every region of the world, significantly reducing nature's capacity to contribute to people's well-being. This alarming trend endangers economies, livelihoods, food security and the quality of life of people everywhere, according to four regional assessments of biodiversity and ecosystem services and the global assessment of Land Degradation and Restoration carried out by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[42] released on 23 March 2018.

  IPBES assessments also stress that there are opportunities to reverse the trends such as investing in avoiding land degradation and the restoration of degraded land through e.g.; green and blue infrastructure action makes sound economic sense; the benefits generally by far exceed the cost. On average, the benefits of restoration are 10 times higher than the costs, estimated across nine different biomes. While challenging, the benefits of restoration include, but are not limited to, increased employment, increased business spending, improved gender equity, increased local investment in education and improved livelihoods. Timely action to avoid, reduce and reverse land degradation can increase food and water security, can contribute substantially to the adaptation and mitigation of climate change and could contribute to the avoidance of conflict and migration[43].

  Another study published recently in Nature[44] illustrated that biodiversity loss reduces ecosystem productivity and stability, and that by contrast biomass production increases with species richness in a wide range of wild taxa and ecosystems. The study also shows that increases in biomass with biodiversity are comparable to or stronger than the effects of other well-known drivers of productivity, including climate and nutrient availability.

[42] https://www.ipbes.net/news/media-release-updated-biodiversity-nature%E2%80%99s-contributions-continue-dangerous-decline-scientists

[43] Summary for policymakers of the thematic assessment report on land degradation and restoration of the Intergovernmental Science - Policy Platform on Biodiversity and Ecosystem Services; IPBES/6/15/Add.

[44] https://www.nature.com/articles/nature23886, Duffy, J. Emmett, Godwin, Casey M., Cardinale, Bradley J. 'Biodiversity effects in the wild are common and as strong as key drivers of productivity'; Nature volume 549, pages 261–264 (14 September 2017)

Two other recent studies corroborate those findings[45]. These results suggest that the role of biodiversity in maintaining productive ecosystems and ecosystem services is crucial.

By conserving and enhancing biodiversity and restoring ecosystems, green and blue infrastructure contribute to the delivery of a bundle of key ecosystem services (such as regulating and cultural services) which provide multiple benefits to people; and contributes more generally to the EU 2020 biodiversity headline target set by EU leaders in March 2010 and supported by the EU biodiversity strategy to 2020[46] and to the 2020 Mission and global strategic plan for biodiversity 2011-2020[47], adopted by all parties to the Convention of Biological Diversity.

Example: a contribution to pollinators' conservation and to pollination

Pollination is one of the key processes in nature that enables the reproduction of plants and production of fruits. In the EU alone, four in five crop and wild flower species depend on insect pollination. Pollinators are mainly insects, in particular bees and hoverflies, but also butterflies, moths, some beetles and other flying insects. Almost €15 billion of the EU's annual agricultural output is directly attributed to insect pollinators. Besides productivity, pollinators support a variety of food sources thus enabling diverse and nutrient-rich diet. Action is necessary to safeguard biodiversity, agriculture and food security. Unfortunately, wild pollinators' populations are declining in Europe and around the world[48], many species groups are not protected by any legislation and there are huge knowledge gaps.

The recent EU Pollinators initiative[49] is aimed at improving knowledge on pollinators and facilitating its dissemination and use across sectors. It will also strengthen collaboration between scientists, policy makers, businesses and the general public. This will support better-targeted and more impactful actions for tackling the causes of pollinator decline[50].

Green infrastructure can further improve the natural conditions needed to sustain thriving pollinator habitats by maintaining and enhancing biodiversity, by restoring degraded

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45 Oehri, J., Schmid, B., Schaepman-Strub, G. & Niklaus, P.A. (2017). Biodiversity promotes primary productivity and growing season lengthening at the landscape scale. Proceedings of the National Academy of Sciences of the United States of America, 114 38, doi:10160-10165. http://www.pnas.org/content/early/2017/08/30/1703928114

And 'Positive relationship between species richness and aboveground biomass across forest strata in a primary Pinus kesiya forest'; Li, S., Su, J., Lang, X., Liu, W. & Ou, G. (2018). Positive relationship between species richness and aboveground biomass across forest strata in a primary Pinus kesiya forest. Scientific Reports, volume 8, 2227, doi:10.1038/s41598-018-20165-y.

https://www.nature.com/articles/s41598-018-20165-y

46 http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

47 https://www.cbd.int/sp/

48 https://www.ipbes.net/assessment-reports-0

49 COM(2018) 395 final

50 https://www.ipbes.net/deliverables/3a-pollination

ecosystems and by and strengthening the coherence and connectivity of the Natura 2000 network in broader rural and urban landscapes.

The EU initiative on Pollinators identifies EU-level green and blue infrastructure projects as landscape-level actions that maintain and restore pollinator habitats and contribute to their integration into spatial planning and other relevant decision-making processes; thus contributing to the protection of wild pollinators.

Example: a contribution to the integration of ecosystems and their services into planning and decision-making

The EU guidance on integrating ecosystems and their services into planning and decision-making (Ref), also under the Action plan for nature, people and the economy, aims to raise awareness and increase understanding of the benefits that healthy, resilient ecosystems can provide to a range of stakeholders, make visible nature's flows into the economy and promote fairness and holistic, long-term thinking.
For stakeholders aiming to develop green infrastructure, this can provide useful reference on possible approaches and tools to assess and integrate the values of ecosystem services in planning processes and decisions, and to prioritise working with nature to achieve socio-economic objectives. This can contribute to supporting GI-related decision-making.

- **Contribution to the objectives of the Nature Directives**

The Natura 2000 network is the backbone of the European green and blue infrastructure: it includes many of Europe's remaining sites that are biodiversity rich. It also provides a legal and organizational framework that can contribute to the long-term security, efficiency and cost-effectiveness of investments in green infrastructure. By connecting existing Natura 2000 sites with buffer zones to defragment the landscape), by improving the state of biodiversity and the functioning of ecosystems, and by restoring degraded habitats, including Annex 1 habitats outside Natura 2000 sites where necessary to achieve a good conservation status; green infrastructure can provide substantial added value and contributes to reaching the objectives of the Bird and Habitats Directives. It for instance directly contributes to the implementation of Article 10 of the Habitats Directive by ensuring the ecological coherence of the Natura 2000 network so that Natura 2000 sites do not become isolated 'islands of nature'.

- **Contribution to EU policy on invasive alien species**

Invasive alien species are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with serious negative consequences for their new environment. They represent a major threat to native plants and animals in Europe, causing damage worth billions of euros to the European economy every year. Particular attention must be paid to avoiding the introduction or further spreading of IAS through green infrastructure. The evidence on whether green infrastructure facilitates the further spread of invasive alien species is not

univocal[51]. However, by supporting biodiversity and restoring ecosystems, green infrastructure contributes to their resistance and resilience against invasions[52].

- **Contribution to EU policy objectives on mitigation and adaptation to climate change**

Climate change increases the intensity and frequency of extreme weather events and natural disasters such as floods, landslides, avalanches, forest fires, storms and wave surges that cause loss of life and result in billions of euros of damage and insurance costs each year in the EU. It also triggers sea level rise and desertification. The impacts of such events on human society and the environment can often be reduced using GI solutions, such as functional flood plains and wetlands, riparian woodland, natural and semi-natural grassland, natural or semi-natural coastal zones, protection of forests in mountainous areas. Corals and mangroves (e.g. in Overseas Territories) have an important disaster risk reduction capacity as well.

Investment in green and blue infrastructure and ecosystem-based disaster risk reduction measures can lead to innovative risk management approaches, adapting to climate change-related risks, maintaining sustainable livelihoods and fostering green growth[53].

Climate change is already affecting species and their distributions. Distributional range changes have occurred and are projected to intensify for many widespread plants and animals, creating associated risks to several ecosystems; for instance very vulnerable ecosystems like coral reefs will die by 2050 worldwide because of the multiple anthropogenic pressures they are under. Many studies[54] illustrated that in a context of climate change and temperatures increase, removing barriers to species movement is critically important for conserving biodiversity, as this allows e.g. species to migrate to areas that are more favourable.

In that context, EU-level green and blue infrastructure projects, by improving or restoring the connectivity of biodiversity areas, can contribute to adapt to climate change and to protect species at risk.

In addition, EU-level green and blue infrastructure can contributes to a Low Carbon Economy, and to disaster risk reduction and prevention.

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[51] Vila, M. & Ibanez I. (2011). Plant Invasions in the Landscape. Landscape Ecology 26: 461–472

[52] Kennedy, T.A., Naeem, S., Howe, K.M., Knops, J.M.H., Tilman D. & Reich P. (2002). Biodiversity as a barrier to ecological invasion. Nature 417, 636-638.

[53] 'Exploring nature-based solutions - The role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards'; EEA Technical report No 12/2015; ISSN 1725-2237.

[54] See e.g. 'The implications of the United Nations Paris Agreement on climate change for globally significant biodiversity Areas'; R. Warren, J. Price, J. VanDerWal, S. Cornelius, H. Sohl, Climatic Change, https://doi.org/10.1007/s10584-018-2158-6

And: 'The projected effect on insects, vertebrates, and plants of limiting global warming to 1.5°C rather than 2°C'; R. Warren, J. Price, E. Graham, N. Forstenhaeusler, J. VanDerWal; Science 18 May 2018; Vol. 360, Issue 6390, pp. 791-795; DOI: 10.1126/science.aar3646

Peatlands and grasslands can be managed or restored with the view of sequestrating more carbon. It has been estimated that the Natura 2000 network currently stores around 9.6 billion tonnes of carbon, equivalent to 35 billion tonnes of CO2[55]. Restoring natural vegetation in Natura 2000 areas contribute to mitigating wild fire risks, restoring wetlands support water security, restoring and managing flood plains (e.g. alluvial forests) help control flood events. Floodplain restoration along the Lower Danube Green Corridor provided significant benefits through the avoidance of damages due to floods (e.g. the 2005 floods resulted in 396 million euro in damages); and expected earnings of 85.6 million euro through ecosystem services (e.g. fisheries, tourism) per year.

- **Contribution to EU regional development and to social cohesion**

  Green infrastructure contributes to regional development and creates jobs. For example, the Emscher Landscape Park (ELP) is one of Europe's largest ecosystem restoration projects, comprising a river revitalisation programme and over 400 green infrastructure projects. Generating employment in the region was a key objective of the project, particularly in light of the de-industrialisation and decline of the coal and steel sectors, which had previously defined the region. By 2020, it is anticipated that the ELP project will have created 55,892 and 101,687 jobs in the region of NRW and across all of Germany respectively (RWI, 2013). Links between natural and cultural heritage – and potential benefits to economy through sustainable tourism – are particularly worth highlighting.

- **Contribution to a more sustainable CAP and enhancing the delivery of environmental and social benefits from agriculture and forestry**

  The management of land devoted to agriculture and forestry has a major impact on the condition of the EU's natural capital. The existing Common Agricultural Policy (CAP) contributes to sustainable agriculture and can support the conservation of biodiversity and GI through different instruments and measures including cross compliance, greening practices and rural development with e.g. measures to enhance high nature value areas, to prevent land abandonment and fragmentation; to encourage agro-environmental measures (e.g. farmed landscape conservation measures, maintaining and enhancing hedgerows, buffer strips, terraces, dry walls), sylvo-pastoral measures etc.; Natura 2000 payments; cooperation on maintaining valuable field boundaries; conserving and restoring rural heritage features; etc.

  GI measures can contribute to significantly reducing forest fragmentation and degradation and restore degraded forests; which can also help improving the conservation status of species and habitats that depend on or are affected by forestry, and improving the provision of related ecosystem services. GI can make a constructive contribution in this regard by providing a coherent framework within which natural features and functions are conserved and enhanced in forest areas.

[55] ten Brink, P., et al., 2013, The Economic benefits of the Natura 2000 Network, Luxembourg: Publications office of the European Union.

For instance, soil fertility, climate regulation through carbon sequestration in soils and biomass, flood protection, water regulation, are multiple societal services delivered by agro-ecosystems, for which farmers and foresters are the first beneficiaries, as clearly demonstrated by the recent French evaluation on ecosystems and their services – EFESE[56].

It is also recalled that biodiversity and green infrastructure provide genetic resources for agriculture.

Because implementing GI approaches requires an integrated view of ecosystem services, it encourages a balanced approach that emphasises the multifunctional nature of rural areas, including access to sustainable, safe and nutritional food through short food supply chains. Green Infrastructure will therefore foster a more coherent approach to decision-making in relation to integrating ecological and sustainability concerns into spatial planning in the rural and urban landscape.

- **Contribution to the EU Common Fisheries Policy (CFP)**

The Common Fisheries Policy [57] include among its objectives implementing an ecosystem approach, minimising the impacts of fishing activities, endeavouring to ensure that aquaculture and fisheries activities avoid the degradation of the marine environment. Fishing and aquaculture activities shall be environmentally sustainable. In particular, Article 8 requires Member States to identify possible suitable areas for the establishment of protected areas due to biological sensitivity, including areas where there is clear evidence of heavy concentrations of fish below the conservation reference size and of spawning grounds. Some areas may be restricted or closed to fishing and additional protection shall be given to existing biologically sensitive areas. Article 8 foresees the establishment of areas forming a coherent network. The deployment of green and blue infrastructure can support those CFP objectives.

- **Green and blue infrastructure can contribute to promoting sustainable transport**

Green and blue infrastructure can contribute to promoting sustainable transport by developing nature-friendly transport corridors (e.g. equipped with wildlife overpasses and underpasses) as a part of larger transport network projects.

Cases studies n° 1 (Transgreen) and n° 2 (Alpine-Carpathian Corridor) contained in Annex I present examples of EU-funded projects similar in scope to EU-level GI and which contribute to improving the sustainability of transport infrastructure.

[56] http://institut.inra.fr/Missions/Eclairer-les-decisions/Etudes/Toutes-les-actualites/EFESE-services-ecosystemiques-rendus-par-les-ecosystemes-agricoles

[57] (Regulation (EU) No 1380/2013

- **Contribution to a sustainable grid development/ energy infrastructure**

  Green and blue infrastructure can complement the development of the energy infrastructure policy and the implementation of Projects of Common Interest in energy (TEN-E policy, Regulation 347/2013) and hence contribute to increasing public acceptance of these projects by providing a series of benefits for the local community. Despite the fact that citizens show support to the transition to a low-carbon economy, there is a lack of understanding/ awareness that this transition entails the building and the upgrade of our energy infrastructure.

  The Commission promotes such best practices[58] for a sustainable grid development that use habitat enhancement in project planning. For example, the LIFE Elia project demonstrated that restoring and maintaining peatlands and other habitats with low-lying vegetation under power lines could reduce maintenance costs, whilst improving biodiversity. This project is presented in Case study n° 3 (LIFE ELIA RTE) contained in annex I, and illustrates the development of the beddings of the electricity transportation network as means of enhancing biodiversity.

  Two European Commission guidance documents recently issued, on 'the requirements for hydropower in relation to EU nature Legislation[59]' and 'Energy transmission infrastructure and EU nature legislation[60]', by addressing the requirement of species protection in the wider landscape, can also help to foster synergies between green infrastructure, EU nature legislation and EU energy infrastructure development.

  Green and blue infrastructure can also contribute to more energy efficient performance of buildings. For instance, green roofs can reduce the energy required for heating and cooling and contribute to biodiversity in urban areas. GI can also help combat urban heat island effect.

- **Contribute to nature-based solutions and EU innovation objectives**

  Green and blue Infrastructure is referring to the spatial and functional structure of healthy ecosystems, part of a strategically planned network aimed at maximising the delivery of their benefits. This is based on the understanding of the structure and functioning of biodiversity and ecosystems and their interactions with human activities.

  Nature-based Solutions are defined as '*solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse,*

[58] https://renewables-grid.eu/activities/best-practices/database.html?no_cache=1

[59] http://ec.europa.eu/environment/nature/natura2000/management/docs/Hydro%20final%20May%202018.final.pdf

[60] http://ec.europa.eu/environment/nature/natura2000/management/docs/Energy%20guidance%20and%20EU%20Nature%20legislation.pdf

nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions'[61].

Nature-Based Solutions also include innovative concepts, tools and approaches to harness nature for human society in a systemic way. They serve to implement solutions that can contribute to green and blue infrastructure; and vice-versa.

Green Infrastructure can also provide new business opportunities for innovative companies and industries and lead to new business models. Green Infrastructure brings alternative solutions to traditional grey infrastructure designed to fulfil specific needs, such as water and air purification or carbon sequestration. It provides improved financial and social cost-benefit outcomes both directly (e.g. through employment in GI projects and their management) and indirectly (e.g. through potential for increased property values and lower spend on clean-up and treatment). While biodiversity remains at the core of GI, it is much more than a biodiversity conservation instrument.

- **Contribution to conserving/restoring the EU's Cultural Heritage**

Cultural heritage comes in many shapes and forms; and can include natural heritage such as landscapes, flora and fauna.

Natural Capital is the stock of natural assets that are vital for our prosperity, wellbeing and even survival. These include biodiversity and ecosystems, as well as climate, air, water, soils, food, raw materials and much more. Cultural Capital, on the other hand, is made up of the many and diverse ways people - in a specific geographical and socio-economic context - deal with and influence nature and these natural resources. There is a growing awareness of how human activity can harm the environment. However, several positive links exist between natural and cultural capital. Productive synergies between the two can lead to enhanced environmental protection and, at the same time, bring economic benefits and employment opportunities, boosting economic, social and territorial cohesion.

Scientists have shown that cultural diversity and biodiversity are spatially associated; and that when biodiversity is eroded, cultural diversity declines. This illustrates that humans and ecosystems not only interact but are also interdependent[62].

Nature provides essential inputs to culture, and culture acts on nature in a permanent "feedback loop". Cultural capital is made up of the many and diverse ways in which one deals with natural capital, and green and blue infrastructure has a key role to play in reconnecting natural and cultural capital[63].

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61 https://ec.europa.eu/research/environment/index.cfm?pg=nbs

62 Summary for policymakers of the thematic assessment report on land degradation and restoration of the Intergovernmental Science - Policy Platform on Biodiversity and Ecosystem Services; IPBES/6/15/Add.

63 Reconnecting natural and cultural capital, contributions from science and policy. EU. 2018

Through the development of green and blue infrastructure, the EU aims to protect and maintain natural heritage and promote cultural heritage and positive human actions[64].

- **Contribution to the goals of EU water[65] legislation, by e.g. contributing to improving the ecological status of waters in a river basin; or by contributing to floods prevention**

  Integrating green and blue infrastructure considerations into river basin management can contribute significantly to delivering good water quality, mitigating the effects of hydro-morphological pressures and reducing the impacts of floods and droughts. Green Infrastructure also offers cost-effective options for better implementing the Drinking Water Directive and the Groundwater Directive. Innovative multi-benefit, highly efficient and cost-effective green solutions are also being developed for treating waste water.

  Green infrastructure also offers natural and cost-effective options for flood risk management. A case study for the Elbe river in Germany shown that green and blue infrastructure measures would be more cost-efficient than grey infrastructure measures to prevent and manage flooding. Re-naturalising a polder area and allowing for 'ecological flooding', would provide for larger economic gains per hectare (net present value of almost EUR 430 000 per hectare) than a grey infrastructure approach[66].

  Case study n° 4 (Lafnitz - habitat cross-linking on an Alpine pannonical river) included in annex I presents an example of an EU-funded project having a scope similar to EU-level GI and contributing to the goals of EU water legislation.

- **Contribution to the goals of EU marine[67] and maritime[68] legislation and policy, e.g. by contributing to enhancing the environmental status of a marine area**

  With regard to the marine environment, green and blue infrastructure can contribute to achieving the objectives of the EU's maritime strategy and marine strategy framework Directives, including as regards land-sea interactions. ,/. It can as well support the implementation of strategies for sustainably managing coastal zones and making coastal defences more efficient. Further developing blue carbon approaches, beneficial for fish stocks, can also profit from the application of GI principles to promote multiple ecosystem services in the marine environment. An ecosystem services approach can also

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64 https://publications.europa.eu/en/publication-detail/-/publication/6a0efd09-0d4d-11e8-966a-01aa75ed71a1/prodSystem-cellar/language-en/format-PDF

https://europa.eu/cultural-heritage/about

65 Water Framework Directive; Floods Directive.

66 'Green Infrastructure and Flood Management: Promoting cost-efficient flood risk reduction via green infrastructure solutions'; EEA Report No 14/2017; ISSN 1977-8449.

67 Marine Strategy Framework Directive 2008/56/EC of 17 June 2008

68 Maritime Strategy Framework Directive 2014/89/EU of 23 July 2014

support the achievement of Good Environmental Status under the Marine Strategy Framework Directive.

- **Contribution to the goals of EU air quality legislation**[69]

Green and blue infrastructure can e.g. help to limit or mitigate emissions of acidifying and eutrophying pollutants and ozone precursors, in order to improve the protection in the EU of the environment and human health. For example, it has been estimated that vegetation in urban areas can reduce particulate matter (PM10) pollution by 5-10 %, and up to 15 % in the case of multiple rows of dense vegetation[70]. An analysis of the air pollutant removal by urban trees and forests carried out by La Sapienza University in Roma shown that a mixture of certain tree species delivers a variety of morphological, physiological and phenological traits which are crucial in the removal of air pollutants, such as PM10 and ozone (O3). This 2016 study reports that the ecosystem service of PM10 and O3 removal by vegetation in 10 Italian metropolitan cities, accounts for a total of 7,150 Mg of PM10 and 30,014 Mg of O3 in the year 2003, with a relative monetary benefit of 47 and 297 million USD for PM10 and O3 removal, respectively[71].

The synergism observed between plant species highlights the need to preserve biodiversity, particularly in metropolitan areas and in a climate change context.

- **Contribution to EU human heath objectives**

The Science for Environment Policy In-depth Report on "The Multi-functionality of Green Infrastructure"[72] draws a conceptual framework linking Green Infrastructure, ecosystems and human health. It distinguishes eight types of green Infrastructure that have an impact on eight ecosystem functions and services (air purification; climate and radiation regulation; water purification; soil and nutrient cycling; habitat provision; waste decomposition; aesthetic and spiritual; noise pollution control) and six aspects of ecosystem health (air quality; soil structure; energy and material cycling; water quality; habitat and species diversity; ecosystem resilience). Together these interact with four socio-economic health factors (income and employment; education and lifestyle; living and working conditions; access to services and housing), four community health aspects (sense of community identity; community empowerment; social capital; culture), six aspects of physical health (cardiovascular; endocrine functions and immunity; nervous system; respiratory**;** digestive; bone tissue) and four aspects of psychological health (relaxation from stress; positive emotions; attention capacity; cognitive capacity). It is a

[69] Directive 2001/81/EC on national emissions ceilings for certain atmospheric pollutants.

[70] Kowarik, I., et al., 2017, Ecosystem Services in the City- Protecting health and enhancing quality of life. Summary for decision-makers, NaturKapital Deutschland - TEEB DE.

[71] Manes, F.; Marando, F.; Capotorti, G.; Blasi, C.; Salvatori, E.; Fusaro, L.; Ciancarella, L.; Mircea, M.; Marchetti, M.; Chirici, G.; et al. Regulating Ecosystem Services of forests in ten Italian metropolitan Cities: Air quality improvement by PM10 and O3 removal. Ecol. Indic. 2016, 67, 425–440.

[72] ENV, 2012. Science for environment policy. In-depth report on the multi-functionality of Green infrastructure, March 2012. Available from: http://ec.europa.eu/environment/nature/ecosystems/docs/Green_Infrastructure.pdf

complex system and many of the interactions are two-way. Some of the most important links are as follows:

- Green Infrastructure helps to regulate air quality by removing contaminants through filtration, decomposition and assimilation;
- Improved noise abatement, trees and shelter belts provide sound screening from traffic noise for human settlements;
- Urban Green Infrastructure helps to regulate the urban heat island effect thereby reducing heat stress;
- Green Infrastructure areas encourage physical activity, which is linked to many aspects of physical and mental health;
- Opportunities for contact with nature offer stress reduction, which is linked to many aspects of physical and mental health; and
- Attractive, Green Infrastructure particularly in cities promotes social cohesion and reduces social inequalities; in turn leading to reduced public health issues linked with inequality (such as diet related health concerns).

- **Contribution to SDGs**

EU-level green and blue infrastructure projects can contribute to reaching several sustainable development goals, such as

- *SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture***:** green and blue infrastructure projects **can** contribute to an environmentally friendly agriculture in Europe thereby contributing to sustainable agriculture, in view of the protection, preservation and improvement in the quality of water, air and soil, in the abundance of bio-diversity and in preservation and enrichment of the EU's landscape.
- *SDG 3: Ensure healthy lives and promote well-being for all at all ages*: with environmental pressures such as air and noise pollution having significant impacts on health, green and blue infrastructure projects contribute to improve health and well-being.
- *SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable*: Urban areas concentrate most of the environmental challenges but also bring together commitment and innovation to tackle them. Green and blue infrastructure projects can contribute to e.g. improving quality of life of urban population, cities' resilience to natural disasters and climate change impact, sustainable and local food production, recreation, etc.
- *SDG 13: Take urgent action to combat climate change and its impacts*: Green and blue infrastructure projects help e.g. restore ecological connectivity, enhance ecosystem resilience and thereby ensure the continued provision of ecosystem services, including carbon sequestration, climate change adaptation and contributing to mitigate heat waves and heat islands.

- *SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss:* Green and blue infrastructure projects directly contribute to all these objectives.

Annex III. Supporting instruments

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I. Targeted presentation of relevant opportunities provided by existing EU financing instruments as well as innovative financing

This section describes the most relevant funding instruments that can support EU-level green and blue infrastructure projects.

i. European Agricultural Fund for Rural Development (EAFRD)

The EAFRD is the funding instrument for the EU's rural development policy, also known as the 'second pillar' of the CAP. The provisions of Regulation (EU) No 1303/2013 (CPR) govern implementation of the EAFRD. The specific objectives and provisions for EAFRD support are set out in Council Regulation (EU) No 1305/2013 of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development.

The EAFRD has the following objectives, as set out in Article 4 of the EAFRD Regulation:

- Fostering the competitiveness of agriculture;
- Ensuring the sustainable management of natural resources, and climate action;
- Achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment.

The achievement of these objectives is pursued through six Union priorities for rural development. The fourth priority – 'Restoring, preserving and enhancing ecosystems related to agriculture and forestry' – is particularly relevant to EU-level GI. In the current programming period, about 44% of the EAFRD is allocated to Priority 4. Priority 5 – 'Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors' – is also of direct relevance as it includes, amongst others, a focus on fostering carbon conservation and sequestration in agriculture and forestry.

The EAFRD is implemented in the Member States through rural development programmes (RDPs). RDPs must address at least four of the six EAFRD priorities, which are all also expected to contribute to the cross-cutting objectives of innovation, environment and climate change mitigation and adaptation. To deliver their chosen priorities, Member States may select any combination of measures from the list of measures detailed in Regulation (EU) No 1305/2013, but among other requirements, the Regulation stipulates that RDPs have to demonstrate an appropriate approach towards the environment, including the specific needs of Natura 2000 areas, and towards climate change mitigation and adaptation (Article 8(c)(v) of Regulation 1305/2013). Member States are required to reserve a minimum of 30% of the total contribution from the EAFRD to each RDP for measures supporting investments related to the environment and climate, forest area development and improving the viability of forests; and for annual payments for agri-environment-climate, forest-environment and

climate and forest conservation, organic farming, Natura 2000 farmland/forests and areas facing natural or other specific constraints (Article 59(6) of Regulation 1305/2013).

Member States may include within their RDPs thematic sub-programmes that address specific needs identified at regional or sub-regional level. Such thematic sub-programmes may focus, inter alia, on climate change mitigation and adaptation and biodiversity (Article 7 of Regulation 1305/2013).

Opportunities for financing EU-level GI in 2014-2020

Several measures provided by the EAFRD Regulation are compatible with the objectives of EU-level GI projects.

Measures particularly relevant to EU-level GI include those under:

- Article 17.1(d): non-productive investments linked to the achievement of agri-environment-climate objectives, including biodiversity conservation status of species and habitats as well as enhancing the public amenity value of a Natura 2000 area or other high nature value systems. This measure could potentially support some of the investments needed for EU-level GI projects involving agricultural ecosystems, for example, investments linked to restoration or connectivity features in agricultural lands.
- Article 18.1(a): investments in preventive actions aimed at reducing the consequences of natural disasters, adverse climatic events and catastrophic events. The measure could be relevant for EU-level GI projects in agricultural ecosystems which include measures to reduce flood risk, such as targeted creation of buffer strips, hedgerows or woodland strips which slow the passage of water, etc.
- Article 21: afforestation and creation of woodland; establishment of agroforestry systems; prevention and restoration of damage to forests from forest fires, natural disasters and catastrophic events; investments improving the resilience and environmental value as well as the mitigation potential of forest ecosystems.
- Article 28: Agri-environment-climate payments, which support agricultural practices that make a positive contribution to the environment and climate. This measure could support, as part of a broader EU-level GI project, actions such as the development of wildlife corridors on agricultural land between Natura 2000 sites, traditional extensive sustainable agricultural practices in areas where this is necessary for the maintenance of valuable habitat, wetland restoration and management, etc.
- Article 34: Forest-environmental and climate services and forest conservation. Forest holders and other entities who commit to undertake forest conservation actions as part of an EU-level project could potentially obtain support for such actions under this measure.
- Article 35: Co-operation, including, amongst others, joint action undertaken with a view to mitigating or adapting to climate change; joint approaches to environmental projects and ongoing environmental practices; drawing up of forest management plans or equivalent instruments.

- Article 44: LEADER[73] co-operation activities. This could support EU-level GI projects linked to local development strategies.

It should be noted that most of the relevant measures are unlikely to support an EU-level GI project entirely, but could finance certain activities therein. For example, under Article 17.1(d), the EAFRD can support "non-productive investments linked to the achievement of agri-environment-climate objectives, including biodiversity conservation status of species and habitats"; the measure is unlikely to finance an entire EU-level GI project, but could support specific investments therein, e.g. linked to restoration, creation of connectivity features, etc.

Other measures are of more indirect relevance to EU-level GI, for example: investments in creation and development of non-agricultural activities in rural areas (Article 19) which could support, e.g., development of eco-tourism and nature-based recreation activities; measures related to 'basic services and village renewal in rural areas' (Article 20) which could support, e.g., restoration of natural heritage; Natura 2000 and Water Framework Directive payments (Article 30) which could be used to compensate farmers or forest holders for costs or foregone income resulting from implementation of EU-level GI projects.

Since the EAFRD presents only limited opportunities for financing projects involving multiple MS, in order to meet criterion iii) concerning scale, an EAFRD-funded GI project would need to have a scale which is significant and transcends administrative boundaries, or implement a national GI strategy or a national restoration prioritisation framework.

Possibilities for transnational cooperation are only explicitly provided in the EAFRD Regulation under Article 35: support for co-operation involving at least two entities, and Article 44: LEADER co-operation activities. Article 35 covers, inter alia, support for joint action with a view to mitigating or adapting to climate change and joint approaches to environmental projects, including co-operation among actors located in different MS (Article 35(7)). Article 44 refers to co-operation projects under the programme LEADER. In the framework of LEADER, the EAFRD may support transnational cooperation projects in line with Local Development Strategies (LDS). These are two specific possibilities for GI projects to receive EAFRD funding and meet criterion iii) by virtue of their transnational scale.

Box 1 below presents an example of EAFRD-funded projects similar in scope to EU-level GI.

Box 1 – The Pumlumon Project (United Kingdom)

Project description: Across 40,000 hectares of the Cambrian Mountains, an upland economy built around wildlife, ecology and long-term sustainability has been developed. It demonstrated how in an area mostly used for agriculture, large-scale ecological restoration can bring economic, social and environmental benefits. The project aimed to restore

[73] LEADER stands for the French name *'Liaison Entre Actions pour le Development de L'Economie Rurale'* (which roughly translates to 'links between actions for developing the rural economy'). LEADER seeks to promote cooperation between local actors and the development of integrated projects. LEADER initiatives are implemented by local area partnerships – known as Local Action Groups (LAG) – which bring together public, private and civil society sector organisations. Each LAG has a Local Development Strategy that contains a set of rural development actions and objectives.

biodiversity, connect nature and people, and to promote sustainable use of ecosystem services. The project was led by the Montgomeryshire Wildlife Trust and funded in 2008-2009.

How the project meets EU-level GI criteria: This project does not demonstrate the criterion concerning significant scale since it was implemented within the territory of only one Member State, and does not implement a national GI strategy or Restoration Prioritisation Framework. Since it satisfies all other criteria, it is, nevertheless, a useful illustration of how projects similar in scope to EU-level GI projects can be financed through the EAFRD. The project is one of several schemes across the UK piloting the application of an Ecosystem Approach to landscape management to deliver a wider and more integrated suite of benefits for people, the local economy and wildlife than the traditional land management practices of the past. This includes a focus on peatland restoration, woodland regeneration, species-rich hedgerows with benefits for yellowhammer and pipistrelle bat, key wildlife corridors and the restoration of heather moorland to increase the populations of ground-nesting birds, such as red grouse and the diversity of grassland with benefits for multiple species such as ospreys.

EU and non-EU funds used for the project: This project was initially funded through donations from the Wildlife Trusts of Wales, and a number of small grants from various institutions including: Waterloo Foundation, JP Getty, the Biffa Award, RDP Funding, Strategic Development Fund from the Wildlife Trusts, Communities Access and Nature Grant through Welsh European Funding Office. It also receives varying levels of year on year financial support from the former Countryside Council for Wales and Environment Agency Wales (now Natural Resources Wales) for capital works. These grants total approximately £650,000 over five years. EAFRD funding was £180,000.

GI activities financed: The restoration of over 250 ha of peatlands and acid grassland; changing grazing patterns in the area by replacing sheep with cattle to increase the number of plant species and help break the hard soil; and the re-creation of six different types of habitats.

Impacts: The project has resulted in numerous environmental and economic benefits: carbon storage, reconnecting and recreating habitats, storing flood water, bringing back wildlife, improving landscape through ecologically sensitive grazing, and increasing green tourism. Since 2005, the Project calculates that it has delivered a wide range of ecosystem services within the pilot Project area at a cumulative monetary value of £892,970.

The 2014 evaluation report by Defra states that the Project has raised £2.3m since 2006 which includes £1.4m for new visitor facilities. Landscape management practices have been changed over more than 450ha and brought over 652.3ha into active habitat management helping to secure and enhance the supporting services provided by this land thanks to the development of new and strengthened partnerships to progress the take up of the Ecosystems Approach and the generation of new income streams for the land owners and farmers.

Sources:

Pumlumon brochure - Invest in the Pumlumon project, available at: http://www.montwt.co.uk/what-we-do/living-landscapes/pumlumon-project

Defra (2014) Defra PES Pilot Evaluation of the Pumlumon Project – Executive Summary, Pumlumon Living Landscapes Project, Alison Millward Associates.

ii. European Maritime and Fisheries Fund (EMFF)

The EMFF supports the implementation of the Common Fisheries Policy (CFP) and the EU Integrated Maritime Policy (IMP). Implementation of the fund is governed by the provisions of Council Regulation (EU) No 508/2014 of 15 May 2014 on the EMFF and the Common Provisions Regulation (EU) No 1303/2013.

The protection and restoration of aquatic biodiversity and ecosystems are specifically mentioned among the EMFF's priorities listed in Article 6 of the Regulation.

For the 2014-2020 period, the allocation for the EMFF amounts to EUR 6.4 billion, of which 11% is under direct management by the European Commission and 89% falls under shared management. The shared management part of the EMFF is implemented by the Member States through national Operational Programmes (OPs). In the current programming period, Member States' OPs foresee to dedicate, in total, 40% of the EMFF budget to the thematic objective of preserving and protecting the environment.[74]

Opportunities for financing EU-level GI in 2014-2020

Several measures provided by the EMFF Regulation are compatible with the objectives of EU-level GI projects.

As a general principle for the content of OPs, Article 18(c) of the EMFF Regulation stipulates that where appropriate, the specific needs of Natura 2000 areas and the contribution of the programme to the establishment of a coherent network of fish stock recovery areas should be integrated into the OPs.

For sustainable fisheries, operations covered by Article 40 – 'Protection and restoration of marine biodiversity and ecosystems and compensation regimes in the framework of sustainable fishing activities' – are particularly relevant to EU-level GI. The measures covered by this article include support for the management, restoration and monitoring of Natura 2000 sites (Article 40(e)) and other marine protected areas (Article 40(f)), as well as several measures which could be included as part of a broader marine EU-level GI project, such as the removal of marine litter (Article 40(a)) and the preparation, drawing-up, monitoring and updating of protection and management plans for fishery-related activities linked to Natura 2000 sites (Article 40(d)).

Similarly, Article 44, related to inland fishing and inland aquatic fauna and flora, supports the management, restoration and monitoring of NATURA 2000 sites affected by fishing activities, and the rehabilitation of inland waters in accordance with the Water Framework Directive, including spawning grounds and migration routes for migratory species. The article would therefore be relevant to EU-level GI projects that aim to benefit aquatic flora and fauna.

[74] European Commission (2016) European Maritime and Fisheries Fund Overview, https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/op-overview-fact-sheet_en.pdf

Other fisheries-related measures financed under the EMFF could be relevant for EU-level GI if such themes were integrated into a broader GI project that meets all criteria. They include, for example, measures set out in:

- Article 30: diversification and new forms of income - for example, development of eco-tourism activities could be one component of an EU-level GI project;
- Article 33: temporary cessation of fishing activities - EU-level GI projects could involve temporary cessation of fishing activities in certain areas with a view to supporting the conservation of the marine environment;
- Article 37: support for the design and implementation of conservation measures and regional cooperation - could be used to fund collaboration with stakeholders in the design and implementation of (transnational) Marine Protected Areas;
- Article 39: innovation linked to the conservation of marine biological resources – could be applicable to the implementation of innovative technologies to limit bycatch, as part of broader EU-level GI project.

With regard to the aquaculture segment of the EMFF, the most relevant provisions for EU-level GI are set out in Article 54; support is provided for the uptake of aquaculture methods compatible with environmental needs, including Natura 2000 management requirements, and to aquaculture operations which include conservation and improvement of the environment and of biodiversity, and management of the landscape and traditional features of aquaculture zones. Such measures could be part of a broader EU-level GI project.

In the framework of community-led local development (CLLD) strategies, Article 64 provides for support for transnational cooperation activities of Fisheries Local Action Groups (FLAGs). However, the precise opportunities depend on the scope of the CLLD strategies, with the scale of such projects likely to be small.

Measures financed under direct management are also relevant to EU-level GI, particularly since such measures could cover multiple MS. EU-level GI projects could potentially be financed under Integrated Maritime Policy (Articles 82-83), while the studies and pilot projects foreseen under Articles 85-86 ('Scientific advice and knowledge to accompany measures for CFP and IMP') could indirectly support EU-level GI (e.g. through data collection) or test new approaches which would then be scaled up in EU-level GI projects.

As in the case of the EAFRD, the shared management component of the EMFF supports mainly projects within the territory of one MS. As such, this component of the fund can support GI projects at a significant scale transcending administrative boundaries, or implementing a national GI strategy or restoration prioritisation framework. Transnational projects can, however, be funded through the direct management component of the EMFF.

Box 2 below presents an example of a project having a similar scope to EU-level GI. Although the project is not funded through the EMFF, it illustrates the types of projects that could in principle receive EMFF funding and meet EU-level GI criteria.

Box 2 - Protomedea – Towards the establishment of Marine Protected Area Networks in the Eastern Mediterranean, Cyprus and Greece

Project description: The Protomedea project aims to design a Marine Protected Area (MPA) network in the territorial waters of Cyprus and Greece to meet the maximum sustainable yield objectives of the Common Fisheries Policy and to protect ecological features. It runs from December 2015 to November 2018. While the project is funded by DG MARE directly, as opposed to via the EMFF, it provides an illustration of how the EMFF could be used to fund cross-border planning for sustainable fisheries, particularly via direct management by the European Commission rather than through Member States' Operational Programmes.

How the project meets EU-level GI criteria: The MPAs planned in this project constitute a strategic network to protect both ecological features of conservation importance and important areas for fisheries. The project is primarily intended to contribute to implementation of the Common Fisheries Policy; its aim is to meet maximum sustainable yield objectives defined by the Policy, which is also a descriptor of good environmental status as defined by the Marine Strategy Framework Directive. However, the MPA network will also be designed to incorporate existing Natura 2000 sites and to reach targets for protected species and habitats, as well as for fisheries. An assessment of the value of ecosystem services, including commercial and recreational fishing, is included as input to the MPA design.

EU funds used for the project: The project is 90% funded by DG MARE through a direct call for funding.

GI activities financed: The primary GI activity financed by this project is the design of a strategically-planned network that protects ecological features and provides ecosystem services in a marine environment.

References:

European MSP Platform, 2015. Protomedea – Towards the establishment of marine protected area networks in the eastern Mediterranean. Available at: http://msp-platform.eu/projects/protomedea-towards-establishment-marine-protected-area-networks-eastern-mediterranean

Protomedea Consortium, 2016. Welcome to Protomedea: Towards the establishment of marine protected area networks in the eastern Mediterranean. Available at: http://www.protomedea.eu/

iii. European Regional Development Fund (ERDF)

The ERDF is one of the three financial instruments for implementing the EU's Cohesion Policy (together with the Cohesion Fund discussed below and the European Social Fund). The implementation of the ERDF is governed by the provisions of Regulation (EU) No 1303/2013 (CPR). The specific investment priorities and scope of support of the ERDF are set out in two regulations corresponding to the two goals of the ERDF for the period 2014-2020, namely, 'investment for growth and jobs' and 'European territorial cooperation':

- Council Regulation (EU) No 1301/2013 of 17 December 2013 on specific provisions concerning the European Regional Development Fund and on specific provisions concerning the investment for growth and jobs goal; and
- Council Regulation (EU) No 1299/2013 of 17 December 2013 on specific provisions for the support from the European Regional Development Fund to the European territorial cooperation goal.

The ERDF is intended to contribute to reducing disparities between the levels of development of regions in the EU and to their economic, social and territorial cohesion. The types of activities eligible for support from the ERDF are set out in Article 3 of Regulation 1301/2013.

The ERDF also supports sustainable urban development – which is also of potential relevance to EU-level GI – "through strategies that set out integrated actions to tackle the economic, environmental, climate, demographic and social challenges affecting urban areas, while taking into account the need to promote urban-rural linkages" (Article 7 of Regulation 1301/2013).

The ERDF supports a range of investment priorities (discussed in more detail below) covering the 11 thematic objectives set out in the CPR (with some of the objectives being subject to thematic concentration requirements which . vary according to the category of regions.

The European territorial cooperation (ETC) goal of the ERDF (also known as INTERREG) provides a framework for the implementation of joint projects and exchange of experience between national, regional and local actors from different Member States (MS). Under the ETC, the ERDF supports three forms of cooperation:

- Cross-border cooperation between adjacent regions – known as INTERREG A;
- Transnational cooperation involving regions from several MS over larger territories – known as INTERREG B; and
- Interregional cooperation covering all MS – known as INTERREG C.

In the current programming period, there are 60 cross-border cooperation programmes along 38 internal EU borders, 15 transnational cooperation programmes, and four interregional cooperation programmes (Interreg Europe, INTERACT III, URBACT III and ESPON 2020).

All investment priorities under the 'Investment for growth and jobs' goal are also available for territorial cooperation. In addition, the ETC Regulation 1299/2013 sets out a number of ETC-specific investment priorities (discussed in further detail below). The thematic concentrations are different from those of the first goal; for each cross-border and transnational cooperation programme, at least 80% of the ERDF allocation must be concentrated on up to four of the 11 thematic objectives, and all of the objectives may be selected for interregional cooperation.

At the start of the programming period, each MS draws up programming documents (Partnership Agreements and Operational Programmes and European territorial cooperation programmes) in cooperation with a broad range of stakeholders (based on the partnership principle) and submits them to the Commission for discussion and approval. In the OPs and cooperation programmes, the overarching strategic objectives agreed in the Partnership Agreement are broken down into more concrete objectives and actions. In 2014-2020, OPs can be fund-specific or multi-fund and can cover entire Member States and/or regions. In general, OPs consist of priority axes, each axis corresponding to one or more thematic objective(s) of the Common Provisions Regulation and comprising one or more investment priorities related to the given objective.[75]

Managing authorities - appointed at national or regional level to administer the implementation of ESI Funds - define and publish calls for project proposals on the basis of OPs, and select the projects which will receive EU co-finance. Monitoring Committees monitor the implementation of the OPs.

The ERDF has a total budget of EUR 199 billion in 2014-2020,[76] including EUR 9.3 billion for the ETC.

Opportunities for financing EU-level GI in 2014-2020

Article 5 of the ERDF Regulation No. 1301/2013 sets out a number of investment priorities (within each thematic objective of the CPR) to be supported by the ERDF. For the ETC goal, these are supplemented by several ETC-specific priorities set out in Article 7 of Regulation 1299/2013. Several of the ERDF's investment priorities are directly relevant to EU-level GI. They would be particularly suitable if implemented in the context of ETC (Interreg) programmes, since the latter targets projects involving multiple MS. Beyond the ETC, the ERDF is relevant insofar as stakeholders in different MS can obtain ERDF funding for parts of a green infrastructure project separately, through their respective managing authorities, and for EU-level GI projects which meet criterion iii) by having a significant scale which transcends administrative boundaries and/or implement a national GI strategy or restoration prioritisation framework. Further, Article 70 of CPR Regulation (EU) No 1303/2013 provides for certain opportunities for support of an operation outside the programme area.

[75] Kettunen, M., Torkler, P. and Rayment, M. (2014) *Financing Natura 2000 Guidance Handbook. Part I – EU funding opportunities in 2014-2020*, a publication commissioned by the European Commission DG Environment

[76] https://cohesiondata.ec.europa.eu/

The investment priorities of the ERDF Regulation No. 1301/2013 which lend themselves most clearly to EU-level GI projects are:

- Article 5(4)(e) - ‘promoting low-carbon strategies for all types of territories, in particular for urban areas, including the promotion of sustainable multimodal urban mobility and mitigation-relevant adaptation measures’: relevant for EU-level GI projects which improve carbon sequestration (e.g. peatland restoration), or reduce an area’s overall energy footprint (e.g. urban GI such as green roofs and walls to increase energy efficiency of buldings.
- Article 5(5)(a) - ‘supporting investment for adaptation to climate-change, including ecosystem-based approaches’ and Article 5.5(b) - ‘promoting investment to address specific risks, ensuring disaster resilience and developing disaster management systems’: could support EU-level GI projects contributing to climate change adaptation and/or disaster-risk reduction (while enhancing the delivery of at least one other ecosystem service).
- Article 5(6)(b) - ‘investing in the water sector to meet the requirements of the Union's environmental acquis and to address needs, identified by the Member States, for investment that goes beyond those requirements’: could support EU-level GI projects involving aquatic ecosystems (e.g. projects aimed at protecting and managing river basins with a view to maintaining/improving the ecological status of waters; or involving green infrastructure solutions for water purification).
- Article 5(6)(c) - ‘conserving, protecting, promoting and developing natural and cultural heritage’: highly relevant for EU-level GI since projects which significantly contribute to the goals of the EU Nature Directives can be said to also contribute to the conservation or protection of the Union’s natural, and in some cases, cultural heritage.
- Article 5(6)(d) - ‘protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure’: this is the priority which lends itself most clearly to EU-level GI projects since it is dedicated to biodiversity and ecosystem services, and specifically covers Natura 2000 and GI.
- Article 5(6)(f) - ‘promoting innovative technologies to improve environmental protection and resource efficiency in the waste sector, water sector and with regard to soil, or to reduce air pollution’: potentially relevant for EU-level GI projects involving deployment of nature-based solutions in those sectors (e.g. management or restoration of wetlands to provide water purification; strategic deployment of GI to improve air quality).
- Article 5(7)(a) - ‘supporting a multimodal Single European Transport Area by investing in the Trans-European Network for Transport (TEN-T)’: could support EU-level GI projects related to the greening of TEN-T infrastructure, such as the creation of ecological corridors.
- Article 5(7)(c) - ‘developing and improving environmentally-friendly transport systems’: EU-level GI projects related to transport systems, such as improvements to reduce fragmentation effects, may be eligible.

- Article 7 - Sustainable urban development: Integrated sustainable urban development strategies are relevant to EU-level GI since such strategies are intended to tackle in an integrated way "the economic, environmental, climate, demographic and social challenges affecting urban areas, while taking into account the need to promote urban-rural linkages". Given the multi-functionality of GI, GI projects could play an important role in such strategies.

Other investment priorities present indirect linkages to EU-level GI. For instance, Article 5(1) ('Strengthening research, technological development and innovation') focusses on research and innovation (R&I) infrastructure and business investment in R&I. As such, it does not appear applicable to directly finance EU-level GI projects, but could contribute to R&I which supports EU-level GI (e.g. methods/tools for identifying areas for prioritisation, assessing ecosystem service delivery, technical capabilities for GI interventions).

The investment priorities under Article 5(2) ('Enhancing the competitiveness of SMEs') present limited opportunities for EU-level GI projects, but could potentially support initiatives related to nature-based entrepreneurship, or activities of SMEs in the Nature-Based Solutions (NBS) sector, thereby supporting EU-level GI initiatives at least indirectly.

Although the priorities under Article 5(9) ('Promoting social inclusion, combating poverty and any discrimination') do not explicitly refer to nature or GI, they may be of some relevance, for example, to EU-level GI projects promoting nature-based recreation and health, or involving GI/NBS as part of urban or rural regeneration initiatives.

As regards the ETC, the specific (additional) priorities set out for cross-border cooperation programmes (Article 7 of the ETC Regulation 1299/2013) mainly relate to employment, social inclusion, education/vocational training, and institutional capacity. As such, these priorities appear of limited applicability to EU-level GI, but some opportunities exist, e.g. if EU-level GI projects include joint initiatives related to nature-based employment, or joint training related to GI. Transnational cooperation programmes are very relevant since EU-level GI projects could be supported as part of broader macro-regional and sea-basin strategies (and related investments). The investment priorities specific to interregional cooperation relate mainly to exchange of experience and strengthening the evidence base for effective implementation of cohesion policy. Similar to cross-border cooperation, the opportunities to support EU-level GI are mostly indirect, e.g., could involve promoting exchange of knowledge and good practice between public authorities and stakeholders in relation to GI aspects of sustainable urban development.

As in the case of the EAFRD and the EMFF, the ERDF mainly supports projects within the territory of one MS but there is also the possibility for support of an operation outside the programme area (Article 70 of CPR Regulation (EU) No 1303/2013. Therefore, to meet criterion iii) regarding scale, the project would need to either have a scale which is significant and transcends administrative boundaries, or implement a national GI strategy or a national restoration prioritisation framework. The ETC under the ERDF is designed to support projects involving multiple MS, providing possibilities for transnational EU-level GI projects. It should be noted that the opportunities for funding EU-level GI projects through the ERDF

depend on whether the relevant investment priorities provided by the regulation have been included in Member States' OPs.

Three case studies presented in Annex I - TRANSGREEN, Alpine-Carpathian Corridor and DANUBEPARKS - illustrate the potential of the ERDF to finance projects fulfilling the EU-level GI criteria.

iv. Cohesion Fund (CF)

As the other ESI Funds, the CF is governed by the provisions of Regulation (EU) No 1303/2013 (CPR). The specific investment priorities and scope of support of the CF are set out in Council Regulation (EU) No 1300/2013 of 17 December 2013.

The Cohesion Fund aims to reduce economic and social inequalities whilst encouraging sustainable development by targeting Member States whose Gross National Income (GNI) per inhabitant in purchasing power parities is less than 90% of the EU average. For the 2014-2020 period, the following 15 MS are eligible for CF funding: Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.

The Cohesion Fund supports several investment priorities (discussed in more detail below) covering five of the thematic objectives set out in the Common Provisions Regulation, namely:

- Supporting the shift towards a low-carbon economy in all sectors;
- Promoting climate change adaptation, risk prevention and management;
- Preserving and protecting the environment and promoting resource efficiency;
- Promoting sustainable transport and removing bottlenecks in key network infrastructures; and
- Enhancing institutional capacity of public authorities and stakeholders and efficient public administration through actions to strengthen the institutional capacity and the efficiency of public administrations and public services related to the implementation of the CF.

Cohesion Fund projects are implemented in the Member States via national OPs. OPs consist of priority axes, each axis corresponding to one or more CPR thematic objective(s) and comprising one or more investment priorities related to the given objective. Joint OPs are commonly developed for the CF and ERDF due to the similarities in programming and structure.

For the 2014-2020 programming period, EUR 63.3 billion is allocated to the CF[77]. The maximum EU co-financing rate for CF projects is 85%.

[77] https://cohesiondata.ec.europa.eu/

Opportunities for financing EU-level GI in 2014-2020

Article 4 of the CF Regulation No. 1300/2013 sets out the investment priorities (within the thematic objectives set out in the CPR) to be supported by the CF. The investment priorities of the CF are also included among those of the ERDF. The key difference between the two funds is the geographic coverage (see above) and the more limited list of thematic objectives supported. .

For a detailed analysis of the scope for supporting EU-level GI projects in relation to each investment priority, the reader is referred to the section on the ERDF (given the overlap in the investment priorities of the ERDF and the CF). The most relevant articles are discussed below.

The investment priorities which are most compatible with EU-level GI projects are those under Article 4(b) on 'promoting climate change adaptation, risk prevention and management' – and Article 4(c) on 'preserving and protecting the environment and promoting resource efficiency'. The former includes two investment priorities which are highly relevant for EU-level GI projects: 'supporting investment for adaptation to climate-change, including ecosystem-based approaches' and 'promoting investment to address specific risks, ensuring disaster resilience and developing disaster management systems'. The latter objective includes support specifically for the protection of biodiversity and ecosystem services (investment priorities 'conserving, protecting, promoting and developing natural and cultural heritage' and 'protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure').

Priorities under Article 4(d) - 'promoting sustainable transport' - are also potentially relevant to EU-level GI projects related to transport systems, if they incorporate green infrastructure elements in contrast to traditional grey infrastructure.

Similarly to other ESI Funds, the CF could support transnational EU-level GI projects if beneficiaries from different countries receive funding separately from their respective MS or if the possibilities provided in Article 70 of Regulation (EU) No 1303/2013 for support of an operation outside the programme area are used. Their OPs need to be aligned on these aspects. To meet EU-level GI criterion iii), a CF-funded project would therefore need to have a scale which is significant and transcends administrative boundaries, or implement a national GI strategy or a national restoration prioritisation framework.

As in the case of the ERDF, the opportunities for funding EU-level GI projects through the CF depend on whether the relevant investment priorities provided by the Regulation have been included in Member States' OPs.

v. Programme for Environment and Climate Action (LIFE)

Council Regulation (EU) No 1293/2013 of 11 December 2013 establishes the fifth version of the LIFE Programme. During the 2014-2020 period, the LIFE Programme is divided into two sub-programmes: one for Environment and the other for Climate Action. The former is

further divided into three priority areas: Environment and Resource Efficiency, Nature and Biodiversity and Environmental Governance and Information. The priority areas of the sub-programme for Climate Action are: Climate Change Mitigation, Climate Change Adaptation and Climate Governance and Information.

For the period 2014-2020, LIFE has a budget of EUR 3,456.7 million. Around 75% of the total LIFE funding is allocated to the sub-programme for Environment. At least 55% of the resources allocated to projects financed by way of action grants under the Environment sub-programme shall be dedicated to projects supporting the conservation of nature and biodiversity. The remaining 25% of the funds is allocated to the sub-programme for Climate Action. Furthermore, the Commission shall endeavour to ensure that at least 15% of the budgetary resources dedicated to projects are allocated to transnational projects.

In 2014-2020, the LIFE Programme includes support for so-called Integrated Projects (see Box 3 below) which implement on a large territorial scale environmental and climate plans or strategies required by environmental or climate legislation.

Box 3 – LIFE Integrated Projects

Integrated Projects are designed to implement on a large territorial scale (in particular, regional, multiregional, national or transnational) environmental and climate plans or strategies required by environmental or climate legislation, pursuant to other Union acts or developed by the Member States' authorities. Integrated projects for the sub-programme for Environment will primarily focus on the implementation of plans and programmes related to nature (including Natura 2000 management), water, waste and air quality. These Integrated Projects should also allow results to be achieved in other policy areas, such as the Marine Strategy Framework Directive (MSFD). For the sub-programme for Climate Action, Integrated Projects should focus on the implementation of mitigation and adaptation strategies and action plans. Integrated projects should aim at mobilising other funding sources by exploiting synergies and ensuring consistency between funding from different sources (EU, national and/or private). A maximum of 30% of the budgetary resources allocated to action grants may be allocated to integrated projects.

Source: Kettunen, M., Torkler, P. and Rayment, M. (2014) *Financing Natura 2000 Guidance Handbook. Part I – EU funding opportunities in 2014-2020*, a publication commissioned by the European Commission DG Environment.

The LIFE Programme is also open to the participation of certain non-EU countries and allows for activities outside the EU, provided those activities are necessary to achieve Union environmental objectives and to ensure the effectiveness of interventions carried out in Member States' territories. This is relevant to EU-level GI projects since such projects may, for example, require actions crossing the EU's external borders.

The Commission in consultation with the Member States is responsible for developing multi-annual work programmes, which lay down the allocation of funds between different LIFE priority areas within each sub-programme, selection and award criteria for grants, and a (non-exhaustive) list of project topics implementing the thematic priorities. Within the framework

of the multi-annual work programmes, the Commission publishes annual calls for project proposals. When selecting the projects, priority is given to those which make the greatest contribution to EU-wide environmental objectives, including transnational projects.[78]

Action grants to finance projects responding to annual calls are the main means of distributing financing under LIFE. The LIFE Programme also allows the use of innovative financial instruments to complement the grant funding.

Opportunities for financing EU-level GI in 2014-2020

Article 18 of the LIFE Regulation sets out the types of projects that can be funded by action grants. These include pilot projects; demonstration projects; best practice projects; integrated projects; technical assistance projects; capacity building projects; preparatory projects; information, awareness and dissemination projects; and any other projects needed for the purpose of achieving the general objectives of the LIFE Programme. EU-level GI projects could represent several of these project types, the most likely being pilot projects, demonstration projects, best practice projects and integrated projects. Given that EU-level GI projects are intended to deliver multiple ecosystem services and benefits in relation to multiple policy areas, they would be particularly suitable for financing as LIFE integrated projects, for example in the areas of water and nature policy.

For the **Environment sub-programme**, Annex III of Regulation (EU) No 1293/2013 sets out a number of thematic priorities corresponding to each of the three priority areas of the sub-programme. The most relevant priority area for EU-level GI projects is that on 'Nature and Biodiversity'. Highly relevant thematic priorities under this area are *'activities aimed at improving the conservation status of habitats and species, including marine habitats and species, and bird species, of Union interest'* and *'integrated approaches for the implementation of prioritised action frameworks'*, since a criterion of EU-level GI projects is to contribute to the goals of the Nature Directives. EU-level GI projects would also be eligible under the thematic priorities *'activities aimed at contributing to the achievement of Target 2'* since such projects would - by definition - contribute to the implementation of Target 2 of the EU Biodiversity Strategy[79]. EU-level GI projects involving agricultural or forest ecosystems, marine environments, or management of invasive alien species would be eligible for funding in relation to the priority *'activities aimed at contributing to the achievement of Targets 3, 4 and 5'*.

The priority area 'Environment and Resource Efficiency' also presents some opportunities for EU-level GI. EU-level GI projects involving aquatic ecosystems (including marine) would be relevant to the thematic priorities for water. This area includes priorities related to the implementation of the Water Framework Directive, the Floods Directive, and the Marine Strategy Framework Directive; EU-level GI projects can contribute to the implementation of

[78] Kettunen, M., Torkler, P. and Rayment, M. (2014) *Financing Natura 2000 Guidance Handbook. Part I – EU funding opportunities in 2014-2020*, a publication commissioned by the European Commission DG Environment

[79] Maintaining and enhancing ecosystems and their services by establishing green infrastructure and restoring at least 15 % of degraded ecosystems

each of these instruments. Two thematic priorities for Resource Efficiency are also of potential relevance: *'activities for the Soil Thematic Strategy with special emphasis on mitigation and compensation of soil sealing, and improved land use'* and *'activities for forest monitoring and information systems, and to prevent forest fires'*. As regards the thematic priorities for air quality and emissions, including urban environment, EU-level GI projects could be part of *'integrated approaches to the implementation of Air quality legislation'*.

Other thematic priorities are of indirect relevance to EU-level GI. For example, *'information, communication and awareness raising campaigns in line with the priorities of the 7th Environment Action Programme'* under the priority area 'Environmental Governance and Information' could support communication activities related to EU-level GI, while '*activities in support of Natura 2000 biogeographical seminars'* under the priority area 'Nature and Biodiversity' may facilitate exchange of best-practice in relation to EU-level GI.

The **sub-programme for Climate Action** covers three broad priority areas: climate change mitigation; climate change adaptation; and climate governance and information. The first two priority areas are highly relevant for EU-level GI projects involving ecosystems services relevant to climate change mitigation (e.g. carbon sequestration/storage) and/or adaptation (e.g. GI projects designed to reduce the risk of climate-related natural hazards such as floods, to mitigate the urban heat island effect, or to enable species to adapt to the impacts of climate change). Articles 14 and 15 of the LIFE Regulation set out specific objectives for the priority areas of climate change mitigation, respectively, adaptation. These objectives mention, among others, the "development, testing and demonstration of policy or management approaches, best practices and solutions for climate change mitigation/adaptation (including, where appropriate, ecosystem-based adaptation)," which is highly relevant to EU-level GI.

Overall, the LIFE Programme is very suitable to support EU-level GI projects since many of its objectives and specific priorities match certain criteria for EU-level GI projects, and the programme can support projects whose scale transcends national boundaries.

Several case studies presented in Annex I - Life-ELIA, Lafnitz, DRAVA-Life, Life-Biocorridors and LIFE-FLANDRE - illustrate the potential of the LIFE programme to finance projects fulfilling EU-level GI criteria.

vi. Horizon 2020 – The Framework Programme for Research and Innovation

Established by Council Regulation (EU) No 1291/2013 of 11 December 2013, Horizon 2020 - the Framework Programme for Research and Innovation sets out the EU framework, priorities and activities in the area of R&I for the period 2014-2020.

Horizon 2020 aims to "contribute to building a society and an economy based on knowledge and innovation across the Union by leveraging additional research, development and innovation funding and by contributing to attaining research and development targets" (Article 5 of the Regulation). Through these objectives, the programme will support the

delivery of the Europe 2020 Strategy. An emphasis is put upon three mutually reinforcing priorities dedicated to excellent science, industrial leadership and tackling societal challenges.

Horizon 2020 is implemented based on a specific programme[80] that sets out objectives and rules for the implementation of the fund. This general programme is implemented through biennial Work Programmes established for each of the themes under Horizon 2020. The Work Programmes are developed by the European Commission following consultation of stakeholders. The concrete project opportunities are then defined by theme-specific calls for proposals. Horizon 2020 has a total budget of nearly EUR 80 billion.

Opportunities for financing EU-level GI in 2014-2020

Horizon 2020 would be particularly suitable to support EU-level projects which entail an innovation or research component. The types of actions most relevant to EU-level GI are research and innovation actions, which could support research activities underpinning the deployment of EU-level GI projects (e.g. scientific research on ecological processes, development of tools for GI mapping and assessment) and innovation actions, which could, for example, consist of the development of new, innovative NBS or innovative approaches to GI implementation. The transnational character of Horizon 2020 projects makes the fund particularly interesting for EU-level GI projects.

In terms of thematic focus, of particular relevance to EU-level GI is the priority 'Societal challenges'. Within this priority, the theme 'Climate action, Environment, Resource Efficiency and Raw Materials' is directly relevant to EU-level GI. Other themes such as 'Smart, green and integrated transport' and 'Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy' are also linked to GI. The 2018-2020 Work Programme also introduces five 'Focus Areas' linking topics from various parts of Horizon 2020. The first of these, '*Building a low-carbon, climate resilient future*', is very relevant to EU-level GI given the contribution of GI to climate change mitigation, adaptation and disaster-risk reduction.

Box 4 below presents examples of relevant calls in the 2018-2020 Work Programme. It should be noted that several projects on the topic of nature-based solutions (and whose scope is relevant to EU-level GI) were funded as a result of calls under previous work programmes.[81]

Box 4 – Horizon 2020 topics potentially relevant to EU-level GI in the 2018-2020 Work Programme*

SFS-01-2018-2019-2020: Biodiversity in action: across farmland and the value chain

[80] Council Decision 2013/743/EU of 3 December 2013 establishing the specific programme implementing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)

[81] For example, the 2016-2017 Work Programme included several calls under the topic of 'Nature-based solutions for territorial resilience' (under societal challenge 'Climate Action, Environment, Resource Efficiency and Raw Materials'). In addition, the cross-cutting call 'Smart and Sustainable Cities' covered innovation actions under the theme of 'Sustainable cities through nature-based solutions'.

RUR-03-2018: Contracts for effective and lasting delivery of agri-environmental public goods

RUR-04-2018-2019: Analytical tools and models to support policies related to agriculture and food

LC-SFS-19-2018-2019: Climate-smart and resilient farming

LC-CLA-10-2020: Innovative nature-based solutions for carbon neutral cities and improved air quality

LC-CLA-12-2020: Climate resilience of coastal cities

LC-CLA-15-2020: Nature based solutions for forest fires risk reduction and multi-hazard risk management in the EU

*Topics for 2020 are only indicative at this stage and details of the call/actions envisaged are not yet provided.

Since the Horizon 2020 programme focuses on research and innovation, it would not be suitable for projects which only consist of the deployment of existing GI solutions. The precise opportunities depend on the call topics included in the Work Programmes.

The box below presents an example of Horizon 2020 projects similar in scope to EU-level GI.

Box 5 - MERCES: Marine Ecosystem Restoration in changing European Seas

Project description: The project focuses on the restoration of different degraded marine habitats in the Mediterranean region, with the aim of: 1) assessing the potential of different technologies and approaches; 2) quantifying the returns in terms of ecosystems services and their socio-economic impacts; 3) defining the legal-policy and governance frameworks needed to optimize the effectiveness of the different restoration approaches. Specific aims include: a) improving existing, and developing new, restoration actions of degraded marine habitats; b) increasing the adaptation of EU degraded marine habitats to global change; c) enhancing marine ecosystem resilience and services; d) conducting cost-benefit analyses for marine restoration measures; e) creating new industrial targets and opportunities.

How the project meets EU-level GI criteria: The project focuses on restoration of marine habitats (including field experiments) and analyses the effects of habitat restoration on the recovery of ecosystem services. It involves multiple Member States.

EU and non-EU funds used for the project: The project is funded through Horizon 2020 from 2016-2020 with a total funding of €6,651,118 and has established a project Business Club of +300 members for stimulating business opportunities and blue growth in European and global markets by sharing inspiring examples of investment in different types of marine ecosystem restoration, in order to create new employment opportunities and develop world markets for European industries, through a specialized newsletter and webinars.

GI activities financed: Pilot studies of restoration will be carried out in marine, shallow soft bottoms habitats (including seagrass meadows and mussel reefs) and shallow hard bottoms and mesophotic habitats in different European Seas (Norwegian coast, Mediterranean Sea). MERCES will devise methods for scaling up restoration practices for a selection of damaged EU marine ecosystems and habitats with the aim of assessing the

effects of the ecological restoration on ecosystem services.

References: Project website: http://www.merces-project.eu

vii. Innovative financing for EU-level GI: the NCFF

In 2014, the European Commission together with the European Investment Bank (EIB) launched the Natural Capital Financing Facility (NCFF), a financing mechanism that combines funding from the EU budget (LIFE programme) and the EIB to support projects focusing on nature and biodiversity and ecosystem-based adaptation to climate change[82].

The objective of the NCFF is to address market gaps and barriers for revenue generating or cost saving projects that are aimed at preserving natural capital, including climate change adaptation projects, and thereby contribute to the achievement of EU and Member States' objectives for biodiversity and climate change adaptation. Another key objective of the NCFF is to demonstrate that investment into biodiversity (and climate change adaptation) can be financially attractive and that biodiversity conservation activities can be bankable projects that can generate revenues or deliver cost savings. With its approach, the NCFF aims to tackle the current lack of experience and track record of profitable business cases for biodiversity conservation actions. Finally, with the use of EU funds, the NCFF's objective is to leverage funding from private investors.

The NCFF consists of EUR 125 million from EIB guaranteed by EUR 50 million from the European Commission. In addition to the EUR 125 million, a further EUR 10 million is provided by the Commission for technical assistance in the form of an NCFF Support Facility, with a limit of EUR 1 million per operation.

NCFF aims to finance a wide range of natural capital projects and in particular investments will support the following four main types of projects: green Infrastructure (green roofs, green walls and ecosystem-based rainwater collection and water re-use systems etc.), payments for ecosystem services (PES) schemes, biodiversity offsets and compensation (beyond the current legal EU requirements), and pro-biodiversity and adaptation businesses (e.g. sustainable forestry, agriculture, aquaculture and eco-tourism).

The following funding mechanisms are available through the NCFF: direct loans to individual, large projects; indirect loans through financial intermediaries aimed at smaller projects; indirect investments aimed at smaller projects via equity funds.[83]

When setting up the NCFF, it was expected that identifying projects with a strong business case would be the key bottleneck for the uptake of NCFF funding. In general, this means that the credit risks of proposed projects are relatively high and that the guarantee provided needs to be higher than usual to de-risk the projects. Proposed projects have so far been smaller

[82] A first-loss policy is an insurance policy for goods in which a total loss is unlikely and the insurer provides cover for a sum less than the total value of, in this case, projects. The EC contribution would be used first to cover potential losses for a portfolio of loans provided to a specific target group, up to a defined percentage of losses ("first-loss" cushion). Only if potential losses were to exceed the EC contribution, the EIB contribution to the RSFF would be used to cover such further losses on an agreed basis.

[83] European Commission (2015) Natural Capital Financing Facility. A Guide for Applicants. http://ec.europa.eu/environment/life/funding/financial_instruments/documents/ncff_guide_applicants.pdf

than expected: between EUR 3-5 million rather than the officially foreseen EUR 5-15 million. Furthermore, the experience shows that the loan tenors need to be longer than the usual standard as many biodiversity projects will not be able to deliver financial returns within the 10-years' timeframe but rather require 20-25 years to generate a profit. This has led to the plans to extend the maximum loan tenor to 25 years. Due to these barriers, technical assistance has played a key role in supporting the development of project applications.[84]

Given the above, while NCFF seems a highly appropriate source for financing EU-level GI projects - including judging by the existing initiatives foreseen to be financed (Box 6) – a number of barriers still need to be overcome for this type of funding to be successfully mobilised for biodiversity.

Box 6 - Examples of projects proposed for NCFF financing

Irish Sustainable Forestry Fund aims to invest in forest assets within Ireland with the aim to transform clear-fell plantations to continuous cover forestry (CCF), a forest management approach which is more favourable to soils and biodiversity by comparison with clear-fell. The fund aims to convert clear-fell forests to the CCF approach, promoting native broadleaf species where appropriate. This will be complemented by afforestation on new land when such opportunities will be available. With such actions the fund is expected to deliver benefits for biodiversity. The project proponents – a real assets investor (SLM Partners LLP) – are applying for an investment under NCFF with a proposed EIB contribution of EUR 12.5 million. The total costs of the operation are estimated to be EUR 50 million. SLM's main goal is to improve the sustainability of the agriculture and forestry sector using the current momentum behind stronger environmental regulation and better consumer awareness. The fund is expected to achieve its first close and initiate operations by December 2017.

Rewilding Europe Capital[85] is an EU-wide project initiated by a group of NGOs (WWF Netherlands, ARK Nature, Wild Wonders of Europe and Conservation Capital). As part of the initiative, funding for small pro-biodiversity businesses which operate in rural areas has been provided, in order to prevent the abandonment of these rural regions. These small pro-biodiversity businesses have a positive impact on restoring landscapes, ecosystems and biodiversity and can therefore contribute to biodiversity conservation. The NCFF project proponents have set up a special purpose vehicle to provide loans for the pro-biodiversity businesses. The vehicle includes a 'rewilding levy' that is payable by the businesses that receive financing, with the proceeds of the levy used for direct rewilding measures. The total costs of this specific operation would be EUR 14 million, with a proposed EIB contribution of EUR 6 million. The NCFF loan to Rewilding Europe Capital was signed in April 2017.

[84] Illes, A., Russi, D., Kettunen, M. and Robertson M. (2017) *Innovative mechanisms for financing biodiversity conservation: experiences from Europe*, final report in the context of the project "Innovative financing mechanisms for biodiversity in Mexico / N°2015/368378". Brussels, Belgium

[85] www.rewildingeurope.com

Source: Illes et al. 2017 with references within, www.rewildingeurope.com

viii. The Connecting Europe facility

Developing a fully integrated internal energy market, with adequate infrastructure to underpin the clean energy transition is a precondition for a genuine Energy Union. To ensure the timely construction of the necessary grid infrastructure, in 2013 the European Union adopted the Regulation on guidelines for Trans-European energy networks (TEN-E). This was accompanied by the Connecting Europe Facility mechanism (CEF) created to financially support the implementation of key infrastructure projects - Projects of Common Interest (PCIs).

The EU's energy infrastructure is aging and, in its current state, not suited to match future demand for energy, to ensure security of supply or to support large-scale deployment of energy from renewable sources. The upgrading of existing, and development of new energy transmission infrastructures of European importance will require investments of about €140 billion in electricity and at least €70 billion in gas.

Despite the regulatory measures and policies that are currently put in place to facilitate such investments, under current market and regulatory conditions some energy projects are not commercially viable, and would normally not make it into investment programmes of infrastructure developers.

The Connecting Europe Facility[86] (CEF) is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. It supports the development of high performing, sustainable and efficiently interconnected trans-European networks in energy.

CEF is engineered to address the different factors behind the investment gap in the energy sector. Financial instruments, by bringing in new classes of investors and mitigating certain risks, will help project promoters to access the necessary financing for their projects. Grants to contribute to the construction costs will be applied to fill in the gaps in commercial viability of the projects that are particularly relevant for Europe.

The provisions of Regulation (EU) No 347/2013 and Regulation (EU) No 1316/2013 govern the identification and selection of Projects of Common Interest[87] (PCIs) and their eligibility for Union financial assistance, together with the conditions, methods and delivery of such assistance.

All PCIs are eligible for Union financial assistance in the form of grants for studies and financial instruments. With the exception of hydro-pumped electricity storage projects, PCIs

[86] https://ec.europa.eu/inea/en/connecting-europe-facility
[87] https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest

are also eligible for financial assistance in the form of grants for works if they fulfil certain criteria.

A total budget of €5.35 billion is made available for energy projects for the 2014-2020 period, of which €4.5 in the form of grants managed by INEA.

Opportunities for financing EU-level GI in 2014-2020

Several measures provided by CEF and TEN-E Regulation are compatible with the objectives of EU-level GI projects. Green and blue infrastructure could support the implementation of Projects of Common Interest in preparatory phases as part of their design, permitting or environmental studies or during works in the form of purchase, supply, deployment, development, construction and installation activities of different GI components, systems and services.

ix. Synergies among different EU funding instruments for EU-level GI: the example of the revised Prioritised Action Frameworks

The revised format for Prioritised Action Frameworks (PAFs) for the post-2020 multiannual financial framework provides opportunities for joint implementation of Natura 2000 and green infrastructure in the context of EU funds. Following several rounds of consultations, the PAF format[88] (PAF) has been updated to include green infrastructure measures that contribute to the ecological coherence of the network.

x. A new information portal to inform about funding opportunities for EU Macro-Regional Strategies: Euro Access

Euro Access Macro-Regions is an online information and search tool on EU-funding available in four EU Macro-Regions covered by EU Macro-regional Strategies: the Danube Region; the Alpine Region; the Baltic Sea Region; and the Adriatic-Ionian Region.

Its target is to help people with project ideas find suitable sources of EU funding. Euro Access contains data from more than 200 EU funding programmes and calls for project proposals within those programmes.

https://www.euro-access.eu

[88] http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

II. Supporting scientific and technical tools

i. Mapping and Assessment of Ecosystems and their Services (MAES)

Action 5 of the EU Biodiversity Strategy to 2020 foresees that Member States will, with the assistance of the Commission, map and assess the state of ecosystems and their services in their national territory by 2014.

The fifth MAES report[89] provides operational guidance to the EU and the Member States on how to assess the condition (or the state) of Europe's ecosystems.

Ecosystem condition is the physical, chemical and biological condition or quality of an ecosystem at a particular point in time. The concept of ecosystem condition is closely linked to well-being through ecosystem services. Ecosystems need to be in good condition to provide multiple ecosystem services, which, in turn, deliver benefits and increase well-being. Drivers of change can have a positive (e.g. conservation) or negative (pressures) impact on ecosystem condition.

Ecosystem condition can be measured using indicators.

The MAES core set of indicators for ecosystem condition can act as main tool for identifying and prioritizing areas for ecosystem restoration and the deployment of EU-level green and blue infrastructure. Table 1 shows the core set of ecosystem condition indicators for terrestrial and freshwater ecosystem types. This set of indicators can be used to measure the condition of Europe's ecosystems in an integrated manner ensuring policy relevance and data coverage.

Five indicators emerge for a cross-cutting ecosystem assessment: conservation status of habitats, conservation status of species, coverage of ecosystems by Natura 2000, fragmentation and soil organic carbon.

The table effectively highlights the key contribution of the EU nature legislation (the Birds ad Habitats Directives) to measuring ecosystem condition. The conservation status of habitats and species reported under Article 17 of the Habitats directive and the status of birds collected under Article 12 of the Birds directive are crucially important to assess condition of almost all ecosystem types. Urban systems and croplands are not or partly covered. The coverage by Natura 2000 can be used as indicator of all ecosystem types including urban and cropland.

Fragmentation is a major determinant of ecosystem condition and appears as indicator across the different ecosystem types (sometimes under slightly different names including for instance also connectivity). Fragmentation can also be reported as pressure but for simplicity we included it here as condition indicator. Fragmentation is related to connectivity but they

[89] http://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/5th%20MAES%20report.pdf

are not the same. Fragmentation is a structural indicator (whereas connectivity can be considered a functional indicator), can be measured in different ways and can be computed within and across ecosystems. In urban ecosystems it refers to fragmentation of green spaces; in freshwater ecosystems it refers to the fragmentation of rivers or the river network.

Table 1: Core set of condition indicators for terrestrial and freshwater ecosystem types

Condition class	**Indicator**	**U**	**C**	**G**	**F**	**H**	**S**	**W**	**RL**
Environmental quality	Percentage of population exposed to noise	●							
	Percentage of population exposed to air pollution above the standards	●							
	Concentration of air pollutants (NO2, PM10, PM2.5, O3)	●							
	Percentage of population connected to urban waste water collection and treatment plants	●							
	Percentage of built up area	●							
	Tropospheric ozone (ground level ozone) concentration				●				
	Concentration of nitrogen, sulphate, sulphur, calcium and magnesium (SEBI 009)				●				
	Percentage of forest under management plan or equivalent				●				
	Nutrient and BOD concentration in surface water (SEBI 016)	●							●
	Water Exploitation Index								●
	Land cover in the drained area or floodplain								●
Structural ecosystem attributes (general)	Fragmentation (SEBI 013 and SEBI 014*)	●	●	●	●	●	●	●	●
	Percentage area of urban green space (or percentage of natural area within the city boundaries)	●							
	Share of High Nature Value farmland in agricultural area (SEBI 020) (AEI23)		●	●					
	Share of organic farming in utilised agricultural area (SEBI 020) (AEI4)		●						
	Livestock density		●						
	Deadwood (SEBI 018)				●				
	Forest area				●				
	Biomass volume (growing stock) (SEBI 017)				●				
	Ecological Status								●
Structural ecosystem attributes based	Farmland Bird Indicator (SEBI 001) (AEI2.4.1)		●						
	Abundance and distribution of common				●				

on species diversity and abundance	forest birds (SEBI 001)								
Structural ecosystem attributes monitored under the EU nature directives	Percentage covered by Natura 2000 (SEBI 008) or by Nationally Designated Areas (SEBI 007)	●	●	●	●	●	●	●	●
	Conservation status and trends of species of Community interest (SEBI 003)		●	●	●	●	●	●	●
	Conservation status and trends of habitats of Community interest (SEBI 005)			●	●	●	●	●	●
	EU Population status and trends of bird species of Community interest (SEBI 003)		●	●	●	●	●	●	●
Structural soil indicator	Soil organic carbon	●	●	●	●	●	●	●	

Tables notes. U: Urban; C: Cropland; G: Grassland; F: Forest and woodland; H: Heathland and shrub; S: Sparsely vegetated land; W: Wetlands; RL: Rivers and lakes; ●: Key indicator for the ecosystem type; For units of the indicators: see Chapter 4 tables 4.1-4.5; SEBI: Indicator of Streamlining European Biodiversity Indicators (* SEBI 014 is under preparation); AEI: Agri-Environment Indicator.

A separate table has been made for marine ecosystems. Table 2 lists the core set of indicators for pressure and ecosystem condition for four ecosystem types: marine inlets and transitional waters, and coastal ecosystems are merged in one column while shelf and open ocean are combined in second column.

Table 2: Core set of pressure and ecosystem condition indicators for marine ecosystem types

Class	**Indicator**	**TC**	**SO**
Climate change	Acidification	●	●
Pollution and nutrient enrichment	Contaminants (MSFD-D9)	●	●
	Nutrient discharge	●	●
Over-exploitation	Fish catch	●	●
	Fish mortality of commercially exploited fish and shellfish exceeding fishing mortality at maximum sustainable yield (MSFD-D3C1)	●	●
Introductions of invasive alien species	Number of annual introductions of invasive alien species (SEBI 010)	●	●
Environmental quality	Chemical Status	●	
	Nutrient and BOD concentrations	●	●
	Bathing water quality	●	
Structural ecosystem attributes (general)	Ecological status	●	
Structural ecosystem attributes based on species diversity and abundance	Spawning Stock Biomass (MSFD-D3C2)	●	●
	Age and size distribution of commercially-exploited species (MSFD-D3C3)	●	●
	Population abundance (MSFD D1C2)	●	●
Structural ecosystem	Conservation status and trends of habitats of	●	●

attributes monitored under the EU nature directives	Community interest (SEBI 005)		
	Conservation status and trends of species of Community interest (SEBI 003)	●	●
	Population status and trends of bird species of Community interest	●	●
	Percentage of Natura 2000 and marine protected areas	●	●

Tables notes. TC: Marine inlets and transitional waters and Coastal ecosystems; SO: Shelf and Open ocean; ●: Key indicator for the ecosystem type; For units of the indicators: see Chapter 4 tables 4.6 and 4.7; MSFD: Indicator of the Marine Strategy Framework Directive; SEBI: Indicator of Streamlining European Biodiversity Indicators

ii. The European Commission's Knowledge Centre for Bioeconomy

The European Commission's Knowledge Centre for Bioeconomy[90] (KCB) is coordinated by the Joint Research Centre in line with the Communication on Data, Information and Knowledge Management at the European Commission. It collects, structures and makes accessible data and information on the bioeconomy from different sources, pulling together the knowledge and expertise needed to assess the status, progress and impact of the bioeconomy. The KCB pulls together existing knowledge, inter alia, on the condition of EU ecosystems and their services, from different sources, through knowledge management tools, processes and technologies, making it accessible through an ICT platform. This knowledge can also support the deployment of green infrastructure in the EU.

iii. Geospatial methods, data and tools

The recently published joint science for policy report on strategic green infrastructure and ecosystem restoration[91] draws on a range of European-wide datasets, geospatial methods and tools available for green and blue infrastructure (GI) mapping, showing how they are used in case studies selected in the rural and urban landscapes. This report highlights two complementary approaches for GI. One starting from a physical mapping of existing GI components identifying and delineating landscape elements such as protected areas, ecological networks, other protected areas, biodiversity-rich habitats, habitats in good environmental condition, etc. To ensure that those elements lead to the delivery of multiple

[90] https://ec.europa.eu/knowledge4policy/bioeconomy

[91] Estreguil, C., Dige, G., Kleeschulte, S., Carrao, H., Raynal, J. and Teller, A., *Strategic Green Infrastructure and Ecosystem Restoration: geospatial methods, data and tools*, EUR 29449 EN,Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-97295-9, doi:10.2760/36800, JRC113815. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/strategic-green-infrastructure-and-ecosystem-restoration

ecosystem services, the second approach is functional and involves ecosystem service-based mapping targeting connectivity and delivery of multiple ecosystem services such as provisioning, regulating and cultural services.

This report provides guidance to support strategic policy and decision-making to deploy a multi-functional GI network, and identifies knowledge gaps. GI mapping can contribute to enhancing nature protection and biodiversity beyond protected areas, the delivery of ecosystem services such as climate change mitigation, the prioritisation of measures for defragmentation and restoration, and finding trade-offs of land allocation involving all sectors.

The tools can potentially be applicable throughout Europe at multiple scales, and can be improved by using data locally available, or to address specific needs. By sharing available knowledge, data and tools, and addressing the linkages between regional, national and EU scales, this report contributes towards building a common understanding of the usability of existing tools, and promote harmonized and reproducible approaches across scales and regions.

The case studies cover areas such as:

- Mapping GI to support and enhance nature protection, beyond protected areas and across country borders, and looking at how well connected protected areas are, and whether connectivity enhances biodiversity (cf. action 6 of the EU Biodiversity Strategy) and the delivery of ecosystem services. Mapping also identifies key corridors between N2000 areas, and can help determine which corridors and landscapes should be prioritized to enhance biodiversity and ecosystem services.
- Planning GI as a cross-border, dynamic and resilient biodiversity network to mitigate climate change.
- Deploying well-connected, multi-functional GI in the rural landscape, prioritizing actions for conservation and restoration, enhancing landscape permeability and prioritizing defragmentation measures to mitigate the impacts of agricultural intensification and road infrastructure on species movement.
- Deploying GI in large urban zones and regions, planning green and multi-functional urban spaces as well as human development infrastructure in an urbanized context.
- Exploring GI for enhanced biodiversity and ecosystem service delivery by spatial modelling land use scenarios of ongoing demographic, economic and agricultural developments in the next decades in Europe, finding trade-offs and resolving conflict of land allocation in decision-making involving all sectors.
- Monetary cost assessment of prioritization measures and GI benefits for society.
- Multi-scale integration of GI maps